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The Effective and Ethical Development of Artificial Intelligence: An Opportunity to Improve Our Wellbeing

Finance

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Artificial Intelligence in Finance – Opportunities, challenges and risks[1]

Executive Summary

Artificial Intelligence (AI) and Machine Learning (ML) techniques and algorithms are already being widely employed for a variety of tasks in financial services firms, large and small, throughout the world, including in Australia[2]. These algorithms and techniques have the potential to expand access to credit, better manage risk, reduce fraud and improve firms' compliance with laws, regulations and codes of conduct, and to very significantly expand industry revenues in the financial services sector. More dramatically, many believe that AI will reshape the industry, globally (see WEF August 2018 report for a detailed exploration of these issues).

Over the past decade, however, we have also seen domestically and internationally that poor model selection and implementation can lead to unfair practices, unsustainable firm losses that may ultimately be borne by taxpayers, and potentially catastrophic economic disruption – as witnessed in the global financial crisis. This is notable and important in the context of AI and ML, given that the application of these new technological developments is in many cases toward the replacement or evolution of these same models[3].

Beginning as early as 2011, in the immediate aftermath of the financial crisis regulators in other jurisdictions, including the USA, UK and Europe, moved to implement very comprehensive, detailed

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[2] See for example: Institute of International Finance, 'Machine Learning in Credit Risk' (Summary Report, May 2018) https://www.iif.com/publication/regulatory-report/machine-learning-credit-risk

[3] Here, for the sake of brevity we are leaving to one side the very important technical distinctions between automation of traditional models, such as Multivariate Adaptive Regression Splines, Principal Component Analysis, Singular Value Decomposition etc., which major Australian banks have been doing for more than a decade, and true AI/ML techniques. For a detailed discussion, see for example: Financial Stability Board, 'Artificial Intelligence and Machine Learning in Financial Services: Market Developments and Financial Stability Implications' (1 November 2017) http://www.fsb.org/2017/11/artificial-intelligence-and-machine-learning-in-financial-service/

and prescriptive standards and guidelines regarding how banks' internal risk models must be designed, tested, implemented and validated. Both transparency and "explainability" criteria are at the heart of the requirements, which are very stringent indeed. Many major banks in these jurisdictions have had, and are still having, very great difficulty in complying with these new requirements. Nevertheless, the necessary skills are currently being built in these offshore jurisdictions to ensure strong and effective model risk management and governance capabilities, both in the industry and in the relevant regulatory sectors. These are the same skills that will be needed to ensure effective and safe implementation of AI techniques in the banking sector.

However, Australia's banks and prudential regulator are not currently well-positioned to address these challenges, relative to their global peers. Perhaps largely (or partly) because Australia's banks emerged essentially unscathed through the GFC[4], our regulators have not implemented similarly stringent, detailed regulations, standards and guidelines over banks' use of models. In consequence, Australia's banks have not invested as deeply in the skills and talent needed for model risk management and control as their international peers who are subject to these more strict regulatory requirements. Likewise, for similar reasons Australia's regulators, bank senior executives and Boards have, in general, relatively little experience and familiarity with leading practice model risk management and governance requirements, compared to their aforementioned international peers.

Big data and suitable controls over the use of third-party vendor offerings are two additional, crucial considerations for banks considering the adoption and implementation of AI and its embodiment in deep learning algorithms. Issues with explainable algorithms will need to be addressed from the earliest days of development if model risk management is to work at all in the new, future AI environment. This is likely to be one of the primary challenges[5] for effective model risk management and governance, which will continue to be essential to ensure the safety and soundness of individual banks, and of the Australian banking system, as a whole.

- Consequently, in order to rapidly build the essential capability and skills necessary for the safe and effective implementation of AI approaches and techniques, and to enable Australian banks and other financial services firms to actively participate and reap the very substantial benefits of the "AI revolution", government should move quickly to require financial services regulators to immediately develop a robust set of specific regulatory standards and detailed associated supervisory guidelines for model risk management and governance for Australian banks (ADIs) and other financial services firms. The standards and guidelines should follow best practices in other jurisdictions, have clear scope of application and should ensure that lines of responsibility for the operation and supervision of algorithmically-driven systems, models and decision processes are clear. These regulations should apply to both human-created models and machine-created models, to ensure that current and future model automation and AI techniques are used appropriately and responsibly. This initiative should be assigned the highest priority.

