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# Markets, bodies, rhythms: A rhythmanalysis of financial markets from open-outcry trading to high-frequency trading

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**Abstract:** This article explores the relationship between bodily rhythms and market rhythms in two distinctly different financial market configurations, namely the open-outcry pit (prevalent especially in the early 20th century) and present-day high-frequency trading. Drawing on Henri Lefebvre's rhythmanalysis, we show how traders seek to calibrate their bodily rhythms to those of the market. We argue that, in the case of early-20th-century open-outcry trading pits, traders tried to enact a total merger of bodily and market rhythms. We also demonstrate how, in the 1920s and '30s, market observers began to respond to a widely perceived problem, namely that market rhythms might be contagious and that some form of separation of bodily and market rhythms might therefore be needed. Finally, we show how current high-frequency trading, despite being purely algorithmic, does not render the traders' bodies irrelevant. Yet high-frequency trading does change the role of the body rather than seeking to attune their bodies to the markets, high-frequency traders seek to calibrate their bodies to their algorithms. While the article demonstrates the usefulness of deploying Lefebvre's rhythmanalysis in analyses of financial markets, it also suggests that high-frequency trading in particular might produce new types of market rhythms that, *contra* Lefebvre, do not revolve around traders' bodies.

Keywords: Bodies, contrarian speculation, financial markets, high-frequency trading, Lefebvre, rhythmanalysis

## Introduction

It is evident to most observers that financial markets have undergone profound transformations during the past century. Whereas the hub of market activity used to be the open-outcry pit, in which traders competed for the best orders in an often loud and hectic body-to-body environment, the main market activity of the present takes place via computers, either by traders interacting via their screens

or through algorithmic trading, in which pre-programmed algorithms place specific orders according to market flows, and without any human intervention. This development seems to suggest a growing detachment between bodies and markets, rendering the operations of the latter largely independent of bodily aspects. To some extent, it is accurate to describe the development in such terms. Yet, as we shall argue in this article, the situation is in fact more complex and ambiguous. We will demonstrate this by analyzing markets and their transformations in terms of their *rhythms*, which will allow us to examine how bodies and markets interrelate in various market configurations. Theoretically and analytically, we will center our investigation on Henri Lefebvre's rhythmanalysis, because it (1) foregrounds the role of the body and (2) offers an explicit attempt to understand and examine connections between bodies and capitalism.

Empirically, we study two radically opposed incarnations or configurations of financial markets, namely the open-outcry pit, where, as mentioned, traders are placed in bodily proximity; and high-frequency trading (HFT), i.e. fully automated, computerized trading, in which orders are executed by algorithms and traders rarely interact.<sup>1</sup> HFT executes trades at very high speed, typically in micro- or even nanoseconds. According to some estimates, 48.5% of all US equity trading today is HFT (Cheplick, 2014), which suggests that whereas open-outcry pit trading used to be at the center of the financial markets, today this position seems to be occupied by HFT. And although HFT might appear to render bodies irrelevant, we argue that, even in an era of automated trading, the bodies of traders need to be calibrated to market rhythms.

The article is structured as follows. In the first section, we present and discuss the central ideas of Lefebvre's rhythmanalysis. The second section outlines our methodological approach, i.e. how we deploy Lefebvre's rhythmanalysis in order to understand financial markets. The third section examines market rhythms in the golden era of open-outcry trading, in the early twentieth century, demonstrating how traders tried to calibrate their bodies to market rhythms. The third section then fast-forwards to present-day HFT. We demonstrate how HFT enacts a change in how traders relate to markets: rather than seeking to calibrate their bodies to the market, they are preoccupied with attuning their bodies to their algorithms. While we show the usefulness of applying a Lefebvrian rhythmanalysis in order to understand HFT, we also discuss how this specific market configuration displays types of *inter-algorithmic*

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<sup>1</sup> We therefore ignore other market configurations, such as screen or click trading, where traders interact with markets through computer screens and execute orders by clicking their mouse. Such markets are analyzed in particular by Knorr Cetina and Bruegger (2002).

rhythm that may require an analytical approach, which, *contra* Lefebvre, does not place the body centrally. There is a brief conclusion.

### **Lefebvre on rhythmanalysis**

Lefebvre's rhythmanalytical project has attracted considerable attention in recent years. He commented upon rhythmanalysis with varying intensity throughout his writings, but never more so than in his final years, culminating in the posthumously published book *Elements of Rhythmanalysis: An Introduction to the Understanding of Rhythms*, which was published in French in 1992 and in English translation in 2004 (Lefebvre, 2004 [1992]). Much of the extant scholarship on Lefebvre's rhythmanalysis examines its potential in empirical explorations of, for example, festival spaces (Duffy, Waitt et al, 2011), the night-time economy (Schwanen, van Aalst et al, 2012), pedagogy (Hopwood, 2014), street performance (Simpson, 2008; 2012), and various other phenomena relating to cities and the everyday (Cronin, 2004; Edensor, 2010; Goh, 2014; Vergunst, 2010). Others have discussed how Lefebvre's rhythmanalysis connects to his wider oeuvre and how it draws inspiration from and may be related to the work of other theorists, be they rhythmanalysts or not (Borch, 2005; Butler, 2012; Crang, 2001; Elden, 2004; Fraser, 2008; Henriques, 2014; Henriques, Tiainen et al, 2014; May and Thrift, 2001; Mels, 2004; Pantzar, 2010; Prior, 2011; Simonsen, 2005).

