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HARNESSING GLOBAL STANDARDS FOR TECHNOLOGICAL LEADERSHIP

A comparative study of the UK and other leading nations

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Executive Summary

- » In the modern global economy, participation in the standards development process (henceforth, standards participation) is a pivotal driver of technological leadership and economic influence. Amidst an increasingly contested global technology arena, technical specifications act as the ‘invisible architecture’ of trade, shaping market structures, enabling interoperability and serving as primary venues for firms to leverage intellectual property and influence future market rules. For governments, facilitating standards participation can strengthen national influence in critical technologies and support wider innovation, trade and industrial objectives.
- » This report asks a timely policy question: how well is the United Kingdom (UK) positioned in the international standards system relative to leading competitors, and what does that imply for UK innovation and industrial policy? This question has become more pressing as the UK government has identified leadership in technical standards as integral to national strength in areas such as 5G, semiconductors, AI and other emerging technologies. Yet, despite this growing policy emphasis, robust comparative evidence on UK participation has remained limited.
- » To address this gap, the report constructs a novel longitudinal dataset covering corporate members of 19 ICT standards development organisations (SDOs), including 2,615,818 firm-year-SDO observations over 1997–2025. It combines membership data from official SDO websites with firm-level financial and innovation indicators from other proprietary data sources. This provides, to our knowledge, the first comprehensive dataset that allows us to assess the extent of the UK’s standards participation against major international peers and identify where targeted policy intervention may be most needed.
- » Section 3 presents a comparative analysis of firm participation in 19 SDOs across the United States (US), the UK and China. Five findings stand out. First, the US remains the dominant actor in absolute numbers, accounting for 81.8% of total participation across the three countries. Second, the UK maintains a credible but modest overall presence, with relative strengths in market-oriented and enterprise-focused SDOs such as TM Forum and The Open Group. Third, Chinese membership is expanding rapidly, especially in technology-oriented SDOs such as 3GPP, JEDEC and Wi-Fi Alliance, with its standards participation highly concentrated in hardware- and engineering-focused standards bodies, reflecting its manufacturing and device

capabilities. Fourth, participation trends in strategically important technology bodies reveal a broader geopolitical rebalancing in standards governance, most notably in 3GPP (responsible for 5G and 6G technology development), where China's share has risen from near zero in 2000 to around 35% by the mid-2020s. Taken together, these findings suggest that UK participation has not yet matched the scale of the government's policy ambition, particularly in hardware and other foundational technology domains.

- » Section 4 turns to the UK firm level and examines who participates in SDOs and what effects participation is associated with. The evidence shows that participation is concentrated among larger, innovation-active firms in technology-intensive sectors, with a notable geographic clustering around London and the South of England. After controlling for firm fixed effects, SDO participation is associated with a 14% increase in employment and a 34% increase in patent families, in line with the view that standards engagement gives firms access to knowledge, coordination opportunities and innovation-relevant networks. Innovate UK-supported firms are also significantly more likely to participate, pointing to a potentially important complementarity between innovation policy and standards engagement. At the same time, the profile of participating firms suggests that smaller firms and those outside core innovation regions may face material barriers to entry.
- » Section 5 extends the analysis by examining US-listed firms and asks whether standards participation translates into stronger positions in global production networks. The results indicate that firms participating in SDOs gain additional supply chain connections and become more central within global production networks. These effects are strongest for more innovation-capable firms, suggesting that standards participation is most commercially valuable when combined with strong underlying R&D capacity.
- » The report's overall message is clear: standards participation is both a reflection of technological capability and a mechanism through which that capability can be extended. The US continues to dominate, China is advancing strategically and rapidly and the UK occupies a position of relative strength in some services-oriented standards domains but remains underrepresented in several technology areas that are likely to shape future competitiveness. If the UK is serious about technological

leadership, standards policy must move closer to the centre of innovation and industrial strategy.

- » On this basis, the report identifies five priorities for policy. First, protect and deepen UK participation in 5G and 6G standards bodies. Second, address the UK's weakness in hardware-related SDOs through more targeted industrial policy support. Third, establish a Standards Participation Fund to help innovative SMEs and scale-ups overcome the costs of meaningful engagement. Fourth, invest strategically in emerging standards domains, particularly AI, clean energy and health data. Fifth, build a more systematic longitudinal evidence base on UK standards participation and its links to innovation, productivity and export performance. Together, these actions would help convert the UK's scientific and technological strengths into greater influence over the standards that will shape future markets.

1. Introduction

1.1 Background

Standards development organisations (SDOs) occupy a critical but under-studied role in global technology governance. These bodies, such as 3GPP (mobile telecommunications), JEDEC (semiconductors) and W3C (web standards), establish the technical specifications that enable interoperability, reduce transaction costs and define the technological frontier in sectors ranging from 5G and semiconductors to artificial intelligence and cloud computing (Katz and Shapiro, 1985, 1994; Swann, 2010; Tasseey, 2000).

Participation in SDOs gives firms direct influence over standard-setting priorities, access to technical knowledge and the opportunity to declare and build Standard-Essential Patent (SEP) portfolios that can support value capture from complementary innovation (Lerner and Tirole, 2015; Rysman and Simcoe, 2008; Teece, 2018). For countries, strong firm participation in SDOs can signal technological capability, shape influence in strategically important technology domains and support wider industrial and trade objectives (Deng et al., 2022; Mattli and Büthe, 2003; Swann, 2010).

Yet firm-level information on participation in SDOs is limited. Existing studies tend to focus on either individual SDOs, individual countries or a narrow set of technology-oriented bodies. There is a paucity of evidence from multi-country and multi-SDO comparisons of firm participation. This gap is particularly striking given the growing strategic salience of standards in US-China technological competition and UK government's ambition to be 'at the frontier of setting technical standards and shaping international regulations' (DSIT, 2023). In the UK Science and Technology Framework, standards are regarded as a core policy lever through which government seeks to secure influence over the rules, architectures and interoperability conditions that shape future markets. The Framework links standards policy to the UK's broader science-and-technology superpower ambition, while the 2025 update shows that this commitment is being operationalised through targeted engagement in international standards bodies including ETSI, 3GPP and IETF, and through institutional support such as the AI Standards Hub (DSIT, 2023, 2025). Against that backdrop, robust empirical evidence on where UK firms participate, and how this compares with US and Chinese firms, is essential for assessing the feasibility of UK standards policy.

This report provides the first comprehensive empirical analysis of SDO participation patterns across the US, the UK and China. Drawing on a membership dataset covering 2,615,818 firm-year observations across 19 SDOs spanning 1997–2025, we document country-level membership composition, growth trajectories, strategic focus on technology versus market-oriented standards and the evolving country share in critical technology SDOs such as 3GPP and JEDEC. This analysis reveals a substantial shift in standards governance over the past two decades, with profound implications for innovation ecosystems, firm performance and technological leadership.

1.2 Related Literature

Technical standards shape market structure, competitive dynamics and the distribution of value across industries. This section reviews the relevant academic literature across five interconnected themes: the economic foundations of standardisation in network industries; the governance architecture of SDOs; the intersection of standards and intellectual property, particularly through standard-essential patents (SEPs), which are patents covering technologies that must be used to implement a given technical standard; the determinants and consequences of firm participation; and the emerging geopolitical dimension of standards governance.

1.2.1 Economic Foundations: Standards as Coordination Infrastructure

The theoretical basis for studying technical standards is rooted in the economics of network externalities and compatibility. Katz and Shapiro (1985, 1994) established that, in industries characterised by strong network effects, the utility derived from a product or service increases with the size of its user base, creating powerful incentives for firms to coordinate on common technical specifications. Their models demonstrated that compatibility choices are pivotal to market structure and social welfare, and that standards which enhance compatibility may simultaneously generate coordination failures and lock-in effects that advantage early movers. Farrell and Saloner (1985) complemented this analysis by exploring the trade-off between standardisation and innovation, showing that, while common standards improve diffusion and reduce consumer uncertainty, the timing and process of standardisation involve trade-offs between the benefits of coordination and the social costs of premature technological lock-in. The same authors (Farrell and Saloner, 1988) subsequently modelled coordination through committees and markets, demonstrating that formal standards committees tend to outperform pure market mechanisms in achieving coordination, particularly when the coordination benefit is large relative to distributional conflict among firms.

Besen and Farrell (1994) categorised standardisation outcomes into cooperative alliance strategies and competitive ‘standard wars’ as well as showing that firms choose between these modes depending on whether compatibility enhances or diminishes competitive advantage. Tassef (2000) extended the framework by highlighting the role of standardisation in technology-based markets, arguing that standards serve as ‘infratechnology’ – a form of non-proprietary technical infrastructure that reduces market uncertainty, supports economies of scale and underpins the commercialisation of research and development. Swann (2000, 2010) similarly emphasised the productivity-enhancing and trade-facilitating effects of standards, documenting their contribution to reducing transaction costs and enabling the diffusion of innovation. David and Rothwell (1996) added a dynamic dimension, arguing that standardisation involves a fundamental tension between diversity (which supports technological learning and exploration) and uniformity (which supports scale economies and network effects), a tension particularly acute in rapidly evolving technology

sectors such as semiconductors and telecommunications. Collectively, this body of work establishes that technical standards are market-shaping institutions whose governance and content carry far-reaching implications for innovation and competition.

1.2.2 The Governance of Standard-Setting Organisations

A central insight from the economics and management literature is that the institutional design of SDOs profoundly affects both participation incentives and standard outcomes. SDOs vary substantially in their governance rules, intellectual property policies, technical scope and membership structures (Fiedler et al., 2023; Narayanan and Chen, 2012). Three main types of standards are generally distinguished in the literature: de jure standards set by formal government-appointed bodies, de facto standards that emerge through market dominance, and voluntary consensus standards developed within multi-stakeholder SDOs – the last category being the primary focus of this report. Simcoe (2012a) develops a model of standard-setting committees in which the consensus process can become politicised when participating firms have heterogeneous incentives. Using data from the Internet Engineering Task Force (IETF), he demonstrates that committee design and bargaining frictions have measurable effects on the speed and efficiency of standards production. Chiao, Lerner and Tirole (2007) offer a complementary empirical analysis across multiple SDOs, finding systematic relationships between an organisation's governance rules, including the degree of sponsor-friendliness and required intellectual property concessions, and the quality of the standards produced, suggesting that rule design shapes the equilibrium between technology contributors and implementers with consequences for innovation incentives. Fiedler, Larrain and Prüfer (2023) employ a game-theoretic approach to model participation in SDOs, distinguishing between firms' incentives to join for licensing revenues, learning benefits or implementation efficiency. Their results show that the extent to which implementers participate in SDO governance has a non-linear (inverted-U) effect on industry welfare. Because SDOs differ materially in governance and strategic value, a multi-SDO dataset is intrinsically more informative than single-SDO studies.

1.2.3 Standard-Essential Patents (SEPs), FRAND Licensing and Value Capture

The intersection of standardisation and intellectual property rights constitutes one of the most economically consequential domains in the SDO literature. When patented technologies are incorporated into a standard, the resulting SEPs grant patent holders significant bargaining power, because the standard cannot be implemented without licensing those patents. Lerner and Tirole (2015) developed a formal framework for analysing SEPs, identifying conditions under which the inclusion of patented technologies in standards can either enhance innovation incentives or facilitate rent extraction, depending on the stringency of the associated licensing commitments. To mitigate the risk of 'patent hold-up' – whereby royalty demands exceed the technical value of the underlying innovation – most SDOs require members to declare their essential patents and commit to licensing them on Fair, Reasonable and Non-Discriminatory (FRAND) terms. Simcoe (2012b) examined the private and public

mechanisms through which SDOs attempt to manage this problem, noting that the effectiveness of FRAND commitments is constrained by the ambiguity inherent in defining what constitutes a ‘reasonable’ royalty, a source of significant global litigation.

Kang and Motohashi (2015) provided important micro-level evidence, demonstrating that inventors’ direct involvement in standardisation work significantly increases the probability of obtaining essential intellectual property rights in wireless communication standards, thereby linking SDO participation to firms’ appropriability strategies. Teece (2018) situates SEPs within the broader challenge of value capture in the digital economy, arguing that the enabling character of many ICT standards creates systemic under-investment in research and development unless licensing regimes adequately reward innovators. The literature thus presents a consistent picture: while SEP portfolios constitute a primary channel through which firms capture returns from standards participation, the design of intellectual property policies within SDOs substantially shapes the distribution of those returns and the incentives for future participation. This dynamic is central to understanding the strategic motivations underlying multi-SDO membership and the differentiation between technology-oriented SDOs (which are typically SEP-intensive) and market-oriented SDOs (which generally operate under royalty-free or less restrictive licensing regimes).

1.2.4 Firm Participation: Determinants, Outcomes and Barriers

A growing empirical literature examines who participates in SDOs, why, and with what consequences for firm performance. A consistent finding is that SDO participants are larger, older and more innovation-intensive than non-participants (Deng et al., 2022; Blind et al., 2020). Deng et al. (2022) established that SDO membership is associated with a significant reduction in firms’ implied cost of equity, consistent with the interpretation that participation provides informational advantages, signals technological leadership and reduces investment uncertainty. The mechanisms through which participation translates into standard outcomes have been examined across several empirical contexts. Dokko and Rosenkopf (2010) showed that firms can acquire social capital in wireless standards committees by hiring staff who carry inter-organisational connections from prior roles, and that this social capital translates into measurable committee influence. Ranganathan, Ghosh and Rosenkopf (2018) analysed the competition–cooperation dynamics among firms in a computing industry SDO over 14 years, finding that firms with more competitive product-market positions exhibit stronger support for emerging standards, while those with broader complementary products are more selective in their engagement.

Two theoretically distinct mechanisms link SDO participation to improved network centrality. The first is enhanced appropriability. When firms secure SEPs through SDO participation, downstream implementers become dependent on their IP, creating a sustained flow of licensing revenue and attracting customers who must comply with the standard. Since technology providers typically operate upstream in production networks, SEP-driven appropriability is expected to manifest primarily as gains in downstream (customer) centrality

rather than upstream (supplier) centrality. The benefits of this channel are likely to be heterogeneous across firms: those with stronger R&D capabilities and absorptive capacity are better placed to generate patentable contributions, navigate FRAND (Fair, Reasonable and Non-Discriminatory) licensing regimes and convert standards-related IP into profitable licensing arrangements (Cohen and Levinthal, 1990; Fiedler et al., 2023).

The second mechanism is access to knowledge. SDO participation exposes firms to two distinct types of knowledge flow: technical know-how (problem-solving capabilities and complementary innovation relevant to implementing the standard) and directional knowledge (information about where the standard is heading, which implementation constraints are likely, and which compliance pathways will be required). Technical know-how primarily drives downstream customer connections by allowing firms to embed their IP in a wider range of applications. Directional knowledge is particularly valuable for configuring upstream supplier networks: by gaining early insight into interoperability requirements and certification regimes firms can more effectively identify, screen and integrate compatible component vendors.

Despite the documented benefits, significant barriers to participation exist, particularly for small and medium-sized enterprises (SMEs). Gupta (2017) analyses 3GPP contribution data and found that while SMEs and startups contribute up to 15% of overall participation in cellular standards development, financial and resource constraints – including membership fees, staff time and travel costs for working group meetings – remain substantial deterrents to deeper engagement. Fiedler et al. (2023) formalise this dynamic, showing that participation incentives vary systematically by firm type and that governance choices which appear ‘implementer-friendly’ can paradoxically reduce welfare by discouraging innovative entrants. Blind et al. (2020) identify the principal drivers of firms’ entry into standardisation as firm size, research and development intensity and strategic objectives relating to market access and intellectual property protection. These findings are particularly relevant to understanding participation patterns in the UK, where a higher concentration of mid-sized technology firms relative to the US may structurally constrain multi-SDO engagement depth.

