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Geographies of High Frequency Trading - Algorithmic Capitalism and its Contradictory Elements

> *The entire commercial existence depended on being faster than the rest of the stock market*" (Lewis 2014, p. 18) *"In high-frequency trading (...) time shrinks, but space doesn't'"* (MacKenzie et al, 2012, p. 286).

1. Introduction: Turbulent Financial Worlds

Since 2007, we have experienced one big economic crisis with a temporality of years and months, weeks and days. We have also experienced 10 crises in minutes, around 300 crashes within seconds and more than 3.000 crashes in microseconds. Therefore, within the global financial crisis we experience turbulent financial worlds, with crises and sub-crises that exist in the interface between different temporalities. For this reason space-time compression (Harvey 1989, p. 240) or what I would tend to call space-time implosion, becomes of crucial importance to understand the radical new dynamics in the financial market – but also more broadly - to understanding the dynamics of contemporary finance driven accumulation regimes.

Much in the wake of the global financial crises, economic geography took up a new financial agenda (Martin and Sundley 2011) partly reintroduces the relevance of finance as political economy, partly in the search of new conceptual economic geographies. As Sokol (2013) argues, there is a need for new "conceptualisations of economic geographies if these are to provide a solid analytical handle on financialising economies (Sokol 2013, p. 501). While financial geographies covers a vast spectrum of areas, including hedge funds (Teo 2009), carbon markets (Knox-Hayes 2013), geographies of investment banking and inequality (Wojick, 2012), finance and the housing crises (Martin 2011) and financialization of the environment (Lofthus 2015), little attention have been given to the geographies high frequency trading (HFT). Zook and Grote (2014), study micro geographies and automated time space compression, Lewis (2014) note how HFT is all about speed in coping with the travel distance between match engines. MacKenzie (2014) turn to laser beaming of stock market data over New Jersey and Muellerleile (2013) looks into performativity in between time and space. This paper by contrast, examine the ways in which HFT produce contradictions in operating at different spatio-temporalities.

In doing so, this article address the following questions. What constitutes crashes in minutes, seconds and microseconds, how are they driven and what are the spatio-temporal implications hereof?

Located within the theoretical underpinnings of David Harvey's Limits to Capital (1982), the first section conceptually elaborates on the work of algorithms in space and time, under which the value of speed is examined. The paper goes on to discuss spaces of timing under continuous acceleration. Hereby three its contradictory elements are addressed. Lastly it is discusses whether capitalism in the form of high frequency trading not only contributes to accelerate crises, but also make crises worse.

Time Shrinks - but space Doesn't?Michael Lewis' (2014) extensive and beautiful writings on high frequency trading conveys the relevance of slicing time into ever-smaller fractions as speculative strategies. To Lewis, the present advantage lies in exploiting knowledge faster than competitors do, in order to preserve financial and ideological control. "The entire commercial existence depended on being faster than the rest of the stock market" (Lewis 2014, p. 18). Though trading in high frequency goes towards the highest possible acceleration of capitalism (the speed of light), by the ways in which laser beamers have now come replace fibre-optic cables (data only travel 2/3 of light in vacuum), speed is of not only interest (Patterson 2014, MacKenzie 2014), but also the expansion and acceleration between different spatio-temporalities.

Whereas Lewis is fully aware that 'time competition' is (a)counted by the travel distance of market information from A to B, hence limited by 'physics' (speed of light), he come to a similar conclusion as does Donald MacKenzie et al., (2012): trading in high frequency is all about speed - time shrinks, but space doesn't. The implication appears to be that time and space need to be separated ontologically – or at best – that time shrinks faster than space. In the following, it is argued that Lewis' (2014) and MacKenzie's (2012) contribution is not only limited as to the matter of time and space, but also illustrate how the spatio-temporal perspective(s) we offer, is imperative to emancipate contradictory elements of these accelerating mobilities of capital.

Let us first turn to explanations in conventional economics. One bounce of explanations, e.g. represented by the U.S. Commodity Futures Trading Commission (CFTC) and the U.S. Securities and Exchange Commission (SEC), suggest that crises at sub-second level are ensured because large traders use automated execution. Selling large volumes in high frequency, affect prices because of changes in market depth. Thus, HFT may produce imbalances if the rates of incoming orders that require execution in microseconds outpace the market depth of buy interest. Therefore, in general HFT improves liquidity, and turbulence is only part of such improvements (Herndershott, Jones and Menkveld (2011). Such arguments are put forward by the owners of the means of HFT production such as investment banks, holding systems or hedge funds. Another set of explanations, e.g. promoted by Deutsche Bank (2011) among others, is that the volume of HFT is never constant, exactly as for the market in general. In peaks of trading, therefore, fluctuations are only result of corrections to supply and demand within these time frames. The result is the same. HFT improves liquidity and equilibrium between supply and demand. A third set of explanations emphasize how

