

SOAS – University of London, London – UK.

April 21, 2017

Digitalized Finance: The role of ICT in the process of financialization of the Brazilian economy

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I would like to begin saying that a simple but important thesis is going to be underlying my whole presentation here: that there is a correlation, a selective affinity, or, better said, a *structural causality* between the development of information and communication technologies (ICT) and the financial dominance observed in the economies all over the world, especially by the 70's and 80's, a process broadly addressed in the economic literature, as we know, as financialization. In other words, I want to stress how a bunch of technological innovation supports the deepening of this structural change in capitalism – conceptualized by some, as Chesnais (2002) and other authors of the French school, as *finance-led regime of accumulation* or even *flexible regime of accumulation*, as called by David Harvey (1992) and others.

More than review what financialization is in its historical, economic and systemic aspects – a long and dense debate – I will focus on how this *structural causality* can be observed in financial markets, and especially in the Brazilian capital market, in the period that goes from mid-90's until now – when the country suffered a neoliberal reform, adopted a new currency (the Real) and opened its market to international capital.

I start with a brief overview on what I've called *Digitalized Finance* (Paraná, 2016), here understood as the technical-operational complex of circulation, accumulation and valuation of financial capital through automated technology resources.

1. The state of the art on Digitalized Finance

That old famous image of a noisy and messy stock exchange market, almost a metonym of financial capitalism, barely exists nowadays. In silence, the physical space of the stock exchanges, as well as the individuals themselves that used to shout inside them, have now little or no practical function.

Trades, as most of you may know, now occur in powerful computers and data centers operated 24 hours a day around the world. In place of the old auctioneers, buyers and sellers of

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shares, are physicists and astrophysicists, statisticians, mathematicians and economists trained in the top universities. These individuals are the ones who design algorithms and automated trading strategies that are performed in milliseconds speed through these systems. The “animal spirits” of markets, as the well-known Keynes’s expression, free of many of its material bonds, now run on the lines of high speed optical fiber transmission or ultra-fast radio waves. This important change took place thanks to the advancement of Information and Communication Technologies that happened especially in the last two decades. Without the help of such technologies, a set of various ongoing financial instruments could not exist or be negotiated, setting thus qualitative and quantitatively different markets from the current ones.

As we know, institutional and regulatory changes related to the neoliberal framework brought about, especially around the 1970s and 80s, increasing competitiveness. This paved the way for a market structure favourable to automated trading. Since the early 80s, with the acceleration of the structural economic transformation process defined by some as “financial mundialization” (Chesnais, 1996) such technological advance, follows, in relation to capital markets, basically, two major trends: i) strong investment in building production systems and dissemination of information in real time and ii) production of means which allow conducting simultaneous trades in different markets as fast as possible.

Thus, following this tendency, the human operator is replaced by a software (or a “robot”), and the difference of time required to place a bid at the front is shortened to milliseconds, which is precisely the time that a robot takes to make a decision, based on technical standards currently available.

The increase in volume and speed of business in the now liberalized markets, in turn, forced a reconfiguration of trading venues. Within a few years, the time used in the processing of offers and business closures in the stock markets was, as I said, no longer being measured in minutes and seconds but in milli, micro, and even nano seconds. This is an important competitive advantage at the hands of actors who have such resources, and are, thus, enticed to reuse their increased earnings to finance advances in this specific field of technology. As a consequence, the technologies are quickly overcoming one another in the level of capability and sophistication, imposing new challenges and difficulties for all categories of investors.

Among the most important logical and cognitive backgrounds that enabled the automation of operations in the markets is the sophistication of the mathematical models used to price and to forecast financial assets performances in shaping the role of negotiation strategies. It’s known that such advances have had a major impact on the evolution of information technology as a whole. In financial markets, particularly, the search focused primarily on developing complex models supported by powerful algorithms to predict the behaviour of markets and thereby gain an

advantage in trades. Since then, even after the 2008 financial crisis, when many were put to the test and failed, these algorithms are custodians of a fervent confidence of agents. This kind of “reification” encouraged investors to put their faith in these technologies as “all powerful” instruments.