1.2.5 Standards Governance, Geopolitics and National Strategies

The political economy of international standards has attracted growing scholarly attention as standardisation has become entangled with technological leadership, trade competitiveness and national security objectives. Mattli and Büthe (2003) argue that international standards-setting is not purely a technical exercise but is shaped by both technological rationality and the primacy of national power. They demonstrated that countries with well-developed private standards infrastructure disproportionately influence global standards, both through the organisational capacity of their national standards bodies and through the pre-coordination of positions prior to international negotiations. This insight proved prescient for subsequent geopolitical dynamics in ICT standardisation.

Seaman (2020) documents China's evolving strategy across emerging technology standards domains, characterising it as a 'dual-track' approach: deepening engagement with established international bodies while simultaneously promoting China-centred standardisation through bilateral and regional channels. The policy agenda often discussed under the label 'China Standards 2035' represents the most explicit articulation of a state-directed strategy to transition from 'standard taker' to 'standard maker' and is closely linked to the 'Made in China 2025' industrial policy. Gao (2014) provides a detailed case study of this strategic transition through the development of the TD-SCDMA third-generation mobile telecommunications standard, illustrating how state-directed standardisation can function as a trade negotiation tactic for a latecomer and as a mechanism for reducing dependence on foreign intellectual property.

Against this geopolitical backdrop, national standards strategies have assumed heightened policy salience. The UK Science and Technology Framework (DSIT, 2025) identifies as being at the frontier of technical standards as a strategic priority, naming five critical technologies – artificial intelligence, semiconductors, advanced connectivity technologies, quantum technologies and engineering biology – as domains where active SDO engagement is considered essential to maintaining technological leadership.

1.3 Empirical Gaps and the Rationale for a Multi-SDO Baseline

A consistent theme across these literatures is the difficulty of measuring standards participation and influence at scale. Most empirical work has relied on proxies such as patent declarations, committee contribution counts, or membership data from individual SDOs – each of which captures only one dimension of the complex relationship between firms, standards bodies and technology governance. Baron and Spulber (2018) argued explicitly that large-scale longitudinal membership datasets are an essential prerequisite for moving beyond single-SDO or single-proxy analyses, enabling researchers to separate organisational design effects from country and firm-level strategies.

This empirical gap is especially significant in the context of multi-country comparison: while there is a growing body of work on US and Chinese SEP strategies (Kang and Motohashi, 2015; Schott et al., 2026) and on individual SDO governance (Simcoe, 2012a; Chiao et al., 2007), no comprehensive empirical evidence has established the relative scale, composition and trajectory of firm participation across multiple SDOs for the multiple technology powers simultaneously. This matters even more because UK policy assigns standards a clear strategic role. The UK Science and Technology Framework places regulation and standards among the central levers of national science and technology policy, with the government explicitly seeking greater influence over technical standards as part of its wider economic and geopolitical strategy (DSIT, 2023, 2025). The accompanying progress update reinforces that standards leadership is intended to be pursued through coordinated

action in priority technology domains and through deeper engagement with major international standards bodies (DSIT, 2025). While the UK’s policy commitment to standards leadership is therefore clear, the empirical evidence on the UK’s actual position relative to the US and China remains underdeveloped. Establishing that evidence base is essential if policymakers are to distinguish between rhetorical ambition and effective standards presence, identify where UK capabilities are under-represented and design targeted interventions to strengthen UK influence in the governance of critical technologies.



Figure 1.1: SDO Examples

2. Data Overview

2.1 SDO Selection and Membership Data Compilation

A central component of this project is the construction of a novel, large-scale longitudinal dataset capturing UK firms' participation in global technology standard-setting activities. To systematically document firm participation, we follow Baron and Spulber (2018) and employ web-scraping techniques to extract membership data from SDO websites. We begin with the full list of 192 SDOs included in the Searle Centre Database (SCDB) developed by Baron and Spulber (2018). The list is originally compiled from two main sources: the 2010 edition of the CEN survey of ICT standards consortia and the standards consortia directory maintained by Andy Updegrove at ConsortiumInfo.org. Baron and Spulber (2018) subsequently classified organisations as SDOs based on their self-descriptions on organisational websites, alongside supplementary information from Updegrove's directory, identifying those that either develop standards or participate in standards-development activities. The dataset covers the period 1997 to 2014 for these SDOs and includes approximately 96,700 unique member entities.

However, a preliminary assessment revealed that many SDO websites, particularly historical pages, are not consistently retrievable using the Wayback Machine. To ensure data quality and feasibility, we therefore focus on SDOs with relatively large and stable membership bases, as these organisations are more likely to maintain accessible records. Specifically, we calculate the average number of identified members over the five-year period 2010–2014 (the most recent years available in the SCDB). Based on this metric, SDOs are ranked by size, and the top 30 organisations are selected (expanded to 31 due to a tie at the threshold). The selected SDOs and their corresponding five-year average membership counts are reported in Table 2.1. Overall, these 31 organisations account for 66,414 unique company names, representing 68.68% of total coverage in the SCDB. We consider this level of coverage sufficient to support the extension of the dataset. These SDOs are therefore selected for membership expansion over the period 2015–2025.

Table 2.1: SDO selection and the average number of members from the SCDB

SDO	Five-year average number of members
Bluetooth	9750
CEA Consumer Electronics Association	2122.5
ASTM American Society for Testing and Materials	1098.6
UPnP Forum	998.8
TM Forum	869.5
PCI-SIG	782.8
ETSI European Telecommunications Standards Institute	777
USB	741
IDEAlliance	661
HIMSS	623.3
XBRL	539.3
WEDI	530.2
Wi-Fi Alliance	511.3
SIA	480
OGC	450
INTERNET2	442.3
TOG The Open Group	385.8
ZigBee	376.3
W3C	366
IDPF	354.75
3GPP 3rd Generation Partnership Project	335
CDISC	326
TIA Telecommunications Industry Assn.	315.4
OASIS	313.4
WiMedia Alliance	304.5
ODVA	296
JEDEC Solid State Technology Association	289.6
MIPI	256
Cellular Telecommunications Industry Association (CTIA)	252
Echonet	231
DLNA	231

For each selected SDO, membership webpages are manually identified from official organisational websites. For previous years, we retrieve archived versions using the Wayback Machine. Among the 31 SDOs, we find that 11 provide complete webpage coverage for the period 2015–2025, 9 have no identifiable webpages, and the remaining 11 have partial coverage. Following webpage identification, automated web-crawling techniques are applied to extract member company names and, where available, membership tiers. Data extraction primarily relied on parsing static HTML content in which company names are directly embedded. Webpages that depend heavily on JavaScript-based dynamic rendering are excluded due to limitations in reliable automated extraction. In addition, some archived webpages are incomplete, particularly where pagination was not preserved, resulting in partial member lists. As a result, we obtain complete member lists for 9 SDOs covering 2015–2025, partial data for 10 SDOs and no usable data for 12 SDOs. The 19 SDOs with at least partial data coverage were retained for further analysis.

Table 2.2: SDO selection and the identified members

	# SDOs	# unique company raw names
SCDB (1997–2014)	192	96,700
	31	66,414
	19	25,263
Websites Crawled (2015–2025)	19	32,401
Combined (1997–2025)	19	50,802

2.2 Company Name Matching and Firm Identification

To link SDO member firms to firm-level data, we match company names extracted from SDO membership lists to a global firm database from Orbis. This database consists of all available company names and their corresponding BvD identifiers from the global ownership data provided by Moody’s Analytics. Given the scale of the data, the matching exercise focuses on firms from the UK, US and China, which together account for the majority of global standard-setting activities. For each company name in the SDO member lists, matching is performed independently against country-specific firm pools using a multi-stage procedure designed to balance coverage and accuracy.

As a first step, company names are standardised to reduce inconsistencies arising from formatting differences (e.g. punctuation, capitalisation and legal suffixes). This process harmonises common business terms (e.g. “Ltd”, “Inc”, “Corp”) and removes non-essential characters, ensuring comparability across data sources. Following normalisation, we apply fuzzy string matching to identify potential matches between SDO member names and firm records. Candidate matches are retained based on a high similarity threshold (>0.90), which allows for minor spelling variations but excludes clearly unrelated entities. This initial step yields candidate matches for approximately 52.5% of unique company names in the SDO dataset, with substantial variation across countries reflecting differences in database coverage and naming conventions.

Because fuzzy matching may generate false positives, particularly where normalisation removes distinguishing information, we introduce a second validation stage based on large language models (LLMs). This step evaluates whether candidate name pairs plausibly refer to the same firm using their original (non-normalised) names. To improve robustness, two independent open-source LLMs are used to assess candidate matches. The models are instructed to adopt a conservative approach, retaining only high-confidence matches. Final matches are determined by combining model outputs: overlapping matches across both models are prioritised, while single-model matches are retained where no conflict arises.

Combining fuzzy matching with LLM-based validation results in 20,314 unique companies (approximately 40% of all SDO member firms) being successfully linked to firm-level records in the database. The remaining firms are not matched, primarily due to incomplete coverage in underlying data sources, name ambiguity, or the presence of non-corporate entities (e.g. universities, consortia, or government bodies). The resulting matched dataset provides the foundation for subsequent analysis by enabling the linking of SDO participation with firm-level information on financial performance and innovation activity.

2.3 Sample Construction

We compile two large-scale datasets for this project to study global standards and technological leadership. The analyses in Sections 3 and 4 draw on the newly constructed SDO membership dataset covering firms from the UK, the US and China. This dataset includes 17,325 firms across 19 SDOs over the period 1997–2025. The analysis in Section 5 draws on a historical SDO membership dataset for US publicly listed firms with detailed information on their global production networks, covering 3,512 firms and 24,337 firm-year observations across 176 SDOs over the period 2003–2014.

The first sample is based on the matched dataset described above and contains key financial information as well as patent-related data from the Orbis Intellectual Property (Orbis IP) database. We further augment this dataset with information on public funding from Innovate UK. The sample used in Section 5 is constructed by integrating three large-scale datasets capturing firms' supply chain relationships, participation in SDOs, and firm-level characteristics. First, supply chain linkages are obtained from [FactSet Revere](#), which provides detailed firm-to-firm customer and supplier relationships identified from regulatory filings, corporate disclosures and press releases. SDO participation data is drawn from the SCDB database as discussed above. Lastly, firm-level financial and accounting data are sourced from the Compustat-CRSP Merged Database, while again patent information is obtained from Orbis Intellectual Property. Firms that cannot be matched are treated as non-participants in SDO activity.

3. A Comparative Analysis of Business Participation in the UK, US and China

3.1 SDO Classification and Characteristics

The 19 SDOs are classified into three categories, following the project's established taxonomy: (i) eight technology-oriented SDOs (3GPP, ETSI, JEDEC, MIPI, ODVA, PCI-SIG, USB-IF, Wi-Fi Alliance) that produce core engineering and hardware specifications, often

with SEP and Fair, Reasonable and Non-Discriminatory (FRAND) licensing frameworks; (ii) eight market-oriented SDOs (CDISC, OGC, TIA, TM Forum, TOG, W3C, XBRL, CTIA) that produce interoperability frameworks, data exchange formats and business-process standards; and (iii) three other SDOs (IDPF, Internet2, WEDI) classified as trade associations or sector-specific bodies. The table below summarises each SDO's technology area, relevance to SEPs, connection to 5G and AI standards and current membership counts by country. Technology-oriented SDOs are shaded green, market-oriented in purple and other in grey.

Table 3.1: SDO characteristics and country membership counts

SDO	Category	Technology Area	SEPs	5G/AI	US	UK	CN
3GPP	Tech	5G / Mobile telecoms	High	5G core	262	74	38
ETSI	Tech	5G / Telecoms / IoT	High	5G / AI	642	180	32
JEDEC	Tech	Semiconductors / Memory	Medium		657	46	62
MIPI	Tech	Mobile hardware / IoT	Medium	5G devices	403	47	47
ODVA	Tech	Industrial automation	Low	Industry 4.0	365	59	32
PCI-SIG	Tech	Computing Interconnects	Low	AI compute	1,571	202	196
USB-IF	Tech	Computing Connectivity	Medium		4,080	659	603
Wi-Fi	Tech	Wireless / Wi-Fi 6/7	High	5G complement	904	145	143
CDISC	Market	Clinical data / Pharma	None		619	76	16
OGC	Market	Geospatial / GIS	None		432	68	23
TIA	Market	Telecoms infrastructure	Low	5G infra	1,993	155	45
TM Forum	Market	Telecoms operations	None	5G operations	816	252	40
TOG	Market	Enterprise IT	None		1,285	277	39
W3C	Market	Web / AI / Accessibility	None	AI/Web	912	143	37
XBRL	Market	Financial reporting	None		263	65	22
CTIA	Market	Wireless trade / Policy	None	5G policy	1,151	88	20
IDPF	Other	Digital publishing	None		252	40	8
Internet2	Other	Research networks	None		1,079	50	12
WEDI	Other	Healthcare IT (HIPAA)	None		521	39	5

Among the technology-oriented SDOs, 3GPP and ETSI are the most directly relevant to 5G standard-setting, with the highest SEP intensity globally. Wi-Fi Alliance bridges wireless connectivity and 5G complementary technologies. JEDEC and PCI-SIG focus on semiconductor memory and computing interconnects respectively, both critical for AI hardware infrastructure. USB-IF, while a connectivity standard, has a very large membership base, reflecting the universality of the USB specification.

Market-oriented SDOs address higher-layer interoperability: W3C for web technologies and emerging AI/accessibility standards, TM Forum for telecom service operations, TOG for enterprise architecture, CDISC for clinical/pharmaceutical data exchange and CTIA for wireless industry advocacy and market coordination. The 'other' category captures Internet2 (a research network consortium), IDPF (digital publishing, now merged into W3C) and WEDI (US healthcare data exchange).

In this section, we provide a descriptive analysis of five themes: (i) the scale and composition of country participation; (ii) membership growth and dynamics, including entry and exit; (iii) strategic orientation toward technology versus market SDOs; (iv) concentration and dominance patterns in critical technology areas (5G, AI, semiconductors); and (v) the breadth and depth of SDO engagement across countries.

