How and to what extent will automation impact financial sector employment in Scotland?

An analysis of the likely impacts of automation on Scottish accountancy, banking and insurance and the implications for public policy

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Financial services have been an important source of Scottish prosperity for over 300 years, with the Bank of Scotland founded as early as 1695, and many other banks, insurance and accounting firms establishing themselves in the country over the following centuries. As a result, today 161,000 are employed in finance in Scotland, with Edinburgh being the UK's largest financial hub outside London (BBC, 2018) - providing services in insurance, retail and investment banking and accounting to customers across Britain and the world. However, many believe the long-established service sector in Britain is set for massive disruption by rapid technological development, such as in AI, leading to automation. Since the financial services industry is an especially important part of this sector to Scotland – with more employment in finance in Scotland per capita than any other country in the Union (BBC, 2018) – it is important to understand what the potential consequences of any changes could mean for Scottish firms and jobs. This research project therefore aims to assess the potential future impact automation might have on the labour market and productivity in Scottish finance – looking individually at accounting, investment banking and insurance – and analysing in particular the potential risks to employment so individuals, businesses and policymakers can prepare accordingly.

Automation and Accountancy

Accountancy represents a vital sector of financial services; an important day to day role for businesses across Scotland. The role of an accountant is wide and varied, playing a substantially different role for firms depending on the size and scope of their operations. Moreover, the role of the accountant appears to be the most fluid and evolutionary of any profession within the industry, as the role has moved from collecting of financial information to strategic analysis and developing key business strategies. Therefore, any change automation will bring to accountancy will have dramatic implications for financial services which, if the sector can adapt, could prove crucial to the economy.

Job numbers: a rising or declining profession?

The most obvious and drastic change that will likely occur within accounting and auditing is a radical shift in the labour market away from many staple manual, data driven jobs. In recent years, many papers cite accountancy and auditing as the most likely professions to become automated (Frey and Osborne, 2013).

The claim that automation could cause disruption in the long-run is substantiated by Frey and Osborne, who gave accounting and auditing a 0.94 probability of being 'computerised' within the next 20 years, suggesting it as one of the most likely professions to be automated (Frey and Osborne, 2013, p68). This sentiment is further echoed in the industry itself, with the Financial Times (FT) reporting that 'The Big Four' accountancy firms – Deloitte, PwC, EY, and KPMG - have altered hiring policies based on fears of automation. Deloitte themselves published a report which details how automation will change accountancy and auditing as a profession (Agnew, 2018; Deloitte, 2018). Figure 1 demonstrates the push

from financial shared services toward greater automation generally, indicating it as a key priority (Deloitte, 2018). Moreover, figure 2 shows that accounting is at the forefront of this, due to its high potential for automation (Deloitte, 2018).

Figure 1: Strategic priorities for shared services and GBS leaders, on a 7-point scale were 1 implies least important priority and 7 implies most important priority (Deloitte, 2018)

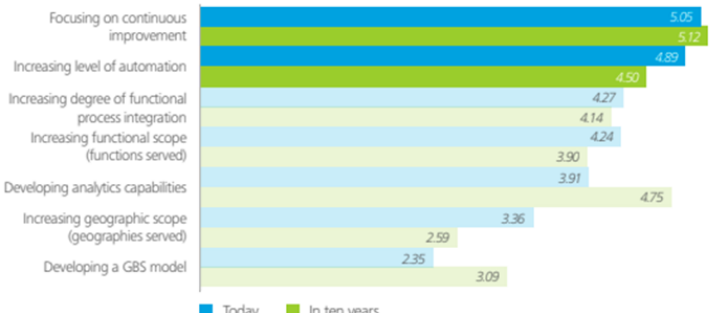
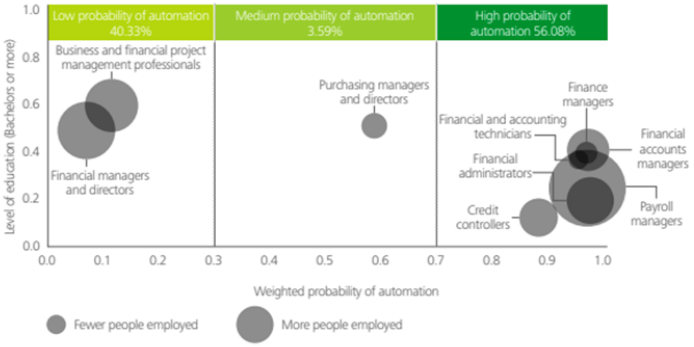


