



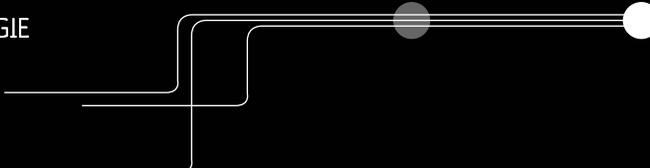
Ethical issues of  
HIGH-FREQUENCY  
TRADING

Summary and recommendations



COMMISSION DE L'ÉTHIQUE  
EN SCIENCE ET EN TECHNOLOGIE

Québec 





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**Commission de l'éthique  
en science et en technologie**

888, rue Saint-Jean, bureau 555  
Québec (Québec) G1R 5H6  
[www.ethique.gouv.qc.ca](http://www.ethique.gouv.qc.ca)

PRODUCTION SUPPORT

Supervision and coordination  
**M<sup>e</sup> Nicole Beaudry, secretary general**

Research and writing  
**David Hughes, ethics advisor**

TECHNICAL SUPPORT

Secretariat  
**Tchonang Chimère Nandjou**

Linguistic revision (French version)  
**Bla bla rédaction**

Communications  
**Évangéline LeBlanc**

Design, accessibility and layout  
**Direct Info**

Translation  
**Constance Durocher**

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To facilitate the reading of the text, the masculine is used without any  
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## LIST OF ABBREVIATIONS AND ACRONYMS

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<b>ACM</b>	Association for Computing Machinery
<b>AMF</b>	Autorité des marchés financiers (Québec)
<b>ATS</b>	Alternative trading system
<b>CFTC</b>	Commodity Futures Trading Commission (United-States)
<b>CSA</b>	Canadian Securities Administrators
<b>DMA</b>	Direct market access
<b>ESMA</b>	European Securities and Markets Authority (European Union)
<b>HF</b>	High-frequency
<b>HFT</b>	High frequency trading
<b>IIROC</b>	Investment Industry Regulatory Organization of Canada
<b>IOSCO</b>	International Organization of Securities Commissions
<b>MiFID</b>	Markets in Financial Instruments Directive (European Union)
<b>MX</b>	Montreal Exchange / Bourse de Montréal
<b>NYSE</b>	New York Stock Exchange
<b>SEC</b>	Securities and Exchange Commission (United-States)
<b>SIP</b>	Securities information processor
<b>TSX</b>	Toronto Stock Exchange
<b>UMIR</b>	Universal Market Integrity Rules (IIROC)

## ABSTRACT

Finance has become a highly scientific and technological activity. Developments in information and communication technology have led to the computerization of financial marketplace infrastructure. Moreover, computerization has increased computing capacity and speed and enabled the automation of trading decision-making, i.e. the purchase and sale of assets on the capital markets. High-frequency trading (HFT) is a form of technological trading that involves the implementation of automated high-speed trading strategies.

Defenders of HFT claim it improves market quality (liquidity, price efficiency, lower transaction costs). However, critics maintain that HFT enables the use of manipulative and deceptive strategies, that it gives some traders an unwarranted advantage, increases volatility and can substantially destabilize the markets. From an ethical point of view, HFT raises issues of fair competition and fairness in the distribution of costs/risks and benefits.

In this position statement, the Commission de l'éthique en science et en technologie makes a series of suggestions and recommendations to the participants involved:

- Increase funding of research on the effects of HFT, particularly in Quebec, and support multidisciplinary.
- Address the practices that lead to inequalities in access to information (direct or enriched market data feeds, communication technologies, co-location).
- Be proactive in the scientific research on and monitoring of new potentially abusive and manipulative trading practices, and provide sufficient means to watch the marketplaces in an effective manner.
- Develop a filing and archiving system for HFT algorithms used in the Canadian marketplaces.
- Determine the appropriateness of implement measures that ensure the reliability of displayed liquidity, given the phenomenon of phantom liquidity.
- Implement measures that ensure the quality of computer hardware and software.
- Amend the legislation so as to increase software developers' liability in the case of failure of their products.
- Impose sanctions on traders responsible for major technical failures.
- Consider the appropriateness of introducing mechanisms that would bring about a slight decrease in trading speeds, given the technological arms race in the marketplace.
- Assess the appropriateness of establishing rules that govern the relationship between the exchanges, institutional investors and the HFT firms.





## SUMMARY AND RECOMMENDATIONS

# SUMMARY AND RECOMMENDATIONS<sup>1</sup>

Today, finance is a highly scientific and technological activity. On the one hand, the arrival on Wall Street of statistician physicists has led to the development of new mathematical models in finance and new trading strategies. On the other hand, developments in information and communication technology have led to the computerization of financial marketplace infrastructure. Moreover, computerization has increased computing capacity and speed and enabled the automation of trading decision-making, i.e. the purchase and sale of assets on the capital markets. High-frequency trading (HFT) is one form of techno-scientific trading.

The mandate of the Commission de l'éthique en science et en technologie (hereinafter referred to as the «Commission») is to instigate reflection on the ethical issues relating to scientific and technological activity and to promote informed public debate on these issues. HFT has attracted the Commission's attention because it is a new techno-science that raises important ethical issues. In this position statement, the Commission identifies and analyzes ethical issues raised by HFT.

