PUBLIC-PRIVATE SECTOR INTERACTIONS IN INNOVATION

UKIS data analysis – separate Annex to the report on *Returns to public R&D*

12 DECEMBER 2024

Contents

This work was produced using statistical data from ONS. The use of the ONS statistical data in this work does not imply the endorsement of the ONS in relation to the interpretation or analysis of the statistical data. This work uses research datasets which may not exactly reproduce National Statistics aggregates.

Introduction

This study uses data from the UK Innovation Survey (UKIS) to document interactions between the public and private sectors that have a bearing on private firms' innovation.[1] [2]

Specifically, we provide estimates for:

- The % share of firms who report that **information from the public sector is important** for their own innovation activities;[3] and,
- The % share of firms who report **collaborating on innovation with the public sector**.

We report the results for both of these metrics, separately for universities or other higher education institutions ("HE"), for government or public research institutes ("GOV") and the combination of the two ("PUB").[4]

We also describe how these metrics have varied over time (using data from UKIS waves 3-11, which cover the period 2002-4 to 2016-18) and how they differ across industry groups.[5]

We use different types of aggregations to define the industry groups studies. These are motived by sample size limitations of the number of firms in certain industries and UKIS waves. Please see the Appendix for a more detailed explanation of these industry groups.

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[1] Department for Business and Trade, released 07 June 2022, ONS SRS Metadata Catalogue, dataset, UK Innovation Survey, https://doi.org/10.57906/bs4h-rh59.

[2] Unless otherwise stated, all statistics in this study refer to results based on UKIS data weighted to ensure these are representative of the UK business population in the sectors sampled by UKIS. We focus on a large subset (not all) of industries from UKIS, therefore our results may not be fully comparable to findings from ONS or others based on data for all industries available in UKIS.

[3] High or medium importance.

[4] That is, at least one of HE or GOV (or both).

[5] We focus on the following waves with corresponding time windows in parentheses: wave 3 (1998-2000); wave 4 (2002-4), 5 (2004-6), 6 (2006-8), 7 (2008-10), 8 (2010-12), 9 (2012-14), 10 (2014-16) and 11 (2016-18).

Differences in interactions over time

Figure 1 below shows that in the period between 2002-2004 (UKIS wave 4) and 2016-2018 (wave 11) about 4-10% of firms found information from the public sector important for their own innovation activities. These figures range between 3-7% both for HE and for GOV over time, which suggests that the majority of firms who found information from the public sector important found information from both HE and GOV important.

Firms' self-reported importance of information from the public sector shows a decrease over time. Nearly 10% of firms reported information from the public sector as being important in 2002-2004 (wave 4), but this had fallen to close to 5% by 2008-10 (wave 7). The proportion increases sharply in 2014-16 (wave 10) to about 10% and stays at a high level (c.7%) in 2016-18 (wave 11).[6]

Figure 1   % share of firms who report that information from the public sector is important for their own innovation activities – by wave
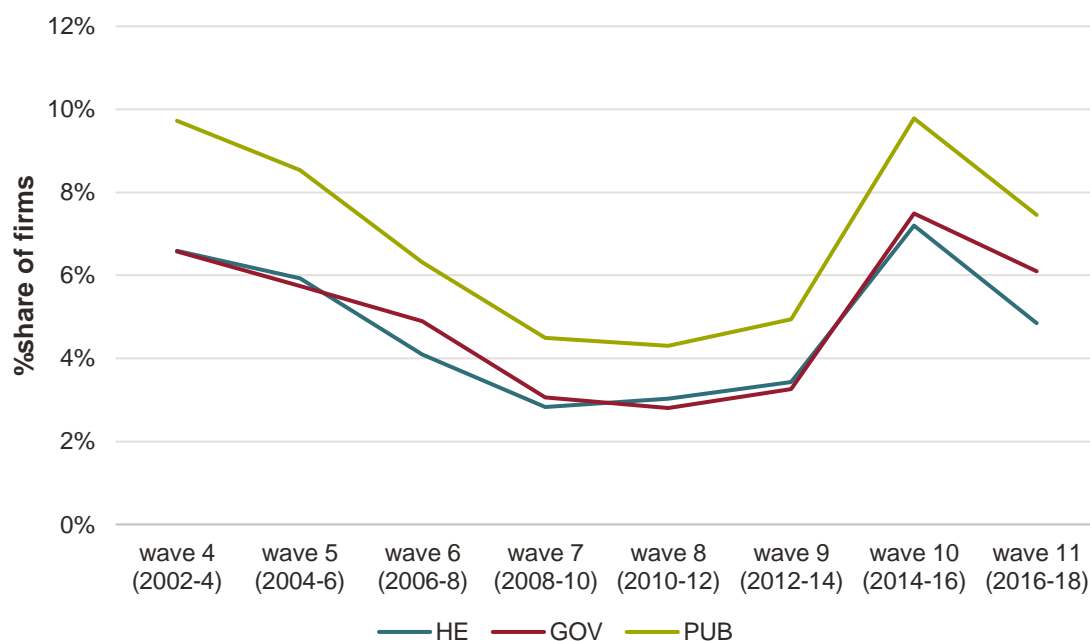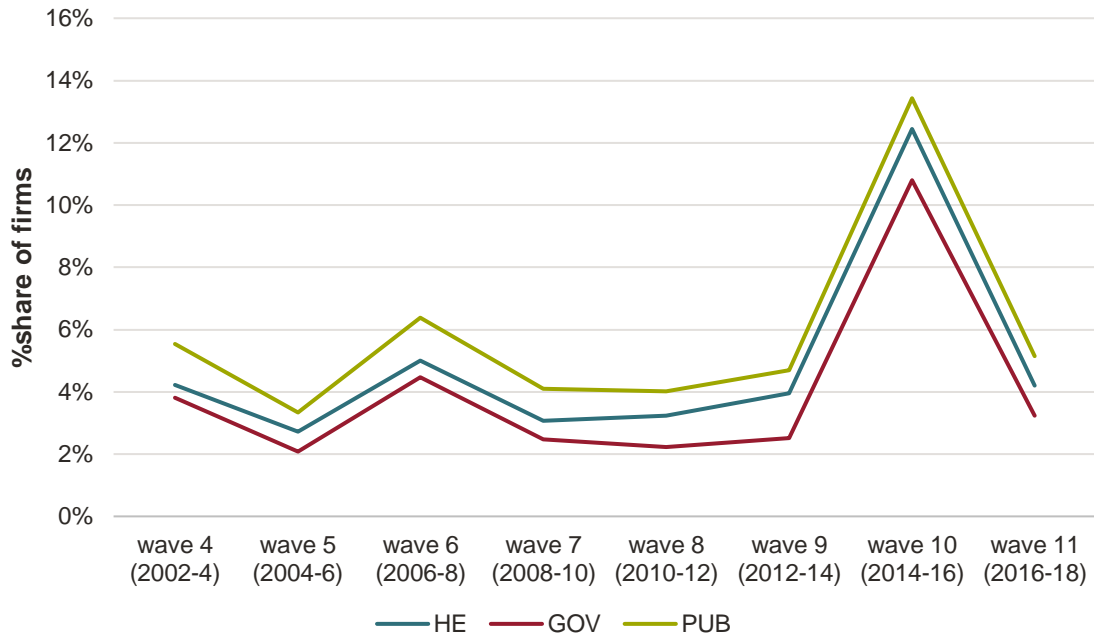