Figure 2: the probability of automation by Finance functional roles (Deloitte, 2018)



Despite this, the idea of there being a direct causal link between greater automation and less employment within accounting and auditing is still hotly contested and has been the subject of huge debate within the industry. Most notably, from the Association of Chartered Certified Accountants (ACCA) who, in response to reports such as that of Deloitte, have suggested that whilst automation is an inevitable part of the future of accounting, the labour market will not be as radically disrupted as many think (ACCA, 2015). Their main claim is that the true breakthrough of automation with regard to accounting will be its ability to circumnavigate monotonous tasks, thus making the industry more productive and efficient. In essence, the idea is that the role of robotics and automation generally is less revolutionary than expected and can be integrated alongside accountants as opposed to replacing them.

Additionally, the paper raises questions with regard to the desirability of automation and claims that the initial investment in automating a whole accounting department is a clear barrier to adoption. This is best summarised by Anirvan Sen, the 'Finance transformation veteran' and business leader who claims, "I don't believe robotics is as big a savings potentially that people are making it out to be. It leads to an increase in overhead through servicing and taking care of the robotic infrastructure" (ACCA 2015, p. 11). These claims stem from a nuanced understanding of automation being incorporated into accounting without overhauling it. This is echoed in PWC's analysis which claims, "The impact therefore, may not be as imminent and as severe as predicted, as long as accountants are willing to reinvent themselves," and sees the role of the accountant as the biggest change that will come from automation, claiming that, "accounting professionals can expect a shift towards more strategic and analytical roles" (PWC, 2016, p2). Therefore, it could be argued that that automation, rather than working against accountants, can boost their efficiency due to its ability to reduce the volume of monotonous tasks.

This is specifically seen in Malaysia, which has become an often-used case study when analysing the effects of automation on financial services. Businesses in Malaysia substantiate the view that automation can work in conjunction with accountants to boost

productivity and free-up time spent doing menial tasks, thus changing the job of the accountant without leading to unemployment. Tom Osborne of Hays Malaysia claims that for accountants "Automation has made things easier", and "The advances in data science and artificial intelligence are opening up new ways to look at businesses and generating insights that can lead to major productivity improvements" (PWC 2016, p. 36). It therefore seems plausible that with the increase in automation within accounting, the increased data available can aid accountants to boost productivity and the marginal product of their labour (ACCA, 2015, p3).

Accountants within Malaysia's biggest firms accept that automation has changed the profession enormously but can be used as a companion to the industry to change the job of an accountant, which for generations has proven to be an adaptive industry. To quote David Chin of ACCA, "let's not forget that the accountant's role has evolved with time; they are no longer just number crunchers. Businesses rely on their finance team to provide strategic advice on top of compliance and cost-saving guidance. This interpersonal capability is where the robots will fall short" (ACCA, 2015, p3). An increase in automation can significantly alter the labour markets of the British financial sector, particularly accountancy which will likely see the greatest transition. However, whilst British firms' fears about redundancies have validity, the optimistic view that the biggest change that automation will bring to accountants is a difference in the role of the profession and the skills needed to perform tasks appears to also be valid. Indeed, in many ways, automation can also serve great benefits by boosting productivity and reducing mundanity of certain tasks.

Can accountants adapt?