Our approach in this article is different. We are not interested in theoretical comparison or conceptual genealogy. Also, our main aim here is not to expand on Lefebvre's rhythmanalysis by incorporating insights from Bakhtin, Deleuze, non-representational theory, or other strands of thinking that have attracted attention in discussions of Lefebvre and rhythm (e.g. Crang, 2001; Latham and McCormack, 2009; McCormack, 2002; Simpson, 2008). Instead, we aim to (1) focus more narrowly on Lefebvre's rhythmanalysis, or rather specific parts thereof (as detailed below) – some of which have been addressed in the extant literature, some less so. Our reason for focusing on Lefebvre's (rather than others') rhythmanalysis is that, in our view, it constitutes a rich reservoir of ideas for empirical work. Indeed, we hope to demonstrate that Lefebvre's particular understanding of rhythms as well as his emphasis on bodies and how everyday rhythms relate to capitalism, render his rhythmanalysis particularly suited to understanding and empirically analyzing financial markets. This does not entail any sort of commitment to a one-to-one application of Lefebvre – not only does Lefebvre's rhythmanalysis offer little in terms of specific methodological guidelines (which we shall address in the discussion of methodology below), but some of his ideas also invite critical discussion when applied to the field of

financial markets. This means (2) that where Lefebvre's rhythmanalysis is in need of adaption or refinement, we wish to point to this not through conceptual or theoretical comparison, but rather through reference to the field to which it is to be applied. That is, we wish to let the empirical field determine the extent to which Lefebvre's work falls short or not. By privileging the field in this way, we in effect (3) use it both as a critical test case of Lefebvre's rhythmanalysis and as a way of bridging debates in geography and economic sociology: we bring Lefebvre's work into dialogue with advances in economic sociology, and we use this dialogue, as well as the empirical analysis, to discuss the benefits and limitations of Lefebvre as a theoretician of rhythms, capitalism, and everyday life.

This approach does not entirely detach our analysis from recent Lefebvre scholarship. Indeed, our use of Lefebvre both builds on recent discussions of his rhythmanalysis and responds to what we perceive as important gaps in the literature. More specifically, our approach is characterized by four key dimensions. First, while Lefebvre's rhythmanalysis is conceived as part of his examination of everyday life – as highlighted by many of the recent empirical analyses, particularly those investigating urban everyday rhythms (Latham and McCormack, 2009; Simpson, 2008; 2012) – there has been a lack of systematic empirical attention to how these everyday rhythms are related to *capitalism*. Specifically, Lefebvre conceives of capital, technology, and industrial production as changing the conditions of the everyday. To be more precise, while most studies note that this relation matters to Lefebvre, the link to capitalism often becomes rather indirect in specific empirical studies, or is missing entirely (e.g. Latham and McCormack, 2009; Mulíček, Osman and Seidenglanz, 2014). In order to address this problem, we will place greater emphasis on capitalism and its relation to everyday rhythms by focusing on financial markets. However, *contra* Lefebvre, what interests us in the analysis below is not so much how capital permeates the (urban) everyday of non-capital, but rather how *capital's own everyday* is organized, as it were. In other words, we wish to analyze the rhythms of capitalism as expressed in particular configurations of financial markets, rather than how capitalism structures the rhythms of market-external everyday life in the city. This will allow us to relax the strong opposition that Lefebvre sometimes posits between capital on the one hand, and (everyday) life and bodies on the other. For example, in *Elements of Rhythmanalysis*, Lefebvre discusses the allegedly “evil power of *capital*”, which is said to “[construct and erect] itself on a contempt for life and from this foundation: the body, the time of living” (2004 [1992], page 51, italics in the original, see also 55). In contrast to this assertion, we wish to allow for the possibility that capitalism and life need not be mutually

antagonistic, and that capitalism and financial markets may have their own life and body rhythms.

An important contribution can be made to both economic sociology and geography by focusing on the rhythms of financial markets. While many economic sociologists have studied financial markets in great detail the past decades, the rhythms of financial markets – including the relation between markets and the rhythms of traders – have never before been systematically examined. This is unfortunate, since, as we shall demonstrate, market rhythms and their links to the bodily rhythms of traders offer a novel understanding of financial markets and their spatio-temporal transformations. The emphasis on financial markets also constitutes the central contribution to extant debates in geography, in which – to the extent that Lefebvre’s (and others’) rhythmanalysis has been deployed to make sense of capitalism – the main focus has been on shopping (Kärholm, 2009) or on the economies of performance (Simpson, 2008; 2012). To be sure, based on an audio and visual montage of activity in Berlin, Pryke has (briefly) observed a connection between Lefebvre’s rhythmanalysis and “the networks of global, financial capital” (2002, page 474). However, as we described earlier, this connection relates more to the effects of financial capital on everyday urban life than to the rhythms of the financial markets themselves. In other words, the rhythms associated with financial markets remain to be explored, which is precisely what this article seeks to do.

Second, while the emphasis on capitalism constitutes a central addition to extant discussions and adoptions of Lefebvre’s rhythmanalytical project, the analysis below also relates directly, and affirmatively, to observations made in the existing literature about the connection Lefebvre establishes between *bodies* and *society* (in this context, financial markets). As forcefully argued by, *inter alia*, Simpson (2008), Lefebvre’s conception of the body is one that privileges an analysis of how society’s rhythms (associated with what Lefebvre calls linear rhythms, i.e. clock time, production, etc.) act upon bodily rhythms (associated with cyclical rhythms, i.e. cosmic, vital and biological rhythms). In other words, Lefebvre’s primary interest is in how the body is an effect of society. In terms of the present article, this would mean focusing on the impact of financial market rhythms on traders’ bodily rhythms. Against this image of the societal rhythms working *on* the body, Simpson suggests seeing rhythms “not inside or outside the body, but folded through it”, as this would better attend to the “body *itself*” (2008, pages 812, 815, italics in the original). While we would contend that there might not exist a body *itself* as a kind of non-mediated entity, we do believe that Simpson has a point in drawing attention to how the relation between body and society might be more complex than Lefebvre suggests. The analysis will

therefore pay attention to how such relations might materialize in relation to the field under study.