## 1. High-frequency trading

High-frequency trading (HFT) refers to the implementation of automated high-speed trading strategies<sup>2</sup>. It is increasingly present in financial marketplaces and is based on a sophisticated techno-scientific infrastructure consisting of mathematical financial models, algorithms\*, computer software and hardware and high-performance communication networks.

Defenders of HFT claim it improves market liquidity\* (bid-ask spread and market depth)<sup>3</sup> and price discovery\*<sup>4</sup>, and lowers transaction costs\*. Critics of HFT maintain that it creates false liquidity<sup>5</sup>, increases costs (ex. market impact, technological costs)<sup>6</sup>, enables the implementation of manipulative and deceptive strategies<sup>7</sup>, increases volatility<sup>8</sup> and can substantially destabilize the markets<sup>9</sup>.

1 In this summary, terms defined in the lexicon are marked with an asterisk the first time they are used.

2 SEC 2014 : 4 (« Use of extraordinarily high speed and sophisticated programs for generating, routing, and executing orders; Use of co-location services and individual data feeds offered by exchanges and others to minimize network and other latencies; Very short time-frames for establishing and liquidating positions; Submission of numerous orders that are cancelled shortly after submission; Ending the trading day in as close to a flat position as possible (that is, not carrying significant, unhedged positions overnight) »).

3 Brogaard and Garriott 2015; Brogaard, Garriott and Pomeranets 2014; Castura et al. 2010; Hasbrouck and Saar 2013; Lepone and Sacco 2013; Malinova, Park and Riordan 2013a, 2013b; Menkveld 2012.

4 Brogaard 2010; Brogaard 2011a; Hendershott 2011; Carrion 2013: 681 (« Prices are more efficient on days when HFTs are more active in a given stock, in the sense that it takes less time for stock prices to incorporate information from order flow and market index returns »); Brogaard, Hendershott and Riordan 2014: 2268 (« Informed HFTs play a beneficial role in price efficiency by trading in the opposite direction to transitory pricing errors and in the same direction as future efficient price moves »); Brogaard, Garriott and Pomeranets 2014.

5 Norges Bank Investment Management 2013; Shorter and Miller 2014; Van Kernel 2012.

6 Australia Industry Super Network, 2013: 1 (« The activity of High Frequency Traders (HF traders) in Australia's equity markets costs other investors, including long term investors such as superannuation funds, an estimated \$1.6 to \$1.9 billion per year »); Tong 2013: 26 (« I find strong evidence that HFT increases the trading costs of institutional investors »); Brogaard, Hendershott and Riordan 2014: 2268 (« We show that HFTs impose adverse selection costs on other investors »); Jones 2013; Hirschey 2013; Shorter and Miller 2014.

7 IOSCO 2011: 30 (« [A concern is] whether technological advantage offers HFT firms the possibility of engaging in abusive practices on a larger scale than would have previously been possible »).

8 Zhang 2010 (« I find that high frequency trading is positively correlated with stock price volatility after controlling for firm fundamental volatility and exogenous determinants of volatility »); Breckenfelder 2013.

9 Barker and Pomeranets 2011; Ben David et al. 2012: 30 (« HFT can be highly destabilizing as it propagates shocks across markets at very high speed »); Easley, Lopez de Prado and O'Hara 2010; GOS 2012 : 43, 52; Huh 2014; IOSCO 2011; Johnson and Zhao 2012; Kirilenko et al. 2014; Shorter and Miller 2014; Stiglitz 2014.

## 2. The complexity of the financial markets

The markets are a system whose components interact in a manner that is complex and difficult to predict. Taking action or making a change at one point in the system is likely to have an impact on other components. Therefore caution must be exercised when making structural changes or imposing measures in the financial system. Moreover, in the course of our work, several experts underlined the fact that the regulatory framework of the Canadian marketplaces is complex and that it is sometimes very difficult to determine the exact responsibilities of each regulatory agency. Therefore:



[1] The Commission invites the regulatory agencies (AMF, IIROC, and the Montréal Exchange Regulatory Division) to:

- a) carefully consider the benefits and risks of each measure anticipated before it is implemented, in order to determine its appropriateness and optimal parameters;
- b) simplify the regulatory framework of the Canadian marketplaces.

## 3. Research on high-frequency trading

The discussion on many ethical issues needs to be based on evidence regarding the effects of HFT. However, to date insufficient research has been done on the impact of HFT on market quality, stability and integrity<sup>10</sup>. Moreover, there is little methodological uniformity in this area of research<sup>11</sup>. This explains in part the lack of consensus on the effects of HFT. This situation is compounded by the fact that there is a lack of diversity in the research on a disciplinary level. We must also address the issue of the funding of this research. Some research is funded by the financial industry. This leads to conflicts of interest that can jeopardize the objectivity and credibility of the findings. Finally, it must be noted that research on HFT published in the form of working papers is widespread.

### The Commission recommends that granting agencies:

- (R-1) a) fund research on measures of market quality and stability;
- b) fund research on the impact of HFT in Canada and in Quebec;
- c) fund a multidisciplinary study on HFT;
- d) opt for anonymous peer review as a preferred method of publication.

## 4. The ethical evaluation approach

The approach taken in this position statement is to: 1) identify and clarify the values at stake in HFT; 2) define the ethical issues that arise in situations where there are conflicts and tensions between values; 3) take a stand on the values that should be prioritized (weighting or ranking of values); 4) determine the best way to follow through on the value ranking established in the previous step and to recommend actions to be taken.