HFT takes into consideration small variations in prices of a particular share traded at different markets simultaneously. Insofar as difference exists, turbulence is a result of corrections to new 'states of equilibria' within microsecond (International Organization of Securities Commissions, 2011). Once again, in the name of the free market, HFTs improve liquidity and correct price differences across markets. Thus, all three explanations suggest (apart from the liquidity thesis) that HFT does not trigger crises within these fractions of time; HFT responds to them. Whereas the first two set of explanations only consider time, the third integrate a spatial framework in that it argues through new technological devises we can better overcome (more effectively) space through faster distribution of market information.What characterizes these conventional explanations is that, the matter of time and space is abstracted in ways that hold space fixed as a constant (Harvey 1982), time as the variable, illustrative to the challenges also Lewis (2014) faces.

2. Spaces of timing – and the value of a millisecond

What is different from other electronic trading is not only the astonishing speed when trading in high frequency. It is either only the ability to carry orders within microseconds making potentially the same share changing hands thousands of times per second, or the ability to take into consideration financial news and key reports before everyone else (Groß-Klußmann and Hautsch 2010). HFT is (temporary) non-human trade (Haug 2012). No person will ever be able to compete against these algorithmic strategies, and yet it is not algorithms that profit from these HFT strategies.

The value of speed relies on access to market information before the competitors. What is sold is access to 'free market information' before the competitors, or as Lewis (2014, p. 30) puts it, it is essentially speed. The entire existence depends on being faster than the rest of the stock market. Thus it is knowledge about private space (ownership of a share as boundary making) that is exploited (exploits) and constituted in public space (the market place), in ways that create temporal 'market informational' monopolies. When algorithms speculate within microseconds, it reduces information to only a matter of affecting the immediate form of appearance (Haug 2012). In socio-economic decision-making information is reduced to be relevant only within that particular timeframe, whereas other spatio-temporalities are outraged. Algorithmic capitalism, therefore refer to a process whereby the value of speed is essential to appropriate value out of other processes. Insofar as it is speed that is traded, it only have value to the extend it is a scarce resource. It follows that time can only be a scare resource to the extend it is contradictory to or separated from other time scale. Market dealers operating at slower time scales, are potentially based on late, say irrelevant market information (Zook and Grote 2014). Further, if it is time that is traded it both has a use value and an exchange value, yet based on the value and the exchange value of the products it relies upon.

Consequently, exchange value takes form also as temporal exchange value (sliced into ever smaller time fractions). This aligns with what Wolfgang Haug (2012) has termed information rent. Information rent, however, has a spatio-temporal dimension too. Information rent, therefore be extended into what I term time rent or rather a spatio-temporal rent; simply because this information has only value in micro seconds. Insofar as a time-information rent, tax or thievery exists (according to whose perspective) it refers to the financial time exploitation; to the (unequal) access of temporal market information between actors. Wherein market competitors receive 'free market information' in milliseconds, microseconds or seconds between one another this is among others dependent on the technologies used, the traders location to the match engines (servers), as well as the distance to other traders (MacKenzie 2014). As far as trader's access to free market information is relative to the geographical distance from the match engines, it converts into temporal-informational epicenters with a particular profitability time-ratio in play, relative to the speed/distance, relational location or co-location. This is the reason why firms are willing to invest millions to billions of dollars for faster technologies, cables, algorithms or simply buying 'first access packages' (MacKenzie et al., 2012). Subsequently, algorithmic capitalism has a strong spatial and hence specifically geographical dimension, due to the differential temporal and spatial scales associated with accelerating mobilities of capital. Time rent, (with multiple temporalities) therefore, is relational to and convertible to a form of 'land rent' not only through the scalar (and slower) process of circulation for fixed or productive capital, but also by the ways in which extraction alienates through the appropriate capacity of the commodities/information upon which the time rent is dependent. The most illustrative example how HFT firms rent space to locate their servers next to an exchange engine. This has driven real estate prices to astonishing rates (fixed capital up to $10,000 per month) for 0,5 M^3. Another way to give an indication of relative profitability, invisible tax or thievery (according to whose perspective) is to estimate turnover from an average HFT trade. Lewis (2014) estimates it to be 0.1 percent of the total price. Pooled with a daily trade volume at $225 billion in U.S stock market (2012), this makes up $160 million a day.