Third, our analysis will attend to the distinction between *cyclical and linear rhythms*, a distinction that is rightly attributed great importance in much of the commentary on Lefebvre's rhythmanalysis. While Lefebvre in principle grants that the interaction of cyclical and linear rhythms need not produce negative outcomes, he generally posits a modern discord between the cyclical and the linear, arguing that the linear rhythms of technology and industrial production seem to colonize the cyclical rhythms of biological or human nature (Elden, 2004, page 196). In Lefebvre's own programmatic words:

*“Critique of everyday life studies the persistence of rhythmic time scales within the linear time of modern industrial society. It studies the interactions between cyclical time (natural, in a sense irrational, and still concrete) and linear time (acquired, rational, and in a sense abstract and antinatural). It examines the defects and disquiet this as yet unknown and poorly understood interaction produces. Finally, it considers what metamorphoses are possible in the everyday as a result of this interaction”.* (2002 [1961], page 49, italics in the original)

Although our analysis will make use of this distinction between the cyclical and the linear, it will also show that the linear's colonization of the cyclical is only one part of the story when examining financial markets. The cyclical resists or counteracts linearization in ways that are surprising (but which also recall Simpson's rhythmanalysis of urban street performance; 2008, pages 817–9).

Common to all three dimensions is that they seek to loosen certain ideas in Lefebvre's rhythmanalytical project, while nevertheless retaining the basic Lefebvorean ambitions. In other words, we argue for the relevance of studying financial markets, their transformations and rhythms on the basis of Lefebvre's work, but we also argue that a thorough understanding of the field of financial markets requires some revision of the theoretical framework. Indeed – and this is the fourth dimension characterizing our approach – our analysis seeks to identify some *limitations to Lefebvre's rhythmanalysis*, and it does so by inquiring whether there are phenomena for which it is ill-equipped to account. We will argue that while the emphasis on bodies and rhythms allows for a novel understanding of financial markets and their transformations, the bodily focus of Lefebvre's project makes it unsuitable for fully grasping the development toward algorithmic trading and HFT. More specifically, on the one hand, HFT algorithms are designed to detect and respond to market rhythms, as per Lefebvre's definition

(for a discussion of the rhythmic character of algorithms, see also Miyazaki, 2013):

“Everywhere where there is interaction between a place, a time and an expenditure of energy, there is *rhythm*. Therefore:

- a) repetition (of movements, gestures, action, situations, differences);
- b) interferences of linear processes and cyclical processes;
- c) birth, growth, peak, then decline and end”. (2004 [1992], page 15, italics in the original)

On the other hand, the rhythmic interactions *amongst* algorithms take place in ways that are not bodily founded or related, meaning that to the extent that a rhythmanalysis of such interactions is to be pursued, it would be in conflict with the core role Lefebvre attributes to the body.

Finally, let us note that, for Lefebvre, rhythmanalysis is not merely about studying singular rhythms. Rather, it is about examining how various rhythms relate to one another (in, say, polyrhythmic, isorhythmic, eurhythmic, or arrhythmic forms). These interdynamics of rhythms, and how they materialize in and affect the everyday, connect to a broader aim of Lefebvre’s work, which we touched upon above – namely, to “show how there is a contrast between natural rhythms, those of the body, for example, and those of mechanism and machines” (Elden, 2004, page 195).

### **Rhythmanalysis applied**

Before getting to the analysis itself, we wish to discuss some methodological issues. In doing so, we must acknowledge that Lefebvre offers little detail regarding how to actually conduct rhythmanalysis. Indeed, according to Amin and Thrift, Lefebvre “is frustratingly elusive [...] about the tools of such a praxis” (2002, page 19; cf. Elden, 2004, page 196). That said, Lefebvre does give some indication of what would be important features of a rhythmanalysis. In particular, two dimensions are important for Lefebvre, both of which center on the person conducting the analysis, i.e. the rhythmanalyst. The first is that the rhythmanalyst “listens – and first to his body; he learns rhythm from it, in order consequently to appreciate external rhythms. His body serves him as a metronome” (2004 [1992], page 19). What this suggests is a broader point, namely that rhythmanalysis is, through and through, a bodily endeavor, an enterprise that involves the total body (2004 [1992], page 22; 2014, page 149). This points to the second important dimension, namely that Lefebvre’s notion of the rhythmanalyst calibrating his or her body as a metronome for external

rhythms mirrors a more general inside-outside *problematique*, one that traverses the rhythmanalytical project. On the one hand, some internal knowledge of rhythms is required. On the other, Lefebvre asserts, immersion is an obstacle to rhythmanalysis. This is why, when analyzing urban rhythms, instead of walking down the street amidst all of the noises and rhythms, Lefebvre prefers the distance afforded by the balcony or the window.<sup>2</sup> In his own words:

“When rhythms are lived, they cannot be analysed. [...] In order to analyse a rhythm, one must get outside it. Externality is necessary; and yet in order to grasp a rhythm one must have been grasped by it, have given or abandoned oneself ‘inwardly’ to the time that it rhythmmed”. (2004 [1992], page 88, see also page 27)

It is this distance – against a backdrop of the inwardly familiar – that, according to Lefebvre, allows the rhythmanalyst to explore rhythms that are otherwise hidden, silenced or unrecognized, i.e. those that escape critical attention or are otherwise considered noise (2004 [1992], pages 25, 27).

In an attempt to further develop a rhythmanalytical method consistent with central Lefebvorean ideas, Simpson (2012) has argued for using time-lapse photography as a means by which to observe everyday rhythms, just as Pryke (2002) has argued for audio and visual montage as a similar means. We suggest an alternative approach that focuses on how traders relate to financial markets in ways that seem to place rhythms in a central position. More specifically, we argue for analyzing traders as rhythmanalysts – much of what they do is about calibrating their bodies to the rhythms of the market (or market devices), either, as per Lefebvre, by utilizing the inside-outside division or, *contra* Lefebvre, by immersing themselves entirely within markets.