3.2 Membership Composition by SDO and Country

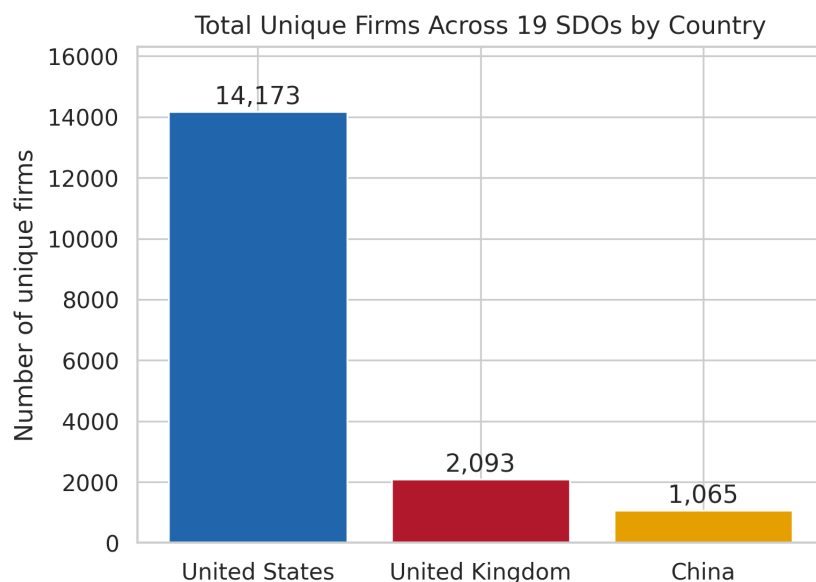


Figure 3.1: Total unique firms across all 19 SDOs by country

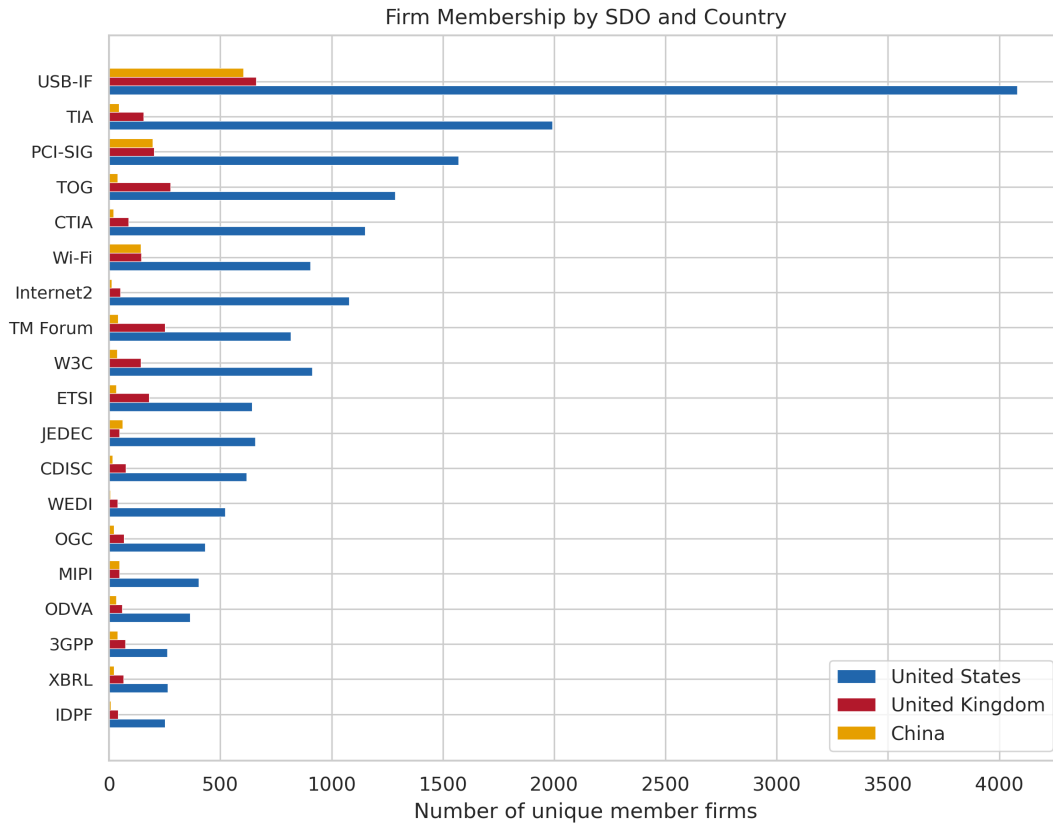


Figure 3.2: Unique firm membership by SDO, grouped by country

Figure 3.1 displays the total number of firms across all 19 SDOs by country. The US accounts for 14,170 unique firms (81.8% of the three-country total), reflecting both the domestic location of many SDO headquarters and the depth of the US technology ecosystem. The UK contributes 2,093 firms (12.1%) and China 1,062 firms (6.1%). While the absolute numbers favour the US heavily, the growth dynamics and sectoral focus of Chinese and UK firms reveal important patterns, examined in subsequent analyses. The distribution of firms across SDOs, shown in Figure 3.2, reveals the absolute scale of US dominance across nearly all 19 SDOs. USB-IF has the largest membership overall (4,080 US, 659 UK, 603 Chinese firms), followed by TIA (1,993 US, 155 UK, 45 China), PCI-SIG (1,571 US, 202 UK, 196 China) and TOG (1,285 US, 277 UK). The UK performs well relative to the size of its economy in TM Forum (252 UK firms vs 816 US) and TOG (277 UK vs 1,285 US), suggesting relative strength in enterprise-oriented and telecommunications service SDOs.

The percentage composition in Figures 3.3 and 3.4 provides a more informative picture of relative positioning. In most SDOs, the US accounts for 70%–95% of the three-country membership. However, China has its highest relative share in JEDEC (8.2%), USB-IF (11.3%), Wi-Fi Alliance (12.0%), MIPI (9.5%) and PCI-SIG (10.0%) – all technology-oriented, hardware-centric SDOs. The UK achieves its highest relative shares in TM Forum (22.8%), TOG (17.3%) and ETSI (20.9%). ETSI’s higher UK share reflects its European

institutional base and the UK's historical ties to the European telecommunications standards ecosystem.

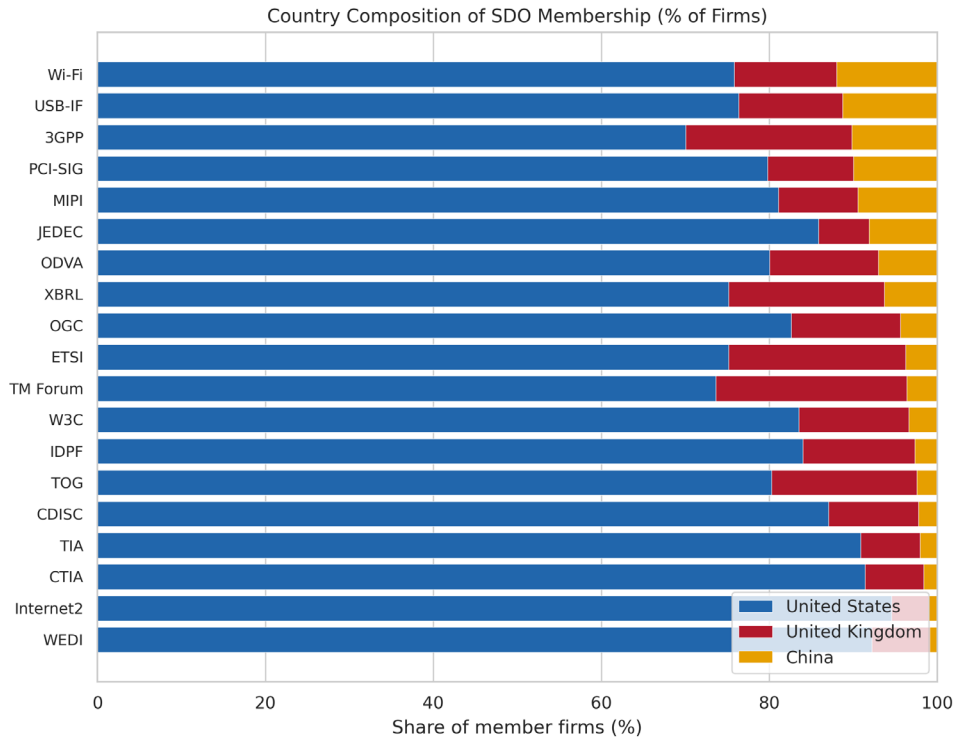


Figure 3.3: Country composition of SDO membership (% of firms)

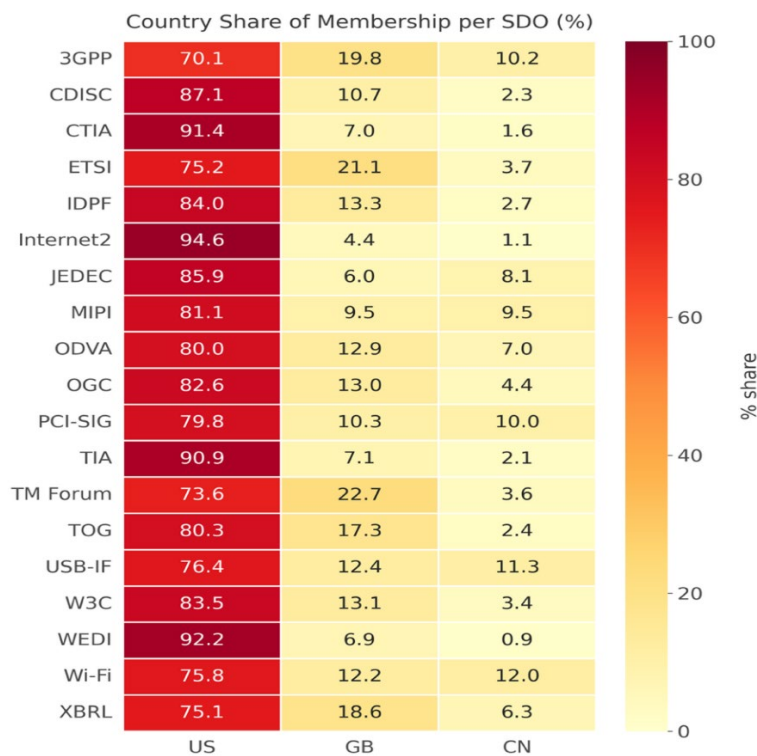


Figure 3.4: Heatmap of country share of membership per SDO (%)

3.3 Membership Growth and Temporal Dynamics

3.3.1 Cumulative Growth and Annual Entry

Figure 3.5 shows that US SDO participation grew steadily from 2000, with a pronounced spike around 2018–2020, likely reflecting 5G standardisation cycles and expansion of USB-IF and PCI-SIG membership. However, a portion of the US spike from 2019 onwards likely reflects a change in USB-IF membership data compilation scope to include Adopter-tier members, many of whom are not IP-contributing corporate members. The membership figures may therefore overstate the increase in strategically engaged US firms.

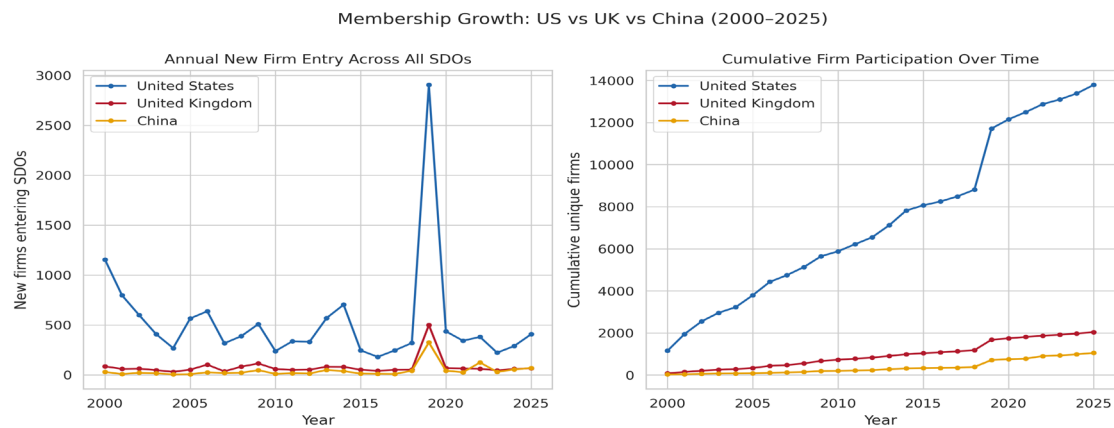


Figure 3.5: Annual new firm entry (left) and cumulative participation (right), 2000–2025

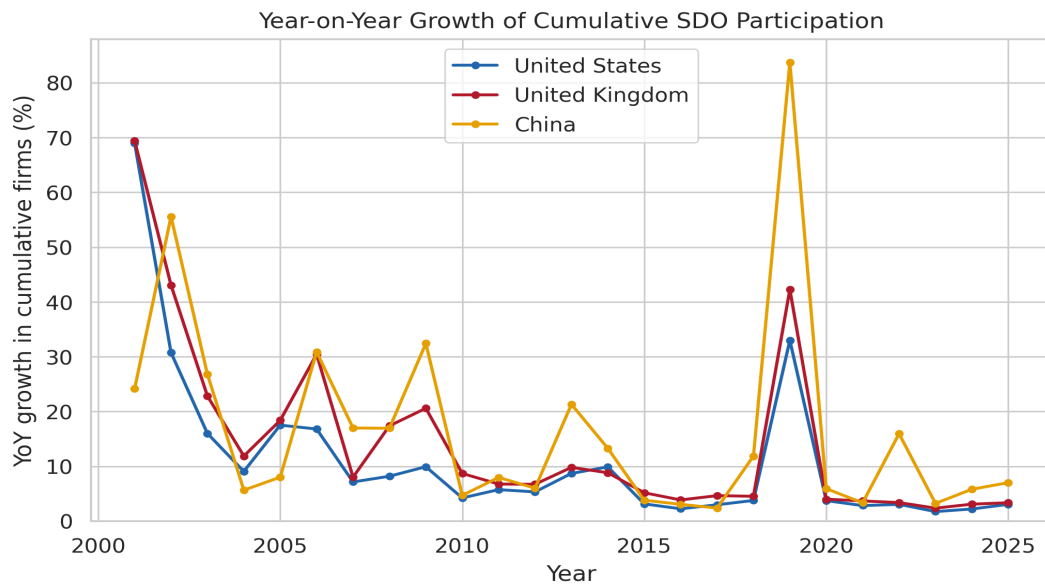


Figure 3.6: Year-on-year growth rate in cumulative SDO participation

The UK shows a later acceleration post-2017, while China’s cumulative curve bends upward from approximately 2012, coinciding with China’s ‘Made in China 2025’ policy framework and increased engagement in global standard-setting. Figure 3.6 confirms that China consistently had higher year-on-year growth rates than the US and UK throughout the 2005–2020 period, albeit from a lower base. This is consistent with a catch-up dynamic in which Chinese firms strategically entered SDOs to secure influence in critical technology standards.

3.3.2 Entry, Exit and Active Membership Dynamics

Figure 3.7 decomposes the membership dynamics into active members per year, new entrants and exits. The US panel shows substantial churn: large numbers of firms both entering and exiting each year, with the active pool peaking around 2019–2020. The UK shows steadier growth with lower exit rates, suggesting greater persistence of membership commitment. China’s panel reveals a marked expansion in active members from the mid-2010s, with relatively low exit, indicating that Chinese firms that enter SDOs tend to maintain membership, which suggests a strategic, long-term approach to standards participation. In all three panels, active membership falls sharply in 2021, alongside a visible spike in exits, before recovering in subsequent years. This pattern may partly reflect the impact of the COVID-19 pandemic, which disrupted international business activity, supply chains and standards-related coordination. Some firms may have rationalised memberships during this period, while others remained engaged because digital infrastructure, telecommunications and supply-chain resilience became more strategically important.