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[4] Perhaps this is largely thanks to a Commonwealth Government guarantee which was applied to all of their domestic and international borrowings in the wholesale markets, from October 2008 onwards?
[5] See, for example: Woodall, Louie, *Model Risk Managers Eye Benefits of Machine Learning: Ramp-up in Regulatory Scrutiny of Model Validation Sees Banks Turn into Black Boxes* (11 April 2017) Risk.net
https://www.risk.net/node/4646956

Discussion

The Global Financial Crisis did major damage to the banking systems and real economies of many countries. The lives and economic well-being of many hundreds of millions of ordinary citizens were negatively impacted; many national economies have still not fully recovered, and the practical and political implications and ramifications of the crisis (including stagnant wages and increased levels of income inequality in many countries) are still being felt globally.

In the years immediately following the crisis, many important lessons were learned about the root causes of the major bank failures, and the very substantial gaps and weaknesses in bank regulation, supervision and governance which led directly to the crisis.

Some of the most important lessons learned from the financial crisis were about the catastrophic failure of the risk management systems and processes in many of the largest banks in the world, which became insolvent and were either rescued at huge expense using taxpayers' money, or allowed to fail, with many negative, unexpected consequences (e.g., Lehmann Brothers in September 2008).

At the heart of the risk management failures were 2 major issues: poor "risk culture" and oversight of risk in many institutions, and the widespread ***failure of banks' internal risk models***. Deep analysis, post-crisis by both industry and supervisors in the most affected jurisdictions revealed that the failure of risk models was really a widespread *failure in many large institutions of bank senior management to fully understand the models, including their intended purpose, underlying assumptions, reliance on historical data and (critically) their limitations of use*. This lack of understanding led directly to an uncritical reliance on crucial model estimates of risk in the lead up to the crisis, which in some cases turned out to be several orders of magnitude too small[6].

In the aftermath of the crisis, a very important consequence of these modelling failures was a widespread loss of confidence by financial regulators, shareholders and many other stakeholders, globally, in banks' capabilities and practices for the robust modelling of risks. This loss of confidence has had many consequences subsequently, notably including in the substantial redesign and tightening of global frameworks for bank regulation. Some of these consequences have very important implications for the future robust control and regulation of AI and ML algorithms in financial services, especially for regulated banks which may potentially carry the implicit guarantee of government and taxpayer support in a crisis (as is generally perceived to be the case, in Australia).

The global response to the crisis was overseen by the G20 and coordinated by the Financial Stability Board (FSB). A central pillar of the global response was the huge amount of work done over almost a decade by Basel Committee on Banking Supervision (BCBS) to revise the international regulatory framework for banks; this ultimately led to the wholesale revision of the 2006 framework of

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[6]See e.g.: Financial Crisis Inquiry Commission, 'The CDO Machine' in *The Financial Crisis Inquiry Report: Final Report of the National Commission on the Causes of the Financial and Economic Crisis in the United States* (US Government Printing Office, 2011) http://fcic-static.law.stanford.edu/cdn_media/fcic-reports/fcic_final_report_chapter8.pdf

international standards for banking regulation and minimum bank capital requirements ("Basel II"[7]) by the new framework of global regulatory standards ("Basel III"[8]) in December 2017.

In light of the widespread loss of confidence by financial regulators in banks' capabilities and practices for the robust modelling of risks, referred to above, a key design feature of Basel III is the very substantial, new restrictions that have now been placed upon banks' ability to use outputs from their own, internal risk models in the calculation of the minimum required level of capital that they must hold to underpin credit, market, operational and other risks, in order to ensure their safety and soundness, and that of the larger banking system as a whole, both domestically and internationally[9].

In parallel with this very significant change in the design of the global regulatory framework for banking, and the very substantial reduction of the banks' modelling freedom within the new framework, regulators in some of the most important countries and jurisdictions, including the USA, UK and Europe, have also moved to implement very comprehensive, detailed and prescriptive standards and guidelines regarding how banks' internal risk models must be designed, tested, implemented, validated and used[10] - these activities are often collectively referred to as *model risk management*.