Source: Frontier Economics calculations based on UKIS data.

Figure 2 below shows that firms are more likely to collaborate on innovation with HE compared to with GOV, albeit the difference is small (about 1%). The % share of firms who report collaboration on innovation with the public sector (i.e. PUB) is in the 3-6% range for most time

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[6] The sharp increase in wave 10 is also documented by the ONS. See Table P5 (for "Higher education institutions" and for "Government or public research institutes") on the "Table_14" tab in the Statistical Annex for wave 10, available at: UK innovation survey 2017: main report - GOV.UK (www.gov.uk). Please note that the panel used by the ONS in table P5 is different from the sample used in this study.

periods (with an unusually high proportion reporting collaboration in 2014-16 (wave 10), which is also documented by the ONS).[7]

Figure 2   % share of firms who report collaborating on innovation with the public sector – by wave

Source: Frontier Economics calculations based on UKIS data.

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[7] Ibid, Table P4.

Differences in interactions between sectors

There is significant variation across industries in both of these metrics of public-private innovation interactions. Figure 3 and Figure 4 below show this variation for the information and collaboration metrics (respectively) across industry groups (combined SIC groups). The industry groups are explained in the Appendix below.
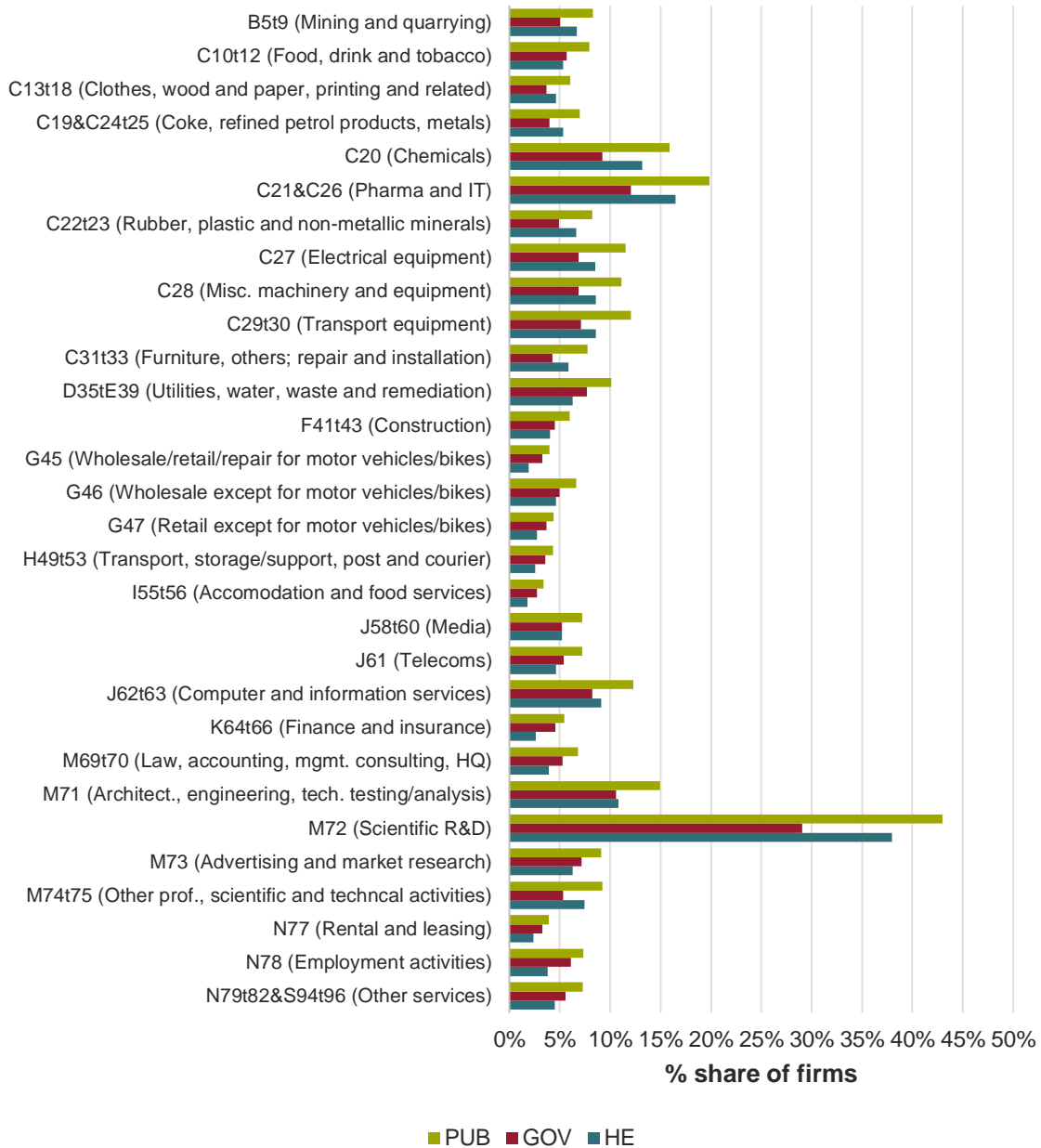
Interactions with HE show a larger variation compared to GOV for both of these metrics. Some of the industry groups show consistently high levels of public-private interactions: M72 (Scientific research and development), C21&C26 (Manufacture of basic pharmaceutical products and pharmaceutical preparations; Manufacture of computer, electronic and optical products), C20 (Manufacture of chemicals and chemical products) and M71 (Architectural and engineering activities; technical testing and analysis). These are generally industry groups with a greater than average focus on research and/or technology.

