

House of Commons
Science and Technology Committee
London SW1A 0AA

Re: Written Evidence on Commercialising Quantum Technologies

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Introduction

On behalf of National Taxpayers Union Foundation (NTUF), I welcome the opportunity to submit the following written evidence in response to Parliament’s inquiry on the commercialisation of quantum technologies. Located in Washington, DC, National Taxpayers Union is the oldest taxpayer advocacy organisation in the United States. Its affiliated think-tank, NTUF, conducts evidence-based research on economic and technology policy issues of interest to taxpayers, including US and international approaches to data protection, artificial intelligence, and emerging technologies. To that end, NTUF advocates technology policy solutions to promote technological innovation, consumer welfare, and fiscal responsibility.

NTUF appreciates Parliament and Government’s recent efforts to improve the United Kingdom’s position as a global centre of scientific and technological innovation. As Government seeks to position the UK as a science and technology superpower, it is right to prioritise quantum technologies. Given the range of potential applications of quantum technologies—from the use of quantum sensing in spatial exploration to the application of quantum computing to modernise logistics and tax systems—they have the potential to reshape the UK’s economic and technological landscape.

That is why NTUF welcomes Parliament’s intention to adopt a flexible, pragmatic approach to quantum technologies as well as its efforts to seek stakeholder input and expert comments through this consultation. By adopting an innovation-first, fiscally responsible approach to quantum governance, Government can set an example for quantum governance on both sides of the Atlantic.

Summary

The main points in this written evidence are summarised below:

1. Parliament and Government need to follow an innovation-focused approach to maximise the economic potential of the quantum technologies sector. Instead of a one-size-fits-all approach, a tailored and context-specific regulatory approach would be a better-suited strategy for quantum innovation.

2. The UK must take steps to address the broader challenges affecting the technology sector, particularly those related to the skills shortage. While the introduction of the Global Talent and High Potential Individual visa programmes is a step in the right direction, they need to be customised to attract individuals with quantum skills to work and set up businesses in the UK. Deepening quantum-focused academic and research partnerships with the EU, the US, and Japan, among others, would also be a welcome development.
3. Financing and scaling up constraints remain a particular challenge for UK startups and tech companies. That is why Government needs to liberalise the London Stock Exchange listing rules, encourage UK-based initial public offerings of technology companies, and improve the overall financing ecosystem.
4. To ensure that limited taxpayer-funded research and development (R&D) expenditures are spent effectively, Government should consider implementing review mechanisms to track and evaluate the impact of R&D spending in different quantum sub-sectors.
5. Creating regulatory sandbox programmes for the application of quantum technologies in different fields, such as encrypted communications and satellite imaging, can help promote regulatory understanding, develop an appropriate legal framework, and accelerate innovation.
6. Government needs to find innovative ways to pursue international cooperation in commercialising quantum technologies and shape global norms and regulations, for instance, through the creation of joint regulatory sandboxes with the US, the EU, and other advanced economies.
7. Given the dual-use nature of quantum technologies, they invariably pose certain national security concerns. While foreign investment review rules are necessary, they should be proportionate and transparent and must not unduly constrain quantum commercialisation.

1. Developing an Innovation-First Approach to the Quantum Technologies Sector

As the UK seeks to position itself as a science superpower, it must develop its leadership in quantum and other emerging technologies. To that end, Government needs to adopt an innovation-first approach that allows the private sector, academic institutions, and research organisations to spearhead innovation in the quantum technologies sector. To that end, the policy goals and strategies outlined in the recently published National Quantum Strategy and the Science and Technology Framework are a step in the right direction.ⁱ As quantum technologies develop further, such policies will need to be calibrated to reflect the changing technology landscape and the effectiveness of different policy tools. In the long run, Parliament will also need to develop a regulatory framework for quantum technologies, especially as they become more widespread.

Due to the potential applications of quantum technologies in a broad range of sectors, Parliament should refrain from developing a one-size-fits-all approach to quantum governance. The three main types of quantum technologies—quantum sensing, communications, and computing—can be applied to widely different contexts, from the manufacturing of new materials to spatial exploration and numerical optimisation. As such, quantum

rules should first and foremost depend on the sector and the specific context in which such technologies are applied. Furthermore, different quantum technologies are also at widely varying levels of potential commercialisation. For example, whereas quantum sensing technologies are already used for image recognition, the less advanced state of quantum computing means that its commercialisation is at least several years away.ⁱⁱ

The divergent applications of different quantum technologies and their varying levels of development mean that unified legislation will be inappropriate to deal with all areas of quantum technologies. Instead, as is the case with the UK's current approach to AI governance, Parliament and Government should develop tailored and context-specific rules for the application of quantum technologies in various sectors.ⁱⁱⁱ

2. Addressing Labour Market Challenges for Emerging Quantum-Focused Start-ups and Companies

The United Kingdom ultimately needs broader structural reforms to turbocharge quantum innovation. Many of the structural challenges that affect the commercialisation of other emerging technologies—from artificial intelligence to semiconductors and biotechnology—also apply to the quantum sector. Despite the presence of leading innovation clusters and universities and the UK's strengths in scientific research, other barriers—especially those related to the labour market and financing—pose major challenges. As in other European countries, the demand for professionals with quantum expertise far exceeds their demand, a problem exacerbated by the UK's recent economic performance. In this context, the introduction of special visa regimes – such as the Global Talent and High Potential Individual (HPI) visa programmes—is a step in the right direction and could help address some of those challenges.