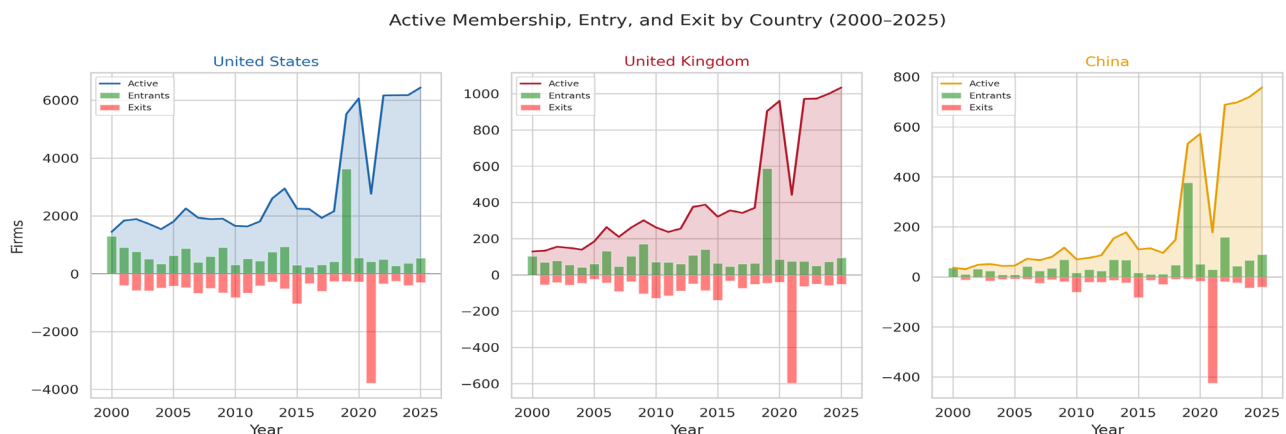


Figure 3.7: Active membership, new entrants and exits by country (2000–2025).

3.4 Strategic Orientation: Technology versus Market-oriented SDOs

Figure 3.8 compares the distribution of firm-SDO memberships across the technology-oriented, market-oriented and other categories. All three countries show a roughly similar split between technology and market SDOs, with technology-oriented memberships

accounting for approximately 55–60% of firm-SDO pairs. However, subtle but significant differences emerge.

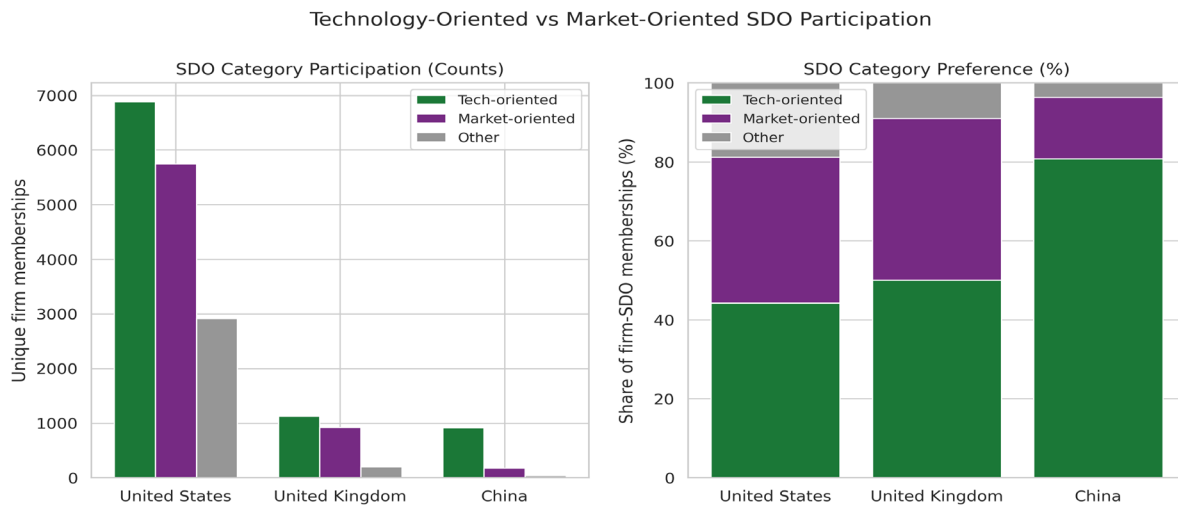


Figure 3.8: SDO category participation by country (counts and percentage)

Chinese firms exhibit a higher technology-oriented share (approximately 60%), driven by high participation in USB-IF, PCI-SIG and Wi-Fi Alliance. In contrast, UK firms show a marginally higher market-oriented share (approximately 48%), driven by strong engagement in TM Forum, TOG (enterprise architecture) and CDISC (pharmaceutical data). These differences are consistent with distinct national technological specialisations: China’s dominance in hardware manufacturing and consumer electronics, versus the UK’s historic strengths in services, finance and enterprise software (CEPR, 2024; ONS, 2024).

This finding aligns with the project’s core hypothesis that countries concentrate their SDO participation in standards domains aligned with their competitive advantages. For China, this means technology-oriented hardware and connectivity standards; for the UK, market-oriented and business-process standards. The implication for policy is that countries cannot simply ‘catch up’ by participating equally in all SDOs but that strategic focus is necessary to build critical mass and influence in standards that matter most for national technological leadership.

3.5 Geopolitical Implications: A Focus on China's Strategic SDO Engagement

3.5.1 Concentration and Focus

Figure 3.9 isolates Chinese firm participation in our SDO membership dataset, revealing a striking concentration in USB-IF (603 firms), PCI-SIG (196) and Wi-Fi Alliance (143). These three SDOs – all technology-oriented and hardware-centric – account for 88.5% of Chinese SDO membership. This pattern aligns with China’s dominance in consumer electronics, computing hardware and wireless devices manufacturing, where participation in connectivity

and interface standards is commercially essential. The USB-IF count should be treated as a potential upper bound: post-2019 membership data collection may have disproportionately captured Adopter-tier members who are implementers rather than IP-contributing corporate participants. Even under a conservative 30% reduction in Chinese USB-IF membership, the three hardware-centric SDOs would account for over 85% of Chinese memberships.

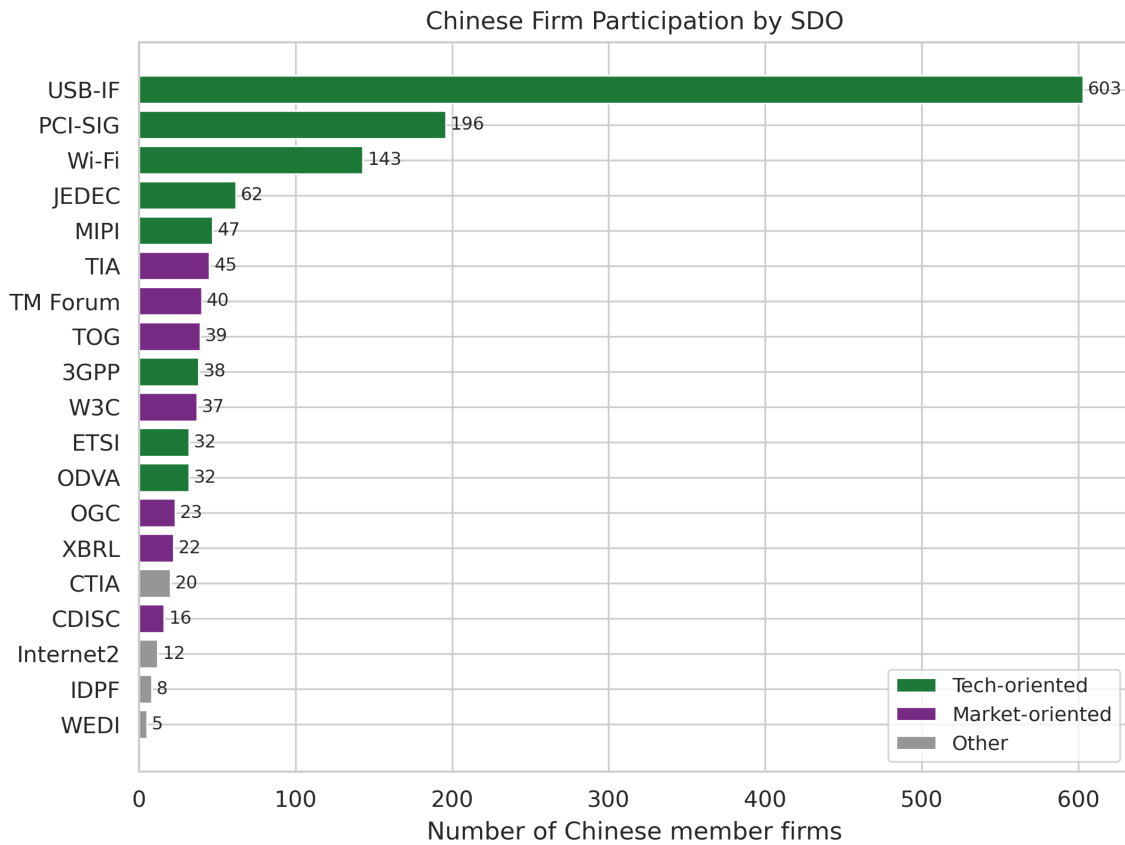


Figure 3.9: Chinese firm participation by SDO (coloured by category)

3.5.2 Entry Timing and Technological Trajectories

Figure 3.10 displays the median year of entry for Chinese firms into each SDO. The earliest entries are in USB-IF and PCI-SIG, reflecting long-standing Chinese hardware manufacturing engagement dating to the 1990s. More recent median entry years in 3GPP (2006–2008), ETSI and MIPI reflect China’s push into 5G and mobile hardware specifications from the 2010s onward. JEDEC shows relatively late but rapidly growing Chinese engagement, consistent with China’s expanding semiconductor ambitions and the strategic importance of semiconductor standards to domestic supply chain resilience.

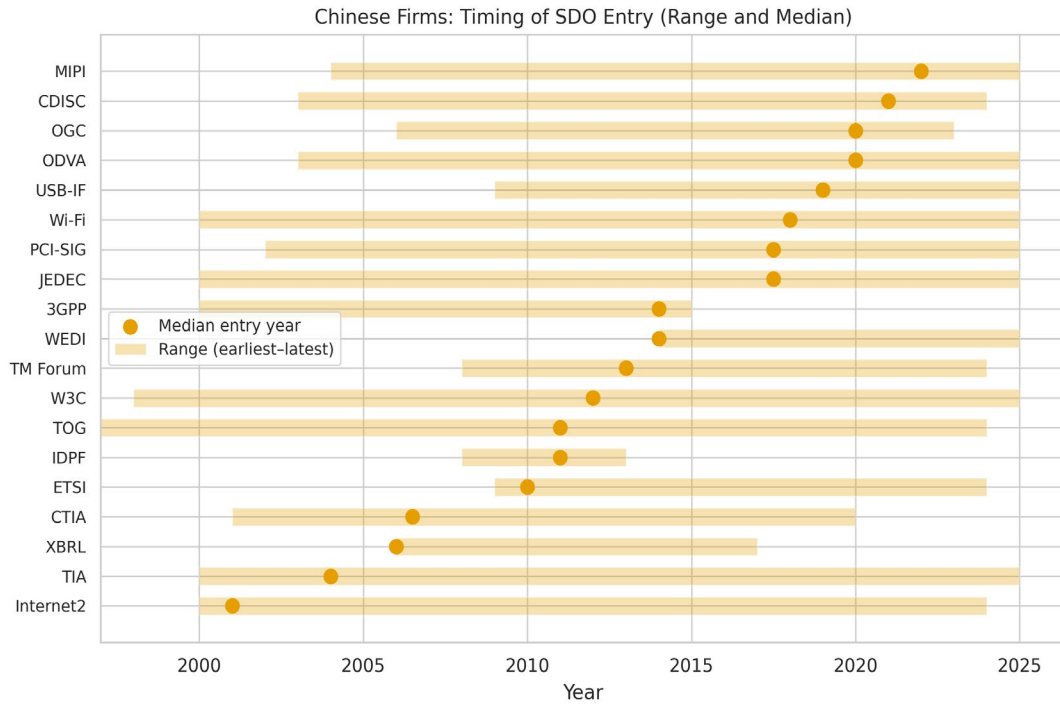


Figure 3.10: Timing of Chinese firm entry into each SDO

3.5.3 Country Share Dynamics in Critical Technology SDOs

Figure 3.11 tracks the evolving country share of active membership in six critical technology-oriented SDOs over time. In 3GPP, China’s share has risen from near-zero in the early 2000s to approximately 35% by the 2020s, while the US share has declined from over 90% to around 65%. This reflects China’s strategic investment in 5G standard-setting and provides direct evidence of geopolitical realignment in standards governance.

Country Dominance in Key Technology-Oriented SDOs (2000–2025)

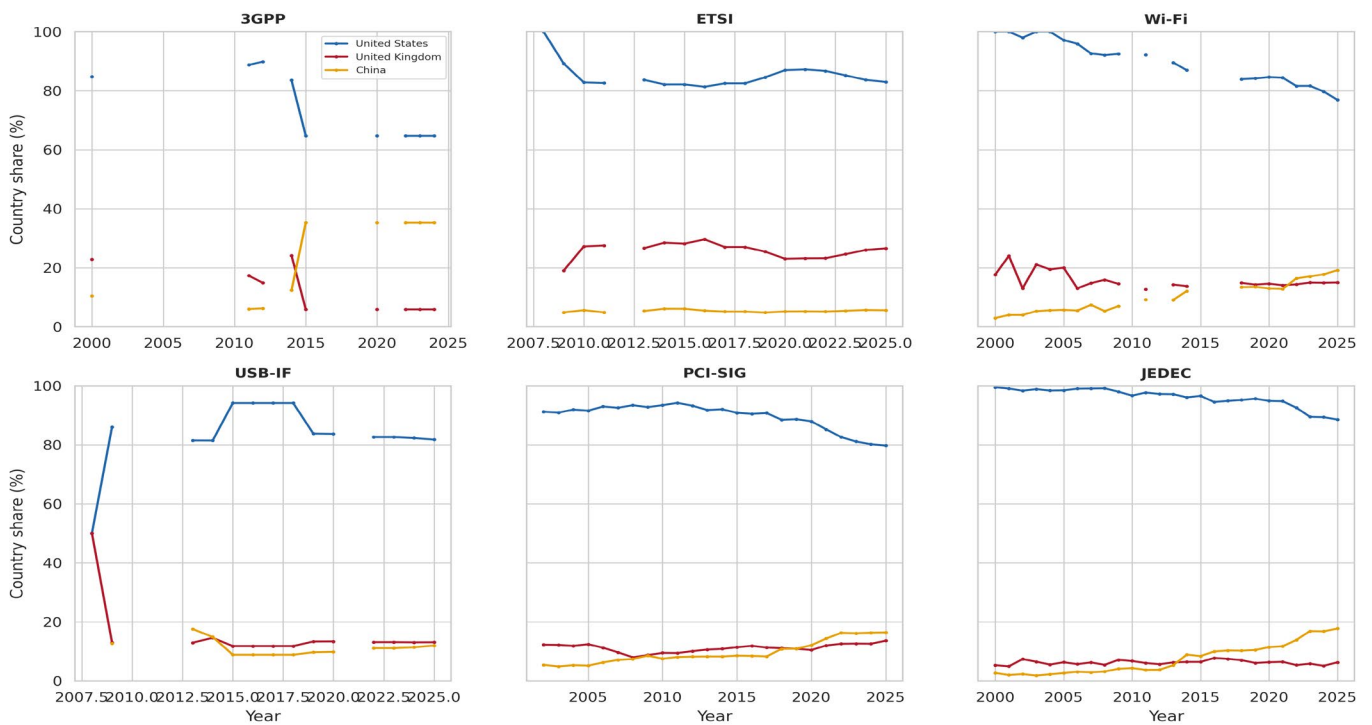


Figure 3.11: Country share over time in six key technology-oriented SDOs

This sustained upward trend in China’s 3GPP share is notable and consistent with SEPs filing data: Huawei, ZTE and OPPO collectively hold the largest 3GPP SEP portfolios globally, confirming China’s technical depth in 5G standardisation (LexisNexis IP, 2025). A similar upward trend for China is visible in ETSI, JEDEC and Wi-Fi Alliance, where temporal data coverage is more complete, though the US retains clear dominance (80–95% share) in USB-IF and PCI-SIG. The UK maintains a relatively stable 5%–15% share across most tech SDOs, with a notably higher presence in ETSI (reflecting its European institutional affiliation). These patterns suggest that while China is actively expanding its footprint in technology standards, the UK’s tech-SDO participation has been comparatively static.