The high-level industry definition on Figure 5 below also shows variation across industry groups in public-private interactions.[8] The variation is smaller compared to when using the more granular industry definition.

Industry groups that have a relatively high % share of firms who report that information from the public sector is important for their innovation activities are also more likely than others to collaborate on innovation with the public sector. Industry groups with relatively high levels of interactions are K (Business activities), E (Electricity, gas and water supply) and D (Manufacturing). The industry groups with relatively low levels of interactions are J (Financial services), GHI (Distribution; hotels and restaurants; transport, storage and communications) and F (Construction).

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[8] These groups broadly align with those used in Goodridge, P., Haskel, J., Hughes, A. and Wallis, G. (2015). "The contribution of public and private R&D to UK productivity growth", Working Papers 21171, Imperial College, London, Imperial College Business School. Available at: The contribution of public and private R&D to UK productivity growth (repec.org).
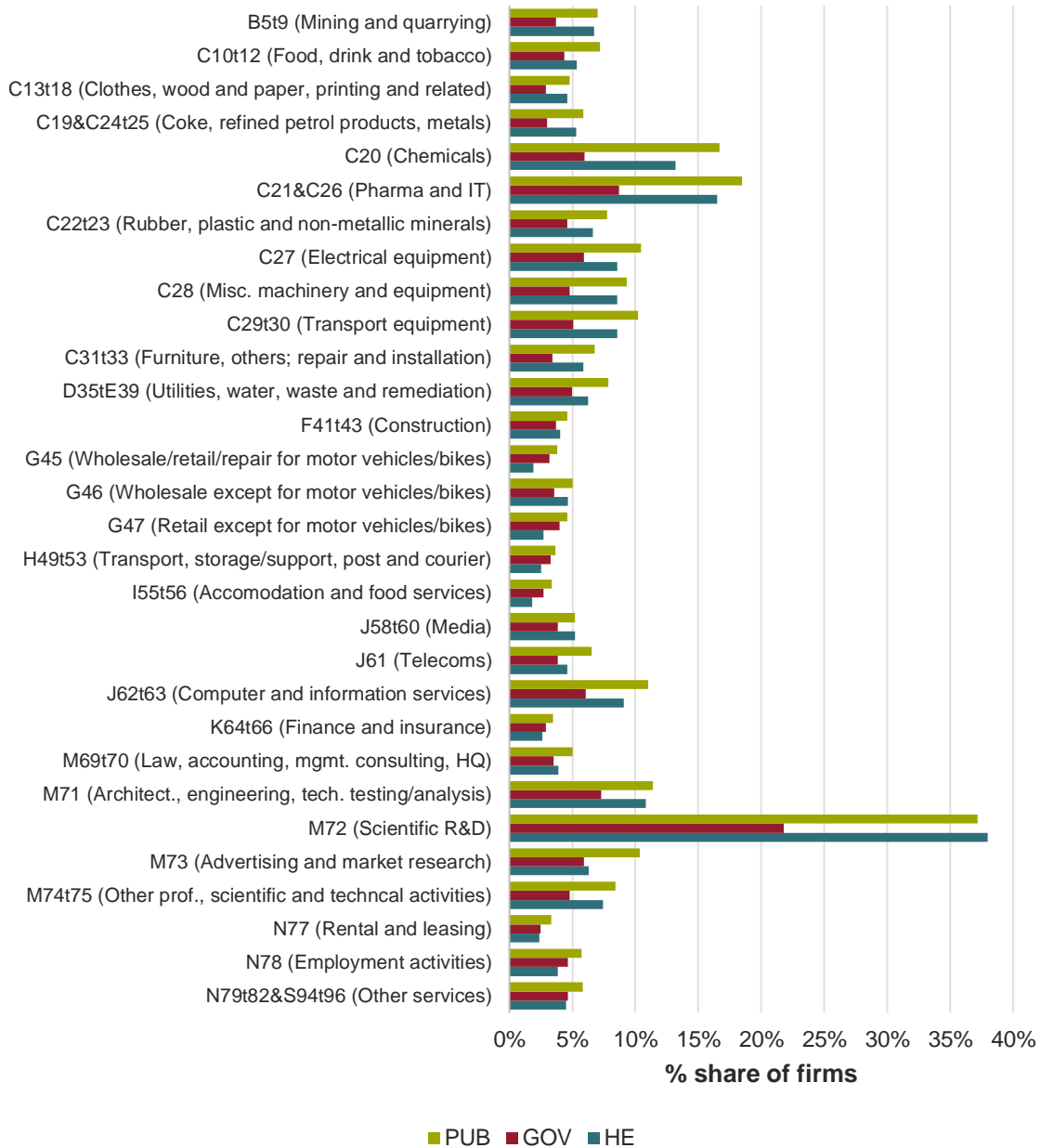
Figure 3 % share of firms who report that information from the public sector is important for their own innovation activities – by industry group