Perhaps a more pertinent question is how accountants will have to change their skillset in order to adapt to changes in the labour market. The consensus within the literature is key - in order for accountants to mitigate the possible disruptions within the labour market, they must become familiar with these technologies in order to incorporate them effectively within their operations. This is applicable to new technologies around machine learning for example which, if utilised by accountants, can vastly increase efficiency and output and reduce risk of unemployment (Davenport, 2019; Wilson, 1992).

The job of accountants, as evidenced in Malaysia, is to integrate and synthesise the automation within their tasks so as to maximise efficiency by developing a distinct skill set. These skills will likely be more technical and analytical and may see the emergence of computer programming alongside accounting analysis. For firms to maximise this potential, training schemes which allow workers the ability to develop programming as well as data analytics skills will be the best way to allow for this shift to be the most frictionless.

Looking at developments in accounting technology over the last decade, it appears as though the most ubiquitous technology change that will transform the role is that of Robotic Process Automation (RPA). RPA will streamline the job of accountants (ACCA, 2015) who currently spend a great deal of their time on paperwork and bookkeeping, as well as reviewing and collecting financial information (ACCA, 2015, p3-4). Often, these changes are tedious, costly and error prone. RPA software can mitigate this by monitoring

data seamlessly and thus can, in large part, do away with the more tedious tasks associated with accounting. To quote Andrew Moyser of Macintyre Hudson, "RPA can integrate to seamlessly enter, maintain, migrate, integrate, mine and test data from spreadsheets. It's an employee who can work 24-7, never get tired and always maintain 100% accuracy in repeating a task over and over again" (Moyser, 2018). This reflects the analysis from ACCA, that RPA can be integrated into accountancy to make the life of accountants more productive and less costly. Indeed, firms will be expected to save substantially after an initial investment as the labour costs as well as error costs will fall dramatically (Moyser, 2018). All of these changes cumulatively, can be expected to boost productivity.

This ability to reduce the inefficiencies of accounting and auditing can further be seen in the application of technologies such as Blockchain. Blockchain provides huge streams of data to be accessed easily and transparently, and thus can cut down the amount of paperwork many firms use. The need for paper records has often been emphasised, particularly with auditors in order to ensure the legality and transparency of a process. However, blockchain can be used in order to reduce the inefficiencies of such a system and once again, allocate time and resources more effectively for firms. Many have predicted the value this can have: "Because blockchain provides an immutable and transparent record of all accountancy-based data, it offers an opportunity for accountants and CPA firms to streamline their processes and audits, while ensuring that the records are accurate and truthful" (Arnold, 2019).

The implications of this allow for businesses to have more transparent, honest and efficient dealings with clients and can, once again be seen to boost productivity and efficiency within CPA firms. The analysis, once again, points to a change for accountants and auditors, but doubts how truly disruptive this will be to the labour market. Arnold claims that "the accountant's role will change, but it will not be eliminated," "by adopting blockchain technology, accountants and accountancy firms will be able to offer their employers and their clients the safety and security of all records – records that can be accessed by auditors" (Arnold, 2019) . Thus, the technology can be seen as an effective means of ensuring transparency and can be used in conjunction with RPA to make the accounting industry far more streamlined and efficient.

AI and accounting: possible implications

However, a technology with more radical implications for accountancy is Artificial Intelligence (AI), and the ability of computer programs to adapt and evolve without human input through the process of machine learning. AI technology will not just store and evaluate data in the same vein as RPA, but will instead have implications for judgements and predictions, and thus can be used as an analytical technology, changing the insights that accountants have. The ICAEW's report specifically on AI and its accounting applications claims, "In the coming decades, intelligent systems will take over more and more decision-making tasks from humans" adding that these insights, "can be extremely accurate, replacing and, in some cases, far superseding human efforts" (ICAEW, 2018, p5). Initially, this may sound like a possible substitute for human insights, however, the report counters this by stating, "they do not replicate human intelligence" and claims that AI can be used to, "radically improve the quality of business and investment decisions" provided by accountants (ICAEW, 2018). Indeed, the report goes on to list a number of ways in which

AI can be used to make more complete predictions by using a more accurate data source which can be used to give valuable insights, as well as totally new implications such as the ability to detect fraud based on a machine learning algorithm.