<sup>10</sup> Carrion 2013.

<sup>11</sup> NBIM 2013: 14 (« Given the significant changes in market microstructure in recent years, more empirical and theoretical work on effective measures of market quality is needed. There is little consensus on what constitutes an appropriate framework for assessing market quality and on a precise definition of HFTs by type of activity. This in our view has led to differing conclusions from the empirical and theoretical work on the impact that HFTs have had on market quality »).

The Commission has identified the following values and principles for the evaluation of HFT.

### Values and principles for the financial markets

**Freedom:** Ability to choose and to undertake economic action (conduct transactions, acquire technology, etc.) and to seek profitability<sup>12</sup>.

**Equality:** Level playing field (the rules apply to all players in the same manner, the prerequisites for trading are available to all)<sup>13</sup>.

Equal access to raw data<sup>14</sup>. Condemnation of the use of inside information.

**Integrity:** Sending true and genuine signals that indicate the intention to buy or to sell securities<sup>15</sup>. The integrity of the marketplace participants ensures the integrity of the financial system.

**Collective utility:** Efficiency in capital allocation, maximizing total benefits<sup>16</sup>.

**Merit-based compensation:** Positive (profit) and negative (loss) compensation based on work, effort and skill<sup>17</sup>. Presupposes the existence of a level playing field and equal access to information.

**Nonmaleficence:** Do not cause harm, take measures to minimize the risk of causing harm (due care).

## 5. Fair competition

### 5.1. Inequalities in issuing information

In HFT, inequality in supply occurs at the stage where the information is issued: flash orders, direct<sup>18</sup>, early or enriched market data feeds and order\* disclosure in dark pools. Are these inequalities unfair?

12 Shefrin and Statman 1992; McNamara 2015.

13 Boatright 1999; IOSCO 2011: 29 (« One [concern] is whether access to technological infrastructure by regulated entities is offered in a fair way. In order to help ensure that the integrity of markets is preserved, it is necessary that access to technological infrastructures is offered in a transparent and non-discriminatory manner to all market participants »); McNamara 2015: 46 (« The notion of a level playing field in financial law means that like market participants will be treated alike. In securities markets this means that the necessary prerequisite of successful performance in the market should be available to all; that with the required investments of time and material resources, in principle anyone could compete successfully »).

14 Shefrin and Statman, 1992: 5 (« Fairness regarding equal information entitles all people to equal access to a particular set of information »); Boatright 1999: 155; BlackRock 2014: 5 (« Trading venues should provide access to information to all participants at the same time; select participants should not be allowed to receive information from a trading venue that is not available to all participants »); McNamara 2015: 46.

15 Shefrin and Statman, 1992: 5 (« Fairness in freedom from misrepresentation entitles all people to rely on information voluntarily disclosed by others as truthful »); Boatright 2008: 31-33; McNamara 2015: 44.

16 McNamara 2015.

17 Shefrin and Statman 1992: 83 (« ... investment activity is a game of skill, much like bridge. As in bridge, investment also has a chance element. Over time, however, skill rather than luck determines the degree of success »).

18 Arnuk and Saluzzi 2009: 1 (« ... using cutting edge technology and co-located servers at exchanges and ATSS, combined with purchases of raw data feeds from these markets centers, to create one's own inside National Best Bid and Offer (NBBO) quote and depth of book substantially earlier than what is publicly available from the Security Information Processor, or SIP quote »); Ding, Hanna and Hendershott 2014.

With flash orders<sup>19</sup>, early data feeds<sup>20</sup> and order disclosure in dark pools<sup>21</sup>, some traders gain access to the information before the others. This runs contrary to the principle of equal access to information.

In Canada, subsection 7.1 of Regulation 21-101 on the trading rules set out by the Canadian Securities Administrators (CSA) confirms this in that it prohibits exchanges\* from providing information on orders before such information is transmitted to a data aggregator\*. Flash orders, early data feeds and order disclosure in dark pools are therefore not permitted.

The case of direct<sup>22</sup> or enriched<sup>23</sup> data feeds is not as clear-cut. Therefore:



[2] The Commission invites the regulatory agencies (AMF, Montréal Exchange Regulatory Division, and IIROC) and researchers to examine:

- a) the impact and fairness of direct data feeds. Do they give an unwarranted advantage to some competitors? Do they contribute to enhancing collective utility? Do they make it easier to implement manipulative and deceptive strategies? Have data aggregators adapted to the new reality of high-speed trading?
- b) the impact and fairness of enriched data feeds. Do they give an unwarranted advantage to some competitors? Do they contribute to enhancing collective utility? Do they make it easier to implement manipulative and deceptive strategies?

## 5.2. Inequalities in transmitting and receiving information

Once the market data is issued, transmission speed factors come into play. First, fiber optic and micro-wave communication technologies increase data transmission speed<sup>24</sup>. Second, colocation\* shortens the distance the information must travel, further reducing data transmission time<sup>25</sup>. In accordance with the level playing field concept, communication technologies and co-location are, in principle at least, available to all who are willing to pay for them<sup>26</sup>. However, one might ask, like the Securities and Exchange

19 McNamara 2015: 25 (« [Flash orders] are a factor in the creation of a “two-tiered” system, where certain inside players have access to fundamentally better information than anyone else. There is much to this charge, and it illustrates the basic phenomena of “unfairness” that many associate with HFT. In a two-tiered system, certain players will be given information – in this case, prior to its general release to the public – that everyone else lacks »).

