

# **‘A Realist Approach to Financial Markets’**

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## **Abstract**

The primary objective of the present thesis is the formulation of a first outline of an alternative conceptualisation of the expectation formation process of stock market (securities) traders, with a view toward a more comprehensive project, which aims at the conceptualisation of the generalizable aspects of cognition applying to financial markets as a whole – an argument that no single thesis would suffice to develop and defend –, to be endeavoured in the future as a preliminary toward a more appropriate scientific approach to the study of financial market processes, one capable of overcoming the impasse of modern mainstream finance research that shall be established as part of the present analysis. The core contributions of the present work shall be the following: First, the exposure of the deep embeddedness of the conceptualisation of the agent in mainstream finance in general neoclassical economics at the level of ontology, methodology and use of methods, as well as its untenability within the context of financial market research; secondly, the outline of a more plausible conceptualisation of the stock market operator's expectation formation process; thirdly, the exposition of the inherent strengths and weaknesses of existing alternative accounts within the wider economics literature with respect to their ability to cater for the requirements that an alternative approach to financial market research in the light of the established ontological and conceptual insights demands; and fourthly, the identification of a suitable methodological approach for transforming the projected re-conceptualisation of financial market processes in terms of processes of cognition, once realized, into a viable scientific research enterprise.

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## Introduction

The *Leitmotiv* of the present thesis is the conceptualization of the expectation formation process of stock market (securities) traders via: (1) the exposition of the inadequacy of the conceptualisation of the agent that underlies current mainstream finance research efforts (both neo-classical and behavioural finance) at the level of ontology, methodology and the use of methods; (2) the explication of a more realistic conceptualization of expectation formation processes for stock market (securities) traders by way of a critical analysis of the *Value Investing* framework; and (3) the search and identification of a more suited methodology and framework for the study of this aspect of financial markets. The imminent core contributions of the present discourse shall be constituted by the above. Nonetheless, as the thesis title, *A Realist Approach to Financial Markets*, indicates, the insights herein gained are envisioned to provide a preliminary toward a future project – the development of the generalizable aspects of cognition that apply to financial markets as a whole – whose scope would exceed the boundaries of any individual Ph.D. thesis. In order to enable the reader to locate the present work within the wider (meta-)theoretic landscape and to assure that she approaches it with the appropriate mind-set, the exposition of the following preliminaries seems necessary in this introductory chapter: First, it is the factor of ‘cognition’<sup>1</sup> that shall take centre-stage in both the present as well as the envisioned future project. For the reasons to be outlined below, it is deemed to provide a promising vantage point for the development of a more realistic understanding of certain processes and aspects of financial markets. Secondly, albeit the present thesis largely abstracts away from the core ‘institutional’ aspects of financial markets, the latter shall be conceptualized as a type of ‘extended cognition’<sup>2</sup> in future work as part of the larger project to explicate the generalizable aspects of cognition that apply to (make up?) financial markets as a whole. Thirdly, the realist character of the present work lies primarily in the adoption and employment of the toolset (i.e., particularly with regard to ontology, methodology and method) that economic realism offers. A verification of the commensurability of the insights produced by the larger project with the existing account of economic realism cannot be attempted prior to the former having reached a sufficiently advanced stage in its development.

The impetus to the present work, as well as for the choice of ‘cognition’ as the underlying guiding theme of the envisioned wider project, is provided by the peculiar ontological character of financial markets, whose idiosyncrasy can be identified in the fact, as noted by Dow (2011, p. 234) with reference to Tuckett (2009), that market “activity is based on

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<sup>1</sup> For a discussion of the definition aspects of ‘cognition’, see below.

<sup>2</sup> See below.

valuation that are bound up with expectations as to price movements rather than the experience of ‘real’ consumption and production”. Expectations, in turn, are the product of cognitive processes that entail, *inter alia*, the selection and interpretation of information for the production of adequate representations of reality that form the basis of agents’ expectations and decisions. Unfortunately, this ‘filter’ is often far from perfect, leading, at times, to – not always innocuous – distortions in these representations and consequently the respective expectations and decisions and therefore, as discussed in the main body, to market inefficiencies or even failures. As demonstrated by behavioural finance research (see Chap. 1) and further discussed in the main body of the present work, these processes – at least as far as the *human* agent is concerned – do not operate in an isolated Cartesian manner, but rather are subject to both biological as well as social influences; the type of cognition to be searched for is thus of an *embodied* and *embedded* rather than an *atomistic* type. Further, as already hinted at above, the wider project even conceives of institutional factors as constituting a type of (*extended*) cognition (see below).

At this point, one might raise the question as to why the present work bothers with the conceptualization of the expectations formation processes for stock market (securities) traders, i.e. *individuals*, if the wider project is ultimately concerned with establishing the generalizable aspects of cognition that apply to financial markets more generally, i.e. the *system level*. The justification for this approach is that, as the thesis will explain in detail, the overwhelming majority of finance literature suffers from inadequately comprehending crucial cognitive processes such as the way the individual agent interacts with her environment, her decision processes, her problem solving capabilities, as well as her ability to interact with other agents and to create cognitive ‘extensions’ in order to overcome her own inherent cognitive limitations as a biological entity. A sound theoretical conception of these factors and processes is crucial, to take an obvious yet pressing example, for addressing the surfacing debate concerning the impact of the proliferation of A.I. in financial markets, which will require a thorough understanding of the cognitive processes of both the *human* and A.I. agent, on the one hand, as well as their interaction, on the other.

But where can one begin to find adequate foundation for understanding such cognitive processes in financial markets? One source drawn on in this thesis is F.A. Hayek’s work and it is important to clarify at the outset how Hayek will be drawn upon in this thesis. A neglected aspect of Hayek’s work is his contribution to the cognitive sciences in Hayek (1952), wherein he, just like Herbert A. Simon after him, takes the view that cognitive and decision processes can be scientifically studied and explained; a position that stands in sharp contrast to the *a prioristic* Austrian conception of the Misesian type, which is just another version of the utility maximization approach (see Simon in Simon *et al.*, 2016, p. 26). Its relevance to the present work lies not so much in its actual contribution to the cognitive sciences, some of which are

now dated and merely of a historical interest (which is not to say that some interesting insights might not still to be gleaned from it), but rather in its advocacy of the scientific approach to the study of human cognition, decision processes and knowledge and, via some of his other works (e.g., Hayek, 1937, 1945), a potential link between the causal cognitive processes on the micro level and certain aspects of market processes on the macro level, whereby it needs to be emphasised, though, that the status of Hayek's (1952) theoretical work on cognition as a 'foundation' for his economics (and politics) has largely been exaggerated (Feser, 2007, pp. 287-8). Feser (*ibid.*) holds that

“claims for such a status typically rest[...] on little more than the fact that the book characterizes the mind just as Hayek characterized economic and social systems, namely as being complex, dynamic, and unpredictable in principle. (Hayek would no doubt have characterized the weather in exactly the same terms. Should we therefore regard meteorology as providing a 'foundation' for his economics and politics?)”

To be absolutely clear, it is neither the present nor the wider project's primary goal to formulate a Hayekian understanding of (certain) financial market processes on the basis of his theory of market and his conception of cognition. Rather, the value of Hayek's (1952) work on cognition is to be found in its advocacy for a scientific approach to human cognition and decision processes as well as its potential bridging function between the wider economics and modern cognitive science literatures, while his pioneering theoretical work on markets provides an important first link between such cognitive processes and (certain) market processes. It is for these reasons that, as shall be expounded in Chapter 3, Hayek's work seems to provide a more plausible starting point for a thorough inquiry into the generalizable aspects of cognition that apply to financial markets than do alternative candidates within the wider economic literature – most notably *Behavioural Finance* – that lack a plausible conception of the way a particular function might be conducted by the *human* brain and eventually be translated into a specific aspect of the market process. The latter will be of particular relevance for any eventual future enquiry into the similarities, differences as well as the interaction between human and A.I. traders and their joint (modifying?) impact on the operation of (certain aspects of) financial markets.

After this brief introduction to the overall project, the concept of cognition, and particularly the way it relates to financial markets, shall be outlined, before a more detailed overview of the present thesis' structure and content shall be produced.

### *What is Cognition?*

First, it needs to be emphasised that neither this, nor, for that matter, any other current work,

is able to provide a definite answer to this question. In fact, a great deal of ambiguity surrounds the subject matter and there exists a wide variety of (sometimes contradictory) views across the cognitive sciences (philosophy, psychology, and neuroscience). Nevertheless, some positive insights, particularly as they relate to the present work, can and shall be provided.

Grush and Damm (2012) provide a brief outline of the traditional conception of *cognition*, which, as shall be discussed in Chapter 1, to a degree, also underlies modern behavioural finance research:

“There is a traditional taxonomy that attributes the *mind* – psychology’s putative object of investigation – a number of distinct faculties. While there are many ways to cut the pie, they typically revolve around the categories of perception/emotion, will/action, memory and cognition. Cognition, in this view, is taken to be something on the model of inference, maybe with some statistics or Bayesianism or some other formalizable procedure thrown in [...]. This sort of faculty psychology would tell the following rough story about the relation between the faculties: perception is a matter of gaining information about the world, cognition employs this information to make decisions about what to do, the result is effected by the will and action. While emotions may have some benefits, their contribution to this process is often thought to be one of disruption, especially at the cognitive level.” (p. 273)

This conception is, however, not universally accepted and has, in fact, been severely undermined by various research strands. Grush and Damm (2012) elaborate on the concept’s general vagueness and its protean denotation across various literatures, including conflicting positions such as Damasio’s (1994, 2000) contradictory view on the role of emotion in ‘rational’ decision processes:

“There is nothing like agreement even at the most foundational level – as the debate about whether behaviours that qualify as ‘reason’ require the involvement of emotion, or involve representation, or are perhaps best understood as a fancy sort of motor control, shows. And perhaps worse, even aside from these sorts of esoteric debates about conceptual foundations, there appears to be good reason to seriously question whether ‘reason’ denotes anything like a natural mental kind amenable to study as such. There is a possibility that nervous system have evolved a number of tricks and abilities that do not map neatly onto folk categories of ‘reason’, ‘perception’, ‘memory’ and so forth, and the best we get is that some orchestrations of these capacities, in some contexts, approximate to some degree the prototype of ‘reason’ or ‘long-term memory’. But if this is the case, then progress might be best served by abandoning the folk taxonomy and

its category of ‘reasons’.” (p. 280)

In this context, it needs to be emphasised, though, that the ambiguity surrounding the concept of ‘cognition’ in the literature does not solely result from our current lack of definite knowledge in the cognitive sciences, but also from the fact that various types of ‘intelligent’ functions exist (or at least can be conceived of) that have no likeness to the actual cognitive processes performed in the biological (human) brain (e.g., classic expert systems – see Marris, 2016, p. 209), but which are otherwise perfectly valid and which even might be successfully employed in other fields, such as computing and A.I. Marris (*ibid.*) mentions the case of

“*Parallel Distributed Processing* (PDP) [...], where the concept, while advancing, but by no means revolutionizing, our understanding of the biological brain, has found immediate spectacularly successful applications in other fields of search-oriented computing.”

This distinction – one, which at times, is unfortunately forgotten – is of particular relevance to any inquiry into the various forms of cognition (and their ‘interface’) that underlie (certain) financial market processes. To clearly distinguish between the human and the A.I. factors of cognition in these markets, it therefore seems prudent to heed Marris’s (*ibid.*) advice:

“It is the general practice of people working in the field of artificial intelligence that they take for granted the scarcity of direct observation on the actual brain. Instead [...] we try to imitate nature, without necessarily following her. To some extent, given the experimental situation, this is inevitable [...] But it is the strongly held opinion of the present author that we should always face up to the question, ‘Is the model I am contemplating a *plausible analogy* to the way the corresponding function might be conducted by the biological brain?’” (p. 209)

He further suggests to never forget the human brain’s evolutionary past for the determination of the plausibility of particular models of cognition vis-à-vis the processes that can reasonably be expected to operate in the former:

“...the fact that the brain originally evolved by a Darwinian process is extremely relevant to everything we think and say about it. Evolution is a powerful, but untidy, form of search. Consequently, it is absolutely certain that the architecture of the brain is not something that would result from the comprehensive design. For example, some geneticists believe that the brain evolved to meet the challenge of sight and movement. Organisms that could do complex movements and eventually could ‘see’ had superior fitness for survival...” (p. 209)

The conceptual plurality of *cognition* is central to a proper understanding of both the present as well as the envisioned wider project. With regard to the present thesis, its relevance

crystalizes in our demonstration of the inadequacy of the models of cognition of the agent that underlie current financial market theories and the search for plausible insights into the realities of the (decision) environment and the core (decision) problem task(s) the stock market (securities) trader – as a particular type of agent – faces in these markets, as a preliminary to the search for a superior alternative framework of cognition and eventually the generalizable aspect of cognition that apply to financial markets as a whole. Whether this alternative can be found in the current cognitive science literature(s), or whether it needs to be developed, will be for future research to determine.

Before elaborating on the above, it needs to be particularised that the present work shall apply the term *cognition* primarily to refer to the decision and problem-solving capability and processes of the human agent. In this context, it is important to emphasise that this type of cognition has one aspect to it, which might be best characterised as its ‘*calculus*’, i.e. the *logical* aspect (or layer) of problem solving,<sup>3</sup> and another, which might be characterised as the *mechanism* of the human agent’s ‘cognitive apparatus’ for performing the actual decision task itself.<sup>4</sup> While the former relates to the problem’s and its solution’s logic space, the latter refers to the actual cognitive processes that the problem solving/decision task entails, including the scanning and identification of the respective logic space of a problem task and the formation of a sufficiently adequate ‘frame’ that nests the eventual decision itself. In order to gain a (very first and) basic understanding of the former, we have to analyse the nature of the decision environment (see Sect. ’s 2&3 in Chap. 2) as well as of the problem task (Sect. 4 in Chap. 2). Once such a first (rough) sketch of this particular financial market agent’s ‘*calculus*’ has been developed from the analysis of the agent’s practical investment framework (*Value Investing*) in Chapter 2, a starting point for the development of an adequate framework for the study of the actual cognitive *mechanism* in this particular type of agent (within financial markets) and its link to (certain) financial market processes needs to be identified; this shall be the primary aim of Chapter 3. These two contributions shall provide the basis for any future work in this area.

Equipped with this additional background information, we shall now return to our previous point, i.e. the plurality of the conception (as well as the models) of *cognition* and its relevance to the present work. To that end, we shall apply Grush and Damm’s (2012) classificatory outline, which is deemed helpful for framing an elaboration on some of the core issues in question. They distinguish between three possible variants with regard to our understanding

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<sup>3</sup> As far as the present work is concerned, the core problem/decision task consists in the development of superior hypotheses and expectations with regard to the economic reality of investment objects for the identification of profitable trading opportunities (see Chap. 2).

<sup>4</sup> A further layer can be identified, i.e. the layer of the actual implementation of this cognitive *mechanism* in the biological brain. This shall be an important area of research for neuroeconomics and -finance.

of and the approach to cognitive processes (they, too, choose to frame their discussion around *cognition* as it relates to *problem solving*): From “the assumptions made by the traditional taxonomy” (see above), they hold that two variants follow,

“[(i)] we know what formal system reasoning implements, or (ii) we at least have an idea of what the relevant alternatives are, and we can ascertain, through behavioural criteria, which one humans implement” (p. 274).

The third possibility, (iii), is that “we have a rough idea of what the relevant options are, but behavioural studies alone cannot ascertain which apply” (*ibid.*, p. 276).

Each one of these possibilities carries a certain set of implications with regard to the study of cognitive processes, an aspect that is highly relevant to the present work. These implications and their relevance shall now be further explored. Grush and Damm (2012) hold that

“if we already know what reasoning is as per (i), then the best way to study it will be neither neurophysiological nor behavioural. The studies of statistics, logic, and so forth, are formal studies with their own disciplines. That human beings implement a certain logical system might be interesting, but would be no more relevant for the study of that logical system itself than the fact that humans are subject to gravity is relevant to relativity physics” (p. 274).

Now, as shall be established in Chapter 1 of the present work, modern mainstream finance research premises on the assumption as to the accuracy of possibility (i). Neo-classical finance theory builds on the expected utility framework, which had been devised precisely for the purpose of purging economics from any traces of psychology (see Chap. 1). Behavioural finance, originally conceived as a research inquiry into the causal factors underlying the well-documented ‘anomalies’, i.e. the observed deviations of financial market (price) behaviour from the predictions of the neo-classical framework, similarly postulates the accuracy of the latter, perceiving and interpreting any deviations accordingly as being ‘irrational’. Now, whereas an (initial) use of a certain *a priori* ‘hard target’ might be defensible on methodological grounds,<sup>5</sup> conceiving it as the unassailable quintessence of rational thought does a severe disavour to the progression of the science. First, as shall be thoroughly discussed in Chapter 1, the expected utility framework is a mathematical-logical construct which, by itself, is sterile with regard to reasoning and rational thought. It is only through the introduction of certain assumptions and interpretative layers that this essential link is established. To reiterate, the expected utility framework is a *mathematical-logical* construct, and *not* a *theoretical* framework about (human) reasoning. Unfortunately, it is this *mathematical-logical*

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<sup>5</sup> Indeed, as shall be argued in Chapter 1, several valuable empirical insights have been produced by testing human agents against the predictions of the expected utility framework.

nature that leads many of its proponents in mainstream finance to claim universal validity for it, even though, as shall be discussed in Chapter 1, the validity of the claim as to its *rationality* depends upon the validity of its underlying ontological assumptions. If the latter are violated, it might even be the case that the application or adherence to this framework itself are *irrational*. This has, as shall be argued, important implications for the accuracy of the interpretations of the empirical findings of behavioural finance research as well as for the consequent inferences for normative policy projects such as Richard Thaler's (Thaler and Sunstein, 2008) *nudging*. As hinted at above, the 'calculus' aspect of cognition is something that has to be deduced from the actual nature of the decision environment and task – our core task in Chapter 2.

A failure to properly distinguish between a purely *mathematical-logical* framework such as expected utility theory and a *scientific* one also impedes the progression of the research enterprise by hampering any attempt to construct a proper scientific framework that explains both the relevant aspects of cognition and their relationship to (certain) financial market processes. Instead, as shall be exhaustively discussed in Chapter 1, the theoretical side of the enterprise is engaged in the (questionable) attempt to try to force the empirical findings, at least those that lend themselves to such an assimilation, into a framework which has – not logically but empirically – been *de facto* refuted by those very findings. In fact, due to the dominant belief in the general validity of the expected utility framework, the question as to the development of an (alternative) proper *theoretical* framework that synthesizes the various – interpretatively sanitized – empirical insights in a non-distortive way, in order to gain a proper understanding of the cognitive *mechanism* involved, does not even arise in the first place. The logic of the expected utility framework is held to be universal and unassailable and any 'apparently' contradictory finding is therefore expected to yield to it, one way or another, eventually.<sup>6</sup> This conflict between the theoretical and empirical side of behavioural finance shall be the topic of Chapter 1.

Now, as Chapter 1 establishes the inadequacy of possibility (i) for the case of the agent operating in financial markets, we proceed by considering the general implications of possibility (ii) and its applicability to the study of (human) cognition in these markets. As to its more general implications, if we assume that possibility (ii) applies,

“then while we still stand to learn nothing about any of the alternatives by studying humans, there is at least a problem to be studied, which is which of the options is implemented by humans. By analogy, this position would be like stating that masses accelerate toward other masses either via gravitational

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<sup>6</sup> For an insight into the various strategies employed by economists, see our critique of Gintis' (2007, 2014) proposal for the *Unification of the Behavioural Sciences* in Chapter 3.

attraction or electromagnetic attraction (we know the possibilities), and we are interested in which of these forces is responsible for humans falling toward Earth – and perhaps we strap some humans with magnets, or have others fall after we have increased Earth’s mass but not its charge, and we get dissociative data that indicates that it is gravity, not electromagnetism, that explains why humans fall. Obviously, such a study tells us nothing about gravity or electromagnetism per se. [...]

In the case of determining which cognitive system human implement, the basic idea would be to set up a behavioural experiment such that the results will implicate one formal system over the competitors, and run the experiment [...]" (p. 294).

As one can infer from the above, possibility (ii) presupposes the knowledge of the set of all *viable* alternative frameworks with regard to cognition. The applicability of this option therefore depends upon the availability of and our acquaintance with the latter. To that end, Chapter 3 shall explore the available alternatives within the wider economics and finance literatures and assess their viability in the light of the insights produced in Chapter 2. It shall be established that these literatures currently lack an adequate conception and theory of (human) cognition, and that future research will have to reach out to the various cognitive science literatures in its search for the set of *viable* frameworks, with Hayek’s work providing a possible bridging element between the literatures. With a view to the wider project, and a look at the current state of knowledge in cognitive science, the question arises, though, whether the prerequisite for the realization of possibility (ii) – i.e. the identification of the set of viable types of cognition – is feasible at all. In fact, Grush and Damm (2012) hold that “the morass of current research indicates, if anything, that neither (i) nor (ii) is true” (p. 276). They therefore propose a third possibility, (iii), i.e. that “we have a rough idea of what the relevant options are, but [that] behavioural studies alone cannot ascertain which apply” (*ibid.*). For the implications of the latter, it is important to re-emphasise that “if (i) or (ii) is right, then the study of the brain is not necessary for understanding cognition”<sup>7</sup> (*ibid.*), rendering neuroscientific (neuroeconomic) insights more or less immaterial to the project of establishing the generalizable aspects of cognition that apply to financial markets. On the other hand, if possibility (iii) applies, then a case might be made for the relevance of such neuroscientific research. Grush and Damm (*ibid.*) point out that

“[i]n this spirit, there are a host of neuroscientific studies aimed at using one or another kind of neuroscientific consideration to make a choice between various

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<sup>7</sup> “[T]hough,” as Grush and Damm (2012, p. 276) add, “it might help, and it would be relevant to understanding how the brain implements whatever formal system it implements.”

options (see, e.g., Sanfey et al. 2006; Goel 2005, 2007).”

Nevertheless, as they establish in their paper, “there is reason to think that all of (i)-(iii) are overly optimistic”:

“While it is manifestly obvious that humans engage in reasoning and make decisions, it is quite far from obvious that we have any clear idea of what the relevant options are for how this is done.” (*ibid.*)

For this reason, as well as the fact that cognition has, as explicated above, different ‘aspects’ to it that are to be analysed for a comprehensive understanding of the phenomenon and the processes at work, the research in the present thesis and the envisioned future project shall advocate – and eventually employ – a multi- and cross-disciplinary approach to the study of individual agents’ cognition in financial markets and the way it translates into wider market processes. The *calculus* and the *mechanism* aspects can thus be studied via the tools supplied by the disciplines of logic, philosophy, psychology and neuroscience, whereby the research effort shall be coordinated by a problem-based methodological approach that shall be outlined in Chapter 3.

There is a further factor that necessitates such a coordinated cross-disciplinary research approach, namely the ambiguity that currently surrounds the relation between *cognition*, the *brain* and the *mind*, i.e. the three core building blocks for any comprehensive understanding of actual decision-processes in financial markets. In fact, a wide variety of – often diverging – views exist across the literatures. With regard to the relation between the first pair above, for instance, Grush and Damm (2012, p. 280) point out that

“[i]f our goal is understanding the relation between cognition and the brain, we face the challenge that at least one of the relata, *cognition*, is not terribly well understood. There is nothing like agreement even at the most foundational level – as the debate about whether behaviours that qualify as ‘reason’ require the involvement of emotion, or involve representation, or are perhaps best understood as a fancy sort of motor control, shows.”

They conclude that

“it is not at all clear what cognition is. Nor is it clear how the brain function even for the simplest phenomena, such as purposefully twitching a finger. So it should not be surprising that that when we return to the question of the relation between cognition and the brain, there is little to be said with any confidence” (p. 287).

Hence, because a pure logic approach (possibility (i)) or one enhanced by behavioural research (possibility (ii)) are, for the aforementioned reasons, insufficient for the development of an

adequate understanding of human cognition in financial markets – which, in turn, is a necessary prerequisite for the formulation of a more general account of cognitive processes that underlie (constitute?) financial market processes –, necessitating therefore the active cooperation with other disciplines such as, most notably, neuroscience, it seems imperative that a common ground is actively looked for among the various disciplines with regard to the concepts of *cognition*, the *brain*, and the *mind*, their relation to each other as well as to the wider financial market processes. Only clearly formulated problems and questions, which are structured around the core aspects of cognition that apply specifically to financial markets – a decision environment that might be very different in terms of the challenges it poses to the human ‘cognitive apparatus’ (hence, different ‘aspects’ of cognition, and/or different ‘architectural structures’ of the brain might apply) –, will be able to provide the guidance and coordination required for a productive and goal-oriented debate.

This concludes our brief overview of some of the core aspects and issues pertaining to the phenomenon of (human) cognition and their relevance to the present thesis and the envisioned larger project. What remains to be established, though, is how generalizable aspects might be distilled with regard to financial *markets* more generally. To that end, the subsequent section shall provide a brief outline as to how Andy Clark’s idea of ‘extended cognition’ might potentially be applied to the institutional aspect of these markets. Although a full treatment of the topic would require a thesis of its own, the sketch shall equip the reader with a helpful overview that will help her to properly frame her understanding of the larger context of the core contributions produced in the main part of the present thesis.

### *Cognition and ‘Extended’ Cognition*

Although the present work is primarily concerned with those aspects of (human) cognition as they pertain to the expectation formation process of stock market (securities) traders, an eventual account of the generalizable aspects of cognition that apply to financial markets as a whole will require the distillation of the cognitive aspects of the social as well as the institutional setting that comprise these markets. For a preliminary understanding of the intellectual path that might eventually lead to the realisation of the latter, it is, first of all, imperative to become consciously aware of the fact that many debates concerning the topic of *cognition*, ex- or implicitly, presume that the factors and processes pertaining to it are somehow limited to the human brain (or wider body). The legitimacy of this skin/skull boundary was, however, challenged by Clark and Chalmers (1998) in their seminal *Extended Cognition* article, wherein they raised and examined the fundamental question: “Where does the mind stop and the rest of the world begin?” (p. 7).<sup>8</sup> Proceeding from the general

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<sup>8</sup> A brief comment with regard to the relation between *cognition* and the *mind*: The relation between

observation that the “human reasoner [tends] to lean heavily on environmental supports” (p. 8), Clark and Chalmers (1998) advance the thesis that *cognition* extends beyond the confines of the skin/skull boundary:

“[T]he human organism is linked with an external entity in a two-way interaction, creating a *coupled system* that can be seen as a cognitive system in its own right. All the components in the system play an active causal role, and they jointly govern behaviour in the same sort of way that cognition usually does. If we remove the external component the system’s behavioural competence will drop, just as it would if we removed part of its brain. Our thesis is that this sort of coupled process counts equally well as a cognitive process, whether or not it is wholly in the head. [...]

[...] The external features in a coupled system play an ineliminable role – if we retain internal structure but change the external features, behaviour may change completely. The external features here are just as causally relevant as typical internal features of the brain.” (pp. 8-9)

At the core of Clark’s and Chalmer’s (1998) thesis therefore lies “the recognition that many cognitive activities require for their completion the exploitation of features in the environment” (Shapiro, 2012, p. 140). Indeed, they point to the various strands of cognitive science research in which such a view has already come to be accepted:

“In areas as diverse as the theory of situated cognition (Suchman 1987), studies of real-world-robotics (Beer 1989), dynamical approaches to child development (Thelen and Smith 1994), and research on the cognitive properties of collectives of agents (Hutchins 1995), cognition is often taken to be continuous with processes in the environment. Thus, in seeing cognition as extended one is not merely making a terminological decision; it makes a significant difference to the

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*cognition* and the *mind* is arguably even more ambiguous than the one between the former and the *brain* (see main text above), particularly as the concept of *mind* is as, if not even more, contested than the concept of *cognition* in the literature. Grush and Damm (2012, pp. 286-87) point out that in the intellectual tradition *mind* was simply conceived as an attribute of man, which distinguished him from the rest of nature, and identified with certain properties and abilities, most prominently *reason* and *cognition*. Grush and Damm (2012) summarize that

“[s]o pervasive is this way of thinking that prominent philosophers have argued for conclusions about features of the *mind* by doing little more than trying to establish premises about properties of *problem solving*. A prime example is Clark and Chalmers’s famous ‘Extended Mind’ paper (Clark and Chalmers 1998), the aim of which is to tell us about the physical instantiation of the *mind*, though the bulk of the considerations involve describing the physical stuff involved in *problem solving* [see main text].” (p. 286; *italics* in original).

As far as the present work is concerned, the *mind* is conceived as the *locus* of expectation-formation, problem-solving and decision-processes, particularly as they relate to financial market processes.

methodology of scientific investigation. In effect, explanatory methods that might once have been thought appropriate only for the analysis of ‘inner’ processes are now being adapted for the study of the outer, and there is promise that our understanding of cognition will become richer for it.” (p. 10; fn. removed)

What needs to be emphasised at this point – particularly as that insight will be central to our subsequent outline as to how the view of an ‘extended cognition’ could potentially open the door to the development of an alternative conceptual framework for the study and understanding of (at least certain aspects of) the institutional setting of financial markets – is the following observation by Shapiro (2012, p. 140): “Of vital importance is that these features [in the environment] are exploited for the information they contribute toward performing a cognitive task.” In this context, it is also important to note that neither the factor of *consciousness* nor the contingency of coupling pose a serious threat to their thesis. With regard to the former, Clark and Chalmers (1998) argue that

“[N]ot every cognitive process, at least on standard usage, is a conscious process. It is widely accepted that all sorts of processes beyond the border of consciousness play a crucial role in cognitive processing: in the retrieval of memories, linguistic processes and skill acquisition, for example. So, the mere fact that external processes are external where consciousness is internal is no reason to deny that those processes are cognitive.” (p. 10)

Similarly, they hold that the “mere contingency of coupling does not rule out cognitive status” (p. 11), arguing that

“[i]n the distant future we may be able to plug various modules into our brain to help us out: a module for extra short-term memory when we need it, for example. When a module is plugged in, the process involving it are just as cognitive as if they had been there all along.” (*ibid.*)

Clark and Chalmers (1998) speculate that ‘extended cognition’, i.e. the extension of cognition beyond the skin/skull boundary, is a product of man’s evolutionary past, which as such conferred a special survival advantage to the species:

“[I]t may be that the biological brain has in fact evolved and matured in ways which factor in the reliable presence of a manipulable external environment. It certainly seems that evolution has favoured onboard capacities which are especially geared to parasitizing the local environment so as to reduce memory load, and even to transform the nature of the computational problems themselves. Our visual systems have evolved to rely on their environment in various ways: they exploit contingent facts about the structure of natural sciences (e.g. Ullman

and Richards, 1984), for example, and they take advantage of the computational short cuts afforded by bodily motion and locomotion (e.g., Blake and Yuille, 1992). Perhaps there are other cases where evolution has found it advantageous to exploit the possibility of the environment being in the cognitive loop. If so, then external coupling is part of the truly basic package of cognitive resources that we bring to bear on the world.” (p. 11)

So far, our outline has solely focused on *extension* as far as it pertains to *cognitive processing*, but what about the *mind* itself? Can it extend beyond the skin/skull boundary as well? Indeed, Clark and Chalmers (1998) propose that it can and that it does:

“Everything we have said so far [i.e., about external *cognitive processing*] is compatible with the view that truly mental states – experiences, beliefs, desires, emotions, and so on – are all determined by states of the brain. Perhaps what is truly mental is internal, after all?

We propose to take things a step further. While some mental states, such as experiences, may be determined internally, there are other cases in which external factors make a significant contribution. In particular, we will argue that *beliefs* can be constituted partly by features of the environment, when those features play the right sort of role in driving cognitive processes. If so, the mind extends into the world.” (p. 12; *italics* in original)

The relevance of this aspect to an understanding of belief- and expectation-formation processes in financial markets dictates a more detailed look at Clark’s and Chalmers’ (1998) argument. They hold that the information contained in and retrieved from a notebook can play a causal role in the belief-formation process that is similar to that of biological memory. They discuss the following example:

“First, consider a normal case of belief embedded in memory. Inga hears from a friend that there is an exhibition at the Museum of Modern Art, and decides to go see it. She thinks for a moment and recalls that the museum is on 53<sup>rd</sup> Street, so she walks to 53<sup>rd</sup> Street and goes into the museum. It seems clear that Inga believes that the museum is on 53<sup>rd</sup> Street, and that she believed this even before she consulted her memory. It was not previously an *occurrent* belief, but then neither are most of our beliefs. The belief was somewhere in memory, waiting to be accessed.

Now, the case of belief originating externally to biological memory:

“Now, consider Otto. Otto suffers from Alzheimer’s disease, and like many Alzheimer’s patients, he relies on information in the environment to help

structure his life. Otto carries a notebook around with him everywhere he goes. When he learns new information, he writes it down. When he needs some old information, he looks it up. For Otto, his notebook plays the role usually played by a biological memory. Today, Otto hears about the exhibition at the Museum of Modern Art, and decides to go see it. He consults the notebook, which says that the museum is on 53<sup>rd</sup> Street, so he walks to 53<sup>rd</sup> Street and goes into the museum” (pp. 12-13).

Clark and Chalmers (1998, p. 13) argue that “the essential causal dynamics of these cases mirror each other precisely,” or, in other words, “[t]he information in the notebook functions just like the information constituting an ordinary non-occurrent belief.” The authors specify that the following set of criteria is involved in the ascription of *extended belief* (always with reference to the two-case example):

“First, the notebook is a constant in Otto’s life – in cases where the information in the notebook would be relevant, he will rarely take action without consulting it. Second, the information in the notebook is directly available without difficulty. Third, upon retrieving information from the notebook he automatically endorses it. Fourth, the information in the notebook has been consciously endorsed at some point in the past, and indeed is there as a consequence of this endorsement. The status of the fourth feature as a criterion for belief is arguable (perhaps one can acquire beliefs through subliminal perception, or through memory tampering?), but the first three features certainly play a crucial role.” (p. 17; fn. removed)

What is of particular relevance to the envisioned project, particularly with regard to the belief- and expectation-formation processes of agents operating in financial markets, is Clark’s and Chalmers’s (1998) insinuation that a plausible case might be made that mental states of one individual are “partly constituted by the states of other thinkers” (p. 17), i.e. for ‘socially extended cognition’. Further, it is interesting to note that *language* is identified as the central coupling-agent:

“Without language, we might be much more akin to discrete Cartesian ‘inner’ minds, in which high-level cognition relies largely on internal resources. But the advent of language has allowed us to spread this burden into the world. Language, thus construed, is not a mirror of our inner states but a complement to them. It serves as a tool whose role is to extend cognition in ways that on-board devices cannot. Indeed, it may be that the intellectual explosion in recent evolutionary time is due as much to this linguistically-enabled extension of cognition as to any independent development in our inner cognitive resources.” (p. 18)

As it is primarily *information* that drives belief- and expectation-formation processes, it shall be of great interest to the future research endeavour to determine whether (and if so, to what extent) financial market prices play a role similar to the one claimed by Clark and Chalmers (1998) for language in the belief formation process. As with most re-conceptions, this view might have significant consequences for our understanding of the operation of financial markets more generally, and human and ‘cyborg’<sup>9</sup> cognition more specifically. These are some of the topics that will have to be explored in future work. For the time being, we can merely provide a brief suggestion as to how certain institutional aspects might qualify as a form of *extended cognition*.

### *‘Extended’ Cognition and (Financial) Institutions*

To reiterate, the present thesis is concerned primarily with conceptualising the expectation formation processes of stock market (securities) traders, which means, that the discussion in the main body of the present work will abstract from several core aspects that are generally agreed to constitute essential elements of these markets, most notably perhaps, institutions. Despite this abstraction in the present work, the wider project recognizes that institutions *do* matter. They will just be conceptualised in a rather different way than is usual in the literature, namely as a part of human agents’ *external* cognition. In order to afford the reader with a better understanding as to how generalizable aspects of cognition that apply to financial markets as a whole might be identified *externally* to the biological ‘cognitive apparatus’ of human agents, it shall be briefly discussed, how the institutional architecture of markets might, in fact, constitute an *extension* of the agents’ ‘internal’ cognitive architecture. In light of Clark’s and Chalmers’s (1998) *Extended Cognition* thesis, it needs to be emphasised, though, that this *institutional cognitive architecture* component – if indeed, its status as such is confirmed by future research – is not a simple *add-on*, but constitutes an essential component of the agents’ cognitive processes in this particular human endeavour. These are issues to be explored in future research, as is the question whether this *extension* is limited to *cognitive processing* or whether it encompasses an extension of the *mind* as well. For the time being, we shall limit the discussion to the illustration – with reference to the existing literature – of how institutional factors might relate to *cognitive processes*.

Now, it is well-known from the line(s) of research pioneered by – most prominently – Herbert A. Simon and Gerd Gigerenzer, that (human) agents employ a set of certain (‘internal’) cognitive procedures – so-called *heuristics* – to reduce (or bypass) the computational complexity of certain decision tasks. Nevertheless, these ‘internal’ cognitive tools are often not sufficient to deal with all computational complexity. Thus, it is important to note, that the

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<sup>9</sup> i.e. the interaction between human agents and A.I.

evolutionary process (biological, social and cultural) has also led to the development of certain institutional constructs – most relevantly *markets* and *organizational hierarchies* (e.g., firms) – that have enabled man to deal with informational and computational complexities to a degree that would have significantly exceeded the individual (biological) entity’s capability. For this reason, and because a certain element of *coupling* can be identified between human decision processes and (certain) institutional constructs, it might not be unreasonable to suggest that the latter constitute important (‘external’) components of these cognitive processes. Let’s begin with the one institutional construct that has traditionally (at least since Hayek, 1945) – at least within the mainstream literature – been ascribed this role as *information synthesizer* that would allow individual agents to efficiently coordinate their actions and choices, the *market*. Egidi (2016, p. 8) summarizes:

“In the neoclassical view the role of the market is that of synthesizing the relevant information and fully reducing the computing complexity that individuals need to make rational decisions.

Complex strategic behaviours are not needed in this view because perfect markets eliminate the reciprocal interdependence among individuals and reduce behaviour to simple parametric choices.”

Egidi (2016) is quick to emphasise, though, that the *market’s* capability of performing this function is inherently limited: “The problem is that this reduction is widely imperfect” (p. 8). He expounds:

“The first point to be stressed is that even if we accept the frame of the general equilibrium analysis, we cannot conclude that the market fully reduces the computing complexity of human behaviours.

As is well known, in the equilibrium framework not all the information that agents need is provided by the market. It is assumed that there is a sort of ‘data base’ to which agents should have access (without costs), which contains information about the nature and quality of goods, about technologies and states of nature, and finally about the allocation (both spatial and temporal) of the markets.

This adds up to an unacceptably vast amount of information that individuals should have freely disposable and on which they should compute. What happens if, following the viewpoint of the Austrian school, we assume that agents possess only fragments of information?

Radner has shown that ‘if economic decision makers have unlimited computational capacity for choice among strategies, then even if there is

uncertainty about the environment, and different agents have different information and different beliefs about [the] environment, then one can apply the standard theorems on the existence and optimality of competitive equilibrium.’

But the core of the theory lies in the affirmation of the role of markets as mechanisms that decentralize decisions, and obviously this task is necessary only if a bounded human capacity is assumed.” (pp. 8-9)

Egidi (2016, p. 9) also rebuts the neo-classical counterargument to such objections, *viz.* the postulated existence of further markets where the required basic information (e.g., with regard to technologies and states of nature is produced and exchanged) is produced and exchanged:

“Evidence has shown that not all these markets do exist and some of those that exist work mainly in a distorted way (they sell incomplete or unreliable information: take for example advertising).

This is due to the peculiar character of information and knowledge; as Arrow pointed out, information does not respect the characteristics that define the exchange of a ‘commodity between private contracting parties: information can only be imperfectly appropriated, is indivisible and imperfectly valuable’.

One consequence of such a situation is that, for lack of some form of legislative guarantee, it may not be worthwhile to produce information. The same goes for invention and innovation.

It follows that generally there is a lack of markets for information (they are drastically fewer than necessary), and consequently the Pareto optimum is not reachable by an economic system.” (p. 9)

Egidi (2016) therefore concludes and emphasises that the *market* systematically fails to fully cater for the informational and computational requirements of human agents who try to coordinate their actions. Particularly its incapacity to fully reduce the computational complexity to a level that is tractable by the human agent necessitates the introduction of an additional layer of a different *form* of institution: “[T]his reduction is incomplete, and therefore alternative ways are needed for organizing and coordinating human activity” (*ibid.*, p. 11). Hence, having established this explanatory gap with regard to informational and computational processing in the institutional framework of *markets*, Egidi (2016) suggests that organizational *hierarchies* (e.g., firms) might constitute the necessary complementary element: “[H]ierarchies can be considered as one of the means by which coordination is achieved in order to solve complex problems” (*ibid.*). He expounds:

The nature of the firm, which in the traditional framework was defined by means

of the production function, can be redefined on the basis of the bounded rationality approach.

Let me provisionally define the *enterprise* as an organization which performs the task of coordinating the limited capacities of different individuals who cooperate to realize a given goal.

In this definition it seems that the organization plays the same role as the market, since it coordinates individual activities. And yet there is an important difference.

The market in fact coordinates the activities of different individuals and organizations within a given division of labour in the society; but organisations, besides coordinating the activities of different individuals, are able to solve a complex problem by dividing it into different sub-problems, to be solved by different functional sub-systems of the firm.” (pp. 11-12).

Organisational hierarchies are therefore not only an important complementary element in the wider institutional framework of the economy, but arguably also constitute an important ‘external’ (cognitive) component for the feasibility and execution of certain cognitive tasks and processes that agents perform in the economy:

“As intentional institutions, firms reflect projecting ability that is the capacity to plan the forms of cooperation which make it possible to achieve desired goals.”  
(*ibid.*, p. 12)

In the light of these insights, Egidi (2016) raises the question as to whether the traditional ‘transaction cost’ approach can “fully exhaust the problem of planning the nature of the firm” (p. 12), holding that a *bounded rationality* approach – i.e. one that emphasises the organizational hierarchies’ (i.e., the firms’) *intentional* character as well as their facilitating role in enabling human agents to (cognitively) deal with the informational, computational and coordinative challenges they encounter in the respective environments – might prove to be more faithful to its true nature and yield more insightful results. Similarly, the envisioned wider project shall inquire into the extent to which the institutional component of financial markets – or at least certain aspects of it – can be re-conceptualised as an ‘external’ extension of the human cognitive architecture. In this view, the human ‘cognitive apparatus’ has, in its evolutionary past, not only developed a set of ‘internal’ strategies and tools (e.g., *heuristics*) to deal with complex environmental challenges, but also the ability to significantly enhance the processing power of the group/species beyond a level attainable by the individual biological entity by itself through the integration of certain ‘external’ elements of the environment – including fellow agents and their ‘cognitive apparatuses’ – into certain informational and computational *processing* tasks, creating thereby a super-cognitive

architecture; one, which shall be further enhanced by the adoption of A.I. technology – particularly within financial markets, leaving us with a spectrum of *cognition* (and *mind*?) that stretches from the individual, to the socio-institutional, to the technological (cyborg). In the present work, we shall take the very first step on this journey, which shall comprise the following three core contributions: In Chapter 1, we shall establish the deep embeddedness of the conceptualisation of the agent in mainstream finance in general neoclassical economics at the level of ontology, methodology and use of methods and untenability of the neoclassical conception of the rational decision process with regard to the study of *cognitive processes* pertaining to the individual stock market operator more specifically and the wider financial market more generally, as well as explain the restraining effect it has had on the development of behavioural finance – the dominant research program in this area – in general and the obstacle it poses to the formulation of an alternative, more plausible, conceptual and theoretical account of financial markets – one more aligned with the empirical findings – in particular.

In Chapter 2, we shall begin with the outline of a more plausible conceptualisation of the aspects that pertain to the cognitive processes on the level of the individual stock market operator on the basis of inferences drawn from an ‘ecologically evolved’ practitioner’s investing account, *Value Investing*, with compatible heterodox finance accounts acting as the midwives in the process. The *Value Investing* framework’s distinct approach to financial markets permits certain inferences with regard to its underlying presuppositions about the nature of the decision environment and the central decision-task the stock market operator faces, which, in turn, shall permit certain inferences as to the type of cognitive features that need to be present in an agent’s ‘decision apparatus’ in order for her to be able to perform the latter while surviving in the former. Further important inferences can be drawn from the framework’s understanding pertaining to the relationship between *price* and *value*; in fact, as shall be demonstrated, certain features, in terms of the nature of the environment, information and cognitive processes *have to be given* for financial markets to display the characteristics they are known for. Although the lack of space precludes the formulation of a comprehensive reconceptualization of these markets, one that necessarily would have to include evolved concepts such as the one pertaining to the aforementioned ‘extended’ aspect of cognition, a sound basis for such a future endeavour shall be established, and so shall the relevant insights for the formulation of a commensurate methodological approach for the scientific investigation of these processes, to be addressed in Chapter 3, that can overcome the impasse of Behavioural Finance established in Chapter 1.

In Chapter 3, we shall apply the ontological and conceptual insights gained in Chapter 2 to identify, firstly, an adequate starting point within the wider economics literature for furthering our conceptual project and for weaving it into the wider (financial) economics discourse,

whereby the following alternative accounts shall be identified as potentially relevant and analysed as to their suitability: (1) Rapp and Cortés (2017) proposal for a ‘Cognitive Finance’ research program, (2) Gintis’ (2007, 2014) proposal for the *Unification of the Behavioural Sciences*, (3) Andrew Lo’s (2004, 2005) *Adaptive Market Hypothesis*, (4) and the *Santa Fe Stock Market Model*. As each one of these accounts will be found wanting in one respect or another, it shall be established that the need for a new alternative framework arises, whereby particularly the respective thought of Johannes von Kries (i.e., one of Keynes’ most important intellectual influences in regard to human decision-making) and F.A. Hayek, as they pertain to matters of cognition, shall be singled out as the probably most fertile starting grounds for such a project *within* the wider economics literature, while also providing the required interdisciplinarity for weaving our project into the relevant (financial) economics and cognitive science discourses. Secondly, and related to the previous point, Chapter 3 shall attempt to identify an appropriate methodological approach that is able to transform a newly conceptualised understanding of cognitive processes as they pertain to the individual stock market operator and, eventually, also those generalizable to the wider stock market into a scientific research enterprise – just like the neoclassical conceptual, theoretical and methodological framework did for behavioural finance – that is able to overcome the impasse in mainstream finance research and provides a more adequate framework for the study of financial market processes, particularly as they pertain to cognition and price movements.

# Chapter 1

## Introduction to Chapter 1

The central focus of the present work is, as elaborated in the thesis' overall Introduction, the conceptualization of the core cognitive function(s) the stock market (securities) investor's 'cognitive apparatus' has to perform in order to satisfactorily approach the core problem the agent faces in this particular decision environment. The first step shall be an explication of the inherent inadequacies of the currently predominant conception of the *individual* – at least as far as they relate to the aspect of *cognition* – in modern financial market research. To this end, the present chapter shall begin with an exposition of the inadequate ontological conception of both the decision environment (i.e., the financial markets) and the decision-task itself employed by mainstream finance, before exploring the insufficiencies of the prevailing conception of *cognition* when confronted with the realities of these markets, both theoretically/philosophically as well as empirically. Particularly the points of rupture and the growing schism, which shall be identified in the field of behavioural finance in the last part of the present chapter, shall underline the impeding nature of these neo-classical presuppositions for a further progression of our understanding of the type of *cognition* that drives actual financial market processes.

### 1. The Neo-classical Conception of the Decision Environment and of the Decision Task

The aims of this section are twofold: first, to provide a general outline of the neo-classical conception of the decision-environment, particularly as far as it relates to the 'openness' of the system, one of the most important factors when it comes to the choice of appropriate decision-tools; secondly, the demonstration of the inadequacy of the 'closed system' presupposition that underpins modern finance theory by explicating the inherent shortcomings of its decision-tools in the actual financial market context and by exposing some of the interpretative misdiagnosis that might follow from it, with potentially severe repercussions if implemented via normative projects such as Richard Thaler's *nudging*.

#### *1.1 The Origins of the Neo-classical Presuppositions with regard to the Nature of the Decision-environment and -task*

In order to understand the origins of the neo-classical presuppositions with regard to the nature of the decision-environment and -task the stock market investor faces in his day-to-day activity, it is important to note that the roots of modern finance research can be traced to Cowles' (1933) early research into the statistical properties of market prices. The methodological presuppositions that underlie such econometric work came thus, together with the dominant

neo-classical paradigm in economics, to define the new field. A brief historical overview seems appropriate: Although the allegedly random character of stock prices was already hypothesized and modelled by the French mathematician Louis Bachelier (1900), it was not until the 1950's-60's that the econometric findings in regard to financial market price behaviour (e.g., Kendall, 1953; Fama, 1965,ab), which had their genesis in Cowles' (1933) original research in the 1930's, sparked a general interest in the formulation of a formal model of the latter. Mehrling (2012) summarizes:

“[T]he famous British statistician M.G. Kendall [...] found that: ‘In a series of prices which are observed at fairly close intervals the random changes from one term to the next are so large as to swamp any systematic effect which may be present. The data behave almost like wandering series ... almost as if once a week the Demon of Chance drew a random number from a symmetrical population of fixed dispersion and added it to the current price to determine the next week's price’ (Kendall, 1953, p. 13). This way of thinking about the data focused attention on two questions: the independence of successive price changes over time, and the shape of the probability distribution of price changes at a point in time.” (p. 62)

Mehrling (2012) explains:

“For economists, the independence question seemed naturally the more important of the two, since statistical independence would imply zero expected speculative profit, which economists recognized as a characterization of equilibrium in competitive markets. Thus, the so-called random walk theory, which was initially only a statistical characterization of the data, came to be endowed with implicit economic content, and was renamed the efficient market hypothesis instead.” (pp. 62-3).

It was Paul Samuelson who would apply the insights and logic of the recently rediscovered work of Bachelier (1900), which had been ignored for more than half-a-century, to develop on the basis of his ‘shadow price’ concept (Samuelson, 1965) – whereby the latter defines a stock's intrinsic, even if not directly observable, value – a formal argument that would conclude that there existed no more accurate measure of that ‘shadow price’ than the current market price, which results from the aggregate trades of Bachelier's buyers and sellers; a hypothesis, which he bolstered with the incorporation of the rational expectations framework (see Bernstein, 1992). Thus, the Efficient Market Hypothesis (EMH) was born, which would

be further developed by Fama (1970, 1991).<sup>10</sup>

Harry Markowitz, the father of Modern Portfolio Theory (MPT), was influenced by Friedman and Savage's (1948) article (Lavine, 2011, p. 18), which postulated a utility function that, by featuring both concave and convex portions, should provide an explanation for the seemingly paradox demand of rational individuals for insurance, on the one hand, and gambles, on the other. Markowitz (1952a) found their proposed solution to be inadequate and developed, first, his customary wealth theory, in order to deal with the shortcomings<sup>11</sup> of the Friedman-Savage framework, and, secondly, his Mean-Variance Portfolio Theory (1952b, 1959).

Markowitz's MPT, in turn, would provide the basis for Treynor's (1962), Sharpe's (1964), Lintner's (1965) and Mossin's (1966) independently derived Capital Asset Pricing Model (CAPM), which led to the formulation of the Arbitrage Pricing Theory (APT) by Ross (1976) and the Fama-French Three-Factor-Model (1993) as potential alternatives. In addition to these asset pricing models, a valuation model for contingent claims was developed by Black and Scholes (1973), and Merton (1973).

At its core, modern (mainstream) finance theory is hence nothing more but the product of the assimilation of financial market research – a subject area previously almost exclusively covered by practitioners (e.g., De la Vega, 1688;<sup>12</sup> De Pinto, 1771; Nelson, 1904;<sup>13</sup> Graham and Dodd, 1934) and those interested in the phenomenon of crowd-psychology (most prominently, Mackay, 1841; see also the works by Gustave Le Bon) – into the prevailing wider research programme of neo-classical economics. It should thus come as no surprise that its theoretical as well as methodological core are fundamentally predisposed toward certain neoclassical presuppositions that subject them to the criticism raised by Lawson (2003), particularly because – in contrast to several other fields and off-springs of modern mainstream economics – neo-classical finance has failed to evolve beyond this early neo-classical stage; most notably perhaps, while mainstream finance has, particularly in the wake of the ascent of

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<sup>10</sup> Alajbag *et al.* (2012) specify: “From the works of Samuelson and Fama we can distinguish two various aspects of market efficiency – efficiency as a state (axiomatic approach) and as a process (empirical approach). Samuelson (1965) defined efficiency as a state which is reached in conditions of perfect competition, zero transaction costs and complete and freely available information. He did not look into how assumptions correspond with the reality of particular markets. Fama's perspective was different. Fama (1965[a]) saw efficiency as an accrual outcome produced by sophisticated traders. However, he failed to analyse these market processes believing that sophisticated traders should always be there to ensure market efficiency. By using an assumption instead of doing analysis if this assumption holds, Fama paved the way for conflicting interpretations and variable definitions of efficient markets (LeRoy, 1989)” (p. 56)

<sup>11</sup> Most significantly, according to the Friedman-Savage utility function, poor people would never buy lottery tickets and middle-income people would never insure themselves against modest losses (Markowitz, 1952a).

<sup>12</sup> Joseph de la Vega (1688) book *Confusion of Confusions* is the oldest – although, strictly speaking not a descriptive – account of the stock market business. See also Corzo (2014).

<sup>13</sup> For a more detailed analysis of the historical finance literature with regard to option-pricing, see Haug and Taleb (2011).

*information economics*, long since discarded with the assumption of perfect information, it continues to be a central building block of modern finance's edifice.

In the subsequent sub-section, we shall identify the core ontological presuppositions that modern finance theory employs with regard to the nature of the decision environment and task, particularly by exposing the inadequacy of its core decision models in a real-world setting. Although we are aware that closed system methods might not necessarily equate with a closed system ontology, as the former might simply be one strategy to address a complex reality (Mäki, 2012, p. 15), the ascription of a normative status to such decision models for the actual financial market setting certainly implies the presumption that the closure requirements for the validity of these models is not violated by the former's nature. In fact, it was Leonard Savage (1954) – the originator of the core theoretical decision construct on which these models build (see below; see also Giocoli, 2013) – himself, who had explicitly warned against applying his subjective expected utility framework outside, what he termed, *small worlds*; and as shall be argued at length in Chapter 2 of the present work, real financial markets seem unlikely contestants for that label.

### *1.2 Neo-classical Finance and the Inadequacy of its ontological Presuppositions*

As already noted above, modern finance theory is an offspring of neo-classical economics and, as such, shares – particularly due to its substantial reliance on and use of the expected utility framework on the theoretical side and of econometric techniques on the empirical side of its research programme – the neo-classical closed-system ontology and a Humean ontology of event regularities, while it ignores the underlying causal mechanisms (see Lawson, 1999, 2003). Already a brief analysis of its core components – i.e. the Efficient Market Hypothesis (EMH), Modern Portfolio Theory (MPT), the Capital Asset Pricing Model (CAPM) and the Black-Scholes-Merton Option Pricing Theory (OPT) – suffices to establish the validity of this statement.

The EMH itself, which underlies the normative pricing (CAPM, OPT) and allocation/diversification (MPT) frameworks, holds that financial market prices follow a random walk pattern and that rational investors with access to perfect information (which is presumed given) guarantee equilibrium market prices, as rational arbitrage trades will instantaneously eliminate any mispricing. The system is thus presumed to be sufficiently closed for market price-changes to be described by Gaussian distributions. This includes the requirement for the presence of atomistic individuals, as a violation of the independence postulate could lead to systematic deviations of prices from their underlying economic values. So, how does the EMH fare in terms of the accuracy of its predictions? Not too well, as it turns out. A number of empirical studies has found that financial market prices *do* – at times at least

– significantly fail to accurately reflect the changes in underlying economic value (e.g., Shiller, 1981; LeRoy and Porter, 1981; Shiller, 1990; Cochrane, 1991). Shiller (2003) summarizes:

“After all the efforts to defend the efficient markets theory there is still every reason to think that while markets are not totally crazy, they contain quite substantial noise, so substantial that it dominates the movements in the aggregate market. The efficient markets model, for the aggregate stock market, has still never been supported by any study effectively linking stock market fluctuations with subsequent fundamentals” (p. 90).

This demonstrates that while Brownian motion provides an ideal modelling framework for the description of pollen particles through a liquid as they collide with its molecules,<sup>14</sup> in the light of the existing empirical evidence it appears less suited to provide an accurate description of stock price movements (see Derman, 2011, pp. 183-4). It seems reasonable to suggest that one of the main reasons for the framework’s success in the case of the one and its inadequacy in the case of the other is to be found in the respective realities and underlying causal mechanisms that ontologically distinguish the two phenomena. Whereas the drift of pollen particles through a liquid is determined by fixed laws of physics, financial market price movements are determined by the constantly evolving and altering expectations and decisions of (fallible) interacting *human* agents, who operate in an environment that seems to be characterized more by *fundamental* rather than *stochastic* uncertainty (see Chapter 2). In addition, there seems to exist – at times at least – a significant two-way interaction between the agent and his environment; in other words, it is not only the agent who impacts and shapes the environment, but it is also the environment that constraints and influences the perceptions, expectations and consequently decisions of the agent (e.g., Soros, 1994). It seems therefore plausible to suggest that the degree of closure is significantly lower in the case of the former than in the case of the latter. This should provide a reasonable explanation as to why a closed-system framework such as Brownian motion provides an accurate description of the drift of pollen particles in a liquid, but not of financial market price movements.

The normative (decision) models that modern finance theory has produced (i.e., the MPT, CAPM and OPT) are nothing else but axiomatic constructs that build on the core tenets of the EMH. Their poor performance in a real-world setting provides evidence for the argument that the closure requirements for a closed-system approach – which ultimately also affects the feasibility of the Expected Utility approach (see below) and the corresponding understanding of cognition – are violated in actual financial market settings. For instance, the mathematical structure of the MPT turns the investing activity effectively into a closed-system gamble (e.g.,

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<sup>14</sup> In fact, this is one of the origins of Brownian motion (see, e.g., Einstein, 1905).

a game of dice). The core inputs to the model are the assets' expected returns, their variances and covariances. All three are (the first explicitly, the last two implicitly) necessarily about the future. However, as the future cannot be observed or measured, the required inputs have to be estimated from their respective historical past,<sup>15</sup> a procedure which is made possible by the closed-system presupposition of the model. Whether the necessary degree of closure is given in an actual financial market setting, is highly questionable, though, particularly as these markets have a tendency of producing unexpected (i.e., non-stochastic) shocks (e.g., Minsky, 1982), which undermine the rationality of relying on normative instruments such as the MPT. Taleb (2012) exposes the deceptive nature of the protection that MPT diversification allegedly affords:

“It does not drive people to take less risk based on diversification, but causes them to take more open positions owing to the perception of offsetting statistical properties – making them vulnerable to model error, and especially vulnerable to the underestimation of tail events. To see how, consider two investors facing a choice of allocation across three items: cash, and securities A and B. The investor who does not know the statistical properties of A and B and knows he doesn't know will allocate, say, the portion he does not want to lose to cash, the rest into A and B – according to whatever heuristic has been in traditional use [e.g., the *Value Investor*]. The investor who *thinks he knows* the statistical properties [i.e., the MPT investor], with parameters,  $\sigma_A$ ,  $\sigma_B$ ,  $\rho_{A,B}$ , will allocate  $\omega_A$ ,  $\omega_B$  in a way to put the total risk at some target level (let us ignore the expected return for this). The lower his perception of the correlation  $\rho_{A,B}$ , the worse his exposure to model error. Assuming that he thinks that the correlation  $\rho_{A,B}$  is 0, he will be overallocated by 1/3 for extreme events. But if the poor investor has the illusion that the correlation is -1, he will be maximally overallocated to his A and B investments. If the investor uses leverage, we end up with the story of Long-Term Capital Management, which turned out to be fuelled by the parameters. (In real life, unlike in economics papers, things tend to change [...]). We can repeat the idea for each parameter  $\sigma$  and see how lower perception of this  $\sigma$  leads to

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<sup>15</sup> Fischer Black seems to have been one of the very few (neo-classical) finance theoreticians that explicitly pointed to the flaw in relying on such projections:

“In one short essay he [Fischer Black] struck at the foundation of financial economics, writing that ‘certain economic quantities are so hard to estimate that I call them ‘unobservables’.’ One unobservable, he pointed out, is *expected return*, the amount by which people expect to profit when buying a security. So much of finance, from Markowitz on, deals with this quantity unquestioningly. Yet, wrote Fischer, ‘Our estimates of expected return are so poor they are almost laughable.’” (Derman, 2004, p. 171; *italics* in original)

overallocation.” (Taleb, 2012, pp. 452-3; *emphasis added*).

Taleb’s (2012) critique is corroborated by the existing empirical evidence. First, the simple heuristic of applying equal weights to portfolio-assets (i.e., ‘naïve diversification’) is well-known to produce superior returns to mean-variance portfolios in practical settings (De Miguel *et al.*, 2009; Jobson and Korkie, 1981; Jorion, 1985). Secondly, mean-variance optimisation does not necessarily lead to well-diversified portfolios (Green and Hollifield, 1992) and can sometimes even produce extreme and/or counter-intuitive weights for some portfolio-assets (Black and Litterman, 1991, 1992). It has even been argued that mean-variance optimizers are often ‘error maximisers’ (Michaud, 1998). It is precisely for this reason that “many practitioners consider the output of risk-return optimization to be opaque, unstable, and/ or unintuitive” (Kolm *et al.*, 2014, p. 357). This demonstrates the practical dangers of ‘construing things after one’s own fashion, clean from the purpose of things themselves’<sup>16</sup>; see also Lo and Miller (2010), who warn that the ‘physics envy’ of neo-classical finance “may be hazardous to your wealth.”

The CAPM has proven to be similarly unreliable in a real-world setting (e.g., Fama and French, 1992). In fact, its empirical record had been so poor that Fama and French (2004) concluded that “the CAPM’s empirical problems probably invalidate its use in applications” (p. 44).

Even the OPT, albeit being more robust than either the MPT or the CAPM (see Derman, 2011), is ultimately vulnerable to the violations of its core assumptions in an actual market setting. Jegadeesh and Titman (1993, 2001), for instance, produce empirical evidence that falsifies the random walk hypothesis for security price movements, and Carr and Wu (2004) find that asset return volatilities are not constant but tend to be correlated with asset returns.

On the basis of the preceding discussion, it seems reasonable to conclude that the realities of the decision-environment encountered by agents in actual financial markets is significantly different from the one postulated by mainstream finance theory. This insight has important implications for the study and eventual understanding of agents’ actual decision processes more specifically, and eventually, the cognitive processes that underlie actual financial market processes more generally. In the following sub-section we shall illustrate how the (decision-making) realities encountered in financial markets significantly alter our view on certain observed decision behaviour that is, due it constituting a deviation from the neo-classical rationality postulate, interpreted and classified as sub-optimal at best and irrational at worst by behavioural finance researchers.<sup>17</sup> This shall constitute the prelude to the dissection and

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<sup>16</sup> Cicero to Caesar, in Shakespeare’s *The Tragedy of Julius Caesar*, 1599, Act I, Scene II.

<sup>17</sup> As shall be expounded in Section 3 of the present chapter, the methodological and theoretical side of behavioural finance continue to be dominated by the neo-classical framework.

criticism of the neo-classical conception of the individual (with regard to cognition) in the subsequent section.