Source: Frontier Economics calculations based on UKIS data.

Note: The Figure uses simplified names for the industry groups. The precise industry groups are explained in the Appendix below. Industry groups starting with the letter "C" are groups for the manufacture of certain goods (e.g. C20: Manufacture of chemicals). "HQ" is abbreviation for "Activities of head offices". C13t18 includes: manufacture of textiles, clothes and leather; wood and paper; printing and reproduction of recorded media.
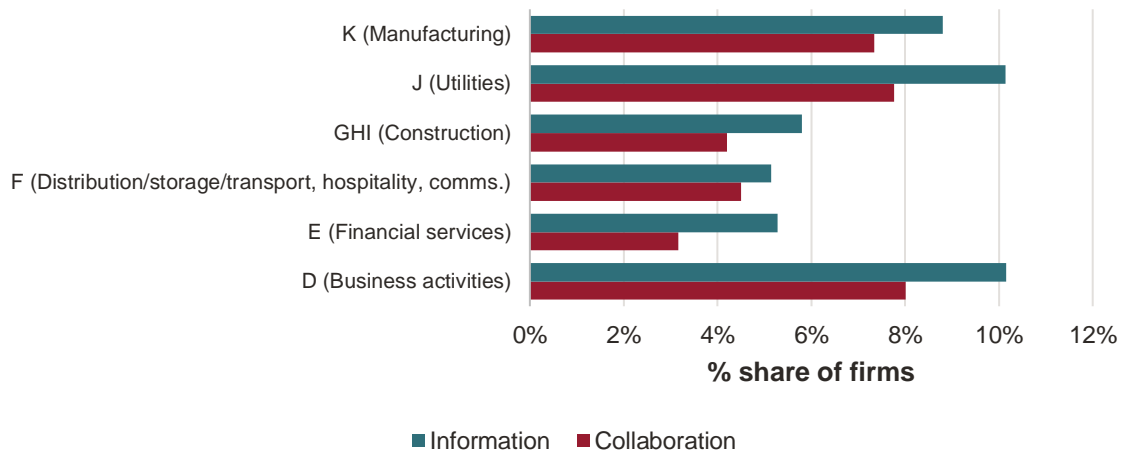
Figure 4 % share of firms who report collaborating on innovation with the public sector – by industry group

Source: Frontier Economics calculations based on UKIS data.

Note: The Figure uses simplified names for the industry groups. The precise industry groups are explained in the Appendix below. Industry groups starting with the letter "C" are groups for the manufacture of certain goods (e.g. C20: Manufacture of chemicals). "HQ" is abbreviation for "Activities of head offices". C13t18 includes: manufacture of textiles, clothes and leather; wood and paper; printing and reproduction of recorded media.

Figure 5   **% share of firms who report that that information from the public sector is important for their own innovation activities ("Information") and % share of firms who report collaborating on innovation with the public sector ("Collaboration") – by high-level industry group**

Source: Frontier Economics calculations based on UKIS data.

Note: The Figure uses simplified names for the industry groups. The precise industry groups are explained in the Appendix below.

Sectoral differences over time

Figure 1 above shows that, between 2002-4 (wave 4) and 2016-18 (wave 11), there was over a 2 percentage point decline in the proportion of firms reporting that information from the public sector was important for their innovation. Figure 2, for the collaboration metric, shows only a moderate decline of less than 1 percentage point during the same time period.

UKIS data shows the extent to which private sector firms interact with the public sector in their innovation activities across different time periods and industries. This is shown below in Figure 6 and Figure 7 (respectively for the information metric and the collaboration metric). This is available only for the public sector as a whole (i.e. PUB), and for less granular industry groups compared to Figure 3 and Figure 4 above due to limited sample sizes of firms in particular industries in individual waves of UKIS.

Figure 8 and Figure 9 shows the change in public-private interactions over time using the high-level industry definition. This is available for UKIS waves 3-11 (for the more granular industry groups there are sample size limitations for UKIS wave 3).

The findings suggest that interactions as measured by the information metric declined over time for most of the studied industry groups and time periods.

- Interactions declined for 14 of the 19 industry groups using the more granular definition available. The decline was largest for some of the industry groups with the highest interaction levels at the beginning of the period examined (i.e. 2002-4): C21&C26 (Manufacture of basic pharmaceutical products and pharmaceutical preparations; Manufacture of computer, electronic and optical products), M71&M73tM75 (Architectural and engineering activities; technical testing and analysis; Advertising and market research; Other professional, scientific and technical activities) and C20 (Manufacture of chemicals and chemical products).

- That said, the industry group with the highest level of interaction (M72 - Scientific research and development) shows an increase in interactions over time.

- Interactions declined for 5 out of the 6 high-level industry groups when using the wave 4 survey results (i.e. 2002-4) as the starting point. Groups with the highest interaction levels at the start saw the largest declines: E (Electricity, gas and water supply) and K (Business activities). These are similar findings as obtained above for the more granular industry groups.

