

Cognitive Economics and the Market Mind Hypothesis: Exploring the Final Frontier of Economics

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Abstract

Cognitive economics partners cognitive science with economics, each instructing the other: cognitive science teaches economics about mentality (present in markets), whereas economics teaches cognitive science about market forces (present in minds). Combining these culminates in a two-way premise: market-as-mind, respectively mind-as-market. Its shared underlying Market Mind principle is intelligent (and sometimes conscious) self-organisation via market dynamics. Cognitive science itself is an interdisciplinary field studying the mind in all its aspects, with consciousness as its final frontier. So, whereas mainstream economics assumes idealised rationality, and behavioural economics observes external behaviour to identify biases, cognitive economics is concerned with the mind’s interiority: what it actually is like to be rational, emotional, exuberant, etc. and how that affects us. Of particular interest is how such experiences extend and are shared with other minds in markets. Specifically, backed by 4E cognition the Market Mind Hypothesis formalises what investors have always casually referred to as “the market’s mind”, including its complex dualist relationship with the real (physical) economy. Prices are its informational signatures while market mood is its immersive phenomenal experience in real time. All this clearly contrasts with the (flawed) machine perspective of mainstream economics. Moreover, it points to the elephant in economics’s room: its version of the notorious mind-body problem. Addressing our wider economic predicament starts by recognising this problem.

Key words: Cognitive Science; Consciousness; Distributed Cognition; Economics; Extended Mind; Fallibility; Finance; Investment; Market Mind Hypothesis; Mind-Body Problem; Philosophy; Uncertainty.

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It is in this middle field that economics lies, unaffected whether by the ultimate philosophy of the electron or the soul, and concerned rather with the interaction, with the middle world of life of these two end worlds of physics and mind . . . the ultimate nature of those two different things will probably remain, a thousand years hence, as far off as ever.

Frederick Soddy (Cartesian Economics, 1921)

Now, the issue, as is plain, relates to the treatment of “consciousness” in human beings. The essence . . . is [economics’s] insistence that we ignore . . . the existence of consciousness . . . In opposition to this view I propose . . . that we cannot treat human beings as . . . mechanisms, and that we do not want to do so even if it were possible.

Frank Knight (Fact and Metaphysics in Economic Psychology, 1925)

1. Introduction¹

This primer will introduce cognitive economics. But it will do so from a particular perspective. In the process I reconnect economics to its philosophical roots, like those established by Adam Smith in his (wrongly neglected) *Theory of Moral Sentiments* (1759). Specifically, Smith’s invisible hand is extended by (the sentiments of) the market mind.

Cognitive economics is an emerging heterodox theory that challenges mainstream economics. It partners cognitive science with economics, each offering explanations to the other. Cognitive science teaches economics about mentality (present in markets; e.g. herd mentality), whereas economics teaches cognitive science about market forces (present in minds; e.g. your unconscious “System 1” competing with your deliberate “System 2”). As I’ll explain, combining these culminates in a reflexive two-way premise: market-as-mind, respectively mind-as-market. Its shared Market Mind principle is intelligent (and sometimes conscious) self-organisation—especially resource allocation—via (spontaneous) market dynamics triggered by (e.g. the tension between) complementary forces, like

¹ This paper is produced on behalf of the new research program in cognitive economics at the Edinburgh Futures Institute, part of the University of Edinburgh. A key aim of our research (e.g. via practical projects) is to bring economic and cognitive experts together, from both academia and industry. This paper is thus worded to reach a wide audience. Regarding terminology, economics includes finance as a nested discipline, while investing includes related activities, like trading and market making. We view mind from a 4E cognition perspective, e.g. in embodied and extended terms. While echoing elements of organicism in general, I only specifically use anthropomorphic and bio-centric language to appeal to the reader’s intuitive understanding of complex topics, especially to contrast it against a mechanical view. In other words, I do not claim Mr Market = human.

competition~cooperation, consumption~production, demand~supply, risk~reward, but also freedom~repression, discovery~concealment, etc. In fact, practical dualism — which will be introduced later—is about mind~matter or psycho~physical.²

This principle is not fail-safe: sometimes there are imbalances, excesses, and other unhealthy conditions, both in minds and markets. Still, it reconciles the many contradictions we can simultaneously observe in markets and their agents, including steady (‘equilibrium’) states being interrupted by various forms of ‘regime shifts’ (e.g. from ‘bullish’ to ‘bearish’). Importantly, it is an explanation which helps to avoid the ontological trap that ‘markets are *fundamentally* different from us’.

Cognitive science itself is a multidisciplinary field that includes AI, anthropology, neuroscience, philosophy, psychology, and sociology. It studies the mind in all its aspects, including consciousness and its collective dimension, which is especially of interest here (as it was, much earlier, to Knight). For those reading this with scepticism but not familiar with developments along mentality’s final frontier (e.g. Overgaard, 2017): the past 25 years have seen growing consensus that, in the words of neuroscientists Giulio Tononi and Christof Koch (2015, p. 2), “the study of consciousness is becoming a science” within cognitive science. For example, their own Integrated Information Theory (IIT) is competing with other consciousness theories, like Global Workspace Theory (e.g. Dehaene, 2014) and predictive processing theories (e.g. Hohwy and Seth, 2020).

This helps, for example, in answering readers who wonder how this differs from behavioural science which informs behavioural economics? Smith (1759), for example, distinguishes between “internal sentiment” and “external behaviour”. So, at the risk of an early oversimplification, and while they sometimes overlap, cognitive science is more internally oriented (i.e. on cognition as *impression*), whereas behavioural science is more externally oriented (i.e. on behaviour as *expression*). For example, the impression of anger (e.g. boiling) is very different from expressing it

² I am using the squiggle symbol (~) of Coordination Dynamics, a cognitive theory that informs the MMH. The squiggle stands for the complementary relationship (e.g. Yin~Yang) between the members of each pair. In general: “Thinking narrowly in terms of contraries and the either/or is easy when life is simple. But in complex coordinated systems it seems that sharp dichotomies and contrarities must be replaced with far more subtle and sophisticated complementarities” (Kelso, 2022, p. 10).

(e.g. yelling), as are its potential consequences. Also, if impression is about consuming information, then expression is about producing it.³

The Market Mind Hypothesis (MMH)—which I am developing with collaborators and will shortly summarise—embraces these developments in the wider framework of so-called 4E cognition (see Section 6.1) and interprets its economic implications. There is precedent for this, as I’ll discuss in section 3. For now, in his stunning (but largely forgotten) “Fact and Metaphysics in Economic Psychology” Frank Knight concluded, among others:

Now the issue, as is plain, relates to the treatment of “consciousness” in human beings . . . The pertinent fact for economics . . . would be that it is useless and a source of confusion in study, destructive of the scientific point of view which is the only fruitful approach to the data. In opposition to this view I propose . . . that we cannot treat human beings as . . . mechanisms, and that we do not want to do so even if it were possible. We necessarily approach the phenomena of conduct from a different direction, and bring to them a different dominant interest, as compared with the phenomena of nature outside the human realm . . . There is nothing to it but to come back to common sense, and the practical necessities of our situation. That is, we come back to dualism . . . (1925b, pp. 248, 265)

Although Knight was criticising (pre-Skinner) behaviourism, his arguments⁴ remain relevant, especially regarding consciousness as the determining factor: “the objects observed by the social scientist all possess an attribute that is lacking in the objects of the natural universe. This is the attribute of consciousness . . .” (Heilbroner, 1973, p. 133). The MMH takes these arguments on board to offer a novel interpretation of cognitive economics that complements and enriches other interpretations.

Specifically, and in contrast to the mechanical view of mainstream economics, it explicitly interprets the economic system and its dynamics in (collective) mind-body, mind-matter, or psychophysical terms. For example, at the macro level the dualist economic system combines the *physical* real economy of markets in goods and

³ Acknowledging the relevance of this interiority for economics disputes, for example, the assumption of equilibrium approaches that instability is only due to exogenous factors, e.g. “Those of us who worry about endogenous uncertainty arising from the interactions of boundedly rational market participants cannot but scratch our heads at the insistence of the mainline models that all uncertainty is exogenous”. Buiter (“The unfortunate uselessness of most ‘state of the art’ academic monetary economics”, Financial Times online, 3/3/2009).

⁴ For all clarity, dualism is interpreted in terms of aspects or properties, not substances (see 6.2). I will return to Knight in Section 7.

services—aka “the economy”—with the *psychological* financial economy of markets in securities—aka “the market”.⁵ This interpretation also points to an endgame: by exploring the final frontier cognitive economics not just pushes behavioural economics’s envelope to its limit but forms the concluding chapter in the revision of mainstream’s paradigm. In short, cognitive economics will finish what behavioural economics started. At the same time, the MMH argues that markets offer important insights and lessons which (should) influence many of the debates in cognitive science. These vary from price discovery⁶—as the shared dual realisation of information (see Section 7)—via their large scale intersubjectivity to their existential threat. Specifically, no theory of human consciousness is complete without considering, let alone explaining, its collective dimension. Speculatively, market forces—aimed at discovery via exchange—spawn consciousness.

In general, a primer is a paper that acts as an introduction to a new subject (at least for most readers). However, it often also ends up as a collection of smaller primers because—attempting to embed such a subject in the existing literature—it touches on important related topics which each deserve their own paper. This primer is no exception, but it is also a bit of a deep dive (again, for some readers). The fact that its subject combines two vast fields—cognitive science and economics—makes this unavoidable. That this may distract some readers from the main arguments is a calculated risk I am willing to take. But just in case: the key message of this primer is, first, that the need and urgency to revise economics’s paradigm has only grown with the recent crises—exactly because they were existential. Second, that this revision must start with replacing its flawed mechanical worldview (based on physics) with a more realistic psychophysical one (based on 4E cognitive science). And third, that the derived Market Mind principle, which acknowledges consciousness, offers a universal approach with broad applications that can restore health to the economic mind-body.

⁵ This is meant, of course, in relative terms: both have material and mental aspects. Still—putting it in sharp contrast to make my point—the economy is about the physicality of (the means of) production combining with the physicality of labour to produce physical commodities (e.g. harvesting grain, drilling for oil, digging for gold, etc.). The market, on the other hand, is about the psychology of their exchange, whereby, e.g., “[t]he price or money-form of commodities is, like their form of value generally, a form quite distinct from their palpable bodily form; it is, therefore, a purely ideal or mental form” (Marx, *Das Kapital*, 1867; Chapter 3, Section 1). Or, as an investment idiom goes (especially relevant for today’s supply-chain disruptions), “You can print money but not commodities”.

⁶ The MMH focusses on prices. However, other ‘big data’ in markets are important as well in capturing (aspects of) market mentality, including e.g. flow, open interest, and volume.

This paper is structured as follows. The next section will briefly highlight a few examples of the literature in cognitive economics. Section 3 will provide some historical background which contains an important message. In Section 4 I will share my motivation to write the paper, as well as its purpose. Section 5 will critically review mechanical economics, the dominant paradigm. It is followed by a brief introduction of the MMH in Section 6. Section 7 will describe economics's so-called "hard" problem about which mainstream economics is in denial.⁷ I will close with a summary and conclusion.

2. Literature review

Early on, Clark suggested that "the frontiers of . . . economics may turn out to border rather closely on those of . . . cognitive science . . . There is clearly much to learn. Perhaps we should learn it together" (1996, p. 288). After a hesitant, and often more behaviourally tilted start (e.g. Bourguine and Nadal, 2004) this is finally gaining some traction. Still, as seems normal for any emerging discipline, the growing literature on cognitive economics reflects differences in approach, emphasis, interpretation, and style. The breadth and depth of the underlying cognitive science literature makes it particularly susceptible to this.

For example, according to Chater "[c]ognitive science views thought as computation" (2015, p. 53). He focuses on the mutual contributions cognitive science and economics can make to each other and, combined, to "new rational theories of human thought and behaviour, upon which accounts of individual and collective behaviour can be constructed" (Ibid). Overall, he echoes my earlier sentiment: "the prospect of moving from behavioural economics to a genuinely cognitive economics" (Ibid, p. 52).

Kimball defines cognitive economics as "the economics of what is in people's minds" (2015, p. 167). He particularly focuses on "novel types of survey data", because they "highlight the importance of heterogeneity across individuals and highlight thorny issues" (Ibid). To achieve progress in cognitive economics he calls

⁷ In reference to the original "hard" problem highlighted by Chalmers (1995). As I'll discuss, it is another term for the mind-body problem. It is also known as the problem of consciousness.

for innovating/strengthening approaches and tools in three particular areas: finite cognition, welfare economics, and data processing (e.g. via surveys).