### 1.3 A New Look at Human Decision Behaviour From a Dynamic Perspective

In the present sub-section we shall demonstrate how an alteration in some of the ontological presuppositions with regard to the respective decision-environment and/or –task can significantly alter our interpretation of and view on the ‘rationality’ and desirability of certain types of observed decision behaviour. To be more precise, we shall demonstrate, with reference to Peters’s and Gell-Mann’s (2016) critique of modern decision theory and the relevant aspects of the informational theoretical framework of Shannon (1948, 1949, 1956), Kelly (1956) and Thorp (1961, 1966; and Kassouf, 1967; 1969, 1971, 1997, 2008a,b), how the desirability of certain cognitive traits uncovered by behavioural economics/finance research such as *loss aversion* (Tversky and Kahneman, 1981b; Kahneman *et al.*, 1991) and *mental accounting* (Thaler and Johnson, 1990) alters if we move from a *static* to a *dynamic* decision-environment and/or -task.<sup>18</sup>

Peters and Gell-Mann (2016) critique modern decision theory, which constitutes the theoretical basis of Behavioural Economics and consequently the *psychology* pillar of *Behavioural Finance*, on the ground that the framework is largely “based on early work in probability theory [...] [that] predates the development of the notion of ergodicity”<sup>19</sup> (p. 2).<sup>20</sup> This leads to – for the in economics as well as in real life ubiquitous *stochastic growth processes* erroneous – assumption “that expectation values reflect what happens over time” (*ibid.*). This, in turn, they argue, leads to the erroneous application of expectation values “to evaluate situations where time averages would be appropriate instead, and the result is a ‘paradox,’ ‘puzzle,’ or ‘anomaly’” (*ibid.*).

First, Peters and Gell-Mann (2016) critique the static and one-off nature of the gambles, which “are the formal basis of decision theory” (p. 3):

“Gambles are often treated in economics as so-called one-shot games, meaning that they are not part of any dynamic and are assumed to reside outside of time, an assumption that is difficult to describe: ‘it’s more or less impossible to consider any gamble as happening outside of time [Buchanan, 2013, p. 3]. The one-shot

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<sup>18</sup> Several of the points discussed here have already been touched upon by Taleb (2018, Chap. 19). The relevant issues shall be discussed in greater depth in the present work.

<sup>19</sup> Ergodic Property: “*The expectation value of the observable is a constant (independent of time), and the finite-time average of the observable converges to this constant with probability one as the averaging time tends to infinity.*” (Peters and Gell-Mann, 2016; *italics* in original)

<sup>20</sup> Peters and Gell-Mann (2016) emphasise the significance of the *ergodic* property [i.e. ‘equivalence of averages] of an observable for its informativity in regard to “what happens to an individual over time” (p. 3) and consequently the significance of expectation value.

setup seems ill-conceived to us because any gamble affects what we may be able to do after the gamble. If we lose our house, we cannot bet the house again. The typical decision problem only makes sense in the context of a notion of irreversible time and dynamics – we cannot go back in time after the gamble, and our future will be affected by the decision we make today. One situation that may be represented by a one-shot game is a bet on a coin toss after which the player (who does not believe in an afterlife) will drop dead. (*ibid.*, pp. 4-5).

They point out that “[e]conomics treats randomness in a purely measure-theoretic way” (*ibid.*, p. 4), which means that “possible outcomes are given weights (measures or probabilities), and [that] the overall quality of a gamble is a weighted average over outcomes, *as if all possibilities were materializing simultaneously with different degrees of reality*” (*ibid.*; *italics added*), whereas

“[m]odern perspectives on randomness actively downplay the importance of the specific model of measure theory and emphasize the need to place the aim of the theory above the conditions imposed by specific axiomatization [...]. In our case, we argue that a *dynamic* is needed in addition to the random variable, turning the gamble into a stochastic process.” (*ibid.*; *italics added*)

Peters and Gell-Mann (2016) specify that “[d]ynamics means *repetition* and requiring the specification of a dynamic is requiring the admission that we *live through time*, not in a superverse of parallel worlds with which we can share resources” (*ibid.*; *italics added*).

Further, due to the “inevitable non-ergodicity of stochastic growth processes, e.g., noisy multiplicative growth” (*ibid.*, p. 9), they propose to “evaluate gambles by averaging wealth growth over time” (*ibid.*, p. 2), i.e. “the stochastic growth process involved in the problem needs to be made explicit; the process needs to be transformed to find an appropriate ergodic variable” (*ibid.*), which, they specify, requires no utility function, but the specification of a dynamic to compute time averages, whereby “logarithmic ‘utility functions’<sup>[21]</sup> appear as transformations that generate [ergodic] observables for [...] purely multiplicative dynamics” (*ibid.*). The key quantity in Peters and Gell-Mann’s (2016) treatment of multiplicative dynamics was thus the expected exponential growth rate of wealth, or the *geometric mean*. Indeed, an optimizing decision framework that corresponds to these insights and that provides the required ergodicity for dynamic betting environments was already developed within the

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<sup>21</sup> Peters and Gell-Mann (2016): “Logarithmic utility [...] is mathematically equivalent to the modern method of defining an ergodic observable for multiplicative dynamics” (p. 9). They argue that it was Menger’s (1934) flawed argument that – for the subsequent development of decision-theory detrimentally – “implicitly ruled out the all-important logarithmic function that connects utility theory to information theory [Kelly, 1956; Cover and Thomas, 1991] and provides the most natural connection to the ergodicity argument we have presented” (p. 9).

school of information theory, particularly through the works of Shannon (1948, 1949, 1956), Kelly (1956) and Thorp (1961, 1966; and Kassouf 1967; 1969, 1971, 1997, 2008a,b). It has become popularly known as the *Kelly criterion*. Within economics it was the work of Latané (1959) that applied the geometric mean criterion to the selection of stock portfolios. Even Markowitz (1959, pp. 116-125) himself, whose Mean-Variance framework is a static, single-period theory, recognizes the value of the *geometric mean* criterion for dynamic investment situations.<sup>22,23</sup> After all, the Mean-Variance framework, which, it shouldn't be forgotten, is just an economical approximation of the expected utility rule (see Markowitz, 2014), is inappropriate for dynamic and thus non-ergodic decisions situations, as it would lead to guaranteed 'ruin'. In the following, an example shall be used to illustrate the difference between the two decision frameworks and demonstrate how an understanding of the true nature of the decision situation fundamentally alters the respective interpretation of the 'rationality' or 'irrationality' of a particular decision-act (or tendency to act). Already Peters and Gell-Mann (2016) have pointed out that

“The dynamic approach to the gambles makes sense of risk aversion as optimal behaviour for a given dynamic level of wealth, implying a different concept of rationality. Maximizing expectation values of observables that do not have the ergodic property [...] cannot be considered rational for an individual. Instead, it is more useful to consider rational the optimization of time-average performance, or of expectation values of appropriate ergodic observables.” (p. 9)

We shall apply the insights in regard to the dynamic nature of decision tasks in financial markets and the respective (in)applicability of the two decision frameworks for a re-assessment of the '(ir)rationality' of *loss aversion* and *mental accounting*.

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<sup>22</sup> He would re-emphasise the importance of denominating the utility function of a long-term investor in terms of compound return in Markowitz (1972, 1976).

<sup>23</sup> Unfortunately, however, Markowitz would remain the only influential economist who would recognize the significance of the *geometric mean* criterion. Others would either ignore it, be unaware of it, or, like Samuelson and Merton, vehemently oppose it (Poundstone, 2005, Part 4).



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<sup>26</sup> i.e., the bankroll of fixed-amount and martingale bettors grows as an arithmetic series.

Before proceeding, it is important to note, though, that the zero-probability of ‘ruin’ assumed for Stocks A and B in the example above does not apply to real life investments or games. A real-life application of the Kelly criterion thus requires the determination of the optimal fraction ( $f^*$ ) of one’s bankroll (wealth, portfolio assets) to be wagered on a particular gamble or investment opportunity, whereby  $f^*$  is determined by the probability of winning ( $p$ ), the probability of losing ( $1 - p = q$ ) and the net odds received on the wager ( $k$  to 1), i.e. you could win  $\$k$  (on the top of getting back your wagered  $\$1$ ) for each  $\$1$  bet. For example, for simple bets with two outcomes only (e.g., a coin toss), whereby one involves the loss of the entire amount wagered, and the other the winning of the amount wagered times the payoff odds, the optimal fraction of one’s bankroll to wager is determined by the following formula:

$$f^* = \frac{kp - q}{k} \quad [1]$$

The fraction,  $f^*$ , is ‘optimal’ in the sense that no other fraction provides a higher return, while protecting the economic agent from ‘ruin’. The underlying concept becomes clearer when we compare the respective risk-return mapping (with leverage permitted) of Markowitz’ Mean-Variance framework and the Kelly approach:

Return

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On the other hand, if the agent's bets (or trades/investments) turn out in her favour and her wealth (or portfolio assets) increases, the Kelly criterion advises the agent – assuming she has got an edge – to increase the bet size in order to fully benefit from the compounding effect, ensuring thereby the optimal use of his financial resources:

“The exponential growth of wealth in the Kelly system is also a consequence of proportional betting. As the bankroll grows, you make larger bets. Assuming you have an edge, in the long run you will win more than you lose. Winnings will parlay.” (*ibid.*)

Thus, once one understands the *dynamic* nature of most real-world decision problems as well as the logic behind the Kelly criterion, one comes to see Thaler's *quasi-hedonic editing hypothesis* and its underlying concepts of *mental accounting* and the '*house money effect*' (Thaler and Johnson, 1990) in an entirely different light. Thaler describes the gist of his theoretical framework as follows:

“According to the quasi-hedonic editing hypothesis, risk aversion can be observed after prior losses because subsequent losses are not integrated with their prior outcome. In the case of prior gains, the opposite effect is predicted. After a gain, subsequent losses that are smaller than the original gain can be integrated with the prior gain, mitigating the influence of loss aversion and facilitating risk-seeking. The intuition behind this effect is captured by the expression in gambling parlance of 'playing with the house money.' Gamblers often use this phrase to express the feeling of gambling while ahead. The essence of the idea is that until the winnings are completely depleted, losses are coded as reductions in a gain, as

if losing some of ‘their money’ doesn’t hurt as much as losing one’s own cash.”  
(Thaler and Johnson, 1990, p. 657)

Whereas Thaler, who approaches his research from a *static* neoclassical vantage point, classifies such behaviour as sub-optimal, a *dynamic* information-theoretic (i.e., ‘Kelly’) view, with its in-built survival logic,<sup>27</sup> comes to the diametrically opposite conclusion; Taleb (2018) explains:

“The Thorp, Kelly, and Shannon school of information theory requires that, for an investment strategy to be ergodic and eventually capture the return of the market, agents increase their risk as they are winning, but contract after losses, a technique called ‘playing with the house-money’. In practice, it is done by threshold, for ease of execution, not complicated rules: you start betting aggressively whenever you have a profit, never when you have a deficit, as if a switch was turned on or off. This method is practiced by probably every single trader who has survived.”<sup>28</sup> (Taleb, 2018, p. 227)

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<sup>27</sup> Hakansson (1971) emphasises that the Kelly criterion has an “automatic built in [...] air-tight survival motive” (p.555).

<sup>28</sup> George Soros’ (2003, 2009) description of his own trading approach seems to confirm Taleb’s (2018) argument.

<sup>29</sup> For an overview of the feud between Samuelson, Merton and the defenders of the ‘Kelly school, see Poundstone (2005, pp. 209-227).

<sup>30</sup> As Poundstone (2005) emphasizes: “What the Kelly system *cannot* do is engineer luck” (p. 216; *italics* in original).

<sup>31</sup> The Kelly system only protects you from *total* ruin.

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<sup>32</sup> As expounded by Poundstone (2005, pp. 209-227). Quotes taken from this source.

<sup>33</sup> Indeed, as argued by Peters and Gell-Mann (2016), the true value of the logarithmic utility lies in its “mathematical[...] equivalen[ce] to the modern method of defining an ergodic observable for multiplicative dynamics” (p. 9), i.e. the logarithmic utility function represents the proper transformation required for producing the required ergodic observables.

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Thus, the observed ‘overweighing’ of small probabilities that constitutes an important aspect of *Prospect Theory* (Kahneman and Tversky, 1979) is thus highly rational within a *dynamic* decision environment. Further, it might be argued that in real life there are very few, if any, truly isolated decisions, as most entail at least some – even if only minuscule – risk(s) to at least one aspect of the agent’s survival (e.g., physical, financial, reputational, etc.) and are usually not reversible. Thus, albeit the decision scientist might think that her test subject is engaging in a *static*, isolated decision-task, she might, in fact, be approaching the decision from a more global perspective, ‘global’ with regard to her overall life. Taleb (2018) provides an illustrative example:

“Say you ask a subject how much he would pay to insure a 1 percent probability of losing \$100. [...] But you cannot possibly ignore all the other financial risks he is taking: if he has a car parked outside that can be scratched, if he has a financial portfolio that can lose money, if he has a bakery that may risk a fine, if he has a child in college who may unexpectedly cost more, if he can be laid off, if he may be unexpectedly ill in the future. All these risks add up, and the attitude of the subject reflects them all. Ruin is indivisible and invariant to the source of

randomness that may cause it.” (Taleb, 2018, p. 227)

Indeed, as Peters and Gell-Mann (2016) have argued, such an experiment is “ill-conceived”:

“It is ill-conceived because any gamble affects what we may be able to do after the gamble. [...] The typical decision problem only makes sense in the context of a notion of irreversible time and dynamics – we cannot go back in time after that gamble, and our future will be affected by the decisions we make today.” (pp. 4-5)

Hence, within a *dynamic* decision environment, so-called *loss-aversion* is – from a survival perspective – a perfectly rational human trait. Consider, for example, the repeatedly observed rejection of “coin-flip bets offering less than two-to-one odds” (Rabin and Thaler, 2001, p. 226) by human test subjects. A look at Table 2, which displays the optimal Kelly fractions ( $f^*$ ), reveals that the optimal Kelly bet on a one-to-one odds gamble would be \$0; any bet above this value would lead to irrational overbetting and eventual ‘ruin’ within a *dynamic* setting. The decision to reject such a gamble is thus perfectly rational within a *dynamic* decision environment. Only if the respective odds and probabilities of winning are sufficiently in the agent’s favour will she accept the gamble. This, once again, demonstrates the potential risks inherent to normative projects such as Thaler’s *nudging* (Thaler and Sunstein, 2008), which, proceeding from erroneous assumptions and interpretations, aim at ‘nudging’ human beings away from – what turns out to be – quite *rational* behaviour outside the strict confines of the experimental set-up.

It needs to be emphasised, though, that the above does not imply that it would be *rational* to avoid any ‘gamble’ where the risk of ‘ruin’ wasn’t precisely zero, as in such a scenario one’s activities in life would be severely limited and one would be foregoing significant upside benefits. Kahneman (2011) holds that

“[a]ll bets are off, of course, if the possible loss is potentially ruinous, or if your lifestyle is threatened. The loss aversion coefficient is very large in such cases and may even be infinite – there are risks that you will not accept, regardless of how many millions you might stand to win if you are lucky.” (p. 284)

Although Kahneman (2011) refers to one-shot games, our arguments above concerning the *dynamic* nature of most actual decision tasks, the multiplicativity of risk(s) and the consequent acute possibility of ‘ruin’, could lead to the inference that no *rational* individuals would ever engage in activities where even the slightest risk to one’s ‘lifestyle’ existed, as the sequence of repeated exposures to the risk could come to be perceived as Kahneman’s (2011) one-shot, ‘potentially ruinous’ gamble, where the ‘very large’ loss aversion coefficient would apply. *Loss*

*aversion* could thus come to be seen as ‘irrational’ as it deters individuals from participating in activities that potentially offer significant benefits. Adopting a Kelly-view, one realizes that *loss aversion*, while increasing the odds of the agent’s survival, must not necessarily impede her from engaging in potentially profitable, though risky, actions; this shall be illustrated via the following example.

Table 2 shows the various optimal (Kelly) fractions ( $f^*$ ) of one’s bankroll (wealth, portfolio) to wager on a particular bet for the respective payoff odds ( $k$ ) and the respective probabilities of winning ( $p$ ), calculated via formula [1], which, as specified above, applies to a simple gamble with two outcomes, whereby one outcome results in the total loss of the amount wagered, and the other in the winning of the original amount wagered times the payoff odds.

According to the dominant SEUT, a rational economic agent would determine the *Expected Value* of the gamble by weighing the respective end states of the agent’s wealth by the respective probabilities:

$$EV = p_w * W_w + p_l * W_l \quad [2]$$

where

- $W_w$  = End-of-Period Wealth in case of the favourable outcome;
- $W_l$  = End-of-Period Wealth in case of the unfavourable outcome;
- $p_w$  = probability of winning;
- $p_l$  = probability of losing.

**Table 2: Kelly-fractions**

	P	50%	80%	90%	99%	99%
	Q	50%	20%	10%	1%	1%
$K$	$f^*$	$f^*$	$f^*$	$f^*$	“half-Kelly”	
1	0	0.6	0.8	0.98	0.49	
2	0.25	0.70	0.85	0.985	0.4925	
3	0.3333	0.7333	0.8667	0.9867	0.4933	
4	0.3750	0.7500	0.8750	0.9875	0.4938	
5	0.4000	0.7600	0.8800	0.9880	0.4940	
10	0.4500	0.7800	0.8900	0.9890	0.4945	
25	0.4800	0.7920	0.8960	0.9896	0.4948	
50	0.4900	0.7960	0.8980	0.9898	0.4949	
100	0.4950	0.7980	0.8990	0.9899	0.4950	
1.000	0.4995	0.7998	0.8999	0.9900	0.4950	
1.000.000	0.5000	0.8000	0.9000	0.9900	0.4950	

If we apply formula [2] to the wager with  $k = 1,000,000$  and  $p = 50\%$ , which means that for every \$1 wagered you have a 50:50 chance of winning \$1,000,000 (on top of getting your original \$1 bet returned), and we assume that our initial wealth is \$1, we get the following *expected value* ( $EV$ ) for the gamble offered:

$$EV = 50\% * (\$1,000,001) + 50\% * (\$0) = \$500,000.50$$

According to the SEUT therefore, one should accept the gamble. Arguably even behavioural economists such as Matthew Rabin and Richard Thaler are likely to “have you declared legally insane for turning down this gamble” (Rabin and Thaler, 2001, p. 224), although they might come to change their minds once they learn that the \$1 wagered in our example constitutes the agent’s entire worth, agreeing thereby in principle with Kahneman’s (2011) quote above, i.e. that “[a]ll bets are off, of course, if the possible loss is potentially ruinous, or if your lifestyle is threatened” (Kahneman, 2011, p. 284). In any case, so-called *loss aversion* can, from the perspective of the Kelly criterion – the other major *normative* framework next to EUT, SEUT and the MV framework,<sup>34</sup> and, as expounded above, the only rational one to be used in *dynamic* decision tasks – be perfectly rational as, on the one hand, and unlike the EUT, SEUT and MV framework, it protects the gambler from potentially – and in *dynamic* decision environments *eventually* – ruinous outcomes, while, at the same time, not (necessarily) precluding the agent from benefitting from the substantial upside that certain gambles offer, i.e. it does not incapacitate the agent from acting when it is in her benefit to do so, it just adds an additional ‘margin of safety’ that increases the likelihood of her survival. Let’s illustrate this point with reference to Table 2: The Kelly bettor does neither commit all of her funds to the gamble with the 1,000,000:1 payoff odds, as the SEUT would recommend her to do, nor does she reject the gamble outright, as she would do if the presence of the 50% chance of ‘ruin’ would lead to a ‘very large’ or even ‘infinite’ *loss aversion* as predicted by Kahneman (2011, p. 284). In fact, she commits 50% of her current wealth to the gamble. Even if the probability of her winning were to increase to 99%, she would never commit more than 99% of her current wealth to it. If she prefers, for the aforementioned reasons, to adopt a ‘half-Kelly’ approach, she would be committing a maximum of 49.50% of her current wealth. On the other hand, she would never engage in a gamble that was, objectively speaking, not sufficiently attractive in terms of odds and probabilities (see Table 2,  $k = 1$ ;  $p = 50\%$ ), as it is the case for coin-flip bets (i.e., 50-50 chance of winning) that are usually rejected by test subjects in experimental set-ups if the payoff odds are below 2:1 that Rabin and Thaler (2001, p. 226) refer to.

The insights, which have been gained through the contemplations in the present sub-section, demonstrate the importance of acquiring a sound understanding of the true nature of the actual decision-environment and –task the agent faces for the identification of truly *rational* decision behaviour and the acquisition of a more plausible understanding of the cognitive processes that underlie financial market processes.

The present sub-section can be thought of as a prelude to the critique of the individual (with

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<sup>34</sup> Kahneman and Tversky’s (1979) *Prospect Theory* is only a *descriptive* decision-framework, not a *normative* one.

regard to the aspect of *cognition*) that dominates mainstream finance, which shall be the core focus of the subsequent section.

## 2. The Conception of the ‘Individual’ in Mainstream Finance

This section shall focus on the identification and the dissection of mainstream finance’s core conception of the individual as far as it relates to the aspect of *cognition* before uncovering its primary shortcomings when it comes to providing a suitable framework for the advancement of our understanding of the actual cognitive factors and processes that underlie financial market processes and phenomena.

### 2.1 Identifying the ‘Individual’ in Mainstream Finance

Johnstone and Lindley (2013, p. 223) point out that whereas “[t]he model of rational decision-making in most of economics is expected utility theory (EU) as axiomatized by von Neumann and Morgenstern, Savage and others,” which, naturally, implies that the (rational) individual is conceived as a von Neumann-Morgenstern utility maximiser,

“[t]his is less the case [...] in financial economics and mathematical finance, where investment decisions are commonly based on the methods of mean-variance (MV), introduced in the 1950s by Markowitz [where] each available investment opportunity (‘asset’) or portfolio is represented in just two dimensions by the ex-ante mean and standard deviation ( $\mu, \sigma$ ) of the financial return anticipated from that investment.”<sup>35</sup>

Indeed, the ubiquity of MV in financial economics is not difficult to discern. It constitutes the core building block of Markowitz’s (1952b, 1959) MPT, which, in turn, constituted the basis for the formulation of the CAPM (Sharpe, 1964). In fact, the CAPM is nothing else but a computationally significantly more economical restatement of the MPT.<sup>36</sup> The CAPM, in turn, provided the intellectual starting point for the derivation of the Black-Scholes OPT (see Mehrling, 2012).<sup>37</sup> Nevertheless, as Markowitz (1991, 2014) himself clarifies, the underlying philosophy and underpinning framework of the MV approach is still EUT. In fact, the former merely constitutes a tool for a more viable implementation of the latter in a practical setting:

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<sup>35</sup> See Kolm *et al.* (2014).

<sup>36</sup> Its calculation requires solely the covariance of the asset’s returns with those of the market portfolio, whereas the MPT necessitates the computation of the variance-covariance matrix for the entire set of portfolio’s assets.

<sup>37</sup> In their seminal paper of 1973, Black and Scholes presented two separate derivations of their option pricing formula, whereby the second derivation started from Black’s original inspiration, i.e. the CAPM (Black and Scholes, 1973).

“[I]f you believe that rational decision making may be characterized by axioms which imply that one should maximize expected utility using probability beliefs where objective probabilities are not known (as Savage (1954) persuaded many including me), then the necessary and sufficient condition for the practical use of mean-variance analysis is that a careful choice from a mean-variance efficient frontier will approximately maximize expected utility for a wide variety of concave (risk-averse) utility functions.” (p. 346)

What about the EMH? What type of individual does it presuppose? As already outlined in subsection 1.1, it was Paul Samuelson, who invoked the *rational expectations* framework pioneered by Muth (1961) in order to formulate, on the basis of his earlier ‘shadow price’ concept (Samuelson, 1965) as well as Bachelier’s (1900) seminal work, a new theoretical framework for financial market price behaviour, which would become known as the EMH. The *rational expectations* [RATEX] framework, in turn, likewise rests on Savage’s (1954) subjective expected utility framework (SEUT). Giocoli (2003) provides the following insights into the RATEX revolution:

“The latter was, in essence, nothing but the extensive application of the requirement that the agent also be rational in formulating his/her expectations. Yet, such a requirement would never be accepted by those interwar and post World War I economists who had just managed to accomplish another ‘escape’, that from perfect foresight.

It was Savage’s legitimization of the imposition of a consistency condition also on agents’ beliefs that made the idea palatable to mainstream economists.” (*ibid.*, pp. 378-79)

It has thus been established that the dominant decision framework in financial economics is the (S)EUT. The corresponding agent is thus the rational (subjective) expected utility maximiser. In the following section we shall delve deeper into the nature of this *individual*, before demonstrating the insufficiency of this particular conception of *cognition* for the study of financial market processes and phenomena.

## 2.2 A Closer Look at the Individual in Financial Economics

First, it needs to be stressed that in contrast to earlier utility-maximising accounts in economics (see Giocoli, 2003), von Neumann-Morgenstern’s (1953) EUT and Savage’s (1951, 1954) subjective version of it (i.e., SEUT), had never been intended to provide an accurate account of actual *human* decision-making; on the contrary, the origins can be traced to von Neumann’s “quest [...] for a formal theory of rationality *independent of human psychology*” (Mirowski,

2002, p. 129; *italics* added),<sup>38</sup> and it constituted the realization of a long-cherished dream by the neo-classical economics community: the purging of the field from any residual traces of psychology (see Giocoli, 2003). Giocoli (2003) emphasises that neither von Neumann-Morgenstern's EUT nor Savage's SEUT

“were [...] justified by empirical evidence, but only by the law of logic: a logically consistent agent could not behave other than in the way prescribed by the relevant axioms – a purely intellectual justification, deriving from a kind of mental experiment. Thus, it may be concluded that the experimental flavour underlying [...] vN/M's and Savage's approaches was purely *fictional*: no real agent was really required to make choices that might be used to reveal his/her preferences or probabilities.” (pp. 392-2; *italics* in original)

The EUT and the SEUT are thus purely mathematical constructs and *not* actual theories of human cognition based on empirical evidence. It is, however, precisely the rigour of the underlying mathematical structure that lures many into the steadfast, but erroneous, belief that they inevitably represent universally valid frameworks of rational decisions and choice. The erroneousness of this view has been demonstrated by the cognitive scientist George Lakoff and the philosopher Mark Johnson (Lakoff and Johnson, 1999). They, first of all, point to the fact that the mathematical edifice of rational choice models is, in the first instance simply that, a mathematical construct that obeys the rules of mathematics. By itself, this construct is unable to make any claims with regard to rational choice behaviour. Then, Lakoff and Johnson (1999) go on to explain that it is only through the introduction of several “layers of metaphorical interpretation that [...] the mathematics can be considered as having anything whatever to do with rational action” (p. 516). In other words, it is the metaphors that decision-scientists (largely unconsciously) employ, which create the link between the bare mathematical structure and rational choice behaviour. These metaphors concern primarily the nature of the decision task and of the decision environment. For instance, rational choice models usually conceptualize the decision-task the agent faces

“as reaching a destination, via the Event-Structure metaphor. In that metaphor, actors are conceptualized as travellers and courses of action as paths that lead to destinations. An action is motion along a path. The state resulting from an action

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<sup>38</sup> The EUT constitutes von Neumann's attempt to apply Hilbert's program in mathematics to the field of decision theory. As a reminder, Hilbert's program instigated “an important shift in emphasis toward *abstraction* in mathematics [...] toward a situation in which mathematical terms were leached of direct ‘external’ empirical content, and simply defined axiomatically within the context of the theory” (Leonard, 1995, p. 733), whereby, as “Weyl remarks, ‘the question of truth [...] shifted into the question of consistency’ (1949, p. 630)” (*ibid.*). Indeed, Giocoli (2003) claims that “the *central underlying feature* of all the characterizations of rationality that really managed to escape from psychology is precisely the requirement of consistency” (p. 392; *italics* in original).

is a location. The choice among actions is the choice among paths. The Event-Structure metaphor has the effect of spatializing action to achieve a purpose as motion to reach a destination. [...] [Next,] desirable and undesirable outcomes [...] must become numbers [e.g., monetary units]. [...] [Then,] [b]y forming a conceptual blend of these two metaphors, we reach the first step toward the mathematization of means-end rationality. [...]

We now need to turn all this into mathematics [...] [,] we need metaphors to conceptualize trees (or branching paths) in which you get payoffs or losses at the ends of branches in terms of some well-known mathematics. The goal is to be able to communicate the ‘best’ course of action, the one where you come out with the highest number at the end.” (Lakoff and Johnson, 1999, pp. 517-18).

Only the addition of such a (multi-layered) metaphorical structure transforms the bare mathematical skeleton into a framework for rational choice, with the well-known properties, which are, in fact, nothing but metaphorical entailments:<sup>39</sup>

- (a) Results of courses of action can always be ranked preferentially.
- (b) Preference is transitive.
- (c) Actors are unitary, distinct, and volitional (in full control of their choices).
- (d) A history can be broken down into a separate sequence of actions.
- (e) There is a final resultant state in history.
- (f) At each point in a history, future courses of action are uncertain, but there is a well-defined set of possibilities, each with a distinct probability of occurrence.
- (g) The probability of courses of action at one point in history is independent of all previous occurrences. (This can be changed in alternative versions)
- (h) If two subgames at different points in a history are identical, then their historical differences don’t matter.
- (i) The model is literal. Within the model there are no alternative interpretation of actions.
- (j) There is no ‘cost’ to using this mathematical model.

As is not difficult to discern from the above, the set of metaphors and metaphorical entailments is accompanied by certain ontological presuppositions, particularly with regard to the decision-environment. Hence, only a conceptualisation of the latter in such a way that it is compatible with the presuppositions underlying the formal and metaphorical structure of the framework will validate its application. Lakoff and Johnson (1999) explain:

“[E]ven with the metaphorical interpretation, the model cannot be applied

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<sup>39</sup> Listed by Lakoff and Johnson (1999), p. 526.

without an artificially constructed version of a situation to apply it to. That constructed situation consists of ‘stylized facts,’ which are themselves arrived at using complex forms of cognition, including implicit moral choices. Without such stylized facts, the rational choice-models cannot be put to use. Therefore, the rational-actor model, even with its layers of metaphor, cannot characterize rational action in any inherent way independently of the cognitive and ethical enterprise of stylized facts.” (*ibid.*, p. 522)

Interestingly enough, in contrast “to the *mathematics* of models of rational actions [that] has been studied in great detail, there is comparatively little, if any, study from a cognitive perspective of the cognitive mechanisms that are used in coming up with the stylized facts” (*ibid.*, p. 530; *italics* added). Thus, whereas decision research has focused on the enhancement of the mathematical framework itself, very little, if any, consideration has been given to the underlying cognitive mechanisms (and biases) that determine how researchers come to perceive and eventually frame various real-world decision-tasks and -environments in their experimental set-ups and/or theoretical frameworks. Even in absence of such cognitive scientific findings, the current state of mainstream finance and the related decision research (see Sect. 4) seems to permit the reasonable inference, though, that, as already suggested above, the rigorous mathematical construct is generally taken to confer universal validity to these frameworks of ‘rational choice’. In other words, the general presumption seems to be that the EUT and SEUT are applicable to all types of economic decision environments and -tasks,<sup>40</sup> and that any rational actors *ought to* reason, decide and choose according to the way prescribed by these frameworks (see, e.g., Hirshleifer and Ryle, 1992). As Giocoli (2003) explains, it is the “axiom-based consistency,<sup>[41]</sup> [which] warrants the theory’s desired normativeness,” and “an agent may label herself rational if and only if her beliefs, as well as her preferences, obey the axioms,” any violation being deemed to “entail irrationality” (Giocoli, 2013, p.80). Binmore (2009) confirms that “the words *rationality* and *consistency* are treated as almost synonymous in much modern work” (p. 4; *italics* in original). Further, it seems as if many researchers in mainstream-economics-related fields such as behavioural finance have come to *ontologize* this particular type of rationality. Taylor (1993) outlines the process of such an *ontologization of rational procedure* with regard to the dominant picture of the individual in Western thought since Descartes:

“[W]hat were seen as the proper procedures of rational thought were read into the very constitution of the mind and made part of its very structure.

The result was a picture of the human thinking agent as disengaged, as occupying

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<sup>40</sup> Or that these can at least be reconceptualised accordingly via the right set of stylized facts.

<sup>41</sup> i.e. *Consistency* being von Neumann’s Hilbertian legacy to the field of economics. See above.

a sort of protovariant of the ‘view from nowhere’, to use Nagel’s [1983] suggestive phrase.” (p. 317-18)

Indeed, it might be argued that the mathematical conceptualisation of rationality via the EUT and SEUT and the active application of these frameworks to the study of human decision and choice behaviour invokes again the image of a Cartesian individual, whose reasoning capability is, at times at least, unfortunately impaired by irrational influences such as emotions. If one accepts the implied presence of a Cartesian image of the individual in mainstream finance and its related decision research (i.e., behavioural finance), then the following philosophical presuppositions apply with regard to cognition:<sup>42</sup>

1. *Separation of Mind and Body*. Descartes claimed that the mind – the seat of reason, thought, and language – is ontologically different in kind from the body. One need not, and should not, look to the body for an account of the autonomous workings of the mind.
2. *Transcendent Autonomous Reason*. Reason is capacity of mind, not of the body. Reason is autonomous. It works by its own rules and principles, independent of anything bodily, such as feeling, emotion, imagination, perception, or motor capacities.
3. *Mathematics as Ideal Reason*. Descartes saw mathematics as the quintessential form of human reason. Correct human reason therefore had to have the same essential character as mathematical reason (see Descartes’ *Rules of the Direction of the Mind*, Rule 4).
4. *Reason as Formal*. The ability to reason is the ability to manipulate representations according to formal rules for structuring and relating these mental symbols. Logic is the core and essence of this rational capacity, and mathematics, Descartes argued, is the ideal version of thought, because it is the science of pure form.
5. *Innate Ideas*. Descartes argued that the mind must have implanted in it by God certain ideas, concepts, and formal rules that he thought could not have been acquired via experience (Letter to Mersenne, July 23, 1641). These a priori structures are just given to us by the nature of mind and reason, and so they are possessed by all rational creatures.

Taylor (1993) provides a brief outline of the type of (cognitive) processing such a conceptualisation of rational choice behaviour entails: the agent “in perceiving the world takes in ‘bits’ of information from his or her surroundings” – i.e. ‘raw data’ stripped of all syntactic and semantic content and relational variables among data, expressed in the most basic possible

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<sup>42</sup> The following defining characteristics of the Cartesian conception of the individual is borrowed from Lakoff and Johnson (1999, Chap. 22, pp. 470-71). Only those considered most relevant to the present discussion are listed.

terms, such as the binary code in modern computational theory – “and then ‘processes’ them in some fashion, in order to emerge with the ‘picture’ of the world he or she has[.] [...] [The agent] then acts on the basis of that picture to fulfil his or her goals, through a ‘calculus’ of means and ends” (p. 319).

That such a conception of cognition has come to dominate the field of behavioural finance is not surprising perhaps, when one considers that Behavioural Decision (BDR), the precursor to ‘new’ behavioural economics and thus to the *psychology* pillar of behavioural finance [see Glossary], was the product of the first cognitive revolution, which occurred in the wake of major advances in the fields of logic and computational theory [see Glossary; Gardner, 1987]. Insights from the latter, for instance, were applied to the study of neural activity, whereby the neuron was modelled as a logical circuit (Jeffress, 1951). Amidst such developments, the conception of human reasoning as “nothing more than the propositional calculus itself” (Inhelder and Piaget, 1958, p. 305) seemed perfectly reasonable, particularly as such a view constituted a continuation of the Western intellectual tradition (see Taylor, 1993). Unfortunately, the historical and continuing dominance of the neoclassical framework [see Glossary: Behavioural Economics and Behavioural Finance] has prevented behavioural finance to progress beyond the first stage of the cognitive revolution.

### *2.3 The Inadequacy of the Neo-classical Conception of Decision Processes and the Individual in Financial Market Environments*

This subsection shall question the suitability of (S)EUT as an adequate framework for the study of decision processes in financial markets. Two core aspects shall be considered: first, its applicability to the financial market environment and, secondly, its viability as a framework for the study of actual *human* decision processes.

First, as already outlined above with reference to Lakoff and Johnson (1999, p. 522), “the model cannot be applied without an artificially constructed version of a situation to apply it to”. Hence, they expressly warn against applying the model to situations that are not reasonably amenable to the stylized facts required by the former to be applicable:

“Since rational-choice theory itself cannot define the situation in which it can be applied, its application is a matter of human judgment. To make such judgments using as much information as possible, one must be aware of how metaphorical thought is used by any such application of the theory. Only in this way can we approach the question of where the model is useful and where it might be harmful” (*ibid.*, p. 515)

This echoes Savage’s (1951) own advice to restrain from applying his SEUT to any decision-

environments and -tasks other than those reasonably amenable to his *small-world* category (i.e., closed systems defined by a specific set of stylized facts; see below), “describe[ing] the idea that one can use his theory in any world whatever as ‘utterly ridiculous’ and ‘preposterous’” (Binmore, 2009, p. 117).

Reflecting on the insights thus far acquired in the present chapter, particularly with regard to the poor performance of the closed-system methodology applied by mainstream finance and the consequent conjecture concerning the likely violation of the closure requirements that such an approach necessitates, on the one hand, and the particular type of metaphorical layers required for the both the metamorphosis of a bare mathematical structure into a framework of rational-choice and its implementation, on the other, it seems reasonable to doubt its applicability to the financial market environment. The insights regarding the realities of the financial market environment and the stock-market (securities) investor’s core decision-task that shall be extracted from a practitioner’s account in Chapter 2, shall provide further support for this view. In this subsection, though, it shall be argued that the empirical results produced by the mainstream research programme suffice to disqualify the validity of (S)EUT as an adequate decision-framework for financial markets. Savage (1951) holds that his framework is only applicable to *small worlds*,

“within which it is always possible to ‘look before you leap’ [...] [or, in other words, where one is able to] take account *in advance* of the impact all conceivable future pieces of information might have on her underlying model that determines her subjective beliefs” (Binmore, 2009, p. 117).

Precisely this feat is impossible in actual financial markets, though. Robert Shiller, for instance, who applied actual historical earnings-, dividends- and interest data to estimate the true value of stock market indices via the Dividend-Discout Model (DDM) and to compare it to the actual market price at the time, found that even with perfect hindsight, changes in dividends and discount rates could explain less than twenty percent of total price variation (Shiller, 1981; Campbell and Shiller, 1988; Shiller 1990). Shiller’s data make it doubtful whether it is ever truly possible to ‘look before you leap’ in financial markets. In fact, the empirical results concerning the CAPM’s accuracy in predicting returns on the basis of historical data seem to further undermine the hope that the necessary realities are given in actual financial markets in order for this – for the SEUT’s applicability necessary – presupposition to hold. The CAPM’s core prediction concerns a purported positive relationship between historical price volatility and future returns, i.e. stocks with a higher volatility (i.e., ‘riskier’ stocks) should produce higher returns than stocks with a lower volatility (i.e., ‘less risky’ stocks). It turns out, though, that precisely the opposite is the case, with low-volatility stocks outperforming high-volatility stocks (see, e.g., Fama and French, 2004). Considering that the CAPM is a ‘demand-side’

model, which builds on the (subjective) expected utility framework and purports to provide the normative solution to the maximization problem the investor, who is conceived of as the ‘consumer’ of assets, faces, the validity of both the CAPM and SEUT for the financial market environment are justifiably doubted. Looking at the empirical evidence, it seems as if financial markets are more appropriately categorized as one of Savage’s *large worlds*, i.e. a decision-environment within which “the possibility of an unpleasant surprise that reveals some consideration overlooked [...] can’t be discounted” (Binmore, 2009, p. 117). If this categorization is accurate, and the empirical evidence suggests that it is, then the consistency criterion, the backbone of (S)EUT, loses its status as a condition for rationality, because within a *large world*

“Knee-jerk consistency is [...] no virtue. Someone who insists on acting consistently come what may is just someone who obstinately refuses to admit the possibility of error. In brief, Savage agrees with Ralph Waldo Emerson that foolish consistency is the hobgoblin of small minds. Only when small minds are encased in a small world does he regard consistency as an unqualified virtue.” (Binmore, 2009, p. 117)

To the detriment of the field’s progression, a perceived methodological necessity turned every economic agent – by assumption – into a *small mind* inhabiting a *small world*. Indeed, neo-classical economists could conceive of no alternate way to theorise about human decision processes. For instance, Kenneth Arrow (1951, pp. 409-10) in his highly influential article concludes that only the businessman conceived of as a statistician permits the formulation of a ‘scientific’ account, otherwise we would be “forced to the melancholy conclusion that little of a systematic nature can be said about the former’s decision processes” (*ibid.*, p. 409). The conception of the individual and the world she inhabited were thus simply recalibrated in order to fit the neo-classical framework.

This leads us to the second topic to be discussed in the present subsection, i.e. (S)EUT’s suitability as a theoretical framework for *human* decision processes. In what way does this topic differ from the one hitherto considered? Well, whereas the latter focused on the question whether the (ontological) realities of the financial market environment permit the application of the latter as a general decision framework, this second topic shall focus specifically on its viability as a theoretical framework for *human* decision processes, including those in financial markets.<sup>43</sup> It needs to be remembered that the (S)EUT was adopted by the economics community because it was seen as the means to complete the field’s long-longed for escape from psychology (Giocoli, 2003). The question as to its general applicability to the financial

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<sup>43</sup> These being, of course, of a primary interest to our work.

market environment arises thus independently from any concerning its relationship to human decision processes; after all, it could be programmed into an artificial agent (A.I. trader) and thus still be realized (if validated). The question as to its worth as a framework for human cognition (decision-processes), on the other hand, arises because, with the advent of ('new') behavioural economics and behavioural finance,<sup>44</sup> psychology has inevitably found its way back into the wider mainstream economics project (see also Sent, 2004). Behavioural finance is, after all, interested in the discovery of those aspects of *human* decision processes that might provide insights into certain financial market phenomena, which the standard framework cannot account for.

Turning thus to this second question, it needs, first of all, to be stressed that most of the economics-related decision research programmes have approached the study of human decision processes with the type of ontological presuppositions – particularly with regard to the individual – that have been explicated above. Hence, (S)EUT has come to be seen as a universally valid framework of rational choice and human test subjects are usually assessed against it. In fact, according to Angner and Loewenstein (2006), 'new' behavioural economics "would not have existed in the absence of [...] rational choice [models]" as the latter provided a "'hard target' – a theory that (in conjunction with widely used auxiliary hypotheses made [...] predictions that could be explored in laboratory and other settings" (p. 29).

Up to a point such a methodological approach is perfectly defensible, particularly in the early phases of a new research programme. The (first) cognitive revolution, for instance, was built on the conception of 'man as computer', and although this model ultimately proved untenable, the research instigated and directed by it led to many valuable insights, particularly with regard to the way man actually differs from this 'hard target' (see Gardner, 1987). The similar approach adopted by 'new' behavioural economics/finance has proven to be successful in similar ways and to a similar degree. Unfortunately, in contrast to the cognitive science enterprise, which has evolved considerably since its early days, developing important methodological and theoretical advances, ('new') behavioural economics and behavioural finance have largely stagnated around (S)EUT, in spite of all the contradictory empirical evidence. The reason for this diverging development is largely to be found in the field's unwavering belief in its theoretical framework, which leaves it entangled in a web of contradictory aims and intellectual positions (see Sect. 3), a situation that poses a significant impediment to any serious scientific progression of 'new' behavioural economics/finance. Boettke *et al.* (2013) summarize:

"Behavioural economics positions itself strangely. On the one hand, it sets out to

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<sup>44</sup> See Glossary.

critique the hyper-rational model of standard economics. On the other hand, it often fails to get far beyond the model as both an analytic and normative benchmark. Reference to the standard model [...] is perfectly reasonable in the case of an immanent critique. But behavioural economics tends not to stray too far from the mainstream. It says that man is not rational in the way that standard models depict but *insists that he should be*. Indeed, the core concept of *irrationality* is, at its heart, a critique. The behavioural economist constructs lists of ‘biases’, implying that these are unfortunate *exceptions* to the general rule of hyper-rationality (c.f. Ariely, 2009, p. xviii).” (p. 106; *italics* in original)

In fact, the preconception in favour of the rational choice model is such, that it biases the interpretation of important empirical findings, entrapping the researcher within a certain type of tunnel vision that prevents her from perceiving potential alternative, more plausible, explanations and consequently from devising superior alternative theoretical accounts. Lakoff and Johnson (1999, pp. 527-28), for instance, provide a reinterpretation of Kahneman’s and Tversky’s observed human ‘irrationalities’ from a later-generation cognitive science perspective, arguing that what the two pioneering researchers

“have actually shown is not that people are irrational, but rather that most people use frames and prototypes and hence do not reason literally and ‘logically, in the technical sense of either formal or probabilistic ‘logic’.” (p. 527)

As their framework no longer embraces a conception of ‘man as computer’, this last point is not perceived as a fault, but rather as an effective feature of human cognition that allows man to navigate real-world settings relatively successfully:

“[H]uman reason is far richer than the rational-actor model and probability theory recognize. Metaphorical, frame-based, and prototype reasoning are cognitive mechanisms that have developed in the course of human evolution to allow us to function as well as possible in everyday life. It would be truly irrational *not* to use the cognitive mechanisms that, in general, allow us to function as well as possible overall.” (*ibid.*)

This alternative, far more positive view of human cognition, which explicitly recognises its strengths in dealing with most real-life situations and tasks, is shared and corroborated by several other lines of research, most prominently, perhaps, Gerd Gigerenzer’s work (and Murray, 1987; *et al.*, 1988; 1991, 1991b, 1993, 1994; and Hoffrage, 1995; 1996, 1998; *et al.*, 1999; 2000; and Selten, 2001; 2008; and Brighton, 2009).

Indeed, valuable new insights can be won from such new interpretations and perspectives,

which can contribute significantly to the furthering of our understanding of certain phenomena. The – for the purposes of the present thesis – most relevant insight to be gained from Lakoff’s and Johnson’s (1999) discussion of Kahneman’s and Tversky’s work, for instance, is their reinterpretation of the latter’s discovery that human test subject use conceptual framing and prototype-based reasoning (e.g., Tversky and Kahneman, 1974, 1981; Kahneman and Tversky, 1984), which points to the presence of ‘mental models’ that form the basis of human decisions.

Now, ‘mental models’ provide a potentially highly promising framework for the conceptualisation and study of human cognition in financial markets and the respective phenomena they give rise to. In fact, the potential existence of differing beliefs and/or models that give rise to differing expectations has already been conjectured in some mainstream outlets. For instance, the economist Mordecai Kurz (1994) has expressed doubts about the economic agents’ capability to truly perform the intellectual feat the rational expectations framework (EMH!) requires them to, such as acquiring accurate ‘structural knowledge’ about the economy (e.g., the true probability distributions), suggesting instead – always within the confines of neo-classical economics, though – a ‘Rational Belief’<sup>45</sup> framework, wherein which rational agents, albeit having access to the same set of historical data, will come up with differing beliefs and expectations. Kurz (1994) argues that this “fact that the agents make incorrect, non-stationary, forecasts at each date introduces a non-stationary component of volatility into the equilibrium market prices,” which gives rise to a higher price volatility than would be the case in a ‘Rational Expectations’ world.

The possibility of agents employing different simplified (‘cognitive’) models<sup>46</sup> when operating in financial markets has been explored by Hong *et al.* (2004), albeit within a neo-classical Bayesian framework. The conclusions of our previous discussion, as well as Savage’s own strong reservations about the applicability and usefulness of Bayesian decision theory,<sup>47</sup> cast however severe doubts on the validity of such an approach. These doubts shall be further bolstered by the explication of the realities that stock market (securities) investors face in actual market environments (Chapter 2). What will become particularly apparent in that discussion is the human mind’s *active* role in these environments, in clear contrast to the entirely *passive* one attributed to it by Bayesianism and the underlying computational functionalist account, which conceives of the agent as a data processor that simply transforms input data into a specific output. On the basis of this insight, we shall advocate in Chapter 3

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<sup>45</sup> Whereby “[t]he concept of ‘Rationality’ employed is expressed in certain axioms which postulate that rational beliefs cannot be contradicted by the observed data” Kurz (1994, p. 860).

<sup>46</sup> i.e., the agent “can never learn the true model” of the relevant aspect of the world (p. 1209).

<sup>47</sup> Binmore (2009, p. 117) highlights: “Although he [Savage] is often cited as though he were the father of Bayesianism, Savage [...] disavowed this creed before it was even born. He didn’t think that Bayes’ rule is the solution to the problem of scientific induction. And [...] he didn’t believe that rationality somehow endows us with prior probability measures with which to start off the process of Bayesian updating.”

that the research on decision processes in financial markets needs to finally emancipate and evolve, embracing, just like certain strands of modern cognitive science have done, a constructivist account of human cognition [see Glossary: **Constructivism**] and identify Hayek's (1952) theoretical work on psychology as a suitable starting point for such an endeavour within the wider economics literature.

For the purposes of rounding out the picture and providing the necessary basis for the advocacy of an emancipation and evolution of Behavioural Finance, the remaining section of the present chapter shall explicate the growing schism between the theoretical and empirical sides of the research enterprise, with a particular emphasis on the ways the former impedes the progression of the latter.

### **3. Behavioural Finance's Struggle to Break Out of Its Neoclassical Mould**

This section shall produce an assessment as to the extent to which behavioural finance research has managed to overcome the theoretical and methodological limitations imposed upon it by the neo-classical framework, which have been the topic of discussion in the preceding part of the present chapter. It shall be concluded that the neo-classical heritage poses a serious impediment to any substantial progression of our understanding of cognitive processes in financial markets.

#### *3.1 A brief Overview*

As a proviso, it is, first of all, important to mention that the research enterprise of *Behavioural Finance* [see Glossary: **Behavioural Finance**] has grown substantially in terms of scope and method over the last two decades. While such a development is laudable from a scientific vantage point, it puts the critical analyst into the most unfortunate position to beset an object that is highly protean in nature. For any critique formulated, there might – especially when one considers the sheer vastness of the current literature in the area – suddenly spring up a work, which defies it.<sup>48</sup> The object of the present critique shall, therefore, consist of rather broad concepts and trends that seem to be resurfacing again and again in the literature.

For the purposes of the present section, two broad levels of research within *Behavioural Finance* shall be distinguished: the *empirical* and the *theoretical*. While the former seems to have heeded Shiller's (2003) advice and has followed an eclectic approach, which resulted in

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<sup>48</sup> Certain areas of research in Behavioural Finance, might, for example, not be as vulnerable to an open system critique as others are; event studies such as those on price/investor behaviour on earnings/dividends announcement dates or in respect to Initial Public Offerings (e.g., Brav, 2000) come to mind. As these events tend to be rather homogenous in nature, a closed system approach might provide sufficiently adequate insights.

a myriad of valuable insights into financial market phenomena, the latter appears unable to resist succumbing to the siren call of elegant mathematical models, adopting a conservative strategy of simply incorporating (some) of the empirical insights into the traditional finance framework.<sup>49</sup> This dichotomy shall, after the formulation of a more general critique, be elaborated on in the main body, where it shall be argued that the empirical side has been steering *Behavioural Finance* into a promising direction<sup>50</sup>, whereas the theoretical efforts call to mind the infamous line uttered by Michael Corleone in *The Godfather III*: “Just when I thought I was out, they pull me back in.”

The critique in this section shall, after producing an outline of the requirements for a non-individualist, non-closed system approach to *Behavioural Finance*, discuss to what extent the field continues to be dominated by its ‘neo-classical’ past.

### 3.2 The Case for a Non-Individualist, Non-Closed System Approach to Behavioural Finance<sup>51</sup>

Unequivocally, *Behavioural Finance* has proven itself to be highly productive, providing many valuable empirical insights<sup>52</sup>. De Bondt *et al.* (2008) classify the central contributions into the following three categories: First, a ‘catalogue of systematic biases’; secondly, insights into ‘speculative dynamics in asset prices’ due to systematic errors of unsophisticated investors (‘noise traders’) and the role of market sentiment; and, thirdly, findings related to ‘decision processes and their outcomes’.

Nevertheless, *Behavioural Finance* continues to be, methodologically and theoretically, widely haunted by its neo-classical past. An individualist<sup>53</sup> and closed system methodology might be sufficient for extracting insights in certain areas concerning financial matters (e.g., retirement planning), but it is unsuited for an inquiry into the operation of financial markets themselves, for the following reasons: First, as far as the individualist account is concerned, modern financial markets are dominated by asset management institutions and not individual investors. The institution sets the agenda via its fund mandate, which determines the investment research and portfolio management processes. In such a setting the individual merely acts as an agent for the institution, which will largely determine and define his/her

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<sup>49</sup> De Bondt *et al.* (2008), for example, state: “[T]he main goal of behavioural finance is to behavioralize finance, *not* to create a *separate* field of scientific study” (p. 15; italics added). The same view is shared by Shefrin (2010), another major proponent of Behavioural Finance.

<sup>50</sup> Although, as will be seen in Section 3.2, there is still much room for improvement.

<sup>51</sup> Several of the arguments presented in this subsection will also support the case for the adoption of an embodied and embedded conception of cognition in this field.

<sup>52</sup> The central insights of behavioural finance are summarized in: Barberis and Thaler (2003), Daniel *et al.* (2002), De Bondt (2002, 2005, 2008), Dreman (1995), Shefrin (2001, 2002) and Thaler (1993).

<sup>53</sup> This refers to the atomistic individualism of neo-classical finance and it is not to be confused with the type of individualism discussed in Chap. 3; the former is methodological in nature, while the latter is ontological in nature.

knowledge, decision processes and actions; the first via the filtering processes<sup>54</sup> at the recruiting and career progression stages as well as through training programmes; the second and third, via training programmes and institutional rules and conventions. The individual has to submit (at least overtly) to this institutional imperative if s/he intends to continue his/her membership (i.e., employment).<sup>55</sup> What is important to highlight at this point, though, is that a defender of the neo-classical framework might, in fact, invoke exactly these same points just raised in *defence* of the orthodox approach. Indeed, Ross (2008, p. 134) argues that it is precisely the institutional setting that “press[es] you to approximate your behaviour to that of an [neo-classical] economic agent,” specifying that:

“They can’t literally transform you, biological-psychological entity that you are, into such an agent. Even while struggling to save, you may visit a casino. You will buy some items this year that you will disdain and throw away in a year’s time merely because your tastes change. But you, together with your fellows in society, have *enough* in common with economic agents, especially in modern institutional settings, that non-trivial predictions about your individual behaviour can be had by modelling you as if, within temporal and institutional constraints, you were such agents” (*ibid.*).

This is a valid argument. For instance, Heath *et al.* (1998) discuss how learning biases can be overcome by organisational practices. Nevertheless, even though the traditional model of the individual might yield some useful non-trivial insights, a proper account of the cognitive processes underlying financial market activity, which will also be critical for regulatory purposes, will necessitate a thorough inquiry into the various processes at work which trigger, alter or alleviate certain cognitive and emotional biases and thereby alter the behaviour of the individual in a non-trivial way.<sup>56</sup> Indeed, De Bondt *et al.* (2008), for instance, criticize the lack of such an institutional inquiry in Behavioural Finance: “On the whole, financial decision-making processes in households, markets and organisations remain a grey area waiting for behavioural researchers to shed light on” (p. 17).

Further, it is important to note that these behavioural alterations are not always necessarily of a rationality-enhancing nature. In fact, the institutional setting within a professional asset

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<sup>54</sup> There is also a self-filtering process on the part of the individual. After all, it is usually the decision of a person to apply for a certain position in a certain institution.

<sup>55</sup> As far as the display of emotions within an institutional setting is concerned Berezin (2003), for instance, argues: “[E]motion managed is emotion short-circuited. Emotions are only expressed if they are appropriate to the institutional framework in which they occur. [...] [E]motion management is a co-terminus part of all service industries” (p. 36).

<sup>56</sup> Also in view toward a reconceptualization of (certain aspects of) the wider institutional framework in financial markets as a manifestation of an *extended cognition* architecture (see Main Introduction to the Thesis).

management firm might force the *employed* portfolio manager to subordinate her behaviour to the goals of the larger asset management institution, even if this leads to sub-optimal investment decisions, which, in turn, translates into sub-par performance for the client's portfolio: Although commonly accepted academic wisdom holds that fund managers are not able to outperform the indices (see, e.g., Jensen, 1968; Fama and French, 2009; Jones and Wermers, 2011), Cohen *et al.* (2010) find that the portfolio managers' 'Best Idea Stocks' do, in fact, produce significant alpha, and that it is due to institutional factors in the asset management industry – echoing Berk and Green's (2004) view – that suboptimal stock picks are included in portfolios, which eventually lead to underperformance. This should not be very surprising. After all, asset management institutions maximise their (fee) income by growing their Assets under Management (AUM), and in order to accomplish this feat, they have to minimise the tracking error(s) of their portfolio(s), which is most simply done by turning into a "closet indexer" (Howard, 2014, p. 12). This shows that even though such a strategy of deluding one's best investment ideas with underperforming stocks might seem irrational from an *individual* investor's perspective, it is entirely rational within an *institutional* context, where, according to Berk and Green (2004), "decreasing returns for managers in deploying their superior ability" (p. 1271) predominate. Hence, economic *inefficiency* is introduced in two ways via the institutional framework: first, individual professional investors might be restraint from acting in the most rational way (i.e., producing the highest possible investment returns) in order to, secondly, maximise the wealth transfer from the saving to the financial sector via management and transaction fees. Such aspects are usually ignored in the neo-classical framework.

Further, as far as the closed-system approach is concerned, financial markets form part of a larger social system, which is inherently open in nature, i.e. it keeps evolving while it follows the arrow of time. For the financial institution that translates into a consistently altering environment, within which it has to optimise its portfolio management processes (e.g., new financial instruments, new technologies, new regulatory environments). Different environments will trigger different responses by different institutions, depending upon the type and extent of their respective (reflexive) interaction with other institutions and institutional layers that, in the aggregate, constitute the financial markets – as well as the institutions' respective internal make-up. For example, the aforementioned fund's mandate determines, *inter alia*, its investment strategy (e.g., value, growth), which, in turn, defines the type of financial environment which, respectively, either offers investment opportunities or poses a threat to its existence (i.e., outflow of AUM). These factors will, *inter alia*, influence how the respective institution will respond to and evolve in different market environments. A closed-system approach is, therefore, mostly misguided; even though, one has to concede that the institutional level *does* provide a 'partial-closure' (Mearman, 2002), especially as many

processes are usually standardized, even for rare events (e.g., via contingency plans), which provides a certain level of stability and reduces uncertainty.

Now, where the case for a non-individualist, non-closed system methodology for the study of financial markets has been established, it is time to assess, to what extent the current approach to *Behavioural Finance* manages to shake off its neo-classical heritage.

### 3.3 To what Extent has Behavioural Finance managed to overcome the Shortcomings of 'Neo-classical' Finance?

A representative example of modern *Behavioural Finance* research is provided by Barberis, Huang and Santos (2001)<sup>57</sup>, who state:

“In the model we present below, the investor derives direct utility not only from consumption but also from changes in the value of his financial wealth [...] the objective function he maximises includes an extra term reflecting a direct concern about financial wealth fluctuations [...] our investor is much more sensitive to reductions in his financial wealth than to increases, a feature sometimes known as *loss aversion*. Second, how loss averse the investor is, depends on his prior investment performance. After prior gains, he becomes less loss averse [...] Conversely, after a prior loss, he becomes more loss averse [...]” (p. 2; *italics* in original).

This quote clearly demonstrates the continuing dominance of the neoclassical conceptual and methodological framework in financial decision research in *Behavioural Finance*, whose adoption, as mentioned above, might be reasonable for certain purposes, such as the analysis of retirement planning, but inadequate for the ‘macro’-study of financial markets. The quote also shows that the elusive concept of ‘utility’ (see e.g., Hodgson, 2012) has managed to infiltrate Behavioural Finance, thus, subjecting the field, *inter alia*, to our critique above, as well as the one formulated by Hodgson’s (2012). In what follows, Hodgson’s (2012) key points shall be outlined, as far as they apply to *Behavioural Finance*, but it shall also be discussed, how this criticism might be overcome by adopting a non-individualist, open-system methodology.

Hodgson (2012) discusses various forms of ‘rationality’, with the central focus lying on payoff- and utility maximisation, arguing that the former has been experimentally refuted<sup>58</sup>,

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<sup>57</sup> Barberis *et al.* (2001) apply *Prospect Theory* to their model, which seems to be one of the dominant approaches in the *Behavioural Finance* field. A series of work has, however, identified its limitations in explaining the behaviour of real-world investors; see e.g.; Hens and Vlec (2005), Barberis and Xiong (2009), and Shefrin (2008). Shefrin (2010) has also criticized the approach.

<sup>58</sup> Hodgson (2012) refers to Bowles and Gintis (2011) for an excellent overview of the evidence against

while the latter represents an empty concept, capable of explaining everything and, thus, being almost tautologically true:

“If we assume an added disutility associated with involvement in a risky and low probability choice, then the theory that people are maximising their utility is not overturned by these experiments. A risk-averse actor may not maximise expected monetary value but still be maximising expected utility” (p. 97).

As discussed above, however, once we enter the non-individualist realm, we are confronted with two different layers of ‘maximising’ entities: the institution and the individual agent working for the latter. Although the payoff maximisation type of rationality might have been refuted on the level of the individual, it might nevertheless apply on the institutional level, where payoff maximisation can be equated with profit maximisation, the central mantra of our “Shareholder-Value” dominated era. The institutional imperative will, most likely, override other factors that would affect the individual decision maker outside such a setting. In fact, it might even help to overcome the problem of preference transitivity on the individual level, as the various filtering mechanisms and internal and external competitive forces will align the individual agents’ goals, at least as far as his/her overt decisions and actions are concerned, with those of the institution.

On the individual agent level, an exclusive focus on payoff maximisation (here, the maximisation of the individual agent’s financial income) remains invalid, as even within an institutional setting (i.e., ‘on the job’) factors other than pecuniary considerations are of relevance (see e.g., Herzberg, 1959; Maslow, 1970). The minutiae of what exactly the individual agent aims to maximise for himself is, however, of a lesser importance here, because in all cases, s/he has to contribute to the overall goals of the institution if s/he intends to continue his/her employment.

Returning to the individualist, closed-system discourse, there are two further issues that such an approach raises in Behavioural Finance: First, the potentially mistaken extrapolative application of both closed-system reasoning and closed-system empirical insights to the explanation of real world (non-closed system) phenomena; and secondly, the potentially doubtful use of biases.

A good example of the tendency to apply closed system reasoning to a non-closed system is provided by portfolio diversification studies. MPT suggests, as Hirshleifer (2008) reminds his readers, that “(apart from transaction costs) everyone *should* participate in all security markets [types and geographic location]” (p. 1562; *italics* added). He points, however, to the empirical

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payoff (i.e. pecuniary rewards) maximisation.

observation that “even now, many investors neglect major asset classes [...] [with] [i]nvestors [being] [...] subject to a strong bias toward investing in stocks based in their home countries and in their local region<sup>59</sup>” (*ibid.*).

When one adopts a closed system view of the investment process, as MPT does, such a behaviour might seem puzzling; once one switches to a non-closed system perspective, however, this reluctance to diversify across asset classes and geographical locations is less surprising. After all, investors are not facing statistical risk as they would in a MPT world, but rather fundamental uncertainty, and this uncertainty is significantly reduced by greater familiarity with the underlying fundamentals of the investment object. Most successful professional investors (Peter Lynch, Mario Gabelli, Warren Buffett) focus on a certain type of investment style (see e.g., Buffett 1994), asset class and/or geographical location – what Warren Buffett describes as his ‘circle of competence’ – for the very reason that it is not possible to acquire expertise of multiple investment types and markets sufficient to have an edge over other market participants in each one of them. The ontology of an investment within a closed system is thus of a very different nature from one within a non-closed system.<sup>60</sup>

Another example of closed system reasoning can be found in the futile attempt to find one (or more) definite factors, such as a certain (combination of) bias(es) that explain(s) so-called ‘anomalies’ or ‘puzzles’, completely ignoring, thereby, the underlying processes and the non-open system nature of financial markets, which keep evolving over time. This is certainly an important reason why *Behavioural Finance* is unable to explain the observation that certain ‘anomalies’, such as, for example, the U.S. small firm effect and value premium, keep appearing and disappearing throughout different time intervals; for example,

“[t]he U.S. small firm effect was strongly positive every year during 1974 to 1983, and then was negative for six out of the next seven years; [similarly] the two closing years of the millennium, which followed the publication of an important paper on ‘Good news for Value Stocks’ (La Porta *et al.* (1997)), were the worst years for value stocks since 1928, though 2000 was better” (Hirshleifer, 2008, fn.8, p. 1539).

This type of closed system reasoning might be so engrained in many *Behavioural Finance* academics that they do (probably) not realize how many underlying assumptions they are (subconsciously) employing when applying the deductions originating in closed-system theories to their reasoning about non-closed system observations. Whitehead's reflection

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<sup>59</sup> See, e.g., Cooper and Kaplanis (1994), Teser and Werner (1995), Kang and Stulz (1997), Coval and Moskowitz (1999), Lewis (1999), Grinblatt and Keloharju (2001) and Huberman (2001).