However, such programmes will need to be better calibrated to attract the best and brightest quantum minds and entrepreneurs to work and start businesses in the UK. For example, as of November 2022, the universities whose recent graduates are eligible for the HPI visa included only five universities from the continent (two universities from Switzerland and one university each from France, Germany, and Sweden).^{iv} While this list reflects the world's overall best universities according to mainstream rankings, it excludes European universities with special strengths in quantum technologies—such as Germany's Karlsruhe Institute and Heidelberg Universität and France's École Normale Supérieure and École Polytechnique.^v Customising policy tools like the HPI visa could make it easier for UK companies to recruit recent graduates and professionals with quantum skills. Likewise, strengthening quantum-related research programmes and partnerships with the EU, the US, and other like-minded nations would help develop quantum expertise, attract foreign talent, and promote innovation.

3. Addressing Financing Challenges for Quantum-Focused Start-ups and Technology Companies

Access to financing remains a major challenge for the commercialisation of quantum technologies. Although the UK tech ecosystem has been successful in producing a relatively large number of innovative start-ups, it has been less successful in producing larger tech firms like in the US and China.^{vi} A major reason behind the more successful performance of US and Chinese tech ecosystems, apart from the size of the large domestic markets, is the availability of financing options that enable start-ups and mid-size technology companies to scale up. In contrast, not only is there less funding available in the UK, but British investors are often also more reluctant to invest in innovative, riskier technology ventures.^{vii} That is why Government should take steps to create a thriving

technology financing ecosystem. To that end, the recent liberalisation of the London Stock Exchange listing rules is a welcome development, but much else needs to be done to encourage UK-based initial public offerings of technology companies. A broader strategy to liberalise the UK's venture capital and public equity markets will be necessary to sustain the continued growth of the quantum technologies sector. Furthermore, Government should consider lowering the corporation tax rate and introducing fiscal reforms to create a more dynamic financing ecosystem.

4. Developing Mechanisms to Review the Effectiveness of Research and Development Spending

As part of the National Quantum Strategy, the Government plans to invest £2.5 billion in quantum research and development in the next ten years.^{viii} Greater transparency and more granular tracking of R&D expenditures and its innovation impact on different quantum subdisciplines can enable the Government to take more evidence-based R&D decisions. To that end, Government should consider implementing measures to track and evaluate the impact of research spending in different quantum areas. For example, are investments in specific quantum disciplines—such as quantum sensing and communications—associated with better research outcomes than certain others? Are certain research institutions more effective in using R&D grants than comparable institutions within the same subdiscipline? It should be borne in mind that certain areas of quantum technologies, such as quantum encryption and communication, are less mature than others, meaning that R&D benefits in such areas might take longer to become evident. Nevertheless, tracking research spending can help policymakers compare the effectiveness of research spending within the same quantum subdisciplines, and if used with caution, across different subdisciplines. Such data can enable policymakers to allocate limited taxpayer resources more effectively and stimulate competition among different components of R&D programmes.^{ix}

5. Creating Regulatory Sandbox Programmes for Quantum Innovation

Government should consider creating sandbox programmes to develop and calibrate regulatory frameworks for quantum technologies and their application in different sectors. Due to the rapidly evolving nature of different quantum technologies, there is a growing need to understand how such technologies interact with existing sectoral legal frameworks. To that end, Government could create sandboxes where companies receive regulatory guidance and regulatory relief for offering quantum-enabled products and services. That would enable lawmakers and regulators to better understand emerging quantum technologies and quantum-enabled business models, create tailored regulatory guidelines, and revise statutes in line with changing technological developments.

The Financial Conduct Authority was the world's first regulator to launch a financial technology (FinTech) sandbox, which was then adopted by more than 50 jurisdictions, including Canada, Singapore, South Korea, and the US. While we are unaware of sandboxes specifically geared towards quantum innovation, several jurisdictions have created sandbox programmes to promote innovation in sectors beyond FinTech. For instance, jurisdictions such as Utah in the US and British Columbia and Ontario in Canada have launched sandbox programmes to promote legal innovation.^x Likewise, in April 2023, a bipartisan bill introduced in the US House of Representatives proposed the creation of a quantum sandbox.^{xi} Meanwhile, the European Union has proposed the creation of national AI sandboxes in individual EU member states (Spain launched the first one in 2021).^{xii} In the UK, Government has expressed interest in creating an AI sandbox,^{xiii} while Ofcom has proposed the

creation of “spectrum sandboxes” to understand the evolving needs of spectrum users and calibrate its authorisation approach accordingly.^{xiv}