Johnson views cognitive science as “the study of how the mind processes information” (2019, p. 2). He first criticises behavioural economics for copying neoclassical economics by neglecting “the role of active sense-making that motivates and guides much human behavior” (Ibid, p. 1). Specifically, what is lacking is “internal states, such as beliefs and expectations with a modicum of psychological realism” (Ibid). He subsequently illustrates how cognitive ideas can illuminate several puzzles in economics.

Following earlier reflections by Searle (e.g. 2005), Gigante (2013) approaches it from a sociology angle and limits her discussion to a particular area by zooming in on how (e.g. social) cognitive theory can help Institutional Economics.

Mulgan researches collective intelligence and self-organising groups, with references to Hayek for example. We can connect this to so-called collective or social neuroscience which acknowledges and investigates the social dimension of cognition, especially how information processed by way of collaborating multiple brains can lead to intelligence. With some distant echoes of Simon (1999), Mulgan also focuses on an economic interpretation of cognition (i.e. mind-as-market) as reflected in his definition of cognitive economics: “the view of thought as involving inputs and outputs, costs and trade-offs” (2017, p. 78). Later I return to Hayek’s opinion on this, as well as that of others. From the Market Mind perspective, our collective embodiment and production of cognition has a rich history as knowledge market. In particular, the Enlightenment and its scientific revolution truly unleashed market forces in our quest for cognition: *demand* for and *supply* of explanations were met by way of *competing* hypotheses, *collaborating* research (including *discovery*), and *exchanging* ideas. Creating this market—in the process replacing knowledge from a central authority (e.g. the Church)—was the real revolutionary part. More generally, reasoning is via interaction and meaning—as Wittgenstein so powerfully argued—and thus a public value, not a private accompaniment. In the case of words, for example, it is determined by their use in *exchanges*. The market thus operates here too: the most ‘popular/appropriate/efficient/ etc’ meaning wins.

Finally, in their book *Economics and the Mind* Montero and White edited a collection of papers, written by leading scholars in various fields, with a focus on the

intersections of economics and philosophy of mind. It “paves the way to a new interdisciplinary approach” and is “of interest to all scholars working in [these] intersections . . . as well as behavioural economics, decision theory, and neuroeconomics” (2007, back cover).

On that note, philosophy of mind, as well as cognitive science more generally, offers extensive literature on consciousness (e.g. Blackmore, 2005; Chalmers, 1996; Dehaene, 2014; Dennett, 1991; Seager, 1999) which is central to the MMH-perspective. It is sufficient for our purposes if we accept consciousness as real and as a capability⁸ that distinguishes us from other animals and from machines. Still, for some readers it is perhaps helpful to think about consciousness as an additional “system” or overlay to the well-known dual system of thinking (aka dual-process thinking; e.g. Kahneman, 2012). Together they form the mind’s 3-system portfolio, if you will.⁹ To wit, whereas our unconscious forms “System 1” (S1, for “fast thinking”) and our deliberation forms “System 2” (S2, for “slow thinking”), consciousness forms a derivative “System 3” (S3) to experience such thinking (its phenomenality) and, reflexively, feed back upon it. For example, this includes feelings about (actual, desired, feared, etc.) outcomes of such thinking, e.g. as a consequence of decisions.¹⁰ How else can you compare, differentiate, and judge any thinking but by (being aware of) what it is like, i.e. by way of its impression? That is to say, not just what it is like to be emotional, compared to being rational, but also what it is like to be right versus wrong. This is, after all, how we learn ‘from experience’: by undergoing it we build experiential knowledge. Viewed from this mind-as-portfolio perspective, by *realising* information (e.g. a decision, its outcome, etc.) as distinct impressions consciousness—including allocated attention—yields mental diversity in a qualitative sense.

⁸ Not a phenomenon unique to humans per se, but in terms of level, e.g. self-consciousness or metacognition.

⁹ This is closely related to my earlier comment on mind-as-market, i.e. your S1 competes with your S2 for S3’s attention.

¹⁰ See also, e.g., Evans (2018). While popular—which is why I’m using it here—I am generally not a fan of this framework, mainly because the systems mingle, and System 2 suggests a rational homunculus. For more criticisms, see Grayot (2019). Related is the distinction between decision and experienced utilities (e.g. Carter and McBride, 2013). And just to be clear, while complementary none of these 3 systems is infallible, i.e. your intuition, respectively logic, and/or impression can be deceiving or erroneous. Also, not to be confused with subsequent memories of them.

To clarify such ‘derivative’ qualities, especially how they can act over and above any quantities, let me give a behavioural example. If I give you a choice between a sure loss of £100 or a sure win of £100, you obviously will choose the latter. But what if, instead of a sure loss, you can avoid the loss? Loss aversion is the anomaly to prefer avoiding a £100 loss (option A) to gaining a £100 win (option B). While these options are quantitatively the same they are qualitatively not valued as such. This is due to our higher sensitivity (or ‘beta’) to pain than to pleasure, leading to their asymmetrical valuation ‘in our minds’. So, for option A, *without* avoidance you will experience pain (as negative impression) due to the loss (as bad outcome¹¹). This compares to option B in which case you will experience pleasure (as positive impression) from the profit (as good outcome). In short, two different qualities for quantitatively the same results. As an aside, let me extend the example by quickly explaining how to apply the Market Mind principle. So, think of it in market terms, in this case financial options: the ‘put’ option A to ‘sell’ pain (thereby transforming it into pleasure) is valued higher than the ‘call’ option B to ‘buy’ pleasure.

My point is of course not about loss aversion. It is about the richness in qualities of experience that offer a reflexive ‘derivatives’ overlay to the underlying portfolio of S1 and S2 ‘cash holdings’. Its diversification adds robustness (e.g. sense-making) to our overall mind-as-portfolio which is important in a world often overwhelmed by the quantity of information.¹²

Apart from this literature, there is an historic element to MMH’s tale of cognitive economics, involving a number of key actors. I’ll turn to it next.

3. Historical background

Adam Smith is not only the father of economics. He is also the first cognitive economist: he combined early cognitive science (in *The Theory of Moral Sentiments*, aka TMS, 1759), with early economics (in *The Wealth of Nations*, aka WN, 1776).

¹¹ Again, in the real world such outcomes could be associated with or the result of earlier decisions.

¹² This applies more widely. For example, physical diversity (e.g. race, gender, age, etc.) in your investment team doesn’t necessarily mean mental diversity (e.g. IQ-EQ, S1-S3, Austrian-Keynesian, fundamental-quant, etc.) On cognitive diversity, see Page (2007). On dual realisation of information, see Section 7.

Many seem to have forgotten this important connection.¹³ For example, in TMS (Part I, Section III, Chapter II, p. 63) Smith describes “that great purpose of human life which we call betterment of our condition” as (the amount of) “sympathy” for your emotional state paid via (the amount of) “attention of the world”. This can freely be interpreted as probably the earliest version of mind-as-market, especially its shared aspects: sentiments being valued via intersubjective awareness.¹⁴ In the same section, his contrast between “the rich man” and “the poor man” specifically highlights the cognitive core of inequality, for example. More broadly, contrary to the traditional biased interpretations of Smith, he had a nuanced philosophical view of selfishness (versus altruism), competition (versus cooperation), and wealth (versus morals). Others have followed in his footsteps.

The year is 1920. A young student by the name of Friedrich (von) Hayek writes his very first paper. It is not about economics, for which he would become famous later in life and win the Riksbank’s Nobel Memorial Prize for economics. No, it is about consciousness. The title of his paper, originally written in German, translates as: “Contributions to the Theory of the Development of Consciousness”. Eventually this evolved into Hayek’s cognitive masterpiece *The Sensory Order* (1952) as well as his development of the idea of distributed knowledge in markets (e.g. 1936, p. 54). Hayek (e.g. 1982)—connecting his cognitive and economic thinking—specifically acknowledged the similarities between mind and market, particularly in terms of complexity.¹⁵ The origin of that complexity? The mind-body problem: “it is the existence of the phenomenal world which is different from the physical world which constitutes the main problem” (1952, p. 28).¹⁶ In simple terms the mind-body problem asks to explain the relationship between matter (i.e. the brain) and mind (i.e.

¹³To the point of raising “The Adam Smith Problem” which (wrongly) suggests Smith’s views in those books are incompatible. For a modern interpretation of morality in markets, see Fourcade and Healy (2007).

¹⁴ For more details see, e.g., “Intersubjectivity and Objectivity in Adam Smith and Edmund Husserl: A Collection of Essays” by Fricke and Føllesdal (eds.; 2012). Indirectly also relevant, for example, for “attention-induced trading” (see section 5).

¹⁵Interpreted in various ways, beyond just complicated.

¹⁶ Descartes is generally credited with originating it via dualism but it is interpreted differently nowadays. Among early thinkers acknowledging its relevance for economics are Hayek, Mises, Smith (e.g. “bodily passions” vs “imaginative passions”), Soddy, and (indirectly) Keynes. More recent reflections include Bryant (2007) and Coates (2012). Bryant further suggests that “individual people interacting together in society, or economy, generate a higher entity”, although he is not “saying that . . . ‘the economy’ has consciousness” (p. 11).

conscious experience). Another way of stating this is how (and why) our physiology gives rise to our psychology, especially its qualities—known as phenomenality—which distinguish experiences. For example, your brain physically processing a 25% drawdown (quantity) in your portfolio is accompanied by the hurt (quality) of that painful loss. How is that quality of experiencing a drawdown related to the neurons that physically carry the signal? Consistent with physicalism, the EMH considers this as epiphenomenal and not relevant. However, if that is the case, then the hurt of pain from a losing trade is causally inert, which contrasts with the reality that it often leads to physical action to close that trade. Somebody who paid attention to hurt, via his famous backpains, is our next key actor.

Roughly forty years later, another student by the name of George Soros, having studied under philosopher Karl Popper, writes his first post-graduation paper. Similarly, it is not about investing for which he would become famous later in life as one of the best investors of all time. No, it is again about consciousness. The revealing title of his paper, “The Burden of Consciousness”, hints at its inspiration from Popper’s own writings on the mind-body problem (1953). Eventually Soros’s reflections would lead him to develop his concept of reflexivity which, as indicated in the subtitle of his bestseller *The Alchemy of Finance* (1987), is about “Reading the Mind of the Market”.

Finally, another forty years later market researchers like Mark Douglas (2000) and Didier Sornette hit the point home with their observations about consciousness in markets: “The global behavior of the market . . . is reminiscent of . . . the emergence of consciousness” (Sornette, 2003, p. 241). However, they did not recognise the importance of this insight and failed to develop it any further.

Meanwhile, in the field of cognitive science two distinguished philosophers co-authored a paper, “The Extended Mind” (Clark and Chalmers, 1998), that has since become a classic. The paper starts with the legendary question: “Where does the mind stop and the rest of the world begin?” Its main argument is that the mind is not bounded by the brain but extends—for example via technologies and other minds—into the world. This emphasis on the bodily, worldly and social basis of cognition—already explored earlier in various Eastern and Western traditions (e.g. Vygotsky, 1962)—has become increasingly influential, developing into an interdisciplinary field of ‘4E’ cognitive science which considers the mind to be embodied, embedded,

enacted, and extended. A key consequence is that this field replaces the computational model of mind with a connectionist view. Interpreted for our purposes, it shifts the focus of understanding mind further away from the outdated hardware/software computer model with a central command executive (i.e. a homunculus) towards that of a cognitive market where values for experienced inner states—like feelings or beliefs—spontaneously fluctuate, with information being dually realised. Among other insights, neuronal noise plays an important role in consciousness (e.g., Dehaene, 2014) and we speculate that, by extension, it may shed a different light on price noise (Schotanus and Schurger, 2020).

These historical anecdotes set the stage for the initial message of this paper: there are profound connections, including similarities, between markets and minds which lead to the Market Mind principle. This reaches far beyond, for example, the rationality of the Rational Expectations Hypothesis (e.g. Muth, 1961) or the biases and heuristics that behavioural economics has highlighted (e.g. Kahneman, 2012). Central is the phenomenon of the market’s mind. Soros is not alone in pointing this out¹⁷. Investors in general have always referred to it in passing in one form or another, including 1920’s old school traders like Humphrey Neill (1931, p. 222), a contemporary of Jesse Livermore. More recent sources include Bruguier et al. (2010), De Martino et al. (2013), Marks (2011), Shermer (2008), Smith (1981), and Thirkell-White (2007). In fact, the presupposition of the market’s mind is implied in any discussion on whether the market is rational or not (e.g. Rubinstein, 2001), let alone whether Mr Market suffers from bipolar disorder (e.g. Cheung, 2010; similarly ‘diagnosed’ by Benjamin Graham).