<sup>60</sup> See the discussion above with regard to the MV vs. the Kelly approach; see also Chap. 2.

comes to mind:

“There will be some fundamental assumptions which adherents of all the variant systems [in our case ‘Neo-classical’ Finance and Behavioural Finance] within the epoch unconsciously presuppose. Such assumptions appear so obvious that people do not know what they are assuming because no other way of putting things has ever occurred to them. With these assumptions a certain limited number of types of philosophical systems are possible, and this group of systems constitutes the philosophy of the epoch.” (Whitehead, 1926, p. 61)

One of the economists, who raised the important issue of underlying assumptions in behavioural studies, was Zeckhauser (1986):

“[W]e should also consider how to extrapolate from what we observe to what we believe about individual’s behaviour. For example, if we mistakenly assume an individual is deciding under nature’s uncertainties [in the portfolio case - deciding within a parametric statistical world], when in fact he believes himself to be in a hostile world [here open, fundamentally uncertain world], we will interpret this behaviour incorrectly” (S443).

Similarly, if we assume that the *modus operandi* of the human mental decision apparatus is the same in both systems, we might also infer erroneous conclusions. Sarapultsev and Sarapultsev (2014), for example, argue that periods of market bubbles and crashes induce a stress reaction, which causes changing endocrine profiles and motivations, “leading to quantitative and qualitative differences in behaviour” (p. 61). This might imply that we are not only dealing with a different ontology of the system, but possibly also with a different ‘type’ of decision maker.

This leads us to the other major factor that is usually missed by the closed system approach of Behavioural Finance: the role of ‘emotion’. Ever since Damasio (1994), we know that emotions cannot be disregarded in decision tasks, and may well play a significant role, even in closed-system settings such as gambles. This is probably even more so in non-closed system settings. De Sousa (1987) writes that the

“role of emotion is to supply the insufficiency of reason... For a variable but always limited time, an emotion limits the range of information that the organism will take into account, the inferences actually drawn from a potential infinity, and the set of live options from which it will choose” (p. 195).<sup>61</sup>

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<sup>61</sup> Quote taken from Elster (1998, p. 60).

Similarly, the cognitive psychologists Philip Johnson-Laird and Keith Oatley (1992) argue that

“{because the ideal of} ‘impeccable rationality’ {assumes that} ‘there are no surprises, no misunderstandings, no irreversible conflicts,’ {it cannot guide action in situations that are characterized by these features. Instead,} ‘emotions enable social species to coordinate their behaviour, to respond to emergencies, to priorities goals, to prepare for appropriate actions, and to make progress towards...even though individuals have only limited abilities to cogitate’” (Elster, 1998, p. 60).<sup>62</sup>

The role of emotions in the financial decision-making process, thus, deserves a far greater emphasis and contemplation by *Behavioural Finance* research.

Moving to the empirical side, one encounters the age-old problem of applying laboratory insights (closed system) to the real world (open system), which could be described as a version of Taleb’s (2007) ‘ludic fallacy’<sup>63</sup>. Whereas the environment and the decision tasks in laboratories are clearly defined and controlled, the number of participants is limited, and the problem situation for the participant relatively easily cognisable, this is not the case in the real world, where there is a myriad of complex, interacting factors that can significantly alter the nature of the problem and/or the outcome of the decision. Zeckhauser (1986), for example, recounts his observation that “some married students are peculiarly risk averse [in small classroom gambles] [...] [as] they cannot bear to tell their spouse that they lost money on a gamble” (S445). He uses, *inter alia*, this example to argue that an isolated individual (e.g., someone in an experimental setting) is likely to decide and act differently from one that interacts with others (e.g., in financial markets): “[O]nce others are involved [as is almost always the case in a real-world setting], even the most thoroughly rational individual will take actions that appear to violate Savage’s prescriptions” (*ibid.*). Zeckhauser (1986), thus, clearly identifies the need to “calibrate the inferences we draw from observed behaviour to the circumstances in which it occurred” (*ibid.*). As far as the financial markets are concerned that includes the institutional framework, within which decisions are made, as well as the various types of social interaction of the decision makers and the open-system nature of the real world.

The inherently distinct nature of the challenges posed by an open-system setting to the decision maker also rises the issue, whether certain ‘heuristics’ and ‘biases’ are irrational after all, as they would be if one were to adopt a closed-system view, or whether they have, in fact, their

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<sup>62</sup> The {} circumscribe the text of Elster (1998), while the “ demarcate Elster’s (1998) quote of Johnson-Laird and Oatley’s (1992) text.

<sup>63</sup> Taleb (2007) criticises “the misuse of games to model real-life situations”, although he focuses mainly on the topic of probability (see p. 309).

distinct advantages in a real-world setting (see e.g., Gigerenzer, 2008).

Next, the discussion shall focus on the potentially dubious use of biases, which, although forming part of the wider ‘closed-to-open system extrapolation’ discourse, merit a separate treatment, due to their central role within Behavioural Finance.

There seems to exist the potential risk that Behavioural Finance economists might be tempted to simply explain a phenomenon with reference to certain biases that may (conveniently) appear to fit the observation and in addition to resonating well with their personal intuitive interpretation of the issue, without corroborating the underlying facts. Hirshleifer (2014) has identified the issue and argues:

“given the large grab of possible behavioural biases to choose from, building a financial model by just assuming some behaviour that seems plausible, or even by invoking a documented psychological bias, is not always compelling” (p. 43).

Behavioural Finance economists should not themselves succumb to the ‘availability heuristic’ or another fallacy when trying to produce a convincing explanation for empirical findings. It is necessary to gain a profounder understanding of the underlying tendencies and processes that lead to certain biases and heuristics, and the way they apply to the real-world setting, otherwise a myriad of contradicting explanations might appear that lack true empirical underpinnings and explanatory power. De Bondt *et al.* (2008), for example, identify “multiple behavioural explanations for momentum, not all mutually consistent”:

“There are at least four separate theories to explain why markets exhibit short-term momentum but long-term reversals. Some psychological explanations, such as Barberis, Shleifer and Vishny (1998) emphasise underreaction. Other psychological explanations, such as Daniel, Hirshleifer, and Subrahmanyam (2001) emphasize overreaction. Grinblatt and Han (2005) emphasize the disposition effect” (fn.17, p. 15).

Understanding the underlying processes and causal mechanisms is also vital for avoiding falling into the (closed-system) trap of simply extrapolating past observations into the future. After all, even if the causal biases for certain phenomena in the past were correctly identified, in an open system there would be no guarantee that the respective insights would continue to hold in the future, as the presence of a myriad of interacting facts might, even under similar circumstances, trigger different heuristics and biases than it had previously been the case. Shiller (2003) correctly identifies this point when rebutting the criticism of Fama (1998): “Since there is no fundamental psychological principle that people tend *always* to overreact or *always* to underreact, it is no surprise that research on financial anomalies does not reveal such

a principle either.” (p. 101-2; *italics* added).

Laudably, however, there are, especially on the empirical side, several research efforts under way that try to (partly) overcome these, as well as several other shortcomings. De Bondt *et al.* (2008), for example, ask: “Why is behavioural research often so convincing?” (p. 9). They also provide the answer:

“One reason is that ‘good’ behavioural research depends on support from multiple sources. For instance, laboratory research permits any reader who doubts the results to replicate the experiment ‘at home’. Further, many studies rely on surveys or observe individual behaviour (e.g., trading records) in a natural environment (e.g., Odean, 1998, 1999). Lastly, behavioural researchers also make use of conventional market-level price and volume data. [...] Decision anomalies (in the laboratory), matched with market anomalies in the behaviour of individual agents (in a natural environment), matched with market anomalies (when social interaction allows fine-tuning) produce a powerful body of evidence. Take, for example, investor overreaction. Certainly, experiments teach us that subjects do not update beliefs in a Bayesian fashion (De Bondt, 1993; Muradoglu, 2002). Second, when asked, investors tell us that they like to buy past winner stocks but that they stay away from past losers. Regardless of what investors say, their trading records confirm the bias [...] Third, at the market level, we find predictable reversals in share prices (De Bondt and Thaler, 1985). The laboratory, financial behaviour, and market results appear to be connected” (p. 9).

This eclectic and multi-level approach is certainly steering *Behavioural Finance* research into the right direction, allowing it to overcome, *pas-a-pas*, the closed-system limitations discussed above as it grows in sophistication and scope. There have also been several early attempts to overcome the purely individualist account by increasing the emphasis on the social dimension<sup>64</sup> of financial decision processes, although research in this area is still in its infancy. Hirshleifer (2014), for example, proclaims that “the time has come to move beyond behavioural finance to *social finance*” (p. 1; *italics* in original), whereby

“[s]ocial finance includes the study of how social norms, moral attitudes, religions and ideologies affect financial behaviors [...]”<sup>65</sup>, and how ideologies that affect financial decisions form and spread” (p.44).

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<sup>64</sup> See, e.g., Shiller and Pound (1989), Strasser *et al.* (1989), Banerjee and Fudenberg (1999), Kuran and Sunstein (1999), Shiller (1999), Cao and Hirshleifer (2000), Hong *et al.* (2005), and Shive (2010).

<sup>65</sup> Hirshleifer (2014) refers here to the works of (Hilary & Hui (2009), Hong *et al.* (2009), Kumar (2009), Kumar *et al.* (2011), McGuire *et al.* (2012), Hong & Kostovetsky (2012), Hutton *et al.* (2013).

Hirshleifer (2014) is also quick to point out the shortcomings of previous research in the area and suggests a more promising direction:

“Previous research has documented the spread of investment [...] behaviors through observation of public behaviors or through social networks (see, e.g., the review of Hirshleifer & Teoh (2009[...])). However, mere contagion is consistent with the spread of almost any behaviour. To derive richer implications, it will be crucial to understand the transmission biases and amplification processes that make some investment ideas spread more easily than others”<sup>66</sup> (p. 44).

Hirshleifer (2014) recognises that the

“[a]nalysis of social interactions promises to provide greater insight into where heuristics come from (since they are far from entirely innate), and to offer a foundation for understanding investor sentiment, [in order to] [...] potentially offer a deeper basis for understanding the causes and consequences of financial bubbles and crisis” (p. 44-45).

Even more important for the present discussion, however, is his speculation about the socio-institutional insights, which a greater emphasis on social factors could potentially yield:

“Even more fundamentally, understanding how financial ideas spread from person to person may eventually suggest theories of how investment and corporate ideologies, such as value versus growth philosophies [...] evolve.” (p. 45)

The discussion in the last few paragraphs has focused on new research endeavours on the empirical side of *Behavioural Finance* that have, via their innovative approaches, partly alleviated the applicability of the ‘closed-to-open system extrapolation’ critique developed above. The subsequent example shall outline an approach that could potentially remedy, at least partly, the ‘doubtful use of biases’ matter.

Baker and Wurgler (2007) take the view that “none of the [‘bottom-up’] models is uniquely true [and that] [...] [r]eal investors and markets are too complicated to be neatly summarized by a few selected biases and trading frictions” (p. 130). In order to overcome this problem, they develop an alternative, ‘top-down’ approach:

“The new direction in this top-down approach builds on the two broader and more irrefutable assumptions of behavioural finance - sentiment and limits to arbitrage

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<sup>66</sup> Hirshleifer (2014) refers, *inter alia*, to the works of Shiller (2000); Kaustia and Knüpfer (2012); Simon and Heimer (2012); and Han and Hirshleifer (2014).

- to explain *which* stocks are likely to be *most* affected by sentiment, rather than simply pointing out that the level of stock prices in the aggregate depends on sentiment” (p.130; *italics* in original).

Their ‘top-down’ model shifts the emphasis toward specific tendencies, i.e. “*which* stocks are likely to be the *most* affected by sentiment” (*ibid.*; *italics* in original), which seems to be a far more sensible approach to be adopted in an open system environment than the mere appeal to the presence of one bias or another.

This shows that the eclectic approach adopted by *Behavioural Finance*, which, indeed, has become a hallmark of the research effort, has yielded many valuable insights into the operation of real-world financial markets. Unfortunately, this methodological spark has not been able to flash over from the empirical to the theoretical side. Some of the chief proponents of the field leave little doubt (hope) on the question as into what direction *Behavioural Finance* is headed: toward an incorporation of (some of the) insights gained from the empirical endeavours into the ‘neo-classical’ finance framework, chaining the field, yet again, to an individualist and closed-system account. Developments to this end have already been identified by Shefrin (2010):

“The behavioralization of finance involves intellectual shifts by two groups. The first shift features neoclassical economists explicitly incorporating psychological elements into their models. [...] The second shift features Behavioral Economists developing a systematic, rigorous framework. [...]

Shifts necessary for the behavioralization of finance are underway. Some neoclassical economists have begun to develop behavioral models. Two prominent examples are Jounini and Napp (2006) and Dumas *et al.* (2009). At the same time, some behavioural economists are beginning to develop models that are as rigorous as their neoclassical counterparts. A good example is Xiong and Yan (2009), whose formal framework shares much in common with Dumas *et al.* (2009)” (p. 3).

Besides, most theoretical efforts have solely focused on calibrating existing finance models with behavioural insights in order to provide explanations for the anomalies that hitherto could not be reconciled within the traditional framework (e.g., Barberis *et al.*, 2001). More notably, even the proposed ‘behavioural’ alternatives to MPT (Shefrin and Statman, 1987, 2000) and CAPM (Shefrin and Statman, 1994) remain largely trapped within the neo-classical framework and its individualist and closed system methodology.

Furthermore, the ontology of financial markets remains unexplored, as the ‘neo-classical’

instrumentalist parametric-statistical perception of investment reality remains largely intact.

### *Conclusion*

On the basis of the considerations discussed above, the following picture emerges with respect to the current state of research into the cognitive processes in financial markets, or rather the field that specialises in the latter, Behavioural Finance: First, the (sub-)field largely continues to be defined by its neo-classical past. Its core models are inherently neo-classical in nature, and so is its conception of the individual and of (human) cognition. Human test subjects are assessed against the normative neo-classical framework, and the empirical findings are interpreted according to the presuppositions of the latter. The result of this state of affairs has been a set of a large number of widely scattered, loosely connected, and largely disconfirming empirical findings in need of a synthesizing theoretical framework and, at least in certain cases, an ‘interpretative sanitization’ in order to reduce the risk of wrong (policy) conclusions being drawn from them. A deep schism can therefore be identified not only between the (sub-)field’s theoretical/methodological core and the various empirical endeavours and findings, but also between its continuing loyalty to the former, on the one hand, and its *needs* if it intends to progress and evolve into a fully-fledged research program, on the other. It is unlikely, though, that either of these schisms will ever be overcome from *within* the (sub-)field. After all, the generally accepted *raison d’être* of Behavioural Finance is the study of those empirical ‘puzzles’ and ‘anomalies’ that, due to their irreconcilability with the predictions of the neo-classical models, threatened to severely undermine the orthodox framework, as well as the specification of appropriate re-calibrations of these models in order to account for at least some of the underlying realities (e.g., *hyperbolic discounting*; see Rubinstein, 2003). The continuity of the neo-classical framework lies thus at the heart of the various research efforts. There exists therefore little (if any) impetus, incentive or support for, but significant cultural and institutional barriers to the development of any *alternative* theoretical framework of human cognition in financial markets.

Behavioural Finance has made a seminal contribution to our understanding of the operation of financial markets by instigating the inquiry into the actual cognitive factors and processes that underlie various market phenomena. Unfortunately, its neo-classical heritage has been impeding it from turning into a fully-fledged, *evolving*, research program with its own distinct methodology and theoretical framework, despite the fact that human agents have found to violate virtually all the prescriptions of normative rationality that follow from the neoclassical model.

An important first step will be the formulation of a more realistic conception of the cognitive factors and processes that underlie the greater part of financial market activity. As we have

learned in the present chapter, two important prerequisites for the identification of a plausible conception of cognition for a given environment are a thorough understanding of the nature of the decision-environment the agent operates in and of the core problem/decision-task she is required to solve for her survival/success. This background-knowledge will provide an important starting point for drawing the relevant inferences. To that end, the subsequent chapter shall focus on the explication of these two aspects as well as any other insights relevant to the development of a more plausible conception of cognition from a theoretical framework that had evolved organically through market-practice: *Value Investing*.

## Chapter 2

### Introduction to Chapter 2

The present chapter shall develop some valuable preliminaries for the formulation of a more realistic conception of human cognition in financial markets, with a particular emphasis given to the expectation formation process.

In Chapter 1, we demonstrated that the currently predominant conceptualisation of the individual (particularly with regard to the aspect of *cognition*) in financial markets is deeply embedded in general neo-classical economics at the level of ontology, methodology and use of method; a fact, which has put significant constraints on the development of alternative – possibly more adequate – frameworks, since this complex set of referents remains, due to various historical and discipline-internal reasons (see, e.g., Chap 1 and the Glossary), *the* central point of departure and analysis. Hence, albeit Behavioural Finance constitutes in certain ways an improvement over the original neo-classical framework and has managed to produce a valuable *internal* critique of financial economics, supported by empirical evidence,<sup>67</sup> it still fails to emancipate itself to a sufficient degree to develop an alternative account of cognition and behaviour of actual financial market participants and, *by inference*, of the market processes that occur. Unlike Ross (2008), who claims that the realities of *human psychology* [and cognition] do not much matter when it comes to the adequacy of orthodox models of agency – particularly not within an institutional setting that “press[es] you to approximate your behaviour to that of an economics agent” (p. 134) –, the present work holds that they *do* make a difference, particularly in financial markets, where *excessive exuberance* and *panic* have been responsible for a variety of well-known episodes of market-inefficiencies, and where the introduction of a new type of ‘cognition’, i.e. A.I. has given rise to new types of price phenomena (e.g., ‘Flash-Crashes’). The key point being made here is that different forms of *cognition* might lead to different price characteristics and behaviour. Hence, albeit the orthodox toolset might continue to yield some useful insights, particularly with regard to some of the statistical properties of financial market prices, the neo-classical framework lacks the capability of producing sufficiently adequate descriptive and explanatory accounts of the underlying causal factors and processes, which might be of particular relevance for the detection of destabilizing factors within these markets and hence for their regulation.

From the discussion in Chapter 1 (see also, Glossary: Behavioural Finance), it should have become apparent that the truly revolutionary aspect of behavioural finance was its break with

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<sup>67</sup> Albeit, as argued in Chapter 1, several of these empirical findings are – most likely due to the still predominant neoclassical thinking in the field – *interpreted* as deficiencies on the part of the *human* actor rather than on the part of the orthodox model.

the chief preoccupation of neo-classical finance since its early days in Cowles' (1933) original research, viz. the mathematical-statistical properties of financial market prices (i.e., the 'surface level'), and its foray into the analysis of 'deeper' underlying factors and processes, such as, most relevantly, *human* cognition. A successful continuation of this highly worthwhile project will, as discussed above, demand an unfettering of its ontology, theory and method from the neo-classical yoke, though. To that end, the present work adopts an alternative starting point: *Value Investing*, at its core, a methodological account of investing and, according to Howard (2014), the 20<sup>th</sup> century first capital market paradigm, originally formulated by Graham and Dodd (1934) in their seminal work, *Security Analysis*. The approach consists of a set of core principles and heuristics that had evolved organically through the day-to-day market practice by traders who were instinctively aware that they were dealing with *technē*, not *epistemē*.

As the framework was developed specifically to provide a robust decision framework that would, on the one hand, maximize the likelihood of the investor's (financial) survival, while, on the other, inform her on how to exploit the cognitive weaknesses and blunders of her fellow market participants, it provides a valuable source for *clues* as to the nature of actual cognitive processes present in these market environments. The term 'clues' has deliberately been chosen in order to re-emphasise that the *Value Investing* account was devised as a *practical* investing framework only and, as such, does *not* yield any *technical* insights into the topic of human cognition. Such matters can only be discussed and developed once the necessary preliminaries have been established, though; a task, which will, in any case, exhaust the entire space allotted by the thesis format.

For the purposes of the present chapter, we shall focus on the development of the first outlines of a potentially more plausible conceptualisation of the expectation formation processes of the stock market (securities) investor on the basis of the aforementioned *Value Investing* framework.

It was argued in Chapter 1, that a proper comprehension of the nature of the decision-environment and -task constitutes an important starting point for the study of cognitive processes because they define the parameters within which the 'cognitive apparatus' needs to operate as well as the set of constraints it faces. The neo-classical framework has never given much consideration to such aspects. As discussed in Chapter 1, economic agents were simply assumed to be *small minds* entrapped within *small worlds*. Being interested in a proper understanding of the realities the agent has to deal with in financial markets, for the purpose of drawing more sensible inferences as to the type of cognitive processes engaged in these

environments, we shall apply a *descriptive* ontological approach (see Mäki, 2001)<sup>68</sup> to the *Value Investing* framework, concentrating on three core aspects that appear most relevant for the purpose at hand: First, the aspect of *fundamental uncertainty* (Sect. 2), which constitutes the key factor underlying the true nature of the risk that an investor faces in financial markets and accordingly determines what types of decision-logic (e.g., ‘survival first’) and behaviours are rational in such a setting and which aren’t. Secondly, the aspect of *multi-dimensionality* (Sect. 3), which refers to the multi-faceted and fuzzy nature of the information the agent has to identify, select and interpret and which consequently can lead to the emergence of varying (sometimes contradictory) ‘pictures’ from one and the same dataset. This factor influences virtually all aspects of the process that leads up to the formation of *expectations* and is thus of the greatest relevance to the *leitmotif* of the present work. Thirdly, the important topic of *Price-Value (In)Congruence* (Sect. 4), a core topic in the financial markets literature that affords deep insights into the nature of beliefs and expectations in these environments, because it is ultimately these two cognitive factors, in conjunction with the associated decision-actions (i.e., trades), which underlie both *price* and *value* as well as their relationship to one another.

Once again, it needs to be stressed, though, that the *Value Investing* account was conceived as a pragmatic investing framework in the first instance, which means that several of the insights produced are primarily of a folk-theoretic nature only, if indeed, they are explicitly dealt with at all. Fortunately, though, it has been found that the core tenets of the approach seem to be largely compatible with two major heterodox accounts in economics, i.e. *Austrian Economics* and *Post-Keynesian Economics*.<sup>69</sup> The relevant literatures are thus deemed sufficiently relevant to act as midwives for the explication, by *inference*, of the required insights. Particularly relevant in this regard are, on the Austrian side, L.A. Hahn’s (1956) – nowadays unfortunately largely forgotten – Austrian account of financial markets; on the Post-Keynesian side, it is Woods’ (2013) comparative analysis of Graham’s and Dodd’s (1934) original *Value Investing* framework, as presented in their seminal work, *Security Analysis*, and J.M. Keynes’

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<sup>68</sup> Mäki (2001, p.6): “Questions about the economic world can often be transformed into questions about economic theories, taking on the general form, ‘What does theory T presuppose concerning P?’. For example, ‘What exactly does theory T presuppose about the capacities and suppositions of economic agents, or the market mechanism?’”

<sup>69</sup> As for the Austrian Economics literature: The general consensus appears to largely subscribe to Leithner’s (2005, p.3) overall assessment that both “hold compatible views about a range of fundamental economic and financial phenomena” (see Mayer, 2000; Krug and Mohelsky, 2010; Grimm, 2012; Spitznagel, 2013; Taghizadegan *et al.*, 2014). Similarly, the intrinsically related topic of *fundamental analysis* (see Kaza, 2000; Chang, 2011) has received a favourable reception within the wider Austrian camp: Pasour and Ernest (1989) on market efficiency and entrepreneurship, Shostak (1997) on market efficiency and business cycles, Kaza (2000) on arbitrage, and Grimm (2012) on stock selection.

mature<sup>70</sup> investment framework,<sup>71</sup> which promises, in conjunction with more general Post-Keynesian insights, to yield the most accurate explication of the former's core insights with respect to the aforementioned topics.

The present chapter shall be structured as follows: Section 1 shall provide a brief overview of the *Value Investing* approach; Section 2 shall discuss the topic of *fundamental uncertainty* that pervades financial markets; Section 3 shall analyse the *multi-dimensional* nature of (economic) reality the investor has to (cognitively) deal with; and Section 4 shall distil the core cognitive aspects from the issues underlying the subject of *Price-Value (In)Congruence*.

## 1. A brief Outline of the Value Investing Approach

This section shall briefly outline the core tenets of the *Value Investing* approach developed by Graham and Dodd (1934).<sup>72</sup>

The core tenet of the *Value Investing* approach is that the investor is fallible in her investment decisions. Both the fundamental uncertainty (Knight, 1925), which characterises the financial market setting (see Sect. 2), and the nature and functioning of her 'cognitive apparatus', with its limited computational capacity and susceptibility to various distorting influences (*internal*: e.g., 'emotions'; *external*: e.g., 'groupthink'; see Sect. 4), make the entire investment decision process highly prone to error. The focus, so the framework suggests, should therefore be on the minimisation of any downside risk (or, in Warren Buffett's words: Rule 1: Don't lose any money; Rule 2: Don't forget Rule No.1"). Hence, the framework advises the investor to take the following steps: First, select a sector/niche, wherein you consider yourself to have a certain competitive advantage (e.g., via some specialist knowledge in the field) and hence an edge

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<sup>70</sup> In his early investing career, Keynes had been a 'credit cyclist'. In other words, Keynes had tried to apply his theoretical knowledge of the business-cycle and his 'hunches' with regard to human psychology to 'time' the purchases and sales of securities (i.e., 'buy at the bottom, sell at the top'; see main text Sect. 3). He abandoned the approach after he had incurred severe losses adhering to it, realizing that the feat of making sufficiently accurate predictions was, due to the realities to be found in these markets, not feasible. He would go on to devise a fundamentally different approach that would produce strong returns for both his own account as well as the Chest Fund he was managing in his role as bursar at King's College (see Keynes, 2013; Woods, 2013).

<sup>71</sup> The author of the present thesis has no information as to whether, and if so, to what extent, Keynes had been knowledgeable of and influenced by Benjamin Graham's writings. Carlen (2012) claims that Benjamin Graham maintained a correspondence with J.M. Keynes (and Friedrich Hayek) on topics of economics, primarily his commodity-reserve currency plan (Graham, 1937, 1944) – which Hayek endorsed in a full-length article (Hayek, 1943) – but he gives no hint as to any intellectual exchanges in regard to their respective investment approaches.

Woods (2013) writes that "[g]iven the fundamental changes that occurred in Keynes's approach to portfolio management during the 1930s and the fact that *SA* [*Security Analysis*] was published in 1934, it is reasonable at least to bear in mind the content of the latter in any examination of the former, even though Keynes did not mention Graham and Dodd" (p. 427).

<sup>72</sup> For a more detailed exposition see, e.g., Graham and Dodd (1934, 1940, 1951, 1962, 1988, 2008), Greenwald *et al.* (2001, 2004), Montier (2009a).

when it comes to the assessment of the security's underlying *value* (see Sect. 4). Secondly, within that niche, try to identify a number of securities that you consider to be under-priced, i.e. where you think that the 'market consensus' errs with respect to the value of the underlying economic entities, and trade accordingly, i.e. buy underpriced securities and sell overpriced ones, if an appropriate *margin of safety*<sup>73</sup> is given (i.e. as an additional buffer against any unexpected market developments and/or errors committed in the valuation process). At this stage, the investor faces the following (cognitive) challenges: (i) the identification of an appropriate data-set, (ii) the application of the most accurate interpretation to the latter, (iii) the formation of a subjective 'picture' (together with the respective expectations as to its future development) of the respective aspect of (economic) reality that underlies the security, (iv) the 'collapse' of this multi-dimensional picture into a single-value figure (or range of values),<sup>74</sup> (v) the assessment as to whether the current ratio between the estimated value figure and the current market price justifies an investment, (vi) the decision whether to act (trade) or not, and (vi) dealing at each stage with the various *internal* and *external* influences that threaten to undermine the correct execution of any one of these steps (e.g., the value investor is highly likely to act contrary to the prevailing 'market sentiment', which means that she will have to volitionally withstand the felt pressure to conform with the group consensus) (see Sect. 3 and 4).

To summarize, the security ought to be purchased when it trades significantly below its estimated *value*, and it ought to be sold once market prices have sufficiently adjusted and thereby eliminated the original mispricing or, alternatively, the recognition of a flaw in the original estimate leads to a reassessment that corroborates the market's original view (i.e. *price*). In any case, the (re-)assessment process is a continuous one as the (economic) system keeps evolving, leading to the obsolescence of initial estimates.

The following premises underlie the *Value Investing* framework: First, financial markets are not informationally efficient at all times; mispricing *does* occur from time-to-time due to the ontology of the economic system as well as the inherent cognitive (and epistemological) limitations of market participants (Howard, 2014). Secondly, it is sometimes possible for the perceptive value investor to identify and 'see through' such 'collective cognitive blunders' and exploit them to her pecuniary advantage (Howard, 2014). Thirdly, market prices will, once the mispricing has been generally recognized, converge toward the underlying economic value (this turns the value investor's 'superior insights' into a tangible financial gain); after all,

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<sup>73</sup> E.g., the value investor will only buy a security if it is trading, let's say, 30% beneath its estimated value.

<sup>74</sup> Benjamin Graham and David Dodd's *Security Analysis* has precisely been devised for this purpose. Woods (2013) stresses that "[i]t is no exaggeration to say that the purpose of *SA* [i.e., *Security Analysis*] is to provide securities analysts with the techniques that will enable them to provide reasonable estimates of intrinsic value" (p. 432).

financial market prices are not entirely random and do eventually *tend toward* their respective underlying values (even though the latter remain ever-moving targets). Hence, the value investor is “interested in both the intrinsic value and the market price – specifically their relationship between them” (Woods, 2013, p. 432; see also Graham and Dodd, 1934, Chap. XXVIII), and therefore, implicitly, in the collective investors’ perceptions, assessments, decisions and actions which ontologically underlie both of them as well as their relationship to each other (see Sect. 4).

Figure 2 graphically summarizes the essence of the *Value Investing* decision process outlined in this section.<sup>75</sup>

**Figure 2:** The Value Investing Decision Process



\*Margin of Safety

As Figure 2 shall be drawn upon for illustrative purposes in Section 2, the elaboration of its details shall be left to the discussion in the latter.

## **2. Uncertainty and the Realities of the Decision Process in Financial Markets**

This section shall discuss one of the most relevant aspects of financial market reality according to the *Value Investing* framework: *fundamental uncertainty*; an intrinsic characteristic of these markets which, by (re-)<sup>76</sup>defining the parameters (and the consequent set of limitations) the investor is (cognitively) confronted with, which include *inter alia* the nature of ‘risk’ and the reliability of certain sets of information over (and across) time, also (re-)defines the suitability

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<sup>75</sup> Used in a similar way by Rapp *et al.* (2017).

<sup>76</sup> *Vis-à-vis* the neoclassical framework.

and hence ‘rationality’ of the adoption of certain types of decision-logic and –behaviour over others. The topic of *fundamental uncertainty*, i.e. “the absence of probabilistic knowledge where ‘there is no scientific basis on which to form any calculable probability whatsoever’ (CW XIV:114) (Dow and Hillard, 1995, p. 256; see also Dow, 2015), has been the topic of elaborate discussions in the Post-Keynesian literature (see, e.g., Lawson, 1985; 1988; Runde, 1990; Runde, 1994; Dow and Hillard, 1995; Runde and Mizuhara, 2003; Dow and Hillard, 2002; Dow, 2015), which, for this reason, shall provide the necessary background material for an adequate exposition of the matter and its relevance for a better understanding of actual decision processes within financial markets.

First, the presence of this ontological presuppositions in the *Value Investing* framework needs to be established. Even though the concept itself has never been properly developed or even discussed at any great length by Benjamin Graham and David Dodd (1934), unsurprising perhaps when one considers their target audience, the framework’s core principles make an inference to that end likely. As already outlined above, it puts a strong emphasis on the ‘safety-first’ principle, insisting – in addition to the already highly prudent standards of valuation and diversification – also on the application of a substantial *margin of safety* to protect the investor from any unforeseeable developments as well as her own cognitive) and epistemological) limitations (see Graham and Dodd, 1934). One might speculate that Benjamin Graham came to devise this particular investment approach in direct response to his traumatic experiences in his capacity as a professional investor during the market turmoil of the late 1920’s and early 1930’s (see Graham, 1996), which, most likely, had imbued him with a deep awareness and respect of the unpredictable vagaries of the stock market. This was certainly the case for another, far more prominent, investor at the time, the economist J.M. Keynes, whose metamorphosis is well documented in his writings and professional correspondence (see Keynes, 2013): In the early years of his career as an investor, Keynes traded on the basis of – what he dubbed – a ‘credit cycling’ approach, which built on the premise that a proper theoretical understanding of the credit-cycle in conjunction with a good grasp of human psychology (i.e., a ‘folk theoretic’ account) would suffice to formulate sufficiently accurate<sup>77</sup> predictions with respect to major turning-points in the ‘financial market cycle’, and hence permit the profitable timing of one’s (security) purchases and sales, whereby the former would have coincided with the market’s trough and the latter with its peak (see Keynes, 2013). For an illustrative example, consider a hypothetical investment in the common stock of XY Inc. (Fig. 2). If the approach had been feasible, an investor would have been able to sell (short) the security at \$34, to buy it back at \$5 and to re-sell it at \$35, extracting thereby the maximum return that the price cycle yielded. As it should have become clear by now, the entire approach

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<sup>77</sup> Whereby ‘accuracy’ is defined in terms of a threshold minimum financial net-gain (i.e., after taxes, transaction costs, etc.) that the prediction was expected to yield.

was concerned with *prediction* and *market timing* and not the accurate assessment as to whether prevailing market prices correctly reflected the underlying economic reality (i.e., whether *price = value*). Severe financial losses, particularly in the wake of the 1929 Crash when Keynes came to experience the nadir of his investment career, would eventually convince him of the practical unfeasibility of the approach (Keynes, 2013; Woods, 2013) and instigate a major metamorphosis of his understanding of economic systems (Skousen, 1992, p. 161) more generally and financial markets more specifically. That new understanding was to become manifest in the radically different investing approach he came to devise; one, whose core structure and tenets would be remarkably similar to those of Graham's and Dodd's (1934) *Value Investing* approach (2013), and one, which would internalize the pivotal insight that, as Lanteris and Carabelli (2011) put it,

“[u]ncertainty and ambiguity are not causal elements that disrupt the orderly working of an ideal decision context, but essential features of almost every real-world decision context” (p. 272).<sup>78</sup>

Indeed, this epiphany would not only radically alter Keynes' thought about financial market reality and his consequent understanding of certain phenomena, such as *market liquidity*,<sup>79</sup> but, as we shall see below, also instigate in him a re-conceptualisation of the decision-problem and -processes and make him instinctively aware of the role that human judgment plays in environments wherein which “the range of future possibilities cannot be known” (Dow, 2015, p. 36).

The conception of *fundamental uncertainty* that came to underlie Keynes', and presumably also Benjamin Graham's, mature investing framework is thus, as will become apparent from the subsequent discussion, the following:

“[U]ncertainty is not fixed exogenously (or stochastic), but is open to exercise of judgment and some knowledge. The emergence of unknowable unknowns is to be expected, yet some knowledge may be brought to bear (see Runde, 2009).

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<sup>78</sup> Hence, Lanteris's and Carabelli's (2011) tentative proposal that the two factors, i.e. uncertainty and ambiguity, “should be integrated, as founding stones, within our approach to individual decision-making[!]” (p. 272), might already have been realized in the *Value Investing* approach, as might have been the internalization of an instinctive understanding of the primacy of *survival (ecological) logic/rationality* (see main text below), which has only recently been rediscovered (e.g., Binmore, 2008; Smith, 2008). The framework's relevance for the development of a different, more plausible conceptualisation of the decision-maker in financial markets should therefore, by now, have become apparent.

<sup>79</sup> Keynes came to realize that *liquidity preference* was the hallmark of investing within uncertain environments (Runde, 1994). Whereas the hypothetical skilled ‘credit cyler’ would have been able to foresee major changes in crowd psychology that could lead to a desiccation of financial markets, Keynes came to recognize that such a feat was, due to the element of *fundamental uncertainty*, inherently impossible.

Further, fundamental uncertainty varies in intensity and can be reduced by appropriate change in institutions and conventions (or increased by inappropriate change). Similarly, the degree to which uncertainty is admitted and the attitude to it are not given in Keynesian uncertainty theory but can vary between different groups and over time. Far from being the given consequence of an exogenous constraint on knowledge, as the dual of certainty, fundamental uncertainty is endogenous to behaviour and to structure, can vary in intensity and is open to degrees of recognition.” (p. 36)

In such a market environment, Dow (2015) argues, “[t]here is,” in contrast to neo-classical finance with its closed-system ontology, “no such thing as ‘true risk’ or a ‘true price’ as a benchmark for market fluctuations (Townshend, 1937; see further Dow, 2013)” (*ibid.*). Unlike modern neo-classical finance theorists and a significant majority of practitioners, Keynes did not engage in any kind of ‘uncertainty denial’ (Dow, 2015, p. 45) when devising – abductively rather than deductively – his mature investment framework, which, tailored to the respective ontological realities, provided him with a decision tool that would minimise his losses in the face of unforeseen/unforeseeable negative events while providing him with a theoretically unlimited upside. This asymmetry, which Taleb (2012) terms *optionality*, is central to Keynes’s mature investment approach and provides him with the most ‘rational’ way of operating in such an environment. The issue of uncertainty is thus not “bypass[ed] [...] [by] the advocates of value investing,” as claimed by Rapp *et al.* (2017, p. 19).

A more accurate and nuanced understanding of the ontology of financial markets is, by itself, however, not sufficient for investment success; one also requires an understanding of how to deal with these realities (and capitalise on one’s knowledge), particularly because the role of an investor forces the one’s hand, and not only because, as Keynes put it, “as living and moving things, [...] [we] are forced to act” (Keynes, 1973, p. 214), but also because the very nature of the ‘investing game’ makes it impossible *not to act*, as the latter constitutes an act in itself. After all, *not-investing* means holding on to one’s cash, which constitutes a distinct asset class in its own right, and one with a potentially high opportunity cost. Not only are cash-holdings vulnerable to depreciation in terms of purchasing power through the constantly present spectre of inflation, but lucrative alternative investment opportunities might be missed (i.e., ‘error of omission’)<sup>80</sup>. A ‘failure to act’ will thus eventually translate into a sub-par investment performance and hence, at least for the professional investor, into the end of her career. The investor has thus no choice but to act *in spite* of the fundamental uncertainty, and for this, Keynes remarked, she “must be guided by some hypothesis” (Keynes, 1973, p. 124). This highly relevant topic of ‘hypotheses’ or ‘cognitive models’ that guide investors’ expectation

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<sup>80</sup> In contrast to an ‘error of commission’, i.e. committing oneself to an investment that leads to losses.

formation and decision processes shall be resumed in Section 3 and then, particularly, in Section 4. In the remainder of the present section, we shall explore the general guidance that the *Value Investing* framework provides as an alternative decision-framework for the financial market context.

Both Benjamin Graham and J.M. Keynes identified a way to deal with an uncertain future. Theirs being, unlike Davidson's (1988),<sup>81</sup> neither a non-fallibilist nor an absolute account, but, similar to the Post-Keynesian one (e.g., Runde, 1994; Dow, 2015), one allowing for varying degrees of uncertainty, whereby the admission of the latter leads to the logical conclusion that decisions in such environments are to be based on those aspects of reality haunted by the *relatively lowest degree of fundamental uncertainty*. Where are those to be found? Keynes knew from his early forays into the financial market arena that any investor relying on macroeconomic projections, or those concerning market price movements or crowd psychology more directly, was building on sand, as neither of them had proved to be a reliable guide to investment success. His focus, like that of value investors more generally, shifted to the *economic realities of individual economic entities*, such as incorporated firms, which were not only of a significantly lower degree of complexity than macroeconomic systems but, unlike their security prices, also significantly less susceptible to the vagaries of crowd psychology;<sup>82</sup> the degree of uncertainty is thus considerably reduced via this step. This last point requires the following qualification, though: The potential investment target has to have certain characteristics in order for the last statement to be true (e.g., a history of stable Free-Cash-Flows); after all, an investment in some biotech start-up with nothing but unproven products in its pipeline cannot be said to differ significantly – at least in terms of degrees of uncertainty involved – from a financial market bet based on a projected market-correction next year. Future projections, on which the greater part of investors' expectations in such start-ups and most speculative booms hinge upon, are, in general, subject to the highest degree of uncertainty, providing thus the least reliable basis for any investment decision,<sup>83</sup> because, as Graham (1958) correctly points out, "highly imprecise assumptions can be used to establish, or rather to justify, practically any value one wishes" (p. 17); such projections are thus to be employed with the greatest caution.

The *Value Investing* framework suggests that the investor begins the valuation task right at the bottom of the 'degrees-of-uncertainty' pyramid, i.e. with the aspect of reality that she can be most confident about. In Graham and Dodd's (1934) original formulation, the latter was

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<sup>81</sup> For a critical account of Davidson's conception of uncertainty, see Runde (1993).

<sup>82</sup> The prominent value investor Seth Klarman (1991) notes that the type of reflexivity that Soros (1987) identifies, tends to be the exception rather than the norm in *equity*-markets.

<sup>83</sup> See Taleb (2005, 2007, 2009a, 2009b, 2010), Taleb and Goldstein (2012), and Taleb and Douady (2013) for an elaborate critique of projections and investors' reliance upon them.

provided by the net-net value (current assets – total liabilities), i.e. the amount of money the investor would be able to realize today if she liquidated the company. As the ‘going concern’ of most companies is haunted by a significantly lesser degree of uncertainty than it was in the 1930s, however, modern value investors generally consider the reproduction value of a firm to constitute the appropriate starting point (see Greenwald *et al.*, 2001); in other words, they enquire into how much it would hypothetically cost a newcomer to establish a replica of the respective company, in terms of tangible and intangible assets, market share, etc. All the relevant estimates can be made with data available at the present and require no projections into an uncertain future. Next, the value investor moves up a step, gaining thereby insights that are of a higher degree of relevance for the investment’s current value but only in exchange for a higher exposure to uncertainty: i.e. the firm’s *earning power*, which is central to both Keynes’ and Graham’s respective frameworks (Woods, 2013) as well as those of contemporary value investors (see Greenwald *et al.*, 2001). The *earning power* concept refers to the degree of average economic profitability that can reasonably be expected on the basis of the firm’s historical past and the nature of its industry (e.g., monopolistic, oligopolistic, monopolistic competitive, etc.) over the subsequent five to ten years. The final and most reliable component in the valuation exercise, the one we find at the top of our ‘pyramid’, is, as already mentioned above, the assessed value derived from the firm’s future *growth prospects*. An appropriate ‘own-rate’ (see Runde, 1994, pp. 134-5), or discount rate,<sup>84</sup> is then applied to account for the time-value of money and the projected risk and for the final assessment of *value*.

The value investing approach thus, implicitly builds upon an ‘antifragility’ principle similar to the one suggested by Taleb (2012, p. 310), who, with reference to Ovid’s *tempus edax rerum* (‘time devours everything’; *Metamorphoses*, 15, 234-236), argues that ‘fragile’ aspects of (economic) reality will fall victim to time much sooner than ‘antifragile’ ones will; or, to put it differently, things with a longer history are more likely to outlive those with a shorter one.<sup>85</sup> This is called the *Lindy effect*,<sup>86</sup> which Taleb (2018) describes as “one of the most useful, robust, and universal heuristics [...] [he] know[s]” (p. 141). This provides support for the thesis that a certain form of ‘survival logic’ underlies Graham’s and Dodd’s (1934) *Value Investing* framework. Indeed, summarizing the core principles of his own (mature) investment approach, Keynes writes:

“My ultimate purpose is to buy securities where I am satisfied as to assets and ultimate earning power and where the market price seems cheap in relation to

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<sup>84</sup> The ‘discount rate’ constitutes the ‘probability component’ in Keynes’s theory of asset choice, while the *margin of safety*, constitutes, together with the *liquidity premium*, the ‘extrinsic uncertainty’ component in that framework (see Runde, 1994, p. 135).

<sup>85</sup> For example, the likelihood of Coca Cola Inc still operating in 2050 is significantly higher than that of Ryanair.

<sup>86</sup> See also Eliazar (2017).

these. If I succeed in this, I shall simultaneously have achieved *safety-first* and capital profits. All stocks and shares go up and down so violently that a *safety-first* policy is practically certain, if it is successful, to result in capital profits. For when the safety, excellence and cheapness of share is generally realised, its price is bound to go up.” (Keynes, 1983, pp. 81-2; *italics* added)

There are, however, far more important insights to be gained from the *Value Investing* framework with regard to certain key aspects of the cognitive processes at work in these markets than the ones hitherto expounded. In this regard, and as a necessary preliminary, it needs to be highlighted that, because the factor of *fundamental uncertainty* makes any attempt to accurately time significant turning points in financial markets – as required, for instance, by Keynes’ original ‘credit cycling’ approach – a virtually impossible one, trades, according to Graham’s and Dodd’s (1934) (and presumably also Keynes’) investing account are to be *priced* and not *timed*.<sup>87</sup> The investor is thus actively discouraged from engaging in any futile attempts to gauge the future behaviour of his fellow market participants (i.e., effectively Keynes’s, 1936, *Beauty Contest*), which, for all practical means, can only ever be achieved by the use of ‘behaviourist’ style approaches (i.e. the analysis of *overt* behaviour) such as the analysis of price and trading data (which constitutes the most accessible form of insight into other investors’ behaviour, particularly as the individual agent in the market is concerned)<sup>88</sup> and related correlates, i.e. methods that Keynes (2013) and others have found to be of questionable value. A far more sensible approach, so the *Value Investing* approach suggests, is, instead of trying to gauge one’s fellow market participants’ future behaviour, to aim at producing the most accurate *value* estimate of the underlying economic entity as possible, applying the steps outlined above, and subsequently compare it to the respective security’s current price in the market.<sup>89</sup> What this effectively means – and this will become much clearer through the detailed exposition in Section 4 – is that the investor *compares* her *assessment* as to the prospects of a certain economic entity (e.g., a particular firm) against the *view* held by the general ‘market’ (i.e. the currently dominant consensus in the investment community. If she deems her view more accurate – for instance, because she thinks to have detected a certain flaw in the ‘market’s’ prevailing ‘hypothesis’ – she will act (i.e., trade) accordingly. If her judgment is vindicated, she will end-up on the winning side of the transaction. Indeed, in his discussion of the role that

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<sup>87</sup> Of course, there is always a certain element of ‘timing’ to any investment decision. The reason for stressing the primacy of the *pricing* over the *timing* element is, on the one hand, the former’s predominant role within the *Value Investing* decision framework and, on the other, and more importantly, the fact that it (implicitly) builds upon a central cognitive aspect that underlies the operation of these markets that has, to the author’s knowledge, never been explicitly discussed in the finance literature, where superior views are usually only attributed to the access to a superior data-set.

<sup>88</sup> One might suggest alternative approaches such as *sentiment analysis* based on media reports, social media, etc. The inferences drawn from such sources are highly questionable, though.

<sup>89</sup> These matters shall be discussed in much greater detail in Section 4.

George Soros' early experiences as a refugee might have played in his later success as an investor, the neuroscientist John Skoyles (2015) speculates, using Adelson's (1995) 'Checker Shadow Illusion' as an illustrative example, that one's success in the financial markets might ultimately depend upon such an ability to detect distortions in the perception of reality in others, while "keeping [...] [one's] own perception free of bias" (*ibid.*). A more elaborate discussion will follow in Section 4. Nonetheless, this brief outline has already touched upon some of the central insights the *Value Investing* framework can contribute to our general understanding of cognitive processes in financial markets. The remainder of this thesis shall build and expand on this kernel. The subsequent section will make the start by elaborating on the '*multi-dimensional*' aspect of reality that the investor faces in an actual market setting. In contrast to the neo-classical agent, who only deals with 'bits' of abstract information, i.e. 'raw data' stripped of all syntactic and semantic content and all relational variables among data, which can readily be processed by means of the (S)EUT calculus, the value investor is usually confronted with a myriad of – often 'fuzzy' – data sets of a heterogeneous type, which can give rise to a myriad of – sometimes conflicting – interpretations. Considering that the value investor's success critically depends upon the formation of a superior *view* of the (relevant aspect) of the underlying economic reality, one comes to realize the significance of getting the tasks of *selection* and *interpretation* right.

The topic of the formation of subjective *views* (i.e., 'cognitive models') as well as its relevance to the systematic understanding of price-formation processes and -phenomena shall subsequently be further developed in Section 4.

### **3. 'Multidimensionality' and Investor Cognition**

This section shall explicate the 'multidimensional' aspect of economic reality as well as its relevance to the understanding of (some of) the core cognitive aspects involved in the investor's expectation formation processes, particularly as far as they pertain to the construction of *interpretations*.

In contrast to the neo-classical finance agent, who seemingly effortlessly separates *relevant* from *irrelevant* information and who equally effortlessly extracts all *factual* content from the former – albeit no explanatory account as to how precisely the agent accomplishes this feat is given – before processing these *facts* in a computer-like manner, the individual presumed by the *Value Investing* framework, who has to face the given ontological and epistemological challenges with her (relatively)<sup>90</sup> limited abilities, must expend considerable cognitive efforts in order to, first, *search for* a data-set that she deems potentially valuable for her decision-task;

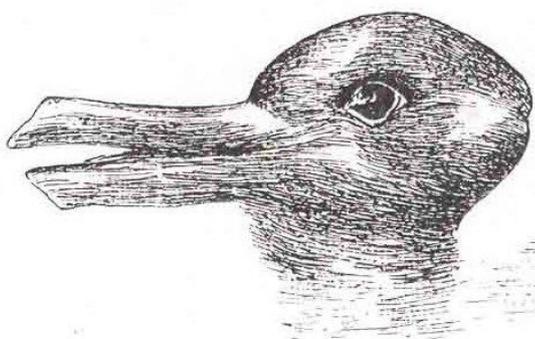
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<sup>90</sup> 'relatively' to the neo-classical 'ideal'.

secondly, *assess* the (degree of) relevance of a certain given data-set; thirdly, *decide* how to *interpret* that particular information (i.e., assigning different ‘weights’ to different aspects of it, etc.); fourthly, *conjecture* how the various inputs carried over from the previous steps are to be combined into a sensible hypothesis, which will constitute the basis for any investment decision-action; fifthly, *determine* how to ‘collapse’ the hypothesis into a *value*-figure; and sixthly, *decide* whether and when to *act* (i.e., buy, sell, etc.).

In this section, we shall focus on the ontological aspect of economic reality that has arguably the greatest bearing on the *interpretative* step, i.e. its *multi-dimensionality*, whereby the latter might be illustrated with reference to the ‘*duck-rabbit*’ illusion (Fig. 3), originally noted by the American psychologist Joseph Jastrow (1899, 1900), immortalized by Wittgenstein (1953, Part II, §xi, fn.1) in his *Philosophical Investigation*, and subsequently applied by Kuhn (1962) in his historical-philosophical inquiry into scientific paradigms and revolutions. The present work’s use of the illusion resembles Kuhn’s (1962), with the core difference being, of course, the subject of inquiry, which shall not be scientific enterprise but rather a particular ontological aspect of financial market reality that poses a particular set of *cognitive challenges* to the investor’s ‘decision apparatus’.

**Figure 3:** ‘Duck-Rabbit’ Illusion



Wittgenstein (1953) argues that “we can [...] *see* the illustration now as one thing now as another. – So we interpret it, and *see* it as we *interpret* it.”<sup>91</sup> (Part II, §xi; *italics* in original). Whereas Wittgenstein (1953) applied the figure to his *conceptual* analysis, though, its intended purpose in the present section is to direct the reader’s attention to an ontological aspect of economic reality that is generally neglected in the literature, namely, its ‘multi-dimensional’ nature, *viz.*, the fact that economic reality, or particular aspects of it, can be *seen* differently, depending on the respective (conscious or subconscious) *interpretation* that underlies the latter,

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<sup>91</sup> This comment has been made by Wittgenstein with regard to the first picture depicted in Part II, §xi, though, and not the ‘*duck-rabbit*’.

which, in turn, is determined by the (conscious or subconscious) allotment of and the respective weights of the ‘salience markers’ assigned to the various aspects of the economic ‘object’ under consideration. Relevant examples that expose (irrational) excesses in regard to this cognitive feature could be observed during the dot-com bubble, where the mere addition of an internet-related prefix and/or suffix had been sufficient to significantly increase the market price of a publicly traded company (Cooper *et al.*, 2001). In other cases, the mere similarity of a ticker symbol with that of a dot-com company would suffice to induce investors to (mis-)perceive underlying economic realities (Rasches, 2001).<sup>92</sup>

It is important to note that both, factors *internal* as well as factors *external* to the agent play a significant and interdependent role in this process of assigning ‘salience markers’ to certain aspects of (parts of) economic reality, which, in turn, influence the agent’s *interpretation* of the latter and consequently the way the agent comes to *see* it (i.e., her “cognitive ‘model’”); this, in turn, shapes her expectations and investment ‘hypothesis’, the basis of her eventual decision-action(s). An agent’s professional background, her knowledge, her experience as well as the operation of her biologically-evolved ‘decision apparatus’ more generally, are all important *internal* factors that affect her perception of reality (i.e., her “cognitive ‘model’”). The environment more generally, as well as social influences more specifically, constitute important *external* factors that influence the way the agent comes to *sees* (economic) reality. The latter certainly played an important role in the aforementioned ‘irrationalities’ during the dot-com bubble, but they do so during more moderate market-phases as well. Even an individual’s perception of the ‘*duck-rabbit*’ illustration is not immune to external influences. For instance, it has been found that children tested on Easter Sunday are more likely to see the figure as a rabbit, whereas when tested on a Sunday in October, they tend to see a duck (Brugger and Brugger, 1993; Kihlstrom, 2002). Whereas momentum traders as well as most ‘ordinary’ investors (see, e.g. Keynes, 1936) simply jump on the bandwagon and adopt the respective *interpretations* that happen to be *en vogue*, the value investor, who, after all, preys on the cognitive errors of his fellow market participants, has – and here we need to introduce a further factor (i.e., *consciousness*) that has generally been neglected in the literature, but which is essential for a proper understanding of both the value investor’s investment decision process and the factor of cognition in financial markets more generally – to be *consciously aware* of these factors and influences on both her own “cognitive ‘model’” as well as those of her fellow market participants. The ability to be *consciously aware* of and to constantly scrutinize her own views and their underlying presuppositions as well as those determining prevailing market prices constitutes one of the necessary requirements for investment success according to the *Value Investing* framework and must therefore not be neglected. Of course,

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<sup>92</sup> E.g., the stock of MCI Corporation (ticker symbol: MCIC) moved in tandem with an unrelated closed-end bond investment fund Mass Mutual Corporate Investors (ticker symbol: MCI).

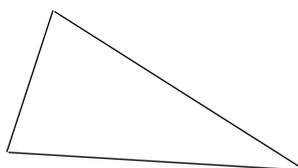
the correct identification of a discrepancy between economic reality and the view(s) that underlie the prevailing market price is, by itself, not sufficient for investment success; the *Value Investor* must also be able to correctly gauge whether and in what way such a discrepancy can be *profitably* exploited.

In the two sub-sections that follow, we shall discuss the factor of *multi-dimensionality* with respect to the two key aspects of any *valuation* task: the general classification of an investment object and the consequent determination of its return potential and valuation parameters (Sect. 3.1), and risk (Sect. 3.2).

### 3.1 Assessment of the Return-and-Valuation Parameter, or: What ‘type’ of company?

Taking the for a practicing (*Value*) investor<sup>93</sup> and author of investment books (e.g., Hagstrom, 2000, 2013) unusual step of using Wittgenstein’s (1958) discussion in regard to the manifold ways a ‘triangle’ (see Figure 4) can be *seen* as a starting point,<sup>94</sup> Hagstrom (2013) draws a striking parallel to the interpretative aspects of the investment-valuation and -decision processes, illustrating it via an example from the realm of equity investing:

**Figure 4:** ‘Triangle’



Source: Wittgenstein (1958, p. 200)

Wittgenstein (1958) writes:

“Take as an example the aspects of a triangle. This triangle can be seen as a triangular hole, as a solid, as a geometrical drawing; as standing on its base, as hanging from its apex; as a mountain, as a wedge, as an arrow or pointer, as an overturned object which is meant to stand on the shorter side on the right angle, as half parallelogram, and as various other things.

‘You can think now of *this* now of *this* as you look at it, can regard it now as *this* now as *this*, and then you will see it now *this* way, ...’” (p. 200; *italics* in original).

After quoting this excerpt from the *Philosophical Investigations*, Hagstrom (2013) raises the

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<sup>93</sup> Robert G. Hagstrom is chief investment strategist and managing director for Legg Mason Investment Counsel.

<sup>94</sup> Part II, §xi, p. 200 of his *Philosophical Investigations*.

question: “How does this relate to investing?” (p. 92), and promptly delivers the corresponding answer himself: “As we will see, stocks have a lot in common with Wittgenstein’s triangle” (*ibid.*), supporting his statement with reference to the interpretative task the investor faces when assessing the equity shares of the online-retailer Amazon.com, which can, depending upon the criteria one applies and the business aspects one allocates the greatest ‘salience weights’ to, be *seen* and evaluated as either a book retailer (e.g., Barnes & Noble), a retailer with a more diversified product portfolio (e.g., Wal-Mart) or a non-Brick-and-Mortar online (tech) retailer such as Dell Inc. (see Hagstrom, 2013, pp. 92-94). The task requires a tremendous judgmental effort as many different aspects of economic reality (e.g., ‘types of product sold’; ‘type of the distribution system’) have to be identified, compared, ranked and weighted, before an interpretation can be formulated, which will be of the utmost importance for the determination of the valuation-multiple as well as any comparative analysis more generally. The outcome of the interpretation will determine the way the particular aspect of economic reality is *seen*, which, in turn will significantly influence the valuation process as well as the respective decision-action: For example, the investor favouring the ‘Wal Mart’ interpretation might judge the market-valuation of Amazon.com to be too high at the prevailing price level and thus decide to sell or, if she does not hold any shares, ‘not to buy’. Another investor might judge the comparison with Dell to be the most appropriate one and deem the equity shares ‘fairly priced’. Yet another investor might come to *see* Amazon.com as resembling more a technology company such as Apple or Google, particularly now as Amazon keeps expanding into other fields such as the Cloud, and therefore deem it ‘under-priced’. The same data can thus lead to a wide variety of (sometimes conflicting) interpretations and consequently different investment/trading decisions.

### 3.2 The ‘Multidimensionality’ of Risk

This subsection shall look at the ‘multidimensionality’ of risk. The general importance of the factor of *risk* for the investment decision process shall be outlined, before the neo-classical ‘one-dimensional’ conception of risk (i.e., primarily conceived as the variability of financial market prices) and its shortcomings shall be expounded and compared to the ‘multidimensional’ alternative conception of the *Value Investing* framework. Subsequently, the relevant cognitive aspects shall be discussed.

The second core aspect of any valuation task (the first one was discussed in the previous subsection) is, as pointed out by McGoun (1995), the assessment of the kind and degree of risk involved in the respective prospective investment asset:

“Economics, finance and accounting are often concerned with value; that is, what something ought to be worth. If that ‘something’ is a financial asset, then its value

depends both on its return (what an investor expects to receive) and its risk (how the return can differ from expectations). Thus, it is important to be able to measure risk because, if we cannot, then for an important class of assets we cannot measure value.” (McGoun, 1995, p. 511)

As shall be expounded in the present sub-section, though, the ‘measurement’ of risk is, due to the ontological and epistemological challenges presented by the fundamental uncertainty that permeates financial markets as well the *multi-dimensionality* of economic reality and risk itself (as well as the nature and operation of the human ‘cognitive apparatus’), far from being the scientific task neo-classical finance claims it to be. Once again, the cognitive factors of, *inter alia*, *perception*, *interpretation*, *judgement* etc. play a central role in the assessment of actual risk, as the mere extrapolation of the respective stock price variance (or std. dev.) is insufficient. Once again, a ‘picture’ in regard to the prospective investment’s *riskiness* has to be formed, which will, together with the ‘pictures’ produced via the steps expounded in Sections 2 and 3.1, be merged into the larger ‘picture’ (i.e., “cognitive ‘model’”) that determines how the investor comes to *perceive* the attractiveness and suitability of the asset, both as a stand-alone investment and/or as part of an investment portfolio. The allotment of the ‘salience markers’ will, once again, determine the way the overall riskiness is interpreted and consequently the way the respective prospective investment is *seen*. The various possible arrangements of the aspects discussed in Section 2, as well the ones expounded in the present section, into one coherent ‘picture’ are (mostly) of a mutually exclusive nature.

The important point to be stressed here is that even if an apparently satisfactory ‘picture’ (i.e., “cognitive ‘model’”) has been formed, this does not preclude the possibility of the existence of a superior one, which approximates the underlying economic reality even better, increasing thereby the likelihood of a successful investment. Indeed, it is – as pointed out repeatedly in the present chapter – the *Value investor’s* core task to search for and identify the faults in the overall ‘picture’ that determines the current market price and to strive to form a superior one, while being constantly aware of her own fallibility and thus on the lookout for faults in her own ‘picture’.

Returning to the core topic of the present sub-section, i.e. the *multi-dimensionality* of ‘risk,’ it first needs to be established, what precisely the term actually refers to. In Chapter 1, it has been argued that, within the neo-classical finance framework, ‘risk’ is defined purely in terms of the statistical variance of the asset’s financial market price. Now, a neo-classical finance advocate would be quick to counter that such a representation significantly oversimplifies the neo-classical position, while failing to highlight the seminal contributions the research program has made to our understanding of ‘risk’ within the financial market context. After all, was it not the CAPM that bestowed upon us the vital distinction between *systematic*, i.e. non-

diversifiable, and *idiosyncratic*, i.e. diversifiable, risk? Further, she would point out that several of the issues raised by critics of the CAPM (e.g., Klarman, 1991; Klarman and Williams, 1991; Montier, 2009a) have been remedied by more advanced versions of the model or alternatives to it such as Ross's (1976) Arbitrage Pricing Theory (APT) and Fama and French's (1993) Three-Factor-Model, which explicitly allow for other 'risk' factors such as firm size and the pricing level.

Nevertheless, such a defence would fail to rebut the core criticism raised by the current thesis, because at its core, it would fail to recognize, understand and properly address the issue that lies at the very heart of this type of criticism, namely the one of *dimensionality*. The entire neo-classical finance research program has – as expounded in Chapter 1 – been developed around the probability calculus and the statistical properties of the ('one-dimensional') observed price level variations: i.e., all key inputs for the investment decision process such as *expected return* and *risk* are extracted from historical price data via the standard statistical toolbox with its Gaussian distributions, their first raw moment (mean) and second central moment (variance), as well as correlation coefficients, before being processed in the respective mathematical-statistical models that are assumed to provide the 'optimal' output, either in terms of price (e.g., CAPM, APT, Black-Scholes) or asset allocation (e.g., MPT). The entire approach is thus, at its very core, susceptible to Taleb's (2005, 2007, 2009a, 2009b, 2010, 2012; and Goldstein, 2012; and Douady, 2013) criticism. Any of the neo-classical insights in regard to 'risk' referred to by our hypothetical neo-classical finance proponent in her defence of the framework are thus limited to this 'one-dimensional' level. What she fails to realize is that this particular conception of 'risk' ultimately leads to the adoption of a dangerously narrow, limited and superficial view on this core aspect of (economic) reality; one is reminded of Russell's (1912) chicken.<sup>95</sup>

“The man who has fed the chicken every day throughout its life at last wrings its neck instead, showing that more refined views as to the uniformity of nature would have been useful to the chicken.