By conceiving of traders as rhythmanalysts, we in effect attend to market rhythms as perceived by traders, i.e. by key market participants. This is consistent with Lefebvre’s emphasis on how the rhythmanalyst must be grasped by rhythms in order to properly understand them. However, there is, of course, no guarantee that different traders would relate in similar ways to market rhythms – nor, more importantly, that they would agree on what actually constitutes market rhythms

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<sup>2</sup> The balcony is portrayed as the ideal spot from which to conduct rhythmanalysis: “A balcony does the job admirably, in relation to the street, and it is to this putting into perspective (of the street) that we owe the marvelous invention of balconies, and that of the terrace from which one dominates the road and passers-by. In the absence of which you could content yourself with a window, on the condition that it does not overlook a somber corner or a gloomy internal courtyard. Or a perennially deserted lawn” (2004 [1992], pages 27–8).

in the first place. While we do not deny that there may be greater variability than we are able to show, we wish to focus on a series of prominent ways in which traders act (or are advised to act) as rhythm analysts, ways that have a substantial empirical grounding.

Since we will primarily be focusing on how traders relate to the specific market configurations of open-outcry pit trading and HFT, and since these two types of markets are differently historically situated – while pit trading has more or less disappeared, HFT is at present rapidly unfolding and developing – we draw on different types of data in our analyses. More specifically, the analysis of pit trading is based on three types of sources. One type consists of existing ethnographic analyses of pit trading – in particular, the work of Caitlin Zaloom (Zaloom, 2006). However, since Zaloom conducted her fieldwork in the late 1990s, when the pits were already being emptied, we have, as a second source of data, included descriptions of pit trading from the heyday of open-outcry markets at the beginning of the twentieth century. Since we have not found any studies that address this period in a manner similar to Zaloom’s work, we have chosen to focus instead on how the tumultuous open-outcry pits of the Chicago Board of Trade are portrayed in fiction – specifically, in the American novelist Frank Norris’s novel *The Pit* (Norris, 1994 [1903]).<sup>3</sup> In the late nineteenth century, stock-market speculation and high finance were becoming ingrained in American culture, which resulted in a substantial amount of novels being published on the theme of finance (Zimmerman, 2006, pages 9–11). One such novel, *The Pit*, was an instant bestseller when it was published in 1903, although literary scholars later deemed it an aesthetic failure (Biers, 2011, page 516). The success of *The Pit* was amplified by Norris’ untimely death aged 32, combined with the publication of an abbreviated and revised version of the novel in the American weekly magazine *The Saturday Evening Post*.

It might be argued that fiction is not a valid resource when it comes to accounting for what actually happened in the pits. To this we would respond, first, that Lefebvre conceived of his rhythm analysis as a means by which to dismantle a strict separation between science and literature (2004 [1992], page 87). For him, the poetic did not merely consist of stylistic inspiration, i.e. in terms of writing, but constituted a resource for an at once internal and external exploration of rhythms. Second, at the very least, fiction offers a sense of how financial markets (and their rhythms) are perceived in popular culture. Third, such vernacular accounts of markets do not, in fact, appear to be disconnected

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<sup>3</sup> The importance of *The Pit* is reflected in the fact that it is mentioned, albeit briefly, in some recent studies of financial markets (Knight, 2012, page 1061; MacKenzie, 2006, page 15; Preda, 2009, page 210). We grant it a more extensive treatment.

from either scholarly accounts or from actual market action. As several scholars have demonstrated, markets and their scholarly representations are indeed indebted to more popular accounts (Hansen, 2012; Knight, 2012; Preda, 2004). In other words, popular accounts that are at first glance fictional need not be in stark opposition to scholarly accounts nor to actual markets, but could well be intimately intertwined with these, although an examination of their complex cross-circulations is beyond the scope of this paper.

The third and final source of data upon which we draw in our historical study of trading pits is what may be broadly referred to as (semi-scholarly) ‘how to’ books, i.e. manuals that offer advice on how to make money on financial markets. We focus on this literature – more specifically, on a particular subset of it that concerns so-called contrarian speculation (to be explained below) – because it presents a market strategy that details how the individual trader should relate to perceived market rhythms. The contrarian tradition has previously been examined by Urs Stäheli (2006; 2013). We draw upon Stäheli’s interesting work, but also further expand on his analyses by emphasizing the role of rhythms (Stäheli does not discuss rhythms, but rather the communication, observations, and self-techniques relating to contrarian speculation). We also include a number of contrarian thinkers not covered by Stäheli.

With regard to HFT, our analysis is based on interviews with and ethnographic observations of high-frequency traders. Interviewing high-frequency traders about their practices and following these closely on a day-to-day basis allows us to examine how this apparently non-bodily type of trading is in fact concerned with the calibration of bodies to rhythms. Specifically, the data used for the analysis of HFT consists of interviews with 22 (current or former) high-frequency traders (some were interviewed more than once), as well as more than 40 other actors involved with HFT, such as software developers, broker-dealers, exchange officials, investment bankers, and regulators (interviews were conducted in Chicago, London, and New York between April 2014 and February 2015). In addition, a Wall Street HFT firm was followed ethnographically over six weeks in spring 2014, with follow-up observations in October 2014. The ethnographic work focused on high-frequency traders’ daily practices, including how they trade while monitoring algorithms and how they develop new algorithms.

### **The rhythm of the open-outcry pits**

The pit is the epitome of open-outcry trading, and is almost synonymous with the Chicago Board of Trade (CBOT), which will be our focus in the following. The pit’s octagonal or round shape, with steps on the inside heading down

toward the center, allows all participants to see and hear each other, while the steps on the outside permit an adroit physical flow of orders into the pit. Introduced at the CBOE in 1869 with the aim of creating a unified marketplace with maximum visibility, the pit represented a spatial rearrangement and transformation of the trading floor that, ideally, would enhance market liquidity by narrowing the spread between bids and asking prices. All in all, the pit led to an emergence of an intensive form of open-outcry trading that was generally perceived as effective (MacKenzie, 2004b, page 86; Schlegel, 1993, page 66; Zaloom, 2006).