Figure 3.12 further focuses on six specific SDOs. Among the SDOs in our sample, these six SDOs have particularly high SEP relevance, reflecting their focus on cellular, wireless, semiconductor-interface and device-interconnect standards, where compliance often depends on patented technical solutions and where SDO-specific IPR policies shape the licensing of essential patent claims. Patent portfolios are therefore especially strategically valuable in these organisations because essential patents can influence access to standard-compliant markets, licensing revenues and firms’ bargaining positions within standards ecosystems. Overall, the US dominates in absolute terms, but China’s growing presence, particularly in 3GPP and Wi-Fi Alliance, reflects the well-documented expansion of Chinese SEP filings in 5G technologies by firms such as Huawei, ZTE and others.

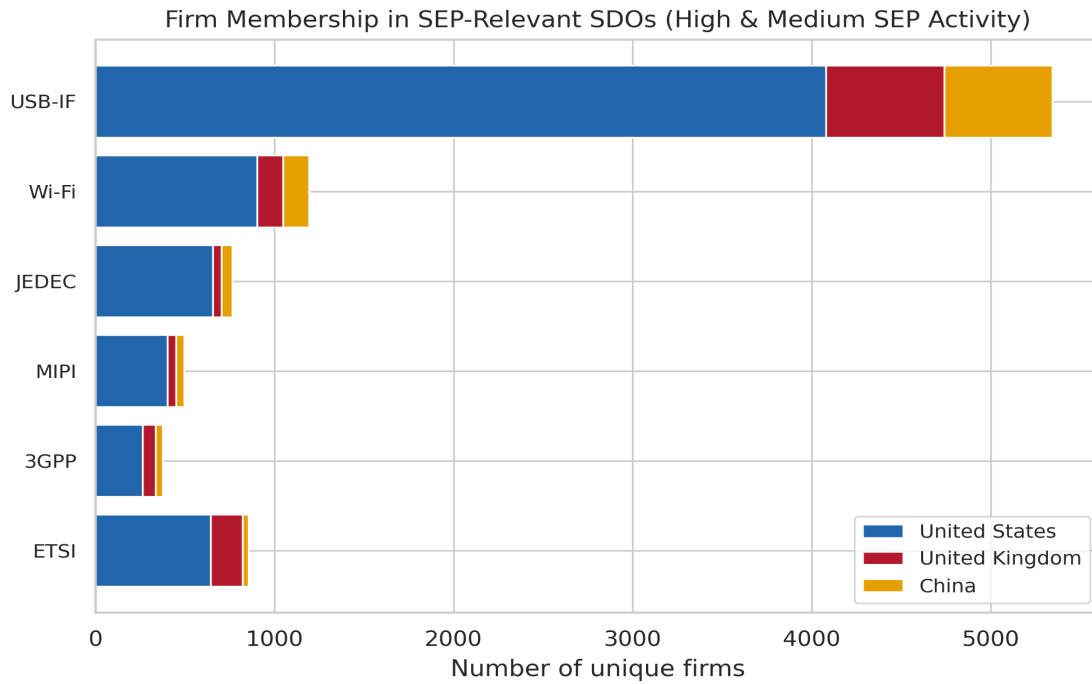


Figure 3.12: Membership in SDOs with high or medium SEP activity

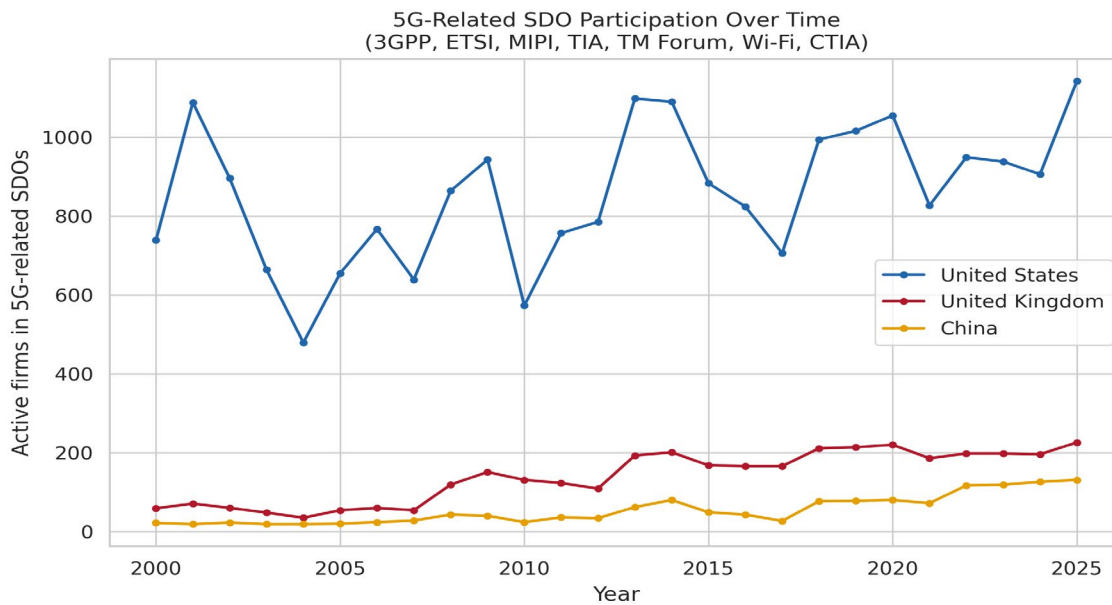


Figure 3.13: Active firms in 5G-related SDOs over time

Figure 3.13 tracks participation in SDOs directly connected to 5G standard-setting (3GPP, ETSI, MIPI, TIA, TM Forum, Wi-Fi Alliance and CTIA). The US shows the largest active membership pool, but China’s trajectory shows a consistent upward trend from the mid-2010s, coinciding with the 5G standardisation timeline in 3GPP Release 15 onward. The UK’s presence in 5G-relevant SDOs is significant but comparatively static.

Overall, the findings presented in this section establish several important stylised facts about SDO participation across the US, UK and China. The US dominates in absolute membership across nearly all 19 SDOs, reflecting the depth of its innovation ecosystem and the historic concentration of SDO headquarters in North America. Yet this aggregate dominance masks significant heterogeneity across SDOs. China has expanded its SDO footprint rapidly from a low base, with participation concentrated in hardware-centric, technology-oriented bodies aligned with its ‘Made in China 2025’ and ‘Standards 2035’ industrial strategies. The UK, while proportionally well-represented in services and enterprise standards bodies, lacks presence in semiconductor and physical-layer SDOs that are increasingly central to the technology agenda. Critically, both China and the US show patterns of multi-SDO breadth that the UK does not match, suggesting that resource constraints and strategic coordination gaps may limit the depth of UK engagement. Against this backdrop, understanding the firm-level determinants and consequences of UK SDO participation is essential for assessing whether policy intervention can translate the UK’s declared standards ambitions into measurable gains.

4. Business Participation in Technology Standards Development in the UK: Catalysts and Impact

In this section, we focus on UK firms' participation in SDOs. Specifically, we consider what characteristics predict participation, which allows us to identify potential barriers to participation, as well as the effects of participation on firm outcomes. We present results for 2015–2023, the period over which we have consistent financial data from Orbis. However, we only have consistent data on SDO membership for this period for eight SDOs (i.e., CTIA, ETSI, JEDEC, PCI-SIG, TM Forum, TOG, WEDI and XBRL), so our indicator of SDO membership is defined only in relation to those SDOs. Participants in other SDOs will therefore be incorrectly classified by this variable and the resulting measurement error will bias downwards any estimated effect of SDO participation.¹ We therefore also present results using data for 2018–2023 and 2021–2023. The former allows us to redefine our treatment variable to include participation in Wi-Fi Alliance while the latter allows us to also capture CDISC, OGC and ODVA.

4.1 Determinants of Firm-level Participation in Technology Standards Development in the UK

Table 4.1 presents the means of the variables used in the analysis by SDO participation status. These show that SDO participants tend to be larger in terms of revenue, employment and assets. They are also far more innovative, as measured by the number of patent applications and patent families. SDO participants are also slightly older than non-participants. Compared to non-participants, SDO participants disproportionately operate in the following industries: Computer, Electronic and Optical Products; Electrical Equipment; Telecommunications; Computer Programming and Consultancy and Scientific Research and Development. Such industries would typically be categorised as high-tech or knowledge intensive. Machinery and Equipment, Legal and Accounting Activities and Education are relatively under-represented among SDO participants. In terms of geographic location, a large proportion of SDO participants operate in the South region, which encompasses Milton Keynes, Oxford and Reading and Southampton, but relatively few are in the West Midlands, Yorkshire and Humberside and, especially, Wales. The vast majority of SDO participants are private or public limited companies. Finally, SDO participants have a much higher probability of receiving Innovate UK grants than non-participants.

¹ These eight SDOs account for more than 75% of SDO participants in the full 19 SDOs in 2023, which indicates that the extent of misclassification is likely to be limited.

Figure 4.1 shows the proportion of firms belonging to an SDO in each postcode area (the first or second letter of a postcode). This confirms that firms to the west and north of London are more likely to participate in SDOs while firms in the periphery of Great Britain have a lower propensity to participate.

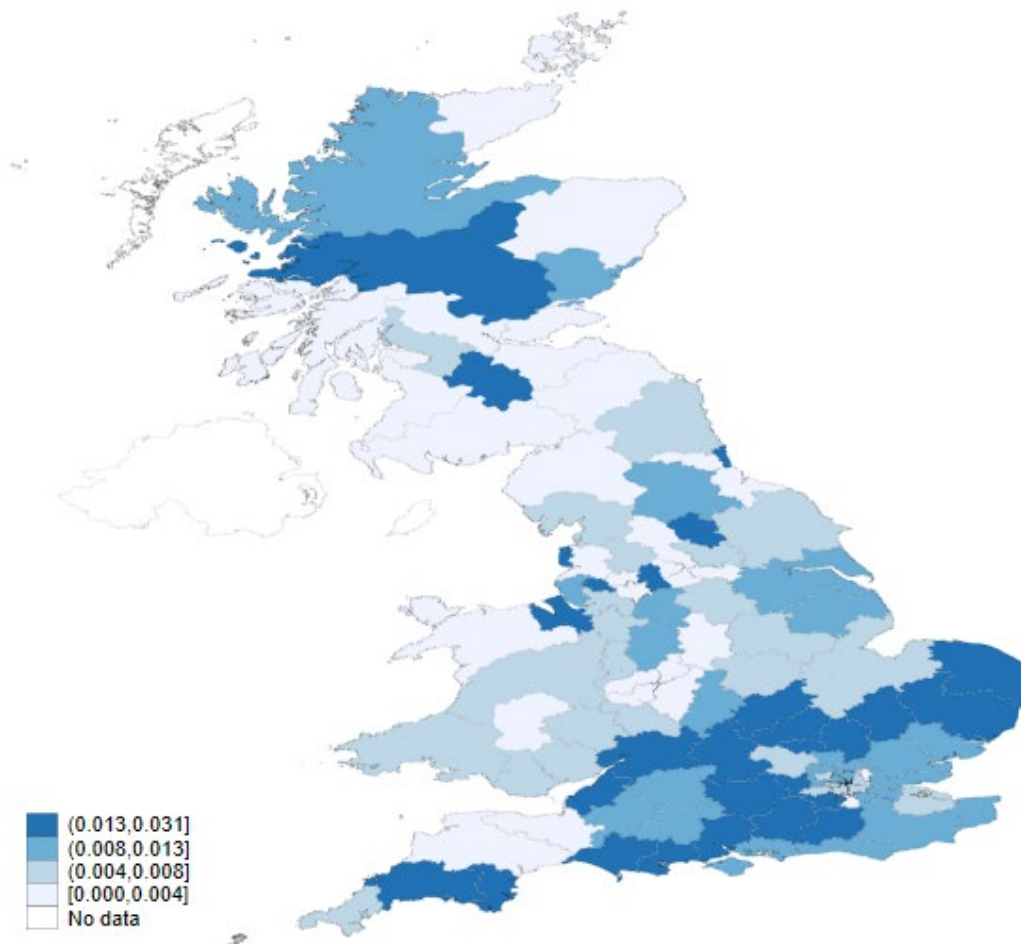


Figure 4.1: Mean of SDO Participation, by Postcode Area, 2015–2023

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Table 4.1: Variable Means, by SDO Participation Status, 2015–2023

	Non-SDO Participant	SDO Participant	Total
In Revenue	14.364	17.986	14.367
In Employment	3.373	3.943	3.374
In Labour productivity	11.691	12.493	11.692
Patent applications	0.458	6.005	0.467
Patent families	0.137	1.760	0.140
In Total assets	13.869	15.290	13.871
In Age	2.559	2.783	2.560
<i>NACE rev. 2 division</i>			
Computer, electronic and optical products	0.018	0.079	0.018
Electrical equipment	0.013	0.029	0.013
Machinery and equipment	0.022	0.002	0.022
Other manufacturing	0.035	0.014	0.035
Wholesale trade	0.141	0.093	0.141
Telecommunications	0.022	0.138	0.022
Computer programming and consultancy	0.132	0.362	0.132
Information service activities	0.029	0.029	0.029
Financial auxiliary activities	0.055	0.019	0.055
Legal and accounting activities	0.031	0.005	0.031
Head offices and management consultancy	0.151	0.102	0.151
Architecture and engineering	0.034	0.031	0.034
Scientific research and development	0.018	0.042	0.018
Other professional activities	0.069	0.020	0.069
Education	0.231	0.037	0.230
<i>Region</i>			
East Midlands	0.047	0.062	0.047
East	0.066	0.091	0.066
London	0.329	0.303	0.329
North West	0.084	0.046	0.084
North	0.028	0.028	0.028
Scotland	0.048	0.049	0.048
South East	0.046	0.039	0.046
South West	0.063	0.074	0.063
South	0.131	0.246	0.131
Wales	0.025	0.002	0.025
West Midlands	0.069	0.029	0.069
Yorks & Humberside	0.065	0.031	0.065
<i>Legal Status</i>			
Foreign companies	0.002	0.006	0.002
Non-profit organisations	0.230	0.011	0.229
Private limited companies	0.752	0.937	0.752
Public limited companies	0.017	0.046	0.017
<i>Innovate UK grant</i>			
No grant	0.990	0.929	0.989
Grant	0.010	0.071	0.011
Observations	398,853	647	399,500

To understand further the potential barriers to participation, we estimate a probit model in which the dependent variable is SDO participation and the independent variables are binary variables for industry, region, legal status, whether a firm received an Innovate UK grant and year as well as the log of assets and age. This has the advantage of allowing us to show conditional relationships between these variables and SDO participation, although

we do not claim that these represent causal effects. Marginal effects for all variables are provided in Table A1 in the Appendix.

The results show a small but statistically significant positive relationship between the probability of participation and assets (used as a proxy for size). This suggests that small firms may lack the capacity to engage in standards development. The estimated marginal effect of age on SDO participation is positive but is not statistically significant. Legal form is not significantly associated with SDO participation. However, we do obtain strong evidence that recipients of Innovate UK grants have a higher (conditional) probability of participating in an SDO. Specifically, grant holders are 0.43 percentage points more likely to participate than non-participants.