But in spite of the misleadingness of such expectations [of uniformity], they nevertheless exist. The mere fact that something has happened a certain number of times causes animals and men to expect that it will happen again. Thus our instincts certainly cause us to believe that the sun will rise to-morrow, but we may be in no better a position than the chicken which unexpectedly has its neck wrung. We have therefore to distinguish the fact that past uniformities *cause* expectations as to the future, from the question whether there is any reasonable ground for

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<sup>95</sup> Bertrand Russell invokes this example to illustrate the *problem of induction*.

giving weight to such expectations after the question of their validity has been raised.” (Russell, 2001, p. 35; *italics* in original)

Spitznagel (2012)<sup>96</sup> identifies in Russell’s ‘uniformity of nature’ a “notion [...] [that – when applied to the field of finance –] is reminiscent of the *neoclassical general equilibrium* concept of economics,” conjecturing that it is “perhaps this methodology [that] is also the very source of perceiving stock market tails [and thus significant losses on the portfolio level] as just ‘bad luck’” (p. 3); a view that is supported by the aforementioned fact that neo-classical finance theory relies exclusively on a certain type of the probability calculus that rates the occurrence of more extreme price movements – which nevertheless seem to have a tendency to befall real financial market relatively frequently – as virtually impossible: the 22.61% drop of the Dow Jones Industrial Index on ‘Black Monday’ in 1987 would be classified as a 20.98 sigma event,<sup>97</sup> the 19% jump in the Swiss Franc against the Euro after the Swiss National Bank had announced the end of the currency cap in 2015 as a 180 sigma event,<sup>98</sup> and the 8.1% drop of the Pound Sterling after the Brexit vote in 2016 as a 15 sigma event. Considering the – from a neo-classical perspective – extreme improbability of any of these or similar market events occurring within a human lifespan, what else could a financial market participant caught on the wrong side of the trade during one of these episodes be described as than ‘unlucky’? This characterisation reveals, however, a fundamental difference between the chicken in Russell’s (2001) parable and the individual perceiving the financial markets through neo-classical spectacles: Whereas the former bases both his understanding of the world and its “expectation as to the future” on “past uniformities,” the latter’s are not “*cause[d]*” by such “past uniformities,” but rather independently (based on the probability calculus) formed and super-imposed onto reality (at least in the neo-classical perception of it), even though they clearly contradict experience; this constituting part of the core criticism raised by, among others, Taleb (2005, 2007, 2009a, 2009b, 2010, 2012; and Goldstein, 2012; and Douady, 2013), Austrians (Spitznagel, 2012) as well as *Value investors* (Graham, 1973; Klarman, 1991; Klarman and Williams, 1991) against the neo-classical conception of and approach to ‘risk.’ To sum up with reference to Russell’s (2001) parable above, in neo-classical finance, “past uniformities” have, in contrast to Russell’s chicken, neither “*cause[d]* expectations as to the future” – quite to the contrary, in fact, as there seems to be a general tendency to ignore the lessons taught by actual experiences in the markets, as those incidents that happen to be incongruent with the core tenets of the neo-classical framework often are simply explained away *a posteriori* (Taleb, 2010) –, nor does there seem to exist “any reasonable ground for giving weight to such

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<sup>96</sup> An investment practitioner and adherent of the Austrian School of Economic thought.

<sup>97</sup> See <https://blogs.cfainstitute.org/investor/2012/08/27/fact-file-sp-500s-sigma-events/>

<sup>98</sup> See <https://www.bloomberg.com/view/articles/2015-01-16/no-one-was-supposed-to-lose-this-much-money-on-swiss-francs>

expectations,” as these are simply the result of a theoretical framework that is at odds with empirical evidence. Why then, do neo-classical finance advocates do so anyway and why do they continue using this approach to ‘risk’? A possible answer to this question might be found in Spitznagel’s (2012) observed “cached and envy of science and mathematics within economics and finance” (p. 3). After all, Russell (2001) points out that

“[t]he business of science is to find uniformities, such as the law of motion and the law of gravitation, to which, so far as our experience extends, there are no exceptions. In this search science has been remarkably successful, and it may be conceded that such uniformities have held hitherto.” (Russell, 2001, p. 35)

Although no such aspiration can be found in the field’s early humble foray into the topic of ‘risk’,<sup>99</sup> which, indeed, was considered to be more an exercise in “sharpen[ing] intuition or to make heuristics” – both of which play a central role in day-to-day financial market decision-making – than anything else, or, at best, a *normative* suggestion as how to approach the topic in an ideal world (McGoun, 1995, p. 514), in the wake of the increasing mathematization of the field of economics in the post-World War II era (see Giocoli, 2003), a dangerously distorted manifestation of the research program did appear, one which, instead of aspiring to “*find* [any] uniformities” (*italics* added), came to superimpose them onto reality – in clear violation of the available empirical evidence as well as the profession’s earlier held views in the 1920s (see McGoun, 1995) – in its desperate attempt to turn the study of ‘risk’ into a *positive* science (McGoun, 1995).

It was Arrow’s (1951) seminal paper on ‘choice under uncertainty’ that would toll the final death knell for the Knightian (1921) and Keynesian (see Sect. 2) type(s) of uncertainty (McGoun, 1995), whose existence, or at least relevance, he denied – most likely for the reason conjectured by McGoun (1995), namely, “in order to preserve the possibility of a ‘scientific’ theory” of risk’ (p. 528) – and which he came to replace by a *probabilistic* conception of it.

It is also testament to (if not even perpetrator of) the intellectual ‘short-cuts’ and logical inconsistencies that came to infiltrate the neo-classical thinking about the topic of ‘risk’ in financial markets: Most pertinently, his classification system of “economic phenomena which have in some way been tied up with the existence of uncertainty” (Arrow, 1951, p. 406) distinguishes between three classes, whereby ‘variations in the rate of return on securities,’ i.e. Class 2, are considered a distinct type from ‘casino-type gambles and insurance,’ – i.e. “those [economic phenomena] which by their very definition are concerned with [probabilistic]”<sup>100</sup>

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<sup>99</sup> Edgeworth (1888), one of the pioneers in this field, cautioned that “[t]he theorist must not pretend to wisdom, if he knows so little what he is about, as to mistake his abstract formulae for rules immediately applicable to practice” (p. 127; quote taken from McGoun, 1995, p. 514).

<sup>100</sup> i.e., Arrow’s (1951) type of ‘uncertainty,’ see main text above.

uncertainty” (Arrow, 1951, p. 407) and where the probability calculus applies for the determination of ‘risk,’ i.e. Class 1, – as Arrow (1951) defines them as economic phenomena “which are not related to uncertainty by definition but nevertheless have no other conceivable explanation” (*ibid.*). So, it apparently not being an ‘analytic’ truth in Arrow’s (1951) view, he nevertheless seems to make no effort to inquire deeper into the ‘empirical’ aspect of the phenomenon – i.e. the other side of the logical positivist medal of inquiry –, simply inferring from the apparent lack of “[an]other conceivable explanation” that his probabilistic conception of uncertainty pertains, or, rather, *has* to pertain if any ‘positive science’ – at least the neo-classical economics’ variant of it – was ever to be aspired to. Within the same classification system, though, Arrow (1951) concedes that ‘business- and profit-risk’, i.e. Class 3, belong to “those [economic phenomena] whose relation to uncertainty is more remote and disputable” (*ibid.*), making the applicability of the probability calculus, arguably, more dubious. For what reason, though, should Arrow’s (1951) probabilistic conception of uncertainty be ‘more’ applicable to the ‘variations in the rate of return on securities’ than to ‘business- and profit risk’? Is the latter Class subject to any confounding factors that the former isn’t? Although an exhaustive discussion of the matter with regard to all types of securities is beyond the scope of the present thesis, at least for plain-vanilla equity securities, i.e. ‘stocks,’ – which require some brief consideration here, because they constitute the asset class, which underlies the core developments in both the *Value Investing* framework (e.g., Graham and Dodd, 1934; Graham, 1973; Greenwald *et al.*, 2004) and neo-classical finance (see Chap. 1), in addition to being of the greatest relevance to the Austrian School of Economic thought and its capital-theory (e.g., Rothbard, 1963; Spitznagel, 2012) – it can be concluded that this is not the case: First of all, it is important to remember that a ‘stock’ represents a title to the profits, or rather the dividends, of a company (Williams, 1938). An entrepreneur, who owns 100% of his business holds 100% of all its (illiquid) ‘stocks.’<sup>101</sup> Any ‘risk’ that arises through the ownership of these securities is thus the ‘business- and profit-risk’ of that particular business, i.e. the ‘risk’ that that the business’s profits and consequently dividends turn out to be lower than expected, whereby these profits are subject to Knight’s (1921) fundamental uncertainty, the existence or relevance of which Arrow (1951) denies. The same applies on the aggregate level, where the ‘risk’ of holding the entirety of all equity shares in an economy is equal to the ‘business- and profit risk’ of the entirety of these businesses, *viz*, what neo-classical finance would define as *systematic*, i.e. undiversifiable risk. So, why is ‘profit- and business-risk’s’ “relation to [Arrow’s (1951) type of] uncertainty [...] more remote and disputable” than that of ‘variations in security returns’? It is true that there are liquidity and diversification benefits that reduce the individual investor’s ‘risk,’ when, respectively, she shifts from holding illiquid securities (as in our

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<sup>101</sup> This simple representation ignores, of course, the legal nuances in regard to a business’ legal- and ownership structure.

example of the entrepreneur) to holding ‘floated’ ones, and from holding shares in a single company to holding a portfolio of a number of different companies, but on the aggregate level these disappear, as there exists no *liquidity* for the community as a whole (Keynes, 1936, pp. 152-3) and because on the level of the ‘market portfolio’ no further diversification benefits can be attained. Besides, the diversification benefits themselves result from the fact that the profits and cash-flows of different businesses – which, in the end, are nothing else but *loci* of cash-in and -outflows – are imperfectly correlated with each other; what a portfolio of equity investment thus ultimately diversifies is the varying ‘business- and profit-risk’ that affects the cash-flows of the respective businesses and ultimately the dividend payments (or the modern equivalent, ‘share-buy-backs’) to the shareholders. Thus, from the very nature of equity securities (i.e., ‘stocks’) it logically follows that Knightian (1921) uncertainty affects the latter to the same degree as it does ‘business profits’. Whether the probability calculus is more applicable to the former than the latter remains thus doubtful, particularly as the ‘liquidity’ aspect that might give raise to the aforementioned argument that security investment are of a lower degree of ‘risk,’ as the individual investor can always – at least theoretically, if not everyone else decides to do so at the same time – revise his decision, does not lend itself easily to mathematical modelling (Derman, 2011). The ‘cognitive’ aspect, particularly as far as it relates to *expectations* and ‘conventions,’ certainly plays a key role in the phenomenon of ‘liquidity’ and its cessation, as the ‘liquid’ state of the markets only prevails as long as the majority of financial market participants *expects* the current ‘conventions’ and market ‘liquidity’ to prevail in the foreseeable future – introducing thus an additional layer of uncertainty that certainly contributes to the challenges that financial modellers face. In any case, empirical evidence has shown that the relative frequency theory of probability is inadequate for the determination of ‘risk’ involved in financial securities’ returns (Mandelbrot, 1963, 1997; Mandelbrot and Hudson, 2005; Taleb, 2005, 2007, 2009a, 2009b, 2010, 2012; and Goldstein, 2012; and Douady, 2013), and also the subjective theory of probability might ultimately be inapplicable to security prices, particularly because of the ‘liquidity’ aspect involved (Runde, 1995).

Mainstream economics’ elusive quest for a ‘*positive science*’ – that is, ‘science’ as mainstream economics had come to understand the concept (see, e.g., Giocoli, 2003; Fine and Milonakis, 2009) – from the 1930s onwards (McGoun, 1995), led to a radical U-turn in its understanding of and approach to ‘risk,’ depriving the field thereby of “more refined views” as to the true nature of ‘risk’ in economics in general and financial markets in particular, which resulted in the development of inadequate risk management tools that have increasingly contributed – particularly through a process that MacKenzie (2006) has dubbed ‘Performativity’ – to the *fragilization* of financial markets.

The mainstream's particular 'scientific' approach to 'risk' would, however, also have a significant influence on the discipline's conception of the individual and her (cognitive) decision-processes: If all economic situations, including those traditionally conceived to be subject to Knight's (1921) *fundamental* uncertainty, were re-stateable and analysable in probabilistic terms (see, e.g., Hirshleifer and Riley, 1992), then the assumption of the decision-maker as a neo-classical type (see Chap. 1) would suddenly seem reasonable. Indeed, Arrow (1951) goes to great length to try to convince the reader that the 'businessman' bears greater resemblance to the – presumably Wald (1950) – 'statistician' than to the 'scientist'; once again, not because this insight constituted one of the "uniformities" uncovered by Arrow (1951) in a study of actual businessmen, but rather on the ground that a resemblance of the latter "would force[...] [us] to the melancholy conclusion that little of a systematic nature can be said about the former's decision-making processes" (p. 409). As expounded in Chapter 1, this conception of the economic decision-maker came to dominate mainstream economics and neo-classical finance, particularly through the work of Leonard Savage (1954, 1962), who further developed Wald's (1950) original project (see Giocoli, 2013).

In contrast to the neo-classical ('one-dimensional') conception of risk, the *Value Investing* framework embraced its *multi-dimensional* nature (see Graham, 1973; Graham and Dodd, 1934; Klarman and Williams (1991). Indeed, Montier (2009b; see also 2009a) considers it to constitute "the only investment approach (of which [...] [he is] aware) that truly puts risk management at the very heart of the process" (p. 1). He briefly explicates the core aspects of its conception of 'risk' as follows:<sup>102</sup>

"Despite risk appearing to be one of finance's favourite four letter words, it remains finance's most misunderstood concept. Risk isn't a number, it is a concept or a notion. From my perspective, risk equates to what Ben Graham called a 'permanent loss of capital'. Three primary (although interrelated) sources of such danger can be identified: valuation risk, business/earnings risk, and balance sheet/ financial risk. Rather than running around obsessing on the pseudoscience of risk management, investors should concentrate on understanding the nature of this trinity of risks." (Montier, 2009b, p. 1)

The individual components of this 'trinity of risk' are defined as follows:

- (a) *Valuation risk*: Paying a higher price for an investment than the estimated *intrinsic value* (+ *margin of safety*; see Sect. 1) would justify.
- (b) *Business/earnings risk*: The risk that the underlying business permanently loses its

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<sup>102</sup> Based on Benjamin Graham's work.

‘earnings power;’ as Graham put it: “Real investment risk is measured not by the percent that a stock may decline in price in relation to the general market in a given period, but by the danger of a loss of quality and earnings power through economic changes or deterioration in management.” (quoted in Montier, 2009b, p. 4)

(c) *Balance sheet/ financial risk*: The risk of insolvency and bankruptcy.

This ‘trinity’ does, of course, not exhaust the entire spectrum of possible risks; for example, it might be the case that a company is *solvent* but not *liquid*.

Further, the differences in the nature of the respective investment types give rise to different types of risk, with some of them manifesting themselves only in particular market environments or over certain time horizons. Let’s take the case of a common stock *vs.* a bond investment: According to the standard neo-classical conception of ‘risk,’ equities are considered categorically riskier than bonds, because stock-prices have historically been more volatile than bond-prices. Now, although such ‘volatility risk’ might be highly relevant for someone with a short investment-horizon, after which she intends to commit her capital to a pre-specified purpose (e.g., paying for her children’s university education), it is of lesser relevance for a long-term saver (e.g., pension-saving programs), particularly as equities have always outperformed bonds over the long-run. Thus, while a bond-investment with fixed coupons and a fixed time to maturity might be less ‘risky’ (i.e., have a lower volatility) in the short-run, it might not be so in the long run (i.e., inflation-risk; high opportunity costs).

Keynes (2013) raised the issue with regard to common stock *vs.* bonds in his review of Smith’s (1925) influential book on (U.S.) common stock investments, who had found that “in almost every case (in ten tests out of eleven), not only when prices were rising, but also when they were falling, that common stocks have turned out best in the long run, indeed, markedly so” (Keynes, 2013, p. 247). Inquiring into the possible underlying economic reasons for this observation, Keynes finds that:

(1) Bond investments are more susceptible to currency depreciation (i.e., inflation) because they constitute “investment[s] in money values,” whereas equities constitute “investment[s] in real values” (*ibid.*, p. 248).

(2) The upside potential of bonds is, unlike that of common stocks, limited, as “no bond ever pays *more* than the stipulated rate of interest [...] [.] [t]hus there can be no exceptional success to average out with exceptional failures” (*ibid.*, p. 249; *italics* in original). Thus, whereas “[t]he purchaser of a selection of common stocks can afford to make an occasional mistake; the purchaser of a bond cannot” (*ibid.*).

(3) The “human factor” is negatively biased against bond-investments, as “[t]he management

of every company is on the side of the common stock holder and opposed to the interest of the bondholders” (Smith, 1925, p. 85; quoted in Keynes, 2013, p. 249), [i]n particular, the management will avail themselves of their rights to repay bonds at dates most advantageous to the shareholders and most disadvantageous to the bondholders” (Keynes, 2013, p. 249).

(4) “In buying bonds, the investor agrees that the issuing companies may retain all earnings over and above the income return which he has agreed to accept. He establishes no reserves of his own and relinquishes all title to the reserves that are established for him. Such reserves, while protecting his income, accrue to the benefit of stockholders of the companies whose bonds he holds.” (Smith, 1925, p. 114-15; quoted in Keynes, 2013, p. 249).

(5) The internal “*element of compound interest*,” as businesses often “retain a part of their profits and put them back into business,” which translates into an appreciation of “the real value of the property of a sound industrial [...] at compound interest, quite apart from the dividends paid out to the shareholders” (Keynes, 2013, p. 250; *italics* in original).

Keynes thus concludes that “whilst an index of bond yields, as we have seen [see (2)], *less* in the long run than its initial apparent rate of interest, and index of shares yields *more* in the long run than its initial apparent rate of interest” (*ibid.*).

So, while proponents of neo-classical finance will argue that common stocks yield higher returns over the long-run because of the greater price volatility, a “more refined view[...]” actually shows that a portfolio of equities is actually less risky over the long-run than a bond portfolio, as the underlying economics operate in favour of the former, but to the disadvantage of the latter.

The discussion in this subsection has hitherto provided a valuable exposition of some of the core aspects of *risk* in financial markets. If one couples those with our earlier insights in regard to the (likely) open-system nature of financial markets, ‘fundamental uncertainty’, the individual’s limited cognitive processing power and the ‘multi-dimensionality’ of information in these environments, the question as to the *visibility* of ‘risk’ naturally arises. This issue shall be reflected upon in the following discussion.

### 3.2.1 The ‘(In)Visibility’ of Risk

The issue of the ‘(in)visibility’ of risk can most vividly be illustrated with reference to Spitznagel’s (2012) discussion of “tail-,” or *Black Swan* events (see Taleb, 2010). Invoking the parable of a turkey on the eve of Thanksgiving (i.e., a slight modification of Russell’s chicken parable), Taleb (2010) stresses that the finance community had entirely been caught off guard by the events that began to unfold in 2008, as the ‘risk’ that had been building up within the

system (but beneath the ‘surface’) over the preceding years had been entirely ‘invisible’ to the statistical methods employed by the profession. Spitznagel (2012) largely agrees with Taleb’s (2010) critical assessment of neo-classical economics (and finance) but questions whether the Crisis had truly been unpredictable in nature, i.e. whether it has accurately been labelled as a ‘Black Swan event’ or not. Spitznagel (2012) holds that the crisis had, in fact, been predictable, but that it was *invisible* to the larger finance community because they *misperceived* financial market reality: “[P]erhaps this methodology is also the very source of perceiving stock market tails as just ‘bad luck’” (Spitznagel, 2012, p. 3). The Crisis, Spitznagel (2012), was eventually to be expected if one had observed the market through the spectacles of an Austrian economist:

“Aggregate, correlated economic loss – the correlated entrepreneurial errors in the eyes of the Austrians – is not a random event, not bad luck, and not a tail. Rather, it is the result of distortions and imbalances [due to the monetary expansion] in the aggregate capital structure which are untenable. When it comes to an end, by necessity, it does so ferociously due to the surprise by entrepreneurs across the economy as they discover that they have all committed investment errors. Rather than serving their homeostatic function of correcting market maladjustments back to the ERE, [<sup>103</sup>] the market adjusts itself abruptly when they all liquidate.” (Spitznagel, 2012, p. 6)

He concludes:

“From my view, empirically and from an *a priori* Austrian interpretation, black swan events have been largely insignificant in the last century of capital investment in the U.S., including the current crisis. Investors have indeed encountered surprising and pernicious events, but the fact is those who were surprised have essentially been those (in the extreme majority) with a brazen disregard for the central concepts of Austrian capital theory and monetary credit expansion; that is, capital goods and the time structure of production.” (*ibid.*, pp. 11-12)

Hence, Spitznagel’s (2012) argument rises the important issue as to the possibility that there *might* exist certain manifestations of ‘risk’ that could be *perceivable* to some (groups of) ‘market participants’ but not others.<sup>104</sup> As the ontological and epistemological matters pertaining to the respective type of risk do, by their nature, not differ between different ‘market

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<sup>103</sup> ERE = Evenly Rotating Economy. See Rothbard (1962) and Spitznagel (2012) for a definition.

<sup>104</sup> It is important to emphasise that in the present discussion we are neither endorsing nor rejecting the Austrian position on that matter. The sole purpose of presenting Spitznagel’s (2012) view is to highlight the possibility that *risks* might be perceivable to different (groups of) ‘market participants’ to differing degrees.

participants’, the reason for the varying degree of ‘*visibility*’ is most likely to be found on the level of cognition (in the broadest sense of the term). The investor who succeeds in forming the most accurate and least biased view with regard to economic reality might thus be able to reap extraordinary profits from the ‘blind spots’ of her fellow ‘market participants’.<sup>105</sup> Spitznagel (2012),<sup>106</sup> who himself is an investor, argues:

“To me, this apparent intellectual nitpicking over the distinction between what is a tail and what isn’t a tail is rather important. In fact, the black swan notion is paramount – in perception. If the market perceives (or rather prices) a large loss in the stock market as a tail event even when such a perception (and pricing) is unwarranted, obviously tremendous opportunity exists – even if only to protect a portfolio against such deleterious losses.” (p. 10)

Adding that

“this is not simply a doom and gloom approach. It is just as likely to be a tremendously opportunistic approach – specifically when malinvestment is being liquidated and the Q<sup>[107]</sup> becomes lower. Capital is not destroyed, but rather title just changes hands at more advantageous prices to the buyer.” (*ibid.*, fn. 22)

Here we are right at the core of the *Value Investing* framework’s understanding as to how financial markets operate and how one’s fellow market participants’ *cognitive errors* – manifest in the form of significant ‘mis-pricing’ – might be exploited to one’s financial advantage, i.e. via the purchase of under- and/or sale of over-priced securities.

These considerations render it advisable to take a closer look at some of the *cognitive* matters involved. This shall be the task of the following part, which concludes the present section and provides the preliminary to the subsequent one.

### 3.3 Value Investing, ‘Multidimensionality’ and Investor Cognition

This subsection shall explore some of the core aspects of *cognition* as they relate to the overall

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<sup>105</sup> Particularly if one takes a (cognitive) ‘model-realist’ view.

<sup>106</sup> See also Spitznagel (2013).

<sup>107</sup> As Spitznagel (2012) specifies, “[t]his is related to Tobin’s Q of James Tobin [1969], which is the ratio of aggregate enterprise value (equity plus debt) to the aggregate corporate assets or invested capital; I am using the equity Q ratio\* in this paper, which is just total equity over the net worth of the firm – where total assets are netted against total debt, so with no debt the net worth is the invested capital.” (fn. 14)

$$*Q \approx \frac{\text{Value}}{\text{Invested Capital}} = \frac{\text{ROIC} - g}{\text{WACC} - g}$$

where, ROIC = Return on Invested Capital, WACC = Weighted Average Cost of Capital, g = Growth rate. See Spitznagel (2011).

*Value Investing* framework and the ‘multidimensionality’ of information in financial markets.

It is important to understand that *Value Investors*, just like Post-Keynesian scholar, conceptualize financial market prices as *psychological constructs* (see Sect. 4). As already outlined above, investors are assumed to form (subjective) “cognitive ‘models’” with regard to (a particular aspect of) economic reality, this constituting the basis for the formulation of their *expectations* and, consequently, *investment hypotheses*, which, in turn, direct their trading decisions. The trading activity itself feeds the individual investor’s *expectations* into the financial market price of the respective security. For this reason, it might be argued, that the financial market resembles a type of mirror (with a bias toward the future) that reflects economic reality as *perceived* through the filter of the ‘cognitive apparatuses’ of millions of *interacting* market participants, ‘collapsed’ into the one-dimensional price-level.<sup>108</sup> In contrast to the neo-classical one, the ‘mirror’ presumed by the *Value Investing* framework is far from perfect, though. The occurrence of collective (cognitive) errors can thus lead to a serious distortion in the ‘picture’ of economic reality as projected by financial markets, which, in turn, can lead to an intensification of cognitive errors (see Soros, 1994) and consequently to erroneous decisions by economic agents. Such developments might create profitable trading opportunities for investors, but they can also cause economic havoc if the larger investment community (as well as policy makers) are ignorant of certain serious issues, such as the build-up of unsustainable systemic risk pre-2008.

Such phenomena, known as ‘Blind Spots’ in the literature (Rapp and Cortés, 2017), cannot be accounted for within the dominant neo-classical framework, nor can the related phenomena of ‘Sudden Deaths’ (Rapp, 2009; Rapp and Cortés, 2017), i.e. the sudden realization of the presence of such ‘Blind Spots’ which leads to (major) correction in beliefs and expectations across market participants and consequently in market prices. A theoretical framework of financial markets that does explicitly account for the underlying cognitive processes might, however, be capable of providing some plausible account of them: Once the various market participants’ “cognitive ‘models’” begin to converge, ‘Blind Spots’ are likely to develop as the degree of heterogeneity of ‘views’ begins to decrease. Once the presence of such ‘Blind Spots’ is recognized then, depending upon their *perceived* significance, the existing “cognitive ‘models’” either have to be significantly updated, or they break down all-together. During the period where the ‘cognitive apparatus’ struggles for the creation of a new “cognitive ‘model’” that provides her with the required framework to coordinate her actions ‘rationally’ in light of her realization of the untenability of her understanding of reality, the cognitive default mode of ‘fight or flight’ is likely to be active, which, in financial markets, usually translates into ‘panic sales’. Perceptive investors such as Burry (2010), who are able to *see* the ‘Blind Spot’

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<sup>108</sup> Due to the process of *financialisation*, an ever-greater part of reality is reflected in that mirror.

before others,<sup>109</sup> might be able to exploit such insights to their financial advantage.

It is, of course, precisely this feat that the value investor endeavours to accomplish. For a full comprehension of the *Value Investing* framework's conception of the operation of financial markets, it is thus imperative to gain a sound understanding of the *cognitive* processes that are implicitly at work in suchly conceived markets and, consequently, of the operation of the (embedded) *human*<sup>110</sup> 'cognitive apparatus'. At this preliminary stage, it is only possible to delineate some of the core issues involved: (1) The "cognitive 'model'" as such, as well as the factors and processes pertaining to its formation, structure, alteration and 'dissolution'/'abandonment', need to be conceptualised, first, on the individual level and, subsequently, on the system-level. (2) A hypothetical framework (which, at a later stage, shall serve as the basis for a more scientific inquiry) needs to be formulated with regard to (a) the formation of such a "cognitive 'model'" through a combination of *internal* and *external* (partly interacting) factors and processes (including the influence that other agents' "cognitive 'models'" might have on the eventual structure of the individual's "cognitive 'model'"), and (b) the factors (e.g., syntactical/semantic/relational) and processes (e.g., encoding of 'meaning') at work that explain (i) why one particular "cognitive 'model'" is able to perceive a certain aspect of reality while another, with access to precisely the same data set, fails to do so, giving thereby rise to the aforementioned phenomenon of a 'Blind Spot'; (ii) why, at one point or another, this 'Blind Spot' all the sudden becomes 'visible' to the latter as well, i.e. what cognitive processes (e.g. an alteration in the syntactical structure of the "cognitive 'model'") underlie the realization of the discrepancy between its representation of (the relevant aspect of) reality and reality itself; and (iii) how the structure is consciously or subconsciously modified (or possibly even replaced by another) in order to help the agent adopt to this now differently perceived environment in terms of her expectations and decisions.

The points just listed in the foregoing paragraph, naturally, give rise to a myriad of questions concerning the nature of *data* and *cognition*. Before proceeding with the discussion, it therefore seems sensible to highlight a few insights from disciplines outside the mainstream finance research programme, which appear to afford highly relevant domain knowledge, which appears to be largely compatible with the implied ontological presuppositions of the *Value Investing* framework. For instance, the complexity researcher Brian Arthur (2000) emphasises that

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<sup>109</sup> In this particular context, the term 'Blind Spot' can also be interpreted in a positive way, i.e. referring to the existence of certain *value*-enhancing features that the 'market' fails to 'perceive' and thus to reflect in the respective price(s). So, once perceived by the wider financial community, we would have, what might be dubbed, a 'Sudden Surge' rather than a 'Sudden Death'.

<sup>110</sup> The *Value Investing* approach was developed in the 1930's; the presumed 'market participants' are thus all *human* (i.e., not A.I. agents).

“Data – literary or economic – have no inherent meaning. They acquire meaning by our bringing meaning to them. And different people, with different experiences, will construct different meanings.” (Arthur, 2000, p. 3)

This, in turn, directs us toward a ‘constructivist’ conception of cognition, which conceives of the mind/brain not as a mere ‘passive receiver of information’ that produces a one-to-one representation of reality, but, on the contrary, as an active participant in the ‘construction’ of reality ‘as subjectively experienced by the individual’ (Singer, 2000: Roth, 2003), which

“constantly forms hypotheses as to what the world might be like, and constantly compares the signals from the sensory organs to these hypotheses” (Singer, 2002, p. 72; my trans.; see also Roth, 2003).

Further, Roth (2003) suggests that the ‘hypothesis’ formed by such processes

“does not permit the drawing of any definite conclusions as to the state of the mind-independent world, because what «externally» enters the brain, cannot reliably be distinguished from what the constructivist brain «adds», as evinced by sensory and neuro-psychological research.” (Roth, 2003, p. 84; my trans.)

Considering the brain’s/mind’s active role in the production of the agent’s subjectively experienced reality as well as the *Value Investing* approach’s requirement for her constant *conscious* awareness of (and inquiry into) the differences between her own ‘view’ and that held by the ‘market’ for the identification of potentially profitable investment opportunities in the stock market, one comes to realize the importance of a factor that has largely been neglected, not only by the behavioural and neuro-finance more specifically, but, as pointed out by Searle (1994) by the mainstream of psychology, philosophy of mind and the cognitive sciences, leading to “much barrenness and sterility” in these fields (*ibid.*, p. 247): *consciousness*. In this context, it needs to be emphasised that consciousness is “*not* [...] the passive subjectivity of the Cartesian tradition” (*ibid.*; *italics* added). Indeed, just like it does in Searle’s (1994) framework, consciousness plays an *active* part in the implied conception of the individual (as far as it relates to cognition) underlying the *Value Investing* framework; after all, the investor is required to actively (and ‘mindfully’) assess and (re-)evaluating existing views, emotional reactions, reasoning processes, as well as to *consciously* override any distorting *internal* (e.g., biases, emotions) and *external* (e.g., ‘group pressure’) influences to her judgment.

The above are some of the core factors that will require a serious discussion and analysis if we are interested in developing a thorough understanding of the cognitive processes at work in financial markets, which might, eventually lead to a better understanding of financial market

processes. The remainder of the present project shall continue with the elaboration of (some) of the necessary preliminaries for such a larger project.

In the subsequent section we shall explore further the aspects related to investors' expectation formation processes as well as its relationship to the overall pricing process in financial markets as they are inferred from the core tenets of the *Value Investing* framework.

#### **4. Price-Value (In)Congruence**

This section shall expand upon our foregoing discussion by drawing valuable inferences as to the investor's expectation formation process and its relationship to the pricing process in financial markets from the *Value Investing* framework's (implied) understanding of the intrinsic relationship between the *value* of an asset and its *price*. Those aspects that cannot be directly gleaned from the *Value Investing* literature itself (e.g., Graham and Dodd, 1934, 1940, 1951, 1962), shall be derived and explicated via reference to the largely compatible (Post-) Keynesian and Austrian (particularly L.A. Hahn's, 1956) accounts, which shall act as midwives to the proposed task of formulating a descriptive ontology on the basis of this *practitioner's* investment framework. The plausibility of the inferred conceptualisation with regard to cognition and financial market prices shall be established via a detailed exposition of the reasons underlying the mainstream's failure to provide an adequate descriptive account as to the operation of these markets, before outlining how the derived alternative might be able to overcome these difficulties. The discourse shall be structured accordingly.

First, it needs to be emphasised that both *price* and *value* are ultimately estimates of the – due to its future-bounded nature – *unobservable* underlying *worth* of a security (e.g., an equity stock), and therefore of a *mental quality*, viz. the product of perception, interpretation and the consequent *subjective* 'views' of investors, particularly as they relate to *expected* future developments in the respective asset's returns. Indeed, the central role of *expectations* in both the *pricing* and *valuation* process is conceded by all major investing and financial market accounts: As for neoclassical finance, the Capital Asset Pricing Model (CAPM) determines the *expected return* of an asset and the latter constitutes a core input to the models of Modern Portfolio Theory (MPT); Keynes refers to the importance of 'prospective yield' in his discussion of the investing activity in financial markets both in his economic writings (Keynes, 1964) as well as his investing-related professional correspondence (Keynes, 2013), while the *Value Investing* framework focuses on *expected economic earnings* and /or *dividends* (Graham and Dodd, 1934; Williams, 1938; Greenwald *et al.*, 2004). Hence, as highlighted by Dow (2011) with reference to Tuckett (2009), "the ontology of financial markets is unusual in that activity is based on valuations that are bound up with expectations as to price movements

rather than the experience of ‘real’ consumption and production” (Dow, 2011, p. 234), and that, “as argued at an early stage by Townshend (1937), the price vector is a psychological construct” (Dow, 2011, p. 237). Similarly, Derman (2011, p. 149) writes:

“[T]here is nothing absolute about the value of a financial asset...

In finance the thread of uncertainty emerges from the start. We cannot know how the value of a security will change through time because we don’t know how the future will affect the promises made by its sellers. Value is determined by people, and people change their minds.”

The core question that arises, though, is that if both *value* and *price* are ultimately estimates of the same respective (unobservable) economic *worth*, just *what* precisely distinguishes the one from the other and what exactly is the relation between the two? As these two questions are intrinsically linked, we shall consider them jointly. First, a financial market price constitutes at any moment in time the investment community’s joint best estimate with regard to a particular asset’s economic *worth*. It is the result of the trading activity of millions of interacting securities investors/traders, who, in turn, trade on the basis of their own private best estimates as to that *worth*. The *price* figure is of a more global nature, and, as long as Surowiecki’s (2008) criteria are not violated,<sup>111</sup> the – on average – most accurate estimate that is epistemologically possible, and, if one accepts this conceptualisation of *value* (its plausibility shall become apparent shortly), hence equal to the latter. When one conceives of the market now as an extended form of human cognition, as outlined in the Thesis’ Introduction with reference to the larger envisioned project, it becomes apparent that the human computational capabilities are significantly extended by the existence of this external ‘cognitive superstructure’, permitting far more accurate estimates as to *worth* than any single human individual ever could, particularly when one considers the complexity of the system. The reliability of this cognitive extension is given only if the above criteria are met, though. Unfortunately, the realities of financial markets of human cognition lead to frequent violations of the above, which, at times at least, can result in significant distortions in the market’s estimate of *worth* as reflected in the *price* figure. If such cognitive distortions infect the greater part of the ‘cognitive superstructure’, it might be advisable to ‘un-couple’ oneself from the latter and start relying on one’s individual cognitive capabilities again. Even though the accuracy of the individual agent’s estimate might not approach the one of a well-functioning market, it might nevertheless be superior to that of the mal-functioning one. She will thus strive to get as close to the *value* figure as she possibly can (remember, that is the best estimate of *worth* that is epistemologically feasible) and exploit any significant price-value

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<sup>111</sup> i.e. agents are sufficiently independent in their respective judgments and there exists a sufficient degree of heterogeneity of views expressed in terms of the respective trades.

incongruence to her financial advantage. In fact, the entire *Value Investing* framework builds precisely upon this premise.

As can be inferred from this preliminary exposé, valuable insights into investor cognition and its relation to pricing processes in financial markets are to be gained from the deeper issues surrounding Price-Value (In)Congruence. A more detailed analysis shall therefore be produced in the present section by exposing and analysing the mainstream framework's failings to provide an internally consistent account with respect to the operation of financial markets. It shall be demonstrated that these failings are ultimately to be traced to the predominant ontological conception of financial market reality in general and of the individual (as far as it relates to cognition) in particular. The relevant (inferred) insights from the *Value Investing* account shall demonstrate that a thorough understanding of financial market processes requires a more plausible conception and understanding of the cognitive processes at work.

#### 4.1 Neo-classical Finance

In the dominant neo-classical finance paradigm, price-value congruence<sup>112</sup> is a (postulated) permanent feature of financial markets. This postulated feature is the result of what Derman (2011) dubs “a fiendishly clever jujitsu on the part of economists” (p. 152) such as – most prominently – Eugene Fama, who “attempt[ed] to turn weakness into strength” (*ibid.*) by, first, transforming an arguably sound empirical insight, namely the virtual impossibility of systematically predicting stock price movements on the basis of historical price data (e.g., Fama, 1965a,b), and thus – it shouldn't be forgotten – the profession's own inability to develop adequate models that were up to the task,<sup>113</sup> “into a fundamental postulate of their field” (*ibid.*) (see, e.g., Fama, 1970, 1991, 1998). This, in turn, prepared the ground for their ultimate ‘leap of faith,’ i.e. the unfounded inference “that any instant current prices reflect all current and past information” (*ibid.*, p. 153),<sup>114</sup> or, to put it differently, the original empirical insight with regard to the unpredictability of financial market prices led financial economists to the (unfounded) assumption that the latter contained the complete set of all relevant information already. The postulate was, as already outlined in Chapter 1, theoretically bolstered by the rational-expectations (RATEX) framework and the assumption of perfect markets. The theoretical edifice provides thus the following explanation for the postulated permanent price-

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<sup>112</sup> i.e. their equivalence in terms of units of *worth* (e.g., \$160 = \$160) and not in regard to their nature, as even in the neo-classical account the two are *ontologically* distinct entities.

<sup>113</sup> To understand the significance of this limitation, consider the weight that Friedman (1953) assigns to the aspect of *prediction* as a qualifying factor for economic models in particular and with respect to the economics enterprise in general.

<sup>114</sup> As Derman (2011, p. 153) emphasises, Fischer Black (1986) was one of the very few finance theorists, who openly acknowledged (some of) the intrinsic defects of the neo-classical conception of price-value congruence, by explicating that “[a]ll estimates of values are noisy, so [that] we can never know how far away price is from value” (*ibid.*, p. 533). See also main text below.

value congruence: Rational agents, having access to perfect information, will instantaneously identify and exploit any mis-pricing and thereby eliminate any price-value discrepancy.<sup>115</sup> As Derman (2011) correctly points out, though,

“[t]he EMM [i.e., ‘Efficient Market Model’], beneath its formal cloak is simply an assumption about human behaviours. It’s therefore either right or wrong.”

In Chapter 1, it was argued that the neoclassical conception of the individual is untenable for the financial market setting, both on ontological and empirical grounds. Defenders of the neoclassical account, such as Ross (2008), might counter that the institutional framework ‘nudges’ human individuals to behave *as if* they were economic agents. As already discussed in Chapter 1 (Sect. 3.2), though, the ‘institutional imperative’ in these markets might, in fact, drive agents away from this ideal. In the present section, it shall be demonstrated that it is precisely the mainstream’s continuing insistence on the superiority of this conception that prevents it from developing a workable descriptive account of financial markets, let alone one that can account for phenomena such as ‘Blind Spots’ and ‘Sudden Deaths’. This argument will be developed step-by-step in what follows.

First, there are three plausible motives that underlie the “trade among individuals” in financial markets: differing tastes (i.e., ‘risk aversion’), differing endowments, and differing beliefs (Grossman and Stiglitz, 1980, p. 395). The first two motives are responsible for only a relatively small proportion of the overall trade, though, and would, on their own, lead to very ‘thin’ markets only, particularly as trades would be likely to happen only sporadically (Grossman and Stiglitz, 1980). The core motive that underpins most of the quotidian financial market activity is to be found in *differing beliefs* and consequently differing expectational ‘models’ and the respective ‘hypotheses’ in regard to the *worth* of financial assets. In fact, no matter what their other differences, all relevant theoretical accounts, i.e. the neo-classical one (e.g., Fama, 1976; Grossman and Stiglitz, 1980; Fama, 1991), the *Value Investing* one (e.g., Graham and Dodd, 1934, 1973), the Post-Keynesian one (e.g., Keynes, 1936) and the Austrian one (e.g., Bragues, 2012; Rapp *et al.*, 2017), basically agree that every (rational) investor aims at developing a superior understanding and formulating a superior assessment of the *worth* of financial asset, which ought to provide them with a competitive advantage relatively to his

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<sup>115</sup> It is this the assumption that underpins the ‘principle of no riskless arbitrage,’\* i.e. the *fundamental theorem of finance*.

\*‘Principle of no riskless Arbitrage’: “Any two securities with identical future payoffs, no matter how the future turns out, should have identical current prices” (Derman, 2011, p. 165; *italics* eliminated)

respective counterparty.<sup>116,117</sup>

What is crucial for the operation of financial markets is the givenness of a sufficient degree of heterogeneity in terms of ‘pictures’, expectations and ‘hypotheses’ in regard to economic reality. The problem with the neo-classical *efficient market* framework is that a heterogeneity in *beliefs* and *expectational ‘models’* is not given,<sup>118</sup> because in a closed-system world with perfect information and unboundedly rational agents, the respective assessments of *worth* are homogeneous and synchronized, for the following reasons:

For the formation of *beliefs* and *expectational ‘models’*, the following steps are required:

- (1) The gathering of data,  $\tau$ ;
- (2) The identification of relevant data, i.e. ‘information,’  $\rho$ , i.e.  $\rho \subset \tau$ ;
- (3) The identification of the relevant aspects of that ‘information,’<sup>119</sup>  $\alpha$ , i.e.  $\alpha \subset \rho$ ;
- (4) The formulation of a ‘model’ of the relevant aspect of reality by combining the elements of  $\alpha$  in a rational manner via the process  $\phi$ .

As information is assumed to be perfect, there is no type of cost involved in gathering and identifying the relevant data, i.e. ‘information’,  $\rho$  (Steps 1&2). Further, as information within such a closed-system framework is ‘one-dimensional,’ there are no ‘relevant aspects,’ i.e.  $\alpha$  to be identified (Step 3). Lastly, as all economic agents are assumed to be unboundedly rational expected utility maximisers, their  $\phi$ s will be identical, as will be their eventual *beliefs* and *expectational ‘models’* as they process the same information in precisely the same way. Thus, it is not merely the case, as *efficient market* proponents claim (e.g., Fama, 1970), that no individual investor is able to consistently formulate superior views as to the respective *worth* of securities – and, thus, the underlying economic reality – and thereby consistently outperform the ‘market’ on a risk-adjusted basis, but rather, that due to the *homogeneity* of *beliefs* following from the aforementioned assumptions, no trading activity, at least not one motivated by the desire to financially profit from a more accurate assessment of *worth* relatively to that of one’s competitors, will materialize at all (see also Mehrling, 2012, p. 234). Costless information is, however, not only a *sufficient* condition for the existence of *informationally efficient* markets as, for example, Fama (1970, p. 387) claims, but, as argued by Grossman and Stiglitz (1980), also a *necessary* one, because, as demonstrated by the latter, if the efficient market hypothesis were true and we allowed for costly information,

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<sup>116</sup> This also corresponds to the view held by practitioners: e.g., Soros (1987, 1994). See also Warren Buffett’s *Letter to his Shareholders*; available at: <http://www.berkshirehathaway.com/letters.html>.

<sup>117</sup> Note that this is only a *necessary* pre-requisite for investment success, not a *sufficient* one.

<sup>118</sup> Grossman and Stiglitz (1980) introduce informational asymmetries to guarantee such a heterogeneity in views. We take a broader view, with particular emphasis on the ontological aspects.

<sup>119</sup> See discussion in Section 3 in regard to the ‘multi-dimensionality’ of reality.

“competitive markets [would] break down [...] [as] price [would] reflect all the relevant information. When this happens, each informed trader,<sup>[120]</sup> because he is in a competitive market, feels that he could stop paying for information and do as well as a trader who pays nothing for information.<sup>[121]</sup> But all informed traders feel this way. Hence having any positive fraction informed is not an equilibrium. Having no one informed is also not an equilibrium, because then each trader, taking the price as given, feels that there are profits to be made from becoming informed.” (*ibid.*, p. 404).

Hence, neither a scenario with costless information nor a scenario with pricy ones leads to an *informationally efficient* market outcome. Further, as a certain degree of heterogeneity in beliefs is a *necessary* condition for any regular trading activity in financial markets, there have to exist certain barriers that obstruct the homogenisation process of the former. As under the assumptions of the neo-classical framework, differing beliefs are solely the result of agents’ differing information sets,<sup>122</sup> a certain degree of informational asymmetry must prevail, which, within the aforesaid framework, can only be the result of significant transaction costs that make it prohibitively expensive to create new markets, where differing beliefs can be arbitrated away (Grossman and Stiglitz, 1980, pp. 404-5).

Over the last few decades, the information set has grown exponentially, while the costs of accessing this information have, particularly due to the unprecedented advances in information technology, markedly declined, as have the transaction costs related to the creation of new markets, which the explosion in the number of synthetic markets and synthetic financial products bears witness to. According to the insights produced by Grossman and Stiglitz (1980), these developments should have led to an increased homogenization of beliefs and therefore to a ‘thinning’ of financial markets. As this has not happened, though, the formation of beliefs must be affected by factors<sup>123</sup> other than the mere access to a specific information set. Fischer Black’s (1986) ‘Noise Trading’ Framework, which deals with precisely the same question as Grossman and Stiglitz (1980) did, might provide some elucidating insights in this regard, particularly as it was influenced by the results of the early research efforts that would eventually develop into the (sub-)field of behavioural finance, an enterprise that Fischer Black

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<sup>120</sup> i.e., the economic agent who incurs cost  $c$  in order to obtain private information  $\theta$  about the underlying economic reality of the risky security.

<sup>121</sup> i.e., the economic agent who does not incur cost  $c$  in order to obtain private information  $\theta$  about the underlying economic reality of the risky security, but who tries to extract that information via the observation and study of the security’s publicly accessible market price  $P$ .

<sup>122</sup> As expounded above, information is assumed to be ‘one-dimensional,’ i.e. there is one way of perceiving and interpreting it only, and economic agents are assumed to be homogeneous in regard to their (cognitive) belief formation and decision processes. Agent A’s belief in regard to a particular aspect of economic reality can therefore only differ from Agent B’s if her information set differs from the latter’s.

<sup>123</sup> i.e., by the nature of human cognition and of actual information. See below.

came to actively endorse until his early death (Mehrling, 2012). In fact, the ‘Noise Trading’ framework can be considered as a bridging framework between neo-classical finance, information economics and behavioural finance (Rapp and Cortés, 2017), reflecting Fischer Black’s own intellectual trajectory (Mehrling, 2012).

#### 4.2 Fischer Black’s ‘Noise Trading’ Framework

As expounded above, Grossman and Stiglitz (1980) fail to provide a truly convincing theoretical account in regard to the causal factors and processes that underlie the actually observed trading activity in financial markets. In fact, due to their (implicit) neo-classical ontological conception of information as ‘crystal clear,’ ‘one-dimensional’ bits, which give rise to no ambiguity in regard to their status (i.e., whether they constitute ‘information’ proper or merely ‘noise’), and the economic agent as a (universally) rational decision maker, it is only through the postulated existence of significant barriers (i.e., high transaction costs) to the creation of new markets that the – for the operation of financial markets and the existence of a *competitive equilibrium* necessary – heterogeneity in terms of beliefs among investors is preserved. Considering that not significant homogenisation of beliefs and consequent ‘thinning’ of financial markets could be observed over the last few decades, and that in spite of the removal of many of these barriers through advances in information technology and major alterations in the regulatory regime, it seems save to conclude, however, that there must exist other causal factors underlying the diversity of beliefs, which the present work shall trace to ontological as well as cognitive aspects that can be identified in financial markets (see below).

It was Fischer Black (1986), who would rescue neo-classical finance from the embarrassing impasse discussed in the previous subsection by introducing the concepts of ‘noise’ and the ‘noise trader’.<sup>124</sup> These topics shall be dealt with shortly; but first it is important to call attention to the fact that Black’s (1986) radical step “of accepting noise traders into the theory of equilibrium” (Mehrling, 2012, p. 234) did *not* constitute “any switch of sides in the great efficient markets debate” (*ibid.*, p. 233) on his part, but rather an attempt to rescue the efficient framework from its own inherent logical inconsistencies through a modification of what are ultimately its ontological presuppositions in regard to the nature of information and the decision-maker, which also entailed a significant re-conceptualisation of both the nature of *efficiency* and of *equilibrium*. As to the latter two, Black (1986) underscores that “[n]oise

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<sup>124</sup> Fischer Black (1986) introduced the concepts of ‘noise’ and the ‘noise trader’, i.e. the agent who would trade on the basis of the former, in order to provide the for the explanation of observed financial market processes required heterogeneity in terms of agent’s beliefs and the informational inefficiencies that would lure rational ‘information traders’ to actively participate in the market by producing the potential profitable trading opportunities.

makes financial markets possible, but also makes them imperfect” (*ibid.*, p. 530), whereby he refers to the necessity of dispensing with the ideas of *informational efficiency* and an equilibrium characterised (and defined) by Price-Value Congruence (e.g., Fama, 1991) for the sake of formulating a viable theoretical account of the operation of financial markets (see Mehrling, 2012, p. 232). Thus, although financial markets might reach a form of *competitive equilibrium*, the (necessary) presence of at least a certain degree of ‘noise’ makes them *informationally inefficient*, at least in the traditional sense of the term, which links informational efficiency to Price-Value Congruence. In fact, within Black’s (1986) framework the nature of noise is such that the existence of the latter at any given point in time cannot be established, at least not with any accuracy: “All estimates of value are noisy, so we can never know how far away price is from value” (Black, 1986, p. 533). Thus, in contrast to the traditional neo-classical finance framework,<sup>125</sup> market prices can deviate significantly from the underlying value (by a factor of 2; see above). Nevertheless, the existence of built-in correction mechanisms ensures that prices tend to converge toward value over time:

“The noise that noise traders put into stock prices will be cumulative [...]. Offsetting this, though, will be the research and actions taken by the information traders. The farther the price of a stock gets from its value, the more aggressive the information traders will become. More of them will come in, and they will take larger positions. They may even initiate mergers, leveraged buyouts, and other restructurings.” (Black, 1986, p. 532)

This convergence is possible because even though the underlying value is itself a moving target due to the constantly changing economic reality, its variation is much less than that of the market price, as was also shown empirically by Shiller (1981, 1984, 1990). Nevertheless,

“[o]ver longer intervals, though, the variances will converge. Because price tends to return to value, the variance of price several years from now will be much less than twice the variance of value several years from now.” (Black, 1986, p. 533)

This view accords perfectly with the *Value Investing* framework’s understanding of the operation of financial markets, as can be inferred from Benjamin Graham’s characterisation of financial markets as ‘voting machines’ in the short-run but ‘weighing machines’ in the long-run (see Buffett, 1993). In fact, the entire *Value Investing* approach builds on the premise that, on the one hand, market prices *can*, at times, significantly diverge from their respective *intrinsic values*, but also, on the other, that the thereby created (potentially) profitable

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<sup>125</sup> According to Fischer Black’s (1986) own assessment, his position “puts [him] between Merton (1985) and Shiller (1981, 1984). Deviations from efficiency seem more significant in [Black’s] world than in Merton’s, but much less significant in [Black’s] world than in Shiller’s.” (Black, 1986, fn.11)

investment opportunities will be recognized by informed investors eventually, who will subsequently eliminate the incongruence via their trading activities. Further, the awareness of the ‘noisy’ nature of *value* is fully ingrained in this framework, as the *margin of safety* principle (see Sect. 1) is not solely devised to protect the investor from any unforeseen future developments, but also from the inherent limitations she faces when estimating the *worth* (or *value*) of a security, which arise from the “fuzziness” of *intrinsic value* (Buffett, 1995); indeed, the elusiveness of the concept of *intrinsic value* itself (Graham and Dodd, 2009, p. 64).

What still needs to be addressed, though, is the central question, as to how Fischer Black (1986) is able to present a framework that, similar to Grossman and Stiglitz’s (1980), commences with the introduction of two different types of market participants, but ends up at a diametrically opposed conclusion and conception of the operation of financial markets, one, which constitutes a more viable theoretical account that widely concurs with the quotidian experience and empirical evidence? The solution to this puzzle is, obviously, not to be found in the existence of informational asymmetries, which, it shouldn’t be forgotten, constitute *the* core factor underlying the functionality of financial markets in Grossman and Stiglitz’s (1980) own account. Nevertheless, their overall approach to the explanation of financial market activity – which, of course, naturally follows from their critique of the neo-classical EMH –, i.e. the analysis of how information regarding the actual economy is transformed into financial market prices via the agency of financial market participants, is, due to the afore-discussed ontology of these prices, fundamentally sound. Hence, both *information* and the *agent* have to constitute the core parts of any viable theoretical account of the operation of financial markets. As the pure matter of accessibility of this *information* by the *agent* or a specific type of *agent* is, as discussed above, not sufficient, though, the very nature of these two factors warrant a closer inspection. Thus, in what follows, it shall be demonstrated that neither *information* nor *noise* can have the ontological character that both neo-classical finance and ‘information economics’ presuppose. Further, the discussion of the latter shall also uncover the unsuitability of the latter’s conception of cognition in financial markets, which, in turn, shall provide the starting point for the discussion in Chapter 3.

As already expounded in Chapter 1, the ontological presuppositions of neo-classical finance reduce *information* to ‘bits’, i.e. to the most basic and abstract level, such as the binary digits 1 and 0 in computational theory, which can be unambiguously ‘understood’ and processed by the agents’ computer-like cognitive ‘decision apparatuses’ (see Chap. 1). *Information* is thus deprived of essential ontological elements such as its syntactic and semantic features and other core relationships among various types of data. That *information* cannot have this ‘crystal-clear’ nature, has already been demonstrated by the insufficiencies of Grossman and Stiglitz’s (1980) framework. More generally, the following can be concluded about the case of ‘crystal-

clear' information in financial markets: Let's assume there exists an information set  $S = \{s_1, s_2, s_3, \dots, s_n\}$ , and its elements can only be accessed – by potentially all financial market participants – via the payment of a price  $c$ , with  $c > 0$  as otherwise we would return to the perfect information case of the EMH that was rejected by Grossman and Stiglitz (1980). Now, if all traders acquired access to the complete set  $S$ , we would, once again be in a situation where everyone held the same view as to *worth* and no belief-motivated trade would ensue. On the other hand, if some traders acquired only a sub-set of  $S$ , containing only a certain number,  $m$ , of elements of  $S$ , they could never be sure, whether their respective counterparty were not in possession of a larger sub-set of  $S$ , with  $m + i$  elements, where  $i > 0$ . Thus, a rational agent would never trade in such a scenario. This means that she would financially be better off not buying access to any information at all (and, indeed, refraining from any trading activity), unless she bought access to the complete information set  $S$ . If she were to opt for the latter, she would be hard-pressed to find a counterparty to her trade, though, as equivalently to her, other rational agents either opt to buy no information at all, foregoing any trading opportunity knowing that the basis of their belief-motivated trades would likely to be inferior, or, alternatively, opt to acquire the complete information set  $S$ , in which case they would end up with precisely the same 'view' as to *worth* as our hypothetical trader and we would, once again, have the problem of homogeneity of beliefs and 'views'. In both cases, no belief-motivated transaction will materialize.

Now, let's move to the scenario where a certain number of traders decided to forego the opportunity to gain access to primary information (and thus saving the cost  $c$  to do so) and instead opted for a secondary source, primarily the movements of financial market prices and their relationship to returns, which tend to be stable within the presumed closed-system environment. Our uninformed but rational trader knows that there exists a high likelihood that her counterparty is either an informed trader or an uninformed trader with a superior inference of the primary information through the secondary source. The likelihood of her ending up on the 'winning side' of the trade is thus relatively low and from a rational perspective she is better off refraining from any trading activity. *Information* can thus not be 'crystal-clear' and the obstacles to its general 'accessibility' is to be looked for in its very nature, i.e. its identifiability, discernibility and interpretability – all aspects related to *cognition* –, rather than external ones such as prohibitively high transaction costs.<sup>126</sup>

Now, let's turn our attention to the factor that constitutes the core innovation in Fischer Black's (1986) account of financial markets, i.e. 'noise', which, according to Black (1986), "makes trading in financial markets possible, and thus allows us to observe prices for financial assets"

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<sup>126</sup> It is important to note that whereas in Chapter 1 we have demonstrated the untenability of the neoclassical conception of the individual (particularly as far as it relates to the aspect of cognition), here we are demonstrating the untenability of the neoclassical conception of *information*.

(p. 529). Due to its core role in facilitating the belief-based transactions in financial markets that are essential to the existence of liquid markets,<sup>127</sup> an analysis of ‘noise’ shall also shed new light onto the nature of its contrasting factor, i.e. *information*,<sup>128</sup> and, eventually, also onto the nature of the cognitive processes that underlie the operation of these markets. First, it needs to be stressed, though, that within the context of Black’s (1986) account, ‘noise’ is *not* to be understood in the mathematical-statistical sense as it is in neo-classical finance or ‘information economics’ (see Grossman and Stiglitz, 1980). In fact, the presence of that particular type of ‘noise’ has contributed nothing to the alleviation of the inherent limitations of these frameworks with respect to their ability to account for the observed trading activity in financial markets and thus disqualifies it right from the start; in other words, Fischer Black’s (1986) ‘noise’ must be of a fundamentally different type.

Assuming that both types of agents in Black’s (1986) framework, i.e. the *information trader* and the *noise trader*, are *rational* in the sense that both strive to maximise the (risk-adjusted) returns of their respective portfolios, they will both search for and process any data *they deem* relevant to that end. This means that both will analyse the available data set,  $T$ , which consists of both, *information*,  $\rho$ , i.e. return-relevant data, and *noise*,  $v$ , i.e. return-irrelevant data:  $T = \{\rho_1, \rho_2, \rho_3, \dots, \rho_n; v_1, v_2, v_3, \dots, v_n\}$ , in search for the former. As pointed out above, though, the mere presence of noise,  $v$ , in the data-set,  $T$ , is not sufficient to explain the belief-motivated trading activity, which constitutes a significant proportion of total trading activity that underlies the operation of financial markets, because if *information*,  $\rho$ , itself were sufficiently unambiguous, all rational market participants would eventually be able to identify it. After all, a sufficiently unambiguous unit of *information*,  $\rho_i$ , will be characterized by a fixed syntactic and semantic structure and fixed relationships to underlying economic reality, particularly realized returns, as well as to other units of *information*,  $\rho_j$  where  $i \neq j$ , or in other words, a closed-system ontology. This means that even if *information*,  $\rho$ , cannot be immediately distinguished from *noise*,  $v$ , in the data-set,  $T$ , traders will eventually be able to separate “the wheat from the chaff” via the application of statistical tools. Thus, just like argued above,

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<sup>127</sup> *Liquidity* is, arguably, a financial market phenomenon that ultimately results from and whose continuing existence depends upon a certain interaction and constellation of *cognitive processes*. Derman (2011) points at our general ignorance in regard to this vital factor in his discussion of “[t]he difficulties one encounters in modelling economic abstractions” (p. 48):

“Liquidity is the metaphorical quality that makes trading possible; it connotes the easy availability of counterparties to buy something you want to sell or sell something you want to buy, and its disappearance in states of fear causes the great damage that characterized the recent global financial crisis. Everyone thinks he knows what liquidity means, yet no one has yet adequately defined and quantified it.” (*ibid.*)

Should it indeed be an emerging property of interacting *cognitive processes*, then the hitherto encountered difficulties in defining and modelling the phenomenon are caused by our general ignorance of the latter.

<sup>128</sup> Black (1986): “In my basic model of financial markets, noise is contrasted with information” (p. 529).

*information*,  $\rho$ , itself cannot be unambiguous, as otherwise we would end up, once again, in a world of ‘thin’ markets or no trading activity at all. The required ambiguity in *information* arises, *inter alia*, from the fundamental uncertainty that characterises financial markets (see Sect. 2) and the ‘multi-dimensionality’ of *information* discussed, and both of them are the result of the open-system nature of the economy and financial markets, which can alter the aforementioned syntactic and semantic structures and relationships. Indeed, one should conceive of *information* and *noise* not as two polar opposites on a binary scale, but rather as data that moves along a ‘spectrum of return-relevance’ with a range from 0% to 100%, whereby data tending toward the former is *noise* and data tending toward the latter is *information*. Thus, apart from the extreme case (100%), *information* does have a ‘noisy’ component.<sup>129</sup> Further, due to the dynamic rather than static nature of the system, certain types of information might (temporarily) slide toward the ‘noise’-end of the spectrum and *vice versa*. For example, the mis-perception of a return-irrelevant data (i.e., *noise*) point (or sub-set) as return-relevant-data (i.e., *information*) by a certain group of traders can turn into a self-fulfilling prophecy, whereby these data-points can, if sufficient momentum has been built up,<sup>130</sup> turn, for a while at least, return-relevant. DeLong *et al.* (1990) demonstrate how so-called *noise traders* can, on the basis of their initial error, carve out a profitable space in the market, which is entirely detached from any underlying economic reality, existing exclusively on the price level.<sup>131</sup> The (temporary) existence and prevalence of such *spaces* is only rendered possible because the *noise traders*’ very own action deters *rational arbitrageurs* (i.e., *information traders*) – who are invoked by EMH advocates such as Friedman (1953a) and Fama (1965a) in order to dismiss the relevance of the former in the price formation process – from eliminating any price-value incongruences, because they introduce an additional element of risk, dubbed “noise-trader risk” by DeLong *et al.* (1990), that pose a certain *limit to arbitrage* trades; just like Fischer Black (1986) explicates:

“The information traders will not take large enough positions to eliminate the noise. For one thing, their information gives them an edge, but does not guarantee a profit. Taking a larger position means taking more risk. So there is a limit to how large a position a trader will take.” (*ibid.*, p. 532)

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<sup>129</sup> Just like Fischer Black (1986) writes, “[i]n my model of the way we observe the world, [it is] noise [...] what makes our observations imperfect” (*ibid.*, p. 529).

<sup>130</sup> For the built-up of such a momentum it is not sufficient that isolated individuals fall victim to such an error, rather a contagion among a sufficient number of traders is necessary. See main text below.

<sup>131</sup> Of course, if there exist reflexive processes between financial market prices and the underlying economic reality such as those discussed by Soros (1987, 1994), then the price distortions produced by the actions of the *noise traders* will also affect the latter. As argued by Klarman (1991), though, these tend to be the exception rather than the norm in securities markets, particularly in equity markets. Soros’ (1987, 1994) reflexivity framework seems to be more relevant in the FOREX markets (see DeGrauwe and Kaltenwaser, 2012).

Thus, data-points that are, on a fundamental level, return-irrelevant (i.e., *noise*) can, at least temporarily, become return-relevant (i.e., *information*) as they affect both the returns of the *noise traders* as well as those of the *information traders*. Alternatively, it is well possible that significant price-value incongruences result from an overweighing (and other exaggerated perceptions and assessments) of certain return-relevant data (i.e., *information*) in the interpretative stage of the ‘model’ formulation process. For instance, in the early stages of the dot-com boom in the 1990s, observed stock-price increases were reasonably justifiable with reference to certain fundamental data. Nonetheless, as the boom progressed, a point was eventually reached, where those positive fundamental data that did exist, were taken for the justification of exaggerated claims, and where the former did not suffice for the latter, new ‘facts’ were simply manufactured, particularly as they pertained to future prospects. Once the market entered bubble-territory, the latter came to be increasingly supplanted by recent price-moves, which increasingly turned into the new ‘information’ that guided an increasing number of transactions, whereas actual fundamental information was increasingly cognitively ‘filtered’, with confirming data being accepted and (often in an exaggerated form) incorporated into trading- and investment decisions and any contradictory information largely ignored (i.e., *confirmation bias*).