A growing number of researchers recognise these similarities. As mentioned, some point out that the explanatory relationship can run in the other direction as well, i.e. from markets to minds. For example, Hayek compared neuronal dynamics to “a stock of capital being nourished by inputs and giving a continuous stream of outputs” (1982, p. 291). More generally, “the same kind of regularities which we have learnt to discover in the world around us [e.g. market] are in principle also capable of building

17 Technically, “reading the market’s mind” is an example of Theory of Mind (ToM) whereby one attributes mentality to others. It subsequently can lead to strategies and approaches to events. Keynes’ famous beauty contest (1936, p. 79) belongs in that category. Related is empathy (e.g. Smith, 1759; Cymbalista, 2002).

up an order like that constituting our mind” (1952, p.178). Others (e.g. Ainslie, 2014, p.1; Ainslie, 2007; Glimcher, 2003; Kelso, 1995) also discuss the mind in market terms. Ainslie, for example, talks about a “marketplace in the brain” (2007, p. 16) which is an “internal marketplace” (ibid, p. 18) that establishes “the value of processes that begin and end in the mind” (ibid, p. 20). We also know that parts of our brain (e.g. reptilian complex) cooperate, compete, and exchange with other parts (e.g. mammalian neocortex).

Specifically, there is competition for (visual) attention (e.g. Beck and Kastner, 2009). Then there is the brain’s reward system (e.g. valuing outcomes versus expectations) which operates like a market via the exchange of dopamine, endorphins, oxytocin, serotonin, etc. whereby perception is the consensus outcome. Structurally, some neurons are dominant, running a monopoly, while elsewhere the neuronal markets are more diverse. In fascinating research, Vértés and her colleagues take this to a higher level when they compare time series of stock prices with fMRI brain data. They conclude that “the conceptual connections between brains and markets are not merely metaphorical; rather these two information processing systems can be rigorously compared” and “share important topological properties” (Vértés et al., 2011, p. 1). These insights and ongoing research are to be welcomed within cognitive science:

Neuroscience is shot through with familiar economic language—delegation, division of labor, constraint, coordination, executive function—but these concepts are not formalized in neuroscience as they are in economics. There is no overall theory of how the brain allocates resources . . . An “economic model of the brain” could help here. (Camerer et al. 2005, p. 56)

I agree. However, Camerer and colleagues fail to highlight the reason why economic and investment language appears so prominent in cognitive science: because we experience our mind as a market. Upon reflection we describe internal market dynamics (using economic vocabulary) because that’s *what it is like*, varying from your constrained memory to your emotions competing with your reason. The latter makes you tired due to “control cost inflation” relating to “the necessity of recycling potentially toxic substances” in the brain “accumulated during cognitive control exertion” (Wiehler et al., 2022, p. 1). The flipside is your intuition cooperating with your logic. Another example is dividing labour between action and perception during

predictive processing (e.g. Constant et al., 2020). Or valuation within the mind-as-market, whereby any mental “object” of attention, “which is characterized by its separation from the subject, who at the same time establishes it and seeks to overcome it by his desire, *is for us a value*. The moment of enjoyment itself, when the *separation* of subject and object *is effaced, consumes the value*” (Simmel, 1978, p. 63; emphasis added). In philosophy, value-driven epistemology (e.g. Kvanig, 2003; Pritchard, 2007) considers knowledge as “epistemic goods”, to be valued versus other such goods, like beliefs. Also following Ainslie, this is echoed by economists Bénabou and Tirole who discuss valuation of “beliefs as regular economic goods and assets—which people *consume, invest in, reap returns from, and produce*, using the informational inputs they receive or have access to” (2016, p. 143).

As an interim summary, the Market Mind principle—intelligent self-organisation via market dynamics—underlies both minds and markets. Specifically, in terms of extended cognition (see section 6.1) it spins—what became known as—Clark and Chalmers’ parity principle (1998, p. 8) into the following: market dynamics (see p. 2 for examples) are the processes that are universal and shared between minds and markets. They reflexively take place in both, meaning minds and markets influence each other via these shared forces. Ultimately this could result, for example, in market-mind correlates whereby a group’s joint gazing at the oscillations of prices increases the (induced) inter-brain oscillatory synchronization of that group (see Section 7.1).

Research elsewhere, particularly in biology, shows that the Market Mind principle occurs more widely. For example, in terms of the ‘economics of the mind-body’, whereas the mind allocates across mental capital, the body allocates across bodily resources, e.g. for its metabolism. Think, for example, of the millions of bacteria and other microorganisms who compete and cooperate, consume and produce, exchange or act otherwise as “agents” within your own ‘internal markets’. For bacteria more general, scientists are now able to reprogram their DNA to create microbial factories capable of making novel products—like drugs or recyclable materials—that are not available in other ways. We know that mitochondria compete, cooperate, and exchange, both within and between cells. Cells themselves are basically miniature chemical factories that help organisms exchange and transform resources. Cancer research (Folkman, 1971) has shown that the development in

tumours largely depends on the demand and supply of chemicals that promote, respectively inhibit blood vessel growth. On a larger scale, research headed by biologist Michael Levin (Gawne et al., 2020) shows that bodily parts compete and cooperate for metabolic and informational resources. The emerging field of Basal Cognition (e.g. Lyon et al., 2021) studies whether any intelligence is involved in this. Other research by Levin's team focuses on so-called xenobots acting as basic minds. Should it offer similar insights, it would further underline the universality of this principle. Earlier Ben-Jacob (1998) discussed how competition and cooperation leads to "bacterial wisdom" and a "super mind" of the genomic web. Chromosomes exchange chunks of themselves, in the process sharing (DNA) information. Together they form biological 'portfolios', optimised for 'evolutionary outperformance' and contributing to 'innovation' and 'diversification' in the biological 'market'. Considering market principles underlying intelligent coordination among collectives higher up in the animal kingdom, a recent special edition published by The Royal Society (Addessi et al., 2022) discusses "Existence and prevalence of economic behaviours among non-human primates", with an introduction by biologist Frans de Waal. As an aside, this obviously negates one of Adam Smith's legendary statements in WN: "Man is an animal that makes bargains: no other animal does this".

The general link between biology and economics goes back to the founders of classical economics, like Hume, Mill, Ricardo, and Smith. It specifically led to the idea of the 'economy of nature' (a term also used by Darwin), suggesting that biology supervenes on economics. Gould, for example, acknowledged this when he argued that natural selection "is, in essence, Adam Smith's economics transferred to nature Reproductive success becomes analogues to profit" (2002, p. 122; see also McCloskey, 1983, p. 487).¹⁸ Keynes agreed: "the economic problem, the struggle of subsistence, always has been the most pressing problem . . . not only of the human race, but of the whole of the biological kingdom from the beginnings of life in its most primitive forms" (1930, p. 361).

This concludes the historical background. The next section will discuss the paper's motivation and purpose.

¹⁸ Still, this is not simply about Smith's "invisible hand". Although I can't go into it here, reproduction can be viewed in terms of Smith's "sympathy" (1759).

4. Motivation and purpose

The motivation to write this primer is manifold but mainly driven by the ongoing debate—led by initiatives like the Institute for New Economic Thinking (INET) and Rethinking Economics—on the need and urgency to change economics. This debate is particularly required in light of (the lingering effects of) the Global Financial Crisis (GFC), the Corona/Covid Virus Crisis (CVC), as well as the challenges offered/tackled by investing according to ESG—Environmental, Social, and Governance—criteria. For example, the GFC showed that what seems ‘rational’ for an individual—e.g. exiting a portfolio holding—can be dangerously irrational if done collectively, which challenges the REH.

To wit, “how did economists get it so wrong?” asked Krugman (2009). Kay (2011) summarised his FT columns, criticising mainstream economics, in a target article for INET which triggered various comments. Wolf admitted that mainstream economics “needs rebuilding” because it does “not fully understand the economic dynamics” (2018). Implicitly criticising its dogmatism, Summers emphasised that “something is wrong with the economics profession if the events of 2008 do not change its thinking” (2018). Discussing policymaking, Haldane wondered earlier “[i]f a once-in-a-lifetime crisis is not able to deliver that change, it is not clear what will” (2012). Well, we just had our second-in-a-lifetime crisis exposing, with a morbid symbolism, the weaknesses of the economic mind-body, including breakdowns in communication, failure of institutions, and strained supply chains. These are begging for answers that go beyond just throwing money (i.e. more debt) at it. For many investors it’s not just surreal negative yields and oil prices that beggar mainstream economic beliefs.

Rather the GFC and the CVC are loud wake-up calls about our unhealthy economic mind-body which was vulnerable long before corona struck. It should worry economists and non-economists alike. They make painfully clear that the economic system affects everybody, to the point of financial Armageddon—first via Lehman’s collapse in 2008, followed by the ‘stealthier’ repo-crisis of late 2019-early

2020.¹⁹ Elsewhere I have called them existential reality checks (e.g. Schotanus, 2014; Schotanus, 2020). They are symptomatic of our wider predicament.

As a young student myself I had the pleasure and privilege to intern with the late Willis Harman, who was professor emeritus at Stanford, a cognitive pioneer and one of the original futurists. Based on research that started in the seventies, summarised in his 1988 book *Global Mind Change*, Harman presciently identified four major challenges the world would (increasingly) face:

1. Environmental sustainability (i.e. biodiversity, climate change, deforestation, pollution, etc.)
2. Inequality (i.e. the “equity and justice challenge” as he called it, but more nuanced than today’s excessive wokeism).
3. Marginalisation (i.e. non-inclusion, populism versus globalisation; think also Raghuram Rajan’s *The Third Pillar*).
4. Worldview challenge (i.e. inaccurate economic thinking).

The fourth challenge plays a key role because a worldview (or paradigm) frames and thus determines how we economically deal with the other challenges, for example via ESG investing. Importantly, the fact that the current worldview led to “the successes in achieving the goals of the existing order” shows “how profound the required changes may be” (Harman, 1988, p. 151) now that the other challenges—as unintended consequences—threaten to overwhelm those successes.

In fact, their continued deterioration over the past decades despite growing awareness—combined with systemic financial instability—should raise red flags that something more fundamental is wrong, which points back to the fourth challenge. Simply shifting from monetary easing to fiscal expansion—aka Modern Monetary Theory (MMT)—is thus not the change in thinking we need. And running yet another regression or identifying the 368th behavioural bias, with all due respect, won’t help much either.

Instead, this is about economics’s fundamentals in the truest sense—like epistemology, methodology, and ontology—which brings us to the purpose of this

¹⁹ Arguably preceded by the 1998 crisis involving the hedge fund Long Term Capital Management (LTCM). Similarly, there is anecdotal evidence that the GameStop saga could have turned systematic, due to the exposure by clearing houses.

primer. Crucially, cognitive science offers the expertise to address economics at those fundamentals—including Soddy’s metaphysics. This particularly applies to the relationship between the market’s mind and the real physical economy which showed a dangerous tail-wagging-the-dog dynamic during the systemic crises. It made many experts conclude that this mind-matter interaction is a key lesson. For example, Nobel laureates George Akerlof and Robert Shiller—like Keynes, inspired by the implied dualism of animal spirits—recognised that “[w]e will never really understand important economic events unless we confront the fact that *their causes are largely mental in nature*” (2009, p. 1; emphasis added). As explained elsewhere (e.g. Schotanus et al., 2020), this is primarily about market prices—as concentrated mentality—affecting the real economy.²⁰ It is economics’s version of the general “claim that something abstract—something non-physical, such as the knowledge in [e.g. prices] . . . —is affecting something physical” (Deutsch, 2011, p. 114).

Here we get into the nitty-gritty of things. While it is acknowledged, for example, that will power contributes to reshaping the brain—thanks to its neuroplasticity—and psychological stress can impact physical health (studied as psychoneuroimmunology) mental (or downward) causation remains a complex and contentious topic in cognitive science (e.g. Batthyány, 2009; Heil and Mele, 1993; Velmans, 2002). Specifically, the terms “causality” and “causation” are considered as slightly misleading. Some completely dismiss it by arguing the principle of physical causal closure (e.g. Kim, 2011, pp. 112-113). Others prefer to think of it as impact or influence, affecting conditions.²¹ In short, casually assuming, implying or stating mental causation often underestimates the complications involved which ultimately are all part of the mind-body problem and require cognitive explanations. Our collective version of this problem is prevalent in the economic system (Section 7).