Table 4.2: Estimated Marginal Effects from Probit Model of Determinants of SDO Participation, 2015–2023

	Marginal Effect
In Assets	0.00014** (0.00006)
Age	0.00019 (0.00021)
<i>Legal Status</i>	
Foreign companies	0.00213 (0.00398)
Non-profit organisations	-0.00179*** (0.00031)
Public limited companies	0.00066 (0.00122)
Innovate UK Grant	0.00431** (0.00187)
Pseudo-R ²	0.114
Observations	399,500
Untreated	398,853
Treated	647
Firms	53,684

Notes: Standard errors, clustered at the firm level, are in parentheses. **/**/** denotes statistical significance at the 10%/5%/1% levels. The model also includes a full set of industry, region and year dummies.

The industry and regional marginal effects, and associated 95% confidence intervals, obtained from the probit model are shown in Figures 4.2 and 4.3. This confirms that firms in Computer, Electronic and Optical products, Telecommunications and Computer Programming and Consultancy are more likely to participate in an SDO than firms operating

in the Education sector (the baseline category). The regional marginal effects once again show that the South region has a higher probability, and Wales a lower probability, of SDO participation than firms in London. This reinforces the impression from Table 4.1 and Figure 4.1, that SDO participation is more likely in the areas around London and may reinforce regional differences in economic performance. Estimation of the probit models using 2018–2023 and 2021–2023 provides generally similar results (see Table A1 in the Appendix).

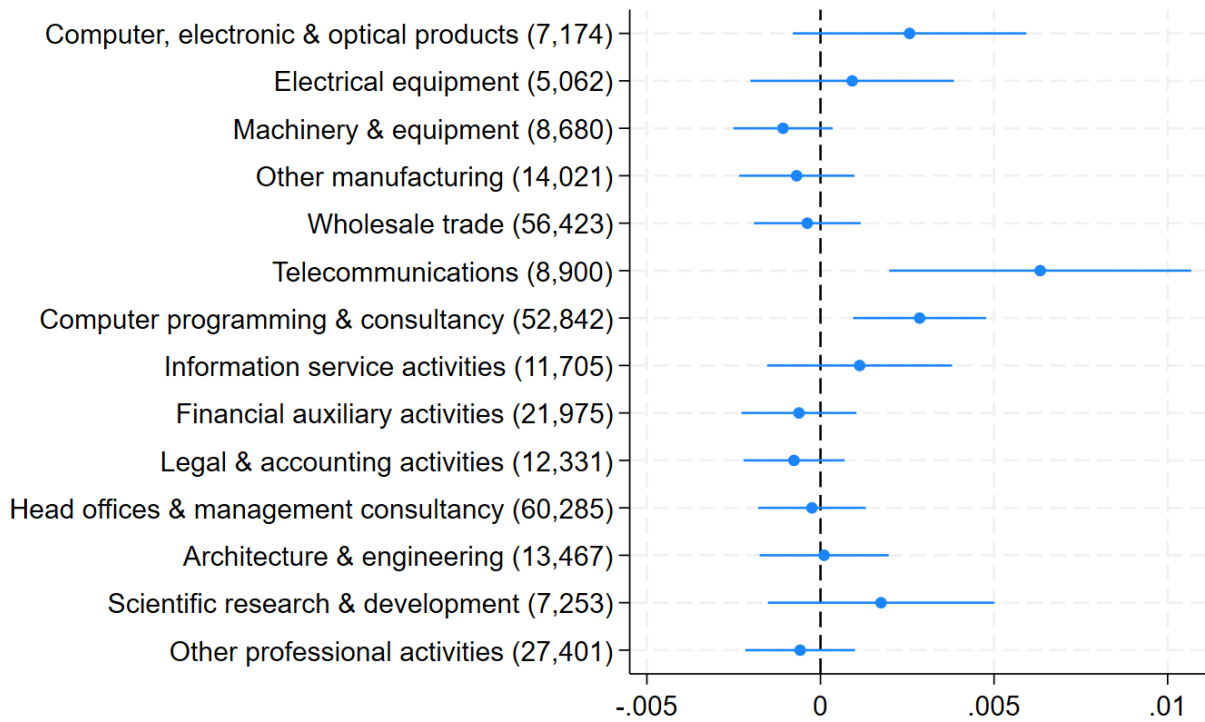


Figure 4.2: Estimated Industry Marginal Effects from Probit Model of Determinants of SDO Participation, 2015–2023

Notes: The baseline category is Education (91,981 observations). Horizontal lines show 95% confidence intervals. Figures in parentheses are number of observations in each category.

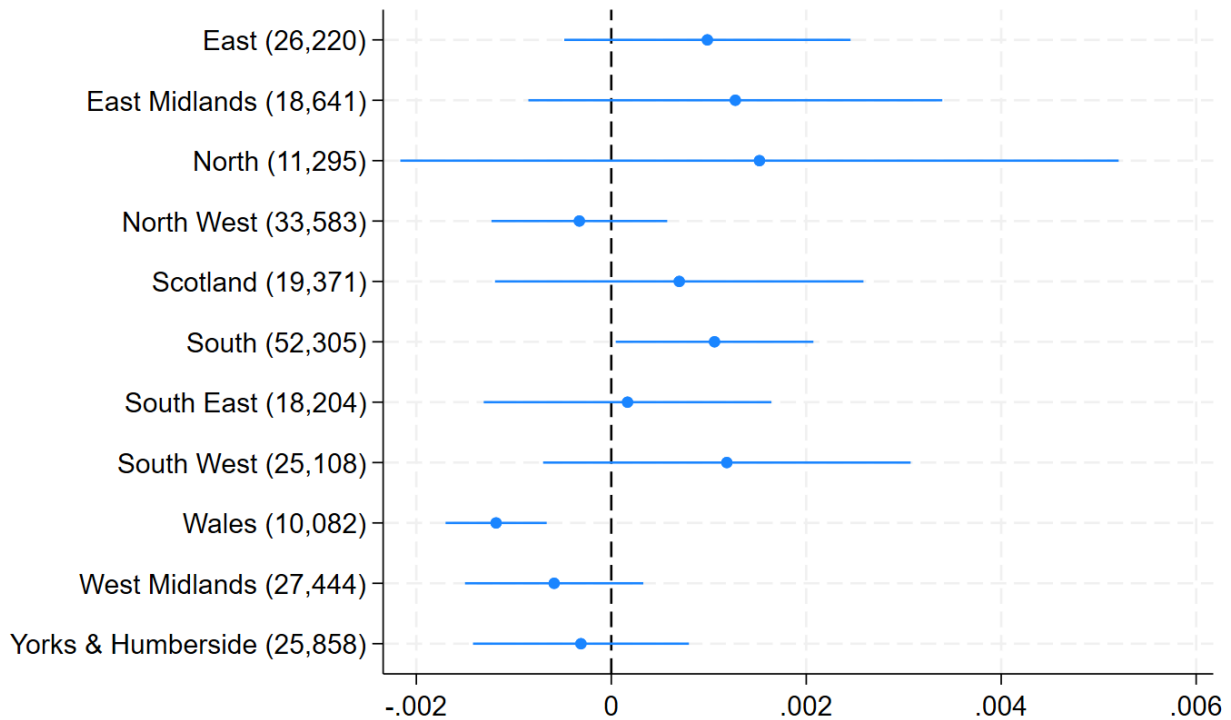


Figure 4.3: Estimated Region Marginal Effects from Probit Model of Determinants of SDO Participation, 2015–2023

Notes: The baseline category is London (131,389 observations). Horizontal lines show 95% confidence intervals. Figures in parentheses are number of observations in each category.

4.2 The Impact of Participation in SDOs on Firm Performance

To analyse the effect of SDO participation on firm performance, we estimate models of the form:

$$y_{it} = \beta SDO_{it} + X'_{it}\gamma + \alpha_i + \lambda_t + \varepsilon_{it}$$

where y_{it} is the log of revenues, employment or labour productivity. The variable of interest is SDO_{it} , which is the binary indicator of participation in an SDO. X_{it} is a vector of firm characteristics, comprising the same variables as were used as independent variables in the probit model. α_i represents firm-specific, time-invariant effects, λ_t is firm-invariant, time-specific effects and ε_{it} measures the effect of unobserved variables that vary across firms and time. We present results obtained from estimation using pooled OLS, which does not control for firm fixed effects, but our preferred estimates are those from two-way-fixed-effects (TWFE) estimation. Since the number of patent applications and patent families are count variables (i.e., non-negative, integers), we use Poisson models to estimate the effects of SDO participation on innovativeness.

Table 4.3: Estimated Effects of SDO Participation on Firm Performance, 2015–2023

	(1)	(2)	(3)	(4)	(5)
	Revenues	Employment	Productivity	Patent Applications	Patent Families
<i>Pooled OLS</i>					
SDO	0.476*** (0.147)	0.049 (0.130)	-0.104 (0.205)	0.890** (0.422)	0.794* (0.431)
Observations	337,708	287,729	261,702	399,500	399,500
Untreated	337,377	287,189	261,384	398,853	398,853
Treated	331	540	318	647	647
Firms	50,847	43,460	41,941	53,684	53,684
<i>Fixed Effects</i>					
SDO	0.143 (0.120)	0.133*** (0.046)	-0.029 (0.112)	0.253 (0.204)	0.291** (0.135)
Observations	335,608	285,621	259,221	19,828	18,598
Untreated	335,283	285,084	258,910	19,664	18,451
Treated	325	537	311	164	147
Firms	48,747	41,352	39,460	2,347	2,194

Notes: Standard errors, clustered at the firm level, are in parentheses. ***/** denotes statistical significance at the 10%/5%/1% levels. The variation in observations is due to missing data on the dependent variables. The lower observation counts in the lower panel are the result of the dropping of singletons and observations separated by a fixed effect. Models include the following covariates: binary variables for industry, region, legal status, whether a firm received an Innovate UK grant and year as well as the log of assets and age (although those variables with no variation over time are dropped when using fixed effects estimation).

The results are shown in Table 4.3. The pooled OLS results (upper panel) show positive and statistically significant effects on revenues and patents. However, after controlling for firm fixed effects (lower panel), the coefficient estimates generally fall, with positive and significant coefficient estimates only observed on employment and patent families. This suggests a positive correlation between time-invariant firm characteristics and SDO participation. The results suggest that SDO participation leads to an increase in employment of 14%² and a rise in the number of patent families of 34%. The estimated effect on patent applications is an increase of 29%, although this is not significant at conventional levels. The full results (shown in Table A2) show that size, as measured by assets, is positively associated with all five outcome variables while older firms have higher revenues and employment but lower productivity, *ceteris paribus*. Receiving an Innovate UK grant is positively associated with revenues and productivity but the coefficient is not statistically significant in the other models.

² This is calculated as follows: $(\exp(0.133) - 1) \times 100$

Tables A3 and A4 in the Appendix provide results for 2018–2023 and 2021–2023. This leads to a substantial fall in the number of observations but allows us to use an SDO participant variable that captures participation in a broader range of SDOs. These results are broadly consistent with those in Table 4.3 but suggest even stronger effects on innovativeness with significant effects on both the number of patent applications and patent families. Using 2018–2023, the estimated effects of SDO participation are 45% and 48%, respectively. Using 2021–2023, the estimated effects of SDO participation on these measures are even larger at 66% and 67%, respectively.

In summary, our results imply that SDO participation boosts firm innovativeness and employment but has weaker or insignificant effects on revenues and labour productivity. The positive effects on innovativeness are consistent with the expectation that firms are able to access technical know-how by participating in SDOs, which they can exploit in their own invention process. The failure to find robust evidence of impact on revenues or labour productivity may reflect the lag between successful innovation and increased revenues.

5. Business Participation in Technology Standards Development in the US: Impact on Global Market Power

Sections 3 and 4 document the breadth, growth and firm-level effects of SDO participation across the US, UK and China, revealing that standards engagement is associated with stronger innovation performance, particularly in patent activity. This section presents an additional analysis of the impact of participation in technology standardisation, drawing on a study of US-listed firms to examine whether and how SDO participation shapes firms' positions within global production networks (GPNs). Standards may affect not only firms' innovation outputs, but also their position within the wider organisation of production. Standards define technical interfaces, compatibility requirements and implementation pathways across industries. Firms that participate in developing these standards may therefore gain advantages that extend beyond patenting or technological reputation: they may become more attractive suppliers, more important customers, or more deeply embedded in the networks through which technologies are commercialised and diffused. Degree centrality provides a way to capture this broader structural effect by measuring whether SDO participants occupy more connected positions in global production networks.

This is important because market power in technology-intensive industries is increasingly exercised through network position as well as through ownership of individual assets. A firm that is central in a production network has access to more customers and suppliers, greater visibility over technological trajectories and potentially stronger bargaining power in coordinating complementary products and services. If SDO participation increases centrality, this suggests that standards engagement can help firms shape not only technical rules, but also the commercial architecture around those rules. The analysis in this section therefore complements the earlier patent-based evidence by examining whether participation in standardisation is associated with stronger positions in global value chains and international business relationships. The answer has direct relevance for UK technology policy, since it provides evidence on the returns to standards engagement that go beyond standard firm-level performance metrics to encompass the broader structure of international business relationships.

5.1 Measurement and Statistics

5.1.1 Centrality

The key outcome variables are three node-level metrics measuring how each firm is embedded within its production network. Degree centrality captures a firm's total direct connections – both suppliers and customers – normalised by network size, so that the measure represents the share of all firms observed in FactSet with which the firm has a direct link. Suppressing time subscripts, the degree centrality of firm i is:

$$C_{degree_i} = \frac{\sum_{j \neq i} x_{ij}}{g - 1} \times 100$$

where $\sum_{j \neq i} x_{ij}$ is a binary variable indicating whether a supply chain link exists between firms i and j and g is the total number of firms in the FactSet network. Given the directed nature of production networks – in which supply relationships run from upstream component suppliers to downstream assemblers and end-product customers – degree centrality can be decomposed into in-degree centrality (the normalised number of upstream suppliers) and out-degree centrality (the normalised number of downstream customers). High in-degree centrality indicates importance as a customer; high out-degree centrality indicates importance as a supplier or technology provider. This distinction is central to the empirical analysis, since the theoretical mechanisms predict asymmetric effects: enhanced appropriability should primarily expand out-degree centrality, while directional knowledge should primarily expand in-degree centrality.

5.1.2 Descriptive Statistics

Table 5.1 reports mean values for the key variables, separately for SDO participants (4,640 firm-year observations; 4,640 treated) and non-participants (19,697 observations).

Table 5.1: Variable Means, by SDO Participation Status

	Non-SDO Participant	SDO Participant	Total
Degree Centrality	0.119	0.263	0.147
In-Degree Centrality	0.047	0.116	0.060
Out-Degree Centrality	0.072	0.147	0.087
In Assets	5.767	6.878	5.978
In Age	2.385	2.624	2.431
In Patents	0.880	2.135	1.119
<i>Standard Industrial Classification (2-digit)</i>			
Textile Mill Products	0.004	0.003	0.004
Apparel and Other Textile Products	0.018	0.007	0.016
Paper and Allied Products	0.015	0.011	0.014
Printing and Publishing	0.012	0.014	0.012
Chemicals and Allied Products	0.218	0.065	0.189
Industrial Machinery and Equipment	0.085	0.134	0.094
Electronic and Other Electric Equipment	0.137	0.276	0.164
Transportation Equipment	0.044	0.033	0.042
Instruments and Related Products	0.124	0.087	0.117
Miscellaneous Manufacturing Industries	0.015	0.009	0.014
Communications	0.068	0.066	0.068
General Merchandise Stores	0.009	0.013	0.010
Business Services	0.218	0.266	0.227
Engineering and Management Services	0.033	0.018	0.030
Observations	19,697	4,640	24,337

Three findings stand out from Table 5.1. First, SDO participants are substantially more central in production networks: degree centrality for SDO participants (0.263) is more than twice that of non-participants (0.119), implying approximately 27 more network connections (13 additional upstream suppliers and 14 additional downstream customers, given a mean network size of 18,741 firms). Second, SDO participants are larger, older and substantially more patent intensive. Third, the industry composition of SDO participants differs markedly from that of non-participants: Electronic and Other Electric Equipment and Business Services are overrepresented among SDO participants (27.6% and 26.6% respectively), while Chemicals (which includes pharmaceuticals) accounts for 21.8% of non-participants but only 6.5% of SDO participants.