Although a prolonged participation in a market characterized by significant fundamentally-unjustified price increases will turn a greater proportion of market participants, ‘objectively’<sup>132</sup> speaking, into *noise traders* (apart from those trying to bet against the general trend on the basis of fundamental data), who act ‘irrationally’ by trying to earn “higher expected returns solely by [unwittingly] bearing more of the risk that they themselves create” (DeLong *et al.*, 1990, p. 706), there is a certain *rationale* in participating in at least the early- to mature stages of such a boom. After all, a *hausse* can last several years before it turns into a full-blown market bubble that is entirely dominated by irrational forces, and even then, prices might still continue to rise for years before the unsustainability of the situation is recognized by the greater part of the financial market community. This means that so-called *noise-traders* can reap handsome profits, while ‘rational’ arbitrageurs might suffer significant losses in trying to bet against the trend. The acceptance of what from a *fundamental* perspective might seem return-irrelevant data (i.e., ‘noise’), can therefore – at least temporarily – be perfectly rational, as the latter might indeed possess some return-relevant aspects that can be exploited for a limited period of time (particularly the insights into the psyche and likely action of one’s fellow market participants through their revealed trading behaviour), as long as that the trader/investor retains such power over herself as to structure her trades in a way that limits

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<sup>132</sup> Inverted commas are applied, because an *objective* mind-independent existence of observable and unobservable physical items (Devitt, 1991, p. 24), and the literal truth of “our best current scientific theories” (Stanford, 2003, p. 533) are not given in economic systems (see Mäki, 2012).

her downside in case the tide begins to turn and to exit the markets and stay on the side-lines once *irrational exuberance* has taken over. Such an understanding is also broadly compatible with the (Post-) Keynesian view on financial market activity:

“Keynes (1936: 155; emphasis added) observed, the speculator was forced to concern himself with the anticipation of those changes by which ‘*experience* shows that the mass psychology of the market is most influenced’. The source of inspiration, for Keynes, is therefore [...] [the] direct experience that results in superior knowledge of the ways markets react. We should thus recognize the rationality or indeed the ‘wisdom of acting on a rumour, which one does not himself believe, if one thinks it will be generally believed’ (Keynes 1910: 109).”  
(Lanteri and Carabelli, 2011, p. 277)

Indeed, a substantial amount of empirical evidence exists that documents – contrary to Fama’s (1970) postulated weak type of financial market efficiency – that *momentum* trading strategies have been consistently profitable in most of the major markets around the world over the last few decades (see, Jegadeesh and Titman, 1993, 2001, 2011; Rouwenhorst, 1998; Griffin *et al.*, 2003; Chui *et al.*, 2010). The reason for this is to be found, (1) in the fuzziness of *information* itself, and (2) in the limitations of the human cognitive ‘decision apparatus’.

As to (1), it needs to be re-emphasised at this point that *information* is inherently fuzzy and ‘noisy,’ which means that it is often not possible to identify *fundamental information* unequivocally.<sup>133</sup> Hence, Fischer Black (1986) stresses that even “information traders can never be sure that they are trading on information rather than noise” (*ibid.*, p. 532), because they can neither be sure in regard to the completeness, the accuracy nor the degree of ‘noisiness’ of their respective *fundamental information* sets. Thus, it is perfectly possible that a (supposed) *information trader* misses a lucrative investment opportunity (i.e., an *error of omission*) or invests in an ultimately unsuccessful business (i.e., an *error of commission*), because she fails to recognize that her *fundamental information* set is incomplete and/or she mistakes *information* proper for *noise* (i.e., a ‘Type 1’ error) or, *vice versa*, *noise* for *information* (i.e., a ‘Type 2’ error). The accuracy of her *fundamental information* set can often only be established *post factum*, and as the types of individuals within Black’s (1986) framework are solely defined by the type of data-input they base their trading decisions on, i.e. *information* and *noise*, respectively, “[t]here will always be a lot of ambiguity about who is an information trader and who is a noise trader” (*ibid.*), particularly in *real-time*. This also affords the necessary background for understanding Fischer Black’s (1986) puzzling statement that *noise traders*, who are otherwise rational economic agents, “trade on noise [...] even though

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<sup>133</sup> Fischer Black (1986) stresses: “All estimates of value are noisy, so we can never know how far away price is from value” (*ibid.*, p. 533).

from an objective point of view they would be better off not trading” (*ibid.*, p. 531). The point is precisely the one raised above, namely that such an “objective point of view” is often not given, and that traders often do, indeed, “think the noise they are trading on is information” (*ibid.*);<sup>134</sup> and sometimes, as demonstrated by DeLong *et al.* (1990) such a misconception might even turn into a self-fulfilling prophecy. Ultimately, though, it is the wide variety of data-choice, -interpretation, and -understanding that leads to the wide variety of ‘models’ and expectations, which underlie the operation of financial markets. Fischer Black (1986) is generally correct in holding that “differences in beliefs must derive ultimately from differences in information” (*ibid.*, p. 531), but these “differences in beliefs” among economic agents does not necessarily arise from differing (‘physical’) access to that *information*, but rather from the wide range of possible interpretations and understandings that the fuzzy and multi-dimensional nature gives rise to, whereby some will necessarily be closer to the ‘objective’ reality than others.

As to (2), in contrast to the neo-classical conception of the rational economic agent, *information traders*, just like *noise traders*,<sup>135</sup> suffer from cognitive limitations and errors, which can lead to a delayed full incorporation of *information* into prices. Jegadeesh and Titman (2011), for example, produce evidence that “suggests that momentum profits arise because of delayed reaction to firm specific information” (*ibid.*, p. 7), which leaves a residue that can be profitably exploited by *noise traders*, even though they might be basing their trading decisions solely on past price movements (i.e., *noise*). Barberis *et al.* (1998) suggest that a form of ‘conservatism bias’ (see Edwards, 1962) might be responsible for investors’ initial underweighting of new *information*, which results in a slow adjustment of prices as investors are hesitant about updating their priors with regard to their trading decisions; opening thereby a transitory time-window that allows for return-predictability and thus momentum profits until this *information* has been fully incorporated into prices.

Overall, it can be concluded that Fischer Black’s (1986) ‘Noise Trading’ framework constitutes an important improvement over both the earlier neoclassical (Fama, 1970) and the information economics (Grossman and Stiglitz, 1980) respective accounts by providing a conceptualization of financial market activity that manages to overcome several of the latter’s internal inconsistencies, primarily via a partial (implicit) departure from some of their core ontological presuppositions and the adoption of some more in line with actual financial market experience. Nonetheless, Black’s (1986) re-conceptualisation remains an incomplete one,

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<sup>134</sup> Black’s (1986) suggested alternative that they “[p]erhaps [...] just like to trade” (*ibid.*, p. 531) is dismissed on the ground that even if their primary utility is derived from the trading activity itself, they still have to aim for a return maximisation, as trading just for losing is truly irrational.

<sup>135</sup> As both types are ultimately human beings, they both share the same type of cognitive ‘decision apparatus’.

particularly because of his failure to provide a proper elaboration of the key concepts he means to introduce, i.e. *noise* and the *noise trader*. *Noise* is primarily presented as any data that is, from a fundamental perspective, irrelevant to the *value* of an asset. Nevertheless, as discussed above, it is more sensible to think of *information* and *noise* as categorizing data along a spectrum rather than as two polar extremes. Further, it has been demonstrated that although a certain type/element of data might fundamentally be entirely irrelevant in terms of the asset's *value* at one point in time, it might, in the course of the evolution of the system, acquire a certain relevance in that respect, particularly within an environment such as financial markets, which is characterized (at least at times), by *reflexive* processes (see, e.g. Soros, 1994, 2013).<sup>136</sup> Further, even if such a *fundamental relevance* is not acquired, it might still be possible that a certain aspect of that data acquires, at least temporarily, a relevance in terms of *trading profits*. All of these elements are implicitly present in Fischer Black's framework, but they remain entirely underdeveloped. The insights hitherto developed in the present chapter, particularly those with respect to the systems openness, the presence of fundamental uncertainty and the 'multi-dimensionality' of various aspects of reality that are of high relevance to the (value) investor, seems to be a plausible starting point.

Similarly, Fischer Black (1986) fails to satisfactorily conceptualise the 'noise trader'. Her sole defining and distinctive characteristic according to Black's (1986) exposé appears to be her tendency to base trading decisions on 'noise' rather than information proper. Short of sheer lunacy, what would drive one to trade on the basis of irrelevant data, though? Once again, the answer is to be found in the plausible conceptualisation of data occupying a (potentially constantly altering) position along the information-noise continuum, rather than falling strictly into either the one category or the other. This inference seems corroborated by Black's (1986) concession with regard to the difficulty of distinguishing the one from the other and, consequently, the 'noise trader' from the 'information trader'. In fact, an agent might be an 'information trader' at one instant in time, and (unknowingly) a 'noise trader' at another. The only plausible conclusion to be drawn is that both types are ontologically ultimately the same type of individual equipped with the same basic (cognitive) toolset, but with certain members of this type showing a greater (cognitive) dexterity in the identification of information proper than others. The relevant core factors are hence to be found on the level of *cognition*. Fischer Black (1986) fails to provide any deeper insights into this aspect. The Achilles' heel(s) of Black's (1986) account is (are), however, the strength(s) of the present work, as not only have we hitherto inquired into the open-system nature and the fundamental uncertainty that characterise financial markets, as well as the 'multi-dimensional' nature of data (a valuable starting point for any future inquiries into the *information-noise continuum*), but also begun to

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<sup>136</sup> i.e., with 'minds influencing prices' and 'prices influencing minds'.

infer some of the core cognitive factors required for the survival of the agent within such a setting. In what follows, this account shall be further expanded via the exploration of the *Value Investing* framework's (implied) view on Price-Value (In)Congruence.

#### 4.3 The Value Investing Framework

This subsection shall dissect the *Value Investing* framework's (implied) understanding with regard to the subject of Price-Value (In)Congruence, in order to advance our present project of outlining the core characteristics and elements that a more accurate conceptualisation of *cognition* in financial markets requires. The (wider) Austrian Economics school of thought shall be assigned a midwifery role in this task. The motives for this particular choice are the following: First, just like the *Value Investing* framework (and Fischer Black's 'Noise Trading' account), Austrian Economics rejects the neoclassical postulate of permanent price-value congruence; it does so, on very different grounds, though, viz. its subjective value theory, which, as shall be argued below, fundamentally differs from the *Value Investing* account's 'subjective estimate as to value', whereby the latter shall be elaborated with reference to L.A. Hahn's (1956) account of financial markets, which, albeit appropriating certain theoretical elements from Austrian Economics, largely accords with the *Value Investing* framework, particularly with regard to the *cognitive* aspects involved. In that context, it should also become apparent that an *a priori* approach to decision-making, such as von Mises', is ultimately doomed to fail to provide an insightful account of the cognitive processes that underlie financial market processes, and that an empirically-oriented one, such as the one developed by Hayek (1952) in his theoretical work on psychology, is likely to provide a far more promising way forward.

Turning now to the main discussion, it needs to be re-emphasised that the *Value Investing* framework builds upon the premise that price-value congruence is not a *permanent* feature of financial markets, as otherwise investors/traders would be deprived of the incentive to trade on the basis of their private 'views'. Similarly, Austrian Economics holds that the admission of such a permanent price-value congruence would deprive economic agents of any "incentive to act (Hering, 2000, p. 441; Olbrich and Rapp, 2012, p. 233; Hering, 2014, p. 9)" (Rapp *et al.*, 2017, p. 8), particularly as its presence would negate any opportunity to "upgrade the level of wealth" (*ibid.*; see also Menger, 2007, p. 141; Hochreiter, 2008, p. 3; Taghizadegan *et al.*, 2014, p. 17). Nonetheless, in spite of these *prima facie* parallels, the two accounts fundamentally diverge on conceptual grounds. In fact, these differences, particularly insofar as they relate to the conceptions of *value* and *price*, have already been identified by Rapp *et al.* (2017). They emphasise that Austrian *subjective value theory* (see Menger, 2007, pp. 145-49) provides no room for the *intrinsic value* concept that lies at the heart of the *Value Investing* approach. What Rapp *et al.* (2017) fail to realize, though, is that investment assets inherently

differ from consumption goods, particularly as all of the former are ultimately about the one ‘universal good’,<sup>137</sup> viz. money,<sup>138</sup> and even the agent displaying the lowest degree of rationality imaginable will, if given the choice between \$100 and \$150, *ceteris paribus*, always prefer the latter over the former. As the financial market ‘game’<sup>139</sup> itself is ultimately about the exchange of one cash-flow (stream) for another, every agent will try to end-up with more ‘cash’ than she started with. An ‘objective’ *value*, i.e. the best estimate of these future cash-flows that is epistemologically feasible, can thus be defended as a valid concept. From a *Value Investing* perspective, the *subjective* feature that enters the picture pertains to the individual agent’s respective ‘best guess’<sup>140</sup> as to this ‘objective’ value figure. Hence, it is in this sense that the Buffett (1995) quote, which states that the investor

“calculating intrinsic value necessarily comes up with a highly subjective figure that will change both as estimates of future cash flows are revised and as interest rates move” (quoted in Rapp *et al.*, 2017, p. 16)

that Rapp *et al.* (2017) invoke in support of their argument, is to be understood. What Buffett (1995) is actually referring to in his quote, is not *subjective value* as understood by Austrian Economists, but rather the investor’s *subjective* estimate of that ‘objective’ *value*. In the light of the present discussion, it should be clear that this figure is the result of a sophisticated cognitive process that involves the selection and interpretation of a myriad of (‘multi-dimensional’) data. It is therefore not the aspect of *subjectivity* that is identified by value investors as the “*troublemaker* that hinders the calculation of intrinsic value” (Rapp *et al.*, 2017, p. 17; *italics* in original), but rather, as exhaustively discussed in the present chapter, the factors of *fundamental uncertainty* and ‘*multidimensionality*’.

The Austrian’s fundamentally divergent conception of *value* also entails a fundamentally different conception of the price-formation process. Both the *Value Investing* framework and Black’s (1986) ‘Noise Trading’ account hold that no matter how ‘fuzzy’, how difficult to gauge, there exists an ‘objective’ *value* (see above) that the market *price* will oscillate toward eventually.<sup>141</sup> Such a price behaviour is, however, denied by Austrian *subjective value* framework, after all, as Rapp *et al.* (2017) point out, “if the intrinsic value was a subjective figure,<sup>[142]</sup> whose value judgment would be the one to cause the market price to oscillate?” (p.

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<sup>137</sup> ‘Universal’, because it can effortlessly be transformed into any other good.

<sup>138</sup> i.e., the intrinsic *value* is ultimately about the total ‘cash’ that can be extracted from an investment assets over its lifetime (see Williams, 1938; Damodaran, 2012).

<sup>139</sup> i.e. arbitrage, investing and speculation are the main drivers of financial market activity.

<sup>140</sup> i.e., her *expectations* and the “cognitive ‘model’” they build upon.

<sup>141</sup> It is important to note, though, that the ‘target’ is, due to the system’s continuing evolution, a constantly shifting one.

<sup>142</sup> They are raising this issue from the perspective of Austrian *subjective value theory*.

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Nonetheless, one single – nowadays unfortunately almost entirely forgotten (Bragues, 2012) – work can be identified within the wider Austrian Economics literature that does contain an account of financial markets that is more plausible than the one offered by the modern mainstream; one that in addition is not only largely compatible with the core tenets of the *Value Investing* framework, but which also distinguishes itself by featuring some pioneering research efforts that modern Behavioural Finance has been credited with, almost thirty years before the (sub-)field had emerged within U.S. American academic institutions: L.A. Hahn (1956).

L.A. Hahn is described by Bragues (2012) as a “German banker and investor who made his name in the mid-20<sup>th</sup> century as a critic of Keynesian economics [see Hahn, 1949]” (p. 89).<sup>143</sup> In spite of Hahn’s fundamental disagreement with Keynes on issues pertaining to economics, though, his theoretical account of financial markets is largely compatible with the core tenets of the latter’s ‘mature’ investing framework, which, in turn, largely accords with the *Value Investing* approach (Woods, 2013).

The fact that three successful investment practitioners (Benjamin Graham, J.M. Keynes, L.A. Hahn), who had different educational and cultural backgrounds (Graham: U.S. American; J.M. Keynes: English; L.A. Hahn: German), and who lived and worked in different societies, came, independently from each other, to hold such highly congruent views with regard to certain core aspects of financial markets, seems to suggest that some fundamental insights into the operation of these markets might be gleaned from an analysis of their accounts, particularly with regard to the decision-maker; after all, accounts such as L.A. Hahn’s seem to occupy a middle-ground between the neo-classical EMH, which “exaggerates the rational side of human nature” (Bragues, 2012, p. 89) and Behavioural Finance, which “goes too far in reducing us to slaves of the emotions” (*ibid.*), providing thus potentially a first stepping stone toward a non-dualistic and non-atomistic understanding of the cognitive processes in financial markets.

Bragues (2012) produces the following summary of L.A. Hahn’s (1956) account:

“Hahn argues that stock prices result from a combination of objective and subjective factors. On his account, the influence of mass opinion and mental inertia over most people’s psyches generates sustained divergences from intrinsic values. Sooner or later, Hahn observes, these distortions are corrected by the pull of the objective factors in a process led by a few alert, independently minded investors. In Hahn’s analysis<sup>[144]</sup> [...] [,] financial markets are neither perfectly

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<sup>143</sup> In fact, L.A. Hahn made millions of US-\$ speculating against the Keynesian prediction that the post-WW II US economy would suffer from a drop in aggregate demand (Braunberger, 2009, p. 38).

<sup>144</sup> which Bragues (2012) finds “has stood the test of time” (p. 92).

efficient, nor animally spirited, but eventually adjusting.” (p. 92)

The first critical point to be noted is that Hahn (1956), just like the *Value Investing* and Black’s (1986) ‘Noise Trading’ frameworks, but unlike Rapp *et al.*’s (2017) Austrian account, explicitly allows for the existence of an ‘objective’<sup>145</sup> *intrinsic value*, which can be estimated – even if highly imprecisely so – by the investor using tools such as the Discounted Cash Flow (DCF) model (see Bragues, 2012, pp. 97-99). Further, like the former two accounts, Hahn recognizes the inherent ‘fuzziness’ of such estimates. Bragues (2012) infers this from the fact that in his study of market efficiency,<sup>146</sup> L.A. Hahn “did use the [DCF] model to generate point estimates of the present value of future dividends,” speculating that the underlying motive was “probably [...] the difficulty of forecasting those numbers” (*ibid.*, p. 92). The conjecture is further corroborated by the ontological and epistemological views with regard to financial markets and the investing activity that im- or explicitly underlie his theoretical account, which largely accord, as already pointed out above, with the ones that have so far been distilled from the *Value Investing* framework. Most noteworthy in this respect is, perhaps, his appreciation of the future’s inherent unknowability – e.g., he writes, “it lies shrouded in a mist, beyond the horizon of time” (Hahn, 1956, p. 203) – and his corresponding verdict as to the inapplicability of the probability calculus in the investing decision-process. Bragues (2012) emphasises that the scope of Hahn’s critique of the latter substantially extends beyond the one common to the usual criticism raised against neo-classical (risk) models such as “the mistaken specification of a normal distribution (Dowd and Hutchinson, 2010; Triana, 2009; Mandelbrot and Hudson, 2006), or the input of insufficient historical data” (Bragues, 2012, p. 112). For L.A. Hahn, “the problem lied in thinking that numerical probabilities could even be assigned at all” (*ibid.*). Instead of resorting to the type of subterfuges that neoclassical finance used to facilitate the modelling of financial market and agents’ decision processes by means of a closed-system methodology, viz. assuming *small worlds* inhabited by *small minds* (see Chap. 1), L.A. Hahn opts for an approach that is significantly more productive in terms of developing a thorough understanding of financial market processes, one kindred in spirit to the one adopted by the present work, and turns his attention to the actual decision-maker herself. Lacking the insights from cognitive science that we have at our disposal,<sup>147</sup> L.A. Hahn (1956) choose to resort to the field that had instigated the investigation into matters pertaining to the mind, i.e. philosophy (see Gardner, 1987). Just like Keynes before him (see Carabelli, 1988; Runde and

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<sup>145</sup> By ‘objective factors moving stock prices’ L.A. Hahn “means all market relevant phenomena operating externally to investor minds compelling their rational faculties towards similar evaluations” (Bragues, 2012, p. 113).

<sup>146</sup> Bragues (2012) emphasises that Hahn (1956) used the DCF model he had forwarded “to test its predictions of intrinsic value against market prices [...], [...] anticipat[ing] the centrepiece of Robert Shiller’s (2000, pp. 184-190) brief against market efficiency” (p. 98).

<sup>147</sup> The enterprise was just getting started at the time L.A. Hahn was writing his book.

Mizuhara, eds., 2003; Dow, 2009, 2011), he draws on David Hume's (1739-40) work:

“Hahn goes so far as to invoke David Hume's (1978, pp. 127-130) contention that probability assessments are subjective mental acts. One simply feels inclined in favour of one outcome rather than another, with the level of intensity felt varying roughly with the preponderance of that outcome relative to other scenarios in one's previous experience.”<sup>148</sup> (Bragues, 2012, p. 113)

Hahn's (1956) pioneering effort thus takes us right to the heart of our research project, which proposes the abandonment of the logic-mathematical conception of the individual and the corresponding methodological approach that have been dominating modern financial market research ever since its inception in the 1960s (see Chap. 1) and suggests the development of a proper cognitive science research program that is tailored specifically to the issues arising in financial market research, addressing particularly L.A. Hahn's (1956) insight that “as the future is ultimately incomprehensible [...] the mind is liberated to conceive numerous scenarios in line with its psychological propensities” (Bragues, 2012, p. 97), an observation that we, who are, unlike L.A. Hahn, in a position to build upon a sound knowledge base of modern cognitive science, interpret as referring to the aforementioned – albeit within the confines of the present restricted work, still highly vague – concept of a “cognitive ‘model’” and its role in the expectation formation process of investors. We shall return to and elaborate on these matters in Chapter 3. In the remainder of the present section we shall try to frame several of the issues raised by Hahn (1956) with a view toward leveraging his insights for our aforementioned goals.

First, it needs to be clarified that – in spite of L.A. Hahn's (1956) reference to David Hume's (1978, pp. 127-130) “contention that probability assessments are subjective mental acts” (Bragues, 2012, p. 113) – our project is in no way to be understood as a return to the type of *psychologism*, fervently criticised by Frege (1884, 1893, 1894, 1918) and Husserl (1900), that postulates that logic (or, in our case, the probability calculus) “*emerges from* the (subjective) psychology of people” (Pelletier *et al.*, 2008, p. 2; *italics* in original). Our core concern shall lie with the aforementioned “cognitive ‘model’” and the related expectation-formation processes that underlie financial market processes. For the purposes of our present work, the ‘subjective mental acts’ that L.A. Hahn (1956) refers to are therefore interpreted accordingly. Nonetheless, in spite of the undoubtedly important role of *subjective* aspects in the process (i.e., particularly insofar as they relate to the factor of *consciousness*), a more plausible conceptualisation of such cognitive factors underlying financial market processes also needs to consider the following *objective* issues that have – apart from the first one<sup>149</sup> – already been

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<sup>148</sup> See Part II of Chapter 3.

<sup>149</sup> For obvious historical reasons.

raised, in one form or another, by David Hume and other representatives of the Scottish Enlightenment (see Dow, 2009, 2011): (1) The human agent and her ‘cognitive apparatus’ are the products of an evolutionary process (Gintis, 2007; Smith, 2008); (2) The rationalist dualist distinction between ‘reason’ and ‘emotion’ is untenable as the latter has been found to play a not insignificant role in ‘rational’ decision processes (e.g., Damasio, 1994, 2000); (3) Cognition and the emotion it rests upon “both have an important social dimension” (Dow, 2011, p. 234).

An important issue to be acknowledged and addressed in this enterprise is that albeit the development of a sophisticated account of the single factors just alluded to in the paragraph above is necessary for the formulation of a proper theoretical account of the cognitive processes driving financial markets, it will be deficient without a detailed understanding as to the way these various factors relate to, interact with and affect each other on the various identifiable levels. The significance of the latter can be discerned from the fact that the occasional malfunctioning of financial markets can reasonably be attributed to certain interplays between various *internal* and *external* factors and processes – whose explication at this point would exceed the allocated space – that result in a convergence and thus a homogenisation of ‘views’ (i.e., “cognitive ‘models’”) and ‘expectations’ in financial markets, depriving them thereby of the – for their ‘efficient’<sup>150</sup> operation necessary – *diversity of views* (see Surowiecki, 2008), which, in turn, can lead to significant price-value incongruences and, in extreme cases, to ‘bubble-crash’ sequences. Hence, contrary to Hayek’s (1945) own ‘anti-rationalist’ stance (see also Hayek, 1967) and understanding of markets, the “individual errors” of the “very irrational and fallible [human] being” are not always “corrected [...] in the course of social processes” (Hayek, 1945, pp. 8-9); indeed, in the case of financial markets, they might even be amplified and potentially even turn endemic through the very cognitive processes the present work proposes to be systematically analysed.

Having thus established some of the preliminaries, we are now in a position to apply the insights hitherto produced in the present chapter, in conjunction with the following logical sequence of the steps leading up to the formation of a “cognitive ‘model’”,<sup>151</sup> i.e.:

- (1) The gathering of data,  $\tau$ ;
- (2) The identification of relevant data, i.e. ‘information,’  $\rho$ , i.e.  $\rho \subset \tau$ ;
- (3) The identification of the relevant aspects of that ‘information,’<sup>152</sup>  $\alpha$ , i.e.  $\alpha \subset \rho$ ;

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<sup>150</sup> ‘Efficient’ in the sense that market prices move within a reasonable band around the ‘objective’ price-value congruence. See the discussion in the main text, particularly in regard to Fischer Black’s (1986) ‘noise trading’ framework.

<sup>151</sup> And they continue to influence it over time, as (cognitive) ‘models’ are not static but dynamic in nature as new information and/or varying *internal* and *external* influences keep ‘updating’ and modifying them on a continuous basis.

<sup>152</sup> See discussion in Section 3 in regard to the ‘multi-dimensionality’ of reality.

- (4) The formulation of a ‘model’ of the relevant aspect of reality by combining the elements of  $\alpha$  in a rational manner via the process  $\phi$ .

to provide a rudimentary sketch as to how the aforementioned Humean insights adopted by L.A. Hahn are to be understood in the light of the larger project.

First, as exhaustively discussed in the earlier sections of the present chapter, the agent, in her role as a stock market operator, faces a highly complex and ‘multidimensional’ reality that raises certain computability issues. Further, as has been established by the line of research pioneered by Herbert Simon, the *human* agent’s cognitive capabilities are inherently limited, particularly on the computational level, which leaves her no choice but to *satisfice* rather than *optimise* (Simon, 1983). In addition, L.A. Hahn’s (1956) work, particularly the Humean account he draws from, suggests that the agent in financial markets is a decision-maker of an *embodied* and *embedded* type,<sup>153</sup> i.e. both corporal factors, such as emotions, and factors in her wider environment, such as fellow ‘market participants’, influence her ‘view’ of reality and accordingly her decisions. Given these factors and constraints, the agent’s task is now to apply her experience, judgment and conscious effort to ‘re-calibrate’ the specifications of her own “cognitive ‘model’”, which, it ought not to be forgotten, produces her subjectively perceived reality, in such a way that *internal* as well as *external* distorting influences and cognitive errors are minimized.

To illustrate one possible way the hitherto discussed factors might interact with each other to produce the temporary price-value incongruences postulated by L.A. Hahn and the *Value Investing* framework, consider the following: Let’s assume that agent A’s ‘experience’ (i.e., an ‘acquired’ *internal* factor) has cognitively ‘marked’ a certain (type of) data point (among the myriad of available data,  $\tau$ ),  $a$ , to be of particular value in the (cognitive) ‘modelling’ of economic reality. In other words, every time  $a$  constituted a member of A’s information set  $\rho$ , i.e.  $a \in \rho$ , the ‘model’ has proven more accurate than in its absence, i.e.  $a \notin \rho$ . This ‘mark’ in the agent’s memory with regard to  $a$ ’s reliability will be strengthened every time the latter is corroborated by a new experience, increasing thereby the likelihood of its inclusion in subsequent “cognitive ‘models’” for similar decision tasks/environments. Further, depending upon its type, rank and weighting in relation to other elements in the information set,  $\rho$ , it will have a marked influence upon the eventual structure and form of the “cognitive ‘model’”. The *perceived* relevance of  $a$  might, however, also originate in a source *external* to the agent; for instance, her fellow ‘market participants’ might provide certain signals to that effect. The agent, trying to orient herself within this complex environment, might opt to embrace this suggestion and update her “cognitive ‘model’” accordingly. In either case, the presence of such *internal*

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<sup>153</sup> See Glossary: ‘Embodied Cognition’, ‘Embedded Cognition’.

and/or *external* influences might result in a (sub-conscious) re-configuration of the “cognitive ‘model’”, altering the subjectively perceived reality and hence the perceived desirability of a certain course of action; a suggestion to that effect can be found in L.A. Hahn’s (1956) account:<sup>154</sup>

“One simply feels inclined in favour of one outcome rather than another, with the level of intensity felt varying roughly with the preponderance of that outcome relative to other scenarios in one’s previous experience.” (Bragues, 2012, p. 113)

This example of a potentially distorting influence upon the agent’s “cognitive ‘model’” demonstrates the importance of her constant conscious vigilance and underscores the significance of the application of sound judgment and the required mental effort to override any (or at least as many as possible) of such biases for maximising her chances of survival and success within the financial market environment.

In clear contrast to the tenets of neoclassical finance, L.A. Hahn (1956) explicitly recognises the potentially *contagious* nature of certain cognitive errors that can be traced, most significantly, to the inherently social nature of the human agent more generally and of the knowledge formation process more specifically; an insight, which leads him to an understanding of financial markets that would be at odds with the modern EMH. Bragues (2012) summarises:

“In evaluating the efficiency of markets, the question thus becomes: do the expectations have a tendency to be on the mark? Prediction errors are inevitable, of course, but if these turn out to be normally distributed around realized levels then the argument for market rationality is greatly strengthened. It is precisely the contention of the EMH that the market’s forecasting mistakes are normally distributed. As such, the subjective element in expectations is rendered mathematically tractable by the application of statistical techniques. The result is that expectations are objected, so to speak, by virtue of being construed as a mechanism reflecting the real probabilities of events. But if expectations err universally and systematically, the human subjectivity cannot be viewed simply as a mirror to the objective world, and must instead take on the character of a truly independent cause of market phenomena. This is exactly Hahn’s point.” (Bragues, 2012, p. 97)

In fact, as discussed by Bragues (2012), L.A. Hahn (1956) formulates his account of financial markets on the basis of “a number of psychological claims that show Hahn foreshadowing

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<sup>154</sup> who draws, as outlined above, on David Hume’s work.

elements of BF [i.e., ‘Behavioural Finance’]” (p. 110). What is of particular interest to our work, is the particular psychological factors L.A. Hahn comes to identify as the, arguably, defining ones in these markets, at least insofar as their observed ‘behaviour’ is concerned, because they might provide a first suggestion as to how the insights from modern cognitive science – such as Lakoff’s re-interpretation of Kahneman’s and Tversky’s results in terms of ‘mental models’ (see Chap. 1) – might be applied to the financial market setting. The following excerpt from Bragues (2012) provides a brief overview:

“By asserting that investors rely on recent trends in forming their expectations, and thus project the recent past onto the future, Hahn is alluding to what cognitive psychologists nowadays refer to as the recency effect, which itself is a variation of the availability bias [...] The mental inertia, too, that Hahn invokes is equivalent to conservatism bias. When he proceeds to outline the implications of this market theory to investing strategy, he cites a third psychological trait, namely the individual’s subjection to mass opinion. ‘It engulfs not only those who easily succumb to foreign influences but even those with normally detached views and sober judgment. An almost superhuman effort is needed to evade the influence of mass opinion’ (*ibid.*, p. 212). What this groupthink does, clearly, is to magnify the predominant trend that the *Zeitgeist* of the period happens to be buttressing. Continuing in this Tocquevillean vein, Hahn even suggest that the democratization of the stock market enhances this dynamic, insofar as the widespread dissemination of prices enables investors to quickly assess what the majority is thinking (Tocqueville, 1969, pp. 254-259).” (*ibid.*, p. 110)

On the basis of this understanding of human psychology, L.A. Hahn (1956) comes to hold the following view of financial markets:

“In place of an efficient market model, Hahn describes the stock market as subject to recurring cycles in which subjective and objective factors combine to set prices. Though the subjective forces of psychology, consisting of mental inertia and dependence on mass opinion, regularly take prices either above, or below, levels dictated by the objective facts, the latter do act as a magnet checking the movement of the former.” (Bragues, 2012, p. 115)

In L.A. Hahn’s (1956) theoretical framework, “financial markets are” thus, as noted by Bragues (2012, p. 89), “neither efficient nor animally spirit, but eventually adjusting.” This is a view that most value investors, and probably certain Behavioural Finance researchers such as Robert Shiller, would likely subscribe to. Nonetheless, the difficulty that supporters of this views and detractors of the EMH face lies in the formulation of a viable alternative framework

that turns this ‘Folk-theoretic’ account into a scientific one. Indeed, this also constitutes one of the major challenges besieging the Behavioural Finance program, which is – constrained by the neo-classical framework – unable to provide a proper descriptive as well as explanatory account on the macro-level. It is for this reason that the present thesis endeavours to inquire into the necessities and possibilities for an alternative conceptualisation of the cognitive processes in the financial market setting, which we consider to be one of the necessary preliminaries to the development of a viable alternative to the EMH. In Chapter 3, we shall take the project a step further by scrutinizing the existing alternatives to the EMH within the relevant literatures in order to identify those shortcomings that ultimately disqualify them from assuming that role, before a possibly more constructive way forward is sketched out. In the remainder of the present chapter, we shall, on the basis of the insights produced so far, produce a speculative outline of the potential factors and mechanisms involved in the development of major price-value incongruences.

#### *4.4 Factors and Mechanisms underlying Major Price-Value Incongruences*

Now, as a few of the preliminaries have been established, a tentative attempt shall be made to formulate a (very sketchy) conceptualisation of the central cognitive processes that are likely to underlie phenomena characterised by major price-value incongruences, underscoring thereby the relevance of the present and proposed future project.

As discussed above, major price-value incongruences are usually the result of an unsustainable homogenisation of beliefs, views, and expectations across the wider investing community. So, what factors and mechanisms are likely to be responsible for this phenomenon of ‘cognitive convergence’? Part of the answer can already be found in Bragues’s (2012) exposition of Hahn’s (1956) account, particularly in his reference to the dynamics of *social imitation* (i.e., “fashion”) and *emotion* (i.e., “fear and greed”). These are, indeed, factors whose potentially destabilizing influence has been raised in a wide range of literatures. For instance, the sociologist Michael Klausner (1984) stresses that

“[t]he behaviour of financial markets is very much a social phenomenon. People’s decisions to buy, hold or sell securities are greatly influenced by what others are saying and doing.” (*ibid.*, p. 57)

Similarly, Adler and Adler (1984a) argue that “[p]eople tend to herd together and sometimes irrationally imitate each other’s behaviour” (pp. 196-7).<sup>155</sup> Michael Mauboussin (2009) writes that

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<sup>155</sup> See also Adler and Adler (eds.) (1984).

“information cascades occur when people make decisions based on the actions of others rather than on their own private information. The cascades help explain booms, fads, fashions, and crashes” (p. 502).

The phenomena of *social imitation* and *social infection* have also been popular topics in Behavioural Finance (see, e.g., Shiller, 1984, 1989; Camerer, 1989). Camerer (1989), for example, explains that

“Fads are mean reverting deviations from intrinsic value caused by social or psychological forces like those that cause fashions in political beliefs or consumption goods.” (p. 3)

Keynes (1936) explicates the influence of mass psychology on the reasoning and trading behaviour of both professional investors and speculators in Chap. 12 of his *General Theory*:

“They are concerned, not with what an investment is really worth to a man who buys it ‘for keeps’, but with what the market will value it at, under the influence of mass psychology, three months or a year hence.” (Keynes, 1936, p. 155)

Further, various attempts have been made to incorporate the above into coherent models of the financial market (e.g., Vaga, 1990; Rapp, 1995; Rapp, 1997).

The other factor referred to above, i.e. *emotion*, and its relevance to financial market activity has also been the topic of various literatures, including the Post-Keynesian literature (e.g., Dow, 2010, 2011), the Behavioural Finance literature (e.g., Elster, 1998, 1999; Berezin, 2003) and the psychology literature (e.g., Tuckett and Taffler, 2008; Tuckett, 2009).

The above constitute the two factors most frequently invoked in the explanation of major price-value incongruences – or, colloquially, the ‘madness’ of financial markets, epitomized by the respective extremes of *bubbles* and *panics* – both in the popular accounts such as Mackay’s (1996), but also, as illustrated above, in the various academic literatures. It needs to be noted, though, that emotional influences are not necessarily of a detrimental nature when it comes to ‘rational’ decision-behaviour; in fact, in certain experiments it has been demonstrated that some of these are even indispensable for ‘rational’ decision-behaviour in human beings (e.g., Damasio, 1994, 2000). Hence, to the extent that emotions simply form a constituent of the human ‘decision apparatus’, they are neither inherently positive nor inherently negative; or, as Paul and Moynihan (2013) phrase it: “Emotions are neither good nor bad; they simply are. They cannot be avoided” (p. 102). It is only once the individual succumbs to *emotionalism* – which *can* be avoided through proper training, self-control and (institutional) safety-measures – and begins to act *primarily* on the basis of certain emotions, will rationality give way to irrationality (Paul and Moynihan, 2013). It does, of course, happen from time-to-time that a

particular individual will succumb to a certain emotion such as panic in the absence of an overt external trigger that will lead to irrational behaviour on her part but, by the very nature of such an incidence, it is likely to remain an isolated case, without any further repercussions for the wider financial market. Nonetheless, human decision makers are generally susceptible to a common inborn tendency that *can* trigger such a collective ‘emotionalism’, namely, the dread of uncertainty (Paul and Moynihan, 2013), which generally induces a certain level of anxiety that human agents try to alleviate via a recourse to *external* guidance. Acting as part of a group (or ‘crowd’) and imitating the behaviour of others will impart an, albeit often illusory,<sup>156</sup> sense of certainty. As financial market activity is fundamentally determined by social processes (Adler and Adler, 1984), though, it is only their extreme manifestations that instigate unsustainable price developments. Even those, however, do not necessarily result in the type of extreme market-wide ‘emotionalism’ that characterised the later stages of infamous manias such as Tulip Mania and the dot-com bubble.

The research community’s general emphasis on the role that ‘emotionalism’ has played in various financial market episodes has, however, led to an almost entire neglect of those cognitive factors and mechanisms that were involved in those instances of significant market-misfunctioning where ‘emotionalism’ did not play the core (cognitive) driving force behind the blunder. Hence, albeit the (sub-)field of behavioural finance might be able to provide a coherent and consistent descriptive account of (some of) the *cognitive processes* at work in the significant mispricing of securities that characterised certain high-tech sectors in the late 1990’s (i.e., the ‘dot-com bubble’) and perhaps even bolster it with germane empirical evidence, it is unable to do so for the systemic mispricing of risk that eventually culminated in the 2008-09 Financial Crisis. The reason for this incapacity has been explained in Chapter 1 of the present thesis: Due to the predominance of the neoclassical framework, the behavioural (finance) economist’s descriptive/explanatory capacity is largely limited to certain ‘biases’ and other ‘limitations’ of the human mind that the research enterprise has uncovered and categorized on the basis of certain observed behavioural deviations from the neoclassical normative model. Not even to mention the risk of the serious mis-categorizations and -interpretations that might arise from the application of a normative framework devised for a static closed-system environment to the assessment of open-system behaviour (see Chap. 1), the best that such an attempted explanation by way of invocation of certain isolated ‘biases’ can amount to is a tentative, unsystematic ad-hoc speculation, because the (sub-)field’s empirical findings have never been systematized within a coherent and consistent *positive* theoretical account of cognition, neither on the micro- nor on the macro-level. Further, it is also the absence of the latter that impedes behavioural finance from providing a *full* account

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<sup>156</sup> Particularly in financial markets!

of the *cognitive processes* involved in the aforementioned cases where ‘emotionalism’ plays a core role. The purpose of the present work is, of course, to uncover these gaps in the literature and to provide some of the preliminaries required for the development of such a framework. As can be inferred from the discussion so far, the primary building blocks for a more plausible conceptualisation of factors and mechanisms pertaining to cognition, as they apply to the individual stock market operator as well as the stock market more generally, are likely to be the following: First, the ultimate (biological) unit of execution is the human individual,<sup>157</sup> i.e. investing and trading decisions are solely made by human individuals and are executed by individuals. Secondly, the “cognitive ‘model’” with its syntactic (logic), semantic (meaning), pragmatic and relational components determines the way the individual comes to subjectively perceive and understand a certain aspect of reality, wielding thus a major influence upon her ultimate decision-act. As previously mentioned, the emotional component plays a certain role, too, and, in extreme cases, might even come to override the more ‘rational’ processes associated with the “cognitive ‘model’”. Thirdly, the agent’s decision behaviour can only ever be markedly altered through a modification of one of the above. For instance, a particular semantic component,  $\check{s}$ , has value 0 (i.e.,  $\check{s} = 0$ )<sup>158</sup> if the number of agents,  $n$ , is less than 3 (i.e.,  $n < 3$ ). If  $\check{s} = 0$ , then all the agents present will act in way  $x$ . Once  $n \geq 3$ , though, the presence of two other agents will (perhaps for reasons to be found in the species’ evolutionary past), will trigger a certain mechanism internal to the biological individual that will cause  $\check{s}$  to switch to 1 (i.e.,  $\check{s} = 1$ ). If  $\check{s} = 1$ , then all the agents present will suddenly act in way  $y$ . The overall behavioural dynamic has thus changed. Fourthly, the biological individual might be able to enhance her cognitive capabilities by means of hooking onto certain forms of an *extended cognition* that might be provided, for example, by the institutional framework (see Introduction to the Thesis).

The allocated space does, unfortunately, not permit a full elaboration of these important topics. What *can* be attempted in the remainder of the present section, though, is a speculative outline as to how major price-value incongruences might arise in the absence of ‘emotionalism’ on the basis of the aforementioned alternative conceptual elements. In this way, we are able to pick up the thread of the present core discussion while providing a few critical – even if highly speculative – insights with respect to the latter.

Turning thus to the question as to how major price-value incongruences might arise in the absence of ‘emotionalism’, we are hard-pressed to identify other cognitive elements and/or mechanisms that might be causally relevant in the homogenisation of beliefs, ‘views’ and

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<sup>157</sup> We focus primarily on the *human* stock market operator in the present work, because all of the major alternative finance accounts we are drawing our inferences for an alternative conceptualisation from (i.e., Graham, Keynes, Hahn) had been developed before the advent of the A.I. trader.

<sup>158</sup> Applying here the binary code: 0 = Off, 1 = On.

expectations across the wider investment community. As outlined above, the individual agent's 'view' can only be altered via a modification of a certain component of her "cognitive 'model'"; in this case, it is not the 'emotional component', but perhaps one of the syntactic-semantic aspects of the "cognitive 'model'", which is altered through the interaction with other agents. If this is the case, we have a homogenisation on this level, not the 'emotional' one. The price-value incongruence might thus not result from an absence of 'reason' and 'rationality', but rather result from the perception (determined by the syntactic-semantic aspect of the "cognitive 'model'") that a particular course of action seems to be the 'reasonable' one. The violation of the necessary criteria for (at least approximately) informationally efficient markets might thus follow via the contagion of the "cognitive 'model'" with a certain (deceptive) 'rationality' element. This process operates much more subtly than 'emotionalism' ever could and can, by its very nature, not be *a priori* avoided: It 'infects' the individual's cognitive 'decision apparatus' via the normal (and necessary) processes involved in knowledge creation and the formation of the respective "cognitive 'models'" that determine the individual's view of reality and consequently her decision-acts. The stock market operator can, for example, not act entirely 'solipsistically' when it comes to determining as to what counts as a 'reasonable' valuation level. The reason for this is that financial market prices are purely psychological constructs (Dow, 2011), which are the result of interacting agents that operate on the basis of their respective "cognitive 'models'". This means that at any time there are certain shared conventions that underlie the price-formation process – this being a *social* process, after all –, which generally happen to be a product of their time. A very insightful glimpse into their evolution over time can be gained by the analysis of the various editions of Benjamin Graham's and David Dodd's *Security Analysis* (1934, 1940, 1951, 1962, 1988, 2008), where valuation criteria were constantly updated in order to take account of such changes. For instance, Graham's original approach that primarily focused on 'net-net' opportunities (i.e., companies whose market prices were below their liquidation value) became obsolete during the booming post-WW era, and any investor waiting for market price valuations to return to the levels of the 1930's would do so in vain. This means that the investor is compelled to take into account certain criteria that determine the current 'picture' of economic reality as reflected in the stock-market prices. In other words, she has to surrender (at least part) of her *cognitive independence*, and the "cognitive 'model'" she forms must, to a certain degree at least, 'hook' onto the existing ones in the market, which will make it susceptible, of course, to potential 'infections' with certain distorting elements, and these might also be of a 'syntactic-semantic' (i.e., 'logic and rationality' elements) kind. If certain distorting 'syntactic-semantic' elements are introduced, then the internal 'logic' of the "cognitive 'model'" will be such that the formulation of certain questions with regard to the underlying economic reality is not even permitted/possible, which might blind the individual – and in the case of a system-wide

infection the larger investing community – with regard to certain shifts and developments in the former and consequently lead to a divergence of reality as perceived through the lens of the respective “cognitive ‘models’” and reality proper and, thus, give rise to certain ‘Blind Spots’.

The detection of contagious ‘(il)logical and (ir)rational elements’ within the wider system is almost impossible, because almost everyone operating in that environment will acquire them at one point or another, largely unconsciously and hence uncritically. Further, once these elements have been ‘installed’, any decisions and actions deduced from the ‘model’ seem perfectly logical and rational, and judged from *within* it, they often *are*. Consequently, any criticism raised against the currently dominant ‘model’ is *seen* as being illogical and irrational, at least until the divergences between reality as perceived and reality proper become so large that the faulty syntactic and semantic nature of a particular “cognitive ‘model’” is recognised and it is either significantly modified or discarded in order to be replaced by another; in the wider market, such an ‘epiphany’ will result in a ‘Sudden Death’ event (see Rapp and Cortés, 2017). Up to that point, however, any criticism raised will be considered to be ‘irrational’ (e.g., warnings of a looming credit crisis in the years 2005-7). Further, certain safety measures that might have been implemented after a certain financial crisis in the past, might come to be seen as no longer adequate and necessary, as they no longer correspond to the *new* logic and rationality of the *Zeitgeist* as infused in the currently dominant “cognitive ‘model’”. Hence, albeit a financial crisis such as the one experienced in 2008-09 might lead to the detection and discarding of certain of these unsustainable elements, they will, most likely, re-appear in the next cycle and, once again, lead to the revocation of certain institutional safety measures.

The key to a proper understanding of the foregoing discussion is to be found in the internal\*-external\* distinction,<sup>159</sup> i.e. the difference between the subjective ontological perspective of the individual who operates *within* a specific “cognitive ‘model’” and the objective ontological perspective, which determines the suitability of a particular “cognitive ‘model’” and its respective internal ‘logic and rationality’ elements with respect to the underlying (objective) economic reality. At this point it needs to be emphasised, though, that *one* singular objective view can never be reached, but a variety of different independent ones can provide insights into the degree of the suitability of one specific “cognitive ‘model’”. In the end, this is precisely why a reasonable approximation – however imperfect it might be (see Black, 1986) – of price-value congruence is given in the financial markets if the necessary criteria are met; and in the case of a violation of the latter, it is the value investor’s task to try to identify the erroneous ‘logic and rationality’ element(s) in the dominant ‘model’ that she can exploit to her

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<sup>159</sup> The asterisk has been added in order to distinguish the use of the term from the one in regard to the *internal* and *external* factors that influence or determine decision processes, such as emotions and social aspects, respectively.

advantage. Hence, albeit perfection can never be attained in the perception of the *objective* reality *as it is*, and thus the *objective* accuracy of a particular ‘model’ never perfectly assessed, it is at least feasible to do so in terms of degrees.

Thus, we have an internal\* part consisting of the respective ‘logic and rationality’ (and semantic) elements of a particular “cognitive ‘model’”, determined by both *internal* as well as *external* factors, which provide a specification of the syntactic and semantic tenor as well as the relational aspects between elements that determine the agent’s view of the world and consequently her ‘hypotheses’ and decision-actions. The internal\* can thus be considered as the *cognitive* part. The external\* part, on the other hand, is of a more practical nature and is concerned with the adequacy of a particular ‘model’ with its respective internal\* elements in respect to a particular economic reality (and its dynamics).

So, how does it work? If an individual engages in a trading or investing activity, her cognitive ‘decision apparatus’ will, largely unconsciously, construct the best possible “cognitive ‘model’” for the determination of *value* and to guide her decision-acts. The logic and rationality elements given by the *internal*, i.e. the nature of the cognitive ‘decision apparatus’ itself, pre-existing ‘models’ built through past experience, etc., as well as *external* factors, i.e. the ‘logic and rationality elements’ underlying the actions of her fellow market participants. These will determine the ‘salience points’, the identification and interpretation of information, the perception and estimation of *worth* as well as her consequent decisions and actions. Each ‘model’ thus constitutes its own framework of logic and rationality that allows the formulation of certain internal\* questions as to the underlying reality and the deduction of a specific set of ‘rational’ decisions and ways of conduct. Once the ‘model’ is deemed too unreliable, it is either amended or, if that is not feasible, discarded and a new one constructed, as it happens in major market panics, where the core ‘logic and rationality elements’ surface as untenable.

#### 4.4.1 A.I. to the rescue?

If one accepts the alternative conceptualisation of cognitive factors and processes in financial markets that has thus far been presented, one might be tempted to blame the emergence of major price-value incongruences merely on the idiosyncrasies of the *human* decision maker. This would miss the point, however, and demonstrate a misunderstanding of the fundamental issues involved in the process of cognition in such environments in general, not only as they pertain to the human decision maker. Every agent, whether human or not, has to operate on the basis of a certain “cognitive ‘model’”, which necessarily will have certain specified syntactic and semantic components to it that will necessarily lead to one particular understanding of the world around it. It is for this reason that many, who, like Marwala and Hurwitz (2017), have hoped that the proliferation of artificial intelligence in financial markets

will render the EMH essentially true, as it will suffer from none of the human ‘idiosyncrasies’ discussed above (i.e., ‘biases’, ‘emotionalism’, etc.).

The question as to what financial markets would look like once they come to be entirely dominated by A.I. traders has already been raised by Rapp and Cortés (2017, pp. 62-3). Although the authors concede their inability to assess the likely impact of ‘true’ A.I. traders, i.e. the type that inhabits the visions and prophecies of – usually over-enthusiastic – computer scientists and whose reasoning power resembles or even exceeds that of the human counterpart – primarily for the reason that they, just like everyone else, have no idea what kind of ‘intelligence’ such types would actually display, how they would reason, operate, etc. –, insofar as the currently technically feasible and, partly, already widely-used algorithms (e.g., ‘Algo-Traders’ and ‘Robo-Advisors’) are concerned, they are highly sceptical with regard to the aforementioned hopes for more efficient and more stable markets: on the one hand, because there exists a high likelihood that their programmers feed their own respective path-dependent “cognitive ‘models’” into their codes and, on the other, because their general degree of diversity is very low. An unforeseen market development, they warn, could trigger an immediate one-sided positioning, with the only potential counterparties remaining likely to be human traders. The various ‘Flash-Crash’ episodes that have been observed in the last decade have already revealed the inherent dangers of these tools. The factor of contagion with respect to certain ‘(il)logic and (ir)rationality’ elements touched upon above might further undermine the hope in efficient and stable markets on the basis of technological advances.

The limited space precludes, unfortunately, a more comprehensive elaboration of these highly relevant and interesting topics at this point. Nevertheless, this brief sketch should have provided a first glimpse into the depth and complexity of the cognitive aspects involved in financial market processes and illustrated why a reduction (or elimination?) of the human aspect might not automatically lead to the consistently informationally efficient markets envisioned by neoclassical finance.

## **Conclusion**

Having had exposed the inadequacy of the conceptualisation of cognition that underlies current mainstream finance research efforts (both neo-classical and behavioural finance) at the level of ontology, methodology and the use of methods in the previous chapter, the present chapter has begun with the formulation of a first outline of an alternative, likely more plausible conceptualisation of cognitive factors and mechanisms as they pertain to both the individual stock market operator as well as the financial markets more generally on the basis of a critical analysis of a practitioner’s – the *Value Investing* – framework, complemented by relevant

insights from largely compatible heterodox accounts of finance. The first part of the chapter has focused primarily on the exposition of the ontology of the decision-environment that any ‘cognitive apparatus’ is confronted with when engaged in the ‘stock market game’. The primary factors that have been identified are: (a) the open-system nature of financial markets; (b) the presence of ‘fundamental uncertainty’; and (c) the ‘multidimensionality’ of this reality that the agent needs to process in order to form the necessary interpretation that serves as the basis for her respective ‘views’ and expectations and consequently her trading decisions. The fact that any ‘cognitive apparatus’ that intends to survive in these markets must be capable of dealing with these realities, has allowed to draw certain inferences with regard to the cognitive processes involved. These insights have been corroborated and supplemented by the subsequent identification and analysis of the ontological and cognitive aspects that necessarily have to be present in financial markets in order for the latter to operate in the way they do: (a) If the neoclassical conception were to apply, all trading activity would immediately cease. (b) The information economics’ conception would – under highly restrictive (and unrealistic) assumptions – permit a certain low-volume trading activity, something which contradicts any actual experience of financial market activity. (3) A superior conception is provided by Fischer Black’s (1986) ‘Noise Trading’ account, not surprising perhaps if one considers that it effectively constitutes a bridging framework between information economics and behavioural finance. Indeed, it is able to explain both the high trading volumes as well as the occasional wide price-value incongruences that can be observed in actual financial markets. Unfortunately, Black (1986) fails to be sufficiently specific with regard to the core concepts that underlie his framework and arguably introduces a certain unwarranted dichotomy, i.e. ‘information vs. noise’ and ‘information trader vs. noise trader’, which, at certain points, he relativizes, though, creating thereby a certain inconsistency within his account. As a proposed alternative, we introduced certain elements drawn from our previous discussion as well as more specific inferences from the *Value Investing* framework and L.A. Hahn’s account. The tentative conceptual framework thus produced appears to overcome the inherent inconsistencies of the neoclassical and information economics’ accounts and the possible dichotomy present in Black’s (1986) account, while, in addition, providing more concrete insights into the possible underlying cognitive processes than the latter ever could. Chapter 3 shall proceed by attempting to identify a theoretical as well as methodological framework that permits to weave the envisioned re-conceptualisation of financial markets on the basis of the preliminary building blocks produced in the present chapter into the existing economics/finance discourse and to develop a more appropriate research framework for the study of financial market processes that is able to overcome the impasse of behavioural finance (see Chap. 1).

## Chapter 3

### Introduction to Chapter 3

The present chapter shall attempt to identify a theoretical as well as methodological framework that permits to weave the envisioned re-conceptualisation of financial markets on the basis of the preliminary building blocks produced in Chapter 2 into the existing economics/finance discourse and to develop a more appropriate research framework for the study of financial market processes that is able to overcome the impasse of behavioural finance (see Chap. 1).

Considering the multiplicity of aspects such a comprehensive study of cognitive processes in financial markets will necessarily have to entail (e.g., perception, interpretation, decision-making, consciousness, A.I.) as well as the general tendency of research efforts into issues pertaining to cognition to be of an interdisciplinary nature (see Gardner, 1987), it seems reasonable to opt for a commensurate methodological approach for our proposed research enterprise, which we shall dub ‘Cognitive Finance’. Ours is, however, not the first proposal for an interdisciplinary approach to the study of cognition and/or decision behaviour within the wider economics/finance literature. Indeed, apart from the behavioural finance program, which, in itself, constitutes an interdisciplinary research project, the following contestants can be identified: (1) Rapp and Cortés (2017) proposal for a ‘Cognitive Finance’ research program (Sect. 1.1); (2) Gintis’ (2007, 2014) proposal for the *Unification of the Behavioural Sciences* (Sect. 1.2); (3) Andrew Lo’s (2004, 2005) *Adaptive Market Hypothesis* (Sect. 1.3); and (4) the *Santa Fe Artificial Stock Market Model* (Sect. 2). A critical analysis of these existing accounts shall, in the first instance, demonstrate that each one of them fails, for one reason or another, short of the requirements that a more appropriate scientific approach to financial markets in the light of the insights produced in Chapter 2 necessitates, establishing thereby the necessity for a new framework. Nonetheless, both their respective strengths and weaknesses shall provide valuable lessons for the formulation of a methodologically more appropriate approach. Further important inspirations shall be drawn from the works of Johannes von Kries (i.e., one of Keynes’ most important intellectual influences in regard to human decision-making; Sect. 2.3) and F.A. Hayek (Sect. 2.4). Both pioneered important conceptual and theoretical insights with respect to human cognition decades before the advent of the first cognitive revolution, some of which it would take a second cognitive revolution to re-discover. Hayek’s work is of particular interest because, unlike neoclassical economics/finance and the Austrian School of Economic Thought he is usually associated with, he does not resort to an *a priori* framework of utility maximisation,<sup>160</sup> but instead adopts an *a posteriori* position in regard to issues

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<sup>160</sup> Although, as Herbert Simon put it, “Austrians put a tremendous emphasis on tacit and personal knowledge” (Simon *et al.*, 2016, p. 26), those following the lead of von Mises, who in his rejection of the mathematical approach to economics resorted “to an extreme *a priori* position in which

pertaining to cognition, knowledge creation and acquisition. Albeit neither of these two accounts can provide a definite framework for the development of the proposed ‘Cognitive Finance’ research enterprise, both seem to provide valuable starting points for further enhancing and developing the core insights produced in Chapter 2 and weaving them into the relevant cognitive science discourse, on the one hand, and the relevant economic discourse, on the other, with the proposed ‘problem-led’ approach weaving together the threads across the relevant disciplines in order to address the key issues that arise in financial markets.

## 1. Searching the ‘Building Blocks’ for an Alternative Framework: Part I

### 1.1 Rapp and Cortés (2017): ‘Cognitive Finance’

Rizzello and Spada (2013, p. 310) point out that

“[i]n his contribution to one of the first systematizations of behavioural economics, Caldwell underlined that ‘behavioural economics (...) may need an Alfred Marshall – someone who can bring together a number of disparate strands of thought into a unified whole’ (Caldwell, 1986, p. 15).”

Within the (sub-)field of *Behavioural Finance*, with a particular focus on financial market research, such a ‘Marshallian’ feat has most recently been attempted by Rapp and Cortés (2017) and their colleagues at the private FERI Cognitive Finance Institute.<sup>161</sup> Arguably, they have even gone a step further, though, as their proposed research program, which they dub ‘Cognitive Finance’, transcends *Behavioural Finance*, which they deem, for reasons similar to (some of) those discussed in Chapter 1, unfit for the study of *actual* financial market processes. Indeed, Rapp’s and Cortés’ (2017) proposed research framework seems to fulfil several of the criteria that the present work deems necessary for a sound methodological approach to financial market research: First, in contrast to the mainstream’s unshaken faith in formal models of rationality (e.g., EUT, SEUT) and the co-opting of “some recent enthusiasm in a trendy corner of current artificial intelligence” (Mirowski, 2002, p. 534) for the characterisation and modelling of mental states by alternative research enterprises (e.g., the Santa Fe Institute; see Mirowski, p. 534), both sharing the philosophical presuppositions of an early, long since outdated, strand of cognitive science (see Chap. 1), Rapp and Cortés (2017)

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someone – perhaps the good Lord – told him what the Truth was, and the Truth was neo-classical theory done non-quantitatively” (*ibid.*), eventually end-up applying just another *aprioristic* utility maximisation framework. This is also the aspect that disqualifies the Austrian School of Economics as a potential candidate for the further development of the re-conceptualisation of financial markets.

<sup>161</sup> The FERI Cognitive Finance Institute (homepage: <https://www.feri-cognitive-finance-institute.de/>) is a private research initiative of the FERI AG in Bad Homburg, Germany. It has been developing this proprietary research approach dubbed ‘FERI Cognitive Finance’ primarily for the purpose of developing relevant insights into financial market processes for its sponsor’s private wealth management business.

emphasise the focus on *human cognition* and thus advocate the active application of theoretical and empirical insights from psychology, the behavioural sciences and cognitive (neuro)science.

Secondly, Rapp and Cortés (2017) explicitly recognize the inherent *complexity* of financial market processes and advocate the active incorporation of complex systems theory into their proposed research framework, for the purpose of furthering our understanding of the respective causal factors involved as well as the nature of this particular manifestation of complexity. This also illustrates their commitment to *understanding*, in Deutsch's (1998) sense of the word, and thus the development of an *explanatory* framework, in sharp contrast to the 'as if' modelling approach that continues to dominate mainstream finance.

Thirdly, Rapp and Cortés (2017) are strong advocates of an inter-disciplinary approach to the study of financial markets, rejecting the, what they dub, 'kartesische Denkweise' ('Cartesian way of thinking'), which has led to the kind of overspecialisation across the sciences that threatens to stultify scientific thinking and thus progress in various disciplines, particularly, of course, within the field of finance that continues to be dominated by the neo-classical paradigm (Rapp and Cortés, 2017, pp. 65-69). They bolster their argument with reference to the myriad of insights that had been lost to the field of finance (and economics more generally) precisely because of such over-specialisation:

"Former explanatory approaches and insights by thinkers like Keynes, Morgenstern or Hayek, in whose economic models and interpretations central aspects of psychology and sociology were always deeply ingrained, are now being troublesomely 're-discovered', however only as a result of new findings in other scientific disciplines." (p. 67; my trans.)

These developments demonstrate, so they argue, that the apparent scientific progress resulting from the ever-increasing specialisation of the sciences, in reality, often turns out to constitute an actual regress in terms of scientific content and understanding; a phenomenon they dub the 'kartesianische Paradoxon' ('Cartesian Paradox'), which, they argue, has sterilized the scientific enterprise as many researchers have never developed the necessary skill-set to contemplate the 'bigger picture' and to work and think cross-disciplinarily (Rapp and Cortés, 2017, p. 67).