To start fleshing this out, the next section will discuss, from this particular angle, what is wrong with the current paradigm of mechanical economics.

²⁰ Regarding prices in the real economy, economists generally assume that inflation expectations can cause actual inflation (e.g. Friedman, 1968; Phelps, 1967; but see Rudd, 2021).

²¹ This is echoed by others outside cognitive science. Mises, for example, argues that it is about “purpose and of conscious aiming at ends”. This relates it to free will (e.g. Schurger, 2017; see also “A Famous Argument Against Free Will Has Been Debunked” in *The Atlantic*, 10/9/2019).

5. Mechanical economics and its flawed worldview

In his 1976 reflections on Adam Smith, George Stigler listed some of his failures, defining the latter as presenting a “mistaken view of the world”. I will similarly point to contemporary economics’s own key failure and flawed worldview. In terms of style, I very much wrote this section as a devil’s advocate, explaining topics in black-and-white terms to get my points across.²²

With this caveat, mainstream economics—at least how many see it—is basically a partnering of the unlikely bedfellows of new classical and Keynesian economics. Largely in agreement with, especially, Frydman and Goldberg (2011) but also other critics—like Bookstaber (2017), Derman (2011), Kay (2011), Keen (2011), Lawson (2015), Romer (2015), and, much earlier, Hayek, Mises, and Robinson—I like to refer to it as mechanical economics. Specifically, it has a mechanical worldview which (ontologically) considers the economy *to be* a machine, the market *to be* an automaton, and humans *to be* robots. Notoriously, Nobel laureate Robert Lucas put it this way:

[Economics is] something that can be put on a computer and run. This is what I mean by the ‘mechanics’ of economic development—the construction of a mechanistic, artificial world, populated by the interacting robots that economics typically studies . . . (1988, p. 5; emphasis added)

The disastrous consequences of exercising this worldview—in this case, turning Mr Market into an actual automaton—is well captured by tech expert Tim O’Reilly²³:

We are already in the thrall of a vast, world-spanning machine that, due to errors in its foundational programming, has developed a disdain for human beings [and] is working to make them irrelevant . . . We are engaged in a battle for the soul of this machine, and we are losing. I’m talking about . . . “the market” (2017, pp. 231-232; emphasis added)

Elsewhere (e.g. Schotanus et al., 2020) we explain the historic background of this

²² I hope this does not put off economic readers. To nuance, based on my own experience, I know that the discipline is capable of introspection, self-criticism, renewal, etc. In fact, I hope this paper—while occasionally strongly worded—will help those attempting to improve economics with formulating their own criticisms. I particularly welcome cognitive contributions on the real economy to complement those on the financial economy which is the natural focus of the MMH.

²³ See also, e.g., Castells (2000).

worldview—what Knight called “mechanistic monism” (1925b, p. 251)—in terms of its ‘exact-science’ premise: objectivism, positivism, and reductionism which promote separation (e.g. brain/world²⁴, man/nature, observer/observed, subject/object, quantity/quality, etc.) It particularly resulted in an unrealistic degradation of human mentality whereby consciousness is ignored (which is the deeper meaning of mechanical: without consciousness; see especially Harman, 1994, p. 10; Knight, 1925b, p. 248). Among economists, McCloskey (1985), for example, provided her interpretation of this premise (“modernism”) and criticised mainstream economics’s unequivocal adoption of it, as did Hayek via his “scientism” label. His criticism applies here, for example: “The methodologies used in aerospace engineering and macroeconomics to make quantitative predictions are remarkably similar now that *macroeconomics has developed into a hard science*” (Prescott and Candler, 2008, p. 1; emphasis added). Its adoption is motivated by “physics envy” (e.g. Lo and Mueller, 2010) and embeds an implied form of physicalism.²⁵ Finally, and important for making my cognitive case, even behavioural economics subscribes to it:

[B]ehavioral economists, despite their critique of rational market models as lacking psychological realism, also presume that irrational individuals’ decisions, and their implications for asset prices and risk, can be adequately portrayed with *mechanical rules* . . . Moreover, the social context within which individuals make decisions—including economic policies . . . —is also supposed to unfold in ways that can be adequately portrayed with *prespecified mechanical rules*. (Frydman and Goldberg, 2011, p. 3)

This flawed worldview ignores the fact that humans have a biological substrate with an embodied conscious mind that extends into real and financial markets (see next section). Worse, it also has the implicit assumption that such mechanical entities—in case they don’t run smoothly (i.e. show ‘disequilibrium’)—can be calibrated, fixed, nudged, optimised, tweaked, etc. by pulling a handle here,

²⁴ We experience the world through the (sometimes illusory) veil of our senses. Physically separated by the skull, the brain is only indirectly in contact with the world, for example via auditory and visual signals. In short, there is no ‘hot line’ between brain and world. However, and as aforementioned (e.g. the embodied mind), this does not mean that there is a clear boundary between mind and world.

²⁵ In that light, it is more than ironic that mechanical economics’s push for dominance particularly gained momentum after the *separation* of money from its original physical anchor when the gold standard was abolished in 1971. Physicalism is closely associated with materialism (see also 6.2). No wonder current economics shows ‘materialistic’ tendencies.

pushing a button there, and turning the knob in the middle. Alternatively, they can simply be replaced or removed.

Not surprisingly, it is consequently coloured by automation bias which translates into over-reliance on (the wrong) mathematical models (including [AI-]algorithms), overconfidence in engineering (including design), and an obsession with control (including intervention, litigation, and/or manipulation). Knight bluntly states what is involved: “the effort to ‘control’ people takes the form in large measure of an effort to deceive, to ‘fool’ them; the prime requisite is to keep them from *knowing* the character of the relation actually aimed at” (1925b, p. 260; emphasis in original). Regarding intervention—and to prevent any potential confusion—even if the Chicago-School section of mechanical economics argues to leave the automaton alone, that doesn’t mean that (particularly powerful) market participants or policy makers will.²⁶ On the contrary, the underlying belief of dealing with (‘merely’) a machine encourages tweaks and other interferences to ‘revalue’ in the eye of the dominating beholder, often (falsely) under the banner of normative economics, e.g. ‘We should do something!’.²⁷ Chicago’s predetermined knowledge, in that case, gets replaced by the (pretended) omniscience of the central planner (or market-maker, or monopolist)—Smith’s “man of system” (1759, p. 275)—piggybacked by uncritical investors. I will next highlight three areas where mechanical economics turns into such dubious practice.

First, mechanical thinking is popular among—often more Keynesian minded—policymakers who think that, with help of their (DSGE/IS-LM/etc.) models, they can steer the economic system. For example, former Fed Chair Janet Yellen believes monetary policy is like driving a car: “Right now our foot is still pressing on the gas pedal . . . Our foot remains on the pedal so that we can make sure economic expansion remains strong enough to withstand an unexpected shock” (2017). Central bank policies more generally are based on erroneously assumed transmission

²⁶ “Markets weed out inefficient practices, but only when no one has sufficient power to manipulate them” (Chang, 2010, p. 156). For example, TBTF banks massively manipulated markets, processes, and products around the GFC. On HFT-manipulation see Lewis (2014). Another example is non-market-based economies, including those run by totalitarian regimes, not just free-riding but parasitising free global markets. On central planning more generally, think Campbell’s law.

²⁷ Like raising rates during the Great Depression and bailouts during the GFC. Yes, I’m channelling Anna Schwartz here in light of her 2008 criticism of the Fed, e.g. “firms that made wrong decisions should fail”.

'mechanisms'. Then there were the lockdowns during the CVC whereby it was assumed that governments could simply shut down their economies—just like machines—and turn them back on without any consequences. These all seem to ignore Goodhart's Law which states that measures to control the economy will turn unreliable once targets (e.g. "2% inflation", "Zero-Covid", "10Y yield pegged at 0%", etc.) are set.

The extreme nature of central-bank-cum-government intervention—to the point of financial repression—and the resulting distortion of prices plus likely misallocation has been covered widely. Already back in 2012 it was admitted as such by Jerome Powell, the current Fed Chair, and his words seems particularly relevant for the current climate of rising rates:

I think we are actually at a point of encouraging risk-taking, and that should give us pause. Investors really do understand now that we will be there to prevent serious losses. It is not that it is easy for them to make money but that they have every incentive to take more risk, and they are doing so. Meanwhile, we look like we are blowing a fixed-income duration bubble right across the credit spectrum that will result in big losses when rates come up down the road. You can almost say that that is our strategy. (Minutes Meeting Federal Reserve, October 2012).

I will not discuss this further except to say that the Market Mind—on cognitive grounds, e.g. via the dismissal of homunculi—rejects such knowledge by central authority (see also Section 6.1).

Second, the mechanical view is held by many investors (e.g. Dalio, 2015), with Wall Street supplying the engineering tools. Known as modern finance, it is increasingly applied via mechanical investing whose origins go back to crude strategies, like portfolio insurance that contributed to the 1987 crash. Nowadays this includes, for example, passive investing (inspired by the Efficient Market Hypothesis or EMH), electronic market making (e.g. high-frequency trading or HFT), robo advisors, structured derivatives (e.g. CDO/CLO), and automated trend-following (e.g. CTA) approaches. The amount of assets controlled by such strategies has grown significantly, a trend that is expected to continue (e.g. their latest encroachment is in the oil market; see Tett, 2022). Advocates argue this is justified by low-cost access/liquidity, relative performance, and other 'benefits'. Unfortunately, modern finance is—like mechanical economics generally—absurdly quantitative and,

according to Das (2010), “incomprehensible to ordinary men and women”. Echoing but more cynical than Knight’s earlier critique, he states that it is “probably designed that way. Like the wolf in the fairy tale: ‘All the better to fleece you with’”. A serious problem is that many mechanical investment strategies only use internal market data (e.g. market capitalisation; bid/ask; momentum) for their trading without reference to the fundamentals that determine asset values. Among others, it leads to mindless investing, something Michael Lewis thinks is positive: “the index fund had this other knock-on effect in the value it had for people’s lives because they could just stop thinking about this stuff. Instead of checking my portfolio five times a day and thinking about what I should do I don’t think about it” (Balchunas, 2022, p. 95). Consequently, as they become dominant Mr Market turns inside himself, as it were, caring less about the economy (or the world for that matter). Stated differently, and keeping Hayek’s arguments of distributed local knowledge in mind: any trickle down of fundamental news via (assumed) information efficiency is substantially diminished—if it occurs at all. Crowded inward-looking strategies as well as the related concentrations in wealth, market making, etc.—which privatise information and further decrease the number of independently conscious market participants—lead to an unhealthy narrow-mindedness in Mr Market, with knowledge and awareness not sufficiently distributed. In terms of complex adaptive systems, the market mind cannot generate the internal endogenous surprises (insights) required to adapt to the external surprises (shocks).

Finally, its corporate embrace—via obsessive control of some ‘moat’—results in the elimination of competition which is manifested in (state) monopolies and other forms of market dominance, often helped by cronyism. This has been spreading into many industries, with Too-Big-To-Care banks and technology giants as poster boys. Let’s call it “The Big 3 in Everything” which risks corporatocracy. Combined with similarly ‘big’ challenges we face (e.g. those mentioned in section 4), Schumacher’s *Small is Beautiful: A Study of Economics As If People Mattered* (1973) comes to mind as one antidote. Related are a number of worries, varying from diminished productivity (e.g. due to perverse incentives; Smithers, 2015), via lack of innovation (e.g. Gordon, 2012; Bloom et al., 2020) to growing concentrations of wealth (e.g. via debt-funded buy-backs).

I highlight these areas because that's when the problems start: when mechanical economics's view turns into machinations—actual treatments, or rather mistreatments. This goes beyond what performativity has raised, for example (e.g. MacKenzie, 2008). What is namely less well understood is the deeper cognitive impact of treating the economy as a machine, Mr Market as an automaton, and humans as robots. In my conclusion (section 8) I call this a form of iatrogenesis: weakening the health of the economic mind-body by (mechanical) mistreatment. The issue is nowadays more serious, but not new. Simon already warned decades ago that an increasingly mechanised economy produces “an overabundance of information” which “creates a poverty of attention”, whereby we struggle “to allocate that attention efficiently” (1971, p. 41). Developments, varying from AI-driven social media distractions to attention-induced trading of meme or “lottery” stocks (Bali et al., 2021; Barber et al., 2020), have since only upped the ante in our age of big market data.