20 BlackRock 2014: 6 (« BlackRock is concerned that an uneven playing field is created by offering different market data feeds to some participants while these feeds are not readily available to most others due to a cost or technology hurdle. This timing gap (or latency between feeds) may contribute to preferential market participation by those firms that are able to gather and digest such information. The data feeds that are available publicly and privately should be in sync so that one market participant does not have an undue information advantage over another »); McNamara 2015: 28 (« Is the creation of a two-tiered system, even where all are in principle permitted to enter into the privileged cohort, fair? Is it inevitable? Or should limitations be put upon the information that exchanges are permitted to disseminate, either for a fee or for free? »).

21 Tymins 2014; Lewis 2014; Shorter and Miller 2014 : 12.

22 SEC 2010: 62 (« Is the existence of any latency, or the disparity in information transmitted, fair to investors or other market participants that rely on the consolidated market data feeds and do not use individual trading center data feeds? »).

23 Greiger and Mamudi 2014; McNamara 2015 : 27.

24 Troianovski 2012; Phillips 2012; Dummet and Hope 2014.

25 SEC 2010: 57; Shorter and Miller 2014: 21; McNamara 2015: 20.

26 IOSCO 2011: 29 (« ... whether access to technological infrastructure (including co-location facilities) by regulated entities is offered in a fair way [...] it is necessary that access to technological infrastructures is offered in a transparent and non-discriminatory manner to all market participants »).

Commission (SEC), whether their high cost constitutes a barrier that raises fairness issues<sup>27</sup>. Moreover, these factors give some traders a competitive edge by enabling them to receive the information before the others do. One can therefore ask whether this helps to create a two-tiered system and goes against the principle of equal access to information<sup>28</sup>. Therefore:



[3] The Commission invites the regulatory agencies (AMF, Montréal Exchange Regulatory Division, and IROC) and researchers to pursue reflection on the fairness issues raised by inequalities in transmitting and receiving information. Does equal access to information imply that the information must not only be issued at the same time but also be received simultaneously by all?

### 5.3. Inequality in information processing speed and capacity

High-frequency (HF) traders use high-performing computer technology that enables them to process massive amounts of data and to make decisions more quickly<sup>29</sup>. In accordance with the level playing field principle, state-of-the-art computer systems are available to all who are willing to pay for them. However, one might ask whether the high cost of this technology and the highly-qualified human resources required to operate it constitute an unfair barrier<sup>30</sup>. Therefore:



[4] The Commission invites the regulatory agencies (AMF, Montréal Exchange Regulatory Division, and IROC) and researchers to pursue reflection on the fairness issues raised by inequalities in the speed and capacity of information processing and decision-making. Do the computing capacity and trade execution speed that high-frequency traders gain from information technology give them an unfair advantage? Does the high cost of this technology and of the human resources required to operate it constitute an unfair barrier?

### 5.4. Strategies that create a false or misleading appearance of trading activity or that cause artificial price movements

Some HF traders use strategies that create a false or misleading appearance of trading activity or that cause artificial price movements<sup>31</sup>. These strategies clearly go against the value of integrity, i.e. the obligation to provide true and genuine signals. Moreover, they undermine collective utility by creating distortions in market information. Finally, some of these strategies are blamed for causing volatility that can expose the markets to systemic risks\*, which is contrary to the principle of nonmaleficence.

27 SEC 2010: 59 (« Is it fair for some market participants to pay to obtain better access to the markets than is available to those not in a position to pay for or otherwise obtain co-location services? [...] Are co-location fees so high that they effectively create a barrier for smaller firms? »); Shorter and Miller 2014: 22 (« Some argue that an advance information advantage of just a fraction of a microsecond can be “enough to get a better price, even for a later placed order”. Others, however, say that securities markets have always been characterized by differential or tiered access to securities trades, going back to the time when floor traders had favored access to stock orders. Moreover, they note that the benefits of direct feeds and colocation are available to anyone willing to pay for the services, albeit at prices that may be beyond the reach of many traders »).

28 McNamara 2015: 22 (« High frequency traders are given a head start that can never be caught up to. In this sense co-location goes directly against the (moral) intuition that at some basic level, participants in the market should be on a level playing field »).

29 SEC 2010: 41 (« ... is it unfair for market participants to obtain a competitive advantage by investing in technology and human resources that enable them to trade more effectively and profitably than others? »).

30 Kirilenko and Lo 2013: 67.

31 IROC 2013b.

Regulatory agencies prohibit submitting orders or executing transactions with the intention of deceiving other competitors or manipulating prices. They are responsible for establishing and enforcing the rules of acceptable trading behaviour. They monitor the markets, investigate suspicious practices and take disciplinary action against or impose sanctions on traders who break the rules.

One of the major challenges these agencies face is to keep up with rapidly changing trading practices. In order to do that, they must do research on and monitor new forms of potential market abuses<sup>32</sup>. Therefore:



[5] The Commission invites the regulatory agencies (AMF, Montréal Exchange Regulatory Division, and IIROC) to:

- a) be proactive in the scientific research on and monitoring of new potentially abusive and manipulative trading strategies;
- b) ensure they have the human and technological resources required to monitor and to watch for market abuses and manipulation.