- However, interactions increased over time for 5 out of the 6 high-level industry groups when wave 3 (i.e. 1998-2000) is considered as the starting point. This finding illustrates the increase in interactions between wave 3 and wave 4. There is also a trend of decreasing interaction levels for most of the industry groups in some of the early time periods (e.g. 2006-8 or wave 6), followed by some increase only in the latest time periods.
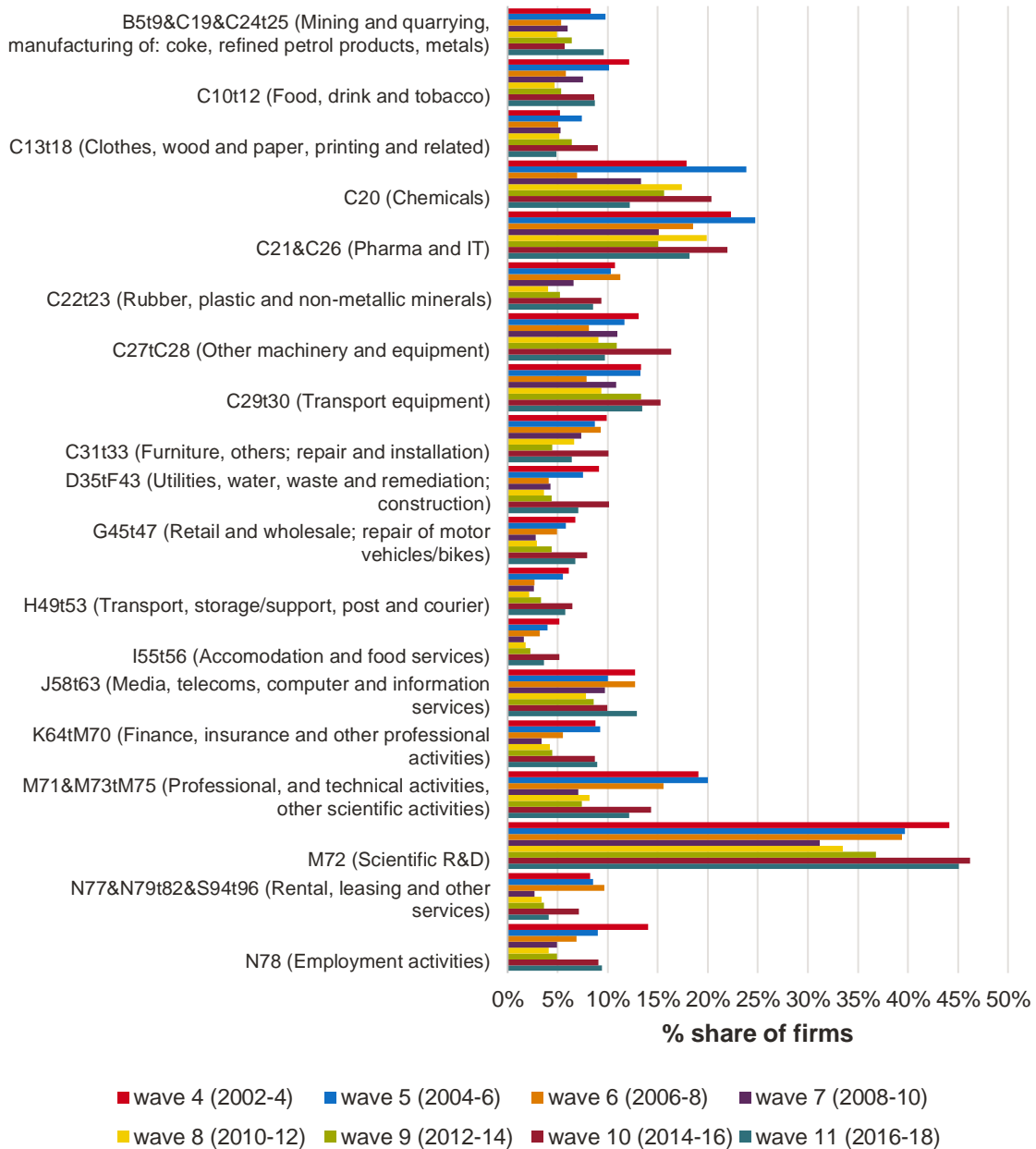
The collaboration metric on the other hand shows a general increase in interactions over time.

- In contrast to the information metric, 13 out of the 16 studied industry groups show an increase in interactions based on the collaboration metric using the more granular aggregation available. Some of the industry groups with the highest initial interaction levels show the largest increases: C20 (Manufacture of chemicals and chemical products), C21&C26 (Manufacture of basic pharmaceutical products and pharmaceutical preparations; Manufacture of computer, electronic and optical products) and M72 (Scientific research and development). C27tC28 (Manufacture of electrical equipment; Manufacture of machinery and equipment n.e.c.) also shows a large increase.

- Interaction declined the most (in percentage points) for N78 (Employment activities) and C22t23 (Manufacture of rubber, plastic and non-metallic mineral products).

- The high-level definition shows similar results, with most of the industry groups where data is available displaying a small increase in, or an approximately constant level of interactions level over time when using wave 4 (i.e. 2002-4) as the starting point.[9] Interactions show a general increase over time when wave 3 is considered.[10]

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[9] Observation not available for industry group E (Electricity, gas and water supply) in wave 4 due to sample size limitations.