Conclusion

It is evident that increasing automation will radically change accountancy as a profession and the surrounding labour market. However, whilst initial impressions might seem ominous and could be seen to lead to mass unemployment within the industry, it is clear that automation technologies can be integrated within firms to increase productivity and make the profession more efficient and streamlined. Whilst some firms fear the worst, it seems clear based on the literature that should the UK automate accounting and auditing, that the changes would be largely beneficial and would prove adaptive rather than disruptive.

Automation and Investment Banking

Investment banking is a large industry in Scotland, which has a history in the financial services sector dating back over 300 years. Edinburgh is the UK's second largest Investment Banking hub, after London. Institutions operating in the Investment Banking sector in Scotland include Citi, HSBC, JPMorgan, Julius Bar, Morgan Stanley, RBS, Barclays etc. Moreover, several big investment funds also operate in the country, including Franklin Templeton Investments, Aberdeen Standard (which is also headquartered in Edinburgh), Psigma, State Street, and many more. To fully comprehend the extend of the impact of emerging AI technologies and further algorithmic asset management likely to take place in Scotland in the future on jobs and firms, a closer look into the innovations brought by new technology must be taken.

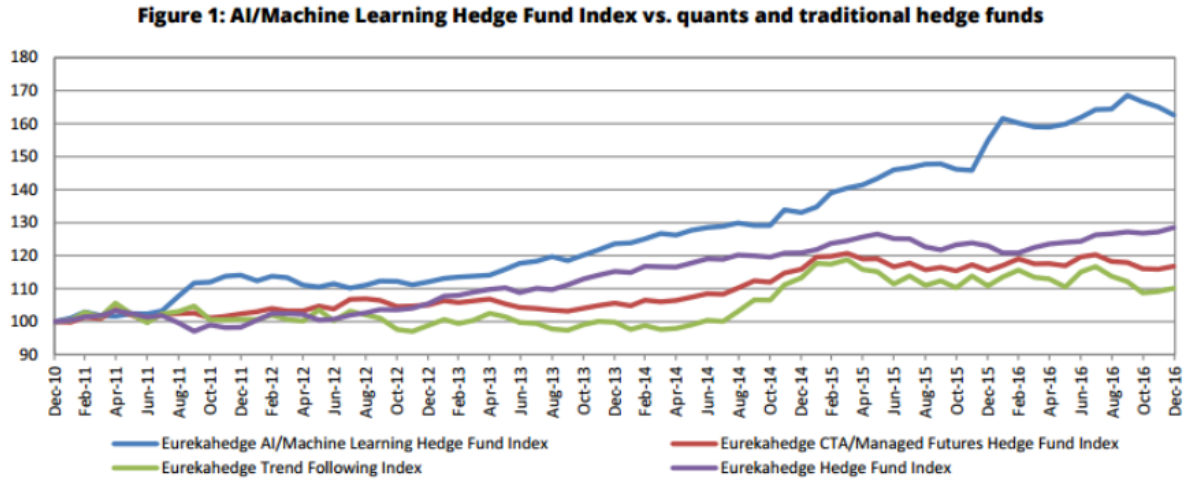
Potential impacts in asset management and jobs

Globally, the amount of funds channeled to Asset Management using algorithms that dictate the buying and selling orders has dramatically increased over the last decade. Such methods, however, carry a lot of risks. The Securities and Exchange Commission in the US has listed them as one of the foremost reasons behind the "flash crash" of the US stock market in May 2010, which was likely a result of algorithms used by different firms seeking to let go of certain positions at the same time, leading to vast decreases in value for certain assets, and of course abnormal losses for ordinary investors (Bloomberg, 2015).