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[7]Basel Committee on Banking Supervision, 'Basel II: International Convergence of Capital Measurement and Capital Standards: A Revised Framework - Comprehensive Version' (Bank for International Settlements, 30 June 2006) https://www.bis.org/publ/bcbs128.htm

[8]Basel Committee on Banking Supervision, 'Basel III: Finalising Post-Crisis Reforms' (Bank for International Settlements, December 2017) https://www.bis.org/bcbs/publ/d424.pdf

[9] This was the result after several years in which fierce arguments raged between international regulators, regarding whether the estimates from internal models should continue to be allowed to be used _at all_ – even on a very restricted basis - in the determination of minimum capital levels for banks. See e.g. Andrew Haldane, 'The Dog and the Frisbee' (A speech delivered by the Executive Director, Financial Stability and member of the Financial Policy Committee and Vasileios Madouros, Economist, Bank of England at the Federal Reserve Bank of Kansas City's 36th Economic Policy Symposium, 'The Changing Policy Landscape', Jackson Hole, Wyoming, 31 August 2012) http://www.bankofengland.co.uk/paper/2012/the-dog-and-the-frisbee; also Wayne Byres, 'Perspectives on the Global Regulatory Agenda' (Speech delivered at the RMA Australia CRO Forum, Sydney, Australia, 2014) https://www.apra.gov.au/media-centre/speeches/perspectives-global-regulatory-agenda ; and Wayne Byres, 'Matching Expectations with Reality' (Speech delivered at the Hong Kong Monetary Authority, Global Association of Risk Professionals, Global Risk Forum, Hong Kong, 11 November 2015) https://www.apra.gov.au/media-centre/speeches/matching-expectations-reality. For an extensive discussion of the issues, including the importance of retaining "risk sensitivity" in the regulatory framework for banks, and the implications of these for Australia see: Kevin Davis and Mark Lawrence, 'BASEL IV and Australian Banking' [2015] (4) *Finsia Journal of Applied Finance 28* https://www.finsia.com/docs/default-source/jassa-new/jassa-2015/jassa-2015-issue-4/basel-iv-and-australian-banking.pdf?sfvrsn=32339493_4 ; also Cowell, F and M Levins, 'Mark Lawrence' in *Crisis Wasted? Leading Risk Managers on Risk Culture* (Wiley, 2015) 141

[10] See, e.g., Board of Governors of the Federal Reserve System and Office of the Comptroller of the Currency, 'Supervisory Guidance on Model Risk Management' (SR Letter 11-7: Attachment, 4 April 2011) https://www.federalreserve.gov/supervisionreg/srletters/sr1107a1.pdf; Bank of England Prudential Regulation Authority, 'Stress Test Model Management: Letter to Firms' (22 March 2017) http://www.bankofengland.co.uk/prudential-regulation/letter/2017/stress-test-model-management; European Central Bank, 'Information on the Current Version (February 2017) of the Guide for the Targeted Review of Internal Models (TRIM)' (ECB-PUBLIC, February 2017) https://www.bankingsupervision.europa.eu/ecb/pub/pdf/trim_guide.en.pdf

These requirements are very stringent indeed[11], and (inter alia) both transparency and "explainability" criteria are at the heart of the requirements. Importantly, many major banks in these jurisdictions have had, and are still having, very great difficulty in complying with these new requirements[12]. For example, in the USA, the Federal Reserve for several years prohibited certain of the largest US banks from paying dividends to shareholders because their risk management processes were not sufficiently robust, at the core of those shortcomings (determined through the annual "CCAR" stress-testing process, conducted by the Federal Reserve[13]) were model weaknesses and the failure to comply with the relevant US standards and requirements for model risk management and oversight, which were issued in April 2011.

Nevertheless, in those major jurisdictions, both firms and regulators are now actively considering and discussing how those detailed standards and guidelines can be adapted and enhance to accommodate AI techniques and ML algorithms, primarily in those relevant parts of the business for which financial stability considerations are of very high importance[14].

- Crucially, the Australian prudential regulator, APRA, has not moved in a substantial way since the crisis to enact a similar, robust, comprehensive set of regulatory requirements and guidelines for model risk management. Consequently, Australian banks have not been required to significantly invest to "lift their game" in this area in recent years, and to build the capabilities that will be needed for the future implementation and robust control of AI algorithms and models in key specific areas, such as credit origination – and mostly, they have not yet done so. From the author's recent, direct experience as a consultant, at least some of the largest Australian banks have very substantial weaknesses in the area of model risk management and governance, when compared with leading practices internationally.

