Finance and artificial intelligence:
A revolution on the march

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Abstract:
After a few years on the outside, artificial intelligence (AI) has once again hit the headlines, raising hopes for a revolution in several sectors. It is benefitting from the combined effects of the exponential growth in computing power and the availability of a wealth of data spawned by the Internet and social media. The financial industry, which depends on its capacity for capturing and processing information and then using it to add value to its operations, is feeling the brunt of this revolution on the march, which could upend its business model as newcomers emerge, such as the GAFA (Google, Apple, Facebook and Amazon). This would force it to make alliances in order to reinvent its business model and services. After describing the situations in trading (which has long used algorithms) and asset management (between reality and prospective studies), this article examines business-to-customer (B2C) relations, since customers are accelerating these changes with their new needs (ubiquity, availability, rapidity) and through their behaviors on the social media. Applying AI is a challenge for industries and, too, for customers, citizens and regulators. Regulators should not stymie the expected benefits from AI-based innovations (which will, for example, improve their knowledge of customers and help them detect abuses) but pay attention to the eventual risks (for investor protection and market operations).

AI and the AMF's purview: From markets to investors

The mandate of the Financial Markets Regulatory Authority in France (Autorité des Marchés Financiers, henceforth AMF) has three pillars: the smooth operation of financial markets, information for investors, and the protection of savings. The technological disruption under way has an observable impact on each of these three to varying degrees.[1]

High-frequency trading

The development of derivatives, the "mathematization" of trading room activities and the relentless quest to find ways to save time have impelled a surge in high-frequency trading (HFT), which now represents more than half the transactions on financial markets. Algorithms are the critical factor in this changing space-time manifold. Now omnipresent, from making a decision to executing it, automation allows for passing (or canceling) an order in a few microseconds. In 2015, the AMF sanctioned Euronext Paris and an HFT company, Madison Tyler Europe, thus reminding all players of the importance of maintaining the market's integrity.[2] However the trading algorithm now solidly installed on financial markets is not necessarily manipulative; regulators are

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[1] This article has been translated from French by Noal Mellott (Omaha Beach, France). The translation into English has, with the editor's approval, completed a few references.

[2] AMF press release of 8 December 2015, "La Commission des sanctions de l'Autorité des marchés financiers sanctionne Virtu Financial Europe et Euronext Paris" available at:
http://www.amf-france.org/Actualites/Communiques-de-presse/Comission-des-sanctions?docId=workspace%3A%2F%2FSpacesStore%2Fd83d375f-f736-40d0-9412-f722decfb4cc.

still closely observing it. In January 2017, the AMF released a study of the comportment of high-frequency traders on the Euronext stock exchange.[3]

Although these techniques are a challenge to regulatory authorities, the new tools for supervising market activities with the help of artificial intelligence (AI) will make it easier to identify patterns of suspicious bargaining on the markets or to automate the supervision and analysis of electronic messaging services.

New opportunities for asset management

For asset management, the digital transformation is both a challenge and an opportunity (AFG 2017). Big data and machine learning are levers for changing the models of production, distribution and costs. They offer asset management the capacity for processing a mass of data, whether annotated or not, whether text, images or sound recordings. They open perspectives for more easily making original analyses and inventing new macroeconomic indicators. They also improve predictions about a firm's sales or about economic cycles in a branch of the economy by garnering the opinions of consumers and diffusing information. Better knowledge about a client's liabilities will allow for a more granular asset liability management (ALM). The risks stemming from systemic or "herd" behaviors could be managed more accurately. Investment strategies, well-honed and diversified, would reckon with the sources of growth and identify the risks of a swing in the market before it occurs.

These prospects are within reach. They call for intellectual investment and a reinforcement of considerations for protecting personal data and giving primacy to the client's interests, the purpose being to work out fair guidelines for future changes.

Which AI applications?

Robo-advisors

In asset management, "robo-advisors" can be used to offer a simplified user experience to clients and better match products with clients, all this at a lower cost. The model for this is "uberization" with shortened channels to clients. Concentrated on satisfying the client's new needs (simplicity, ubiquity and availability), robo-advisors provide services for profiling clients and simulating performances using complicated techniques that are, ultimately, not very disruptive. The actual cause of disruption is their marketing model. Robo-advisors give advice in place of human beings or complete human advice.