[10] Observation not available for industry group E (Electricity, gas and water supply) and J (Financial services) in wave 3 due to sample size limitations.
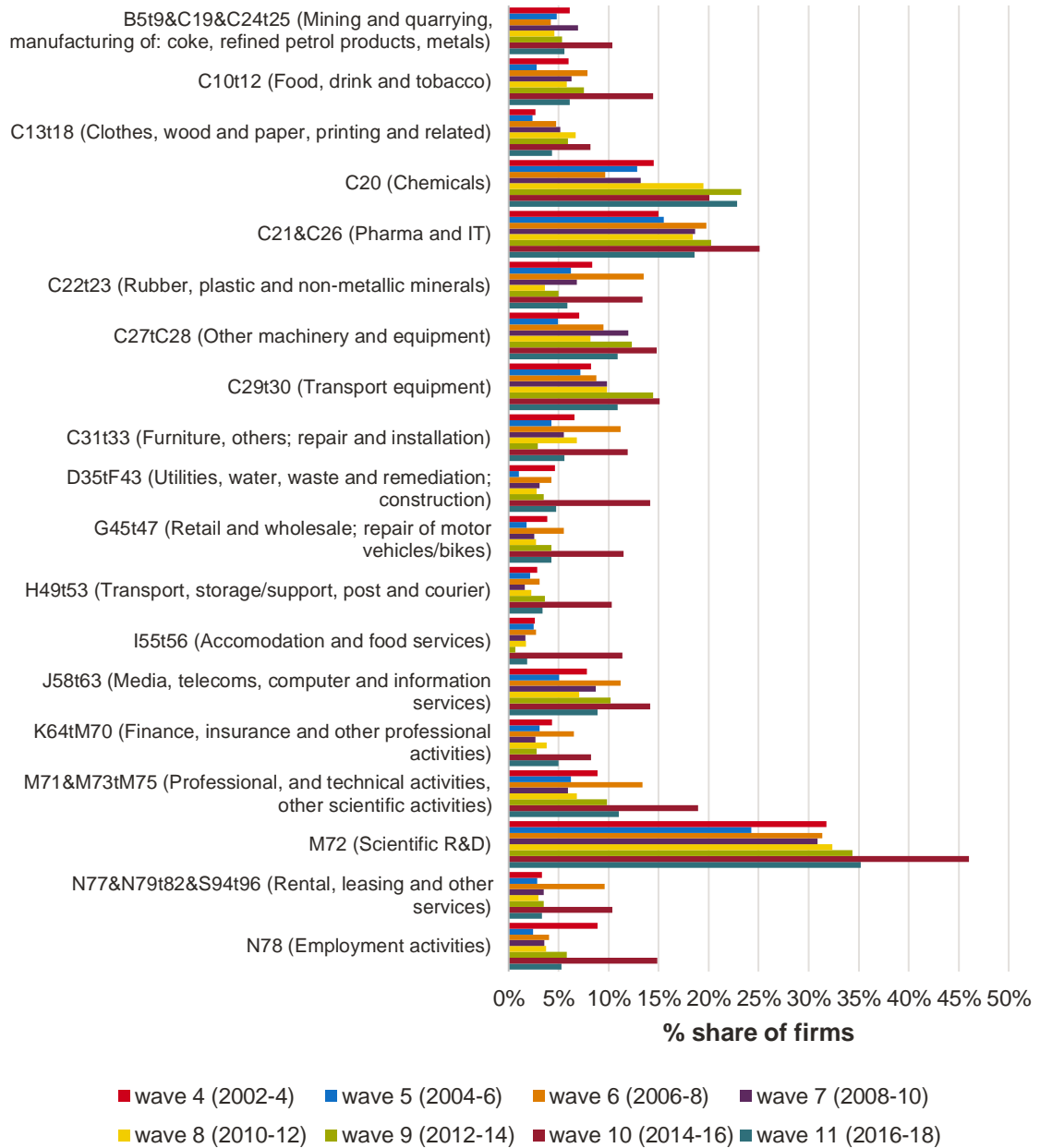
Figure 6 % share of firms who report that information from the public sector is important for their own innovation activities – by industry group and wave

Source: Frontier Economics calculations based on UKIS data.

Note: The Figure uses simplified names for the industry groups. The precise industry groups are explained in the Appendix below. Industry groups starting with the letter "C" are groups for the manufacture of certain goods (e.g. C20: Manufacture of chemicals). C13t18 includes: manufacture of textiles, clothes and leather; wood and paper; printing and reproduction of recorded media.

Figure 7   % share of firms who report collaborating on innovation with the public sector – by industry group and wave