Primarily, open-outcry pits are places of intense bodily sociality (MacKenzie, 2004b, page 88). The increased visibility created by the pit's architecture allows traders to read each other's gestures and body language. In her ethnographic studies of the Chicago pits, Zaloom defines the pit as "the space and time of the market", arguing that anything "outside the pit is beyond the market" (Zaloom, 2006, page 135; cf. Lefebvre, 2004 [1992], page 6). According to the pit traders in Zaloom's study, configuring and adjusting one's body and mind to the market's rhythms is necessary in order to gain full access to its interior. In open-outcry trading, the body constitutes an important medium for "sensory estimations"; an instrument of both "reception and delivery of underlying market numbers" (Zaloom, 2003, page 264). When the trader merges completely with the market, this is referred to as being "in the zone" or "flow". It is within this zone or flow that the trader is said to gain access to "the natural rhythms of financial fluctuations" (2006, page 135). Thus, total immersion is praised as being central to pit trading – in other words, pit traders do not seek to occupy an analytical external position. To put it in Lefebvre's terminology, what they seek is the state of *eurhythmia*, i.e. a harmonious unity of rhythms of body and market that being 'in the zone' amounts to.

Zaloom's work offers a valuable resource for understanding the market rhythms of the pits in the late 1990s. During the period in which she conducted her studies, pit trading was about to fade away as the main trading practice. Consequently, we believe that other texts better capture the market rhythms of pit trading prior to its demise. One such text is the second (and final) novel in Frank Norris's unfinished "Epic of the Wheat" trilogy, *The Pit* (Norris, 1994 [1903]), which presents a series of prolific depictions of open-outcry trading at the CBOE during a time when the pit was at the center of action in the financial markets. Similar to most other early-twentieth-century novels thematically based on the American stock market, *The Pit* was inspired by real events. The book's protagonist, Curtis Jadwin, was based on the notorious bull trader Joseph Leiter.

Just like his fictional counterpart in the novel, Leiter managed to corner the wheat market at the CBOT in 1897–8 (McElrath, Jr. & Jones, 1994, page 18).

Apart from narrating the epic rise and disastrous fall of Jadwin (as well as a classic love triangle), *The Pit* offers a means by which to understand how pit traders' bodies are calibrated as metronomes of market rhythms. It does so, for example, by demonstrating the different sensitivity to market rhythms of a pit trader and an outside observer of financial markets. Here, the outsider is personified in Page Dearborn (sister of the protagonist's wife-to-be Laura Dearborn), who is only affiliated with the market by proxy. One day she finds herself in a position similar to Lefebvre's idealized balcony while sitting in the exchange's visitors' gallery as the pit trading unravels:

“Small wonder that the building to Page's ears vibrated to a strange and ominous humming. She heard it in the distant clicking of telegraph keys, in the echo of hurried whispered conversations held in dark corners, in the noise of rapid footsteps, in the thrilling of telephone bells. These sounds came from all around her; they issued from the offices of the building below her, above her and on either side. She was surrounded with them, and they mingled together to form one prolonged and muffled roar, that from moment to moment increased in volume”. (Norris, 1994 [1903], page 333)

What the distanced observer, Dearborn, experiences in the CBOT is a strange polyphony of utterly meaningless noise and chaos. She lacks what Lefebvre demands from the rhythm analyst: she has never been grasped by the rhythms of the market, which makes her misplaced and unable to resonate and thus reason with it. While for Dearborn, markets are mere noise, for the broker's clerk Landry Court, markets constitute a flow of rhythms in which the trader can immerse him- or herself. Court has been grasped by the market rhythms and thus possesses the mental poise needed to get to grips with and feel the market:

“[Court] would sell another fifty thousand bushels if the price went to ninety-four and a half, and would then ‘feel’ the market, letting go small lots here and there, to test its strength, then, the instant he felt the market strong enough, throw a full hundred thousand upon it with a rush before it had time to break. He could feel – almost at his very finger tips – how this market moved, how it strengthened, how it weakened. He knew just when to nurse it, to humor it, to let it settle, and when to crowd it, when to hustle it, when it would stand rough handling”. (Norris, 1994 [1903], page 90)

The reason why Court has this almost direct corporeal and mental connection to the market is that he possesses the ability to align his body and mind to the rhythms of the market, to such an extent that he actually feels it. In the case of Court, the practice of aligning mind and body to the rhythm of the market is significant because it also entails a personality transformation. With the sound of the 9:30 am gong that signals the opening of the CBOT, Court changes from being “rattle-brained”, “absent-minded”, “impractical”, and “easily excited” to becoming the most level-headed and focused person in the exchange (Norris, 1994 [1903], page 83). The market’s rhythms come together in a eurhythmic configuration with those of Court’s body.

However, the process of aligning mind and body with the rhythms of the market entails an inevitable risk of being caught up in the flow and swept away. The market in *The Pit* is portrayed as an irresistible vortex or whirlpool – sometimes luring people in, sometimes dragging them down with so much brute force that quitting becomes impossible and devastation inevitable (Norris, 1994 [1903], page 233). Although the wording is opulent and, at times, overtly naturalistic, Norris’s depiction of Cutis Jadwin’s mental disarray once he realizes that he has pushed the wheat market too far into a corner is an extreme example of complete physical and mental immersion in the market. It is also an example of the market’s rhythms overtaking the mind and body of the trader, rather than the reverse. In his attempt to corner the wheat market, Jadwin becomes gradually more withdrawn from his private and social life. Even when he is at home, the market does not seem to loosen its grip –indeed, it almost completely preoccupies his waking hours:

“Only one function of the complicated machinery persisted; but it moved with a rapidity of vibration that seemed to be tearing the tissues of being to shreds, while its rhythm beat out the old and terrible cadence: ‘Wheat – wheat – wheat, wheat – wheat – wheat’”. (Norris, 1994 [1903], page 343)

So while Landry Court had only to cope with the internalization of the market rhythm during the CBOT’s opening hours, Jadwin’s mental machinery (including his market-external everyday life) has become one with the market machinery and is overtaken by its rhythm. This is *The Pit*’s most visible illustration of the Lefebvrian idea that capital is destructive and that its rhythms are fundamentally different from, yet tend to infiltrate and dominate, the non-market rhythms of everyday life.