This technology also has implications for Wealth Management. Actively managed funds – those which a human fund manager places orders on buying and selling stocks – appear to perform worse on average compared to algorithmic trading: over 10 years, 83 percent of actively managed funds fare worse than algorithms, which has led to the closure of many (FT, 2017). Additionally, within investment Banks that adopt this technology, workers spend less time managing the portfolio of the wealth management unit. For example, UBS's automated system that deals with clients' trading requests can save up to 40 minutes from a human Investment Banker (FT, 2017). This allows them to focus on other, more important functions of the business, making Banks that deploy such technologies more efficient and therefore profitable. Still, when the trading algorithm comes up with certain stocks to buy, a

human being has to approve the order before it actually takes place, rendering the existence of human traders necessary. Developments in AI could mean even human approval one day becomes unnecessary; indications from Eurahedge (2017) show, for their AI hedge fund management vs other hedge fund management options, AI management clearly had the ability to deliver higher returns over the long run (see figure 3). While this was one isolated test, it certainly provides an indication that there can be incentives to give both the decision-making process and execution of trading in investment banking to technology.

Figure 3: AI / Machine Learning Hedge Fund Index vs. quants and traditional hedge funds (Eurahedge, 2017)



Potential for job disruption: financial advice

A second area being disrupted by automation is investment advice. Many banks, including UBS and more recently RBS, have launched Robo-advisors that consult clients with small sums of money to invest. This service is aimed at almost all customers of the bank, and especially those who have as little as £500 to invest. This technology aims to create a personalized plan for individual investors who are not confident in investing their money by themselves, by asking them a set of questions such as their financial situation, goals, and risk appetite. As a result of these robo–advisors, RBS is cutting 220 Investment advice positions and 200 protection advice jobs (FT, 2016). It is therefore retaining human advisers only for clients with more than £250,000 to invest. Information on how successful robo-advisors are in creating returns for their customers is not yet available. In this case, it is evident that automation does not necessarily benefit the employees of the Investment banking sector, as it results in job losses; the benefit lies in reducing firms' costs through a reduction in their labour costs.

Conclusion

The impact of automation on Investment Banking and Wealth Management is not yet evident, however these two areas of disruption mean that it is likely that bankers will require new skills in order to stay useful in the workplace. While the exact nature of these required skills is ever-changing as important technologies are evolving, the ability to use

computerized software to analyse options and give advice, and to understand asset management algorithms, appears likely to be a significant feature of the new, more digital skills bankers look set to need. Since we cannot know for sure whether bankers can keep up with these changes in skill requirements, we also cannot be sure whether the benefits technology yields will overcome the costs. Therefore, in the long run, the success of robots in dealing with clients' money and conducting trades will determine whether human beings are still required in Banks and Asset Management firms. Until then, at least, employees of such institutions will likely be required to adapt to new technologies so that their jobs are reinforced rather than replaced by AI.

Automation and Insurance

Recent technological innovations such as AI, 'big data' and the Internet of Things have opened up the possibility of analysing trends in large data sets, allowing machines or humans to make 'smart' decisions accordingly. Insurance will perhaps be one of the most affected industries in the financial services, given the large amount of data that companies have to analyse in order to categorise their clients. The evidence points to it being likely that automation will have a disruptive effect on the business model of insurance providers, changing the value chain from underwriting to client interactions and potentially reconfiguring the skill sets necessary for workers in the sector.

'Insurtechs': a cause for concern or excitement?