Similar arrangements could be highly beneficial for understanding different categories and applications of quantum technologies and tailoring regulatory approaches accordingly. However, because quantum technologies could be applied in a range of sectors, Government should consider creating separate thematic sandboxes targeted towards quantum innovation in different areas, such as remote sensing and encrypted communications. Furthermore, because such sandboxes will most likely implicate the overlapping jurisdictions of multiple departments, Parliament might ultimately need to provide a statutory basis for joint supervision by multiple regulators. Greater engagement between national regulators through fora such as the Digital Regulation Cooperation Forum will also be crucial to regulatory efforts to that end.

6. Establishing Reciprocal Sandbox Programmes with the United States and the European Union

In addition to UK-wide sandbox programmes, reciprocal sandbox arrangements can help promote innovation and British leadership in global quantum governance. Since quantum regulations and norms are not yet well defined, Government has correctly identified an opportunity for the UK to become a global leader in establishing international quantum technology standards.^{xv} To that end, policymakers must think creatively about ways to pursue closer engagement with like-minded nations, shape international quantum standards and rules, and promote innovation. For example, in the context of UK-US technology cooperation, a joint reciprocal sandbox could allow UK companies to offer innovative quantum-enabled products in US markets and vice versa, promoting innovation on both sides of the Atlantic. Likewise, a better understanding of quantum-enabled business models could help transatlantic policymakers develop innovation-friendly regulatory frameworks.

Given that many quantum technologies are in the early stages of development, the United States have not finalised any sandbox arrangements for quantum technologies. However, as previously discussed, a growing number of US states—such as Arizona, Hawaii, and Utah—have created sandboxes to promote innovation in financial and legal services. State-level sandboxes are a promising area where the UK could pursue closer economic cooperation with the US since most state sandbox statutes typically allow US state governments to sign reciprocal agreements with foreign jurisdictions.^{xvi} Depending on the role that individual US states play in quantum innovation, Government should explore the creation of quantum UK-US sandbox programmes both at the state and federal levels. Likewise, reciprocal sandbox programmes with the EU, Switzerland, Japan, and South Korea could also help the UK play a leadership role in internationalising quantum technologies and shaping global quantum governance.

7. Developing Risk-Based, Proportionate Foreign Investment Review Rules for Quantum Investment

Given the dual-use nature of most quantum technologies, Government rightly wants to ensure that quantum investments do not contravene UK national security interests. However, any foreign investment review rules should be proportionate and transparent and must not unduly burden the quantum technologies sector. To that end, Parliament should consider reforming the National Security and Investment (NSI) Act 2021, which provides the statutory basis for reviewing foreign investment in 17 sectors, including quantum technologies. The

NSI Act is overly broad in scope, meaning that quantum technologies with little national security implications could come under regulatory crosshairs. Furthermore, the legislation applies extraterritorially and uses the overly broad personal jurisdiction definition of whether a company “carries on activities” or supplies “goods or services to persons in the United Kingdom”.^{xvii} As a result, even internal restructuring or merger between two companies with limited presence in the UK could be subject to scrutiny and potentially blocked by the Investment Security Unit. Unlike similar laws in comparable jurisdictions, the NSI Act also applies retroactively, meaning that investments completed up to five years ago could be brought under review.^{xviii}

Since the NSI Act became law in early 2022, the Investment Security Unit has rightly exercised restraint in applying the legislation and subjecting potential investments to national security screening.^{xix} However, if the Investment Security Unit changes its approach and begins to apply the law more loosely based on weak jurisdictional grounds, it will harm the UK’s international reputation as a leading hub of quantum innovation. In the long run, reforming the NSI Act and making it more focused could provide a better legal framework that more carefully balances legitimate national security concerns with innovation and commercial considerations.

Conclusion

In summary, Parliament and Government are right to identify the commercialisation of quantum technologies as a strategic priority and take steps to develop policies accordingly. Since quantum technologies can be applied to a wide range of sectors, such technologies have great potential to turbocharge UK innovation and economic growth. To that end, Government needs to design policies that enable the private sector to play a more important role in driving quantum innovation and implement measures to spend limited R&D resources more effectively. Ultimately, as quantum technologies become more widespread, policymakers will need to be pragmatic and flexible. While the UK is currently a frontrunner in its efforts to develop a quantum commercialisation strategy, other countries will follow suit, especially as such technologies mature. As different jurisdictions develop and implement such strategies, Parliament and Government must carefully study these policies and, if needed, calibrate the UK’s quantum rules based on empirical evidence from other advanced economies. Such a flexible, pragmatic approach that balances competing priorities of innovation, commercial needs, consumer welfare, and national security considerations will be key to developing and maintaining a successful UK approach to quantum technologies in the long run.

Endnotes

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