*The Pit* suggests that, in pit trading, calibrating the body to the perceived market rhythm is (was) central to traders, even to the extent of not merely using

the body as a metronome but letting it merge eurhythmically with the market rhythm, which entails a risk of the self becoming subsumed. Other accounts of financial markets would seek to pin down, and then respond to, the dynamics allegedly underpinning market rhythms. A prominent example of this approach can be found in the tradition of *contrarian speculation*, which was developed in popular, non-academic ‘how to’ books in the 1920s and ’30s. As Urs Stäheli (2006; 2013) has demonstrated in his analyses of the contrarian tradition, one of its central observations was that market fluctuations could be *deceptive*, to the extent that they become contagious (a possibility that Lefebvre does not address). More specifically, advocates of contrarian speculation argued that since markets are made of people, and that people are gregarious by nature, then upward or downward market movements should not be taken at face value. Such fluctuations were thought to be expressions of collective emotion, opinion, or sentiments at large, rather than reflections of real changes in the value of, say, stocks. Contrarians found themselves constantly searching for the perfect balance between observation and participation, i.e. being able to detect the psychological rhythms of the market without having their own psyche contaminated by the market crowd’s purportedly irrational behavior. Neither the trader’s own body nor the bodies of other traders were to be trusted. The problem of how to overcome this enormous distrust stood between the contrarian trader and the actual practice of trading (see e.g. Kelly, 1930; McNeel, 2005 [1921]; Neill, 2007 [1931]).

How then did the contrarians deal with this distrust and the lingering fear of mental contamination? According to the father of the “theory of contrary opinion”, the Vermont Ruminator, Humphrey Bancroft Neill (Neill, 1963 [1954]), the first step was to acknowledge that understanding how markets behave presupposes familiarity with the psychology of the market crowd (Neill, May 1930, pages 9–12). In the eyes of Neill and other proponents of contrarian speculation, market rhythms usually reflect the masses’ overexcitement or unsubstantiated pessimism (which arises from a fear of losing), rather than the true value of, for instance, stocks. On this basis, the next step was to deploy a series of techniques recommended in the contrarian literature, which would ensure, so it was claimed, that the individual investor would remain unaffected by contagious market rhythms. For instance, in his ‘how-to’ guide *Speculation: Its Sound Principles and Rules for its Practice*, which Stäheli does not examine, Thomas Temple Hoyne outlined the following rules for the average speculator: “He [*sic*] must never buy or sell on impulse; he must never allow himself to be poisoned emotionally and swept into the unconscious unity of crowd action” (2012 [1922], page 56).

In order to avoid the problem of market rhythms entirely overtaking the body and everyday life, such as befell Jadwin in Norris's novel, Neill recommended that the individual investor use certain techniques to prevent him- or herself from becoming too affected by contagious market rhythms (in fact, it may be argued that contrarian investment theory is one big attempt to prevent market rhythms from entirely contaminating the individual trader). One such technique was to fixate one's attention by using "pad and pencil" to record movements in the market (Neill, 2007 [1931], page 85). The aim of this technique was to calibrate, in a literary sense, the body as a metronome of the market, in a manner that focused attention on the market rhythms without the individual becoming *mentally* subsumed by the rhythms' contagiousness. In other words, Neill essentially argued for the need to separate the bodily and mental rhythms of the investor: while the former might merge eurhythmically with the market rhythms, it was critical to ensure that the latter did not. Having achieved such arrhythmic discord between market rhythms and those of the self, the contrarian investor could then begin to make money by speculating against allegedly irrational and (for others) contagious market rhythms.

The conceptions of traders and market rhythms in Zaloom's work, in *The Pit*, and in contrarian thinking address a distinction that is not systematically discussed in Lefebvre's rhythmanalysis, namely between bodily and mental rhythms. In the writings on pit trading, it is often assumed that the two unite in eurhythmic harmony (an assumption that also seemingly underpins Lefebvre's rhythmanalysis): in other words, what happens to bodily rhythms also happens to mental rhythms. The novelty of contrarian speculation might be said to lie in seeking to profit from separating the two – accepting that the bodily rhythms are colonized by the linear rhythms of financial markets, and putting one's faith on the mental rhythms' ability to resist this colonization. Viewed more conceptually, this distinction recall the discussion of the connection between society's rhythms and the rhythms of bodies. Lefebvre, as noted earlier, tends to be interested mainly in exploring how the former impact the latter. The contrarian position, on the other hand, invites us to consider this relation in more complex terms, namely as a matter of how "linear and cyclical rhythms are intercalated with and through" not only a body, but body *and* mind (Simpson, 2008, pages 815–16). As we shall argue in the next section, algorithmic trading and the traders operating the algorithms are enmeshed in precisely such intricate situations of polyrhythmia, i.e. situations with a multiplicity of simultaneous rhythms.

### **Algo-rhythms and high-frequency trading**

Upon entering the trading room of an HFT firm, one is surprised by the lack of intensity and noise so characteristic of the pits. High-frequency traders are typically isolated from one another behind their screens. The silence might be broken by a mechanical ‘fill’ sound: in some firms, software simulating the sound of an old-school cashier chimes each time one of the traders’ algorithms earns a solid profit. Traders sit in front of their screens, focused upon the codes constantly running in front of them. They discuss algorithms, coding language, and programming software, but the market’s moves are rarely mentioned – economic fundamentals, even less so. A HFT trading room often consists of 7–10 algorithmic trading desks. The desks are placed some distance from one another, with the traders encircled by multiple screens. The visibility created by the architecture of the pit described above is replaced by a machinic constellation, with traders facing their screens. Consequently, bodily proximity is replaced by trading screens, and by walls that delineate each trader’s working space. No one yells or points at each other. Some traders have privacy filters on their screens to hide the source code.