As the temporality of HFT strives towards the highest possible acceleration of capitalism (the speed of light), it both stretches (expands) and alienates the contradictory elements to the use value of the products it relies upon and run against physical, hence spatio-temporal limits. This is the reason why I talk about time-space implosion. As capitalism accelerates, according to the work of David Harvey (Limits to Capital, 1982), it needs to compensate by expansion geographically in order to survive. Nevertheless, if everything is about speed, it both opens spaces for actors operating at slower temporalities as it is dependent upon them. Rather, therefore, there are limits to HFT. As capitalism accelerates, there is however another synergetic dynamic relevant to address.

3. Accelerating capitalism – accelerating contradictions

As capitalism accelerates, market dynamics run faster. Likewise, as capitalism accelerates, the markets internal contradictions run faster. Consequently we will observe crashes and bubbles more

frequently in a given time-scale ratio. The UK foresight project (2011) exemplifies the acceleration perfectly well. If financial capital operates with and without algorithms, we have two temporalities working at different scales (t/t). *"Imagine a movie which you slow down frame by frame. Then, HFT slows down and become low frequency trading, such as daily trading. If the correspondence is 1 second of HFT corresponds to 1 day of low frequency trading in 1962, say, then one crash per year in 1962 would corresponds to one crash every 4 minutes in HFT time!"*(UK Government Office for Science 2011, p. 10).

This is an extraordinary explanation and it points to the markets internal contradictions run faster, because algorithms intensify the production of them, while responding to them. Yet the illustration is incomplete. The reason why the illustration is incomplete is that it does not take into account interconnections between different temporalities at work at different markets (spaces), or the relation between financial and productive capital. What it essentially also implies is that the profit from financial capital represents another temporality than productive capital (working capital). In consequence new formation of knowledge exploitation have different temporalities, in which generation of profit in HFT time systematically exploit actors operating at slower time scales. The acceleration of capital seems consequently to restructure its production of uneven development. Different temporalities between fixed capital, productive capital and financial capital thus reconfigure the geographical distribution of wealth and crises.

But this has further implications. As Harvey (1982) observes, capitalism has an inherent logic of expansion (and concentration) in space and acceleration in time. Against that background, he suggests that the space-time processes of capitalism rely on fundamentally contradictory elements. To Marx, primitive accumulation is constituted through industrial capital (Harvey, 1982). During the past decades however, financialization has gone away from investments in real economy, toward profit seeking activities in the financial markets. Today, financial capital dominates the world market and in 2007, financial assets reached 450% of GDP in the United States and 356 % in the EU. *"By way of illustration: the global value of financial assets (which means: debt) in the whole world by September 2008 - as the crisis was exploding with the collapse of Lehman Brothers - was $160 trillion: three-and-a-half times larger than the value of global GDP* (Sassen 2009).

One difference from the global financial crises (with injection of trillions of dollars of Governmental liquidity into the financial system, frankly to support financial capital to keep going) from previous ones, is that financial capital dominates, hence inherent tensions and dynamics between fixed, productive and financial capital in time and space. Thus, the past decades demonstrate continuation in the geographical imbalances of relations between fixed, productive and financial capital under continuous acceleration. Despite the financial crisis, the introduction of HFT increased dramatically. From 2006 or so,HFT has gone from being a niche strategy to a lucrative industry executing approximately half of the US daily trade volume (Lewis 2014). As the circulation of financial capital has accelerated exponentially,the issue of how microstructures in algorithmic capitalism affects large macro-structures in days, months and years is most important. Not only because finance capital has been extraordinary in extraction of value from other economic sectors, at ever accelerating rates, but because a significant volume of assets correlated in HFT,

have impact on macro-economic forces too. According to the explanatory framework from conventional economics, we set out in the first section, HFT stabilizes price variations between a particular share traded at different markets simultaneously, hence minimizing fluctuations and improving liquidity. The greater the variation in or between markets, however, the better chances to profit from the bid-offer 'spread' and market fluctuations. Strategies involved in quickly placing and removing false orders (e.g. piggybacking, quote-stuffing or spoofing) in effect have the manipulative purpose to bike on or create waves (IOSCO 2011), fluctuations or market differences and thus contribute to make them worse.

What blinds so many of us, including politicians, is that algorithmic ideology has the capacity to transform technological tricks, into manifestations of "entrepreneurship" and innovation or even research and development, while it at the same time essentially is manipulation of information and accumulation by dispossession.

4. Conclusion

Algorithmic capitalism is part of financial capital and exists in the interface between multiple spatio-temporalities. Algorithmic capitalism is produced by high frequency trading (HFT) and operates in ways that differentiates the rhythms of economic cycles between industrial and financial capital. Subsequently, it has a strong spatial and hence specifically geographical dimension, due to the collapsing of temporal and spatial scales associated with accelerating algorithmic mobilities of capital. HFT create temporal monopolies, accelerates contradictions while simultaneously producing implicit financial scalar politics and techno-idealism(s).

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