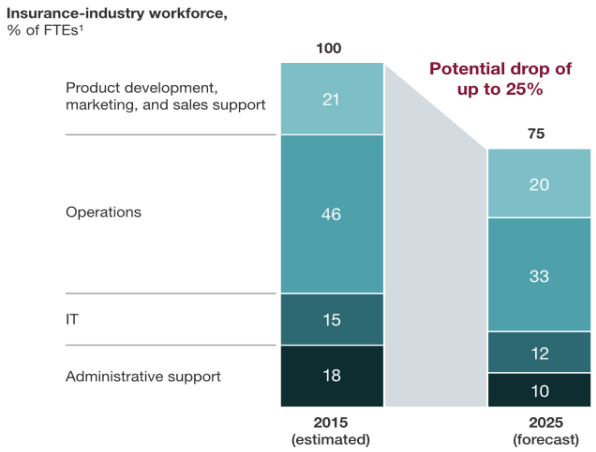
In recent years, an increasing number of insurance companies have begun financing actuarial start-ups (the so-called "insurtechs"), driven by cost-reduction in an increasingly competitive market. In fact, Accenture reported that about $2.3 billion was invested in insurtech deals last year, an increase of 32 percent compared to 2016 (Accenture, 2018). These investments cover multiple aspects of insurance, from the introduction of chatbots that advise clients on their choice of product to the development of RPA to streamline claim processing. As a result, insurance firms will be able to benefit from faster, cost-efficient operations, which in turn may translate into lower insurance premiums and higher quality services for clients – of course depending on how competitive the industry remains in the future, as re-investment or retained profits could prevent these savings being passed on to the customer.

The enhanced quality argument, however, appears more persuasive: evidence, for example the Scotland-based insurtech Cuvva that allows its user to buy insurance on an hourly basis through a mobile application with a built-in algorithm quickly verifying the clients' identity and DVLA records, has shown this can significantly reduce the amount of paperwork the buyer and the seller have to complete. One can easily imagine further developments of the service to allow per-journey based, tailor-made insurance products. Such system could take into account endogenous factors such as the drivers' habits, as well as exogenous risks such as the weather into its algorithm to generate an insurance premium that reflects the actual risk profile of the driver.

Jobs numbers

On the other hand, these innovations may also create job losses in the sector, especially in areas that can easily be automated such as administrative functions and operations. According to a research conducted by Mckinsey (see figure 4), up to 25 percent of full-time positions in the insurance industry are expected to be replaced[1], net of the new roles that automation will create (McKinsey, 2016). Moreover, the disruptions caused by automation may occur sooner than some predict given firms' incentives towards cost-cutting and the nature of the sector which makes it particularly suited for automation. Scotland could be particularly vulnerable to such changes, with insurance and long-term saving firms providing more than 10,000 jobs in Glasgow alone (Insider, 2018).

Figure 4: Mckinsey expectations of consolidation or replacement of full-time positions of the insurance industry workforce (Mckinsey, 2016)



Conclusion: the impact on skills

These disruptions will therefore almost certainly be a threat to jobs growth and maintenance – to an uncertain degree, however; to respond to such threat, workers in the actuarial sector may have to adapt their skills and move onto other roles that are more difficult to replace – these include marketing and software development, which often require more creative inputs. Major restructuring on the firms' part will therefore be necessary to cope with the changing business requirements of the industry and the shift towards a workforce that will create more value for the client.

Automation and Public Policy

As discussed in our evaluation of the effects of technology in all sectors of finance it appears that both throughout the past and in foreseeable future automation has been and will be taking people in some degree out of certain processes. While in the past this has often been focused on administrative processes, current trends in the development of AI technology mean that it is likely than decision making processes will be increasingly automated in the future; a problem that state regulators – such as the Financial Services Authority, the Treasury and the Bank of England - will likely have to contend with. This is because the sheer pace of change in technology in this sector means developing effective policy to curb the dangers and risks in the financial sector will be a difficult and constantly evolving task. However, looking back to the financial crash of 2008 shows just how vital it

[1] Figures based on Western European insurance, may differ for the UK and Scotland specifically.

is to have a safe financial system based on transparency and accountability – since the whole economy is exposed to failures with the banks.

Regulation: does automation present problems or solutions?

To some degree, the ability of technology and AI to access big data has assisted with this; enhanced ability by firms to store, use and understand big data means that "RegTech" – regulation focused technology - can "make reporting procedures – such as know your customer rules, tax reporting, or anti-money laundering rules – easier for firms" as well as "showing management to gaps in control requiring attention – giving firms a chance to identify problems ahead of time rather than being reactive" (KPMG, 2018). Furthermore, it is not unlikely that the ability of AI to comprehend huge amounts of data may allow us to predict future economic risks better – both on a micro level for certain banks and on a macro level for the whole economy. This is the promise that AI offers to the financial sector, should it work correctly; should this be the case, further regulation and policy may not be considered necessary.