These insights, particularly with regard to the re-discovery of valuable insights from earlier thinkers in the light of scientific advances in other fields (e.g., cognitive science), shall play a central role in Part II of the present chapter, where valuable inputs for the development of an alternative account of cognitive aspects and processes in financial markets shall be extracted from Johannes von Kries' (i.e., a major intellectual influence on J.M. Keynes' thought about human decision processes) and F.A. Hayek's work. This leads us to another important facet of

Rapp's and Cortés' (2017) proposal, i.e. their recognition of the critical role that *cognitive aspects* play in financial markets; indeed, they consider the reconceptualization of financial market research in *cognitive* terms to constitute the next logical step in the genealogy of financial market research, which they illustrate in the table below:

**Table 3:**<sup>162</sup> The Evolution of Theoretical Approaches to Financial Markets since the 1930s

<p><i>This table has been removed by the author of this thesis for copyright reasons</i></p>
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Nevertheless, their proposed 'Picture' (i.e., the 'cognitive' one) is devised to be of a markedly different nature than that of its predecessors, which Rapp and Cortés (2017, p. 65) criticize on the ground that the respective core would come to dominate and mould the discipline in its image, to the exclusion of all other influences; in this regard, Rapp and Cortés (2017, p. 65) identify the following: (1) the early '**sociologically**' denominated approach (Morgenstern, Keynes, etc.); (2) the '**analytical-empirical**' conception of the 1960s (Mandelbrot, Cootner, etc.); (3) the subsequent '**mathematical-physicalist**' view (Fama and Sharpe); and (4) the '**(social)-psychological-behavioural**' approach of the outgoing 20<sup>th</sup> century. In stark contrast to this historical predecessors, Rapp's and Cortés' (2017) *cognitive* 'Picture' is conceived to be not of an *exclusive* but rather a *primus inter pares* type, i.e. to embrace an interdisciplinary approach whereby the *cognitive* aspect is to take centre-stage (see Fig. 5) – a methodological framework that the research enterprise proposed by the present work largely agrees with on grounds of the ontological insights established in Chapter 2. In any case, Rapp's and Cortés' (2017) advocacy of interdisciplinarity should not be surprising, considering their fervent opposition to the 'Cartesian way of thinking' that has been stultifying scientific progress in the

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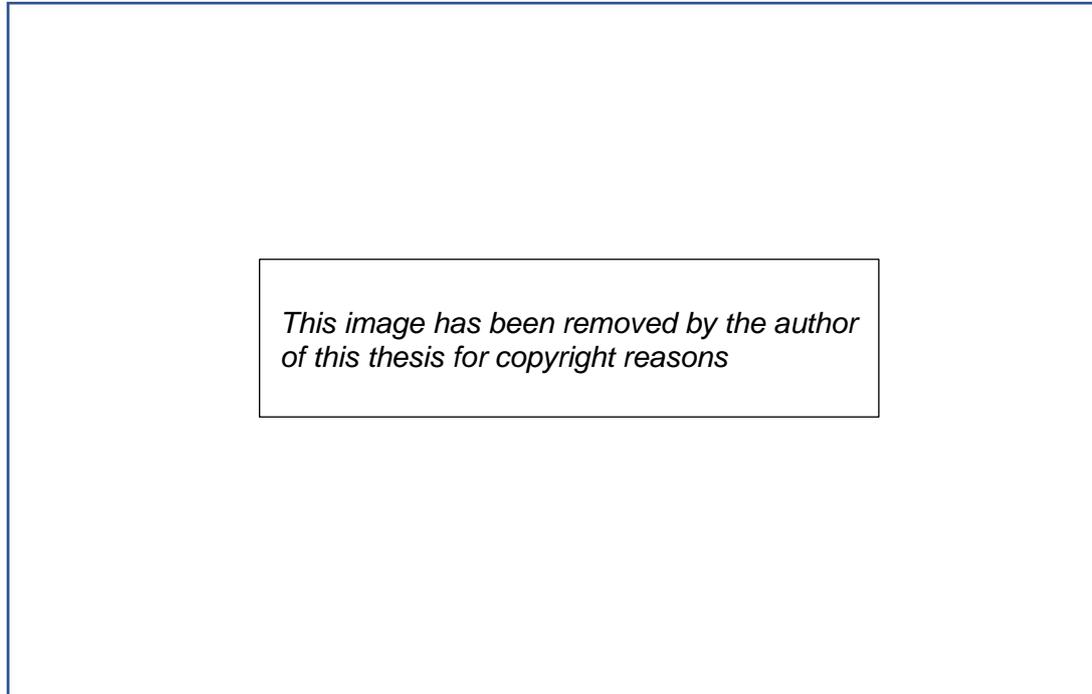
<sup>162</sup> H. W. Rapp (2016), reprinted in Rapp and Cortés (2017, p. 66); translated from German into English by N.E.

Translator's Note: The term 'neuronal' in the 'Since'-row and 'Picture'-column was replaced by the term 'cognitive', in order to prevent any unwarranted accusations of reductionism.

field for so long.

Rapp and Cortés (2017) outline the core of their proposed research program in the following

**Figure 5:** Outline of Rapp’s and Cortés’ (2017) proposed ‘Cognitive Finance’



terms: “The analytical basic structure of ‘Cognitive Finance’ is inter-disciplinarily orientated, system-dynamically oriented and cognitive-theoretically sound” (p. 108; my trans.). It thus appears to satisfy all of the aforementioned criteria and to address the questions that arise from our ontological analysis of financial markets in Chapter 2. Nevertheless, three major shortcomings can be identified. First, Rapp and Cortés (2017) as well as their parent institute, the FERI Cognitive Finance Institute, are not – at least not primarily – interested in the development of a research program that meets *academic* standards. After all, their research initiative is a private one, motivated primarily by the desire to develop new insights that are of a pecuniary relevance to the wealth-management business of its sponsor, the FERI AG. The actual motives and research approach applied might thus significantly diverge from an academic one. Even if this were not to be the case, the proprietary nature of both the method used as well as the knowledge produced would exclude the required peer-review process, primarily as new advances would likely be kept private as long as they conferred a competitive advantage, impeding thereby an uninterrupted and continuous academic discussion from taking place.

Secondly, and more importantly, Rapp and Cortés (2017) fail to specify a clear ‘nucleus’, i.e. a central conceptual and/or theoretical framework that turns their proposal into a *distinct* research enterprise by specifying a paradigmatic core, which provides the basis for the

particularisation of the core questions to be formulated and investigated as well as the parameters for the systematisation and synthesising of the insights produced into a coherent and consistent descriptive or explanatory account. Although the authors do, as outlined above, elevate the ‘cognitive aspect’ to the rank of *primus* and promote the adoption of relevant theoretical and empirical insights from the field of cognitive (neuro)science – such as ‘Constructivism’ (Roth, 2003), the ‘Theory of Mind’ (Förstl, 2012), ‘Path-dependency’ in the selection and interpretation of information (Singer, 2002) and a ‘Limit to Free Will’ due to unconscious influences (Rapp and Cortés, 2017, p. 60) – while recognizing the necessity of a “purpose-built combination and synthesis of the relevant aspects of the various cognitive science sub-fields” (p. 93; my trans) for the development of a ‘Cognitive Analytic’ that meets the specifications and criteria sketched out on pages 93-94, they fail to actually specify how this is to be achieved, i.e. to identify a guiding organising principle and/or core theoretical framework to direct the work toward a comprehensive synthesis that is tailored to the needs of financial market research. In the absence of such a systematic framework, the proposed research enterprise might soon find itself in a situation similar to the one of behavioural finance (see Chap. 1); this, in turn, might result in ‘cherry-picking’ and ‘ad-hockery’ when it comes to the application of (some of) these insights to the explanation of certain market phenomena. Only a comprehensive theoretical framework that is devised specifically to the realities of financial markets (see Chap. 2), can provide the basis for the formulation of adequate research questions, the development of sensible hypotheses, and the furthering of our understanding of the nature and (causal) processes underlying these markets.

Third, Rapp and Cortés (2017) fail to provide any guidance as to how they conceive their proposed interdisciplinary research enterprise to be, methodologically, effectively coordinated; for example, how disparate fields such as cognitive science and complexity science – two of the core disciplines of their proposed ‘Cognitive Finance’ program – are to be united in a joined effort to inquire into the nature and operation of financial market processes. Such an endeavour will require a sound ontological and theoretical basis it can build on. Rapp and Cortés (2017) provide neither; albeit it needs to be noted that they propose *Cognitive Computing* as a possible technical bridge and modelling approach (Rapp and Cortés, 2017, pp. 100-03). This leads us to the discussion of Gintis’ (2007, 2014) proposal for the *Unification of the Behavioural Sciences* – which holds that modern economics possesses of the appropriate technical and modelling tools for bridging the disciplinary boundaries – with regard to its suitability as a framework for the study of financial market processes and its phenomena in light of the respective insights produced in Chapter 2.

### *1.2 Herbert Gintis’ Proposal for the ‘Unification of the Behavioural Sciences’*

Herbert Gintis’ (2007, 2014) proposed framework for the *Unification of the Behavioural*

*Sciences* appears to provide an attractive alternative – or at least suited complement – to Rapp’s and Cortés’ (2017) proposed ‘Cognitive Finance’ research program, as it appears to share its strength while seemingly being able to overcome its weaknesses: First, in contrast to Rapp and Cortés (2017), Gintis (2007, 2014) has conceived and developed his proposal within the wider economics literature, rendering it thereby, right from the start, part of the standard academic discourse. Secondly, similarly to Rapp’s and Cortés’ (2017) proposed research enterprise, Gintis’ (2007, 2014) framework is highly interdisciplinary in nature, as his call for unification encompasses the following disciplines:

“economics, biology, anthropology, sociology, psychology, and political science, as well as their subdisciplines, including neuroscience, archaeology, and palaeontology, and to a lesser extent, such related disciplines as history, legal studies, and philosophy.” (Gintis, 2007, p. 1)

What unites them in Gintis’ (2007) view is that “each includes a model of individual human behaviour” (*ibid.*). Thirdly, just like Rapp and Cortés (2017), Gintis (2007) recognizes “[t]he mind as decision-making organ [...] [as] the organizing principle of psychology” (*ibid.*). Unlike Rapp and Cortés (2017), Gintis (2007) does not fail, however, in specifying unifying principles and identifying clear nuclei, i.e. conceptual units, for his proposed framework (Gintis, 2007, p. 45): (a) gene-culture coevolution;<sup>163</sup> (b) evolutionary game theory; (c) the beliefs, preferences, and constraints (BPC) model of decision-making; and (d) the notion of human society as a complex adaptive system with emergent properties. These nuclei constitute the spine of the proposed unification attempt, affording thereby also a glimpse into the coordinative side of Gintis’ (2007, 2014) program. This last feature constitutes the fifth point in favour of Gintis’ (2007, 2014) proposed framework. What renders it ultimately unsuited to an inquiry into the cognitive processes that underlie the operation of financial markets is the fact that its theoretical nucleus in regard to decision-processes, i.e. the BPC-model, was primarily devised as a tool for ‘a *compact analytical representation* of behaviour’ (Gintis, 2007, p. 48; *italics* in original) rather than as an *explanatory* framework. Hence, defending the BPC-model and its presuppositions against critiques like Gigerenzer and Selten (2001), Gintis (2007) argues that

“just as billiards players do not solve differential equations in choosing their shots, so decision makers do not solve Lagrangian equations, even though in both cases we may use optimization models to describe their behaviour.” (p. 9)

As the discussion in the present work has demonstrated that a thorough comprehensive account

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<sup>163</sup> Also known as Dual Inheritance Theory; it claims that human behaviour is the product of a complex interaction between genetic and cultural evolutionary processes.

of financial market processes and phenomena requires a sound understanding of *actual* cognitive processes, rather than ‘as if’ modelling approaches, we shall side with the cognitive scientist Gow (2007) and reject Gintis’ (2007) framework for our immediate purposes. Gow (2007) argues that for the cognitive sciences with their “emphasis on explanation,” a unification under a framework such as Gintis’ (2007), “would constitute a step backwards in their development” (pp. 27-28). To underscore his argument, Gow (2007) points to “Gintis[‘] express[ion] [of] surprise at the fact that cognitive psychology devotes most of its energies to understanding ‘the processes that render decision making possible’ (sect. 3, para. 3)”<sup>164</sup>; emphasising that – and we wholeheartedly agree – this “this is exactly what we must do if we are to truly understand those decisions” (Gow, 2007, p. 28).<sup>164</sup> He illustrates the fundamental differences between the behavioural and the cognitive scientist’s respective approaches on the basis of the ‘framing bias’:

“Gintis notes that subjects show framing biases because they tend to map the formal structures of games encountered in the lab to experiences of facets of their normal lives. As a cognitive psychologist I would argue that the framing bias reflects limits imposed by operating characteristics of human memory, attention, and problem-solving, as well as the way the listeners map linguistic descriptions of task parameters onto conceptual representations. Rather than dismissing all deviations from the predictions of the model as ‘performance errors’ (sect 3, para. 4), game theorists could improve their models by addressing how cognitive mechanisms produce systematic variations in performance.” (*ibid.*)

We wholeheartedly agree with Gow’s (2007) ‘cognitive science’ perspective – as would Rapp and Cortés (2017) – and therefore deem a proper cognitive science approach to be much more appropriate for the study of financial market processes and phenomena than any of the ‘behavioural’ approaches that have been devised within the field of economics (e.g., *Behavioural Finance*),<sup>165</sup> particularly because of the type of stratagems that economists employ – as illustrated in the quote above – in order to neutralize the impact of any empirical insights – impeding thereby the growth of proper knowledge and understanding – for the sole purpose of defending the cherished (‘rigorous’) model from refutation. In what follows, some of the core stratagems employed by Gintis (2007, 2014) shall be outlined as part of the wider critique that reveals the ultimate unsuitability of his framework for the proposed research enterprise of ‘Cognitive Finance’, as such immunization strategies are considered to be irreconcilable with the present project’s goals of furthering our understanding of *actual*

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<sup>164</sup> The importance of investigating *actual* decision-processes has also been stressed by Gigerenzer (2004).

<sup>165</sup> Already Dow (2011, p. 234) conjectures that ‘cognitive psychology’, i.e. one of the sub-fields of cognitive science, might have ‘particular purchase’ for the study of financial markets.

cognitive processes that underlie the operation of financial markets, particularly because they clearly violate the ontological insights developed in Chapter 2, while suffering from some of the same distortive interpretative issues discussed in Chapter 1.

The following stratagems can be identified in Gintis' (2007, 2014) formulation of his proposed framework for the unification of the *Behavioural Sciences*: (a) the assimilation of new (deviating) empirical findings by way of an amendment to the original framework (e.g., a modification of the preference function); (b) the classification of such 'deviations' as 'performance errors'; and (c) their dismissal on the grounds of insufficient relevance.

To (a):

Gintis (2014) argues that as long as individuals know their own preferences, any claims by behavioural decision theorists as to *preference inconsistency*<sup>166</sup> rest on "a conceptual error based on a misspecification of the decision maker's preference function. [...] Adding information concerning the current state of the individual to the choice space eliminates preference inconsistency", defending this approach by adding that "this addition is completely reasonable because preference functions do not make sense unless we include information about the decision maker's current state"<sup>167</sup> (p. 2). Gintis (2014) concedes that the individual's *current state* has been ignored by traditional decision theory but adds that "this is just an oversight that behavioural decision theory has brought to our attention" (*ibid.*). 'Deviations' such as the ones observed by Kahneman *et al.* (1991), Tversky and Kahneman (1981), thus, pose no challenge to the core rationality postulate of *preference consistency*:

"The brilliant experiments by Kahneman, Tversky, and their coworkers clearly show that humans exhibit systematic biases in the way they make decisions. However, it should be clear that none of the above examples illustrates preference inconsistency once the appropriate parameter (current time, current position, status quo point) is admitted into the preference function. This point is formally demonstrated in Sugden (2003). Sugden considers a preference relation of the form  $f \succeq g|h$ , which means "lottery  $f$  is weakly preferred to lottery  $g$  when one's status quo position is lottery  $h$ . Sugden shows that if several conditions on this preference relation, most of which are

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<sup>166</sup> *Preference consistency* is the core axiom upon which the 'rational actor' model rests: "A *rational actor* is an individual with *consistent preferences*," (Gintis, 2014, p. 1; *italics* in original), and as long as it holds, individuals "can be modelled as maximising an objective function" (Gintis, 2007, p. 9). This protects the framework from any criticism that rejects the *maximiser/optimizer* conception (e.g., Gigerenzer and Selten, 2001; Krantz, 1991).

<sup>167</sup> i.e. Preferences are state-dependent; as "[t]he idea that we should have a utility function that does not depend on our current wealth, the current time, or our current strategic circumstances is also not plausible" (Gintis, 2014, p. 2). Thus, "when the individual's social or personal situation changes, his preference will change as well. Unless this factor is taken into account, rational choices may superficially appear inconsistent." (*ibid.*, p. 6).

direct generalizations of the Savage conditions [...], obtain, then there is a utility function  $u(x, z)$  such that  $f \succeq g|h$  if and only if  $E[u(f, h)] \geq E[u(g, h)]$ , where the expectation is taken over the probability of events derived from the preference relation.” (Gintis, 2014, pp. 28-9).

To (b):

Other documented cases of systematic violations of the expected utility principle are simply dismissed as systematic *performance errors*, which are attributed to decision makers’ incorrect *beliefs*; most significantly, those regarding the probability calculus (Levy, 2008), on which decision theory and the respective experiments largely built (Gintis, 2014, p. 2). According to Gintis (2014), these *performance errors* “can be reduced or eliminated by formal instruction, so that the experts that society relies upon to make efficient decisions may behave quite rationally even in cases where the average individual violates preference consistency” (*ibid.*, p. 7).

One important example of how such a systematic violation is explained by means of invoking a *performance error* is the *conjunction fallacy* (i.e., the ‘Linda Case’; Tversky and Kahneman, 1983), which Gintis (2007, sect. 9.6) simply blames on faulty logic (i.e., a *performance error*). Zizzo (2007), however, challenges this conclusion on the grounds that “the fallacy can be reproduced in a purely behavioural context and [that it] is behaviourally robust to learning opportunities (Zizzo, 2003; 2005)” (Zizzo, 2007, p. 45).

Another important empirical insight, the Wason and Johnson-Laird decision task (Wason, 1966; Johnson-Laird and Wason 1970; Wason and Johnson-Laird, 1972) – which demonstrates that humans (including professional logicians) are generally weak at solving abstract reasoning tasks, but are quite capable of solving *precisely the same logical problem* if re-stated in terms that the test-participants are familiar with from their quotidian lives (see Gardner, 1987, Chp. 13) – is explained, in passing, on similar grounds by Gintis (2007, sect. 9.6), i.e. by the context dependence of the interpretation of propositional logic, even though this does not apply to the Wason and Johnson-Laird decision task, because the underlying logical structure and solution is precisely the same in both versions of the game, whereas the interpretation he invokes as explanation for the ‘Linda case’ (i.e. the conjunction fallacy and representativeness bias) differs from the original logical structure intended by the experimenters:

“Let  $p$  and  $q$  be properties that every member of a population either has or does not have. The standard definition of ‘the probability that member  $x$  is  $p$ ’ is the fraction of the population for which  $p$  is true. But an equally reasonable definition is ‘the probability that  $x$  is a member of a random sample of the subset of the population for which  $p$  is true.’ In other words, the subjects interpret the question

as asking for the conditional probability that an individual is Linda given that the individual is a banker vs. a feminist banker. Obviously, given the information, the latter alternative is much more likely.” (Gintis, 2014, p. 30).

To (c):

Other empirical results that challenge the postulate of *preference consistency* are simply dismissed as being of little relevance. “A key example” being, as pointed out by Hammond (2007), “Gintis’s [2007] dismissal of Tversky, Slovic, and Kahneman’s foundational demonstration of preference reversal in the choice of lotteries (Tversky *et al.*, 1990),”<sup>168</sup> on the grounds that “the choices [were] so close to indifference,<sup>169</sup> [that] it [was] not surprising that inappropriate cues [were] relied upon to determine choice” (Gintis, 2007, p. 10). Hammond (2007) criticises this dismissal with the following words: “So, there it is; in those few sentences, Gintis dismisses 30 years of the celebration of a major finding by psychologists that trumped (or so they believed) a major underpinning of economic theory and led to a Nobel Prize” (p. 29).

Another example is the so-called *Allais paradox* (Allais, 1953). Gintis (2014) conjectures that “[p]erhaps [...] *regret*, which does not mesh well with the expected utility principle (Loomes, 1988; Sugden, 1993)” (p. 20; *italics* in original) might be the cause for the observed systematic decision errors by test-subject, but dismisses the ‘real world’ relevance of the results:

“The Allais paradox is an excellent illustration of problems that can arise when a lottery is consciously chosen by an act of will and one *knows* that one has made such a choice. The regret in the first case arises because if one chose the risky lottery and the payoff was zero, one knows for certain that one made a poor choice, at least *ex post*. In the second case, if one received a zero payoff, the odds are that it had nothing to do with one’s choice. Hence, there is no regret in the second case. But in the real world, most of the lotteries we experience are chosen by default, not acts of will. Thus, if the outcome of such a lottery is poor, we feel bad because of the poor outcome but not because we made a poor choice.” (*ibid.*; *italics* in original; emphasis added).

This does certainly *not* apply to financial markets, where investment objects are chosen by ‘acts of will’.

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<sup>168</sup> Gintis (2007): “These preference reversals were explained [...] by Tversky *et al.* (1990) as a bias towards the higher probability of winning in lottery choice and towards the higher the maximum amount of winnings in monetary valuation. If this were true for lotteries in general, it might compromise the BPC model.” (p. 10).

<sup>169</sup> i.e. “the average difference between expected values of comparison pairs was [...] 13.01% [for Tversky *et al.*, 1990).

Overall, it can be concluded that Gintis' (2007, 2014) proposed framework is unsuited for the task of developing a comprehensive understanding of the cognitive processes that underlie the operation of financial markets. Further, the kind of insights afforded by Gintis' proposal into the general nature of *behavioural* approaches, particularly those developed under the aegis or come under the sway of mainstream economics, demonstrated that any research effort into the (cognitive) issues raised in Chapter 2, has to be conducted on a very different plane, namely a proper cognitive-scientific one, as already argued by Rapp and Cortés (2017). This does, of course, not preclude the possibility that (some of) the insights thereby produced might eventually be modelled via the tool-set outlined by Gintis (2007, 2014). Nevertheless, the proposed research enterprise of 'Cognitive Finance' shall endorse a 'problem-based' approach to meaningful interdisciplinary work; indeed, as shall be outlined in the final section of the present chapter, a general 'problem-based' methodological framework shall constitute the coordinating backbone of this proposed interdisciplinary research program.

For the sake of comprehensiveness, the subsequent section shall argue that Andrew Lo's *Adaptive Market Hypothesis*, a reconciliatory effort between traditional EMH and *Behavioural Finance*, ultimately also fails to provide a suitable starting point for the proposed research enterprise into the cognitive processes that underlie the operation of financial markets.

### 1.3 The 'Adaptive Market Hypothesis'

Andrew Lo (2004, 2005) proposes a reconciliation between the neo-classical EMH and the findings of *Behavioural Finance* through the adoption of evolutionary principles. In terms of its status within academia, it is to be noted that the AMH might be classified as a 'hybrid' type, as it is being developed by a full-time (MIT) finance professor but its exposition has, most likely due to the field's general antagonism toward non-neoclassical contributions and influences, largely been limited to professional finance journals.

With regard to the AMH's suitability as a point of departure for our proposed research enterprise, the following issues need to be raised: First, as the AMH merely constitutes a very rudimentary attempt to extend the neo-classical EMH by the *Behavioural Finance* dimension, its scope and degree of interdisciplinarity is too limited for our purposes; a critical point that was also raised by Rapp and Cortés (2017, pp. 78-79). More important though, is its utter ignorance in regard to the central importance of the agent's diverging views and interpretations of reality ('pictures') as well as their corresponding expectations in regard to the future, i.e. those (cognitive) factors that were identified to underlie the greater part of the trading activity of financial markets. This might also explain the absence of a (call for a) clear theoretical 'nucleus' in regard to human cognition. In fact, the entire approach to the attempted reconciliation seems to be nothing but a naïve application of some evolutionary principles and

concepts to the financial market environment – e.g. “[t]he profit opportunities in any given market are akin to the amount of natural resources in a particular local ecology” (Lo, 2004, p. 23), with various ‘species’ (i.e., types of market participants) competing for them, whereby the richest ones have the best chances of survival (i.e., ‘survival of the richest’; *ibid.*, p. 24) – in order to introduce a certain dynamic into the EMH, which permit the ‘explanation’ of certain market environments, within which certain ‘biases’ and ‘heuristics’, identified by *Behavioural Finance* scholars, seem perfectly reasonable (and not ‘irrational’). The AMH is thus nothing more but an attempt to save the EMH by, first, introducing the aforementioned dynamic element by way of a questionable application of ‘evolutionary principles’ that allow the framework to ‘account’ for any type of empirically observed deviations from the predictions of the original EMH, while, at the same time, providing the proper framework to, secondly, identify certain market constellations in whose light the supposedly ‘irrational’ elements identified by *Behavioural Finance* seem perfectly reasonable, which, in turn, thirdly, permits the reconciliation of the supposedly contradictory findings of the latter with the (modified) tenets of the former. Lo’s AMH is thus nothing but an – on ontological grounds questionable<sup>170</sup> – exercise in creative ‘modification’ for the purpose of a creative (ad-hoc) ‘re-interpretation’ of various empirical findings of *Behavioural Finance* bare any interest in an actual inquiry into the nature, type and operation of the cognitive factors and processes that underlie the operation of financial markets. The AMH can thus not be regarded as a theoretical alternative to the EMH, particularly not one that provides a more comprehensive and ‘deeper-level’ understanding of the nature and operation of these markets, rather, it constitutes a flawed attempt of formulating an extended version of the EMH, “in which the traditional models of modern financial economics can co-exist alongside behavioural models in an intellectually consistent manner” (Lo, 2005, Abstract), and is therefore entirely unsuited for an inquiry into the issues raised in Chapter 2 of the present work.

As none of the existing frameworks within the wider economics and finance literature(s) seems to be able to provide an adequate theoretical starting point for our proposed research enterprise, an alternative will have to be developed. As already pointed out by Rapp and Cortés (2017, p. 67), the ‘Cartesian’ approach to science has, particularly within the field of economics – where matters of cognition are treated within an entirely inadequate formalist framework (i.e., EUT, SEUT; see Chap. 1) –, led to the loss of valuable insights by earlier thinkers such as Keynes and Hayek, which are only now being (slowly) ‘re-discovered’ in the wake of advances in other fields such as (and most relevantly) the cognitive (neuro)sciences.<sup>171</sup> Part II of the present

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<sup>170</sup> Particularly when one considers our discussion in Chapter 1 in regard to the irreconcilability of the theoretical and empirical sides of *Behavioural Finance*.

<sup>171</sup> Hayek’s (1952) theoretical insights in regard to neuroplasticity and constructivism, for example, had pre-dated the corresponding findings in the respective fields by decades, which was also acknowledged by some of the leading thinkers working in those fields (e.g., Edelman, 1982; Fuster,

chapter shall thus ‘re-discover’ some of the core insights of two thinkers that appear to hold the greatest potential within the wider economics literature as adequate starting points for a thorough inquiry into the cognitive aspects in financial markets that have been uncovered in Chapter 2. The two thinkers are Johannes von Kries, a German physiologist and logician who was a major intellectual influence on Keynes’s thought on human decision-processes, and Friedrich von Hayek, an economist with a profound understanding of the operation of the human mind (see Hayek, 1952). Due to the limited space, the discussion shall be focused primarily on Hayek, on the one hand, because his work provides a more direct link between the economics and modern cognitive (neuro)science literatures and, on the other, because his thought encompasses the important related topics of *information* and *knowledge* as well as their fundamental role in market processes (Hayek, 1937, 1945), covering thus several of the topics that play a fundamental role in the development of a thorough understanding of the cognitive processes that underlie the operation of financial markets (see Chap. 2).

The emphasis of Part II will, due to the restricted space, lie primarily on the ‘re-discovery’ of some of the more relevant insights that the respective works of Johannes von Kries and Friedrich von Hayek afford. A somewhat more detailed analysis of the implications of Hayek’s thought on our picture and understanding of financial markets as well as its methodological implications shall be provided as well.

## **2. Searching the ‘Building Blocks’ for an Alternative Framework: Part II**

### *2.1 General Overview:*

In Part I, the methodological untenability of the accounts that had been deemed the most plausible candidates within the wider economics literature for providing a more plausible framework for the study of financial markets in the light of the foregoing discussion was established. The lack of an appropriate framework among the existing accounts leads to the conclusion that an alternative one needs to be developed, whereby the insights hitherto produced shall provide the initial ‘building blocks’. Hence, Part II shall systematize our understanding of financial markets hitherto gained and identify some valuable sources for furthering the proposed project in the future. The discussion shall thereby follow the same structure as the critique of the various alternate existing frameworks in Part I, in order to illustrate how the proposed framework might be able to overcome the shortcomings of the former.

### 2.1.1 Part of the Academic Debate

It shall be noted that unlike Rapp and Cortés (2017) proposed research enterprise, the proposal for our ‘Cognitive Finance’ research project is being conceived within the wider economics literature and is intended to form part of the standard academic debate.

### 2.1.2 The ‘Nucleus’

The ‘*nucleus*’ of the proposed research program shall be constituted by the protagonist of our alternative conceptual outline in Chapter 2; i.e. the ‘cognitive apparatus’ as the *locus* of the central cognitive processes that continuously produces and updates the investor’s subjective ‘picture’ of reality, continuously assesses its adequacy in light of new information and/or alternative interpretations of existing information, while scanning for weaknesses in the respective ‘pictures’ that dominate and determine market price developments at any moment in time, in order to eventually trigger a decision-action (‘trade’ or ‘don’t trade’), which will filter into the respective market-price at that time, in general, and the “cognitive ‘model’” as the active ‘frame’ that determines the subjectively perceived reality, in particular. As argued in Chapter 2, these processes play a central role in the construction of our subjectively experienced reality, which, in turn, determines our decisions and actions. Further, as any one individual can only ever perceive one fragment of reality at any one time, it is the trading activity among millions of financial market participants – which might be conceived as a form of ongoing ‘dialogue’ – that *should* produce an ever more accurate – albeit ‘one-dimensional’ – ‘picture’ of this reality. Of course, for the reasons expounded in Chapter 2, the accuracy of that ‘picture’ is not always given.

In any case, the selection of the “cognitive ‘model’” as the ‘*nucleus*’ of our proposed ‘Cognitive Finance’ enterprise will allow us to side with Rapp’s and Cortés’s (2017) argument that a proper understanding of actual financial market processes and phenomena requires the application of the theoretical and empirical insights of modern cognitive (neuro)science, while overcoming the latter account’s failure of providing a proper hard core that provides a clear research focus and structure, which is indispensable for the success of such an interdisciplinary research program. Indeed, the significance of such a ‘*nucleus*’ for the proposed research program’s nature, cohesion, coordination and progression, as well as its impact on the nature and type of questions that are allowed to be asked, cannot be overrated. Further, it is decisive in determining the type of insights that other disciplines are actually allowed to contribute to the field and the degree to which they are permitted to influence the nature and research direction of the latter. Within the confines of the standard neo-classical framework, for example, it would be impossible to overcome the intellectual impasse of the field, as the insights from any other discipline are generally considered to be subordinate (if not even

inferior) to its own (Fine and Milonakis, 2009), or simply irrelevant. Adopting an approach akin to the latter would therefore preclude us from truly embracing Rapp's and Cortés' (2017) argument in support of the active incorporation of cognitive (neuro)science insights into financial market research. Davis' (2010) critical analysis as to 'whether neuroscience might sufficiently inform neuroeconomics so as to lead to any genuinely new questions in economics' reveals a largely 'instrumental orientation' in the field of neuroeconomics. In other words, neuroscience is largely seen

“as a means of securing further evidence for propositions which economists already have some confidence in or alternatively as an opportunity for settling existing disputes between economists regarding theory selection.” (Davis, 2010, p. 582)

The neuroscientific influence in economics is thus largely confined to the corroboration of existing theories and conceptions of economics (Davis, 2010) – in a complete disregard for the treasure trove of relevant insights the field holds, particularly for financial market research (Rapp and Cortés, 2017), and the wider research horizons it might open up –, leaving the nature of economics (and finance) research and the type of questions asked and issues to be analysed largely unchanged. Such a research approach not only harbours “the risk that neuroeconomics carried out on this basis will spend much time heralding ‘discoveries’ already well-established outside of economics” (Davis, 2010, fn. 10), but will also impede the progression of a deeper and broader understanding of economic reality. The proposed “cognitive ‘model’” that shall be developed on the basis of relevant theoretical and empirical insights from modern cognitive (neuro)science that are able to address the various (cognitive) issues raised in the present work shall thus significantly alter the type and degree of influence of such disciplines on financial market research.

The “cognitive ‘model’s’” nuclear role shall, however, not be limited to the theoretical ('scientific') side. Indeed, as, particularly, the discussion in regard to the *'interpretative matters'* in Chapter 1, and the explication of the wide-ranging aspects of financial market reality that are largely ignored by current research programs should have amply demonstrated, the philosophical aspect must not be ignored, particularly within inter-disciplinary research programs such as Rapp's and Cortés' (2017) and the one that is being proposed by the present work. Indeed, as Redner (1986) emphasises:

“In dealing with complex objects and systems, many sciences have come together and interact, for such objects cannot be restricted to the few parameters within which one specialised science normally works. As scientific research of necessity has to become more multi-disciplinary, thus open up properly philosophical

problems in the integration of the sciences.” (Redner, 1986, p. 363)

Unfortunately, almost no scholar in the field of financial market research shows any interest in such philosophical matters. The situation is not much different in ‘new’ behavioural economics (Sent, 2004) and *Behavioural Finance*, where most scholars seem to have opted for an entirely empirical approach to the study of topics of the mind, i.e., they have chosen to investigate it ‘von unten’ (‘from below’) as Fechner (1897) would have classified their method. This stands in sharp contrast with the approach taken by such pioneering thinkers in the field of psychology as William James, John Dewey, Jean Piaget and F.A. Hayek, whose thought and works had a strong philosophical bend; for example, both Piaget’s and Hayek’s work on human cognition were strongly influenced by an evolutionary conception of epistemology<sup>172</sup> (Chelini and Riva, 2013). Further, Chelini and Riva (2013) emphasise that

“both Piaget’s epistemology and Hayek’s theories of cognitive mechanisms have been derived from their interpretation of human nature under a new light, which was different from the one already established as the ‘orthodoxy’ in both disciplines (i.e., psychology and economics).” (p. 129)

Indeed, Gardner (1987) points out that philosophical considerations have played an important role in the development of the cognitive sciences, and they shall also play a key role in the proposed ‘Cognitive Finance’ research enterprise, particularly with regard to epistemology and the philosophy of mind. Nevertheless, due to the project’s primary concern with the development of a comprehensive framework – both theoretical and philosophical – for a thorough understanding of the phenomenon called ‘financial market’, with a key focus on the cognitive processes that underlie its operation, the ontological aspect shall play an important role in the endeavour, too.

More generally, the relationship between the theoretical (scientific) and philosophical side is conceived to be of an ouroboric manner. The necessity of informing the scientific endeavour with philosophical insights should have become apparent by the explication of the faulty (ontological) presuppositions underlying two of the ‘crown jewels’ of the (sub-)fields of ‘new’ behavioural economics and behavioural finance, *viz.* Daniel Kahneman’s and Amos Tversky’s *loss aversion* (Tversky and Kahneman, 1981b; Kahneman *et al.*, 1991) and Richard Thaler’s *quasi-hedonic editing hypothesis* (Thaler and Johnson, 1990), respectively, as well as the consequent erroneous conclusions drawn from them for normative projects such as Thaler’s *Nudging* (Thaler and Sunstein, 2008). Further evidence for the relevance of philosophical work was provided by the explication of the cognitive processes underlying the operation of

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<sup>172</sup> i.e. that epistemological questions can be answered by a proper understanding of the functioning of cognitive structures.

financial markets by way of ontological analysis in Chapter 2, which raised fundamental issues that need to be addressed before a thorough (scientific) understanding of the relevant market processes and phenomena can be attained, but which have remained largely undetected by mainstream finance research efforts. The philosophical side, in turn, will also benefit from the scientific advances, particularly in regard to the insight into cognitive processes. The latter will be particularly relevant not only for evolutionary epistemology and the philosophy of mind but, importantly, also the metaphysical account. We share the view of Whitehead's (1978) speculative philosophical account that a metaphysical framework needs to be continuously updated in the light of new scientific insights. The proposed research program's attitude can be best summed up by way of a paraphrase of a Kantian insight, i.e. that a science lacking the guidance of philosophy is *blind* (see Thagard, 2009), while a philosophy that turns its back on the most intriguing insights of science, has become *empty* (see also Goldman, 1993; Thagard, 2009).

The "cognitive 'model'" shall also constitute the '*nucleus*' of the proposed metaphysical framework, which shall play an important role in the formulation of the comprehensive account that the proposed 'Cognitive Finance' research enterprise aspires to; after all, as pointed out by J. Watkins (1958, p. 360), metaphysical ideas are perfectly "suited to act as organizing principles at the centre of a system whose parts have a mutual affinity because they all come under the same central [metaphysical] influence." Its central role in financial market processes due to it constituting the *locus* of the core (cognitive) and decision-tasks qualify it as the *locus* of the 'purposive act', which Pepper (1966) thought

"held promise as the core of a metaphysical theory, i.e. a theory that is absolutely comprehensive rather than about merely one aspect of reality, because 'it is the act associated with intelligence,' and is 'possibly the most highly organized activity in the world of which we have any considerable evidence' (CQ, p. 17)" (Hoeflin, 2011, p.1).

It seems that this holds great promise as an organizing principle for the comprehensive synthesis that the proposed project aspires to; after all, Hoeflin (2011) applied it successfully to the formulation of a 'comprehensive synthesis of truth theories'. Unfortunately, the lack of space precludes any further explications of this topic at this point and needs to be deferred to future work.

The other principal feature of financial markets that might be illuminated by the adoption of such an ouroboric approach is their *complexity*. As meticulously expounded in various parts of the present work, the neo-classical finance paradigm is, primarily because of its ontological presuppositions, ill-suited to deal with the various emerging properties, feedback loops and

complexity that are characteristic of these markets (see Rapp and Cortés, 2017), which disqualify any reductionist methods of study. Such systems must be studied at a level of description that preserves them in their entirety. Proceeding from McIntyre's (1998) argument that the seemingly enigmatic nature of the complexity that pervades such systems is a derivative of the way we think, i.e. the way we intellectually approach the phenomenon, rather than an innate feature of the world itself – or, to paraphrase Alexander Pope, 'disorder is nothing more than order misunderstood'<sup>173</sup> – and his allusion to the "possibility that some alternative description – some redescription – of the system will yield regularities that are simpler and can be handled by science" ((McIntyre, 1998, p. 28), Dow's (2011) ontological insight that financial market "activity is based on valuations that are bound up with expectations as to price movements rather than the experience of 'real' consumption and production" (Dow, 2011, p. 234; with reference to Tuckett, 2009), Arthur's (2015, p. 7) observation that we live "in a world where beliefs, strategies and actions of agents are [constantly] being 'tested' for survival within an outcome or 'ecology' that these beliefs, strategies and actions together create" as well as our explications in Chapter 2, the present work comes to the conclusion that the aforementioned dual-aspect (i.e., with a cognitive science and a philosophical side) "cognitive 'model'" to hold the greatest promise for the study of the *complexity* aspect of financial markets within the wider envisioned comprehensive framework. The reasons for this are the following: As explicated in Chapter 2, the entire financial market process is driven and determined by a particular problem-solving process that investors and traders engage in. Any problem-solving process follows a particular unconditional, *a priori* logical structure (Smetslund, 1984) that allows to discern the centrality of the "cognitive 'model'" in the entire process and the importance of understanding its operation. Hence, if expectations are indeed *the* core factor that underlies financial market activity and consequently the determination of financial market prices – and in the light of the insights hitherto produced it seems plausible that they are – then it is necessary to inquire into the causal processes underlying the formation of these expectations.<sup>174</sup> Expectations are the results of the individual's perception and understanding of the respective aspect of reality. This subjectively perceived and 'understood' reality, in turn, depends upon the individual's information set, the interpretation of the elements of the latter as well as their arrangement in a way that the respective 'cognitive apparatus' deems appropriate and 'logical';<sup>175</sup> as Arthur

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<sup>173</sup> See Hagstrom (2013), p. 88.

<sup>174</sup> Indeed, already Dow (2011) emphasises the (potential) relevance of the cognitive sciences for the study and understanding of the operation of financial markets: "Psychology (and in particular cognitive psychology) therefore potentially has particular purchase" (p. 234)

<sup>175</sup> As Lanteri and Carabelli (2011, fn. 4) put it: "Even 'somewhat objective' reasons are ultimately subjective (Carabelli, 2002, p. 170). Indeed, taking a decisive step away from the orthodox conception of the *representative agent*, they defend a notion of rationality that is central for the day-to-day operation of financial markets, i.e. that "we can see two individuals make completely different choices in the same situation and still claim that both are being perfectly rational, because

(2000) emphasises:

“Data – literary or economic – have no inherent meaning. They acquire meaning by our bringing meaning to them. And different people with different experiences, will construct different meanings.” (p. 3)

The *subjective* frame through which the individual perceives reality is the “cognitive ‘model’” that the ‘cognitive apparatus’ constructs in order to enable the individual to engage with her environment (see, e.g., Singer, 2002; Roth, 2003). Both *internal* and *external* factors play a role in this process; at least that is the premise upon which the present work builds (see Chapter 2). Further insights into the “cognitive ‘model’” shall be provided below. What remains to be sketched out at this point is how such an understanding of the operation of the “cognitive ‘model’” might elucidate the inquiry into the complexity aspect of financial markets. Already the complexity scientist Brian Arthur (2015) explicated that

“[w]e are in a world where beliefs, strategies and actions of agents are [constantly] being ‘tested’ for survival within an outcome or ‘ecology’ that these beliefs, strategies and actions together create.” (p. 1)

Arthur’s (2015) insight corresponds to Hagstrom’s (2013) formulation, which is more explicit in linking these cognitive processes to complexity:

“The critical variable that makes a system both complex and adaptive is the idea that agents (neurons, ants, or investors) in the system accumulate experience by interacting with other agents and then change themselves to adapt to a changing environment” (Hagstrom, 2013, p. 23)

And both of these insights ultimately link back to Hayek’s (1952) work on human cognition, which also provides the required causal link:

“...structure of a complex dynamic system whose elements are connected as cause and effect” (Hayek, 1952, p. 109)

It is therefore crucial to get the conception of the individual and human cognition correct, before a more accurate understanding of the issue of *complexity* in financial markets can be expected.

An attentive reader acquainted with the literature on financial market research might recognize the (apparent) family resemblance of the above outline with the current research efforts at the Santa Fe Institute, which applies inductively learning A.I. agents in their models (e.g., the

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each had different knowledge and different reasons for acting” (p. 273).

*Santa Fe Artificial Stock Market Model*; see Arthur *et al.*, 1997; Palmer *et al.*, 1999), which explicitly allow for differing expectations, the endogeneity of these expectations, co-evolutionary learning mechanisms, feedback loops, emerging properties, etc. in order to simulate various stock market phenomena and inquire into various *complexity* issues. Nevertheless, the ontological conception of the agents that constitute the *nuclei* of such models is questionable. Although even simulations that are based on an inadequate, or even faulty, micro-theoretic understanding of the factors and processes that govern the system components might yield some interesting theoretical insights, particularly with regard to the identification of those “features of market outcomes [that] are largely robust to variations in the decision-making behaviour of the agents who participate in them” (Sunder, 2004, p. 514), their suitability for furthering our *understanding* (Deutsch, 1998), and thus to inform policy decisions, remains questionable, as uninformed configurations of agents as some type of utility-maximising algorithm could produce dangerously deceptive outputs, particularly as specifications might be tweaked in order to get a desired result.

The origin of this flawed methodological approach was identified by Mirowski (2002) in the proclamation by a group of “self-stylized ‘theorists’” within mainstream economics – and *not*, as Mirowski (2002) emphasises, by actual *empirical cognitive scientists* – that

“it is possible to access some algorithms from artificial intelligence, combine them with a particular tendentious understanding of the theory of evolution, [...] all to the ultimate purpose of maintaining that all human endeavour is constrained maximization ‘all the way down’” (p. 533).

Mirowski (2002) describes the *modus operandi* within this research program as follows:

“[T]he analyst starts out with what she considers to be a plausible characterization of the cognitive states of the agent, usually co-opted from some recent enthusiasm in a trendy corner of current artificial intelligence, and rejoices that neoclassical results can be obtained from a machinelike elaboration of agent states, perhaps with a dollop of ‘evolution’ thrown into the pot” (p. 534).

In addition, Mirowski (2002) obliges us with the “key to understanding the literature,” while exposing one of its major methodological flaws:

“[O]nce ‘algorithmic reasoning’ attains the enviable state of ontological promiscuity, then any arbitrary configuration of computers is presumed fair game for economic appropriation, as long as they arrive eventually at what is deemed to be the ‘right’ answer. The distinctive move within this tradition is make numerous references to an agent’s mental operations as being roughly similar to

some aspect of what computers are thought to do, but simultaneously to studiously avoid making reference to any computational theories [...] The rationale behind this awkward configuration of discourse should by now have become abundantly apparent: no one here wants to openly confront the noncomputability of basic neoclassical concepts.”<sup>176</sup> (*ibid.*)

Mirowski (2002) contends that Herbert A. Simon, who was, it ought to be remembered, not only a pioneering economist in the field of decision research, but also one of the most notable first-generation cognitive scientists, would have disapproved of such an approach, as he

“neither promot[ed] a global unified computational model of the mind nor regard[ed] the neoclassical economic model as a serious fit candidate for such a mental model” (*ibid.*)

Herbert A. Simon thus might also have agreed with our argument that a realistic understanding of actual cognitive processes is necessary if we like to gain a proper understanding of financial market processes, phenomena and its complex nature; after all, he held that the

“[u]nderstanding [of] the [underlying] mechanisms [...] [puts one] in a better position to judge how likely it would be to keep the evolving system in the neighbourhood of its equilibrium, and whether deviations from equilibrium would likely be sufficiently great to affect policy significantly.” (Simon, 1983, p. 39)

From the perspective of the *prophylactically* and *therapeutically* oriented proposed research enterprise (see below), the most valuable type of insight that might be gained from such agent-based models that build on a realistic framework of human cognition (i.e., the “cognitive ‘model’”), are those related to the identification of the weak points of the cognitive processes that underlie the operation of financial, e.g. the interacting (interpersonal) factors responsible for the development of ‘blind spots’ that can lead to major price-value divergences. Whether the “cognitive ‘model’” framework will be able to throw new insights on complexity issues, remains for future research to determine.

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<sup>176</sup> As Gigerenzer (2004, p. 392) points out: “[I]n most natural situations, optimization is computationally intractable in any implementation, whether machine or neural (Michalewicz and Fogel, 2000)”. Indeed, in many cases, optimization becomes feasible only through the adoption of some idealized version of the decision situation (see Chap. 1; Lakoff and Johnson, 1999), which “may,” as Gigerenzer (2004) puts it, “mean abandoning our study of chess in favour of tic-tac-toe” (*ibid.*)

### 2.1.3 The “Cognitive ‘Model’”

In this section we shall inquire further into the nature of the “cognitive ‘model’”, the protagonist of the proposed ‘Cognitive Finance’ research enterprise. The inquiry will thereby be limited to the elaboration of some of the insights produced in Chapter 2, as any more sophisticated developments will require demand an in-depth analysis of the current cognitive science literature, which would significantly exceed the scope of the present project. Nevertheless, some potential starting points within the wider economics literature for such a project will be outlined in the subsequent section.

As explicated in Chapter 2, each investor is continuously striving to develop a “cognitive ‘model’” with the greatest possible degree of congruence between the subjective reality it affords and the ‘objective’ reality it tries to depict. As the latter two are ontologically different – i.e., the cognitive aspect can be described to be of a (cognitively) ‘constructivist’ type –, it is of course possible that, at times, the former significantly deviates from the latter. Further, as “cognitive ‘models’” interact inter-subjectively, it is possible that certain erroneous views achieve a certain dominance in the cognitive processes that determine the market prices, which can lead to significant discrepancies between the underlying economic reality as it *is*, and the way it is reflected in its one-dimensional ‘mirror’, i.e. the respective financial market price(s). The financial market participant is, however, not necessarily irrevocably trapped in such an erroneous “cognitive ‘model’” – no matter whether the error that distorted the subjective view of the ‘objective’ reality originated from an *internal* or an *external* source. In fact, as it should have become apparent in Chapter 2, the entire *Value Investing* framework was built around the premise that it was possible to identify errors in both the “cognitive ‘models’” of others, primarily of course those that currently dominate financial market activity and thereby distort current market prices, creating thereby potential ‘pockets’ that might be exploited for ‘alpha’, but also one’s own; after all, if the investor were blind in regard to her own cognitive errors and distorted ‘picture’ of reality, she would never be able to identify genuine errors in the “cognitive ‘models’” of others, which is a necessary pre-requisite for mid- to long-term survival and success in financial markets. The possibility of a cognitive self-assessment can be illustrated with reference to *Moore’s paradox* (Moore, 1993, pp. 207-212; Wittgenstein, 1953, p. 190).

Moore’s paradox lies in the apparent absurdity involved in the assertion of – otherwise true and logically consistent – sentences of the following logical form: “P and NOT(I believe that P)” or P and I believe that NOT-P”, such as the following: “It is raining, but I don’t believe it is raining” or “It is raining, but I believe it is not raining” (see Hintikka, 1962).

This apparent absurdity disappears, however, in the ‘cognitive framework’ proposed by the

current project for the explanation of financial market processes. A brief illustration as to how the latter manages to overcome the former shall provide a few valuable preliminary insights into some of the core ideas that underlie the proposed framework.

Before proceeding, it is important to emphasise, though, that financial market participants are often confronted with propositions that are not so easily and objectively verifiable as the aforementioned P: ‘It is raining’. In fact, some of the core aspects of economic reality that are of the utmost relevance to the investor (e.g., *value*) are themselves often significantly influenced by *subjective* factors such as expectations and the currently prevailing (*subjective*) perception of them by the ‘market’, which, in turn, can influence both the reality *subjectively* experienced by the individual (i.e., this being one of the *external* factors influencing the individual’s “cognitive ‘model’”) and the ‘objective’ reality itself due to the presence of certain feedback mechanisms (see e.g., Soros, 2013) that can lead to *self-fulfilling prophecies*. The nature of *worth*, *value*, and (financial market) *prices* have been inquired into in Chapter 2.

In order to avoid any unnecessary (over-)complication of the discussion, we shall continue to use the ‘It is raining’ proposition, which the reader might interpret as a metaphorical characterisation of one of the aspects relevant to the investor, such as the *value* of a particular economic entity, in order to reduce the degree of ontological objectivity that an entirely *objective* as mind-independent – aspect of reality, such as the absence or presence of precipitation, is characterised by.

According to our proposed ‘cognitive framework’ for financial markets, the human cognitive apparatus creates a ‘model’ for a particular decision-environment/situation, which, in turn, produces – under the influence of *internal*<sup>177</sup> as well as *external* factors (see Chap. 2) – the agent’s *subjectively* perceived reality, on the basis of which the individual decides and acts. The ‘model’s’ ‘frame’ determines its respective syntax and semantics in regard to the interpretation of the ‘objective’ reality. These factors also constitute the *interpretative filter* that determines what data can be classified as information, in what way it is to be interpreted as well as its relationship to the information that already constitutes part of the *subjective* reality perceived through the ‘model’. As far as a specific ‘model’ is concerned, this does, of course, entail a certain risk of ‘model’-blindness, whereby certain, potentially highly relevant, aspects of the ‘objective’ reality might come to be entirely overlooked, at least from within the ‘model’. The human cognitive decision apparatus is, however, not limited to that one particular ‘model’. In fact, the latter is merely a (likely temporary) construct of the former, i.e. one possible ‘conjecture’ in regard to the ‘objective reality’ (see Popper and Eccles, 1977); and the individual is, if not consciously, then at least unconsciously, aware of the fact that there is a

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<sup>177</sup> Whereby, of course, also aspects such as *satisficing* play an important role (Simon, 1956; Manktelow, 2000).

myriad of other possible ‘models’ – which assign, for example, different weights to certain aspects of reality (see Chapter 2) –, particularly as there is a continuous (unconscious) comparison between the incoming new data and the prevailing *subjective* reality that is determined by the ‘model’. This occurs, however, on a ‘higher’ level, or, at least, external to the ‘model’ itself, within which, certain parameters need to remain fixed in order for the individual to be functional. In addition, as pointed out by Moran (2001), human beings are capable of (conscious) *self-knowledge*, which includes the ability to know one’s own mind, at least partly. This, in turn, opens up the door to mindfulness, introspection and the possibility to reflect, to assess and to re-evaluate one’s thoughts – including the ‘model’ itself in a Spinozean manner. Human beings thus have the ability to consciously assess and modify the prevailing ‘model’ – i.e. the ‘picture’ that the mind constructed of reality – at least up to a certain extent.

So, how does the framework that has been sketched out above overcome the apparent absurdity of a ‘Moorean sentence’?

First, to reiterate, *reality* is perceived *subjectively* through a specific ‘model’ created by the cognitive apparatus – under the influence of various *internal* as well as *external* factors – in order to enable the decision-maker to operate within a particular environment. The ‘model’s’ respective syntax and semantics are instrumental in determining this *subjective reality* and there exist certain filtering mechanisms that permit certain ‘updates’ to the ‘model’, but not others, particularly not those, which would put the ‘model’s’ ‘core’ in jeopardy,<sup>178</sup> and which would necessitate the formation of a new ‘model’. It is important to re-emphasise that these ‘models’ are merely cognitive ‘instruments’, means to an end, devised to enable the decision-maker to survive and strive within a particular (decision-) environment.

Now, the *subjectively* perceived reality produced by the ‘model’ – and remember, the individual can only ever consciously access the ‘objective’ reality through such a *subjective* representation of it – might, depending upon the given (filtered) data as well as the ‘model’s’ syntax and semantics, give rise to the truthful proposition P, e.g., ‘It is raining’. Thus, within the parameters of the ‘model’, the proposition P is true and the individual decides and acts accordingly. Nevertheless, this truth is not absolute as the ‘model’ itself is, as already pointed out above, just one among a myriad of possible ‘models’. Further, as aforementioned, the cognitive apparatus is aware of this aspect, and tries to continuously adjust the ‘model’ to incoming data. It is important to note that the cognitive apparatus continuously registers (at least unconsciously) incoming data, even if the latter are filtered out from the ‘model’ itself. Nevertheless, as argued above, there is an inherent limit to the degree one particular ‘model’

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<sup>178</sup> Think of Quine’s ‘Web of Beliefs’ or Lakatos’ ‘Research Programs’.

can be modified and adjusted. Thus, it is possible that ‘contradictory evidence’ – i.e. the given realities in financial markets are dynamic and constantly changing, which could lead to the ‘obsolescence’ of a particular ‘model’ – is being registered by the cognitive decision apparatus, *externally* to the ‘model’ in question, and that *intuition*, which draws, *inter alia*, from experience (i.e. pre-existing structures and memory), might recognize certain patterns that put the reliability of the particular representation of reality created by the ‘model’ into doubt. Once a certain threshold is reached that might manifest itself either unconsciously (e.g., like Soros’ (2003) aching back), or consciously, the ‘model’ might be discarded. Thus, a point might be reached, where the individual (consciously) states that he ‘does not believe in P’ or that he ‘believes not-P’ (e.g., He does not believe that a stock’s price truly reflects the underlying *value* of a company). It is important to note, that this statement occurs *externally* to the ‘model’. Now one might argue that the individual is acting irrationally, because he does not correctly update his ‘model’, or, if that is not possible, create a new, more accurate one.

There exist several obstacles to such ‘rational’ updating or new ‘model’ formulation, though. First, the current ‘model’ has liked proved to be useful so far, e.g. through significant pecuniary rewards and/or social validation. Secondly, and linked to the latter, is the ‘inductive-probabilistic’ nature of these ‘models’, i.e. a positive feedback loop keeps (cognitively) strengthening the ‘model’ and the trust in its reliability, which makes it extremely difficult for an individual to consciously (or unconsciously) abandon it – and indeed, the *rationality* of a decision to do so might itself be doubtful (see point 4). Thirdly, the ‘model’ might largely correspond to widely held views and the individual might experience severe *internal* (e.g., fear of ‘going against the crowd’, ‘being alone with one’s opinion’) as well as *external* (e.g., clients might withdraw money from the investor’s fund if she appears to fail to grasp the *Zeitgeist*) obstacles. Fourthly, there is always the possibility that one’s belief(s) *external* to a particular ‘model’ are themselves mistaken; after all, they do not enjoy any privileged insight into the ‘objective’ reality and are produced by the same decision apparatus as the ‘model’ was. Once again it must be stressed that many aspects in financial markets are often not as clearly and objectively verifiable as the current precipitation rate. This list is not intended to be in any way exhaustive, but it should provide a first glimpse into the mechanisms and factors that underlie suboptimal financial decision-acts. A thorough understanding of these mechanisms and processes is required in order to understand how the financial market participant operates, how he can protect himself from his inherent shortcomings through certain pre-emptive strategies and how it might be possible for him to escape a particular ‘model’ and gain a more refined view of reality in real-time.

A thorough understanding of this aspect is, however, not only imperative for professional investors but also for those devising and implementing policy measures that are targeted at

affording a greater degree of financial market stability. Further, as has been argued in Chapter 2, it won't suffice to merely devise pre-emptive and prophylactic policy-measures. What is required *in addition*, is a 'quietist' (in the sense of *therapeutic*) approach to decision processes in financial markets in order to *enable* financial market participants, economists and policy-makers alike to uncover unsustainable market developments as they emerge in *real-time*, rather than being surprised by them through a major crash and financial crisis. For this purpose, it is imperative that all relevant parties are aware of the following: (1) All decisions are made within certain cognitive 'models', who determine the *subjectively* experienced reality and whose formative process is influenced by a myriad of *internal* as well as *external* factors; (2) No-one is afforded any privileged insight into the 'objective' reality, i.e. the human decision maker has only access to the *subjective* reality afforded by the respective cognitive 'model(s)', or, as L.A. Hahn (1956) puts it, "the world does not consist of economists who know and business men who err" (p. 166); (3) Decisions and actions can appear perfectly *rational* within the frame of a particular cognitive 'model' – i.e. *subjectively*, even though from an 'objective' perspective they might not be; (4) Due to the constant interaction of individuals and the consequent *external* influences on the respective cognitive 'model(s)' it is possible that certain cognitive errors and mis-perceptions/interpretations infect a significant proportion of financial market participants, economists and policymakers; (5) It is possible to at least partly escape from a cognitive 'model' once formed, i.e. to gain a more refined view of reality; (6) This is an on-going process. Thus, whereas Keynes' approach to economics might give allusions to the work of a 'Doctor' (see Hoover, 2006) – i.e. "Keynes's pragmatic, diagnostic conception of economic theory provides a different, and perhaps more satisfactory understanding, of the role of the economist in the economy" (*ibid.*, p. 94) –, the one that can be distilled from Keynes's (and Graham's) *investment philosophy* (see Chapter 2) gives, without doubt, allusions to the approach of a *therapist*. From the perspective of the latter and in view of what such an approach requires, it would be advisable for financial market participants, economists and policy makers alike to overcome their – what the Cambridge theologian Dr Stephen Cherry (2016) terms – *love of certainty* – which, in Cherry's (2016) opinion, had been one of the main causes behind the most recent financial and economic crisis, as it had fostered an almost limitless faith in and reliance upon abstract theoretical frameworks and models when engaging with the (highly complex and uncertain) real world – and, instead, cultivate what Keats (1899) termed, *negative capability*, i.e. being "capable of being in uncertainties, doubts, without any irritable reaching after facts and reason" (Keats, 1899, p. 277),<sup>179</sup> whereby we interpret the quote as referring to 'the willingness and ability to accept and deal with the uncertainties that permeate the real world, resisting the urge to flee into and hold onto fixed frames that consist

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<sup>179</sup> Letter to George and Thomas Keats, 22 December 1817; reprinted in Keats (1899, p. 277). Quote taken from Misak (2016, p. 237).

of prematurely constructed or outdated ‘facts’ and ‘reasoning’ in order to mitigate the anxiety induced by those uncertainties,’ and instead to adopt a fallibilist attitude when one engages with the complex reality of financial markets (see e.g., Soros, 1987, 1994, 2003, 2008, 2009, 2010, 2012, 2013). One’s currently dominant cognitive ‘model’ has to be understood as *one possible* (subjective) representation of the underlying ‘objective’ reality among many – after all, each financial market participant thinks that her ‘model’ is the superior one, and if those were to afford precisely the same *subjective* interpretation of reality, very little, if any, trading activity would take place at all in financial markets (see Chap. 2). Cognitive ‘models’ and ‘facts’ thus have to be treated as provisional hypotheses that might be correct or incorrect, but it would be irrational to place too much faith in any single one of them.

The “cognitive ‘model’”, whose basic properties and workings have been explicated in this section on the basis of the ontological insights gained in Chapter 2, represents, at the present stage, nothing more but a very rudimentary sketch of a framework that might be able to incorporate relevant theoretical concepts and empirical insights from modern cognitive (neuro)science in a – unlike Rapp and Cortés (2017) – *systematic* way, as it has been devised specifically to account for the individual agent’s ability to master the type of cognitive challenges the nature of financial market harbours and, *vice versa*, the various empirically well-documented financial market phenomena (see Chap. 2). Further, as shall be explicated in the subsequent section, several of the inferences made, overlap with theoretical insights produced by F.A. Hayek. Subsequent work shall develop the “cognitive ‘model’” framework on the basis of *inter alia* the modern cognitive (neuro)science literature; for the time being, though, it shall be illustrated that the core ideas of two thinkers within the wider economics literature might have particular purchase in the construction of a fertile dialogue of financial market research with modern cognitive science, namely Johannes von Kries (an important intellectual influence on J.M. Keynes’ thought about human decision processes) and F.A. Hayek, particularly via his work on theoretical psychology (Hayek, 1952) and on information and knowledge (1937, 1945).

## *2.2 Identifying an alternative Starting Point within the (wider) Economics Literature*

The present project has, at this stage, hopefully succeeded in making a sufficiently strong case *against* the adoption of the neo-classical rational-actor model as the nucleus of the research-program that aims at developing a thorough *understanding* of the cognitive processes that underlie the operation of financial markets (see Chap. 2). Chapter 1 has demonstrated that it is precisely the continuing dominance of this theoretical framework with its outdated conception of ‘man as a (serial) computer’ that reasons via formal rule of inference – a view that it shares with an early research-strand in the cognitive sciences (see Gardner, 1987; Davis, 2003) – that curtails any progress – indeed, the emancipation – of the field. The very empirical

insights produced by *Behavioural Finance* and related research-strands, which have *de facto* refuted the rational-actor model, and which should therefore have inspired the search for adequate alternative theoretical frameworks, have either been (a) assimilated into the neo-classical framework, (b) classified as ‘performance errors’, and/or (c) dismissed on the grounds of insufficient relevance. These developments can be contrasted with those in the field of cognitive science after the emergence of, *inter alia*, Behavioural Decision Research (BDR), which formed the intellectual basis for ‘new’ behavioural economics (Sent, 2004). The accumulating evidence against the conception of mind as a computational symbol-processing device that operated according to the prescribed formal rules of logic and the probability calculus, led to the development of alternate research strands, which have provided a much richer and more realistic understanding of human cognition. Needless to say, these developments and the new theoretical and empirical insights they afford, have been largely ignored by *Behavioural Finance* scholars.

The lack of space precludes a more detailed discussion of the vast cognitive science literature. Nonetheless, an attempt shall be made to (very) briefly sketch out some of the more notable developments, particularly as far as they hold promise to act as a starting point for the development of the proposed “cognitive ‘model’” framework: One modern research strand of cognitive science conjectures that instead of processing incoming information according to the formal rules of inference, the mind forms ‘models’ whose structure is analogous to the (aspect of) reality that they represent and which provide the basis for the individual’s decisions and actions. An early version of this understanding of the operation of the human mind had already been proposed by the philosopher and psychologist K.J.W. Craik (1943). The work of researchers like Johnson-Laird (1983, 2006) would eventually establish this ‘model’ theoretic framework as one of the alternatives to the logical symbol-processing conception of the individual of first-generation cognitive scientists (Gardner, 1987). Cognitive scientists like Kintsch (1998) have developed frameworks that conceive of a ‘dialectical interplay’ between receptive processing and active shaping of ‘situational models’, an understanding that, according to Carus (2010, p. 268), “is complemented and reinforced by Vygotskian theories of the interface between socially mediated knowledge and individual development (e.g., Wertsch, 1985; Tomasello, 1999).” Others, such as Lakoff (e.g., Lakoff and Johnson, 1980, 1999) have proposed an understanding of the human mind that afforded *metaphors* a central role in cognition. A brief glimpse into this framework was already provided in Chapter 1, where it was applied to the discussion of interpretative matters in regard to some of Kahneman’s and Tversky’s findings. What is important to note that the latter belongs to a research strand that conceives of cognition to be *embodied*. Other landmark works in this ‘tradition’ include Valera *et al.* (1991, 2016) and Thompson (2010). They stress the importance of such factors as subjective experience and consciousness, two topics that had formerly been

largely neglected by earlier research efforts; as was the role of emotional factors (Damasio, 1994; Pessoa, 2013). It will be the task of future research to determine which of those research strands provides the most suited starting point for the development of the proposed “cognitive ‘model’” framework that is intended to constitute the *‘nucleus’* of the ‘Cognitive Finance’ enterprise. All that can be accomplished in the remainder of the present work is the identification of some relevant contributions within the wider economics literature that are congruent – or at least compatible – with the insights thus far established in regard to the cognitive processes in financial markets, in order to see whether they might provide a first bridgehead into the modern science literature and thereby some direction for the aforementioned task. Some further direction shall be provided by the discussion of some of the core methodological issues that the proposed ‘Cognitive Finance’ research enterprise raises, particularly also with regard to the coordination of the interdisciplinary project.