It can be painstaking to determine from observable data whether a series of messages is a legitimate strategy or an attempt to deceive the other traders or to manipulate prices. The trader's intention is a key factor in determining whether a trade is carried out with malicious intent. Now determining someone's intention is a major challenge. In order to solve this problem, experts suggest that HF traders' intentions can be revealed by analyzing the code of their algorithms. However, since this code is sensitive, proprietary business information, traders are reluctant to systematically disclose it<sup>33</sup>. One option might be to require traders to archive their code, and to analyze the code when there is a presumption of market abuse or manipulation.

### The Commission recommends that the regulatory agencies (AMF, Montréal Exchange Regulatory, and IIROC)

(R-2) Establish a filing and archiving system for HFT algorithms used on the Canadian exchanges.

## 6. Fairness in the distribution of the risks, costs and benefits of high-frequency trading

### 6.1. Phantom liquidity

According to some critics, HF traders' propensity to cancel a high proportion of orders submitted means that the liquidity that is actually available is far less than it might appear. Traders therefore cannot rely entirely on the information contained in the order books\* and trading becomes less predictable, which would be contrary to the value of **collective utility**. A high rate of order cancellation could also overload the exchanges' systems and destabilize the markets.

32 IOSCO 2011: 30 (« Many trading strategies used by HFT participants are so sophisticated that they raise an issue as to regulator have the necessary resources to conduct effective market surveillance. It is critical that competent authorities' market surveillance capabilities keep pace with HFT, in terms of technological infrastructure, resources and market knowledge, in order to maintain a high degree of investor protection in a high speed and fragmented trading environment »).

33 Davis, Kumiega and Van Vliet 2013: 859 (« For any observed behavior, the question is: Is it driven by a [prudent, legitimate] model, or is it spoofing? Is there, or is there not, a proven mathematical reason that the system is updating and cancelling orders? Few firms would divulge such mathematical proof (the program's logic) »).

Some measures could be taken to ensure more stable liquidity and more predictable trades, while lessening the congestion created by trade-messaging (e.g. set a minimum execution ratio for orders submitted<sup>34</sup> or a minimum order display time<sup>35</sup>). However, these measures could also decrease liquidity by impacting certain market making strategies. Therefore:



[6] Considering the phenomenon of phantom liquidity, the Commission invites the regulatory agencies (AMF, Montréal Exchange Regulatory Division, and IIROC) to consider whether it is appropriate to require the exchanges to put measures in place that ensure the reliability of displayed liquidity (e.g. a minimum execution ratio for orders submitted or a minimum order display time).

## 6.2. Market destabilization

Many factors associated with HFT have the potential to destabilize markets. These factors include information technology failure<sup>36</sup>, interpretation of data by machines<sup>37</sup>, interaction between algorithms<sup>38</sup>, autonomous evolution of algorithms<sup>39</sup>, as well as propagation, acceleration and amplification of price movements by algorithms<sup>40</sup>. When they occur, these market destabilizations have an adverse effect on capital allocation because they impair liquidity and price discovery. They therefore run counter to the value of **collective utility**.

Traders and investors\* may sustain significant losses when destabilizing events occur. If the destabilization spreads to the financial system and the real economy (systemic risks\*), entire populations could be adversely affected. Therefore, in accordance with the principle of **nonmaleficence**, the participants involved should take any measures that will minimize as much as possible the risks of causing such damage.

### Measures for computer hardware manufacturers and software developers

Computer hardware and software should be thoroughly tested in order to ensure a maximum level of effectiveness, reliability and security. Now it would appear that there is no requirement to implement quality control standards (e.g. the ISO 9000 series) in the information and communication technology industry, contrary to what is done in the biomedical field or the avionics industry, for example. Moreover, software developers may legally include a clause in their licences that releases them from all liability in the case of failure or malfunction of their products.

34 NBIM 2013: 17; GOS 2012: 113; BlackRock 2014: 5 (« Market participants should agree and establish order-to-trade ratios to ensure that quotes represent true economic interest. Doing so would help curb behaviour that is both potentially misleading and a stress on the overall market »).

35 GOS 2012: 111; NBIM 2013: 17 (« Minimum resting time increase likelihood that current quotes are tradable (i.e. increase order book predictability) »).

36 IOSCO 2011: 31.

37 Moore et Roberts 2013; Philips 2013.

38 GOS 2012: 65; Danielsson and Zer 2012: 3.

39 GOS 2012: 10 (« Computer-designed and computer-optimised robot traders could become more prevalent. In time, they could replace algorithms designed and refined by people, posing new challenges for understanding their effects on financial markets and for their regulation »).

40 IOSCO 2011: 31 (« A flip side of the price consistency that high frequency traders may bring to markets by employing arbitrage strategies is that extreme price shocks may also be transmitted more easily both between different asset classes and between different trading venues »); Ben-David, Franzoni and Moussawi 2012; Kirilenko et al. 2014; Huh 2014.

## The Commission recommends that the government of Quebec:

- (R-3) a) impose quality control standards on computer hardware manufacturers and software developers;
- b) amend the legislation in order to increase software developers' liability in the case of failure of their products.

### Measures for IT professionals

Certain measures could be put in place for IT professionals. Some experts believe that the Quebec Code of ethics of engineers is not precise enough and that its enforcement mechanisms are inadequate. In addition, they believe it would be advisable to adapt certain parts of this Code to IT engineers.