It's important to recognise that the mechanical worldview acts like a contagious virus whereby mechanisation begets mechanisation: it invites and promotes mechanistic policies, practices, and products in a biased self-reinforcing loop. For example, AI requires more and more data which, in turn, requires more automation to collect, distribute, and store it, etc. The latest instalments include AI-driven mechanisms to expand and protect economic and political moats of all shapes and forms, often at all costs. Instead of being disruptive these technologies strengthen the status-quo. This concern doesn't turn the MMH into some kind of Luddite theory: 4E cognition has a generally benign view of AI (including machine-learning), quantum computing, and other technologies in that they could potentially augment and form beneficial extensions of our minds (see, e.g., Chrisley, 2009 and Clark, 2003). A recent example is DeepMind's AlphaFold which can help to better understand proteins. And most of us developing the MMH are excited about the potential of digitalisation to decentralise and disintermediate (e.g. via blockchains).

However, technology is not naturally neutral.²⁸ The risk is that automation bias morphs into an automation paradox characterised by reliance on an elite of expert-owners-cum-social-engineers (see also, e.g., Zuboff, 2019). The consequences could reach far, for example worsening marginalisation. Moreover, if run

²⁸ For a deep dive, see “The Question Concerning Technology” by Heidegger (1977).

autonomously, the algorithms involved form part of the growing cognitive nonconscious—also known as technological unconscious—which has major implications for our own mentality. In discussing HFT and other applications Katherine Hayles, doyen of posthuman studies, is troubled by its:

pervasiveness and computational potential, and its ability to pose new kinds of challenges not just to rationality but *to consciousness in general*, including the experience of selfhood, the power of reason, and the evolutionary costs and systemic blindnesses of consciousness. (2014, p. 199; emphasis added)

In a recent special in the FT (Thornhill, 2020), Shannon Vallor—an expert on AI and ethics—warned that the concern should not be that AI is becoming too human but that humans are more and more behaving artificially, forced to adapt to the (e.g. social media) algorithms.²⁹

Most importantly, cognitive science tells us that there is nothing mechanical about consciousness itself. Its phenomenality enriches our explorations, intrinsically motivating us. For example, in making predictions: “prediction is a [conscious] interest on its own account. *We like* to predict, entirely aside from the utilitarian motive of prediction for the sake of control . . . a kind of curiosity seems, like irritability, to be an ultimate property of living matter; it is explorative” (Knight, 1925b, p. 256, 257). In the process, instead of mechanical, consciousness secures adaptability and spontaneity by realising endogenous novelty, starting with two simple and related facts. First, it is a person’s consciousness (i.e. subjectivity) that makes each human being unique. Second, each experience is unique, with insight—the Aha sensation in the eureka moment of gaining new knowledge—being of the exceptional kind (e.g. Kounios and Beeman, 2015; Klein, 2013; Harman and Rheingold, 1984). I call them internal surprises, if only because their content, let alone timing, cannot be predicted. They are non-routine changes in mentality which sometimes lead to shifts in paradigms (Kuhn, 1962). Also, in our attempt to adapt and solve problems we seem eager to seek insights. In fact, Deco and Kringelbach echo the Market Mind principle (2020, p. 1) and argue that our ‘noisy’ brains value

²⁹ Combined with hardware (e.g. smart phones) this expanded ‘brain’ is known as the “exo-cortex”, the technological extension of our minds by way of devices. Again, problem being that it is increasingly controlled by tech giants.

nonequilibrium. Viewed in extended mind terms, this clearly is an implicit challenge to mechanical economics's equilibrium.

Overall, such novelty is crucial for our cognition in general and economic discovery in particular. After all, society's discovery process via the economic system forms a reflexive chain. Simplified, it starts with an insight of a scientist/inventor, which is subsequently turned into an innovation by an entrepreneur, and then culminates in its valuation (and reflexively back into funding) via price discovery in the market. Price discovery is crucial for our collective attempt to understand and adapt to the world, i.e. bridge our mentality with its physicality.³⁰ At the same time, it is a delicate process and interference has damaged it.

Arguably, markets have always been interfered with. Criticism of 'free markets' being 'part of the problem' is thus a straw man: they never existed in the first place.³¹ Unfortunately, interference is now occurring at an industrial scale, while its consequences have become systemic. Beyond interference, as I have just explained, mechanical economics weakened the economic mind-body more widely. Instead of adaptable, spontaneous and resilient, it has become ill (e.g. debt-addicted) and vulnerable (e.g. awareness-loss). In short, mechanical economics is the virus that struck long before corona did.

Fortunately, there is a vaccine.

6. The MMH: standard-bearer of cognitive economics

Earlier references to consciousness and the market's mind offer an entry into the libraries of cognitive science to push cognitive economics to its natural limits (and lead behavioural economics to its logical conclusion). While the premise of the MMH is two-way, here I will only focus on the market-as-mind, instantiated by socio-technological symbiosis.

³⁰ Ultimately, our demands and supplies are largely exogenously determined by nature's physical demands (e.g. terrain, weather), respectively the supplies it offers (e.g. radiation, sweet water). In relative terms, our forefathers passively accepted this. However, over time and with growing cognition humans (e.g. via markets) started to actively change those balances (to the point of ruining nature or escaping via virtual worlds). Related, for example, is Predictive Processing (e.g. Constant et al., 2020).

³¹ There are many interesting asides to this, especially regarding the Market Mind principle, e.g. along the lines of Ayn Rand's statement that "Intellectual freedom cannot exist without . . . economic freedom; a free mind and a free market are corollaries." I will not discuss these here.

Specifically, the MMH turns the idea of the market’s mind, expressed by numerous investors through time, into a thesis (e.g. Schotanus, 2014 and 2016). More generally, it offers a psychophysical worldview with a mind-body perspective of the economic system, rather than that of a machine. Formally, the MMH states that the market, by embodying interacting investors and their technologies, not only distributes³² and shares their knowledge but also intersubjectively extends their conscious minds, manifesting collective consciousness. Prices and their patterns are its informational signatures, while market mood—varying between depression (despair) and mania (exuberance)—is its phenomenal experience (via sentience) in real time. As I’ll discuss, as part of price discovery mood is crucial since it precedes any rationality. How else can you rationally adjust your expectations (according to the REH), respectively change your “System 2” thinking (which is slow, according to behavioural economics) if you have not consciously (i.e. dually) realised information as novelty, i.e. as insight?³³

In sum, and translated in popular terms, Mr Market is not a voting or weighing machine but a collective entity with a mind—warts and all. This is how many participants always viewed market reality:

You know it’s an invisible hand. The market is . . . a lifeform that has being in its own right. You know, in a sort of Gestalt sort of way . . . it has form and meaning . . . a greater being. (Knorr Cetina, 2003, p.12).

Again, the MMH sets out formalising this backed by cognitive science.

6.1 The MMH via 4E cognition

The particular cognitive perspective backing the MMH is called 4E cognition (e.g. Menary, 2010-i; Newen et al., 2018; Rowlands, 2010; Ward and Stapleton, 2011).

Specifically, per 4E cognition the individual mind is:

- ✓ Embodied, meaning that the purpose and significance of psychological states is grounded in properties of the whole embodied organism, not just the states and properties of its brain (e.g. Varela et al., 1993). For example, the gut

³² For example, per Hayek (1945). A somewhat related modern term is crowdsourcing.

³³ Using default interpretations, notice the inconsistency between these mechanical views: rationality’s immediate discounting (as assumed by mechanical economics, e.g. the EMH) and rationality’s slowness (as assumed by behavioural economics, i.e. “thinking slow” via “System 2”).

contains millions of neurons and is connected via the nervous system to the brain. Another example is the way in which bodily gestures both help constitute the meaning of speech, and feed back into the cognitive capacities of the cognizer (e.g. Clark, 2011, Sections 6.7-6.9). A more pertinent example is Soros's famous back-pains which—acting as warnings—supported his decision-making (e.g. Cymbalista, 2002).

- ✓ Embedded, meaning that mind is situated in and influenced by its environment (e.g. Clark, 1997). An example is the role of culture and institutions—including their biases, habits, laws, and rules—in shaping the kinds of cognitive capacities available to human agents. Hayek, for example, stated that “[m]ind and culture developed concurrently and not successively” (1979, p. 156).
- ✓ Enacted (or enactive), meaning that mind emerges from patterns of (physical) interaction with the world (e.g. Stewart et al., 2014; Ward et al., 2017), not just neuronal processes. In one respect, the wish to act in or upon the world often comes from an uneasiness or dissatisfaction with its existing state. Mind (e.g. building architectural knowledge) and world (e.g. building physical structures) are then influenced by the form such action takes (e.g. design). Enacted cognition provides a lens through which we might better understand, for example, Mises's “purposeful action”.
- ✓ Extended, meaning that, first, the physical basis of psychological states can extend beyond the brain to encompass, for example, worldly structures—the artefacts, technologies, and tools with which embodied agents couple in order to get the cognitive job done (e.g. Clark and Chalmers, 1998; Menary, 2010-ii). Moreover, extension particularly involves other minds via social structures, resulting in collective intentionality (e.g. Tuomela, 1991), distributed cognition (e.g. Huebner, 2014; Merritt and Varga, 2013; Palermos, 2016), extended affectivity (e.g. Colombetti and Roberts, 2014), and social phenomenality (Szanto and Moran, 2016), to the point of extended/collective consciousness (e.g. Mathiesen, 2005; Overgaard and Salice, 2019; Pacherie,

2017; Schwitzgebel, 2015; Valencia and Froese, 2020; Vold, 2015)³⁴.

This last “E” is the most important for our purposes, especially in light of market mood. To get the key argument regarding extended consciousness, consider the following:

The position we defend here is that the mind has no fixed boundary. The locus of conscious experience can smoothly shift from on occasions being inside of the head of the individual to on other occasions forming out of a nexus of interactions between brain, body, and environment. (Kirchhoff and Kiverstein, 2019, p. 1)

When that “nexus of interactions” includes other people, the resultant conscious experience depends on the states of more than one embodied agent, and in this sense becomes shared, i.e. intersubjective: “The intersubjective is something that exists within the communication network [e.g. the market] *linking the subjective consciousness of many individuals*” (Harari, 2014, p. 117; emphasis added). Moreover, “if there is no such thing as group consciousness, then we cannot literally ascribe beliefs to groups” (Overgaard and Salice, 2019, p. 1).

The results of psychological states that extend beyond individuals and into groups can be worrying. For example, burn-out can be contagious (e.g. González-Morales et al., 2012). Results can even be counter intuitive. For example, “a group can in principle believe that p even though everyone in it personally believes the opposite” (Gilbert, 1987, p. 201). As I’ll discuss in more detail below, this also relates to market mood which can overwhelm any individual investor mood, e.g. despite being bearish you are stunned by the mania of the market.

More generally, the other “E”s above can be applied to the collective level, in our case the market’s mind. In other words, the market’s mind is:

- ✓ Embodied: its mentalities essentially depend on the physical structures—including human bodies, buildings, IT, and screens—in which it is embodied. The felt quality of disappearing liquidity, for example, cannot be divorced from key bodily parts—the financial system’s plumbing, including (physical)

³⁴ Much earlier, pioneers like Durkheim, Husserl, Merleau-Ponty, Nietzsche, Plato, and Teilhard, while representing different view-points, discussed the collective aspect of mind and consciousness. More controversially, Le Bon and Jung pointed to the collective dimension of the unconscious.

collateral chains—freezing up. More generally, as Charles Schwab’s chief investment strategist states, “[t]he plumbing system that connects QE (or QT) to asset prices is indirect and complex . . . [while] the psychological system connecting them tends to be more direct” (Sonders, 2021). In (Schotanus, 2014) I discuss in more detail the market’s body.

- ✓ Embedded: its mental efforts are situated in the wider economic environment, including its cultural traditions, legal/regulatory/tax frameworks and rules of engagement (e.g. Granovetter, 1985; Clark, 1996). In cognitive terms, its environment provides the market “affordances” (Gibson, 1979), which can be constraining, liberating, protecting, etc. For example, it forbids to trade on inside information. On the other hand, as previously mentioned, market interference, to the point of manipulation, means that criticism of ‘free’ markets falls flat.
- ✓ Enacted: its states lead to changes in the world that both shape and are channelled by existing transmission structures—for example the design of market (micro)structure, processes, and products. History is full of stories how, consequently, Mr Market changed our wider economic setting (e.g. Bernstein, 1998). Two examples along the psychophysical scale are risk sharing (i.e. hedging) via derivatives at the psychological end and funding for infrastructure—like rail roads and residential housing—at the physical end. Such market-induced changes in the world feed back into market activity, in an example of the kind of reciprocal, circular causality emphasised by enactive approaches to the mind. See also Gallagher et al. (2019).
- ✓ Extended: the market’s mind is the composite of our own extended minds, supported by advanced and extensive technologies. This results in supercharged and supersized “active externalism” (Clark and Chalmers, 1998, p. 7): it extends to the wider real economy in support of collectively adapting to states of the world. The market’s mind is basically economics’s modern update of earlier reflections on group minds, particularly the arguments provided by Smith, Hayek, and other pioneers of distributed cognition. The MMH adds that it is unrealistic to place the boundary of such extension at the frontier of consciousness, let alone the skull. In other words, cognitive extension includes consciousness by way of intersubjectivity. In markets this

is primarily manifested via market mood which I will discuss in the context of economics's hard problem in Section 7.