### 2.3 Johannes von Kries

As already pointed out in Chapter 2, the required link to the modern cognitive science literature might be established through the work of two of the most influential economists of the 20<sup>th</sup> century, i.e. J.M. Keynes and Friedrich Hayek. In case of the former, though, it is not, in the first instance, his own thought that is of primary relevance here, but rather that of one of his key intellectual influences on his understanding of human decision processes, i.e., the German physiologist and logician Johannes von Kries, a pioneer in the emerging empirical research efforts into the operation of the mind, who – long before the eve of the ‘cognitive revolution’ – came to reject the view of man thinking and acting according to the prescriptions of formal logic and the probability calculus. Indeed, as Fioretti (2003) points out, “von Kries was very much ahead of his time” (p. 134), possessing of an understanding of “the operating principles of mental categories [...] that only began to surface in the cognitive sciences in the 1980s (Barsalou, 1987; Lakoff, 1987; Hampton, 1993)” (*ibid.*) during the ‘connectionist revolution’, which came to corroborate several of his pioneering insights. Unfortunately, his work was, apart from Keynes himself, largely ignored in the English-speaking world and is now almost entirely forgotten. Nevertheless, Fioretti (2003) argues that his work provides “a good starting point for improving on Keynes’ thought, both with respect to individual as well as collective behaviour” (p. 139). As far as an improved understanding of the *individual* might be possible, he expounds:

“[F]ollowing von Kries, animal spirits, just like any human motivation, could be understood in terms of idiosyncratic mental categories and causal maps [see also von Hayek, 1952]. Ultimately, von Kries may act as a link between Keynesian economists and cognitive scientists. The cognitive sciences have undergone impressive developments since the ‘connectionist revolution’ of the 1980s, and

*these may yield a basis for a true microfoundation of Keynes's economics.” (ibid.; italics added)*

Similarly, in regard to a superior understanding of *collective* behaviour, Fioretti (2003) explicates:

“Prospects for improving our understanding of the collective behaviour are even more exciting. Von Kries’s account of the formation of possibility judgments rests upon structures of information and cognitive processes of information classification, which represent a proper framework for investigating the possibilities for unemployment equilibria under alternative institutional arrangements. Keynes scholars have already hinted at opportunities for understanding conventions in terms of common knowledge and self-organization (Dupuy, 1989[...]), Wittgenstein’s later views on ‘language games’ (Davis, 1996) and Hayek’s concern with social constructs (Lawson, 1996). Much more could be achieved by applying connectionist models to social interaction.” (*ibid.*)

The most valuable aspect of von Kries’ thought for the purposes of the present work is his concern with *actual* mental processes. As a physiologist, who “was intrigued by the classification of environmental stimuli into mental states, and particularly by the construction of generalizations (von Kries, 1901, 1923)” (Fioretti, 2001, p. 246), he was aware of “the fuzziness and open-endedness of generalisations conceived by the human mind” (*ibid.*) and the significance of such factors as *interpretation* and *analogies* in human reasoning, and would therefore have rejected the conception of ‘man as a serial symbol processor’ that operated according to the prescriptions of formal logic that his contemporary Gottlob Frege (1879) was laying the foundations for.<sup>180</sup> His account of non-numerical probability (1886) and logic (1901) might thus – where not already adopted (or independently ‘re-discovered’) and further developed in the relevant literatures – provide some of the basic building blocks for the formulation of an alternative to the Bayesian framework that has come to dominate some cognitive science research efforts (see, e.g., Griffiths *et al.*, 2008).

Two of the more noteworthy similarities between von Kries’ insights and those of modern cognitive science which might also be of relevance for the development of our proposed “cognitive ‘model’” framework, are the following: First, similarly to Lakoff and Johnson’s (1980) account, von Kries holds that human thought operates by way of analogy; for example, with regard to his conception of mental processing of probability judgments, Fioretti (2001) summarizes:

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<sup>180</sup> He would also have disapproved of Keynes’ neo-Platonic account of probabilities (Fioretti, 2003).

“Von Kries viewed probability as a logical relation based on analogy: by drawing analogies between the present and the past, an individual is able to say that a certain course of events is more or less ‘probable’.” (p. 247)

Secondly, his account of human cognition, which resulted from a combination of his “juvenile interest in Kant’s epistemology merged with his professional activity as a physiologist” (Fioretti, 2001, p. 246), might, just like Singer’s (2000), be categorized to be of a *constructivist* type. The latter is also the type of account that, arguably, would be most suited for the formulation of the proposed “cognitive ‘model’” framework.

Similar – and arguably theoretically more elaborated – insights into the operation of the human mind were provided by a *Renaissance man* whose primary profession was that of an economist: Friedrich von Hayek, who not only developed a detailed account in theoretical psychology (Hayek, 1952), but who, in addition, was also interested in the nature of information and knowledge as well as their role in market processes, more generally (Hayek, 1937, 1945). Although his work on human cognition was largely ignored during the two ‘behavioural economics revolutions’ (i.e., the ‘old’ and ‘new’ one; see below), more recent scholarship has begun to re-discover his theoretical insights as well as their potential relevance for behavioural economics (see Frantz and Leeson, 2013). In what follows, we shall emphasise some of the core aspects of his work that might be relevant for the development of our proposed “cognitive ‘model’” framework.

#### 2.4 F.A. Hayek

The more elaborated bridgehead into the modern cognitive science literature, one that is also more firmly entrenched within the traditional economics literature, is Friedrich von Hayek’s work. As already pointed out in the introductory section in Chapter 2, Hayek’s (1952) work provided the initial inspiration for the – at this stage very rudimentary – conception of the “cognitive ‘model’” (framework), i.e. the suggested ‘*nucleus*’ of the proposed ‘Cognitive Finance’ research enterprise, particularly as his related work on the nature and information and knowledge and their role in market and price-formation processes (Hayek, 1937, 1945) already provides the required link within the existing economics literature between human cognition and these processes.

In what follows, a brief outline of some of those Hayekian ideas in regard to the operation of the mind as well as the related topics of information and knowledge shall be produced, which are considered most relevant in the light of the ontological insights thus far gained in regard to financial markets and the proposed “cognitive ‘model’”; ideas that, in spite of their palpable significance, were ignored by both waves of Behavioural Economics (i.e., ‘old’ and ‘new’; see Sent, 2004) but which shall play a central role in the proposed ‘Cognitive Finance’ research

enterprise. The lack of space unfortunately precludes any further elaboration on these important topics.

Hayek's interest in the field of psychology can be traced back to his student days at the University of Vienna where, after a brief period as a research assistant in the laboratory of the brain anatomist Constantin von Monakow (Hayek, 1994, pp. 63-64) in Zurich, he completed a brief paper titled "Beiträge zur Theorie der Entwicklung des Bewusstseins," which would turn out to be the embryonic sketch of his mature thought that fully developed in his *The Sensory Order*, which would be published in 1952 (see Caldwell, 2004). One of Hayek's (1952) core tenets is the postulate "that there is no one-to-one correspondence between stimuli and response, respectively between the physical and phenomenal order" (Ivanova, 2016, p. 700), and one of the central questions that would occupy him his entire life was "how a psychological stimulus is concerted into a conscious sense experience" (*ibid.*). Ivanova (2016) summarizes:

"The last observable point in the process that takes place between the external stimulus and the emergence of a sensation is the arousal of the ganglion cells in the brain. Beyond that point, there is a time lapse until the final appearance of the original stimulus as a conscious sense experience. It is the reconstruction of what is happening during that time lapse that Hayek attempts to accomplish. He is critical of the perspective of psycho-physical parallelism which, according to his presentation, sees the conversion of the impulses into sensations by the brain as a simple inexplicable and thus basic fact which does not merit further examination." (*ibid.*)

Hayek's (1952) framework can thus, similarly to Johannes von Kries', be considered as an early precursor to the 'connectionist revolution' in cognitive science in the 1980s. According to the latter, the coordination of sensory impulses is the means by which an effect is created (Steele and Hosseini, 2013, p. 317); or, as Hayek (1952) summarizes: "Perception is...always an interpretation, the placing of something into one of several classes of objects" (Hayek, 1952, p. 147; quote taken from *ibid.*), and, as such, a *constructivist* cognitive process.<sup>181</sup>

Earl (2013) notes that Hayek's (1952) conception of the mind holds great potential for an advanced study and the development of a better understanding of the phenomenon of choice, particularly with regard to Dewey's (1910) decision cycle, which, albeit being employed by some 'old' behavioural economists (see Loasby, 1976), has been largely ignored by 'new' behavioural economists, "who seem to view choice merely as entailing a somewhat twisted version of constrained optimization" (Earl, 2013, pp. 278-279). Earl (2013) also explicates a

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<sup>181</sup> See Glossary.

few key aspects of Hayek's (1952) conception of the mind that he considers particularly relevant for the study of choice:

“In *The Sensory Order*, the mind is [...] portrayed as operating systematically in a manner akin to an internet search engine [‘when presented with a set of search words as stimuli’ (*ibid.*, p. 282)]. It is the stored sets of neural connections that have been activated most frequently in recent times that will initially be tried for a fit with the set fired up by incoming stimuli. (Hayek’s thinking is consistent with the empirical work on ‘priming’ surveyed in Kahneman, 2011). Other things being equal, in terms of recent activation, a set of connections is more likely to be tried if it has a strong history of cumulative activation. If a fit cannot be found, the mind tries patterns from further back in memory, ranked in order of their cumulative past frequencies of being activated, or patterns that have been fired up recently but rank lower in frequency [...] with activations in previous period being weighted less and less the further back in the past they occurred.” (pp. 283-4)

Should there be any “partial fits with several conflicting stored patterns”:

“the decision maker will perceive uncertainty and may experience feelings of discomfort associated with cognitive dissonance. If so, the decision maker will either have to accept that a definite classification cannot be made (that is, accept the uncertainty), or find a way to remove the conflict.” (*ibid.*, p. 282)

The relevance of the above and similar Hayekian insights into the operation of the mind for an understanding of the cognitive processes that underlie the operation of financial markets can be discerned from Earl's (2013) following outline, which might well provide a sound starting point for an inquiry into, for example, the why and how the financial market community – at times at least – can come to perceive even extreme market-valuations as ‘normal’, in spite of all the empirical data in regard to mean-reversion and/or their own negative experiences in the past market cycle, and eventually comes to revert back to more conservative views; in both cases the processes of repeated exposure and consequently the repeated activation of certain sets of connections are involved:

“Hayek’s view of the mind also provides a means for understanding how people who have grown accustomed to phenomena that once seemed radical and/or outrageous can revert to much more conservative ways of thinking if repeatedly exposed to conservative stimuli. These conservative sets of stimuli will be categorized with the aid of frequently activated sets of connections and then stored.... However, these recently activated conservative stimuli sets have a good

chance of being tried for fit against subsequent incoming stimuli sets, whether the latter are similar sets of stimuli or rather different sets that nonetheless fall into the same context. They thus become more entrenched in the memory and begin crowding out rival sets of connections that are becoming less and less frequently activated.” (Earl, 2013, pp. 293-4)

Unfortunately, this outline emphasises merely the *passive* mental processes at work. One of the core aspects of the project that is being proposed in the present thesis shall, however, be the *active* participation of *consciousness* that *should* be part of every (*Value*) investing reasoning process. Earl (2013) points out that “[e]conomists habitually construct models of choice that implicitly proceed as if the decision maker has already made three other kinds of choice:

- (a) How to construct the problem that the decision-making process is trying to solve;
- (b) The set of potential strategies for solving the problem that has been identified; and
- (c) How to construe the problem-solving potential of the rival strategies between which the choice is to be made” (p. 278)

The brief outline of Hayek’s (1952) insights into the operation of the mind reveals, however, that the agent cannot even be sure in regard to the accuracy of the subjective ‘picture’ of reality produced by her mind that ought to constitute the basis for her decisions. It is thus imperative for the aspiring (*Value*) investor to *actively* and *constantly* monitor (i.e., via ‘mindfulness’) as well as assess and re-assess this ‘picture’ that is being produced and constantly updated by the cognitive apparatus through the interaction of the respective *internal* as well as *external* factors and to re-interpret them wherever deemed necessary in order to proceed toward a clearer and more ‘objective’ view of reality. After all, this is the core (cognitive) task that any investor must strive to accomplish, i.e. try to identify errors in the currently dominant ‘picture’ that determines current market prices, while ensuring that her own ‘picture’s’ distortion is of a lesser degree than that of the ‘market’ (see Chap. 2). As expounded in Chapter 2, this feat is possible as a significant proportion of market participants might be blind to certain unsustainable developments – and Hayek’s insights just outlined above might provide some further explanation for this phenomenon – while astute individuals might be able to reduce the degree of distortion in their own respective “cognitive ‘models’” and thus be able to exploit their superior insights as to reality for their financial gain.

The above should also further the reader’s comprehension of the ‘therapeutic’ approach that had been suggested earlier in the present work. After all, if such distortions – and no human agent is entirely immune to them – can have such severe repercussions as the ones experienced in the wake of the 2008-9 crisis, it is imperative to gain a thorough understanding of the

cognitive processes involved and to develop adequate methods and tools for the minimisation of their detrimental effect on our perception of reality. The understanding of such cognitive processes is, however, also relevant for other fields in which human choice plays a significant role; for example, Earl (2013) illustrates that Hayek's ideas provide some insights into the cognitive mechanisms that, for instance, marketing campaigns successfully exploit for the creation of (artificial) *wants* and *desires*:

“As Hayek (1961) ... emphasised, aside from a few basic needs, people do not have innate, absolute wants. What they aim to achieve depends on the interpretation they have made of their experiences in a particular socio-historical context, and on what they have made of stimuli they have picked up from suppliers that were trying to interest them in their products” (Earl, 2013, p. 298).

In the subsequent (sub-)section we shall turn our attention to Hayek's views on two core topics for a thorough understanding of financial market processes, i.e., *information* and *knowledge*.

#### 2.4.1 Hayek's views on 'information' and 'knowledge'

Hayek's views in regard to the operation of the mind most certainly wielded a significant influence on his thinking on and conception of *information* and *knowledge*, which he developed, most famously, in Hayek (1937, 1945). As already pointed out above, Hayek's project was driven by an *evolutionary epistemology*, as Chelini and Riva (2013) expound:

“In Hayek's view knowledge is represented as a descriptive process strictly dependent on the interconnection between three different kinds of order: the neuronal, the physical and the mental. The first is the order represented by chemical impulses at the level of neurons, the second deals with external facts and objects of the world, the third is the level of phenomenal perceptions which refer to things as they appear to us. Between the second and the third order there is no isomorphism, which is reflected in the fact that ‘things which are physically the same sometimes appear different, or (...) different things may appear to differ from each other in a manner which is in no way commensurable with the physical differences which objectively exist between them’ (Hayek, 1952, p. 26). Hayek's epistemological investigation aimed then at discovering how the physical and mental order interact, and at understanding the nature of knowledge triggered by their relationship” (pp. 131-2).

The relationship between *information* and *knowledge* is thus the following in Hayek's view:

“Information is given by external data and it is objective; knowledge is the result

of a reading and an interpretation of external data (information) through cognitive patterns, personal experiences and social culture: so it is subjective and idiosyncratic.” (Rizzello and Spada, 2013, p. 303)

Further insights in regard to Hayek’s understanding of the cognitive processes involved in knowledge formation that are highly relevant for the present work are provided by Chelini and Riva (2013); first, in regard to the *internal* processes:

“According to Hayek, the personal formation of knowledge can occur both through the influence of the structure of each subjective mental framework – that is, the cytoarchitecture of the mind – and through the influence of previously acquired knowledge which has been accumulated in the subject’s repertoire as a ‘building block’ which can be used again in similar contexts (Hayek, 1952).” (p. 139)

In regard to *external* factors:

“The process of classification of external factors through individual cognitive structures and the mechanisms of feedback between the agent and the environment are fundamental features of knowledge formation” (Hayek, 1952)” (Chelini and Riva, 2013, p. 128)

*Information* is therefore conceived as “a non-model datum coming from the external environment,” whereas *knowledge* is understood as “an active process of continuous and subjective construction and interpretation” (Chelini and Riva, 2013, p. 139).<sup>182</sup> This means that Hayek’s view on cognition is, similarly to Johannes von Kries’, of a *constructivist* type:

“In Hayek’s view, knowledge is a process of personal construction produced by the subjective interpretation of the agent [...] Hayek explains that each relationship with the external world exists just in the mind of the subject and is not necessarily characterized by any objective reality. [...] Each individual is equipped with cognitive structures which are semi-permanent: they depend on the specific cytoarchitecture, which is the spatial disposition of neuronal cells, but at the same time they are flexible and subjected to change according to the various personal experiences of each individual [see above] (Hayek, 1952).” (*ibid.*, p. 140).

Thus, according to Hayek’s epistemology,

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<sup>182</sup> The topic of ‘knowledge creation’ has also been the topic of more recent research in economics; see, e.g., Smith (2008).

“[t]he process of elaboration of knowledge [...] is a ‘construction’ – elaboration, continuous processing and evolution from the subject’s point of view. The role of subjective perception is then fundamental in the process of classification, the most important process in knowledge formation. ‘Classify’ means to attribute to external facts meanings which do not exist in an objective way in the physical world, but strongly depend on subjective perceptions and interpretation, and are made possible by individual cognitive structures and previous experience.”<sup>183</sup>  
(*ibid.*, 141)

It should not be difficult for the astute reader to recognize the relevance of Hayek’s respective theoretical accounts of cognition, information and knowledge for our inquiry into the cognitive processes that underlie the operation of financial markets. Particularly the following Hayekian insight bolsters our discussion in regard to the investor’s core (cognitive) task of striving for a superior view (‘picture’) of reality in order to maximize her chances of financial survival and investment success:

“[A]ccording to Hayek, in explanation of economic performance what matters is not just how much information an economic subject can collect, but the knowledge he is able to build on that information. It is the result of the complex interaction between external information, mental structures, and their modifications as a consequence of past information.” (Rizzello and Spada, 2013, p. 303)

It is this partial, imperfect and idiosyncratic nature of knowledge (as well as the *multi-dimensionality* of data; see Chap. 2) that leads to the heterogeneity of investors’ views; a heterogeneity, which underlies the greater part of all financial market activity (see Chap. 2) and thereby provides the much-needed *liquidity* element. Nevertheless, it does not incapacitate agents from forming conventions and institutions that constitute the financial market(s) in the first place:

“[I]t doesn’t prevent subject from sharing several norms, which emerge spontaneously as a consequence of their free action and lead toward a spontaneous order. Hayek provided a deeper explanation in another essay, “The use of knowledge in society” (Hayek, 1945), in which he highlights the connection that can be established between the structure of the human mind and institutions [...]” (*ibid.*)

The cognitive processes involved in the formation and maintenance of conventions and

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<sup>183</sup> See Arthur (2000, p. 3), quoted in the main text above.

institutions, which, by the very nature of their purpose, are primed for *continuity*, are thus distinct from those involved in the investor's core (cognitive) task, i.e. the constant re-evaluation and updating of her 'picture' (i.e., "cognitive 'model'") of (the relevant aspect of) reality, which are *disruptive* in nature. It is up to future research to inquire deeper into these matters.

At this point it remains to be noted that, in spite of their palpable relevance, most of these Hayekian insights were almost entirely ignored throughout both waves of the behavioural economics revolution – i.e. the first ('old') wave during the 1950s-1960s, and the second ('new') wave during the 1990s (see Sent, 2004). Rizzello and Spada (2013) identify different reasons as to why Hayek's profound insights failed to diffuse during either of these two periods: The first behavioural economics program, they argue, was primarily concerned with the critique of the neo-classical rationality postulate on the basis of the new empirical evidence that became available at the time. The topics of *information* and *knowledge* were thus not on the top of the agenda, if they were considered at all. The reasons for their neglect might simply lie in the fact that the empirical tools that an inquiry into such cognitive matters would have necessitated, were simply not available at the time. Further, Rizzello and Spada (2013) stress that this first behavioural economics program also lacked a well-defined research program, which might have been necessary for the coordination of a concerted research effort into these topics. Now, several of these obstacles to the inclusion of Hayek's thought into behavioural economics seem to have disappeared by the beginning of the 1990s. After all, important strides had been made in the field of information research – even mainstream economics was transformed by the advent of a new research stream dubbed *information economics* (e.g., Akerlof, 1970; Grossman and Stiglitz, 1980; Akerlof and Stiglitz, 1987) – and in cognitive science (see above). Furthermore, the 'new' behavioural economics program could even boast of "an organic research project" (Rizzello and Spada, 2013, p. 309). Notwithstanding these apparent favourable conditions for a systematic inclusion of Hayek's ideas, they were, once again, largely ignored. Rizzello and Spada (2013) hypothesize that the reason for this repeated exclusion of Hayek's theoretical accounts in regard to human cognition, information and knowledge is to be found in the self-understanding of the 'new' behavioural economics research program, which, as discussed in Chapter 1, largely conceived itself as convergent rather than divergent with the neo-classical paradigm; lacking thereby vital elements for the development of a more realistic understanding of human decision processes in economic contexts (Rizzello and Spada, 2013, p. 310), particularly the financial market context (see Chap. 2).

The relevance of Hayek's thought for the development of a thorough understanding of the cognitive processes that underlie the operation of financial markets should – if it hasn't already

– become apparent through a re-examination of the core insights produced in Chapter 2 in the light of these Hayekian insights in regard to the operation of the mind, the complexity of information and the nature of knowledge. The development of our proposed “cognitive ‘model’” framework will of course necessitate the consideration of more recent developments in the cognitive sciences, but Hayek’s work can direct us toward the right questions, issues and topics to be researched, while providing the required bridgehead into this literature. Thus, the opportunity that was missed by both ‘waves’ of the Behavioural Economics revolution shall be seized by the proposed ‘Cognitive Finance’ research enterprise, as its utility for the inquiry into the cognitive processes underlying the operation of financial markets can – apart from those aspects already outlined above – be discerned from Altman’s (2013) following observations in regard to arguably the most important topic in current financial market research, i.e. their *efficiency*:

“Hayek’s approach raises important questions about whether individual rationality necessarily implies economic efficiency and whether the evolutionary process necessarily imposes economic efficiency on economic outcomes. Too often behavioural economics pays little heed to the survival test when analysing human decision making and the invariable non-conventional decision-making processes and economic outcomes.” (Altman, 2013, p. 258)

Unfortunately, the lack of space precludes any further elaboration on Hayek’s thought. The last aspect to be considered in the present work is some of the methodological implications and requirements of the proposed ‘Cognitive Finance’ research program with the “cognitive ‘model’” framework as its *‘nucleus’*.

#### 2.4.2 Hayek, Individualism, ‘Cognitive Finance’ and Realism

In this sub-section, we shall discuss the conceptualisation of financial markets that emerges when Hayek’s thought is applied to the elaboration of the insights produced in Chapter 2 as well as the methodological implications that follow from it.

The discussion shall revolve around the following key insights that have thus far been established:

I. *With regard to financial markets (Chap. 2):* Cognitive factors and processes play a central role in financial markets. These can be segmented into three interrelated but categorically distinct aspects, or tasks: First, the individual agent’s unremitting struggle to develop a superior understanding – i.e. a superior *subjective* ‘picture’ – of (the relevant part of) an uncertain and ‘multi-dimensional’ reality by way of a constant endeavouring to (i) gather all information *deemed* relevant for the task, (ii) formulate the most sensible *interpretation* of this

information, and (iii) identify and (re-)assess the most sensible way of its combination into – what is *deemed* – a (satisficingly)<sup>184</sup> consistent *internal structure*. One might label this *cognitive* task the *conjectural* one. Secondly, the agent’s constant endeavour to detect major ‘errors’ in the respectively prevailing ‘picture’ that determines financial market price(s) at a particular instant in time, primarily by way of comparison of the latter with her own *subjective* ‘picture’ (and the corresponding *value* figure), in order to detect potentially profitable trading/investment opportunities. This second task might thus be labelled the *comparative* aspect. Thirdly, the agent needs to be constantly on her guard against distorting *internal* (e.g., ‘biases’) and *external* (e.g., ‘group pressure’) influences that could deteriorate the accuracy of her *subjective* picture of reality and to constantly struggle to become *consciously* aware of these (often unconscious) influences and – wherever necessary and feasible – to try to override them. This third task, which we might label the *therapeutic* one, is of primary importance for the agent’s (financial) survival and success in financial markets; after all, her *subjective* ‘picture’ is her only access to the underlying ‘objective’ reality and due to the nature of the operation of her ‘cognitive apparatus’ and its inherent limitations, there are various influences that can distort this ‘picture’. The awareness of these facts coupled with the ability to exploit them to one’s advantage thus constitutes an important competitive advantage in the financial market environment, because ultimately *all* economic agents face these same limitations and are affected by the same distorting influences, which ultimately also affect the degree to which financial market prices – which themselves are purely psychological constructs (Dow, 2011) – accurately depict the respective underlying economic reality (*worth*). Thus, albeit the agent’s respective ‘picture’ is of a *subjective* nature, *external* influences (e.g., the media, the interaction/communication with fellow market participants, etc.) can ‘plant’ certain distorting elements into her ‘way of *seeing* reality’, which, if ‘contagious’, can spread throughout the market-community, coming to affect thereby the level and dynamics of the financial market price(s). A sufficiently *cognitively independent* individual who is aware of these factors and mechanisms, as well as of that particular distorting element (i.e., awareness and knowledge of the former does not guarantee that she will detect all of these elements due to their nature<sup>185</sup> and the nature of the operation of the ‘cognitive apparatus’), might be able to keep her ‘picture’ sufficiently clear from its influence and thereby possess of a *subjective* ‘picture’ that more accurately depicts the underlying ‘objective’ reality than the one dominating the prevailing market price. If circumstances (i.e., not ‘limits to arbitrage’; no regulatory or legal obstacles, etc.) *and* the agent’s professional situation (i.e., she possesses the necessary financial, technical,

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<sup>184</sup> In this context, it should be noted that Earl (2013) suggests to combine Hayek’s theoretical framework of cognition with Herbert Simon’s account (i.e., ‘bounded rationality’, ‘satisficing’).

<sup>185</sup> Many of these influences operate on an *unconscious* level. Once again, Hayek’s (1952) provides a suited starting point, as it entails a certain “*continuity* between basic (unconscious) acts of classification and interpretative acts of consciousness” (Fiori, 2013, p. 265; *italics* added).

organisation, legal, etc. means) permit, she can exploit such a ‘pictorial advantage’ to her financial benefit. Note that her advantage is of a *pictorial* and not of an *informational* type, as agents with access to the same information set can come up with diametrically opposed views of economic reality. This is a fundamental point as we no longer have to rely on asymmetric information as Grossman and Stiglitz (1980) did in order to explain the trading activity in financial markets (see Chap. 2). Approaching the study of financial markets from this vantage point, though, requires a thorough understanding of the nature and operation of the human ‘cognitive apparatus’ that constitutes the ‘nucleus’ of the processes underlying the operation of these markets. As outlined above, Friedrich von Hayek’s work affords some interesting first insights into the operation of the mind, as well as the role of *information* and *knowledge* in market processes more generally. Thus, the central insights that are of relevance to the present discussion shall be outlined in what follows.

II. *F.A. Hayek’s insights*: Hayek’s understanding of human cognition, the nature of information and knowledge largely overlaps with the insights inferred from the ‘ecologically-evolved’ *Value Investing* framework with regard to the operation of financial markets in Chapter 2. An excellent summary of Hayek’s account is provided by Chelini and Riva (2013):

“Hayek explains that each relationship with the external world exists just in the mind of the subject and is not necessarily characterized by any objective reality. This kind of method is based on the importance of each individual conjectural ontology. Each individual is equipped with cognitive structures which are semi-permanent: they depend on the specific cytoarchitecture, which is the spatial disposition of neuronal cells, but at the same time they are flexible and subjected to change according to the various personal experiences of each individual (Hayek, 1952). The kind of rationality which Hayek addresses is the ‘evolutionary rationality’ of the Kantian tradition<sup>[186]</sup> – opposed to the positivistic rationality of the Cartesian tradition: the former is based on rule-following reasoning, according to environmental constraints and a limited mastering capacity of the human mind. Mental categories develop according to the relative frequency with which past perceptions coincide with new and more recent interpretations of the world. Subjects tend to formulate interpretations more and more closely related to the ones that have already been formulated, using pieces of knowledge that are already available and stored in memory in a *path-dependent*

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<sup>186</sup> As pointed out by Caldwell (1994, p. 309), however, Hayek’s view that “neural connections are themselves affected by past perceptions [...] challenges the Kantian notion that the categories of the mind which govern perception are fixed.” See also Kluever (1952, p. xx): “Dr. Hayek, therefore, does not take a static view of either the ‘elements’ or the ‘relational’ structure involved in the sensory or any other kind of order.”

way. The mind, then, is considered to be a [...] self-organizing system in which knowledge accumulated from previous experience interacts with sensory inputs derived from new perceptions. In order to elaborate and understand the knowledge acquired in this way, subjects rely on their mental categories, which work as frames of reference in a complex and articulated world. Moreover, knowledge is ‘dispersed’ and ‘fragmented’ (Hayek, 1937) because each individual can possess just her/his own piece of knowledge and – due to the limits of rationality and the subjectivity of perception – she cannot master, in a single mind, all the knowledge available in society.” (p. 140; *italics* in original)

In Hayek’s account, the agent’s dispersed *subjective* knowledge and the corresponding (heterogeneous) views are homogenised in the market place, with market prices providing the most complete and accurate depiction of economic reality that is epistemologically feasible.<sup>187</sup> Hence, the following common elements can be identified between Hayek’s thought and the insights produced in Chapter 2: the *subjectivity* of knowledge and the agent’s view of the world, a constructivist<sup>188</sup> conception of the mind, the inherent limitations of human cognition, the complexity of information, an evolutionary epistemology, the homogenisation of the *subjective* (heterogeneous) views in the market place and the market price as a depiction of reality through the contribution of the *subjective* knowledge and views by the many. The major difference between Hayek’s account and our insights produced in Chapter 2 is the fact that the ‘one-dimensional’ depiction of reality by financial market prices can – due to their very nature, the nature of the decision-task in financial markets and the nature of human cognition (particularly its susceptibility to *external* influences) – at times significantly deviate from the ‘objective’ underlying reality and thus provide a – often dangerously – deceptive ‘picture’ of the latter. In any case, the following core aspects can be inferred from the above: *subjectivism*, *cognitive limitationism*, and *individualism*. Together these aspects suggest a picture of financial markets as social institutions whose operation, nevertheless, can be explained by the cognitive abilities of their human participants, and financial market prices as epiphenomenal, i.e. they lack any independent existence apart from their mental representation (and the corresponding action of the individual), which points us toward a cognitive/psychological-realist account. In what follows, we shall analyse these points in greater detail.

#### 2.4.3 *Subjectivism, Cognitive Limitationism*

The relevance of *subjectivism*<sup>189</sup> for the proposed research enterprise should, in the light of the

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<sup>187</sup> See particularly Hayek (1945).

<sup>188</sup> i.e. ‘constructivist’ in the cognitive (neuro)scientific sense.

<sup>189</sup> Boehm (1982) holds that *subjectivism* is a highly ambiguous notion (see, e.g., our discussion with regard to the two Austrian accounts in Chap. 2). We shall adopt a version that is widely congruent

key insights produced in Chapter 2 and summarized above, be sufficiently clear. To reiterate: It is the *subjective* ‘picture’ the individual’s ‘cognitive apparatus’ forms that provides the basis for the formulation of *subjective* expectations, which, in turn, determine the agent’s decisions and action in financial markets (buy, hold, sell).<sup>190</sup> This decision-act, manifested in the actual order, feeds the agent’s *subjective* view into the larger ‘picture’ constituted – albeit only one-dimensionally – by the financial market price, which homogenizes the myriad of heterogeneous individual *subjective* ‘pictures’ into a more comprehensive and accurate ‘picture’ of the underlying ‘objective’ reality, as long as the degree of heterogeneity among and independence of individual *subjective* views is sufficiently given (see Chap. 2). These conditions might be violated due to the permeability of the ‘cognitive apparatus’ with regard to *external* influences, which, if of a sufficiently distorting and contagious nature, can lead to – sometimes substantial – errors and distortions in this ‘picture’.<sup>191</sup>

A further argument in favour of *subjectivism* can be identified in the fact that the central ‘purposeful act’ in financial markets consists in the determination of whether the *value* one receives when exchanging a particular financial asset for another is higher than the *price* one gives up in return (see Chap. 2), and this feat can only be accomplished by ensuring that one’s own *subjective* ‘picture’ of reality is more accurate than the counterparty’s.

Further, even if the agent is swayed by external pressures (e.g., fear of rejection, group pressure, etc.) that trigger a loss of confidence in the accuracy of her own *subjective* ‘picture’ and expectations and thus, instead of following the suggestions of the latter comes to submit to the former, the explanation for the agent’s action is ultimately to be discovered in the operation of her ‘cognitive apparatus’ (i.e. the limbic system overriding the prefrontal cortex). If human agents are replaced by A.I. agents, for example, this type of behaviour is likely to be eliminated, which would alter the accuracy and behaviour of financial market prices (see, e.g., Marwala and Hurwitz, 2017). This shows that the limitations of the ‘cognitive apparatus’ of the respective type of agent (whether biological or artificial) play a major role in the accuracy of financial market prices and their dynamics, which should not be surprising, considering that financial market activity “is based on valuations that are bound up with expectations as to price movements rather than the experience of ‘real’ consumption and production” (Dow, 2011, p. 234; with reference to Tuckett, 2009). Thus, as already pointed out by Dow (2011, p. 234), “[p]sychology (and in particular cognitive psychology) therefore potentially has particular

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with Hayek’s account (see main text below).

<sup>190</sup> If the agent is *sufficiently* confident in them and is not swayed by certain external pressure that might lead to decision and actions that are diametrically opposed to the ones that would follow from his *subjective* ‘picture’ and expectations.

<sup>191</sup> A valuable starting point for the development of this aspect can be found in Hayek’s (1952) theoretical work on human cognition, which Caldwell (1994, pp. 309-311) argued, provided the scientific (physiological) foundation for his subjectivism.

purchase.” As the nature and properties of financial market prices are thus ontologically linked to the cognitive features of the agents that operate in these markets, it seems reasonable to suggest that a scientific identification and inquiry into these properties is essentially a cognitive science enterprise.

Further, in the light of the above, it seems reasonable to characterize the financial market price vector as an epiphenomenon of investors’ preferences, belief-states, views and expectations. For instance, there was no real economic event that would have justified the Black Monday Crash in October 1987; rather, investor psychology played a decisive role in the extreme price swings that shook financial markets in the last quarter of that year (Shiller, 1987). Nevertheless, due to the reification of this non-entity by economic agents, financial market prices can have real economic effects (see, e.g., Soros, 1987). The mechanism by way of which this non-entity can affect the real economy occurs via the agents’ ‘cognitive apparatuses’ and might be best illustrated by outlining how Hayek’s (1952) theoretical account of cognition overcomes the problematic distinction Hayek ([1942-1944] 1979) drew in his earlier *Scientism* essay between

“the ideas which are ‘*constitutive* of the phenomena we want to explain,’ that is, those ‘beliefs and opinions which lead a number of people regularly to repeat certain acts’ against the ‘speculative or explanatory views which people have formed about the ‘wholes’ (Hayek, [1942-1944], 1979, pp. 62-4), such as, for example, ‘society,’ ‘economic system,’ ‘capitalism,’ and ‘imperialism’.” (Fiori, 2013, p. 264; *italics* in original)

According to Hayek’s earlier views, “[o]nly the former are the cause of social phenomena” (Fiori, 2013, p. 264). As correctly pointed out by Fiori (2013), however, this distinction is problematic, because “[h]uman behaviour is conditioned by both simple beliefs – regarding, for instance, production, selling or buying – *and* ideologies or theories about society” (*ibid.*; *italics* added); after all:

“If I believe that a collective entity called capitalism exists and that it is a system which exploits labourers (and I am a labourer), then this opinion, derived from a theory, will influence my political and social behaviour” (Fiori, 2013, pp. 264-265).

Nevertheless, Fiori (2013) identifies in Hayek’s (1952) theory of human cognition a certain

“continuity [...] between simple beliefs and more articulated thoughts (like those regarding ‘wholes’) – because both presuppose a view of the world which establishes the framework in which courses of actions are selected” (Fiori, 2013, p. 265).

Ultimately, the ‘cognitive apparatus’ is all about classification, concept-formation, the interpretation of reality and the devising of adequate courses of action for the individual agent; the agent’s beliefs and views in regard to certain abstract concepts can therefore influence her actual behaviour just like her beliefs and views in regard to more concrete entities can. Similarly, the reification of financial market prices – a process, which, it ought to be remembered, is itself of a cognitive nature – can lead to real economic consequences by way of altering the agent(s)’ behaviour.

Further, the financial market price vector merely represents the respective dominant ‘picture’ of the underlying economic reality, i.e. the respective dominant opinion about that reality and its future. Whether the individual agent accepts it as accurate or not is the core decision task she faces when participating in the ‘financial market game’ – it is ultimately a matter of pure judgment. Thus, the financial market price level, its dynamics, and its effect on real economic activity is ultimately determined by what agents take the price vector to be, the properties they ascribe to it, and the inferences they draw from it that determine their actions and ultimately again the price vector and potentially also real economic activity; only the agents’ beliefs, views, etc. are real, and any real effects of these prices on real economic activity are once again determined by such beliefs, views and the corresponding actions of these agents. The financial market price vector has thus no existence apart from its mental representation, and its nature and properties are ultimately determined by the nature, limitations and operation of the cognitive processes of the respective agents (whether biological or artificial). Besides, also the emergence and functioning of the market process itself ultimately rests upon the agents’ innate ability to devise and obey adequate rules and conventions for the development of an adequate institutional framework.

Such a subjectivist understanding of financial market prices therefore implies that no inquiry into financial market processes and phenomena (e.g., ‘blind spots’, ‘sudden deaths’, bubbles, etc.; see Rapp, 2009; Rapp and Cortés, 2017) can be successful unless it builds on a sound theoretical framework and understanding of the relevant cognitive processes. It therefore rejects the neo-classical finance approach, which treats financial market prices as if they were objective entities, whose properties can be discerned via mechanistic (econometric) discovery procedures, and bolsters its findings and interpretations wherever necessary with inadequate conceptions of the decision-maker (see Chap. 1). Proponents of this approach might defend it along Friedman’s (1953) lines and hold that the research focus lies on the discovery of adequate patterns and structures in prices that can be used for predictive purposes and *not* the development of a cognitively/psychologically realistic account. Not only has the adequacy of the neo-classical statistical tool-set for the analysis of financial markets be questioned by various critical accounts (e.g., Mandelbrot, 1963; Black, 1986; Mandelbrot, 1997; Mandelbrot

and Hudson, 2005), though, but the most recent financial crisis has also cast serious doubt on any claims as to the approach's suitability to afford any accurate insights into the operation of actual financial markets, particularly as it had failed to cater even for one of its core areas of concern, i.e. the pricing of risk. Already the neo-classical economist and risk-theoretician *extraordinaire* Kenneth Arrow had cautioned against the adoption of mathematically driven risk management approaches, stressing that "[o]ur knowledge of the way things work, in society or in nature, comes in trailing clouds of vagueness," adding that "[v]ast ills have followed a belief in certainty.<sup>[192]</sup>" (K. Arrow, quoted in Bernstein, 1996, p. 7). It lies beyond the scope of the present work to identify those aspects of the neo-classical research program that might be worth retaining, but on the basis of the arguments developed in the present thesis, it seems safe to conclude that any research enterprise into financial market processes and phenomena that ignores the inherently *subjective* nature of financial market prices and consequently the respective underlying cognitive aspects and processes is inherently flawed and incomplete.

In addition, the subjectivist account of financial market prices that is being defended here implies that agents' internal states, perceptions, beliefs, conscious techniques for overriding (*internal*) biases and negative *external* influences, as well as the conscious approach to the core decision problem the investor faces in financial markets (see Chap. 2) constitute appropriate areas of research and important sources of evidence for the development of a proper theoretical account of financial market processes and phenomena.

Hayek's work provides an ideal starting point within the wider economics literature for such a project, particularly if one accepts Caldwell's (1994, p. 309) argument that "Hayek's project in *The Sensory Order* was to provide a physiological (hence 'scientific') foundation for subjectivism." Caldwell (1994) holds that

"[t]his fits into his larger project of providing a scientific basis for his bedrock claim that we face limits in our ability to understand and control complex phenomena. On this reading, Hayek was thoroughly committed to the scientific worldview. Where he differed from other modernists is that he believed that our scientific understanding of social phenomena faces severe limits, and that these limits apply also to our ability to control such phenomena." (p. 309)

Such an interpretation of Hayek's work certainly resonates well with the cognitive/psychological realist account of financial market prices that is being proposed here, as well as the more general approach to the study of financial market processes and phenomena that is being advocated by the present work and, last not least, its call for *prophylactic* and

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<sup>192</sup> A term, which presumably comprises 'stochastic uncertainty'.

*therapeutic* measures that ought to be devised in order to reduce human error within the system as well as its negative effects on the system.

In addition, the acceptance of this view allows us to pull several of the core threads running through the present thesis together, explicating thereby the internal coherence of the overall work, while further elaborating on some of the core aspects of the proposed account and bolstering the case for the adoption of a cognitive science approach to the study of financial markets, i.e. for the proposed ‘Cognitive Finance’ research enterprise. This feat shall be accomplished by outlining how Hayek’s and Keynes’ respective understanding of market processes, which are built on their respective accounts of subjectivism, which, in turn, are the product of their respective philosophical views,<sup>193</sup> might be successfully merged by way of the insights distilled from Keynes’ mature professional (*Value*) investing account (see Chap. 2), which are, as outlined in the present chapter, largely congruent with Hayek’s evolutionary epistemology, his theory of cognition and, if we accept Caldwell’s (1994) view, with his subjectivist account, while being fundamentally at odds with Keynes’ own account that underlies his understanding of financial market processes as expounded in Chapter 12 of his *General Theory* (see Butos and Koppl, 1997).<sup>194</sup>

Butos and Koppl (1997) argue that both Hayek and Keynes embraced – albeit fundamentally different versions of – subjectivism, whereby they trace the difference to their differing philosophical positions, particularly with regard to epistemology. What makes their work interesting for the present discussion is the conclusion they draw from the analysis of the two accounts of subjectivism and the corresponding understanding of (financial) market processes:

“Hayek’s theory, not Keynes’, allows us to say when markets will behave in a way Keynes described and when they will instead behave in more coordinated ways. We claim, in short, that a Hayekian theory is needed to understand a Keynesian world.” (p. 329).

Their work is thus highly relevant for our present purposes, and so are the insights it affords, which shall constitute major elements in the discussion that follows.

First, Butos and Koppl (1997) explicate that Keynes’ epistemology is incompatible with Hayek’s theory of cognition. Interestingly enough, it was also Keynes’ philosophical views that led him to distort Johannes von Kries’ original ideas (Fioretti, 2003). Johannes von Kries was, like F.A. Hayek after him, interested in the study of human decision processes as they

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<sup>193</sup> See Butos and Koppl, 1997; see main text below.

<sup>194</sup> It is important to note, however, that they do not “show that the philosophical vision of either thinker logically implies his market theory,” rather, they “argue [...] that the respective philosophical positions of Keynes and Hayek conduce toward their market theories” (Butos and Koppl, 1997, p. 329).

resulted from actual cognitive processes that could be scientifically studied, and thus developed his account of probability (1886) and logic (1916) on that basis. Fioretti (2003) holds that in his lifelong quest for a better and more truthful account of human reasoning and decision processes than the ones afforded by orthodox economics (i.e., formal logic, the probability calculus and utility maximization), “he never came so close to the goal as when he met von Kries” (p. 138); unfortunately however, his earlier philosophical convictions – a product of G.E. Moore’s (1903) influence – led him to transpose von Kries’ revolutionary ideas “into an alien, misleading philosophical framework” (Fioretti, 2003, p. 134):

“Keynes, at least at the time he was writing *A Treatise on Probability*, was a Neo-Platonist who conceived of probabilities as real objects apprehended via pure intuition. Von Kries, on the contrary, considered probability relations as the outcome of mental processes. While both of them were purporting to advance a logical view of probability relations, they had opposing ideas about where probability relations came from.” (*ibid.*)

Fioretti (2003) adds that

“History has proved von Kries right, not Keynes. The enormous development of cognitive science in recent decades has shown that many aspects of human cognition can be understood, and that von Kries’ ideas were well ahead of their time.” (*ibid.*)

Butos’ and Koppl’s (1997) critique Keynes’ epistemological account that underlies both his subjectivism as well as his understanding of market processes on the basis that it “was essentially the [...] ‘Cartesian’ rationalism at whose feet Hayek laid the blame for the sins of modernism”<sup>195</sup> (p. 331), which required that “demonstrated truths had to be ‘logically derived from explicit premises that were ‘clear and distinct’ and therefore beyond possible doubt’ ([Hayek] 1973, 19)” (*ibid.*). Keynes’ own reasoning processes therefore

“begins, as O’Donnell notes, with ‘intuitions (or direct knowledge) [that] eliminate infinite regress through providing putatively true knowledge incapable of further proof’ (1989, 93).” (*ibid.*)

The wider tenets of such philosophical presuppositions are the following:

“When Keynes claimed the right to judge each case on its merits, he also claimed the power to do so. ‘Ought’ implies ‘can’. His was the rationalist view of knowledge as justified true belief emergent from the sort of ‘argument’ that one

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<sup>195</sup> See, e.g., Hayek, 1967a, pp. 98-90.

can carry out like Descartes in his ‘closet,’ that is, alone and isolated from the inhibitory force of common opinion. And it was this view of knowledge that made the binding force of externally imposed rules seem irrational and objectionable to him.” (*ibid.*, p. 333)

This leads us to the question as to what ramifications such a subjectivist account based on Cartesian rationalism has for a theoretical understanding of financial market processes. Butos and Koppl (1997) argue that because of the ubiquitous (fundamental) uncertainty, the actual world severely restricts the economic agent’s ability to build long-term<sup>196</sup> expectations on an “adequate or secure foundation” (Keynes, 1937, p. 218), and all investment activity is necessarily driven by ‘irrational’ factors, i.e. Keynes’ so-called *animal spirits*;<sup>197</sup> a concept that is “radically divorced from cognition, as the history of the term reveals (Koppl, 1991)” (Butos and Koppl, 1997, fn. 25). Now, in a pre-financial market capitalist system, these *animal spirits* have a largely positive effect, as they drive man, or at least some of the species, to “embark on business as a way of life” (Keynes, 1973, p. 150). Once organized investment markets become established, however, and ownership becomes largely divorced from control, *animal spirits* turn into a destabilizing factor within the system; or, as Butos and Koppl (1997) put it:

“The very animal spirits that were once a counterweight to the precariousness of our knowledge of the future now exacerbate the instabilities implicit in our fundamental inability to ‘defeat the dark forces of time and ignorance’ ([Keynes, 1973] 157)” (p. 348).

This view of an alleged destabilizing effect of financial markets on the economic system follows directly from Keynes’ philosophical position. As the type of Cartesian rationality that his account presupposes lacks the necessary building blocks and thus becomes unfeasible within a real-world setting (particularly within a financial market setting), the knowledge, views and expectations on which investment decisions are based, are largely detached from any underlying economic realities (Butos and Kopp, 1997, pp.348-9) and thus more volatile, particularly as “a process of mass psychology induces waves of optimism and pessimism” with important ramifications for economic activity (*ibid.*, p. 349). Thus, it is imperative to understand that not only are “[l]ong-term expectations [...] *subjective* in Keynes’ theory,” but they are also “fundamentally *exogenous* to the economic process” (*ibid.*, p. 349; *italics added*):

“John Hicks (1969, 313) argues that ‘expectations do appear in *The General*

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<sup>196</sup> i.e., those relevant for capital investments and thus the financial market context; see Keynes (1936, Chap. 12).

<sup>197</sup> The classification of *animal spirits* as ‘irrational’ is adopted from Koppl (1991, p. 205), who argued that: “People who are propelled by animal spirits are not guided by estimates of more and less probable; in that sense, their actions are irrational.”

*Theory*, but (in the main) they appear as *data*; as autonomous elements that come in from outside, not as elements that are moulded in the course of the process that is being analysed” (Butos and Kopp, 1997, fn. 22; *italics* in original)

This stands in marked contrast to Hayek’s and the *Value Investing* position, where expectations are of an *endogenous* nature.<sup>198</sup> That Keynes’ particular treatment of long-term expectations can lead to odd results is illustrated by Butos and Kopp (1997) with reference to his *theory of liquidity preference*:

“The speculator, Keynes holds, is driven to hold money or buy consols based on current levels of interest (or price of consols) relative to a ‘critical rate of interest’ toward which the speculator believes the market interest must gravitate. This ‘critical rate of interest,’ however, appears as a fully exogenous and non-revisable datum to which each speculator clings, even if we must suppose, the preponderance of evidence might suggest otherwise. Because each speculator’s belief in a ‘critical level of interest’ cannot be falsified, we must infer that no learning can take place. In light of this, it is not surprising that Keynes would conclude that financial markets generate inefficient and perverse outcomes.”  
(*ibid.*)

Thus, as within Keynes’ Cartesian framework “long-term expectations do not and cannot bear any systematic relationship to underlying economic reality,” they are not formed with reference to or on the basis of the latter, but are largely the product of a “process of mass psychology [...] [that] is mostly self-referencing and not causally dependent upon other economic processes” (Butos and Kopp, p. 349).

This leaves us with the ‘animally spirited’ conception of financial markets that was criticized by Bragues (2012) on grounds of its inherent inability to account for the observed tendency of financial market prices to (eventually) converge toward a reasonably accurate reflection of the respective underlying *value* (i.e., economic reality) and for the fact that price-value congruence is – even if only imperfectly so – relatively frequently given for most securities. As already discussed in Chapter 2, Bragues (2012) advocates L.A. Hahn’s (1956) theory of financial markets as a viable and superior alternative to the neo-classical EMH and the Keynesian ‘animally spirited’ conception of these markets. It has also been established that the insights into financial market processes provided by L.A. Hahn’s (1956) account are largely compatible with the tenets of the *Value Investing* framework, which we have identified as Keynes’ mature professional investment framework (see Chap. 2). According to L.A. Hahn’s (1956) – and the *Value Investing* framework’s – view, “financial markets are neither efficient nor animally

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<sup>198</sup> See main text below.

spirited, but eventually adjusting” (Bragues, 2012, p. 89). Even though both L.A. Hahn’s (1956) theory and the *Value Investing* framework hold implicit views in regard to the cognitive processes that underlie the market processes that they describe (or, at least, presume), however, neither provides any explicit account of them. The only work within the wider economics literature that seems sufficiently developed in order to provide detailed theoretical insights into cognitive processes and price mechanisms, and therefore a suited starting point for the proposed research enterprise, is F.A. Hayek’s. As pointed out by Butos and Kopp (1997, p. 356), though, “a full reckoning of the relationship between his [Hayek’s] cognitive theory and his theory of markets has yet to be undertaken.” A further explication and development of the relationship between Hayek’s theory of cognition and his conception of market processes will constitute a natural stage in the development of our proposed framework, which, as shall be outlined below, will be of a more general nature than Hayek’s, as it will be able account for both the (positive) signalling function of financial market prices during the ‘stable periods’ (i.e. when a sufficient degree of price-value congruence is given) *and* systematic mis-pricing phenomena (i.e. when prices diverge significantly from underlying economic reality) that can have destabilizing effects on the wider economic system. Thus, we shall apply the insights extracted from Keynes’ mature investment framework (see Chap. 2) as well as Hayek’s theory of cognition and the market pricing mechanism as starting points for the development of a framework that is able to account for both the positive functions of markets expounded by Hayek and the destabilizing effects of financial markets that occupied Keynes in his *General Theory*, while overcoming the epistemological weaknesses and the inadequate account of human cognition that underly the latter. To accomplish such a feat, it will be necessary to develop a comprehensive theoretical account of cognition that is able to account for the destabilizing aspects of cognition, providing thereby a further justification of our proposed ‘Cognitive Finance’ project. These developments will have to be deferred to future work, though. All that can be provided at this stage, is some preliminary work by contrasting Hayek’s subjectivist account and its implications for the understanding of market processes with Keynes’, that have been expounded earlier. Thus, like Bragues (2012), we contrast two extreme positions, i.e. the Keynesian ‘animally spirited’ conception of financial markets, on the one hand, and, on the other, – not the EMH like Bragues (2012) did and which has already been the target of our critique in Chapter 1 and 2, but – Hayek’s view of markets (prices) as reliable signalling and coordinating phenomena, in order to present, at the end, a framework within which “financial markets are neither efficient nor animally spirited, but eventually adjusting” (Bragues, 2012, p. 89).

As already pointed out above, Hayek rejected Cartesian rationalism and embraced, just like Johannes von Kries (see above) and Jean Piaget (see Chelini and Riva, 2013) an evolutionary epistemology, which, it might be conjectured, might have been a result of his deep intellectual

interest in the nature and operation of human cognition (see Hayek, 1952). Further, as already noted, Caldwell (1994) holds that Hayek's (1952) theory of cognition constitute the scientific (physiological) basis of his subjectivism. It thus seems safe to conclude that Hayek's subjectivism was of a very different kind than Keynes', too. Although, as pointed out by Butos and Koppl (1997, pp. 351-2),

“[m]ore work is needed to explore whether Hayek's confidence in market coordination is strongly driven by this theory of mind in the way that Keynes' doubts about coordination are strongly driven by his Cartesianism”,

it appears that there are sufficient parallels to “suggest at least a kind of ‘weak driving’ of his market theory by his philosophy” (*ibid.*, p. 352). In what follows, we shall, on the basis of Butos and Kopol (1997), provide an outline of the implications of Hayek's subjectivist account and his theory of cognition for his understanding of market processes and provide suggestions as to how his account can be extended and improved upon in order to provide a theoretical framework that is able to explain well-known financial market phenomena such as bubbles, ‘Blind-Spots’, ‘Sudden Deaths’, as well.

As already hinted at above, Hayek (1952) understands the human ‘cognitive apparatus’ as a classificatory and interpretative biological device that is a product of natural evolution. Importantly, his theory “implies that the properties of the external world perceived by an organism are properties of the operation of its central nervous system” (Butos and Koppl, 1997, p. 338). Butos and Koppl (1997) summarize:

“The taxonomic framework created by the operation of the central nervous system interprets signals according to the mind's classificatory apparatus. [...] Thus, whereas experience is the source of perception, all experience in Hayek's system is perceived and made meaningful because it can be ordered into pre-existing [...] ‘categories’ of the mind. These categories, in turn, may be affected and themselves reorganized or displaced by experience.<sup>[199]”</sup> (*ibid.*, pp. 338-9).

From this conception of cognition, which is highly relevant for our proposed “cognitive ‘model’” framework, it follows, first, that all our knowledge is fallible:

“If none of the elements of perception are perfectly static, all knowledge is subject to revision. But then all knowledge is fallible. All knowledge is a fallible interpretation of a world we cannot know directly, but only through the filter of

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<sup>199</sup> fn14: See Nishiyama 1984, xlvi-l, on Hayek's synthesis of the a priori and the a posteriori. Nishiyama calls this the “most unique significance of his contribution” and “worthy of the name ‘Hayekian revolution’” (xlvi).

our perceptions.” (*ibid.*, pp. 339-40)

Secondly, with regard to the diversity and variety of interpretations (and thus ‘pictures’ of reality) the mind can produce and their link to the formation of *expectations*, Hayek’s theory contributes the following insights:

“Where the rules governing the classificatory functioning of cognitive activity are in principle finite, the various permutations of interpretation that can be construed are limitless. This means that the mind can not only reorder its perceptions of reality, but also create new theories about reality. The mind, for Hayek, is thus an instrument of learning and creativity. And this functioning, according to Hayek, accomplishes this by ‘representing both the actual state of the environment’ as it is perceived and ‘the changes to be expected in the environment’ so that individuals actually live ‘as much in a world of expectation as in a world of ‘fact’” (1952, 11, 121).” (*ibid.*, p. 340)

The fundamental difference to Keynes rationalist position, which required “*some constant and reliable centre in thought and perception*” (*ibid.*), should thus have become apparent. This insight also undermines Fioretti’s (2003, p. 139; see above) suggestion that by “following von Kries, *animal spirits* [...] could be understood in terms of idiosyncratic mental categories and causal maps” (*italics added*) and thereby provide, via von Kries, a potential “link between Keynesian economics and [modern] cognitive scientists,” because *animal spirits* are, as pointed out above, of a non-cognitive nature, at least as far as von Kries’ and Hayek’s conception of the term ‘cognition’ is concerned. Thus, as argued in the present section, it is not Keynes’ *General Theory* but his professional investment account (see Chap. 2) that might, via Hayek’s theory of cognition and market processes that is being outlined here, provide the required link to modern cognitive science; and why, one might ask, would financial market research require insights from the field of modern cognitive science? Because these are required to extend Hayek’s framework sufficiently to allow for the destabilizing aspects and phenomena that might be peculiar to financial markets and are rooted, as expounded in Chapter 2, in the nature of these markets and human cognition itself. So, while Keynes was worried about these aspects of financial markets, he failed to provide an adequate epistemology and theory of cognition, Hayek was concerned with market processes more generally and paid scant (if any) attention to the peculiarities of financial markets. This might also explain why in contrast to Keynes, he failed to develop an explicit account of *expectations* (Butos and Koppl, 1997, pp. 349-50; see below). In fact, this shall constitute an important aspect of any future work with regard to financial market processes and one, that will – for reasons that shall become apparent from the discussion below if they aren’t already – go hand in hand with the development of a comprehensive account of cognition for financial markets on the basis of

Hayek's work and more recent developments in the cognitive sciences.

Before proceeding to the exposition of Hayek's understanding of market processes in the light of his epistemology and theory of cognition, it needs to be noted, that the insights Hayek's work affords into cognition are not limited to the (isolated) individual biological entity. In fact, as shall be outlined below, his wider account puts significant emphasis on social and cultural factors in decision processes.

As already noted above, Hayek failed to provide a fully developed theory of expectations. Nonetheless, Butos and Koppl (1997) are able to extract the following insights from his work:

“In an earlier work (Butos and Koppl 1993), [...] we identified four essential features of the theory of expectations consistent with Hayek's cognitive and philosophical work. First, [...] all knowledge in Hayek's view is fallible interpretation. Thus ‘expectations are formed in the context of ignorance about reality’ (314). Second, and individual's knowledge and, therefore, expectations ‘derive from a mental classificatory apparatus,’ the taxonomy induced by the operation of the central nervous system. This, this taxonomy is ‘a mechanism of adaptation’ and the changes it undergoes are governed by a goodness-of-fit criterion. Finally, the knowledge and expectations governing an individual are endogenous to its environment (315).” (p. 350)

In contrast to Keynes' Cartesian rationalist account, agents' expectations are determined endogenously, and not exogenously, to the system. Apart from constituting a vital key for a proper understanding of Hayek's theory of cognition and his account of market processes, it also constitutes a central element in any explanation as to how cognitive processes affect market processes. Butos and Koppl (1997) expound:

“In the original biological context of Hayek's theory of mind, it is clear that knowledge and expectation are endogenous. What the individual can know is a function of the taxonomic framework of its central nervous system. The structure of that framework, in turn, is produced by the experience of the organism and its species in its environment [...]

A parallel insight applies to the knowledge created by social experience. Our expectations about social and economic events are embodied in our habits of action. These habits, in turn, are endogenous to that same social and economic environment. [...] It follows from Hayek's view of knowledge that the evolutionary conditions of the economic environment influence the reliability of economic expectations.” (pp. 350-1; fn. removed)

According to Hayek's account, it is therefore not some *a priori* rationality that underpins the soundness of expectations and the reliability of the pricing mechanism as the primary coordinating device within society, but rather a type of evolutionary selection process, which entails the elimination of those market participants who fail to adopt "rational methods" (Hayek, 1979, p. 75):

"Hayek tells [...] that competition induces such rational habits and procedures even though the great majority of those who are forced to adopt them do not understand why they are useful." (Butos and Koppl, 1997, p. 351)

For Hayek, it is therefore competitive pressures that lead to the (sometimes forced) adoption of 'rational methods' and thus more accurate expectations, which, in turn, translate into a greater congruence between market process and the underlying (economic) reality. In conjunction with Hayek's (1937, 1945) theoretical account of information and knowledge, this conjectured evolutionary process turns market prices into the most accurate reflection of the underlying reality and thereby into the most reliable coordinating device within society. Unfortunately, Hayek's account of market processes is unable to account for the idiosyncrasies of financial markets and therefore unable to account for significant mis-pricings (e.g., the system-wide mis-pricing of *risk* in the years leading up to the 2008-9 Crisis) and well-documented financial market phenomena (e.g., 'Blind Spots', 'Sudden Deaths', 'Bubbles'). In fact, his subjectivist account is not configured to allow for factors such as the 'waves of pessimism and optimism' that Keynes (1936) correctly identified as intrinsic elements of financial markets, which concerned him as they carried the seeds of financial and economic instability. Butos and Kopp (1997, p. 333) point out:

"We find in Hayek a kind of subjectivism that entails no mass psychology guiding individual behaviour and implies no systematic discoordination of economic activity."

It seems likely that at least part of the reason for the latter is to be found in the fact that the type of *expectations* that Butos and Koppl (1997) extract from Hayek's account bears greater resemblance to Keynes' (1936) *short-term expectations*, which are primarily concerned with the output-levels and prices in goods markets, than Keynes' (1936) *long-term expectations*, which are relevant for capital investments and thus for financial markets. Indeed, when one takes a closer look at the former, one recognizes important similarities between the two conceptions, particularly with regard to feedback mechanisms and thus the 'evolutionary market process' at work:

"As Keynes explains in chapter 5 of *The General Theory*, there is a feedback mechanism working to keep short-term expectations in close conformity with the

underlying realities of supply and demand. [...]

Keynes noted that it would be ‘too complicated’ for entrepreneurs to recalculate short-term expectations *de novo* from day to day. Besides, ‘circumstances usually continue unchanged from one day to the next,’ so it would be ‘a waste of time’ ([CW 1973] 51). Entrepreneurs wisely choose to assume that present conditions will continue ‘except in so far as there are definite reasons for expecting a change’ (51). In practice, ‘producers’ forecasts are more often gradually modified in the light of results than in anticipation of prospective changes’ (51). In other words, a stable negative feedback loop keeps short-term expectations close to underlying real values. Because this loop operates quickly, we may safely substitute realized results for expected outcomes.” (Butos and Koppl, pp. 341-2; fn. removed)

As emphasised by Butos and Koppl (1997, p. 342) with reference to Keynes’ work, though,

“[n]o such feedback mechanism keeps long-term expectations in line with realized values. ‘It is in the nature of long-term expectations that they cannot be checked at short intervals in the light of realized results’ ([CW, 1973] 51). Because long-term expectations concern relatively far-off events, a negative feedback loop cannot operate. Too much time and too many changes intervene between choice and outcome for such a mechanism to work. ‘Thus the factor of current long-term expectations cannot be even approximately eliminated or replaced by realized results’ (51).”

The type of ‘Hayekian’ expectations inferred by Butos and Koppl (1997) from his work are thus inadequate for the financial market context. As expounded above, however, so is Keynes’ Cartesian rationalist account, which is unable to explain why and how financial market prices tend toward their respective underlying *values*, i.e. toward a relatively adequate (even if not perfect) reflection of the underlying (economic) reality, at least most of the time. An adequate comprehensive framework that is able to explain how actual expectations are formed by financial market participants and how they determine market processes is therefore lacking.