However, flaws in financial technology in the past – as well as developmental flaws in recent AI – show that it is unlikely that new tech developments will be without its risks, and the pace in which the financial sector appears to be embracing this new, far from perfected technology for major decisions is a great cause of concern for regulators. Take for example the impact of automated trading algorithms. If behaviour tends to mirror that of algorithms more generally, flaws can occur – such as during the Flash Crash of 2010, when the Dow Jones industrial average dropped 9% in one day almost entirely from failures in automated trading algorithms (Bloomberg, 2015) – the result can have large macroeconomic consequences, losing funds billions of dollars. Whilst such algorithms often already have circuit breakers, ensuring that large decisions are stopped at a certain point pending a human to confirm the decision, in the future we could see this mandated by law.

Many other questions in finance – such as who should gain access to credit or who can be insured – can also therefore not be entirely trusted on technology. AI, through machine learning, has the power of being able to make complex decisions that are incomprehensible to many humans, meaning many will be disincentivised to work in financial services where they are required to simply approve the decisions of algorithms – handing over both responsibility and trust to technology. This carries with it substantial risk; bad decisions may become difficult to detect and solve. Therefore, it is vital that humans understand how the technology works for regulators to be truly satisfied that flaws will be detected before causing damage to the industry: meaning training on the potential consequences of AI use and staff demonstrating proficiency in the systems they use looks to be a likely requirement that regulators may impose.

Job losses: a reason to intervene?

Our analysis of data from the investment banking sector suggests job losses are likely as algorithms increasingly perform many tasks typically carried out by humans indeed, nearly $1 trillion in assets are managed at least in part by algorithmic trading (FT, 2019), rendering many on the trading floor redundant, as well as accountants. Centre's of Insurance in Scotland – especially Glasgow – may also be under threat as administrative

jobs are no longer required. However, regulation, it appears, may not required to save jobs: instead the nature of jobs is changing, with required skills in accounting especially changing from data management and administration to coding and IT, and therefore the ability of employees to engage in lifelong learning – accessible through business partnerships with many of Scotland's universities – may provide a way for those in former administrative roles to switch to supervising the technology across the financial sector, and could be encouraged by subsidy by the Scottish Government to prevent potential future job losses from those without the skills to keep their usefulness in the workforce. In accounting, for example, this could mean former accountants are taught how to competently create and manage software in order to perform their former tasks.

The case for non-intervention

Of course, our evidence in other sectors has also pointed to a number of important roles being unlikely to be trusted on algorithms alone; indicating that much administration at the top levels will likely be unaffected by improvements in technology. Also, the development and maintenance of labour intensive technology such as AI is likely to create new jobs. Therefore, while many continue to argue that automation will kill jobs in Scotland's financial sector in years to come – and while the future of finance is uncertain – the fact that Scotland's financial sector saw record job growth last year (BBC, 2018) despite automation advancing even further is a sign that more tech does not have to mean fewer jobs.

Conclusion

As it is First Minister Nicola Sturgeon's ambition to make Scotland a "leader in financial technology" (Scottish Government, 2018) – with regulation, as discussed, being unlikely to need to significantly harm the development and use of the technology – we can see the state as, if anything, speeding up developments in new financial technology through grants and education provision. Steps to introduce, for example, coding into the school curriculum in Scotland have already been made and could somewhat help and it is very possible that the UK and Scottish Governments' will continue to build on this education provision at all levels in order to facilitate the growth of a well equip labour force with the skills the industry is likely to demand.

Conclusion: so how will automation impact the financial sector employment in Scotland?

Clearly each element of the financial sector in Scotland is likely to experience different degrees of automation due to the varying nature of work their employees typically undertake.