Not all programmers and algorithm coders who work in finance are engineers. According to some experts, it would be advisable that IT professionals have their own professional corporation and develop a code of ethics adapted to their profession. It is believed that financial markets regulatory agencies should also play a role in supervising programmers and algorithm coders who work in finance. Therefore:



[7] The Commission invites the regulatory agencies (AMF, Montréal Exchange Regulatory Division, and IIROC) to establish rules of good practice for algorithm programmers and coders who work in finance.

### Measures for traders and broker-dealers

In order to comply with best practices, high-frequency (HF) traders should test their computer systems and algorithms<sup>41</sup>. These tests should first be performed in a simulated trading environment. If the test results are conclusive and the required adjustments are made, further tests could then be performed on small trades in a live environment. Further adjustments could then be made if necessary and then the algorithm could be entirely rolled-out in the marketplaces.

Canadian regulations require that tests be performed. However, they do not explain clearly what such tests should entail. CSA Regulation 23-103 requires that automated order systems (computer systems and algorithms) be tested. Regulation 21-101 states that marketplaces shall make testing facilities available for this purpose.

Once the algorithm has been rolled-out, best practices recommend that HF traders use risk management systems. Broker-dealers\* who provide direct access to markets are responsible for the activities of their customers who are traders. According to the experts, these broker-dealers should ensure that their customers have put in place appropriate risk management mechanisms and they should also ensure that the traders' risk management systems include adequate pre-trade controls<sup>42</sup>. The systems should have certain predetermined threshold values, such as a maximum quantity per order, a maximum number of simultaneous positions and credit limits or capital limits<sup>43</sup>.

CSA Regulation 23-103 states that traders must comply with risk management standards. In addition, it states that broker-dealers must establish these standards, and ensure that their customers comply with them.

41 Clark and Ranjan 2012a; BlackRock 2014.

42 IOSCO 2011: 32 (« When a HFT firm that is not a member of a given venue has direct access to that venue's market through the facilities offered by a member's systems, it is the member's responsibility to ensure that appropriate risk controls are in place »).

43 Clark and Ranjan 2012b: 7.

According to good practice, broker-dealers should also have risk management mechanisms in place in their own systems. These should include a pre-trade control mechanism that checks orders before they are sent to the marketplaces<sup>44</sup>. At the post-trade stage, the system should also assess the risk level of each firm's global position on an ongoing basis. If an algorithm is behaving in an erratic manner and the risk management system of the customer who is a trader has not stopped it, then the next line of defence is the broker-dealer's system, which should be able to halt the customer's transactions if need be<sup>45</sup>.

CSA Regulation 23-103 stipulates that the broker-dealer is responsible for protecting the marketplace. He must establish and apply pre-trade and post-trade risk management measures that include predetermined limits on order size, credit limits, capital limits and price limits. The dealer should also be able to halt a customer's transactions and block his or her access.

Algorithms that make trades based on news get their news feeds from news providers. Some firms provide raw data that comes notably from social media<sup>46</sup>. Now, unlike human beings, machines don't always know how to evaluate the reliability of information. Therefore fake news about an event that would have a major financial impact could trigger a strong reaction in trading algorithms and lead to acceleration of market movements. Consequently, if a trader uses news from social media, he or she must ensure that the news providers have evaluated and filtered the information.

According to the experts, one of the problems, other than market losses, is the lack of real penalties that would strongly encourage traders to work harder to prevent technical failures. Regulators should levy heavy fines on traders responsible for a material technical failure or force them to pay the costs incurred by the other traders.

### **The Commission recommends that the regulatory agencies (AMF, Montréal Exchange Regulatory Division, and IIROC)**

(R-4) Impose sanctions on traders responsible for technical failures.

#### **Measures for exchanges**

Market making has long been ensured essentially by designated market makers. In periods of market turbulence, designated market makers must continue to stimulate the marketplace and to provide liquidity. They get some benefit for doing this, such as a monopoly on a security, greater access to order book information and a minimum bid-ask spread\*. Today, in addition to designated market makers, HF traders play a predominant role in market making. However, they have no obligation to provide liquidity outside normal financial conditions. They could withdraw massively and suddenly from the marketplace in times of market stress, which would cause a shortage of liquidity. One way to ensure ongoing liquidity would be to extend the obligations and benefits of designated market makers to high-frequency traders<sup>47</sup>. Therefore:

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44 Clark et Ranjan 2012a: 7.

45 Clark et Ranjan 2012b.

46 Philips 2013.

47 GOS 2012: 108-110; Clark et Ranjan 2012a: 14 (« If regulators required high speed traders to become market makers they should provide privileges along with these obligations »); NBIM 2013: 18 (« Obligation for HFTs to provide meaningful liquidity regardless of market conditions »).



[8] Considering the phenomenon of HF market makers' withdrawal in periods of market stress, the Commission invites the regulatory agencies (AMF, Montréal Exchange Regulatory Division, and IIROC) to assess the appropriateness of extending to HF market makers the obligations and benefits that apply to designated market makers.

Exchanges may have trading halt mechanisms known as «halts»\* or «circuit-breakers» or «kill switches». These mechanisms halt trade on a security when price fluctuations reach a certain threshold. They are useful and are sometimes able to contain extreme price movements that are not related to the real economy. However, even if a flash crash is halted and quickly overcome, those who in the meantime submitted market orders will nevertheless not have been able to complete their trades.