5.2 The Impact of Participation in SDOs on Firm Centrality

The baseline econometric model estimates the effect of SDO participation on a firm's centrality in production networks using TWFE:

$$C_{it} = \beta SDO_{it} + X'_{it}\gamma + \alpha_i + \lambda_t + \varepsilon_{it}$$

where C_{it} is a centrality measure for firm i in year t ; SDO_{it} is a binary variable equal to one if firm i participates in at least one SDO in year t ; X_{it} is a vector of firm-level controls (log assets, log age and log patents granted); α_i are firm fixed effects capturing time-invariant firm characteristics; λ_t are year fixed effects capturing common time trends in network formation; and ε_{it} captures remaining idiosyncratic variation.

Table 5.2 presents the baseline TWFE results for the three primary centrality measures. The estimated coefficient on the SDO Participant indicator is positive and statistically significant for degree centrality and out-degree centrality, with magnitudes that imply economically meaningful improvements in production network position.

Table 5.2: Baseline Estimated Effects of SDO Participation on Centrality

	(1) Degree	(2) Out-Degree	(3) In-Degree
SDO	0.010** (0.004)	0.008** (0.003)	0.002 (0.002)
Observations	24,337	24,337	24,337
Untreated	19,697	19,697	19,697
Treated	4,640	4,640	4,640
Firms	3,512	3,512	3,512

Notes: ***/**/* indicate significance at the 1%/5%/10% level. Standard errors clustered at the firm level in parentheses. Controls include log of assets, log of age and log of patents. All models include firm and year fixed effects. All centrality measures are normalised by network size (percentage of firms in FactSet with a direct link to the firm).

SDO participation is estimated to increase normalised degree centrality by 0.010 percentage points, which, given the mean network size of 18,741 firms in the sample, corresponds to approximately 1.9 additional supply chain connections. The effect operates asymmetrically across the supply chain: the gain in out-degree centrality (downstream customers) is 0.008 percentage points while the gain in in-degree centrality (upstream suppliers) is only 0.002 percentage points and not statistically significant. This suggests that SDO participation, particularly through SEP contributions, primarily attracts implementer-customers who depend on the participating firm's standardised IP, rather than expanding upstream supplier relationships. The following analysis further unpacks the heterogeneity of these baseline effects to show whether the effects differ with the firm's own innovation capacity.

5.2.1 Innovation Capacity and Absorptive Capability

The conceptual framework predicts that firms with stronger knowledge assets are better placed to exploit the appropriability and knowledge access channels that SDO participation provides: they can generate patentable contributions (strengthening the appropriability mechanism), absorb and act on the technical and directional knowledge available in SDO forums and navigate complex FRAND licensing regimes. Table 5.4 tests this prediction by interacting the SDO participation indicator with a binary variable for above-median patent intensity within the firm's industry.

Table 5.4: Estimated Effects of SDO Participation on Centrality by Patenting Intensity

	(1) Degree	(2) Out-Degree	(3) In-Degree
SDO	0.003 (0.005)	0.002 (0.004)	0.001 (0.002)
SDO × High Patents	0.015** (0.006)	0.011** (0.005)	0.003 (0.003)
Observations	24,337	24,337	24,337
Firms	3,512	3,512	3,512

Notes: ***/**/* indicate significance at the 1%/5%/10% level. Standard errors clustered at the firm level. 'High Patents' is a binary indicator for firms with above-median patent intensity (patents per unit of assets) within their 2-digit SIC industry. Implied effect for high-patent firms = SDO Participant + SDO Participant × High Patents. Controls as in Table 5.2.

For firms with below-median patent intensity, the estimated effect of SDO participation on degree centrality (0.003) is small and not statistically significant. For firms with above-median patent intensity, the implied effect (SDO Participant + interaction term = 0.003 + 0.015 = 0.018) is almost twice the baseline average effect and is significant at the 5% level.

The differential is driven almost entirely by the downstream customer channel: the implied effect for high-patent firms on out-degree centrality (SDO coefficient 0.002 + interaction term 0.011 = 0.013, significant at 5%) corresponds to approximately 2.4 additional downstream customers ($0.013\% \times 18,741$ firms). No significant interaction effect is found for in-degree centrality, suggesting that the upstream supplier configuration channel – which operates primarily through directional knowledge rather than through IP appropriability – is somewhat less dependent on pre-existing patent capacity.

These findings imply that the market power gains from SDO participation are concentrated among those with the capacity to contribute meaningfully to the standards development process through patentable innovations. This finding complements the UK evidence presented in Section 4, where SDO participation was most strongly associated with innovation outputs (patent families) rather than with productivity or revenue.

5.2.2 Summary

The main findings are two-fold. First, SDO participation leads to a statistically significant improvement in firms' degree centrality within global production networks. Second, the network benefits of SDO participation are concentrated among patent-intensive firms. This finding underscores that SDO participation is most valuable as a complement to ongoing investment in R&D and IP development.

6. Concluding Remarks and Policy Implications for the UK Innovation Ecosystem

This concluding section draws out the findings most relevant to UK industrial and innovation policy as well as identifies areas where targeted intervention may help UK firms maintain and extend their standards leadership.

6.1 The UK's Starting Position: Relative Strength in Services, Relative Gap in Hardware

The UK's 2,093-firm presence across 19 SDOs (12.1% of the three-country total) is proportionately larger than its share of global technology output alone would predict. UK firms are particularly well-represented in enterprise architecture standards (TOG, where the UK accounts for 17.3% of three-country membership), telecommunications service operations (TM Forum, 22.8%) and European 5G/telecommunications standards (ETSI, 20.9%). These positions reflect the UK's capabilities in telecommunications services, financial infrastructure and business software.

However, the data also reveals a lack of engagement with other SDOs. In hardware-centric, semiconductor and physical-layer connectivity SDOs – JEDEC (semiconductor memory), PCI-SIG (computing interconnects), ODVA (industrial automation) and USB-IF (connectivity) – UK firm counts are low in both absolute terms and relative share. China, despite its smaller overall SDO footprint, has roughly comparable or superior absolute representation to the UK in JEDEC (62 China vs 46 UK), PCI-SIG (196 China vs 202 UK) and Wi-Fi Alliance (143 China vs 145 UK) – SDOs that are increasingly central to semiconductor strategy, AI compute infrastructure and wireless device ecosystems. For a country with significant ambitions in semiconductor design and compound semiconductors (evidenced by the National Semiconductor Strategy and the Catapult network), this lack of involvement with hardware SDOs merits attention.

6.2 The 5G and 6G Standards Opportunity: Building on the UK's ETSI and 3GPP Presence

The UK's relatively strong position in ETSI and 3GPP – the two SDOs most central to 5G and future 6G standardisation – is a strategic asset that Innovate UK and UKRI should actively seek to protect and deepen. UK firms and research institutions contributed significantly to 5G standards via organisations such as BT, Vodafone, ARM and a number of university spin-outs. With 3GPP Release 18 (5G Advanced) already underway and 6G standardisation beginning in earnest through ITU-R and the IMT-2030 framework, the UK has a narrow

window to shape the next generation of mobile communications standards from a position of relative strength.

A note of caution is warranted, however. The UK's 3GPP and ETSI presence has historically benefited from European institutional alignment. Post-Brexit, the UK's relationship with European-headquartered standards bodies requires active management. ETSI is a European regional standards body with a formal role in 3GPP governance so, while UK firms continue to participate as full members, the risk of progressive marginalisation in administrative and committee structures should not be dismissed. DCMS, Innovate UK and the British Standards Institution (BSI) should collectively monitor UK representation at the committee and working-group level within ETSI and 3GPP, and ensure that UK firms and research bodies have adequate resourcing to sustain their delegate presence as 6G standardisation intensifies.

6.3 Closing the Multi-SDO Breadth Gap: Funding SDO Participation for Innovate UK Firms

The data reveals that UK firms are the least likely of the three countries to hold memberships in multiple SDOs simultaneously (14.2% multi-SDO vs 15.8% for the US and 18.3% for China). Firms with broad multi-SDO portfolios tend to be large technology conglomerates (e.g., Qualcomm, Intel, Samsung, Huawei) that can afford to fund multiple memberships, delegate costs and contribution workstreams. The UK's comparatively low multi-SDO breadth is likely in part a size-of-firm effect: the UK technology sector is relatively skewed towards mid-size and growth-stage companies that face real financial barriers to multi-SDO participation.

This is an area where Innovate UK can play a direct enabling role. SDO membership fees, delegate travel and the staff time required to contribute meaningfully to working groups represent costs that may be prohibitive for an innovative SME or scale-up. Critically, the evidence from this report shows that Innovate UK grant recipients are significantly more likely to participate in SDOs than non-recipients, indicating a complementarity between public innovation support and standards engagement. This finding suggests that direct co-funding of SDO participation costs could be a highly effective policy lever. Models from peer countries demonstrate this approach: Germany's WIPANO funding for DIN/ISO participation³ and

³ Executed through the WIPANO programme ("Knowledge and Technology Transfer through Patents and Standards") and managed by the Federal Ministry for Economic Affairs and Climate Action (BMWK), this scheme provides SMEs and research institutes with non-repayable grants covering up to 50% of eligible costs (up to €16,600) for standardisation and patenting activities.

Japan's METI co-funding⁴ of private-sector standards delegation both substantially raise the rate at which domestic firms shape international standards. South Korea's KATS (Korea Agency for Technology and Standards) operates targeted subsidies for SME participation in priority technology standards⁵, while Canada's Standards Council similarly co-funds Canadian firm participation in international standards bodies (like ISO/IEC) aligned with national industrial policy priorities.⁶ A targeted Innovate UK 'Standards Participation Fund' or a ring-fenced standards component within existing innovation grants could directly improve participation rates, particularly for firms in sectors where UK firms have strong technology positions but limited standards visibility.

6.4 China's Strategic Trajectory: Implications for UK Competitive Positioning

The data documents a sustained and strategic expansion of Chinese firm participation in global SDOs over the past two decades. Chinese firms have grown from a negligible presence in most SDOs around 2005 to rough parity with the UK in several hardware and semiconductor standards bodies by the mid-2020s. Critically, Chinese participation has been concentrated in exactly the standards bodies that are most important for future technology infrastructure: 5G (3GPP, ETSI), semiconductor memory and compute (JEDEC, PCI-SIG) and wireless connectivity (Wi-Fi Alliance). This suggests a deliberate industrial standards strategy backed by state policy, corporate R&D investment and coordinated delegation activity by firms including Huawei, ZTE, Xiaomi, OPPO and CATT. This increasingly contested standard landscape implies that UK firms should be supported in maintaining their delegate presence, contributing technical proposals and holding positions on editorial and steering committees.

⁴ Japan's Ministry of Economy, Trade and Industry (METI) operates a subsidy for international standardisation activities. This programme specifically co-funds the travel and delegate costs for private-sector experts to participate in ISO and IEC technical committees, ensuring Japanese interests shape global specifications.

⁵ South Korea's Korea Agency for Technology and Standards (KATS), under the Ministry of Trade, Industry and Energy (MOTIE), administers targeted support programmes for SME participation in international standards bodies, including co-funding for delegate travel and committee membership costs in priority technology areas. Additionally, its Ministry of SMEs and Startups (MSS) offers up to KRW 100 million (approx. \$77,000 USD) in funding to startups and SMEs to acquire global certifications, such as CE or UL, as part of its 2025 support programme.

⁶ The Standards Council of Canada (SCC) manages the Standards Development Participation Program, which provides financial assistance to Canadian experts (from firms and academia) to join international technical committees. This is a core part of Canada's National Standards Strategy, designed to align standardisation with national competitiveness.

6.5 The UK's Emerging Technology Opportunity: AI, Clean Energy and Health Data Standards

This analysis captures participation in 19 established SDOs, many of which were founded to address connectivity, computing and telecommunications standards of the 2000s and 2010s. The standards landscape of the coming decade will be shaped by emerging frameworks in artificial intelligence (ISO/IEC JTC 1/SC 42, NIST AI RMF), clean energy and grid interoperability (IEC TC 57, IEEE P2030) and health data exchange (HL7 FHIR, SNOMED CT). In these domains, the institutional landscape is less settled, the number of established corporate incumbents is smaller and new entrants – including innovative UK firms and research-intensive universities – have an opportunity to shape foundational standards.

The UK has substantive assets in all three of these domains: world-leading AI research concentrated in universities and spin-outs (UCL, Oxford, Cambridge, DeepMind and many others); an advanced energy transition programme through UKRI's Energy theme and the Net Zero Innovation Portfolio; and the NHS as both a data asset and a potential test-bed for health data interoperability standards. Translating these research and deployment assets into standards influence requires deliberate action. UKRI and Innovate UK are well-placed to signal that participation in AI, clean energy and health data standards bodies is a legitimate and strategically important activity, and to provide direct support for UK firms and institutions seeking to contribute to these emerging frameworks.

6.6 Policy Recommendations

Drawing together the empirical findings and the analysis above, we propose the following five priorities for Innovate UK and UKRI in supporting UK standards leadership.

First, protect and deepen UK participation in 5G and 6G standards bodies. The UK's existing presence in ETSI and 3GPP is a strategic asset. As 6G standardisation intensifies through 3GPP Release 19 and IMT-2030, Innovate UK and DCMS should work with BSI to monitor and, where necessary, co-fund UK committee-level participation in these bodies, to help ensure that UK research institutions and scale-ups are able to participate to the same extent as better-resourced delegations from China and the US.

Second, address the hardware SDO gap through targeted innovation support policy. UK firms are underrepresented in semiconductor and hardware-layer SDOs relative to their technology capabilities. The National Semiconductor Strategy and the Catapult network should incorporate SDO participation as a metric of technology leadership and consider making SDO membership an incentive within Innovate UK grant schemes for semiconductor and compound semiconductor firms.

Third, establish a Standards Participation Fund for innovative SMEs and scale-ups. The cost barriers to meaningful SDO participation – annual membership fees, delegate travel and staff time for contribution workstreams – are disproportionately burdensome for smaller firms. A dedicated Innovate UK co-funding mechanism, modelled on peer-country programmes in Germany and Japan, could raise the multi-SDO participation rate among UK SMEs and ensure that the UK's innovation base is reflected in the standards that will govern future markets.

Fourth, invest in emerging standards bodies for AI, clean energy and health data. The UK's technology strengths in AI, net zero and health data are not yet reflected in its standards body participation, in part because the relevant bodies are newer and less established than the 19 SDOs analysed here. UKRI programme offices (AI, Energy, Health) should identify the key emerging standards bodies in their technology domains and provide targeted support to UK participants, treating standards engagement as an integral component of technology translation and market development.