The role of the accountant has already been moving away from data collection roles to strategic analysis, and since computers can typically be more accurate and efficient in this role there is a strong incentive for firms to continue investing against humans. Barriers to completely taking humans out of accountancy from our analysis appear to be the cost of further automation, trust in algorithms and the effectiveness of technology in strategic business analysis; recent developments in blockchain could enhance reliability and trust in

algorithms and AI machine learning, fed by big data, may lead to business advice being provided by computers; and is the reason we project accountancy to be the most likely element of the financial sector to see most roles being automated at the quickest rate. However the expense of new technology on overhead costs could prolong this change; and since we project automation will mean a mix of retaining jobs (since new technology might make existing accountants more productive), a rise in jobs in servicing and developing technology and job losses from automated roles, the net affect on jobs cannot be certain yet.

Algorithms have undeniably disrupted the core of Investment Banking in Scotland already, and indeed the world, with algorithmic management of funds generally shown to outperform human management and now accounting for a significant proportion of funds globally. While humans are still required for the decision process and analysis, developments in AI may speed up the decline away from human management even more, with decision processes based on machine learning, and thus possibly beyond human understanding. Of course, until such technology becomes widely used, understood and trusted, human supervisors will still be necessary and human managed funds still in demand, and for firms where technology helps increase returns for investors, perhaps jobs may be added for these roles. Financial advisory – in which human advisors have always arguably been more desirable than machines – could also be set for disruption if more banks in Scotland follow the approach of RBS in cutting jobs to make way for 'Robo advisors'. Jobs in financial advice may therefore depend on how the public come to trust apps or websites for financial decision making or prefer face to face contact, as well as in the input the existing workforce can have in programming and maintaining the technology behind this. Either way, for now jobs in investment banking on the whole appear to be reinforced by technology, not replaced by it, however further developments could change this if workers cannot keep their skills relevant.

Continuing high employment in Scotland in insurance will likely be threatened by 'Insurtech' developments, which are achieving large investments with the promise to streamline humans out of much basic administrative work and improve the speed of service and create a more tailored insurance product; the potential for great efficiency and quality gains these offer for a relatively low cost means companies have all the incentive to invest soon and heavily. As the insurance industry is becoming particularly competitive, if basic administrative jobs will necessarily be lost depends almost entirely on the ability of workers to shift their skills radically towards other departments where they can remain useful such as marketing or software development. Maintaining jobs – such as the 10,000 in Glasgow alone – should depend greatly on how firms choose to act, as if firms aim for personal customer service quality or lower overhead costs and high investment, job numbers will likely be maintained or forced downwards respectively.

Public policy has the ability to mitigate some of these risk to employment – but also can create new risks of getting in the way of progress than can create new jobs and aid with

regulation. The highly international nature of finance today means national and regional government action is unlikely to be able to make significant changes to the direction or pace of change of technology and costs, however can work with firms to ensure workers are equipped with the new skills they need to continue useful employment: whether that means a switch of department to marketing based roles in insurance, for example, or getting the skills in technology to become part of the growing workforce who create, service and use automotive technology to enhance their work and productivity in accountancy and investment banking. This could be through providing relevant skills at school and university level to the upcoming workforce, as well as perhaps subsidising and providing life-long learning in partnership with businesses. Since in any case we project small startups – as has been the case in recent years – to be part of the driving force behind many industry wide changes, ensuring that Scotland has the tech infrastructure, entrepreneurial, business friendly environment and education system it needs to be at the forefront of developments in financial technology is important. This will ensure jobs are maintained and grown in Scotland rather than elsewhere in the UK or overseas.

Overall it should therefore be clear that the impact of automation on financial services employment in Scotland is still to be determined as it depends on the motivations of individual firms, the cost of new technology and the pace of ongoing technological change, the degree of preference for human customer service and trust in algorithms, as well as how willing and able workers are to adapt their skills and to what degree national and regional government will address the issue and the policies they choose to implement. However, it must be realised that, particularly for jobs in accounting and insurance, many staple roles appear to be headed for replacement by technology, and unless employees are able to gain new skills and roles a difficult phase for employment in these areas of Scottish finance appears likely going forward.

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