Retail banking: Administrative automation and advice to customers

Retail banking (the interface between the client and the offer of banking, insurance and other financial services) has recognized the importance of investing in AI to maintain its place in the transformation of the financial industry. Bankers foresee using AI as the principal vector of interactions with clients.[4]

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[3] AMF press release of 26 January 2017), "Comportement des traders haute fréquence sur Euronext Paris" available via: http://www.amf-france.org/technique/proxy-lien?docId=workspace://SpacesStore/e4cc75a0-490e-45f0-bb24-56cabeccaf33&langue=fr.
[4] Accenture, "Banking technology vision 2017: Latest technology innovations and trends". Available via https://www.accenture.com/us-en/insight-disruptive-technology-trends-2017.

Plans have been made to automate time-consuming tasks. Semantic analysis is used for rereading contracts and translations. The AI tool can handle complaints by detecting the claimant's state of mind so as to orient his request. These techniques, similar to tools using machine (or deep) learning, require access to a "data lake" and the formation of a data base from professional know-how. They also require mature information systems and solid experience in data management.

Smart robots are also being developed to assist financial advisors in banks. These robots can efficiently manage e-mail and improve the proposals for savings.[5] It does not suffice for a financial investment advisor to have the client's profile (financial status, knowledge of and experience with financial products, the client's proclivity to take risks, objectives).[6] Obligations under the EU's Markets in Financial Instruments directives (in particular for assessing a client's suitability for types of investment products) will be reinforced as of 3 January 2018.[7] The offer of financial products to clients is too often unbalanced; and the information on fees is not clear. The technical expertise of advisors should be improved. AI tools for assisting them should improve the quality and traceability of the recommendations they make. This problem concerns all banks, whether brick-and-mortar or purely on-line.

Several AI applications (for processing natural language or images, automatic learning, multi-agent and robotic systems) are rapidly changing the tools used for customer relations. Besides the traditional channels for these relations (mail, telephone), a useful new one is the chatbots and other conversational tools (with vocal or visual recognition) or even interactive vocal servers. Profiling clients, classifying queries, adapting communication to the type of client ("millennials" now 18 to 30 years old, the "vulnerable"…), the automation of relations with clients is experienced as a break with the traditionally procedural environment; the socioeconomic consequences are to be taken into account.[8]

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[5] CHOCRON V. (2017) "Le Crédit mutuel déploie le robot d'intelligence artificielle Watson dans son réseau", *Le Monde Économie*, 20 April. Available at: http://www.lemonde.fr/entreprises/article/2017/04/20/le-credit-mutuel-deploie-le-robot-d-intelligence-artificielle-watson-dans-son-reseau_5114032_1656994.html.

[6] See the "mysterious visits" since 2010 reported in the AMF's *Lettre de l'Observatoire de l'Épargne*, issues 22 (March 2017), 17 (April 2016) and previous issues available at:
http://www.amf-france.org/technique/multimedia?docId=workspace://SpacesStore/db0ceb5c-c5ce-4a2a-8262-db6d68a32b09_fr_2.0_rendition
&
http://www.amf-france.org/technique/multimedia?docId=workspace://SpacesStore/ce9ab69d-c7b1-4dd3-b7bf-cd2cf1194130_fr_1.0_rendition.

[7] Texts of European Union law are available via
http://eur-lex.europa.eu/browse/directories/legislation.html.
The original MiFID (Markets in Financial Instruments Directive) is available at:
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32004L0039:EN:HTML.
MiFID 2 is available at http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0065.

[8] "Fermeture d'agences, suppressions de postes… Ce que prévoit le plan d'économies de la Société Générale à 1 milliard d'euros", *Challenges*, 28 Novembre 2017. Available at:
https://www.challenges.fr/finance-et-marche/banques/fermeture-d-agences-suppressions-de-postes-ce-que-prevoit-le-plan-d-economies-de-la-societe-generale-a-1-milliard-d-euros_516246.

Artificial intelligence and regulatory authorities

The MiFID 2 directive

The effective date of the EU's MiFID 2 is January 2018.[9] This Financial Instruments Directive is going to deeply reorganize these markets and relations with clients.