It could seem that the transition towards HFT radically questions the relevance and usefulness of Lefebvre’s rhythmanalysis. Since HFT-dominated financial markets are principally focused on making algorithms faster than their competitors, the question of the human body and its relation to market rhythms appears obsolete. And yet, we will argue, this is only seemingly the case. Upon closer inspection, rhythmanalysis in fact offers a valuable tool – not for understanding the disappearance of bodies from trading, but for understanding how bodily rhythms and market rhythms are reconfigured through the technological developments that characterize HFT.

In this context, it is helpful to extend the above description of HFT trading rooms by focusing on how the individual traders relate to their computers. For example, one of the traders we observed sat facing two sets of screens. One set offered a visualization of the electronic limit order book, showing the bid and ask prices. These screens basically depicted the rhythms of the market, but interestingly, the trader paid hardly any attention to them. Instead, his<sup>4</sup> attention was directed toward the other set of screens – six in total, illustrating the operations of the trader’s algorithms, the coding, and graphs of, for instance, yield curves. What this suggests is the broader point that, in HFT, traders do not use their bodies as a market metronome, nor do they seek to merge eurhythmically with market rhythms. Instead, they *calibrate their bodily rhythms to their algorithms* (and

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<sup>4</sup> We have not so far encountered a single female high-frequency trader.

thereby *indirectly* to markets), which includes programming new algorithms but also detecting and responding to bugs. One aspect of this calibration relates to ensuring close physical-bodily proximity to the algorithms. When “algo-rhythms” (to use the expression of Miyazaki, 2013) are at the center, “you can’t afford to crash, you can’t have a blind spot. You can’t have three hours where you are out and don’t check the algo”, as one HFT trading group manager put it. However, it may at times be necessary to leave the algorithm, if only for natural reasons (although the HFT environment abounds with stories of traders being so fixated on the algorithms that they do not even go to the toilet). In order to deal with this, many high-frequency traders have an application on their phone that alerts them in the event of abnormalities, meaning that the eurhythmic merger of bodily and algorithmic rhythms can be maintained even when they leave their screens.<sup>5</sup> At times, however, this eurhythmia might be interrupted by sudden breakdowns (e.g. a power cut due to extreme weather conditions, or the breakdown of Bloomberg terminals, as happened in April 2015), and the traders need to be able to deal properly under such circumstances. A former CTO of a major HFT trading firm explained that he would sometimes pull the plug without giving his staff any pre-warning. The point of this was not merely to monitor whether the staff could react fast enough to such breakdowns; rather, it was an exercise in training new staff to emotionally deal with such externalities without being too aggressive, punching the screens, or yelling at their colleagues.

The reason why HFT traders calibrate their bodily rhythms to algorithms rather than directly to market rhythms is that, in fundamental ways, market rhythms have become increasingly out of sync with natural body rhythms. This is a result both of temporal market *extension* and *intension* (the latter of which we shall return to below). Temporal market extension has to do with markets being open virtually 24/7. For example, the US traders we followed operate on the futures market, which is open 23 hours. Consequently, the traders use working shifts to ensure that their algorithms can be constantly monitored during the market’s opening hours: some traders develop and monitor the algorithms during daytime, others during the night. Lefebvre (2004 [1992], pages 30–31) notes that the nocturnal rhythms of the street are slower than their diurnal counterparts, and similarly it is not uncommon that night traders fall asleep during their shift, as their natural bodily rhythms are not well suited to nocturnal work. At the same time, the high-frequency trader who developed the algorithms would often

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<sup>5</sup> The interview situation would often interrupt this eurhythmia. It was a regular occurrence during our conversations, meetings, and interviews with high-frequency traders that their phones would start to vibrate in their pockets or flash a signal. The trader would then take a quick look at it and immediately leave the meeting, saying something like “sorry, I need to check the algo”. They would dash back to their desk and resume working on the codes.

encounter difficulties in leaving the algorithms to be monitored by somebody else. Not only does proper monitoring require an in-depth understanding of how the algorithms operate, the traders need to trust that the person monitoring their algorithms will alert him or her in time if something seems to be “out of normal”. As a result, high-frequency traders often describe the ideal trader as a “machine”, i.e. someone who can work on his or her code non-stop for two days, without sleep. Yet since humans are not machines, traders might use various ‘optimizing’ substances to calibrate their bodily rhythms to those of the algorithms (diurnally as well as nocturnally), and thereby minimize the opposition Lefebvre identified between the linear time of calculation and the cyclical ‘lived’ human time. Further to the previous discussion of how to conceive of the relation between bodies and society, this use of substances suggests that high-frequency traders’ bodies are not simply an effect of the rhythms of society, markets, or algorithms. However, nor would it make sense to center the analysis on the trader’s body *itself*. Rather, what we see here is that, through substances, bodies are *modified* to be able to relate in allegedly optimal ways to the perceived rhythms of markets and algorithms.

While the market extension might suggest a heavy algorithmic pervasiveness on financial markets today, certain cyclical rhythms characterize the algorithms’ periods of high and low activity. Regarding the latter, the high-frequency traders we followed would usually suspend their algorithms around the announcement of key economic numbers (announcements that themselves are cyclical in nature). They would do so because such numbers would often produce unpredictable market activity. One trader explained:

“[A] few times a day economic numbers come out across the world, almost every day. What we do [when this happens] is [...] what is called whitening out, where we pull our bids and offers and then [after a while] we resume our market activity”.

In other words, events such as announcements are examples of particular market patterns that repeat themselves over and over again. However, since it is deemed too risky to program HFT algorithms to try to profit from such patterns, traders instead prefer to pause trading until they have other types of data (namely, orders) that provide a better basis on which to predict market trends.