On the basis of the insights thus far produced in the present thesis, it seems sensible to conclude that the necessary background knowledge for such a framework is to be found in the cognitive sciences. After all, as expounded in Chapter 2, what determines the actions of financial market participants is largely the *subjectively* perceived ‘picture’ their respective “cognitive ‘model(s)’” produce. Thus, it is necessary to understand how this ‘picture’ is formed, how it is updated, how the investor can become consciously aware of negative *internal* and *external* influences that distort this ‘picture’ – influences, that are responsible for significant price distortions if they ‘infect’ a significant proportion of market participants – and how she can re-

assess and re-interpret (aspects of) this ‘picture’ in order to minimise these distortions, how the investor compares her ‘picture’ with the dominant one in the market place in order to gauge what kind of action she ought to take, and ultimately how these aspects are related to and inform expectations. An adequate starting point for these questions is arguably Hayek’s theory of cognition, with its important insights in regard to “the complexity of the relations between ‘the factor of ‘experience’” in perception and ‘the conditions, or presuppositions which make experience possible’ ([Kluever, 1952] xx),” on the one hand, and, what the physiological psychologist H. Kluever (1952, p. xx) identified as Hayek’s most original insight, “that neither element in perception is stable or ‘given’” (Butos and Koppl, 1997, p. 339), on the other. Hayek’s account by itself will, of course, not suffice to provide the necessary answers to the questions raised above. It is for this reason that the present work proposes the development of a ‘Cognitive Finance’ research enterprise that will supplement Hayek’s theory with the methods and insights of more recent cognitive science research programs and tailor those to the needs of financial market research. The significance of such a research program becomes apparent when one (re-)considers the discussion of the last part of Chapter 2, which outlines some potential defects in more traditional policy measures adopted to ward off the destabilizing aspects of financial market processes. In the light of the new insights gained in the present section, particularly also with regard to Keynes’ work, some of the core points can be reiterated for purposes of clarity.

Butos and Koppl (1997, p. 354) hold that

“Keynes, despite dismissing the applicability of Cartesian rationalism as a force from within the system, still retains it as an epistemological authority. But now such authority enters as an exogenous constructivist element in the form of government intervention.”

This raises, of course, “the question of asymmetries in the knowledge that Keynes assumes that private and public actors hold [see Allan Coddington, 1982]” (*ibid.*, fn. 28), because, as L.A. Hahn (1956, p. 166) put it, “the world does not consist of economists who know and business men who err.” As economists and policy-makers operate with the same cognitive limitations as private actors do, with their *subjectively* ‘pictures’ of reality being formed, just like theirs, *within* the system, their views are just as susceptible to the influence of certain distorting factors, and their knowledge not necessarily superior. Indeed, as the run-up to the 2008-9 Crisis has demonstrated, policy makers and economists can become victims of ‘Blind Spots’ just like private actors.<sup>200</sup> However, also the “alternative viewpoint” in regard to Keynes’ position that Butos and Koppl (1997, fn. 28) identify – i.e., the one holding that “Keynesian

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<sup>200</sup> See Chapter 2 for a more detailed discussion.

policymakers impose a Cartesian rationalist [...] vision upon the system” – is challenged by the cognitive aspects outlined in Chapter 2. Economists and policymakers might, just like everyone else (perhaps under the influence of certain interest groups) come to *see* certain earlier regulatory and institutional safety measures (e.g. Glass-Steagall) to be outdated and remove them. A thorough understanding of these cognitive mechanisms might thus allow the design of more robust institutional frameworks and assist in the identification of hitherto un(der) identified fragile aspects of financial markets that might require certain buffers against the occasional market-wide cognitive distortions in market prices. This aspect constitutes the *prophylactic* pillow of the proposed framework. On the other hand, the insights gained from a comprehensive cognitive framework of the type outlined in the present work, might also permit the development of tools and techniques for the identification of distortions in the ‘picture’ in real-time. This might be possible, for example, by the identification of the nature and causes of ‘Blind Spots’. This aspect constitutes the *therapeutic* pillow of the proposed framework. The development of these aspects lies beyond the scope of the present work, though.

#### 2.4.4 Individualism

Albeit the lack of space precludes a more detailed argument *for* the adoption of an individualistic approach to the study of financial market processes and phenomena, it seems necessary at this point to outline at least a few of the particulars of the proposed approach – which builds on Hayek’s own work and appears, in the light of the various insights hitherto gained, to be the most appropriate one for the purpose of financial market research –, particularly for driving home the key message that financial market prices are ultimately epiphenomena of cognitive processes in financial markets,<sup>201</sup> and as such unsuited as (isolated) *objective* objects of study – i.e. the view underlying the majority of mainstream financial market research – if we want to gain a proper *understanding* of financial market processes and phenomena that provides a sound basis for the design of both sound policy and sensible investment tools and strategies.

To begin with, we shall sketch out the picture of the *individual* that has been crystallizing throughout the discussion so far. The conception of the *individual* that plays the core role in our framework is the *locus* of the ‘purposive act’, i.e. the ontological entity that has the ability to gather and process relevant information in order to build an adequate ‘picture’ (understanding) of reality that this entity is consequently able to apply as the basis for the formulation of a plan of action that enables it to succeed in achieving a certain end, and then to execute it. In the present work, this entity has been identified – albeit, for the time being,

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<sup>201</sup> Ours is, as mentioned above, a cognitive/psychological realist position.

rather abstractly – as the ‘cognitive apparatus’, i.e. the *locus* of intelligence that provides the necessary means for the ‘purposive act’ to be designed and executed. The focus of our discussion was primarily the *human* agent, and the conception of the ‘cognitive apparatus’ that underlay the explications in Chapter 2 had the following components:<sup>202</sup> (1) consciousness as the executive/control/(re-)assessment/(re-)interpretative function; (2) the primary and secondary components and functions (e.g., memory) that are largely the product of evolution; (3) the largely fixed traits and propensities of the individual agent that are the product of her personal genetic background, and the more malleable ones that are the product of her personal experiential background; (4) the “cognitive ‘models’”<sup>203</sup> that are formed by the ‘cognitive apparatus’ in order to enable the individual to strive within a particular (decision) environment; the greater the purposeful active interaction with the respective problem/environment, the deeper and more complex the respective ‘model’ and consequently the better the individual’s understanding of the respective problem/environment and the more refined her skill in dealing with/navigating it successfully. It needs to be noted that unconscious processes play an important role in the formation and structuring of the respective “cognitive ‘model’” (see Lakoff and Johnson, 1999). Further, once formed to a satisficingly ‘deep’ structure, the ‘model’ and the related skills and propensities to act will operate largely unconsciously if triggered; albeit certain aspects might still be over-ruled by consciousness if they are assessed to be inappropriate (in the end this is necessary as there are always some variations even in the same (type of) problem/situation the “cognitive ‘model’” was developed for). It is the formation of an adequate “cognitive ‘model’” by the ‘cognitive apparatus’ that permits the individual to adapt quickly to new environments and to be able to strive in a wide variety of decision-tasks and environments, whether they are of a closed or an open-system nature.<sup>204</sup> Otherwise the agent would seriously be impeded in his ability to survive.

This rudimentary sketch of the conception of the *individual* affords some important insights: First, it reveals the *complexity* of the cognitive processes that underlie decisions, particularly within a financial market context. This is an aspect that has – with the notable exception of F.A. Hayek – largely been ignored within the wider economics literature:

“Hayek’s treatment of the individual’s ‘choice-theoretic’ problem may be unique in that other theories, like Herbert Simon’s ‘bounded rationality’ and Keynes’ approaches, emphasise the complexity of the external world confronting the individual and not the cognitive complexity of the acting agent. For Hayek, the

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<sup>202</sup> This is merely intended to be a rudimentary sketch.

<sup>203</sup> It needs to be reemphasised that the exact nature and operation of the “cognitive ‘model’” is for future research to be determined.

<sup>204</sup> The closer a new decision-problem or situation is to one already encountered (and mastered), the easier it will be for the ‘cognitive apparatus’ to create such a new ‘model’, as it can build on existing knowledge; thus, there is a certain degree of path-dependence involved.

mind – like the market, law, and language – is a complex phenomenon.” (Butos and Kopp, 1997, fn.8)

Indeed, Fiori (2013) suggests that

“*The Sensory Order* can be interpreted as an attempt to provide a more comprehensive view of the individual, because the book describes how the mind, as a distinctive trait of the individual, is decomposable into many properties.” (p. 267)

The above will also be of consequence for the second major insight to be extracted from our rudimentary sketch of the individual above, as well as our understanding of *individualism*. First, though, it is necessary to add the following details to our conception of the *individual*. As should have become clear through our discussion in Chapter 2, our conception of the *individual* is not of an isolationist or atomistic type. Both *internal* and *external* influences have explicitly been mentioned. In the case of the human agent, we therefore have an ‘embodied’ as well as an ‘embedded’ type of cognition. Both irrational *internal* (e.g., emotions) and irrational *external* (e.g., social/group pressure, institutional imperative, etc.) factors can therefore impact the way reality is perceived and/or how the agent acts in a particular situation.<sup>205</sup> This conception of the *individual* also allows for ‘extended cognition’ (See Main Introduction to the Thesis).

It is precisely this recognition that certain factors *can* distort the ‘picture’ the individual and thereby adversely affect the ways she acts (trades) that suggests an individualistic approach to financial market research. After all, the primary focus of any inquiry into financial market processes ultimately rests on price efficiency, price behaviour and price phenomena, and if an alteration of the *individual* – e.g., the removal of the individual’s susceptibility to certain factors by way of replacement of human traders by A.I. traders (see, e.g., Marwala and Hurwitz, 2017) – might lead to important changes in market price behaviour and alterations in well-documented financial market phenomena (e.g., some might disappear, others might alter in terms of their severity) or the emergence of new ones (e.g., ‘Flash Crashes’), then these cannot be causally *sui generis*, and can only be understood on the basis of a sound theoretical account of the cognitive processes involved. The proposed framework recognizes, as already hinted at above with reference to ‘extended cognition’, that these ‘cognitive processes’ are not limited to the *individual* (see also Wilcox, 2008), and it recognizes, *inter alia*, the socio-institutional

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<sup>205</sup> These factors could distort the agent’s subjectively perceived ‘picture’ of reality, so that she acts differently than she would without these influences, but is convinced of the appropriateness/correctness of her decision; or, alternatively, the factors might ‘persuade’ the agent to deviate from decision that she considers the most ‘rational’ one by either undermining her trust in her own judgment or triggering a certain anxiety/fear of acting against the expectations of her (social) environment.

aspects of these cognitive processes (i.e., the *external* influences); nevertheless, drawing on the insights from Chapter 2, it considers the *individual* to constitute the ‘*nucleus*’ of any research program into the cognitive processes that underlie the operation of financial markets, because the key empirical questions concern the nature and operation of the *locus* of the ‘purposeful act’, e.g. how the ‘picture’ of reality is formed; how *internal* and *external* factors come to distort it; how the individual can assess the adequacy of her ‘picture’ relatively to that reflected in market prices in order to spot potentially profitable price-value incongruences; how the individual can override negative *internal* and *external* influences, and to what extent; etc. It is, as expounded in Chapter 2, these cognitive processes that are central to any understanding of price formation, -behaviour and -phenomena in financial markets. This does not deny, of course, the “existence [–] independent of any particular agent’s identification of them” – of the type of *social rules* that Fleetwood (1995, p. 108; see Chap. 8) discusses. They form part of the *institutional* framework of these markets, though, i.e. the set of rules that determines how the actual transactions are executed and settled once the decision has been made by the agent, and as such part of the market infrastructure. The primary factor determining market prices and behaviour are, however, the cognitive processes which are of an inherently creative and iconoclastic nature; in the end, the *individual* is constantly challenged to create a more accurate ‘picture’ of reality than her fellow market participants’. Further it is our conception of the *individual*, i.e. the ‘cognitive apparatus’ of the individual, that lends itself to the scientific method, while the more complex processes that eventually lead to a certain price might be less so. Indeed, this shall be discussed further in our proposal to include subjectivism into the wider framework of complex order. Before proceeding, it is important to mention, though, that certain institutional aspects might, as already outlined in the main introduction to the thesis, turn out to constitute important components of the larger ‘extended superstructure’ that exists above and beyond the skin/skull boundary of the individual human agent. Nonetheless, such a manifestation of ‘extended cognition’ would be a distinctly human one and thus be traceable, even if not reducible, to the nature and functioning of the human ‘cognitive apparatus’, which can therefore still be considered the ‘nucleus’ of the entire structure.

Resuming the main discussion and continuing with the explication of the important insights our brief sketch of the *individual* affords; whereas the previous insight revealed the – in the (wider economics) literature largely ignored – cognitive complexity of the individual, this second insight reveals the varying ‘degrees of malleability’ of different parts and properties of the human ‘cognitive apparatus’. As pointed out above, there are, for example, certain traits and propensities of the individual agent that are the product of her (personal) genetic background. These properties are likely to have a far lower ‘degree of malleability’ than, for example, those that are the product of the agent’s personal experiential background. The one

component – of those identified in the sketch above – with the arguably highest ‘degree of malleability’ is the “cognitive ‘model’”, which is being constantly updated and altered through an active interaction with a problem(-situation) or even the mere contemplation about it. This malleability is, as pointed out above, necessary to explain the individual’s ability to deal with a theoretically unlimited variety of decision-situations and –environments with a finite resource (i.e., her cognitive resources and abilities). If the *individual* recognizes that a particular “cognitive ‘model’” is deeply flawed (e.g., if a major, by its nature formerly unnoticed ‘Blind Spot’ is suddenly recognized), a ‘model’ might – at least partly – break down and the ‘cognitive apparatus’ might have to resort to its more basic default-setting such as the ‘fight or flight’ response’ to guide her actions until either the original “cognitive ‘model’” has been sufficiently modified and ‘re-activated’ or a new one has been constructed, and a more rational and purposeful course of action – on the basis of such a “cognitive ‘model’” – resumed. In fact, such “cognitive ‘models’” might be relatively quickly (re-)built if the new problem(-situation) and/or its elements bear sufficient resemblance to those already familiar to the *individual*, as this might allow the adoption of ‘building blocks’ from already existing ‘models’. Such a transfer mechanism is important for the *individual’s* ability to cope with a wide variety of – often previously never encountered – problems and environments. With regard to *pattern recognition*, for example, Fleetwood (1995, p. 111) points out that

“Hayek [...] argue[s] that it is the brain’s capacity to classify sensory elements which allow patterns to be recognized as ‘one of the same kind’ even when it has never been experienced before”

Fleetwood (1995, p. 111) produces the following quote in support:

“Whenever the capacity of recognising an abstract rule which the arrangement of these attributes follows has been acquired in one field, the same master mould will apply when the signs for those abstract attributes are evoked by altogether different elements. It is the classification of the structure of relationships between these abstract attributes which constitutes the recognition of patterns as the same or different.” (Hayek, 1962, p. 50)

On the other end of the ‘malleability’ spectrum we arguably find *consciousness*, the quintessential *locus* of pure awareness, albeit it is likely that its awareness (mindfulness), (re-)assessment, and (re-)interpretative functions can be improved by focused training.

Albeit the above constitutes a merely rudimentary outline of the topic of differing ‘degrees of malleability’ among the different parts of the ‘cognitive apparatus’, this first insight, coupled with the former with respect to complexity permeating not only the decision-environment and

the economic system as a whole, but also the cognitive processes internal (and external)<sup>206</sup> to the human agent, plays an important role in the selection of an adequate methodological approach to the study of financial markets. A look at Hayek's work provide important first insights into the subject matter: First, it is important to note that Hayek's (1952) understanding that the mind itself is a complex emergent order and the individual thus a 'whole' implies that holistic elements are not entirely rejected by his methodological approach.<sup>207</sup> Nonetheless, as Fiori (2013) expounds:

“[T]he properties of individual neural phenomena, considered in isolation, differ from the properties that they possess ‘as a result of their position in the order of inter-connected neural events’ (Hayek, 1952, p. 46; §2.27). The reason is that the emergent properties of the whole do not reproduce those of their separated elements, because only the interrelation among the elements allows the emergence of properties of the whole. Hence, ‘[a]n order involves elements *plus* certain relations between them’ (Hayek, 1952, p. 47; §2.30; emphasis in original). The consequence is that a holistic perspective takes shape ‘only when we understand how the elements are related to each other [so that] the talk about the whole being more than the parts becomes more than an empty phrase’ (Hayek, 1952, p. 47; §2.30).” (pp. 268-9)

Thus, the adequate approach to these phenomena is the following:

“The strategy adopted consists in applying the ‘compositive approach’, to identify a specific property required of elements to engender the properties of the whole, that is, their ‘capacity’ to enter into relations with each other (Hayek, 1952, p. 47; §2.30). This point draws a demarcation line between individualistic and holistic methodologies because, in Hayek's view, the capacity to have interrelation is a property of the individual elements. [...] However, the differentiation of properties of order from properties of its elements is clarified by ‘theoretical biology’, which shows ‘the significance of structural properties as distinct from the properties of the elements’ (Hayek, 1952, p. 47; §2.30)” (p. 269)

Fiori (2013) expounds that Hayek's evolving understanding of emerging orders and his realization of “the practical impossibility of knowing all the events which determine the rose of abstract orders” (263), led him to the advocacy of “explanations of the principle,” which focus on the general properties of such orders:

“It seems indeed not improbable that, as the advances of the sciences penetrates

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<sup>206</sup> See ‘extended cognition’ in the main introduction to the thesis.

<sup>207</sup> Hayek's framework also opposes isolationism and atomism; see Zwirn (2007).

further into more complex phenomena, theories which merely provide explanations of the principle, or which merely describe a range of phenomena with certain types of structures are able to produce, may become more the rule than the exception [...] And the more we move into the realm of the very complex, the more our knowledge is likely to be of the principle only, of the significant outline rather than of the detail” (Hayek [1955] 1967, p. 26; quoted in Fiori, 2013, p. 271)

Tying our earlier insights and Hayek’s methodological ideas together, we propose the following methodological approach to the study of financial markets: First, for the reasons that have been expounded above, the *individual*, i.e. the ‘cognitive apparatus’ of the agent, the *locus* of the ‘purposeful act’, shall constitute the ‘*nucleus*’ of such a research framework, whereby the research agenda shall focus on its nature and its core functions that have been explicated above. Besides, it is held that the ‘cognitive apparatus’ is sufficiently ‘closed’ in nature to permit the application of the scientific method. Indeed, the type of questions raised are very close in nature to those dealt with by naturalistic theories of mind, which

“focus on what a mental system is and ‘does’ in the head: its specific nature, what it takes as ‘inputs’, what kinds of operations it performs on them, and what ‘information’ it provides to other mental systems.” (McGilvray, 2017, p. 176)

Whether the ‘cognitive apparatus’ in fact lends itself to such an investigation via the scientific method, will in itself be a question for future inquiry and discussion.

Once we move the investigation to the realm outside the immanent human ‘cognitive apparatus’, the degree of complexity and ‘malleability’ (i.e., ‘openness’) might be such, that the traditional scientific method no longer applies.<sup>208</sup> In that case, ‘explanations of the principle’ might provide adequate tools for the determination of certain properties and patterns underlying certain financial market price behaviour and phenomena. Such an approach has already been hinted at above with reference to the *Santa Fe Artificial Stock Market Model*. Albeit it won’t yield any definite predictions, it might permit the identification of certain destabilizing patterns and aspects within the wider system, which, couple with a sound theoretical understanding of the ‘cognitive apparatus’, might facilitate the development of adequate safety measures and buffers. Overall, such an approach would also resonate well with the general fallibilist view the present work takes as well as its advocacy for *prophylactic* as well as *therapeutic* measures. Once again, more elaborate discussions of these issues will have to be deferred to future work. Concluding it might be added, though, that in the proposed methodological approach, “subjectivism is not rejected; rather, it is included in a more general

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<sup>208</sup> It remains to be seen how aspects of ‘extended cognition’ in financial markets can be best studied.

theory of the spontaneous order” (Fiori, 2013, p. 272).

### **3. A Methodological Approach for the Coordination of the proposed Interdisciplinary Research Project**

The author of the present work deems a ‘problem-based’ methodology to be the most appropriate approach for the proposed interdisciplinary research enterprise of ‘Cognitive Finance’. Its nature seems to lend itself to the adoption of such an approach. Rapp’s and Cortés’ (2017) outline advocates the adoption of relevant theoretical, empirical and methodological insights from a variety of disciplines in order to produce a more realistic understanding of financial market phenomena, but the absence of any specificities, such as a clear ‘*nucleus*’, clear research questions and thus a clear direction as to how the research effort is to be orchestrated in order to produce a comprehensive understanding of financial markets, makes it merely resemble the wider field of Cognitive Science, albeit with a ‘finance’ undertone (see Fig. 5 above). Such an uncoordinated methodological approach might leave the research effort end up with a myriad of scattered and merely loosely connected research findings that lack the required coherence and completeness necessary for the development of an alternative theoretical framework – i.e., in the type of state that Rapp and Cortés (2017, p. 34) themselves have reproached the (sub-)field of *Behavioural Finance* for. In contrast, the ‘Cognitive Finance’ research project proposed by the current work will be structured around the alternative conceptualisation of *cognition* in financial markets that will be developed on the basis of the core insights produced primarily in Chapter 2 of the present thesis. The ‘nucleus’ of the proposed conceptual framework shall be the ‘cognitive apparatus’ as the *locus* of the decision-act in general, and the “cognitive ‘model’” as the subjective basis for the latter in particular. The influence of *external* factors on the latter are, as discussed in Chapter 2, conceptualised as influences (e.g., ‘triggers’) in certain elements internal to the skin/skull boundary of individual agents. Atop of this original (skin/skull bounded) cognitive basis, the ‘cognitive super-structure’, composed of the various elements and emerging properties related to *extended cognition* (see Introduction to the Thesis), shall be added, in order to gain a complete picture of the cognitive factors and processes that are generalisable to the wider financial market. As demonstrated in Chapter 1, a sound conceptual basis is imperative for any successful empirical scientific endeavour, and, in turn, no tenable conceptual framework can constantly be at odds with the empirical evidence, like the neoclassical one is (see Chap. 1). Having thus, hopefully, outlined a more plausible conceptualisation, we can now see that (some) of the central *problems* to be addressed by the suggested ‘Cognitive Finance’ programme are related to the ‘constructive’ aspect of human cognition, i.e., the way the human ‘cognitive apparatus’ produces the subjectively perceived reality through the “cognitive ‘model’” that form the basis for the agent’s decision-acts, particularly with regard to its core task of trying to constantly

produce a superior ‘picture’ of (economic) reality through, *inter alia*, the identification of errors in the current ‘picture’ produced by its own “cognitive ‘model’” as well as the ‘picture’ dominating current market activity and consequently the current price level. The other core *problem* and *questions* relate to the issue how these processes lead to the formation of expectation in financial markets and how these are eventually translated into the market price, which, as argued above, constitutes a ‘one-dimensional’ picture of reality as filtered through millions of interacting agents. It will be interesting to discover, how precisely the subjectively experienced reality on the ‘lower basis’ of the overall cognitive structure in financial markets relates to this final picture on the top of the cognitive ‘super- structure’.

Rapp’s and Cortés’ (2017) and our respective visions for a ‘Cognitive Finance’ research program can thus be respectively compared to the ‘weak’ and ‘strong’ visions for the Cognitive Sciences more generally that were outlined by Gardner (1987). The ‘weak’ vision

“calls for cooperation among the six member-disciplines,<sup>[209]</sup> each still retaining its primary questions, methods and goals [...] [with] philosophy suppl[ying] the principal issues and help[ing] to judge the extent to which they have been successfully handled [...] [n]euroscience and anthropology remain[ing] as border disciplines, psychology and artificial intelligence [...] [forming] the core disciplines, and linguistics offer[ing] an account of that ability which is most central in the human cognitive armamentarium.” (Gardner, 1987, p. 389)

In this ‘weak’ vision, the nature of the research effort is primarily dictated by the idiosyncrasies of the individual disciplines, i.e. it is the respective scholar’s disciplinary background rather than the aspect of cognition to be inquired into that sets the research agenda and determines the research approach or, as Gardner (1987) puts it, “whether one works as a philosopher or an anthropologist is more salient than whether one works on issues of language or social interaction” (p. 390).<sup>210</sup> In fact, Gardner (1987) argues, it is only “[w]hen collaborating [...] [that] these researchers [from the various disciplines] are ‘practicing cognitive scientists’; otherwise, they are simply doing their own thing” (p. 389-90). Gardner (1987) stresses that such a vision “scarcely warrants the label of an important new science” (p. 390). He holds that such an

“organization around the traditional disciplines would be appropriate if the *actual domains of cognition* did not make a central difference; so long as the same processes are believed to occur irrespective of the content of a domain (musical

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<sup>209</sup> These are, in the sequence of their discussion in Gardner (1987): Philosophy, Psychology, Artificial Intelligence, Linguistics, Anthropology and Neuroscience.

<sup>210</sup> This description also fits the current situation in behavioural economics and *Behavioural Finance*.

versus spatial cognition, for example), the conventional disciplinary division of labour makes sense.” (*ibid.*; *italics added*)

Questioning the premise of this statement, Gardner (1987) advocates a different, a ‘strong’, vision for cognitive science – one that is largely in line with the one underlying the ‘Cognitive Finance’ research enterprise that is being proposed in the present work – wherein “the crucial divisions within cognitive science are *not* the traditional disciplinary perspectives but rather the specific cognitive elements” (*ibid.*; *italics in original*). Gardner (1987) therefore advocates

“a gradual attenuation of disciplinary boundaries and loyalties [...] [which are then to be] replaced by a concerted effort by scientists committed to a representational account to model and explain the most crucial human cognitive functions”

and the according reorganization of the research enterprise (as well as the required scientific training) ‘around these problems’ (*ibid.*). Thus,

“[w]hen focused on these problems, scientists should fuse their necessarily different perspectives in order to arrive at a full account of a particular cognitive domain at issue. And so, the ultimate cognitive picture of synthetic processing, or of language as a whole, should be a coordinated representational account which covers the full gamut of the traditional disciplines without any need even to mentioned them.” (*ibid.*; *italics in original*)

A ‘problem-based’ approach might, however, not only greatly enhance the coordinative aspects of the core research efforts of the proposed ‘Cognitive Finance’ research enterprise itself, but arguably also direct us toward a feasible cooperative agenda with the current (sub-)field of *Behavioural Finance*. After all, a ‘problem-based’ approach was also suggested by the cognitive scientist Gow (2007) as a viable alternative to Gintis’ (2007) proposal for a *Unification of the Behavioural Sciences*. He proposed this alternative because, albeit rejecting the latter, he did identify areas of overlap between the cognitive and behavioural sciences that might provide a fertile ground for cooperative research efforts:

“The cognitive sciences also need to explore the domains occupied by the behavioural sciences to explore the full complexity of how different representational types and processes interact over time in the broader social context that defines human experience. This recognition of a broader context also enables the realization of the cognitive science’s potential for practical application.” (p. 28)

Gow (2007, p. 28) emphasises that “meaningful integration is already occurring between the

two fields through such problem-based research programs,” while preventing the “step backward” in the cognitive sciences that he outlined in his critique of Gintis’ (2007) proposed framework for unification (see above). He concludes by affording the following insight:

“The lesson here is that cross-disciplinary integration is not impossible in principle. It simply requires training and scholarship that are defined by problems rather than historical boundaries.” (Gow, 2007, p. 28).

To summarize, the core ‘problems’ identified with regard to cognitive processes of stock market operators revolve around the ‘cognitive apparatus’ in general and the “cognitive ‘model’” in particular: (a) its nature; (b) the way it is formed and ‘frames’ reality; (c) the role that *internal* as well as *external* factors play; (d) the way it is transformed, both consciously as well as unconsciously; (e) the way it interacts with other agents’ “cognitive ‘models’” in the financial market; and (f) how sufficient individual independence from such influences can be achieved, in order to produce a less biased ‘picture’ of reality for the identification of profitable trading/investment opportunities. Once these ‘micro’ level issues come to be better understood, it might be possible to proceed to questions concerning the ‘macro’ level; most importantly of course, those concerning the process as to how (economic) reality comes – through the cognitive ‘filtering’ processes and the various interactions of the (cognising) individuals – to be ‘translated’ into the one-dimensional market price(s), which represent a type of (imperfect) mirror image of that reality as *perceived* by the interacting agents. This, in turn, might provide a better understanding of the nature of financial market processes and new insights into the development of certain financial market phenomena. It will be the task of future research to inquire into these exciting topics, which might also shed some light on the adequacy of certain policy measures and proposals, such as Richard Thaler’s (Thaler and Sunstein, 2008) *nudging*.

## Conclusion

The primary objective of the present thesis was the formulation of a first outline of an alternative conceptualisation of the expectation formation process of stock market (securities) traders, with a view toward a more comprehensive re-conceptualisation of cognitive processes as they pertain to the individual agent more specifically and the financial markets more generally as part of a larger (future) project to develop a more appropriate scientific approach to the study of financial market processes that is capable of overcoming the impasse of modern mainstream finance. The core contributions of the present project to that end were the following: Chapter 1 established the deep embeddedness of the conceptualisation of the agent in mainstream finance in general neoclassical economics at the level of ontology, methodology and use of methods, as well as its general untenability in the area of financial market research. These points were developed particularly through a detailed exposition of the *constraining effect* that this set of complex referents – which remains the main point of departure for most research efforts in the field – has had on the evolution of the behavioural finance enterprise. It was argued that despite the fact that behavioural finance built on much stronger empirical foundations than neoclassical financial economics had, the aforementioned constraints have prevented it from developing an alternative, more adequate account of the actual activity of ‘financial market participants’ and, by inference, of the market processes that occur.

Chapter 2 saw the outline of an alternative, more plausible, conceptualisation of the stock market operator’s expectation formation processes on the basis of inferences drawn from the ‘ecologically evolved’ *Value Investing* account, which were bolstered and supplemented by the exposition of the corresponding insights from complementary accounts in the wider economics literature. The *Value Investing* framework’s distinct approach to financial markets permitted certain inferences as to its presuppositions with respect to the nature of the decision-environment and -task that the stock market operator faces in a real-world setting; with regard to the former, the following were identified as being pivotal: the open-system nature of financial markets, the presence of ‘fundamental uncertainty’, and the ‘multidimensionality’ of data and aspects pertaining to economic reality. On the basis of these inferred insights, it was possible to draw inferences with respect to the sort of cognitive aspects that are plausibly involved in the expectation formation process of the stock market operator: Most importantly, the factor of ‘multidimensionality’ implies that often only fragmented, mutually-exclusive ‘pictures’ of a certain aspect of (economics) reality can be formed, irrespective of what the human agent’s actual cognitive processing powers are. This means that two agents with access to the same information set could come to (sometimes significantly) divergent ‘views’ as to the *worth* of a particular asset; and, indeed, as the analysis of the subject of Price-Value (In)Congruence has demonstrated, a certain degree of heterogeneity in terms of ‘views’ is a

necessary condition for the informational efficiency of the price vector as well as the well-documented high trading volume in financial markets, and as in the modern information age this heterogeneity cannot be solely attributed to a wide range of differing private information sets of individual agents, at least part of it, can plausibly be traced to this aspect of ‘multidimensionality’ and the related fact that the human brain is ‘constructively’ involved in filtering, sorting and interpreting this type of data in order to create a particular “cognitive ‘model’” of reality. Such an inference would also resonate well with the *Value Investing* framework’s understanding as to the core task of a stock market operator: i.e., the identification of flaws in the ‘views’ and expectations of her fellow financial market participants in an attempt to develop a superior ‘view’ of (a particular aspect of) economics reality in the search for potentially profitable trading/investment opportunities. In turn, the inferred insights with regard to the presence of fundamental uncertainty and the open-system nature of financial markets more generally suggest that these ‘views’ and the corresponding “cognitive ‘models’” require constant ‘updating’ for maximising the agent’s chances of survival and success, but also that they are, most likely, of a non-Bayesian nature.

Chapter 3 applied the ontological and conceptual insights produced in Chapter 2 to the identification of a compatible alternative framework within the wider economics literature that would permit to weave the former into the existing economics/finance discourse in view to develop a more appropriate approach to the study of financial markets that would be able to overcome the impasse of mainstream finance that had been identified in Chapter 1. The following potential contestants were identified and analysed to that end: (1) Rapp and Cortés (2017) proposal for a ‘Cognitive Finance’ research program; (2) Gintis’ (2007, 2014) proposal for the *Unification of the Behavioural Sciences*; (3) Andrew Lo’s (2004, 2005) *Adaptive Market Hypothesis*; and (4) the *Santa Fe Artificial Stock Market Model*. The critical analysis revealed a deficiency of one sort or another in each one of those accounts. Nonetheless, the exposition of their respective strengths and weaknesses has produced a valuable source of insights as to what aspects ought to be considered and what issues ought to be avoided in the development of an alternative research framework for financial market research in the future. The possibly most fertile lines of thought and ideas for our intended purpose were identified in the works of Johannes von Kries (i.e., one of Keynes’ most important intellectual influences in regard to human decision-making) and F.A. Hayek. Both had pioneered important conceptual and theoretical insights with regard to human cognition decades before the advent of the first cognitive revolution, some of which it would take a second cognitive revolution to re-discover. Although neither of these two accounts can produce a definite framework for the development of the proposed ‘Cognitive Finance’ research enterprise, both seem to be able to provide valuable starting points *within* the wider economics literature for further discussions on and developments of the core conceptual insights produced in Chapter 2 and for weaving

them into the relevant cognitive science discourse, on the one hand, and the relevant economics discourse, on the other, with the proposed ‘problem-led’ approach weaving together the threads across the relevant disciplines in order to address the key issues that arise in financial markets.

To sum up, whereas it was arguably *Behavioural Finance*’s single greatest contribution to put the topic of cognition (back) onto the agenda of financial market research, the present work’s most noteworthy contributions are: (i) the exposure of the deep embeddedness of the conceptualisation of the agent in mainstream finance in general neoclassical economics at the level of ontology, methodology and use of methods, as well as its untenability within the context of financial market research; (ii) the outline of a more plausible conceptualisation of the stock market operator’s expectation formation process; (iii) the exposition of the inherent strengths and weaknesses of existing alternative accounts within the wider economics literature with respect to their ability to cater for the requirements that an alternative approach to financial market research in the light of the established ontological and conceptual insights demands; and (iv) the identification of a suitable methodological approach for transforming the projected re-conceptualisation of financial market processes in terms of processes of cognition, once realized, into a viable scientific research enterprise.

## Glossary

**Adaptive Market Hypothesis (AMH):** Andrew Lo's (2004, 2005) proposed synthesis between the EMH [see **EMH**] and behavioural economics/finance [see **Behavioural Economics** and **Behavioural Finance**]. Lo invokes concepts and principles of biological evolution (e.g., competition, adaption and natural selection) in order to explicitly allow for a complex and dynamic interaction of a wide variety of different types of agents ('species') with each other as well as their environment. This, in turn, permits him – or at least so he thinks – to reconcile prominent behavioural economics/finance insights such as the presence of *heuristics* and *loss aversion* with (some of) the core tenets of the EMH. *Market efficiency*, for instance, can now be reconceptualised in ('ecological') context-dependent and dynamic terms, with its degree being determined *relatively* to such factors as the respective availability of profit opportunities and the number, diversity and adaptability of the present market participants.

**Arbitrage:** A trading strategy that exploits mis-pricings in (between) inefficient markets with the goal of generating positive expected returns without incurring any incremental risks or having to commit any additional capital. For example, if gold trades at €1,150 per *oz.* in Paris and at €1,200 per *oz.* in Frankfurt, the arbitrageur would *short* (sell) gold in Frankfurt and instantaneously buy the same amount (in unit terms) in Paris. This way, the arbitrageur makes a risk-less profit of €50 per *oz.* (ignoring the transaction costs, taxes, etc. involved).

**Arbitrage Pricing Theory (APT):** A general asset pricing theory, which holds that expected asset returns can be modelled as linear functions of certain economic factors. The sensitivity of the asset return to the respective factor is captured by the respective beta coefficient.

$$E(r_j) = r_f + b_{j1}RP_1 + b_{j2}RP_2 + \dots + b_{jn}RP_n$$

where

$E(r_j)$  is the *expected asset return*,

$r_f$  is the *risk-free rate*, and

$RP_n$  is the *risk-premium* of the factor  $n$ .

The name of this pricing theory derives from the assumption that any potential mis-pricing of an asset could theoretically be detected by applying the calculated  $E(r_i)$  as a discount-rate to the cash-flows the asset is expected to produce over its lifetime in order to determine its Net-Present Value (NPV) and compare the latter to the asset's prevailing market price; any detected incongruence would constitute an arbitrage opportunity that could be profitably exploited and thereby eliminated, which would restore the equilibrium state.

The APT is an alternative to the CAPM [see **CAPM**], whereby it is to be noted that the former is less restrictive in terms of its assumptions; most noteworthy, whereas the latter assumes that

all investors hold the market portfolio, the APT allows for investors to hold unique portfolios. Nonetheless, like all neo-classical finance models, it builds on several assumptions, such as perfect competition and the independence of idiosyncratic shocks across assets and with regard to the respective economic factors.

Further, it needs to be noted that the APT is a ‘supply side’ model, as its beta factor coefficients capture the asset’s sensitivity to the respective underlying economic factors, whereas the CAPM is a ‘demand-side’ model, which builds on the expected utility maximization problem of investors, who are assumed to ‘consume’ the assets.

**Artificial Intelligence (A.I.):** A term that broadly encompasses all types of ‘intelligence’ demonstrated by machines/computers, in contrast to the forms of ‘intelligence’ demonstrated by biologically evolved entities.

**Behavioural Economics:** A research programme that focuses on the systematic study of the influence of cognitive, emotional and socio-cultural factors on the outcomes of economic decision behaviour of agents and their deviations from the predictions of rational-choice theory.

Behavioural Economics emerged in the wake of the wider *Cognitive Revolution* [see **Cognitive Science**]. It was realized at the time, like it was in several other disciplines that studied human behaviour, that the then-predominant behaviourism was theoretically and methodologically too restrictive for the development of a proper understanding of the various factors and processes involved in a particular observed behaviour. Lewin (1996) identifies the following problems with the behaviourist approach to economics: First, she argued, that the behaviourist methodological approach “placed economics into a straightjacket” (p. 1313), and that even relatively prudent forays into other areas, such as Becker’s (1974) models of altruism, “could never have passed scientific scrutiny during the heyday of behaviourism” (p. 1314), and were only possible after the descent of the latter. Secondly, ordinalism itself failed the empirical verification requirement of logical positivism and behaviourism as, in practice, the derivation of preferences from observed choice-behaviour was not possible (p. 1317). In fact, the 1930’s, 40’s and 50’s witnessed several (failed) attempts to derive utility functions empirically, by both the more “decision-theoretic” oriented studies (Luce, 1959) and those “concerned with the more general role of indifference functions in economics” (Wallis and Friedman, 1942) (p. 1315). Lewin (1996) summarizes:

“According to the logical positivist philosophy, preferences could be a valid concept only if they could be linked to measurements of behaviour. Revealed preference theory attempted to provide this link. The link had now been broken; in practice, the derivation of preferences could not be done. Therefore, preference theory was left without any *raison d’être* [...] In 1950, utility theory was once

again in a state of crisis.” (p. 1317).

In this intellectual milieu, a new breed of economists emerged, who were interested in studying and “discovering the empirical laws that described behaviour as correctly as possible” (Sent, 2004, p. 742), ascribing to the rational choice model at best a conjectural status. Hence, ‘old’ behavioural economics was born.<sup>211</sup> Unfortunately, however, and in spite of Herbert Simon, one of the pioneers in the field, having been awarded the Nobel Prize in Economics, ‘old’ behavioural economics would, “[p]artly due to its explicit efforts to distance itself from the mainstream [...], never [...] [catch] on in economics ‘proper’” (Sent, 2004, p. 742), nor would it have any major influence “on the development of the ‘new’ behavioural economics; the rise of behavioural decision research (BDR) would be far more significant.

It was the seminal work of Kahneman and Tversky (e.g., 1974, 1979, 1984), which would eventually “bring [BDR] [...] to the attention of economists” (Angner and Loewenstein, 2006, p. 30), mainly because “they [...] [were] able and willing” to apply mainstream economic methods and “standard economic language” (Rabin, 1996, p. 111), but also because in addition to their critique “of expected utility theory [Bernoulli, 1738; von Neumann and Morgenstern, 1953] as a descriptive model of decision making under risk” (Kahneman and Tversky, 1979, p. 263), they also offered with *Prospect Theory* (*ibid.*) a – for the mainstream acceptable – alternative (Sent, 2004). Their work would yield many valuable insights and add new concepts to the economics lingo. Some of their seminal contributions are the following: *Heuristics* (1974), *Prospect Theory* (1979, Tversky and Kahneman, 1992), *Framing* (Tversky and Kahneman, 1981), *Loss Aversion* (1984b), *Endowment Effect* (Kahneman, Knetsch and Thaler, 1990), *Status Quo Bias* (Kahneman, Knetsch and Thaler, 1991).

One of the protagonists in establishing Kahneman’s and Tversky’s findings within the wider research programme of mainstream economics, and therefore in the conception and evolution of ‘new’ behavioural economics, was Richard Thaler (e.g., 1992). He pioneered the behavioural economics approach into consumer choice research (Thaler, 1980, 1985) and eventually into financial market research (Thaler, 1993, 2005) [see **Behavioural Finance**].

**Behavioural Finance:** A research programme that specializes in the identification of the causes behind the empirical anomalies that have emerged in financial market research over the last few decades.

The emergence of these anomalies, which had already been reported in Fama (1970), marked

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<sup>211</sup> Sent (2004) introduces this taxonomy in order to distinguish the original intellectual enterprise of, among many others, Herbert A. Simon, Richard Cyert and George Katona from the more recent one of the Kahneman-Tversky-Thaler brand (i.e., ‘new’ behavioural economics), which has come to define the current research programme.

the peak of the EMH in terms of its influence within academic circles, which, captivated by the rational expectations revolution at the time, had (unsuccessfully) been attempting to “tie together finance and the entire economy in one elegant theory” (Shiller, 2003, p. 83). In order to respond to that impasse, new strands of research emerged that inquired into the underlying causes of these anomalies. Hence, behavioural finance was born: New econometric evidence systematically uncovered the weak spots of the EMH (e.g., Shiller, 1989; Shiller, 2003; Baker and Wurgler, 2007), while the emerging field of ‘new’ behavioural economics [see **Behavioural Economics**] provided new, alternative, theoretical frameworks (e.g., *Prospect Theory*) for the explanation of certain observed phenomena in financial markets (see, e.g., Shefrin and Statman, 1984).

Barberis and Thaler (2003) identify two broad ‘building blocks’ of behavioural finance: First, there is *limits to arbitrage* (e.g., Shleifer and Vishny, 1997; Daniel *et al.*, 2001). This is largely a micro-structure approach that tries to uncover the factors that hinder rational traders from correcting any mispricing caused by the actions of less rational market participants. The research in this area has revealed several important insights, such as prohibitive transactional and informational costs (e.g., D’Avolio, 2002; Geczy *et al.*, 2001), informational imperfections (e.g., Rashes, 2001) and certain types of risks to arbitrage trades (e.g., De Long *et al.*, 1990). Such findings challenge fundamental assumptions of modern finance theory, as these imperfections allow ‘irrational’ market participants, i.e. so-called *noise traders*, not only to survive, but potentially even to profit from the price distortions that they create (De Long *et al.*, 1990).

The other ‘building block’ is *psychology*, i.e. the study of factors that cause significant deviations from the predictions of the rationality postulate, such as over-confidence (e.g., Odean, 1998; Daniel and Hirshleifer, 1998; Barber and Odean, 2001) and loss aversion (Barberis and Huang, 2001). Its scope has expanded considerably over the last thirty years and now covers such diverse factors as investor sentiment (Barberis, Shleifer and Vishny, 1998), investor mood (Saunders, 1993; Kamstra *et al.*, 2000; Dremen and Lufkin, 2000), gender (Barber and Odean, 2001), social interaction (Hong *et al.*, 2004) and herding (Chan, 2001).

Behavioural finance has thus made an important first step toward the development of a *positive* framework of financial markets, which, in addition, is underpinned by empirical evidence.

**Black-Scholes-Merton Option Pricing Theory:** A mathematical model for the determination of the theoretical price of European call and put options (these can, in contrast to *American* options, be exercised only at the time of their maturity, not before), given that a set of assumptions (e.g., no arbitrage condition, short-selling permitted) holds.

The general Black-Scholes formula (for a call-option)<sup>212</sup> is the following:

$$C(S_t, t) = S_t N(d_1) - K e^{-r(T-t)} N(d_2)$$

$$d_1 = \frac{1}{\sigma \sqrt{T-t}} \left[ \ln \left( \frac{S_t}{K} \right) + \left( r + \frac{\sigma^2}{2} \right) (T-t) \right]$$

$$d_2 = d_1 - \sigma \sqrt{T-t}$$

where

$S_t$  is the spot price of the underlying asset

$K$  is the strike price

$r$  is the risk-free rate (annual; continuous compounding applied)

$N(\cdot)$  is the cumulative distribution function of the standard normal distribution

$T-t$  is the time-to-maturity (in years)

$\sigma$  is the volatility of returns of the underlying asset

The intuition behind the model is the following: Two types of plain vanilla assets, i.e. equity stocks and (zero-coupon) bonds can be combined in such a way as to create a synthetic copy of any option. The Black-Scholes model specifies the number of units and their precise combination that are required for the replication of a particular option, or, as Derman (2011, p. 176) puts it: “It’s like a recipe that tells you how to make fruit salad (an option) out of fruit (stocks and bonds) and hence, via the Law of One Price, what the fruit salad is worth.”<sup>213</sup> Hence, looking at the price formula for the call-option, we can discern the equity stock component ( $S$ ) and the (zero-coupon) bond component ( $K$ ), both of which are assumed to vary<sup>214</sup> in terms of market price up to the time-of-maturity. The investor will only exercise the call-option if  $S > K$  at the time-of maturity. The following example shall illustrate the mechanisms of a call-option: Assume we have good reason to expect that the share price of *Microsoft Inc.* will increase over the next three months. We can now either purchase the stock for \$100 and hold it for three months or, alternatively, purchase the *option* to buy the stock three months hence at a pre-specified price (e.g., \$115) for \$5 (this is the price of the option). These two scenarios work out in the following ways if the stock price has increased to \$120 after the passage of three months’ time: In scenario 1, we can sell the stock for \$120 and realize a profit of \$20, which corresponds to a return of 20% on our investment. In scenario 2, we can exercise the option, purchase the stock at \$115 and sell it for the prevailing market price at \$120 (i.e.,  $S > K$ ). This translates into a profit of \$5 on an initial investment of \$5 (i.e., the price of the option), or a 100% return on our investment.<sup>215</sup> This leverage effect renders the

<sup>212</sup> A European call-option is an option to buy a particular asset at a particular time ( $T$ ) for a particular price ( $K$ ). A European put-option is an option to sell a particular asset at a particular time ( $T$ ) for a particular price ( $K$ ). Due to lack of space, the explanation shall solely focus on the call-option.

<sup>213</sup> Of course, due to a myriad of complicating factors that exist in actual markets, such a “synthesis is [...] imperfect in practice” (Derman, 2011, p. 177).

<sup>214</sup> The price variation is assumed to follow the standard normal distribution.

<sup>215</sup> We could use the full \$100 to buy 20 call-options (i.e. \$100 : \$5 = 20) and realize a nominal profit

option attractive as an investment instrument, but it also significantly increases the investor's risk. For instance, if the stock price ends up at \$105, then scenario 1 would still leave us with a positive return on our investment (i.e., \$5 on \$100; a 5% return), but scenario 2 would result in a total loss of our initial investment (i.e. the purchase price of the option), because the right to purchase a stock at a price of \$115 would be worthless in an environment where it could be purchased for solely \$105 in the market (i.e.,  $S < K$ ).

It is important to note, though, that several of the model's core assumptions (e.g., standard-normally distributed asset returns, delta-hedging) are violated in the real-world context. A practical application of the model therefore requires a significant degree of caution and dexterity.

**Capital Asset Pricing Model (CAPM):** An asset pricing model that derives the theoretical expected return for an asset in the market from the risk-free rate (i.e.,  $\sigma = 0$ ),  $R_f$ , the return of the market portfolio,  $R_m$ , and the asset's return's ( $R_i$ ) correlation with the latter. The standard expression of the CAPM is:

$$E(R_i) = R_f + \beta_i(E(R_m) - R_f)$$

where  $\beta_i$  (or, 'Beta') is a measure of asset  $i$ 's sensitivity to movements in the overall market. Beta is usually determined via regression analysis of historical return data. A Beta of  $>1$  indicates a higher than average risk contribution, a Beta of  $<1$  indicates a lower than average risk contribution;  $(E(R_m) - R_f)$  is the market premium, i.e. the market portfolio's expected return over the risk-free rate.

The CAPM builds on the expected utility maximization (EUT) framework. It is assumed that investors are the 'consumers' of assets who try to maximize their utility by choosing the appropriate assets (in terms of risk and return). It is a model about what investors *should* expect with regard to asset returns *if* investors and asset prices behave the way the model assumes they will. Unfortunately, most of the time, they don't. Behavioural finance research has demonstrated empirically that investors systematically deviate from the prescriptions of the EUT and that, in practice, both volatilities and covariances change over time.

**Closed/Open Systems:** The terms 'open' and 'closed' systems are not definitively defined in the literature and a wide variety of (sometimes diverging) usages seems to exist. Mainstream economists, for example, might define stochastic models as 'open', as they allow for (statistically) probable developments to occur, whereas a heterodox account might perceive them as 'closed', as they are clearly defined within a parametric statistics framework. Even within the heterodox camp the usage of the terms varies (see e.g., Chick and Dow, 2005).

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of \$100.

Often, the concept of ‘open systems’ seems to be defined in negative terms, i.e. as ‘non-closed’ (Mearman, 2002). According to Dow (2013a), for example, there are “many possibilities for open system” and defines a system as “open if any one of the conditions for a closed system is not met”<sup>216</sup> (p. 74). Mearman (2002, p. 574) identifies further instances of this ‘negative’ definitional approach (see e.g., Grunberg, 1978; Olsen, 2000) and highlights some of its shortcomings<sup>217</sup>, such as the collapse of all potential types of open systems into one single category, leaving no room for a richer taxonomy (e.g., ‘partial closure’).<sup>218</sup>

As far as the present work is concerned, the ‘negative’ definition shall suffice, as the parametric statistical closed-system world of ‘neo-classical’ finance shall represent the benchmark against which the ontological status of Behavioural Finance and Financial Markets shall be determined. The degree of ‘openness’ shall not constitute part of the proposed research.

**Cognitive Science (1<sup>st</sup> and 2<sup>nd</sup> generation):** Cognitive science is the interdisciplinary study of the *mind*. The field encompasses the disciplines of philosophy, psychology, artificial intelligence, neuroscience, linguistics and anthropology (see Gardner, 1987). Its intellectual origins can be traced to the 1950’s and 1960’s when important advances in the aforementioned disciplines undermined the tenets and methodology of the predominant behaviourist school of thought. George Miller’s (1956) seminal article, for instance, which described, most prominently, the limitation of the human working memory to 7 +/- 2 items as well as the observation that a re-coding of information into chunks permitted test-subjects to overcome this limitation, highlighted the necessity of studying the functioning of the mind itself. Another seminal article was Noam Chomsky’s (1959) review of Skinner’s *Verbal Behaviour*, in which he argued that Skinner’s stimulus-response approach failed to provide a viable account for language acquisition in children, speculating that the rules and mechanisms underlying the latter were innate.

The first cognitive revolution comprised, on the one hand, the realization that the study of the mind was fundamental to the acquisition of a viable scientific understanding of important phenomena such as language acquisition, and that “adherence to behaviourist canons was making a scientific study of the mind impossible” (Gardner, 1987, p.12), and, on the other, the

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<sup>216</sup> The conditions are specified in her Table 4.1 (p. 75): (1) All relevant variables can be identified; (2) The boundaries of the system are definite and immutable (i.e. it is clear which variables are exogenous and which are endogenous, with the categories being fixed); (3) Only the specified exogenous variables affect the system in a known way; (4) Relations between the included variables are either knowable or random; (5) Economic agents (whether individuals or aggregates) are treated atomistically; (6) The nature of economic agents is treated as if constant; (7) The structure of the relationship between components (variables, subsystems, agents) is treated as if it is either knowable or random; (8) The structural framework within which agents act is taken as given.

<sup>217</sup> See also Mearman (2004, 2006).

<sup>218</sup> For further discussion on open systems, see esp., Mearman (2002, 2004, 2006), Chick and Dow (2005).

development of an alternative approach that introduced “a separate level of analysis, which can be called the ‘level of representation’” (*ibid.*, p. 38), a “level of analysis wholly separate from the biological or neurological, on the one hand, and the sociological or cultural, on the other” (*ibid.*, p. 6). The term *cognitive science* was introduced by Christopher Longuet-Higgins in his 1973 commentary on the Lighthill report, a document that reviewed the then-current state of research in A.I. In the same decade, the *Cognitive Science Society* was founded and the journal *Cognitive Science* published for the first time.

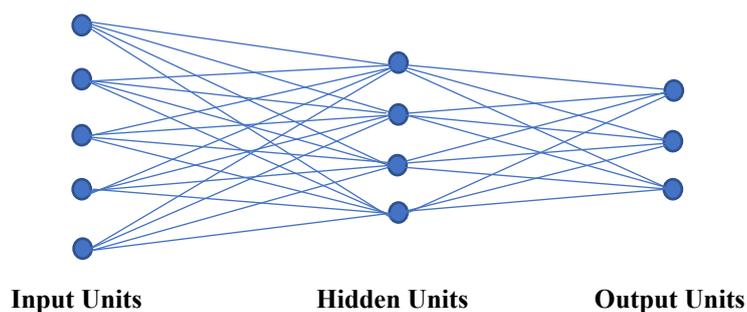
Landmark works, other than the aforementioned Miller (1956) and Chomsky (1959), which contributed some of the core insights to the first cognitive revolution, were, *inter alia*, Broadbent’s (1958) *Perception and Communication*, Newell *et al.*’s (1958) article “Elements of a Theory of Human Problem Solving,” and Neisser’s (1967) *Cognitive Psychology*. In fact, Neisser (1967) synthesized the research in the various areas, and was thus, frequently referred to as the “father of cognitive psychology” (Hyman, 2012).

By the late 1970’s and early 1980’s, cognitive psychology had eclipsed behaviourism as the dominant research programme in most fields of psychology (Frieese, 2005).

As the new research enterprise progressed, it became increasingly apparent, though, that several of its original tenets – particularly the assumption that the human brain operated like a von Neumann symbol-processing computer – were untenable. In response to the emerging challenges, alternative approaches were devised by a new generation of cognitive scientists such as George Lakoff in the field of linguistics. One prominent development was the rise of artificial neural network approach and connectionism as a research program (see **Connectionism**).

**Connectionism:** An approach to cognitive science that came *en vogue* in the 1980’s. It applies so-called *artificial neural networks*, i.e. simplified (mathematical) models of the neuronal structures of the brain, to the study and explanation of various cognitive processes.

Here we have an illustration of a simple neural net:



Garson (2015) provides an insight into the operation of such an artificial neural net:

“Each input unit has an activation value that represents some feature external to the net. An input unit sends its activation value to each of the hidden units to which it is connected. Each of these hidden units calculates its own activation value depending on the activation values it receives from the input units. This signal is then passed on to output units or to another layer of hidden units. Those hidden units compute their activation values in the same way, and send them along to their neighbours. Eventually the signal at the input units propagates all the way through the net to determine the activation values at all the output units.”

Further particulars:

“The pattern of activation set up by the net is determined by the weights, or strengths of connections between the units. Weights may be either positive or negative. A negative weight represents the inhibition of the receiving unit by the activity of a sending unit. The activation value for each receiving unit is calculated according a simple activation function. Activation functions vary in detail, but they all conform to the same basic plan. The function sums together the contributions of all sending units, where the contribution of a unit is defined as the weight of the connection between the sending and receiving units times the sending unit’s activation value. This sum is usually modified further, for example, by adjusting the activation sum to a value between 0 and 1 and/or by setting the activation to zero unless a threshold level of the sum is reached.” (*ibid.*)

Connectionists presume that certain cognitive phenomena and processes such as learning, decision making and language comprehension can be explained by such artificial neural network models (see Garson, 2015).

**Constructivism:** A ‘school’ within cognitive science that postulates an active role of the mind in knowledge-creation and its interaction with the world. The mind is understood as playing an active role in producing the agent’s subjective experience of reality.

**Diversification:** The result of the combination of not perfectly positively correlated assets ( $\rho_{ij} < 1$ , where  $\rho_{ij}$  is the correlation coefficient between assets  $i$  and  $j$ ) in a portfolio. This will result in lower portfolio risk.

**Efficient Market Hypothesis (EMH):** The cornerstone of modern finance theory. It states that financial market prices fully reflect all relevant information at all times, making it therefore impossible to consistently outperform the market, except by pure probabilistic ‘luck’. An assumption of perfect markets underpins the EMH.

Three levels of market efficiency are distinguished in the literature: weak, semi-strong and strong. In weakly-efficient markets, it is not possible to use historical price-data to devise profitable trading rules. An informational advantage might be gained from other public (e.g., Quarterly Reports) as well as private (inside-information) sources, though. In the case of semi-strong efficiency, even publicly available information will not suffice to devise outperforming trading strategies as markets are assumed to instantaneously incorporate all relevant information into prices as soon as it is released into the public space. Access to private information might still lead to excess trading-profits. In strongly-efficient markets, *all* forms of information, including private information, are assumed to be instantaneously incorporated into price.

**Embedded Cognition:** A conceptual framework of *cognition*, which, in clear contrast to the traditionally held view in cognitive science and the philosophy of mind, conceives of the agents' physical and socio-cultural environment not as a passive factor 'awaiting' alteration by the decisions and actions of agents, who, *cognitively*, approach it from a 'view from nowhere', but, on the contrary, as an active influence on the cognitive processes that occur within the human agents' skull/skin boundary, shaping the agents' perception of reality, their decisions as well as behaviour.

Embedded Cognition can be viewed as an extension of Embodied Cognition [see **Embodied Cognition**], as it acknowledges the important role that factors *external* to the agent's skull/skin boundary play in cognitive processes and incorporates them accordingly into its conceptual framework.

**Embodied Cognition:** A conceptual framework of *cognition*, which, in contrast to the traditionally held views in cognitive science and the philosophy of mind, attributes to the agent's body a "significant causal or physically constitutive role in cognitive processing" (Wilson and Foglia, 2017). Whereas traditional cognitive science conceives of the mind as a distinct entity, attributing to the agent's physical body virtually no role in cognitive processing, Embodied Cognitive Science challenges this view, arguing that the nature and form of the mechanics of human *cognition* are fundamentally shaped by the biological body.

**Expert System:** A particular type of computer system, operating primarily on the basis of if-then rules that are applied to a set of known facts for the deduction of new facts. It represents one of the first attempts to artificially emulate the decision-behaviour of knowledgeable human agents (i.e., 'experts'). In contrast to the latter and, indeed, modern Artificial Intelligence (A.I.), they lack the ability to learn autonomously from external data (see, e.g., Kaplan and Haenlein, 2018).

**Kelly Criterion:** A formula for bet-sizing in intertemporal choice theory that advises the agent

on what optimal fraction of his current wealth to wager in a particular ‘bet’ (gamble, investment, etc.). In the long-run, disciplined adherence to the Kelly criterion will result in wealth levels ( $W_t$ ) higher than those achievable by any other strategy. At the same time, it eliminates the risk of ruin (i.e.,  $W_t \leq 0$ ), because the Kelly fraction ( $f$ ) will always be  $f < 1$ , unless the probability of a loss is 0 (but in that case we would not be dealing with a ‘bet’).

The Kelly fraction is mathematically found by maximizing the expected logarithm of wealth, or, equivalently the expected geometric rate of return.

It is named after J.L. Kelly, Jr., who developed the formula while working as a researcher at the Bell Laboratories (Kelly, 1956).

**Mean-Variance Analysis:** Refers to Markowitz’s (1952b, 1959) decision framework, which culminated in his Modern Portfolio Theory (MPT). The rational decision-maker will choose the portfolio with the highest expected return (measured by the combination of the proportion-weighted *mean* returns of the constituent assets) for a given level of risk (measured by proportion-weighted *variance-covariance* matrix of the constituent assets’ return data), or, alternatively, the portfolio with the lowest risk for a given expected return. The rational investor will only accept a higher degree of risk, if she is adequately compensated by a higher expected return in her portfolio-choice.

**Modern Portfolio Theory (MPT):** The two core building blocks of MPT are the trade-off between expected return and risk (see ‘Mean-Variance Analysis’) and the diversification benefits that arise from investing in assets with imperfectly correlated returns, which allow to eliminate the idiosyncratic (i.e., diversifiable) risk the investor would otherwise incur.

In general:

*Expected Portfolio Return:*

$$E(R_p) = \sum_i w_i E(R_i)$$

where  $R_p$  is the return on the portfolio,  $R_i$  is the return on asset  $i$  and  $w_i$  is the weighting of component asset  $i$ .

*Portfolio Return Variance:*

$$\sigma_p^2 = \sum_i \sum_j w_i w_j \sigma_{ij}$$

where  $\sigma_p^2$  is the portfolio return variance and  $\sigma_{ij}$  is the (sample) covariance of the asset returns, which can alternatively be written as  $\sigma_i \sigma_j \rho_{ij}$ , where  $\sigma_i$  and  $\sigma_j$  are the (sample) standard deviations

of the respective portfolio assets, and  $\rho_{ij}$  is the correlation coefficient between the returns on assets  $i$  and  $j$ .

**Ontology:** Ontology, very broadly speaking, is the philosophical study of being. As far as it applies to economics, it constitutes the inquiry into and explication of the fundamental nature of the economy, or a specific aspect of it (such as the financial market and the human agent operating in it, the primary object of inquiry in the present work) and into the presupposed reality underlying theoretical accounts of economic phenomena (Mäki, 2001).

Why is ontological work important? Ideally, it should elucidate the nature of economic reality and scrutinize the framework through which economists perceive that reality, in order to provide us with a deeper understanding, not only of the issue at hand, but also of economics as a scientific discipline as well as its perspective, methods and tools, which should helpfully provide insights for enhancing their sophistication and relevance (Mäki, 2001). Similarly, Lawson's (2003) project explicitly ascribes the two following roles to ontological enquiry: first, the determination of "the (usually implicit) conceptions of the nature and structure of reality presupposed by the use of any specific set of research practices and procedures" (p. xvi); and, secondly, "the elaboration of [...] the broad nature and structure of (a relevant domain of) reality" (*ibid.*).

Mäki (2001) distinguishes, *inter alia*, between *descriptive* and *revisionary* ontology, whereby the former imposes an explication of "the ontological underworld in our belief system" (p. 11), and the latter represents an "attempt to change, rather than just describe, the prevailing ontological categories and presuppositions of a belief system" (*ibid.*). The present work shall primarily be concerned with the *descriptive* type – but with a view toward the formulation of a *revisionary* ontology of financial markets with regard to the generalisable cognitive aspects and processes that apply to them in the envisioned wider project. Our analysis of the various finance accounts in the literature (including the *Value Investing* account) therefore resonates with Mäki's (2001) postulate that

"[q]uestions about the economic world can often be transformed into questions about economic theories, taking the general form, 'What does theory T presuppose concerning P'. For example, 'What exactly does theory T presuppose about the capacities and suppositions of economic agents, or of the market mechanism?'" (p. 6).

**Parallel Distributed Processing (PDP):** The currently dominant form of **Connectionism**. An artificial network approach, with an emphasis on the parallel nature of neural processing and the distributed nature of neural representation, constitutes its theoretical (and mathematical) core. The core aspects of the framework are: (1) a set of *processing units*, (2) an *activation* of

the individual units, (3) an *output function*, (4) a *pattern of connectivity*, (5) a *propagation rule*, (6) an *activation rule*, (7) a *learning rule*, (8) an *environment* that provides the system with ‘experience’. See **Connectionism**.

**Standard Deviation (SD,  $\sigma$ ):** A measure that quantifies the amount of dispersion of a set of data values. The smaller the SD, the closer the data points tend to be to the mean, and *vice versa*. In neo-classical finance the SD is used as a measure of risk, as it indicates the variation of financial securities returns. The greater the variation, the ‘riskier’ the asset (or portfolio). Mathematically it is the square root of variance.

**Variance:** The expected squared deviation of a random variable from its mean.

**Volatility:** In neo-classical finance the degree of variation of the price of a traded security.

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