Algorithmic trading

To ensure the integrity of the market, MiFID 2 provides for measures to prevent the risks related to algorithmic trading. High-frequency traders will be held responsible, and have to be capable of: notifying regulatory authorities about how they use automated processes, of testing algorithms, and of keeping records of the orders passed using them. To ensure transparency and fairness, this directive also pushes for a tighter oversight of the markets, of trading platform fees and of "colocalization services". Colocalization is the placing of computer servers as close as possible to those of target firms in the markets so as to pass orders even faster.

A focus on end clients

For the sake of protecting investors, one of MiFID's three pillars reinforces procedures related to: information about the client's knowledge and expertise, channels of distribution and the execution of orders. This directive establishes a framework for selling practices and fosters the utilization of digital technology by fund managers. The provisions about "product governance" precisely distribute responsibilities between "producers" and "distributors" of financial instruments for: designing financial products, adapting them to the client's needs and choosing the suitable channel of distribution (See Figure 1).
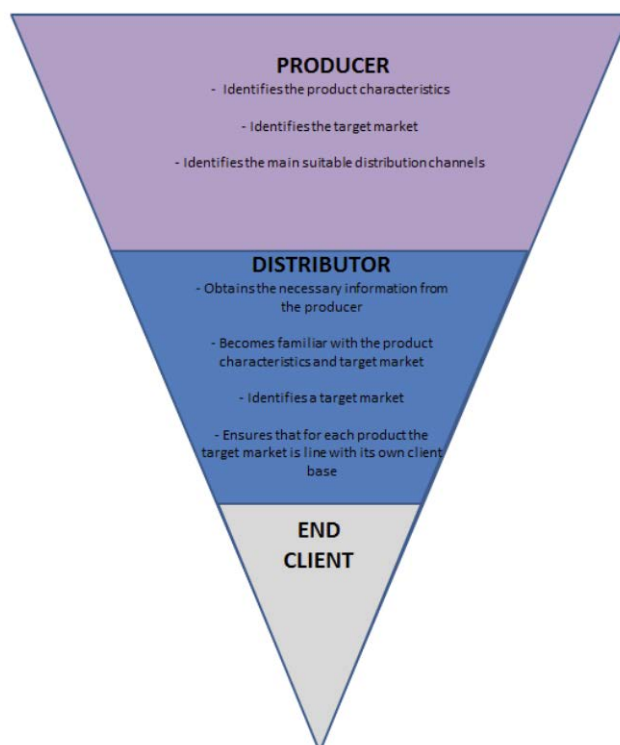

PRODUCER
- Identifies the product characteristics
- Identifies the target market
- Identifies the main suitable distribution channels

DISTRIBUTOR
- Obtains the necessary information from the producer
- Becomes familiar with the product characteristics and target market
- Identifies a target market
- Ensures that for each product the target market is line with its own client base

END CLIENT

Figure 1: Product governance of financial instruments
Source: AMF (February 2017, p. 11)

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[9] MiFID 2 updates the EU's MiFID 1 directive of 2004. See note 2.

Before offering an investment service, the suitability of the financial product with the client's profile must be verified. MiFID 2 enlarges this "know-your-customer" obligation: the client's capacity for financial losses is to be taken into account by measuring his risk tolerance and setting his investment goals.

Given this use of digital technology, how do cybernauts perceive the questions they are asked? Tests have to avoid negative biases in client protection and in the client's understanding of offers. A joint cross-sector committee of EU regulatory authorities is conducting exploratory studies on this issue.

Provisions have been added on after-sales services: the obligation to provide, at the client's request, a record of the service. The investment service provider (ISP) must be capable of proving that it has satisfied "best selection" and "best execution" requirements to obtain the best possible result when executing a client's order.

The AMF's evolving doctrine

The AMF has already adopted a position for overseeing certain negative externalities observed during the digitization of financial market processes. With respect to know-your-customer practices, ISPs have the responsibility of being aware of the risks of automation for client verification procedures (AMF 2013) and of the risk that their systems become a gaming platform (similar to on-line games). In May 2017, the AMF modified its general rules and issued a recommendation to market players who propose simulations of financial securities. Recalling the legislative and regulatory measures that apply to investment service providers and to financial investment advisors, this recommendation sets technical requirements for simulators.

To satisfy the growing requirements of conformity (owing to the RegTech project), these contributions from regulatory authorities help delimit technological possibilities while boosting their use by fund managers.