Finally, our findings from the US analysis in Section 5 have several important implications for UK innovation policy. The evidence that standards engagement translates into measurable gains in global market connectivity – more customers, stronger international supply chain integration – provides empirical support for policies that encourage UK firms to participate actively in SDOs. However, the results suggest that support for SDO participation will generate the largest returns when targeted at R&D-active firms that already have the absorptive capacity to convert standards-related knowledge into competitive IP and supply chain advantage. This reinforces the integrated approach to standards policy recommended in this report, which combines support for SDO participation with complementary investment in R&D capability, IP management and standards-related skills.

The overarching finding of our report is that standards participation is simultaneously a reflection of a country's existing technological capabilities and a mechanism through which those capabilities can be extended. China's ascent in SDO governance is well underway; the US retains its dominant position, grounded in the depth of its innovation ecosystem; and the UK occupies a position of relative strength in services-oriented standards bodies, while facing challenges in hardware and semiconductor standards that are increasingly central to the technology agenda of the coming decade. The evidence presented here provides an empirical foundation for an integrated policy response that combines strategic SDO engagement, targeted co-funding for innovative SMEs and deliberate investment in emerging standards bodies. Translating the UK's strengths in science and technology into durable international standards leadership requires sustained effort across the innovation, industrial and diplomatic dimensions of technology policy; this report offers an evidence base and a concrete set of actionable priorities with which to begin.

Now that you have read our report, we would love to know if our research has provided you with new insights, improved your processes, or inspired innovative solutions.

Please let us know how our research is making a difference by completing our short feedback form [via this link](#).

You are also welcome to email us if you have any questions about this report or the work of the IRC generally: info@ircaucus.ac.uk

Thank you

The Innovation & Research Caucus

References

- Baron, J. and Spulber, D.F. (2018) 'Technology standards and standard setting organizations: introduction to the Searle Center database', *Journal of Economics and Management Strategy*, 27(3), pp. 462–503.
- Baron, J., Li, C. and Nasirov, S. (2019) 'Why do R&D-intensive firms participate in standards organizations? The role of patents and product-market position', SSRN Working Paper. Available at: <https://ssrn.com/abstract=3287475>.
- Besen, S.M. and Farrell, J. (1994) 'Choosing how to compete: strategies and tactics in standardization', *Journal of Economic Perspectives*, 8(2), pp. 117–131.
- Blind, K., Lorenz, A. and Rauber, J. (2020) 'Drivers for companies' entry into standard-setting organizations', *IEEE Transactions on Engineering Management*, 68(1), pp. 33–44.
- Chiao, B., Lerner, J. and Tirole, J. (2007) 'The rules of standard-setting organizations: an empirical analysis', *The RAND Journal of Economics*, 38(4), pp. 905–930.
- Cohen, W.M. and Levinthal, D.A. (1990) 'Absorptive capacity: a new perspective on learning and innovation', *Administrative Science Quarterly*, 35(1), pp. 128–152.
- David, P.A. and Rothwell, G.S. (1996) 'Standardization, diversity and learning: strategies for the coevolution of technology and industrial capacity', *International Journal of Industrial Organization*, 14(2), pp. 181–201.
- Deng, X., Li, Q.C. and Mateut, S. (2022) 'Participation in setting technology standards and the implied cost of equity', *Research Policy*, 51(5), p. 104497.
- DSIT (2023) *The UK Science and Technology Framework*. London: Department for Science, Innovation and Technology. Available at: <https://www.gov.uk/government/publications/uk-science-and-technology-framework/the-uk-science-and-technology-framework>.
- DSIT (2025) *Science and Technology Framework*. London: Department for Science, Innovation and Technology. Available at: <https://www.gov.uk/government/publications/science-and-technology-framework/science-and-technology-framework>.
- Dokko, G. and Rosenkopf, L. (2010) 'Social capital for hire? Mobility of technical professionals and firm influence in wireless standards committees', *Organization Science*, 21(3), pp. 677–695.
- Farrell, J. and Saloner, G. (1985) 'Standardization, compatibility and innovation', *The RAND Journal of Economics*, 16(1), pp. 70–83.
- Farrell, J. and Saloner, G. (1988) 'Coordination through committees and markets', *The RAND Journal of Economics*, 19(2), pp. 235–252.
- Fiedler, C., Larrain, M. and Prüfer, J. (2023) 'Membership, governance and lobbying in standard-setting organizations', *Research Policy*, 52(6), p. 104761.
- Gao, X. (2014) 'A latecomer's strategy to promote a technology standard: the case of Datang and TD-SCDMA', *Research Policy*, 43(3), pp. 597–607.
- Gupta, K. (2017) 'The role of SMEs and startups in standards development', SSRN Working Paper.

- Kang, B. and Motohashi, K. (2015) 'Essential intellectual property rights and inventors' involvement in standardization', *Research Policy*, 44(2), pp. 483–492.
- Katz, M.L. and Shapiro, C. (1985) 'Network externalities, competition and compatibility', *The American Economic Review*, 75(3), pp. 424–440.
- Katz, M.L. and Shapiro, C. (1994) 'Systems competition and network effects', *Journal of Economic Perspectives*, 8(2), pp. 93–115.
- Lerner, J. and Tirole, J. (2015) 'Standard-essential patents', *Journal of Political Economy*, 123(3), pp. 547–586.
- LexisNexis IP (2025) 'Who is leading the 5G patent race? 2025 report'. LexisNexis IP. Available at: <https://www.lexisnexisip.com/wp-content/uploads/2025/01/2025-LexisNexis-5G-SEP-Report.pdf?hsCtaAttrib=185191375501>
- Mattli, W. and Büthe, T. (2003) 'Setting international standards: technological rationality or primacy of power?', *World Politics*, 56(1), pp. 1–42.
- Narayanan, V.K. and Chen, T. (2012) 'Research on technology standards: accomplishment and challenges', *Research Policy*, 41(8), pp. 1375–1406.
- Ranganathan, R., Ghosh, A. and Rosenkopf, L. (2018) 'Competition–cooperation interplay during multifirm technology coordination: the effect of firm heterogeneity on conflict and consensus in a technology standards organization', *Strategic Management Journal*, 39(12), pp. 3193–3221.
- Rysman, M. and Simcoe, T. (2008) 'Patents and the performance of voluntary standard-setting organizations', *Management Science*, 54(11), pp. 1920–1934.
- Seaman, J. (2020) China and the new geopolitics of technical standardization. Paris: Institut français des relations internationales (IFRI). *Notes de l'Ifri*, 34, pp.20-21.
- Schott, L., Schaefer, K.J. and Bekkers, R. (2026) 'Chinese firms bridging the standardisation gap in 3GPP: liabilities of outsidership and the role of technological shifts', *Journal of Economic Geography*, forthcoming.
- Simcoe, T.S. (2012a) 'Standard setting committees: consensus governance for shared technology platforms', *American Economic Review*, 102(1), pp. 305–336.
- Simcoe, T.S. (2012b) 'Private and public approaches to patent hold-up in industry standard setting', *Antitrust Bulletin*, 57(1), pp. 59–88.
- Swann, G.M.P. (2000) The economics of standardization. Report for the Department of Trade and Industry.
- Swann, G.M.P. (2010) International standards and trade: a review of the empirical literature. OECD Trade Policy Working Paper No. 97. Paris: OECD.
- Tassey, G. (2000) 'Standardization in technology-based markets', *Research Policy*, 29(4–5), pp. 587–602.
- Teece, D.J. (2018) 'Profiting from innovation in the digital economy: enabling technologies, standards and licensing models in the wireless world', *Research Policy*, 47(8), pp. 1367–1387.

Appendix

Additional Analysis of the Determinants and Impact of SDO Participation in UK Firms (Section 4)

Table A1: Estimated Marginal Effects from Probit Model of Determinants of SDO Participation

	(1) 2015–2023	(2) 2018–2023	(3) 2021–2023
In Assets	0.00014** (0.00006)	0.00016** (0.00007)	0.00017** (0.00007)
In Age	0.00019 (0.00021)	0.00007 (0.00026)	-0.00023 (0.00035)
<i>NACE rev. 2 division</i>			
Computer, electronic and optical products	0.00257 (0.00172)	0.00339* (0.00195)	0.00551** (0.00249)
Electrical equipment	0.00092 (0.00150)	0.00230 (0.00192)	0.00461* (0.00268)
Machinery and equipment	-0.00108 (0.00073)	-0.00091 (0.00072)	0.00160 (0.00150)
Other manufacturing	-0.00069 (0.00085)	-0.00052 (0.00085)	-0.00027 (0.00085)
Wholesale trade	-0.00038 (0.00079)	0.00002 (0.00081)	0.00031 (0.00080)
Telecommunications	0.00633*** (0.00222)	0.00781*** (0.00263)	0.00864*** (0.00291)
Computer programming and consultancy	0.00286*** (0.00098)	0.00329*** (0.00105)	0.00424*** (0.00113)
Information service activities	0.00113 (0.00136)	0.00128 (0.00143)	0.00175 (0.00165)
Financial auxiliary activities	-0.00062 (0.00085)	-0.00055 (0.00082)	-0.00039 (0.00079)
Legal and accounting activities	-0.00076 (0.00074)	-0.00064 (0.00074)	-0.00017 (0.00079)
Head offices and management consultancy	-0.00024 (0.00079)	-0.00018 (0.00078)	0.00019 (0.00076)
Architecture and engineering	0.00011 (0.00095)	0.00040 (0.00101)	0.00164 (0.00127)
Scientific research and development	0.00175 (0.00166)	0.00188 (0.00168)	0.00312 (0.00212)
Other professional activities	-0.00058 (0.00080)	-0.00042 (0.00080)	0.00018 (0.00084)
<i>Region</i>			
East Midlands	0.00127 (0.00108)	0.00101 (0.00116)	0.00103 (0.00123)
East	0.00099 (0.00075)	0.00099 (0.00087)	0.00107 (0.00100)

	(1) 2015–2023	(2) 2018–2023	(3) 2021–2023
North West	-0.00033 (0.00046)	-0.00020 (0.00057)	0.00008 (0.00077)
North	0.00152 (0.00188)	0.00135 (0.00190)	0.00090 (0.00188)
Scotland	0.00070 (0.00096)	0.00062 (0.00103)	0.00009 (0.00104)
South East	0.00017 (0.00075)	0.00067 (0.00099)	0.00011 (0.00098)
South West	0.00119 (0.00096)	0.00131 (0.00107)	0.00259* (0.00138)
South	0.00106** (0.00052)	0.00095* (0.00057)	0.00120* (0.00069)
Wales	-0.00118*** (0.00026)	-0.00131*** (0.00033)	-0.00149*** (0.00049)
West Midlands	-0.00059 (0.00047)	-0.00077 (0.00052)	-0.00081 (0.00067)
Yorks & Humberside	-0.00031 (0.00056)	-0.00053 (0.00058)	-0.00043 (0.00077)
<i>Legal Form</i>			
Foreign companies	0.00213 (0.00398)	0.00223 (0.00425)	0.00288 (0.00540)
Non profit organisations	-0.00179*** (0.00031)	-0.00188*** (0.00037)	-0.00224*** (0.00045)
Public limited companies	0.00066 (0.00122)	0.00062 (0.00128)	0.00121 (0.00161)
Grant	0.00431** (0.00187)	0.00555** (0.00249)	0.00560** (0.00279)
<i>Year</i>			
2016	0.00003 (0.00009)		
2017	0.00015 (0.00014)		
2018	0.00011 (0.00015)		
2019	0.00019 (0.00017)	0.00007 (0.00010)	
2020	0.00029 (0.00019)	0.00018 (0.00015)	
2021	0.00030 (0.00020)	0.00018 (0.00016)	
2022	0.00029 (0.00021)	0.00014 (0.00017)	-0.00001 (0.00009)
2023	0.00054** (0.00024)	0.00041* (0.00021)	0.00034* (0.00017)
Pseudo R ²	0.114	0.117	0.113
Observations	399,500	260,037	124,234
Untreated	398,853	259,573	123,958

	(1) 2015–2023	(2) 2018–2023	(3) 2021–2023
Treated	647	464	276
Firms	53,684	48,178	43,416

Notes: Standard errors, clustered at the firm level, are in parentheses. */**/** denotes statistical significance at the 10%/5%/1% levels.

Table A2: Estimated Effects of SDO Participation on Firm Performance from Two-Way-Fixed-Effects, 2018–2023

	(1) Revenues	(2) Employment	(3) Productivity	(4) Patent Applications	(5) Patent Families
SDO	0.143 (0.120)	0.133*** (0.046)	-0.029 (0.112)	0.253 (0.204)	0.291** (0.135)
In Assets	0.447*** (0.007)	0.231*** (0.005)	0.237*** (0.007)	0.189*** (0.032)	0.227*** (0.037)
In Age	0.170*** (0.011)	0.276*** (0.010)	-0.070*** (0.010)	0.162 (0.100)	0.091 (0.112)
Innovate UK Grant	0.036* (0.021)	0.043*** (0.014)	-0.012 (0.018)	0.099 (0.091)	0.159 (0.152)
Observations	335,608	285,621	259,221	19,828	18,598
Untreated	335,283	285,084	258,910	19,664	18,451
Treated	325	537	311	164	147
Firms	48,747	41,352	39,460	2,347	2,194

Notes: Standard errors, clustered at the firm level, are in parentheses. */**/** denotes statistical significance at the 10%/5%/1% levels. The variation in observations is due to missing data on the dependent variables. Models include the following covariates: binary variables for industry, region, legal status, whether a firm received an Innovate UK grant and year as well as the log of assets and age (although those without variation over time are dropped when using fixed effects estimation).

Table A3: Estimated Effects of SDO Participation on Firm Performance, 2018–2023

	(1)	(2)	(3)	(4)	(5)
	Revenues	Employment	Productivity	Patent Applications	Patent Families
<i>Pooled OLS</i>					
SDO	0.457*** (0.163)	-0.001 (0.134)	-0.157 (0.232)	1.156*** (0.423)	1.023** (0.451)
Observations	226,253	198,363	179,460	260,037	260,037
Untreated	226,016	197,948	179,232	259,573	259,573
Treated	237	415	228	464	464
Firms	45,726	40,363	38,527	48,178	48,178
<i>Fixed Effects</i>					
SDO	-0.044 (0.118)	0.093* (0.052)	-0.121 (0.133)	0.373** (0.147)	0.393*** (0.080)
Observations	224,114	195,847	176,592	10,028	9,261
Untreated	223,884	195,437	176,372	9,932	9,171
Treated	230	410	220	96	90
Firms	43,587	37,847	35,659	1,737	1,600

Notes: The lower observation counts in the lower panel are the result of the dropping of singletons and observations separated by a fixed effect. Refer to Table A2 for notes.

Table A4: Estimated Effects of SDO Participation on Firm Performance, 2021–2023

	(1)	(2)	(3)	(4)	(5)
	Revenues	Employment	Productivity	Patent Applications	Patent Families
<i>Pooled OLS</i>					
SDO	0.285 (0.199)	0.014 (0.135)	-0.245 (0.258)	1.227*** (0.344)	1.180*** (0.369)
Observations	106,290	97,446	86,690	123,952	123,952
Untreated	106,157	97,199	86,564	123,678	123,678
Treated	133	247	126	274	274
Firms	39,381	35,541	32,676	43,310	43,310
<i>Fixed Effects</i>					
SDO	-0.248 (0.326)	0.045 (0.044)	-0.410 (0.412)	0.592*** (0.142)	0.601*** (0.089)
Observations	102,834	94,677	83,214	3,270	2,830
Untreated	102,705	94,436	83,093	3,219	2,779
Treated	129	241	121	51	51
Firms	35925	32772	29200	1103	953

Notes: Refer to Table A3 for notes.



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