Such trading algorithms have become the cognitive support base of these orders execution “robots” that automatically buy and sell assets in the markets. Over time, these mathematical models become more and more sophisticated as the data processing capability and quality of information used on parameterization advanced. This gave rise to what is called Algorithmic Trading (AT), automated trading by computer, which runs mathematically oriented strategies to obtain financial gains in the markets.

The High Frequency Trading (HFT), direct offshoot of this technical advance is nothing more than a form of Algorithmic Trading carrying out orders at extremely high speed thanks to the help of cutting-edge information technologies in multiple dimensions (like software and hardware network infrastructure). The most sophisticated automated trading mechanisms use computer learning and artificial intelligence to extract gains through knowledge of the markets trading structure and information on investor-order flows. The general principles of this trading model are basically: i) labor savings and reduced risk of “human factor” (emotions, subjectivity) via automation, ii) increase in speed and trading volumes to achieve economies of scale by small arbitrage conducted thousands of times in very short time intervals, and simultaneously iii) obtaining certain “omnipresence” in the operationalization of trades through high-volume data processing and information on markets prices, offers, and so on.

It’s necessary to remember that this “annihilation of space by time”, as part of capital contradictions movement, was somehow anticipated by Karl Marx in *The Grundrisse*. I quote:

“Thus, while capital must on one side strive to tear down every spatial barrier to intercourse, i.e. to exchange, and conquer the whole earth for its market, it strives on the other side to annihilate this space with time, i.e. to reduce to a minimum the time spent in motion from one place to another. The more developed the capital, therefore, the more extensive the market over which it circulates, which forms the spatial orbit of its circulation, the more does it strive simultaneously for an even greater extension of the market and for greater annihilation of space by time” (Marx, 2013, p. 538-539).

In recent years, the adoption of automated trading has grown considerably. They are already present in about 40% of all stock trades in Europe (UK included) and somewhere around 50% to 60% of all trades with shares in the United States. In Brazil, about 40% of all businesses in the stock exchange are performed by robots in automated strategies.

Anchored in the increasing use of high speed automated trading, this new model leaves

qualitative assessments of market behaviour and listed companies' economic health to match buy and sell orders using basically two variables: time and price. We know that is part of the financial dominance logic in itself, but the intensive use of technology makes such logic even more urgent, especially for large investors. Thus, brokers and even stock exchanges are forced to reconfigure their business models.

In this scenario, where the increasing reduction in operating times benefit and attracts investors, especially those who trade large volumes, the ability to quickly receive and send information about what is happening in his trade books has become crucial to the competitiveness of stock exchanges, that even charge by some of these data, at least the more stratified. In response, they embrace even more the model of electronic trading, adopting technological advances and solutions to attract clients with this profile. In consequence, short-term business, daily range (intra-day), focused on speculation, and more susceptible to competition around speed, gain additional incentives to be dominant. In this way, a circle is formed: the growing search for quick gains and short-term insurance enables the development of new strategies, tools and technology solutions for conducting automated trading at high speed. Such advances, in turn, enable and expand further such earning opportunities, encouraging that more resources are allocated to the advancement of this trading model.

2. Mapping Digitalized Finance

Generally speaking, this digitalized way of governing finance, as part of a new globalized financial system, operated in "real time" with intensive use of technological features, is characterized by three major tendencies: i) first, the compression of space-time flows in search of speculative gains; ii) the creation of new difficulties for the control and regulation of markets, and, finally, iii) the deepening of capital concentration and centralization in the hands of a small group of financial capitalists, located in few central markets around the world, specially US and Europe. I combine this three trends in what I've called *The Digitalized Finance operational cycle*.

PICTURE 1

As we can see in picture 1, these tendencies are articulated in the model first by the growth in the number and volume of trades; second, and more important, by the consequent increase in financial gain, and finally, third, by the increasing of technological investment.

As this process does not happen only by the use of technological advances, though these are fundamental its objectification, this cycle is here correlated with what I'm calling the *The Digitalized Finance spiral of complexity*, which we can see in picture 2. This is a way to summarize one of the main processes that I've observed in my fieldwork in the markets: growing

operational complexity and growing opacity as a result of technological competition – an arms race which, as we know, is a genetic tendency of capitalist mode of production in its own systemic aspects. This spiral is linked to the sieve magnification of systemic risk that is possible to observe in financial markets nowadays.