This is an example of how the linearization characteristic of financial markets is briefly suspended, even within a regular rhythm. However, there are other, more mundane obstacles to linearization. Cyclical natural processes are one such obstacle. Today, financial data transmission increasingly takes place through

microwaves, as this method is faster than transmission by fiber-optic cable. However, compared to fiber-optics, microwave transmission is less reliable, as it is susceptible to atmospheric conditions. This means that cities with regular heavy rain are less prone to host the types of linearization produced by the most recent advances in high-frequency trading technology (see MacKenzie, 2014a; see also 2014b). In other words, the cyclical here counteracts linearization.

While what we have discussed so far is consistent with basic analytical ideas from Lefebvre, HFT constitutes a field that invites discussion about the need for *a different kind of rhythmanalysis*, one in which the human body is not necessarily at the center. This relates to the market *intension* we mentioned above, which concerns the speed with which HFT operates. By utilizing microwave technology, the current roundtrip time for data transmission between Chicago and New York (the most important route in US financial markets) is about 8.1 milliseconds. By comparison, a blink of an eye takes 3–400 milliseconds. Since HFT algorithms are operating at such super-fast speeds that far surpass human perception, their rhythm is fundamentally incompatible with a human timescale. Against this backdrop, we might ask if it makes sense to conceive of a rhythmanalysis that draws on Lefebvre, but dispenses with his foregrounding of the body. We will argue in the following that this does indeed make sense, although we are well aware that discussing Lefebvrian rhythmanalysis without addressing the role of bodies requires a heterodox reading of Lefebvre. And yet rhythms certainly do seem to be present in HFT – and much of the activity of HFT algorithms is about relating to and seeking to make sense of market rhythms.

One commonly used HFT strategy is arbitrage, in which, for example, traders profit from prices being out of sync. This may relate to price differences between similar products or between identical products being traded at different exchanges. Such arbitrage, where profit is made when one price is seen as being out of step, is based essentially on particular market rhythms – some products may move in tandem (such as the S&P 500 index and the Spider EFT), and therefore HFT algorithms can make an easy profit by detecting irregularities in this rhythm. More complex strategies seek not merely to react to rhythmic irregularities but rather to anticipate market rhythms. An HFT analyst explains:

“Manual markets are reactive; an opportunity shows up and you react to it. In an automated market, you have to be proactive; you have to be there waiting for the opportunity before it exists [...] Anytime you’re dealing with computer programs, you have to be proactive. So a high-frequency trader who wants to make a trade has to get there before the opportunity to trade shows up”.

In relation to anticipating market rhythms, an important piece of information is whether specific orders are filled or not. This is valuable market information, because each order is initiated as a message to the market – and upon its return, it brings information about the market’s next moves. Given the speed with which this occurs, the anticipation of market rhythms is essentially a question of understanding how various algorithms are ‘dancing’ next to one another. However, this is not a dance that seeks to achieve an overall harmony. According to one high-frequency trader, “[i]f we feel that someone is anticipating what our next move might be, then we might switch to a different algorithm”. In addition, as the importance of whether orders are filled or not illustrates, information about market rhythms can only be obtained by participating in the dance. “You read the market by active participation”, as one trader put it. This also means that ‘being in the zone’ assumes a new meaning in HFT. It is not about bodily and/or mental immersion in markets, but about being algorithmically present in markets in order to be able to sense their rhythms and proactively adjust the strategies on this basis. However, the dancing of algorithms – to adhere to this image – need not lend itself to immediate interpretation (and hence proactive adjustment). Lefebvre notes that the rhythm analyst must “listen to the world, and above all to what are disdainfully called noises” (2004 [1992], page 19), and in a similar manner, a central part of understanding and anticipating market rhythms concerns distinguishing information from noise (see also Black, 1986). What is noise to one algorithm may be market rhythm to another.<sup>6</sup> This is the central challenge for HFT algorithms, and the level of complexity involved is far greater than was ever the case in pit trading. Whereas pit traders could derive useful information from apparent noise (e.g. the facial expressions of fellow traders), algorithms operate in a polyrhythmic world beyond human perception where, it might be speculated, mutual co-ordination (e.g. being ‘in the zone’) is more likely to produce a cacophony rather than harmony of rhythms (and rhythm interpretations).

## **Conclusion**

This article has deployed Lefebvre’s rhythm analysis in an examination of financial markets. The analytical advantage of Lefebvre’s work lies in its foregrounding of the role of the body. We have argued that this foregrounding

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<sup>6</sup> The struggle to separate noise from information hints at how algorithms might be considered as something different from instruction-based repetition. A central aim of many trading algorithms is to recognize the recurring rhythms of other algorithms, which involves detecting stops, silences, blanks, and irregular intervals. Consequently, rhythms are both anticipated and provoked in the order book.

adds new insights into financial markets, and especially into how traders relate to them. Specifically, we have demonstrated how traders operate as rhythm analysts in different market configurations, such as open-outcry trading and present-day HFT. We have further demonstrated that, while traders seek to calibrate their bodies to rhythms in both pit trading and HFT, there are important differences in how they do so in these two market configurations. Whereas pit traders would seek to establish a eurhythmic merger of bodily and market rhythms, high-frequency traders are preoccupied with ensuring that their bodily rhythms correspond to those of their algorithms – and therefore only indirectly with market rhythms.

While the article has drawn much inspiration from Lefebvre, it has also pointed to certain limitations when it comes to applying his rhythm analysis to the everyday activity of financial markets. For example, we have argued (as per Simpson) that the connection between bodies and society is less clear-cut than Lefebvre proposed. Similarly, Lefebvre's tendency to see linearity colonizing the cyclical has been questioned – or at least nuanced. Finally, and most importantly, we have argued that while rhythm analysis holds great promise, including in terms of understanding financial markets, its foregrounding of the body might – despite its productive insights – conceal key rhythms of current HFT markets. As such, there might therefore be a need to further develop Lefebvre's ideas, and to explore how his rhythm analytical program could be revised to account for rhythmic constellations in which the central market activity plays out on the level of interacting computer algorithms.

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