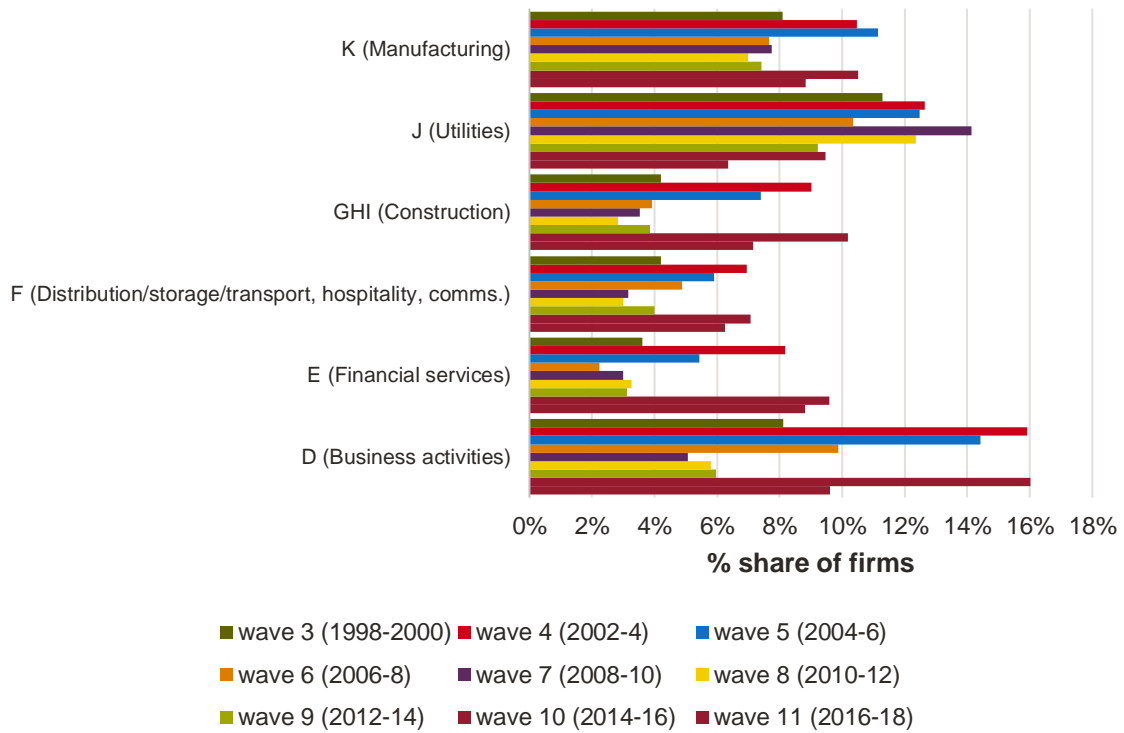Source: Frontier Economics calculations based on UKIS data.

Note: The Figure uses simplified names for the industry groups. The precise industry groups are explained in the Appendix below. Industry groups starting with the letter "C" are groups for the manufacture of certain goods (e.g. C20: Manufacture of chemicals). C13t18 includes: manufacture of textiles, clothes and leather; wood and paper; printing and reproduction of recorded media.

Figure 8   **% share of firms who report that information from the public sector is important for their own innovation activities – by high-level industry group and wave**

Source: Frontier Economics calculations based on UKIS data.

Note: The Figure uses simplified names for the industry groups. The precise industry groups are explained in the Appendix below.

Figure 9   % share of firms who report collaborating on innovation with the public sector – by high-level industry group and wave
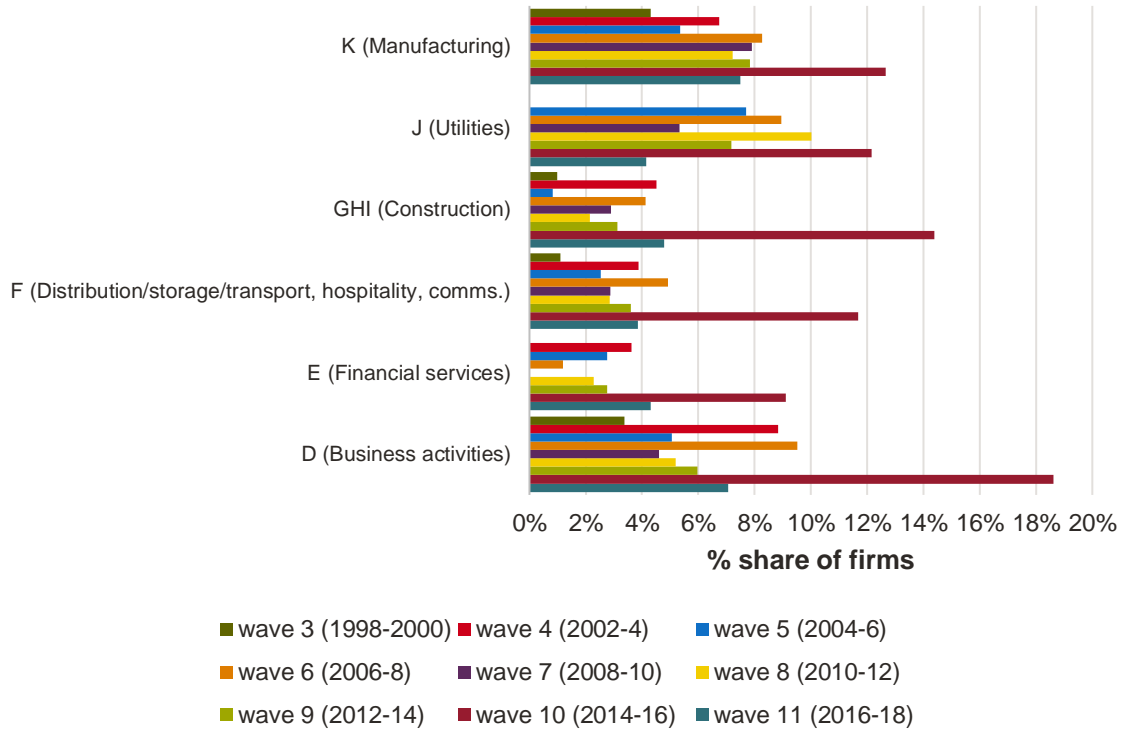
Source: Frontier Economics calculations based on UKIS data.

Note: The Figure uses simplified names for the industry groups. The precise industry groups are explained in the Appendix below. Observations suppressed for industry group E (wave 3 and 4) and J (wave 3 and 7) due to sample size limitations.

Appendix

This section describes the composition of the industry groups used in this note. These are groups of SIC (2007[11]) codes combined in a way to ensure:

1. that each constituent SIC group in a combined industry group has similar rates of public-private interactions; and,

2. that each combined industry group includes SIC groups with similar industry characteristics.[12]

Table 1 shows the composition of the groups used in Figure 3 and Figure 4. Table 2 shows the composition used in Figure 5, Figure 8 and Figure 9. Table 3 shows the composition used in Figure 6 and Figure 7.