Importantly, we can judge markets' collective agencies properly when we understand that

both the agency of the components, and the agency of the collective are spectra, and both will differ individually not only along the dimensions of individuality, interactional asymmetry, and normativity but also through time. (Stapleton and Froese, 2015)

A final take-away is to repeat and emphasise that cognitive science has dismissed the homunculus. In other words, minds have no use for any central executive and the Market Mind, in that regard, rejects knowledge by authority or design. It makes central planning—to coordinate the collective economic mind from the top-down—dubious to say the least.

6.2 The MMH's metaphysical stance

As if to summarise all criticisms of mechanical economics, Soros states that it “provides a distorted picture of reality” (1994). Metaphysics is the field that deals with the nature of reality, especially the question whether something is (perceived as) material or mental. There are a number of metaphysical stances but here I will limit it to physicalism and dualism. The former considers only the material to be real, whereas the latter considers both the material and the mental to be real.³⁵

In our economic narratives and encounters most of us make distinctions between the material and mental all the time (even though we are not aware of simultaneously taking a metaphysical stance): the physical economy versus the psychological markets, the industrial/manufacturing economy versus the experience/knowledge economy, physical versus intellectual property, fiat money versus gold, tangible assets versus intangibles, etc.³⁶ Part of this is explained by the

³⁵ Formally, physicalism states that all of our reality is physical and nature is what physics is about, i.e. physics can fully explain nature. Other metaphysical stances include emergentism, idealism, materialism (similar to physicalism), and panpsychism. The latter arguably offers a potential alternative metaphysical stance for the MMH, but I won't discuss it here.

³⁶ Bank of America recently estimated that, as a percentage of total assets, intangible assets of S&P500 companies have roughly grown from 17% in 1975 to 85% currently. Besides Hayek, people like Peter Drucker and Fritz Machlup contributed to understanding (distributed) knowledge in the economy.

fact that our needs or wants—for example based on Maslow’s (pyramid) hierarchy—vary from physiological (e.g. satisfied by food and shelter) to phenomenological (e.g. satisfied by self-actualisation and enlightenment). Even if academics think of themselves as physicalists, this makes most of us ‘agents’ closet dualists which—via the related beliefs, perceptions, etc.—has a few consequences. First, this dualist majority ‘votes in’ the mind-body problem—extending it, at least as perception, into the collective economic setting—regardless of the metaphysical stances of other minorities or observers. Second, it offers another reason why the physicalism underlying mechanical economics doesn’t make sense (pun intended) to the average agent (see also later comments by Frank Knight). This is where the MMH differs, for example, from those heterodox theories that focus on narratives: it zeros in on the metaphysical assumptions/implications, etc. of those narratives—taking into consideration important aspects like their essence/meaning in terms of type, e.g. as allegory, metaphor, myth, etc. Moreover, the MMH submits that metaphysical considerations should be included when using economic variables. For example, comparing GDPs between countries generally does not make sense without consideration of their metaphysical make-up. Take the case of ranking their “economic power”: while country A’s GDP (based on a dominant IT sector) may be ten times bigger than country B’s GDP, it becomes economically impotent when the intangible services of that sector (e.g. centred on users’ social and virtual ‘experiences’) are deprived, say due to sanctions, from the necessary and scarce commodity produced by the miners of country B (who can easily sell it instead to country C).

Unfortunately metaphysics is completely ignored in mechanical economics. But that doesn’t mean it can be escaped. As Einstein asserts “every true theorist is a kind of tamed metaphysicist” (1950, p. 13) and “It finally turns out that one can, after all, not get along without metaphysics” (1946, p. 291). More to the point, fellow physicist Carl Friedrich von Weizsäcker emphasised that “every scientist works with metaphysical assumptions, and those who deny this most usually work with the poorest ones” (Atmanspacher and Müller-Herold, p. 141; fn. 11). This was echoed by Knight: “We can “argue” away from [conscious interests], but it can be shown that the one who does so is the one who is putting metaphysical prepossessions ahead of the facts of experience, the actual empirical data” (1925b, p. 249). Finally, according to

cyberneticist Heinz von Foerster it applies to us all: “I say we become metaphysicians whenever we decide upon in principle undecidable questions” (2003). Economics has quite a number of such questions, some of which are asked by market participants (see Schotanus et al., 2020). Other questions relate, for example, to the nature—not functions!—of money (e.g. Simmel, 1900) which makes currencies metaphysically suspect.³⁷

Fortunately, a select group of economists—including Mises, Soddy, and Weber—did realise the importance of metaphysics. For example (relevant for prices; see below), Smith stated that “[n]umber . . . is one of the most abstract and metaphysical ideas, which the mind of man is capable of forming” (1759, p. 418). Earlier I cited Knight and his key point on “the practical necessities of our situation. That is, we come back to dualism” (1925b, p. 265). Hayek, of course, explored it further in *The Sensory Order*. With him the MMH is in good company. Not only because Hayek acknowledged the parallels between markets and minds. He also clarified the mind-body problem and offers the MMH a useful metaphysical stance, echoing Knight, called “practical dualism”³⁸:

While our theory leads us to deny any ultimate dualism of the forces governing the realms of mind and that of the physical world respectively, it forces us at the same time to recognize that for practical purposes we shall always have to adopt a dualistic view . . . [Meaning that] in discussing mental processes we will never be able to dispense with the use of mental terms, and that we shall have permanently to be content with a *practical dualism*, a dualism based not on any assertion of an objective difference between the two classes of events, but *on the demonstrable limitations of the powers of our own mind fully to comprehend the unitary order to which they belong.* (1952, p. 179, 191; emphasis added)

With it, Hayek provides a clear motivation for why we can live with dualism while trying to bridge matter and mind.³⁹ Physicist Wolfgang Pauli saw this in terms of complementarity, a concept popularised in physics by Niels Bohr but borrowed from

³⁷ Underlying this, with competing arguments, are the commodity price theory and the credit price theory. They have different views, for example, on monetary risks, like inflation.

³⁸ Formally it is a form of dual-aspect (some would argue neutral) monism. Still, in other respects MMH’s view differs from Hayek’s view (e.g. his general internalist opinion on cognition).


³⁹ One way to see the practical part is in terms of pragmatism (thanks to Robbie Mochrie for pointing this out). More specifically, pragmatism subscribes to fallibilism, with Popper (who was a friend of Hayek) generally considered a pragmatist. In this case, Hayek shows sympathy with fallibility when he acknowledges the “limitations” of our mind.

William James:⁴⁰

the only acceptable point of view appears to be one that recognizes both sides of reality—the quantitative and the qualitative, the physical and the psychical—as compatible with each other. It would be most satisfactory of all if [matter and mind] could be seen as complementary aspects of the same reality (1948, p. 164)

Accepting practical dualism means that the MMH assumes that the average person most of the time views and thus describes the world in dualist terms, recognising both its mental and physical aspects as, for example, per their own mind-body. There are two reasons for this recognition. From a popular perspective, most of us would agree that we experience reality in this dual sense, and it forms part of so-called folk psychology. Second, and from a scientific perspective, the challenge to discover this “unitary order” remains to this day and is, as Hayek submits (with a Gödelian echo), mainly due to the structural limitations of the mind understanding itself. It turns out that this assumption is realistic and starts at an early age: “With regard to ontology, children as young as three years firmly divide the mental and physical worlds . . . young children appropriately distinguish between real and mental entities.” (Wellman 1993, p. 14; see also Bloom, 2004).

By interpreting it in metaphysical terms, practical dualism helps to better describe and understand the complex interactions in the economic system. Practising it is about identifying (and, if need be, explicating) the material and/or mental aspects of economic phenomena, and subsequently recognising possible implications. In many cases it is reasonable to assume some kind of correlation between these, just like the so-called neural correlates between brain and mind. At the top macro level this concerns the aforementioned physical real economy and the psychological financial economy. Such perspective can then highlight the extent and specifics of their (implied) separation.⁴¹ For example, for much of the past two years this has looked very pronounced, reflected in the market’s dislocation from fundamental

⁴⁰ See also Wilczek (2016). As an aside, it is also associated to the yin-yang concept in Taoism, symbolised by the famous .

⁴¹ Over the past few decades, the financial economy has experienced remarkable growth relative to the real economy, to the point of dangerous imbalances. This has mainly been fuelled by three forces: globalisation, marketisation, and financialisation (e.g. securitisation). I will not discuss these here, except to say that (the consequences of) the latter contributed most to the over-leveraging, with the IIF estimating that global debt to GDP reached a record 365% by year-end 2020.

realities. It suggests a breakdown in correlation into singular mental dependence: stretched leverage and valuations completely relying on faith in (repression by) central banks.

An excellent related example comes from the book *Between Debt and the Devil* by Adair Turner because it immediately jumps out. Turner argues that financial instability is basically caused by the “interaction” between “limitless credit” and scarce “urban land” (p. 247). For the sake of argument, let’s assume we agree. As a throwaway comment he then adds in a footnote that land is “the *most physical* thing of all” (p. 276, fn 11, emphasis added). Per practical dualism, that footnote should instead have been prominently in the text, contrasting it to mental credit to emphasise their reflexive psychophysical relationship: faith-based liabilities backed by physical assets. In particular, the more credit grows (in dollars) versus land (in acres), the more faith it demands. This brings us to the true culprit of financial instability. By disregarding the sensitivities involved, mechanical economics recklessly meddles in this relationship. Specifically, credit becomes “limitless” exactly because mechanical policies of distorted interest rates and automatic bailouts (seemingly) remove all credit risk. This not only invites moral hazard but can also, ironically, raise people’s desire for some physical stability as a balance against excessive faith, thus fuelling Turner’s “interaction”.⁴²

Practical dualism—sometimes combined with epistemology and other cognitive tools—helps to clarify in many other ways. Here are some examples:

- The internet bubble of the late 1990’s consisted of make-belief: overweighting the mental domain of imagination (e.g. accepting rudimentary business plans due to blind faith in the future of the internet, symbolised by the “.com” postfix), while underweighting the material domain of producing tangible results, including hard earnings. In short, psychophysical transmission via mental causation was assumed. The recent phenomenon of Non-Fungible Tokens (NFTs) is a recent variation, whereby momentum in prices are based on “vibes” and start-ups in this space hire “chief vibes officers” to raise the mood.

⁴² A related dynamic is inflation (aka currency debasement) leading to growing demand for gold.

- A similar situation exists in the formerly hot market in “SPACs” (Special Purpose Acquisition Companies). These are cash vehicles that make promises about potential future business activities, which mostly remain unspecified. The standard SPAC does not consist of anything but such a promise, a mental construct that may turn empty. It echoes the most notorious shell company of the South Sea Bubble of 1720, which promised to carry on “an undertaking of great advantage but *nobody to know* what it is” (emphasis added).
- Combining the macro level and over-reliance on models, remember those infamous DSGE models which, leading up to the GFC, simply ignored the financial economy because, supposedly, it didn’t ‘matter’?
- Central bank policies like the wealth effect and forward guidance rely heavily on metaphysical assumptions, which are sometimes inconsistent, e.g. the wealth effect is supposedly aimed at trickling down into the real economy, making it healthier. Instead it has increased inequality, including imbalances between the market and the economy.
- As a behavioural example, metaphysical profiling suggests that what is rational for a physicalist may not be for a dualist (let alone an idealist).⁴³ This can help, for example, to explain differences in investment behaviour, particularly in the area of ESG.

Finally, the MMH is still evolving. We particularly strive to put more empirical meat on its theoretical bones. For example, I created a model that compares the belief of the market regarding the phase of the business cycle with the reading of that phase according to the real economy. One connection lies in stretched supply chains: if—in the physical domain—companies raise inventory levels to ensure they have adequate stocks of materials, then—in the mental domain—the market will prepare itself for more volatility in the business cycle. For now, the MMH is the first promising attempt to formalise a number of earlier intuitions and speculations about economic mind-matter dynamics—culminating in the market’s mind—into a robust academic research program.