I also argue that this is part of the constitutive nature of socio-technical systems (here included the stock exchanges and financial markets), sociologically configured from multiple dimensions as cultural, political and other aspects. In line with this view, pointing to a complex dynamic in the relationship between financial gains and increasing technological advances, I describe what follows as being the mentioned spiral: i) first, the quest for financial gain demands new technical means. This enables it to overcome actual material and technical boundaries for obtaining them. ii) Second, the embracement of these technologies gives rise to the need for new institutional structures, modes and dynamics of socio-technical operation in the markets, which are reconfigured from the present socio-economic conditions and social/political conflicts around their developments. Finally, iii) through competition between investors, and consequent investment in research and development, there is an increase in possibilities for even more gains. This makes possible a new institutional and technological environment that encourages the development and implementation of new technical solutions, returning to feed this circle of increasing complexity.

PICTURE 2

Together, these two schemes (figure 1 and 2) compose my effort to conceptually explain what I'm here calling *Digitalized Finance*, or, in another words, how this structural causality between the financialization process and the ICT development can be understood.

3. The Brazilian case

The Brazilian market has its own model of operation and management, recognized as better regulated than many of the so-called advanced markets. But Brazil is not an exception, however, to the growing presence of HFT, the domination of the market by large institutional and foreign investors, and the large concentration observed at different levels. The respondent A, representative of a major Brazilian brokerage, commenting on the transformation that the new business model brought to his company, said: “We are not brokers only. More than an investment management firm that invests in technological modernization, we have set today as a technology company that negotiates investments”.

The growing automation in the Brazilian capital market, following at a rapid pace, is clearly accompanied by acceleration processes, increased number and business speed performed, concentration on different levels (investors, listed companies, brokers), increasing the prominence

of foreign investors and brokers, and decreasing the participation of retail investors in the market. Regarding Brazilian stock market, for the period of 1994 to 2016 the following could be observed:

i) The number and volume of trades grew at a rapid pace, far exceeding the performance of the Brazilian economy. This development occurs more strongly in periods marked by the adoption of important operational technical changes. Advancing more strongly from 2005, the average daily number of trades carried out on the stock exchange has risen from just over 10.000 in 1994 to about 62.000 in 2005, when from there climbs to reach more than 980.000 transactions performed per day in 2016; total accumulated growth of almost 9.800 % in the period.

The year 2005, as we will see in the data, is especially important: it marks the growing adoption of AT and HFT in US markets, due to changes in the country's legislation, which opened scenario for this model of negotiations. In Brazil, it takes place the end of the speakerphone trading due to the advancement of automated standard negotiations. At the same time, the stock market starts to demand a standard of operational quality of the broker that asks, among other obligations, the constant technological updating.

ii) Although capitalization raised, in number of trades and financial volumes, the Brazilian stock market has been concentrating since then in the hands of decreasing number of companies listed on the stock exchange and fewer companies in the brokerage industry. Here, also the most accelerated periods both of fall in the number of brokers and increases in market concentration in a few of them also coincides with the adoption of relevant changes in technical and operational dimension of the markets. Following this trend of concentration, the number of companies with listed shares fell more than 35% from 1994 to 2016. The fall, however, cannot be explained just by an alleged adverse economic scenario. While the number of companies with listed shares fell considerably in the analysed period, the total capitalized value on the stock market grew 1.500 %, an average rate of more than 20% per year. The year of 2005 also marks, in Brazil, the beginning of a downward trend in the number of brokers in the market, 91 for a total of 79 in 2016. In the same period, the market share concentrated in the hands of the five largest brokers jumps from 35% to 51% of the market, with particular growth from 2010, coinciding with the implementation of the Co-location² system in Brazil (2009-10). In 2005, among these five major brokerage firms, only two were foreigners, today they are three.

iii) In the same period, we can observe growing foreign presence in the Brazilian stock market. It occurs both in terms of investor profile, and leading brokerage firms. In 2010, moment of euphoria about Brazil in the international scenario, the BM&FBovespa reached its peak of more than 610.000 listed investors. At the time, its president announced goal of reaching 5 million