In Canada, the regulatory agencies require the exchanges to have circuit-breakers<sup>48</sup>. Trades on a security are halted for a 5 to 10 minute period in the event of a price increase or decline of at least 20% of that security in a five-minute period at the opening or close of a trading session or in the event of a price increase or decline of at least 10% in a five-minute period between 9:50 a.m. and 3:30 p.m.

### 6.3. Market impact costs for institutional investors

Detection of large orders (abusive liquidity detection or electronic front running\*) is one of the main concerns investors and regulators have regarding HFT<sup>49</sup>. This strategy would go against collective utility by causing a temporary increase in price beyond a stock's fundamental value, and would adversely affect price discovery. By taking advantage of fundamental knowledge (see fundamentals\* in the lexicon) produced by institutional investors and profiting from it at their expense, order detection adversely impacts price discovery in two other ways. On the one hand, it is believed to reduce the incentive to do fundamental research<sup>50</sup>. On the other hand, it would seemingly lead investors to leave more transparent marketplaces and to go trade in dark pools<sup>51</sup>. Moreover, it is believed that order detection increases institutional investors' transaction costs (market impact\* costs), which decreases the rate of return of institutional investment portfolios and adversely impacts investors, retirees, etc. Furthermore, it would seem that liquidity detection leads to a socially-inefficient process of concealment and detection of large orders<sup>52</sup>. Finally, it would seem that order detection goes against the value of integrity because it gives a false impression that one intends to provide liquidity<sup>53</sup>.

In its Guidance on Certain Manipulative and Deceptive Trading Practices, IIROC (2013b) considers abusive liquidity detection (electronic front running) to be a manipulative and deceptive practice. Unlike IIROC, the Montréal Exchange (MX) Regulatory Division does not explicitly identify abusive liquidity detection as a manipulative and deceptive strategy in its Rule Six on Trading on the Montréal Exchange. Therefore:

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48 IIROC 2012b,2013a, 2015.

49 NBIM 2013 : 20; SEC 2014 : 31; PwC 2015 : 5.

50 Hirschev 2013.

51 NBIM 2013.

52 Stiglitz 2014 (« But these actions to reduce information disclosure are costly. And, of course, these actions induce the flash traders to invest still more to figure out how to de-encrypt what has been encrypted. If, as we have suggested, the process of encryption and de-encryption is socially wasteful – worse than a zero sum game – then competition among firms to be the best de-encryptor is also socially wasteful »).

53 Scopino 2015.



[9] While abusive liquidity detection may be inferred from Rule Six, the Commission invites the Montréal Exchange Regulatory Division to explicitly identify this strategy as a manipulative and deceptive practice in its regulations.

#### 6.4. Message processing and monitoring costs for non-high-frequency traders

Several HFT strategies require transmission of a substantial amount of messages (orders, modifications and cancellations). These strategies benefit those that implement them. However, processing of this message flow is costly for the other financial markets participants. In particular, the regulatory agencies, exchanges and direct access providers must invest in technology and devote a significant share of their resources to message processing and risk monitoring and management. These costs are then passed on to their customers. Their pricing models can therefore lead to inequities.

Indeed, if the fees charged are not proportional to the volume utilized, traders who trade less extensively in fact end up paying for the HF traders. These costs are not allocated based on merit and can therefore be considered to be detrimental to the interests of some traders. One way to solve this problem would be to internalize these costs by charging for messages on a pro rata basis<sup>54</sup>.

#### 6.5. Technological arms race

HFT is often accused of leading to technological arms race. It would seem that the sole aim of the participants in this race for speed is to get to the markets first, without any benefit of the investments and innovation accruing to competitors or to the financial marketplaces. It is believed that this race causes an inefficient allocation of resources for both the traders themselves and the financial system. Moreover, this technological race could well bring about a decrease in the number of competitors and a decline in competitiveness. It therefore goes against the maximization of collective utility. HF traders are caught up in a situation where it would be in the interest of all of them to cooperate and to put an end to this one-upmanship, but they nevertheless all feel compelled to continue to acquire technologies and services that increase their speed. Mechanisms that would bring about a slight reduction in speed would enable the competition to be focused more on prices. Therefore:



[10] Considering the technological arms race present in the financial marketplaces, the Commission invites the regulatory agencies (AMF, Montréal Exchange Regulatory Division, and IIROC), the exchanges and researchers to consider whether it would be appropriate to introduce mechanisms that would slightly reduce trading speeds (e.g. speed bump, batch auctions)<sup>55</sup>.

54 Cohn 2014 (« Currently there is no cost to market participants who generate excessive order-message traffic. One idea would be to consider if regulatory fees applied on the basis of extreme message traffic – rather than execution alone – are appropriate and would enhance the underlying strength and resiliency of the system »).

55 Budish, Cramton and Shim 2013: 1 (« We argue that the high frequency trading arms race is a symptom of a basic flaw in the design of modern financial exchanges: continuous-time trading. [...] We propose a simple alternative: discrete-time trading. More precisely, we propose a market design in which the trading day is divided into extremely frequent but discrete time intervals; to fix ideas, say 100 milliseconds. All trade requests received during the same interval are treated as having arrived at the same (discrete) time. Then, at the end of each interval, all outstanding orders are processed in batch, using a uniform-price auction, as opposed to a serial processing that occurs in the continuous market »).