⁴³Already in 1879 William James, in his essay “The Sentiment of Rationality”, argued that differences in people’s metaphysical stances matter.

Next, I will briefly explain economics's hard problem, of which the market's mind-body problem is part, as well as offer short replies by the MMH to other open questions and key issues in investment management.

7. Key (open) issues

7.1 Economics's hard problem

Akerlof and Shiller's mental causation, Soros's reflexivity, and earlier observations by Hayek, Mises (1957, p. 65), and Soddy all point to the elephant in economics's room: its version of the mind-body problem. This concerns the perceived dualism at the heart of the economic system in general and the role of agents' consciousness in particular. To hit it home, here is Knight once more:

The power of mechanistic logic over common-sense is great! But it does not extend to making the plain man deny that he and his fellows are conscious beings moved by conscious interests. Once more, one who denies the significance of consciousness is simply putting the abstract criteria of a logical system ahead of the fundamental principles [PS: psychophysical interaction] which form the only foundation for that system itself. (1925b, p. 253)

The original mind-body problem has bedevilled philosophers, scientists, and other researchers for centuries. Mind-bodies are peculiar in that regard. For example, they are subject to psychophysical laws: you jumped up because you experienced fear.⁴⁴ Machines, on the other hand, are subject to mechanical laws: the clock chimed (simply) because its long arm hit twelve. But the mind-body problem reaches into the general dichotomy between the mental world and the physical world more deeply.

Why is it a problem? Mind engages with matter as part of our survival in general, and to coordinate our behaviour in particular. However, there seems to be a gap in our understanding of their interaction. In other words, we do not exactly know the psychophysical laws. This especially concerns the nature of consciousness which, as I mentioned, is particularly manifested via phenomenality—peculiar feelings and sensations that affect (e.g. Panksepp, 1998) and complement any behaviour and

⁴⁴ For the purists: yes, it could be the other way around. This type of detail and related issues will not be discussed in this paper.

thinking. Although not infallible, we consequently experience a world that is frequently very distinct from the scientific clinical descriptions of it. This (inter)subjectivity adds a qualitative impression to any quantitative analysis of its state. While real it is also ineffable.

Dealing with the mind-body problem—let alone solving it—is about bridging this gap whereby the challenge is twofold:

1. In terms of theory: how to explain mind-matter interaction. This is appropriately called the “explanatory gap” (e.g. Levine, 1983) and is the traditional focus of cognitive science. In particular, *expressive* limitations (i.e. not able to express or capture mental qualities in quantitative vocabulary) lead to *explanatory* limitations (i.e. not able to explain mental qualities in quantitative terms).⁴⁵ For example, statistics quantify economic events after they have occurred (as static snapshots), not their real-time experience (which has duration; e.g. experiencing price moves).
2. In terms of practice: how to improve mind-matter interaction, especially when our mental world (e.g. perception) does not match the material world (e.g. reality). Individual efforts, for example, include yoga, tai chi, and other contemplative practices. This is also where action to change the world, as per the free energy principle (e.g. Constant et al., 2020), plays out. On a larger scale, such practical attempts are especially relevant for instances where multiple mind-bodies deal together with states of the world, often tackling problems that cannot be solved by an individual. This makes it the focus of cognitive economics. Recognising this is one of the distinguishing features of the MMH. Over time, in industry and science, we created methods and tools (e.g. telescope) to transform objects (e.g. planets) and materials in order to better ‘handle’ them mentally. More generally, economics is “a technique for controlling nature and bending natural forces and *materials* to the *will* of man” (Knight, 1925a, p. 373; emphasis added). A modern development is digitalisation/ virtualisation to dematerialise⁴⁶ physical objects (e.g. into digital assets). The markets have been crucial in (e.g. funding) these collective efforts. Specifically, the coupled system of investors with their terminals—in functional terms—are so coordinated that they operate the collective bridge between the physical and the psychological, with prices as informational building blocks..

For the economic system the mind-body problem extends to the collective level, meaning that it involves the composite economic mind-body which consists of the interacting conscious mind-bodies of economic agents and their technologies, divided between the real and financial economies. So, when Alan Greenspan, in his

⁴⁵ This is also what Hayek meant when describing practical dualism.

⁴⁶ Metaphysically, think Wheeler’s “It from Bit”.

famous 1996 “irrational exuberance” speech, talks about “the complexity of the interactions of asset markets and the economy”⁴⁷ it ultimately concerns the dualism of the psychological of the former and the physical of the latter. This macro level interaction confronts us—particularly those experiencing it as participating (dualist) agents—with the overarching problem, something I refer to as economics’s hard problem.⁴⁸ A nested sub-problem is what I refer to as the market’s mind-body problem. Keynes implicitly refers to it via (Descartes’) “animal spirits” which manifest as “waves of optimism and pessimism”. In basic terms it is captured in the following question: what is market mood and how do we account for it?

As indicated, price discovery is crucial to how we deal with the second challenge of large-scale bridging of mind and matter: allocating capital to investments which eventually find their way into physical assets (i.e. output) of the real economy. The purpose is to collectively benefit from/hedge against states of the world (e.g. Bernstein, 1998). This is what the market tries to achieve, as expressed by Bill Miller, legendary (ex-)fund manager of the Legg Mason Value Trust:

One of the things capital markets do is consider possible worlds. The level and direction of prices reflect the markets’ assessment . . . of possible worlds becoming actual . . . There are advocates for many of these views. Investors consider the risks and rewards and allocate their money accordingly. (Zenios and Ziemba, 2007, p. 879)

The market’s intention is thus to allocate society’s material and mental resources as efficiently as possible. As Hayek and others have extensively argued, this is not something any individual can know, let alone achieve. So, in 4E’s extension terms, we ‘unload’ this task to the market who “knows more than any individual investor can know” (Bernstein, 1992, p. 136). Still, that doesn’t make Mr Market perfect. The key aspect of the challenge in that regard is not necessarily that these resources are all scarce per definition, or that each agent only has local information. Rather it is our ignorance of our mind-matter interaction in a collective setting which brings (radical, aka Knightian) uncertainty. In other words, the “mystery” of price discovery, so beautifully expressed by Vernon Smith (1982, p. 952), is part of the mystery of our

⁴⁷ See also Claessens and Kose (2017).

⁴⁸ In this context, “complete knowledge” can be considered as neoclassical economics’s reductive attempt to interpret and deal with the ‘easy’ version of consciousness (i.e. access consciousness/ awareness).

collective mind-body problem.

As I just mentioned, in the market it manifests itself primarily via mood. Fed Chair Jerome Powell admitted that, concerning the impact on the real economy, “[t]he linkages among monetary policy, asset prices, and *the mood of global financial markets* are not fully understood” (2018; emphasis added).⁴⁹ Soros had already warned earlier that “markets are not supposed to have moods. Yet they do” (2009). In fact, the influence of mood has a rich history (ahead of it): “Thus it has been for centuries; thus in the long future it will also be.” (Galbraith, 1990, p. 110).⁵⁰ The MMH describes market mood in detail, but here I’ll provide a short version.

It starts with the now familiar question how mind and matter interact in the economic system. For conscious humans a proper understanding of a market state requires the inclusion of the experience to which the physical properties of that state give rise.⁵¹ Mechanical economics, per the EMH, describes a market state as being in equilibrium, correctly valued, etc. That description, in turn, is based on how certain functions and processes are performed in various domains for which mechanical economics has detailed explanations. For example, these include order routing, custody, clearing and settlement. Other functions are in the form of the combined analyses by macro, fundamental, quantitative, and technical investors.⁵² Even behavioural interpretations, like loss aversion and utility maximisation, are functional. However, the resulting description cannot convey properly—that is to say meaningfully let alone exhaustively—the full market state. So, market functions are necessary but insufficient explanations of a market state. There is namely something in addition: what it is like to be in that state for investors as (part of) a collective. This is what we mean with market mood. In complexity terms, mood is the synergy that

⁴⁹ Although without any explicit reference to mood, the May-2021 FOMC minutes highlight the kind of tail-wagging-the-dog sequence that worries the Fed: “should investor risk appetite fall, an associated drop in asset prices coupled with high business and financial leverage could have adverse implications for the real economy.”

⁵⁰ Earlier references include, e.g. Jevons’ “Investigations in Currency and Finance” (1884, p. 184).

⁵¹ Although it applies to some extent to real market phenomena, like consumer confidence, the “distortion” from mechanical economics due to “separation” (Soros, 1994) particularly affects financial markets.

⁵² Per practical dualism, these primarily involve physical properties. For example, for a fundamental investor they consist of physical components (e.g. company fundamentals, like goods, factories, and machines) and processes (e.g. business activities, like construction, storage, and transport).

makes a full market state exceed the sum of its (functional) parts.⁵³ Prices are the key conductors that bring this across, not in a functional/analytical way but phenomenally as the sensation of despair, exuberance, etc. That phenomenality—feeding back on all the deliberations (i.e. S2) and emotions (i.e. S1)—is central in market awareness.

Allow me to highlight this with a simplified example. Imagine a market that consists of two assets, A and B. On two occasions through history A is quoted at 10, and B at 20. According to the EMH, this supposedly already reflects all relevant information and indicates those two market states are the same. Still, for the sake of argument, let's further assume that secondary characteristics, like valuations, are also equal for each asset on those occasions. Nevertheless, for participants these states can feel completely different *at those respective moments*, implying the 10 and 20 readings are 'imperfect'. What does it mean when such quantitatively equal states feel dissimilar? It must mean that there is an additional aspect to information being realised.

Of course, there is narrative economics: when investors see correlations breaking down, divergences (e.g. between value/growth) widen, or other patterns emerge, Mr Market is telling a story. However, at the same time but at a deeper level, by feeling such dynamics via their portfolios investors experience the mood of that story. The idiosyncratic mood completing a market state is due to the active dynamic of price discovery, i.e. it's the verb, not the noun. That dynamic is, after all, what investors experience as 'reversals', 'squeezes', 'swings', 'trends', etc. by being in the market (via their portfolios), e.g. being squeezed hurts, trending up elevates, and reversing annoys. It may be irrational or random, but it is still real (in a phenomenal sense) and cannot be "un-experienced", to use a term tweeted (in a different context) by neuroscientist David Eagleman. In the final analysis investors identify with their portfolios. And "[o]nce you identify with your portfolio, your survival is at stake" (Soros, 1987 [2003], p. 41).

In other words, price discovery and mood mutually influence. They are the market's own reflexivity (Mr Market's self-reflexivity, e.g. mood/momentum). Yet,

⁵³ Minds and markets are special cases of complex adaptive systems. For an introduction of complexity theory applied to economics, see Arthur (2015). On synergy, see Kelso (2022). A recent addition is Balland et al. who, showing sympathy with collective intelligence, conclude that "the idea of a social brain [is] more than just a metaphor" (2022, p. 3).

consistent with physicalism the EMH considers this as epiphenomenal and not relevant. However, it raises certain questions that mechanical economics consequently leaves unanswered, for example regarding the mood/momentum feedback:

why do *states of optimism* lead to different choices than *states of pessimism*? Why when the market is *crashing* everyone rushes to *sell*, and when it is *growing*, everyone rushes to *buy*? (Bechara and Damasio, 2005, p. 362; emphasis added)

Adam et al. (2017) tried to answer this. They use survey measures to show that investors' subjective expectations of capital gains, i.e. price moves, display excessive optimism (pessimism) at market peaks (troughs). In short, they confirm that investors are trend followers, chasing momentum. They conclude "We formally reject the hypothesis that this is compatible with rational expectations".

In (Schotanus et al., 2020) we connect this to Popper's mental-causation comment (1953, para. 6.3-6.4) on being influenced by abstractions, in this case by prices as numbers. Their movement affects outcomes. It certainly attracts attention. Wittgenstein once remarked that "[t]he human gaze has the power of conferring value on things; but it makes them cost more too." Regarding (joint) gaze and attention-inducement, for example, Jesse Livermore famously stated that "the greatest publicity agent in the wide world is the ticker" (Lefèvre, 1923, p. 211). In modern times, retail investors are "mesmerised by the movement of share prices on their cellphone screens" (Tett, 2021). We also explain how this likely involves the cognitive faculty of number sense (e.g. Dehaene, 1997) whereby numbers "possess a dynamic, active aspect which is especially important to keep in mind. It is not what we can do with numbers but what they do to our consciousness that is essential" (Von Franz, 1974, p. 33).⁵⁴ This occurs, for example, via extrapolation of prices and returns. Pioneered by technical analysts, researchers are now incorporating this into asset pricing in the mainstream literature. In another format it also occurs via the experienced difference between physical (i.e. calendar) time and so-called intrinsic time (e.g. Derman, 2002). The following describes what it entails:

⁵⁴ Applied to the economy, think of recency bias, for example: consumers base their belief of inflation on the prices of regularly purchased items above those of occasionally purchased ones.