As noted above, the figures use different compositions due to sample size limitations. Table 4 describes the SIC groups used to construct these industry groups.[13] [14]

Table 1   SIC composition – narrow groups

Combined industry group	SIC 2007 group
B5t9	B5 to B9
C10t12	C10 to C12
C13t18	C13 to C18
C19&C24t25	C19, C24 to C25
C20	C20
C21&C26	C21 and C26
C22t23	C22 to C23
C27	C27

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[11] The high-level industry aggregations are based on SIC 2003 codes in the sense that the groups obtained mirror the SIC 2003 structure but the aggregations were obtained using SIC 2007 codes for simplicity.

[12] For example, combining C21 (Manufacture of basic pharmaceutical products and pharmaceutical preparations) with C26 (Manufacture of computer, electronic and optical products) due to their technology focus.

[13] The starting point for this analysis was the TPI aggregation of SIC 2007 groups. The dataset is available via the 'The Productivity Lab' subgroup of the Figshare platform: TPI UK Intangibles Growth-Accounting data set (manchester.ac.uk). For background, see: Goodridge, Peter, and Jonathan Haskel (2022), "Accounting for the slowdown in UK innovation and productivity", TPI Working Paper No 022, The Productivity Institute. Available at: Accounting for the slowdown in UK innovation and productivity - The Productivity Institute.

[14] Note that the groups used do not represent the entire UK economy (e.g. agriculture is not included) but rather a large subset of it that was the focus of this study.

Combined industry group	SIC 2007 group
C28	C28
C29t30	C29 to C30
C31t33	C31 to C33
D35tE39	D35, E36 to E39
F41t43	F41 to F43
G45	G45
G46	G46
G47	G47
H49t53	H49 to H53
I55t56	I55 to I56
J58t60	J58 to J60
J61	J61
J62t63	J62 to J63
K64t66	K64 to K66
M69t70	M69 to M70
M71	M71
M72	M72
M73	M73
M74t75	M74 to M75
N77	N77
N78	N78
N79t82&S94t96	N79, N80 to N82, S94 to S96

Source: Frontier Economics analysis based on UKIS data.

Table 2   SIC composition – high-level groups

Combined industry group	SIC 2007 group
D	C10 to C33
E	D35, E36 to E39

Combined industry group	SIC 2007 group
F	F41 to F43
GHI	G45 to G47, H49 to H53, I55 to I56, J58 to J63
J	K64 to K66
K	M69 to M75, N77 to N82

Source: Frontier Economics analysis based on UKIS data.

Table 3   SIC composition – wide groups

Combined industry group	SIC 2007 group
B5t9&C19&C24t25	B5 to B9, C19, C24 to C25
C10t12	C10 to C12
C13t18	C13 to C18
C20	C20
C21&C26	C21 and C26
C22t23	C22 to C23
C27tC28	C27 to C28
C29t30	C29 to C30
C31t33	C31 to C33
D35tF43	D35, E36 to E39, F41 to F43
G45t47	G45 to G47
H49t53	H49 to H53
I55t56	I55 to I56
J58t63	J58 to J63
K64tM70	K64 to K66, M69 to M70
M71&M73tM75	M71, M73, M74 to M75
M72	M72
N77&N79t82&S94t96	N77, N79, N80 to N82, S94 to S96
N78	N78

Source: Frontier Economics analysis based on UKIS data.

Table 4   SIC composition – SIC 2007 aggregation

SIC 2007 group	Description
B5 to B9	Mining and Quarrying
C10 to C12	Manufacture of food, beverages & tobacco
C13 to C15	Manufacture of textiles, wearing apparel & leather products
C16 to C18	Manufacture of wood & paper products; printing and reproduction of recorded media
C19	Manufacture of coke and refined petroleum products
C20	Manufacture of chemicals and chemical products
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
C22 to C23	Manufacture of rubber, plastic and non-metallic mineral products
C24 to C25	Manufacture of basic & fabricated metals
C26	Manufacture of computer, electronic and optical products
C27	Manufacture of electrical equipment
C28	Manufacture of machinery and equipment n.e.c.
C29 to C30	Manufacture of transport equipment
C31 to C33	Manufacture of furniture; other manufacturing; repair and installation
D35	Electricity, Gas, Steam and Air Conditioning Supply
E36 to E39	Water Supply; Sewerage, Waste Management and Remediation Activities
F41 to F43	Construction
G45	Wholesale and retail trade and repair of motor vehicles and motorcycles
G46	Wholesale trade, except of motor vehicles and motorcycles
G47	Retail trade, except of motor vehicles and motorcycles
H49	Land transport and transport via pipelines
H50	Water transport

SIC 2007 group	Description
H51	Air transport
H52	Warehousing and support activities for transportation
H53	Postal and courier activities
I55 to I56	Accommodation and Food Service Activities
J58 to J60	Publishing; Motion picture, video and television, sound recording and music publishing; Programming and broadcasting
J61	Telecommunications
J62 to J63	Computer programming, consultancy and related activities; Information service activities
K64 to K66	Financial and Insurance Activities
M69 to M70	Legal and accounting activities; Activities of head offices; management consultancy activities
M71	Architectural and engineering activities; technical testing and analysis
M72	Scientific research and development
M73	Advertising and market research
M74 to M75	Other professional, scientific and technical activities
N77	Rental and leasing activities
N78	Employment activities
N79	Travel agency, tour operator and other reservation service and related activities
N80 to N82	Security and investigation; Services to buildings and landscape; Office administrative and other business support
S94 to S96	Other Service Activities

Source: Frontier Economics analysis based on TPI data:
https://figshare.manchester.ac.uk/articles/dataset/TPI_UK_Intangibles_Growth-Accounting_data_set/21631814.