This observation has important implications for the readiness of both Australia's banking system and its prudential regulator to move forward with the implementation of AI models, which should be addressed with the highest priority.

Conclusion and recommendation

A key lesson from the global financial crisis is that business leaders must understand how the models which are at the heart of their businesses are designed, implemented, validated and used, and the

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[11] See, for example, the section on internal validation, pp 16 – 21 of European Central Bank, 'Information on the Current Version (February 2017) of the Guide for the Targeted Review of Internal Models (TRIM)' (ECB-PUBLIC, February 2017) https://www.bankingsupervision.europa.eu/ecb/pub/pdf/trim_guide.en.pdf, especially paragraph 57.

[12] Parvez Shaikh, Michael Jacobs and Neha Sharma, 'Comprehensive Capital Analysis and Review: Industry Practices and Model Validation' (Accenture, 2016)

[13] See for example Board of Governors of the Federal Reserve System, 'Comprehensive Capital Analysis and Review 2015: Summary Instructions and Guidance' (October 2014) https://www.federalreserve.gov/bankinforeg/stress-tests/CCAR/2015-comprehensive-capital-analysis-review-summary-instructions-guidance-appendix-a.htm

[14] See for example, the conference agenda and papers here: https://www.frbatlanta.org/news/conferences-and-events/conferences/2018/0506-financial-markets-conference/agenda , including e.g. Matthew U Scherer, 'Regulating Artificial Intelligence Systems: Risks, Challenges, Competencies, and Strategies' (2016) 29(2) *Harvard Journal of Law and Technology* 354 http://jolt.law.harvard.edu/articles/pdf/v29/29HarvJLTech353.pdf

limitations of those models, including their key assumptions and the nature of their reliance on historical data.

It is essential *that business leaders must take responsibility for the outcomes, decisions or actions which are created by, or a consequence of, the use of the models in the business*.

Moving forward, in an "AI world", as the machines cannot be held responsible for their actions, people must still exercise their oversight role and be held responsible for outcomes, even — and perhaps especially — when utilizing automated processes[15]. This is a core principle which must be clearly and prominently stated at the outset, if adverse outcomes are to be avoided in the banking sector.

Ideally, this core principle should be clearly and prominently articulated as part of a broader, coordinated, national strategy and approach for AI across all sectors of the Australian economy. However, because of the unique, central role that banks play in our economy — and the very large risks that their failure may pose to the national economy and society — some very high quality, sector-specific controls are needed to ensure the safe and effective development and implementation of AI approaches in the financial services sector.

Recommendation

- Government should move quickly to require financial services regulators in Australia to immediately develop a robust set of specific regulatory standards and detailed associated supervisory guidelines for model risk management and governance for Australian banks (ADIs) and other financial services firms. The standards and guidelines should follow best practices in other jurisdictions, have clear scope of application and should ensure that lines of responsibility for the operation and supervision of algorithmically-driven systems, models and decision processes are clear. These regulations should apply to both human-created models and machine-created models, to ensure that current and future model automation and AI techniques are used appropriately and responsibly[16]. This initiative should be assigned the highest priority.

In light of experience offshore, it may be valuable to convene a special Task Force/Working Group of experts to ensure that the necessary and appropriate, sector-specific regulatory framework is developed and adopted. Such a group of experts should consult widely with industry and with other domestic and offshore regulators throughout this process.

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[15] See, for example: Bundesanstalt für Finanzdienstleistungsaufsicht, 'Big Data Meets Artificial Intelligence: Changes and Implications for the Supervision and Regulation of Financial Services' (16 July 2018) https://www.bafin.de/SharedDocs/Downloads/EN/dl_bdai_studie_en.html

[16] This is especially important in the particular use case in which automated or AI models may be employed within a credit decisioning process - i.e., the decision whether to approve or deny credit (a loan) to an applicant - where the "*explainability*" of the credit decision is essential, for both financial stability and fairness reasons. For a detailed discussion of this case, including prudential risks, see pp 25 – 27 of European Banking Authority, 'Report on the Prudential Risks and Opportunities Arising for Institutions from Fintech' (3 July 2018) https://www.eba.europa.eu/documents/10180/2270909/Report+on+prudential+risks+and+opportunities+arising+for+institutions+from+FinTech.pdf