Researchers have traditionally analyzed the responses of traders in physical time . . . Such an approach does not adequately reflect the *subjective experience* of time . . . [Instead] intrinsic time weights chronological flow according to price action: during highly volatile periods time is expanded; during quiet periods, when market volatility is low, time is compressed. (Olsen, 2004, p. 4; emphasis added)

From a behavioural perspective, Mastrogiorgio and Petracca (2014) investigate how numbers can lead to different dynamics of activation of dual-process thinking. Specifically, they show that “their role goes beyond and cannot be reduced to that of . . . magnitudes” and associate it with embodied mathematical cognition. Other research connects numbers to the extended mind (see De Cruz, 2008, and the references therein).

To recap, the market’s physical (e.g. functional) information processing is accompanied by market mood, a collective experience which uniformity can vary between despair and exuberance. Mechanical economics does not acknowledge its qualitative sensations which complete a market state and are intersubjectively experienced by market participants. For these ‘consumers’ of information there is an actual ‘taste’ to it. We can interpret this dual realisation of information for the general case of conscious experience. It was famously described by Chalmers:

[W]hen an experience realizes an information state, the same information state is realized in the experience’s physical substrate . . . We might even suggest that this *double realization is the key to the fundamental connection between physical processes and conscious experience*. We need some sort of construct to make the link, and information seems as good a construct as any . . . We might put this by suggesting as a basic principle that *information (in the actual world) has two aspects, a physical and a phenomenal aspect*. (1996, pp. 284-286; emphasis added)

Still, it is closely related to earlier comments by David Bohm (think prices as “active information” here):

There is a kind of active information that is simultaneously physical and mental in nature. Active information can thus serve as a kind of link or bridge between these two sides of reality as a whole. These two sides are inseparable, in the sense that information contained in thought, which we feel to be on the mental side, is at the same time . . . a physical activity.” (1990, p. 282)

I thus didn't exaggerate when I mentioned the deep-seated connections between minds and markets: investor consciousness extends when information is realised both physically and phenomenally in the market's mind via the concentrated numerical format of prices. In other words, prices form our “construct”. They are the informational building blocks—acting as conductors—to collectively bridge mind and matter in our efforts to benefit from/hedge against states of the world. Among others, this should change our view not just of what prices are but what they do. In turn, this has implications for how we investigate them and thus also for our methodologies as well as policies and practices. Specifically, mechanical analysis methods do not capture mood, i.e. it is not like sentiment which can be modelled via indicators like the bull-bear spread or VIX index.

On that note, Powell's admission that market mood was “not fully understood” mirrored an earlier admission by one of his predecessors: “[w]e have never successfully modelled the transition from euphoria to fear” (Greenspan, 2009). In light of my arguments, this is not surprising, i.e. mechanical modelling is inappropriate. Instead—and most unfortunate for those who prefer separation—the essence of the market in general and its mood in particular is its interiority, namely how it feels to be in it:

I don't know how to explain it. It's so wild. If a guy sees it who's not in it, all he could say is, 'They should be locked up!' It's so violent when it takes off. It's violent, the power of the market . . . when it starts moving . . . You've got to be in it all the time to know . . . (Hassoun, 2005, pp. 107-108)

For investors market moods are irreducible because market states are infused by them. By having skin-in-the-game investors are immersed in the market and ‘feel and feed’ its ‘temperature’:

What we need to do is “take the market's temperature.” If we are alert and perceptive, we can gauge [it] . . . (Marks, 2011, p. 126)

Moods provide experiential knowledge in that investors recognise and distinguish them because of their (previous) distinct impressions.⁵⁵ Ultimately this is an intersubjective awareness conveyed (in concentrated format) by price dynamics, not price statistics. And to repeat the importance: on two recent occasions those moods were not just causal (e.g. per Akerlof and Shiller) but existential, overwhelming any individual moods. As I wrote elsewhere (Schotanus, 2016), regardless whether you were a bull or a bear, we all became rabbits caught in the headlights of these events.

7.2 Other issues and short MMH replies

Going forward, there have been a number of initiatives to take the many lessons of the past on board, i.e. to revise economics’s paradigm. For that we need a new research agenda which, per the MMH, includes developing novel software and other tools to investigate what are, in essence, psychophysical phenomena. This certainly applies, for example, to price dynamics and calls—following the GFC—to focus less on prices risk throwing away the baby with the bathwater.

Our research program, which has a number of planned projects, is ambitious in terms of answering open questions and addressing other key issues in investment management. To finish this section, let me briefly list a few of these, adding short replies by the MMH which we hope to explore in detail in future research.

Question/Issue:	MMH reply/interpretation:
Bubbles, crashes, and their reversals	During a bubble/crash the psychophysical feedback between the (mental) belief and the (physical) action of buying into that bullish/bearish belief is positive. The usual causes for its reversal are specific intersubjective experiences of discovery which shift moods. Specifically, information—as novelty—is dually realised (as per Chalmers) in the form of a shock/surprise which accompanies some sudden insight. Crucially, such an insight is not limited to fundamentals (e.g. company news, a fraud, a technological breakthrough, etc.) but can also be market action (e.g. the reversal) itself, thus creating momentum. After all, due to their ownership of (and “identification” with) their portfolio investors are aware and pay attention to the market. Consequently, investors are primed by market

⁵⁵ Arguably, history rhymes in financial markets (over longer cycles) because experienced investors retire from the battlefield (thus removing experiential knowledge), leaving younger participants to fight the last battle (again).

	<p>action itself to ‘expect surprises’. Moreover, we suspect ‘random noise’ in minds (e.g. “conscious cascades”, Dehaene, 2014; “Readiness Potential”, Schurger et al., 2012) is correlated to ‘random noise’ in markets (e.g. excess volatility). This could play a role in terms of the exact timing of reversals which, as just mentioned, are initially novel themselves.</p> <p>The point is, mood conditions any rationality, it shapes any narratives, and it is entangled with any fundamentals.</p>
How can we monitor systemic risk?	<p>To prevent another near-comatose event (like Lehman’s collapse), we need to build a deep neural network model to measure and monitor Mr. Market’s access consciousness. This points to our different approach: securities are considered the “neurons” in the market mind, in contrast to traditional agency/neural-net models. The ambition is to have the model stream data and run real-time 24/7. Call it “Mr Market’s EEG model”. Its goal is to help generate early warnings for global systemic risk. It will thus be particularly of interest to policy makers, including central banks and institutions like the BIS and the IMF.</p>
Why do people with the same information make different (rational) decisions, e.g. on ESG?	<p>Metaphysical Investment Profiling (MIP) is inspired by William James who, in his 1879 essay “The Sentiment of Rationality”, argued that differences in people’s metaphysical stances matter. MIP could do for cognitive investing what, for example, personality tests did for recruiting and investor risk profiling did for financial advice. MIP will borrow and amend research material (e.g. questionnaires) from earlier studies in cognitive science. The goal is to show that a subject’s metaphysical stance (dualism, idealism, physicalism, etc.) can explain their preference for a particular investment thinking/decision-making format, or even preferences for asset classes, investment styles, etc. This particularly applies in an ESG context.</p>

Size constraints unfortunately prevent a more detailed discussion of these and other implications of the MMH—for example on ESG, behavioural economics, and financial literacy.

8. Summary and conclusion

The task is not so much to see what no one has yet seen, but to think what nobody has yet thought about that which everybody sees.

Arthur Schopenhauer

This primer introduced cognitive economics which partners cognitive science and economics. A specific interpretation, the MMH, derives the Market Mind principle which connects markets and minds. In the process several issues were raised that probably pushed some readers outside their comfort zones. One of the more memorable earlier comments I received on my papers was that I had “opened a can of worms inside Pandora’s box”. I make no excuse and believe that this is necessary. Underlining that the revision of economics remains topical in the tercentenary of Smith’s birth, Edinburgh-born Nobel laureate Sir Angus Deaton concluded in his Christmas reflection for the new year:

[W]e economists often assume a mantle of policy expertise for which we have no qualification, with predictably disastrous outcomes . . . is there a deep flaw in economics that continuously leads its practitioners astray? I tend to favour the latter hypothesis . . . above all, we need to spend more time with philosophers, recapturing the intellectual territory that used to be central to economics. (Deaton, 2022)

Regarding economics’s hard problem there are those who still wonder “so what?” In response, let me recap by rephrasing why identifying this problem is critical: it zeros in on mind-matter interaction which is the endogenous transmission process of the economic system. This is what Akerlof and Shiller recognised (but didn’t explore sufficiently). It matters whether we consider or treat something as mental or physical, especially in a world of (mostly) conscious humans who are closet dualists. Soros (1987), for example, implicitly raises this in the Epilogue of *The Alchemy of Finance* when he distinguishes between “ideas” and “material conditions”. It also leads to the (practical) dualism reflections by Knight and Hayek.

On a related matter, I agree that “economic laws do not yield to political will” (Summers, 2015). In turn, however, economic laws supervene on psychophysical laws. We may not yet completely understand the latter, but we know one thing: there are limits to the greater fool theory. That is to say—interpreting Lucas’s version of Abraham Lincoln’s argument and throwing it back at him—we can’t all fool ourselves all the time in terms of buying into mechanical economics. Specifically, category mistakes make an ontological commitment that can be very expensive. Mechanical economics made such an error many decades ago and society can no longer afford it. Fortunately, we can correct it by adopting cognitive economics. If

behavioural economics showed that homo economicus has no clothes, then cognitive economics points out—even more revealingly—that he is not aware⁵⁶. That is not just embarrassing. It makes him a kind of zombie: the nakedness is inside, there is nobody home. No wonder we do not identify with him.

This primer briefly explored awareness and consciousness more generally. In particular, and in reference to Sornette’s earlier statement, market consciousness does not somehow “emerge” from simple rules leading to complex behaviour (even though some like to equate the two). Instead, per 4E cognition it emerges only because investor minds are conscious, and their consciousness does not suddenly disappear but morphs and extends, e.g. into intersubjectivity, when they *interact*. This can go as far as collectively realising in our Minsky moment that, to paraphrase Walt Kelly, we have seen Mr Market and he is us. Again, from an existential point-of-view this was particularly prominent during the reality checks.

If the role of consciousness in agents’ mentality is mechanical economics’s blind-spot, then economics’s version of the mind-body problem is the elephant in its room. Our universe seems fragmented. We’re trying to figure out how to piece it together. Starting from our own mind-bodies, combining the mental and physical aspects is our biggest challenge. Ignoring this elephant is not only irrational but increasingly irresponsible in light of our growing plight. Financial repression, financial engineering, and other interferences—justified by mechanical economics—supposedly serve ‘the greater good’. However, upon closer cognitive scrutiny ‘greater’ is literal here: they actually benefit the moats of mechanically minded behemoths in both the real and financial economy, often supported by revolving-door central planners. They crowded out pesky consciousness and limit creative (but for them disruptive) discovery.

There is another kind of ESG message here, with a big G, namely about Governance of Markets. Specifically, self-regulation leads to lobbying, regulatory arbitrage or, worse, manipulation. Instead, a cognitively inspired Hippocratic Oath is called for: “first do no harm” to the economic mind-body. Specifically, promote (price) discovery and protect the small/vulnerable to enable future creative destruction

⁵⁶ For all clarity: formally in a phenomenal sense.

rather than a misplaced-Darwinian ‘survival of the biggest’. Those who commit economic iatrogenesis thus break this oath.

It makes this paper more than just a primer. It is a call to arms for heterodox economists and cognitive scientists to work together to raise cognitive economics as the rightful (and obvious) heir to behavioural economics. This will benefit both. Specifically, markets offer a treasure trove of empirical (intersubjective) data, in particular prices, to be newly explored from a psychophysical perspective, rather than—as has been the case—a mechanical one. For cognitive science this could help solve, for example, the “enormous problem for a theory of consciousness . . . : the lack of data” (Chalmers, 1996, p. 215). Thanks to its expertise in market forces—observed ubiquitously in our world—economics’s label of “the dismal science” can be removed in the process. Finally, while Soddy’s cited last words admittedly linger, consciousness should no longer be a “burden”.

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