The challenges of AI

AI is already present in everyday life: voice and face recognition, medical diagnoses, etc. (BRAUNSCHWEIG 2016). In 2017, it moved into financial services, a movement relayed by the media. This technology fascinates: research, human enhancement, a source of wealth and jobs… but it also arouses fear. Might AI not outstrip human beings and dominate them? Might it (via HFT) not trigger stock market crashes? Might it not penetrate the secrets of our private lives by analyzing personal data or massively destroying jobs?

Putting AI to use

The implementation of AI is part of a firm's strategy. Given the innovativeness of this technology, a framework must be set up for respecting and protecting people. The goal is not to require that AI understands what users want but, instead, to interpret users' instructions and not become the sorcerer's apprentice (DIETTERICH & HORVITZ 2015). For AI to be accepted by all stakeholders (customers, wage-earners), this framework must be explained. Several researchers in this field are convinced of this need for transparency.

A supervised system with continuous governance
Learning systems define rules that can be automatically applied on a large scale. The hypotheses underlying these systems must be identified, explicated and debated collectively. Omitting doing this could lead to discrimination (age), exclusions from financial services (income level), or unfair treatment (fees)…

Since unexpected information can create inadequate results, the quality process inherent in the system must be up to par. It can serve to pilot the architecture, benefit from a metalevel of control over the coherence of the established framework with the results generated by the system. Circuit-breakers are indispensable. Ethics and the sensitivity of stakeholders must be taken into account. The governance of an AI system must be permanent and robust.

Cyberattacks can target AI systems. A major issue for risk management (which has to be supervised at the highest level) is to identify the AI systems that interest cybercriminals.

One of AI's objectives is to reduce human mistakes. A fine point is to determine when an analysis by humans is required so that the advice delivered is truly personalized.

Studies of behavioral economics in finance have focused on the cognitive biases of the consumers of financial products and services. Daniel Kahneman (2011) has described two systems of decision-making. System 1 — emotional, fast and intuitive — operates automatically. System 2 — reflective, calculating and slower — requires mental effort. AI corresponds to system 1, the system "naturally" used when making a decision. But might this rapidity not be counterproductive when the objective is to obtain the consumer's enlightened consent? Should we not foresee circuit breakers in the increasingly fluid interactions with clients? By crossing information from studies in various academic disciplines, we could detect the cognitive biases that risk being produced by using these new AI tools, and make the needed corrections.

Financial service providers are ultimately fully responsible for the suitability and adequacy of their advice in relation to the client's needs and profile. The new AI systems have real advantages (efficiency, guided assistance, the improvement of the knowledge available to advisors, etc.), but they require an enlightened governance for steering them. Major issues arise with regard to human resources: cultural changes, training the developers of algorithms in client protection and behavioral finance, the skills for data analytics, etc.

Using data

Investors who have been attracted by the offer of more fluid client services are entering their personal data into AI programs, which have a voracious appetite for information. The bigger the data, the faster they circulate, and the more varied they are; the better the results yielded by algorithms — the four *v*'s of big data; volume, velocity, variety and value. The coherence of the data used warrants the veracity of the findings made using them (GANAY& GILLOT 2017). Investors have to know the parties with whom they are contracting a relationship: who will be using their data? and for what purpose?

The EU's General Data Protection Regulation, effective in May 2018, will reinforce the human rights defined under article 8 of the European Convention on Human Rights. It f[10]oresees the portability of personal data, and Article 22 specifically addresses the issue of "*automated individual decision-making, including profiling*", whereby, except for situations stipulated in the regulation, "*The data subject shall have the right not to be subject to a decision based solely on automated processing, including profiling, which produces legal effects concerning him or her or similarly significantly affects him or her.*" In general, the GDPR grants citizens more control over their personal data. The CNIL, which oversees the GDPR's application in France, is addressing the ethical issues raised by trends in the development of algorithms and artificial intelligence.[11]

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[10] The GDPR (General Data Protection Regulation): "Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC". Available via:
http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1478961410763&uri=CELEX:32016R0679.
The convention in human rights is available at: https://www.coe.int/en/web/conventions/full-list/-/conventions/treaty/005.
[11] Commission Nationale de l'Informatique et des Libertés (CNIL) (2017), "Éthique et numérique: les algorithmes en débat", web page https://www.cnil.fr/fr/ethique-et-numerique-les-algorithmes-en-debat.

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