## 7. Conflicts of interest: an industrial organization issue

HF traders and many financial markets participants have converging interests. Exchanges benefit from HFT in different ways. On the one hand, they benefit from the trade volume HF traders bring to the exchanges. On the other hand, the fees they charge these traders generate significant revenue (e.g. co-location, sale of data feeds). Conversely, HFT firms sometimes hold shares in exchanges, which can reinforce the impression that these exchanges favour the HF traders. Institutional investors (banks, pension funds) hold interests in the exchanges. Now, exchanges earn significant revenue from HF traders. Moreover, the big HFT firms are often owned by banks.

These arrangements can potentially put the exchanges and institutional investors in a position where they must choose between the interests of the HF traders and those of their other customers. Moreover, converging interests in HFT could present an obstacle to tighter supervision of this practice. Furthermore, the lack of research on the industrial organization of HFT deprives us of knowledge on the ways of structuring this industry in a manner that promotes the usefulness of the financial marketplaces. Therefore:



[11] The Commission invites the government of Quebec to assess the appropriateness of establishing rules that govern the relationship between the exchanges, institutional investors and the HFT firms.

## LEXICON

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**Algorithm:** Series of logical instructions to be followed in order to accomplish a task or to solve a problem.

**Bid-ask spread:** Difference between the highest price a buyer is willing to pay and the lowest price a seller is willing to accept for a given security at a particular time.

**Broker or broker-dealer:** Licensed professional who serves as an intermediary between customers (individuals, institutions) and the marketplaces. The broker has access to the exchanges. He or she receives and submits the orders.

**Co-location:** Installing traders' and broker-dealers' computer servers in the data centres where the exchange's servers are located in order to shorten the distance that data must travel and thereby reduce transmission time.

**Data aggregator:** Information processor or market data vendor who gathers data from different exchanges, aggregates it and disseminates consolidated data feeds to the public.

**Direct market access provider:** Broker who provides access that allows traders to submit automated orders on the exchange's order book without going through a traditional human broker.

**Efficient price:** Price that takes into account all available information about a security and reflects the fundamental value of that security.

**Exchange:** Physical location or virtual place where financial instruments are traded. Exchanges include traditional regulated stock exchanges, alternative trading systems (ATs) that can be more opaque, and over-the-counter (OTC) markets.

**Financial instruments:** Securities and financial instrument contracts that can be traded on the marketplaces. There are various types of financial instruments: stocks, bonds, derivatives (futures contracts, options), etc.

**Front running:** Traditionally, a trading strategy whereby a broker benefits from privileged information on a customer's transactions. When a customer is just about to place a large order on a security, the broker buys or sells that security just before executing its customer's order so that he or she can profit from the price movement that the customer's order will cause (market impact). This strategy is also used in HFT, except that in HFT anticipation of large orders is done through computer systems using publicly-available information (and detection of such orders is done using techniques such as pinging or pattern recognition).

**Fundamentals:** Real economy factors that impact the success of a corporation and the value of its securities. These include the economic environment, growth, revenue, management, business strategy and business plans, etc. They do not include factors related to the capital markets, such as supply and demand for the corporation's securities and the trading patterns of these securities.

Fundamental analysis is the analysis of data on the fundamentals in order to forecast the performance of a corporation and the value of its securities. It contrasts with technical analysis, in which forecasts are based on data relating to the financial markets.

**Halt, circuit-breaker or kill switch:** Mechanism that halts trading when price fluctuations reach a certain threshold.

**Investors:** Individuals (or groups of individuals), companies or institutional investors (pension funds, banks, insurance companies, mutual fund investment managers) who provide money to the capital markets.

**Issuer:** Institution that issues securities (stocks, bonds or debt securities) in order to fund its operations. An issuer can be a corporation, a government or a public agency or para-public agency.

**Liquidity:** Ability to execute a trade on a security quickly when desired without substantially affecting the security's price.

**Market impact:** Effect of a transaction on the price of the financial instrument being traded. A purchase can bring about a price increase while a sale can have the opposite effect.

**Order:** Instructions for the purchase or sale of a financial instrument. This includes information such as the security to be bought or sold, the number of securities to be purchased or sold, a price and a deadline.

**Order book:** List of orders for a particular financial instrument on a given exchange. It includes the quantities and the bid prices and asking or offering prices. Orders are prioritized for execution based on characteristics such as the time they arrive at the exchange or the price. Execution priority modes vary based on the exchange.

**Price discovery:** Process by which the interaction between buyers and sellers on the marketplaces leads to the establishment of an equilibrium price.

**Quant:** Mathematician whose role is to develop financial models and profitable trading strategies.

**Systemic risk:** Market dysfunction that leads to paralysis, and perhaps even a crash of the entire financial system in a more or less wide geographical area.

**Traders:** Persons or entities who buy and sell financial products. They make financial transactions for profit. They work on behalf of institutions (banks, brokerage firms), their customers' portfolios or their own portfolios (prop traders).

**Transaction costs:** Costs that include both explicit direct costs (broker commissions, exchange fees) and implicit direct costs (bid-ask spread, market impact costs, etc.) as well as indirect costs (e.g. technological and administrative costs).

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Faculté de droit, Université Laval  
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ApSTAT Technologies

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ApSTAT Technologies

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Ethics advisor  
Institut national de santé publique

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**Caroline Joly**

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Autorité des marchés financiers (AMF)

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Regulatory division  
Montréal Exchange (MX)

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Polytechnique Montréal

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Autorité des marchés financiers (AMF)

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Senior Vice-President, Market regulation  
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Observatoire de la finance, Genève  
Professeur associé  
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