² Co-location is an installation system by which investors hosts their servers within the stock exchange to accelerate operations.

individual investors by 2015, with an additional gain of 200 new companies listed on the stock exchange by 2014. Contrary to the projection, however, the number of investors has fallen, as well as the number of companies with shares listed on the stock exchange (from 544 in 1994 to 349 in 2016). All in all, the scenario has become more favourable for large institutional investors, especially foreign, operating with knowledge, advanced technological solutions and advantages of scale in markets around the world. Growing more or less in a sustained manner since 1994 until 2016, the share of the stock market in the hands of foreign investors has more than doubled, jumping from 21,4 to 52,1% in this period, with sharper high from 2005 and 2010, years that coincide precisely with the adoption of important technical and operational advances in the stock market: the beginning of the Operational Qualification Program (PQO) and the end of the speakerphone trading on Bovespa; and the implementation of the Co-location system – 2009 in the BM&F segment (commodities, futures), 2010 at Bovespa segment (stocks) –, which made it possible to expand the penetration of AT and HFT in the Brazilian market.

iv) Finally, except for the period that corresponds to the adoption of the technology called *Home Broker* (through which small investors can trade from their personal computers connected to the Internet), objectively directed to the attraction of investment for small individual investors, their participation decays considerably between 1994 and 2016, as opposed to the trend for large foreign and institutional investors. Again, the sharpest declines coincide with those periods of significant technological changes. After significant growth in 1999, driven by the adoption of the *Home Broker* technology, the participation of individual investors in relation to all investors on the stock exchange grew by an average of only 0,7% per year from 2002 to 2006. After recovering breath, from 2007 to 2009, when the percentage share of this type of investor came to add up 30% of the total, it has been falling since then, to close the year of 2016 accounting for only 16,9% of the total number of investors in the capital market Brazil. This is a level close to that of 1999 – before the implementation of this system developments.

Final considerations

As we saw, software and hardware innovation are attached to the development of sophisticated electronic negotiation strategies in globalized markets. As part of this increasingly complex environment, investors rely on connectivity solutions to access, in the shortest possible time, gain opportunities in different parts of the globe. Among these market participants, the ability to accelerate processes, analyse and react to this avalanche of data is a key component in the composition of their competitive advantage.

Exploring the growing liberalization and flexibility of financial markets globally, technological advances eventually impose itself as one of the main boundaries of competition

between investors, jealous of increasingly high earnings in the shortest possible time. The trajectory of such breakthrough ended up producing a scenario in which automated high-frequency trading are used as speculation and arbitrage instruments between different assets in markets, in micro and even nano seconds margins, inflating the margins of investors who have such technologies.

As noted, on a global connectivity context, the markets digitalization process in recent decades points out to the possibility of commercial fraud scenarios and additional instability in capital markets operations, what further extend their systemic risk. Encouraged by the belief in the neutrality and technical infallibility in overcoming the errors arising from the “human factor”, operators and investors are betting on trading strategies even more bold and risky.

This complexity gives rise to a confused mode of operation of the systems, which few experts and operators dominate completely. It grows thus the opacity of markets as the locus of strategic information management by increasingly closed elites of investors, hindering access to governments, regulators and to the understanding of the society as a whole. It also creates difficulties for the operation of small investors on the side-lines, which became more dependent on large funds, big brokers and transnational financial institutions to manage their investments, most of them often little transparent. Thus, as well of being a resource to strengthen the march of concentration in markets, this arising opacity and increasing complexity extend risk management and governance to the extent that few people know in fact how the digitalized financial markets really works.

In addition, the growth of this operational complexity in its own opens up new business opportunities, as demands further investments in technologies that make possible to manage the financial transactions in a such kind of environment. The self-management complexity becomes thus an attractive business, especially for large leading companies in the technology industry.

Finally, and most important, these technologies allow the emergence of new financial instruments, further fetishists, which would not be possible if such technical artefacts did not exist – as well as the regulatory framework related to it. This makes possible, or anchors operationally, new forms of reproduction and circulation of fictitious capital (Marx, 1988), thus expanding the financial sieves characteristics of financialization processes.

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