Measuring quality change in the services sector

Case studies into Information Services and Architecture and Engineering Services

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1 Context

For deflators to be fit for purpose, it is essential that they are always comparing like-with-like across the time series. While this can be relatively straightforward for some products, accounting for quality change in services can be incredibly difficult due to the nature of many services as intangible, perishable and unique.

Accounting for brand-new services, such as those associated with rapidly changing technologies, presents a further challenge as classification systems may not yet capture them adequately. It is with these challenges in mind that we have conducted this investigation.

2 Introduction to case studies – CPA J63 and CPA M71.1

We have investigated quality change in two services that we believe have experienced significant quality improvements which are not currently being adequately captured. These are CPA J63 – Information Services – and CPA M71.1 – Architecture and Engineering Services. While the nature of the quality change in each is different, we have identified a number of similarities and specific challenges in measuring them accurately.

At the ONS, these are services for which we have recently introduced the use of SPPIs in measuring output in the National Accounts.

2.1 J63 – Information Services

The first case study in this paper is about the Service Producer Price Index (SPPI) for CPA J63, which is defined as Information Service activities.

We understand that Information Service activities have changed significantly over the last few decades, especially with the rise of cloud computing services. This has led us to investigate the suitability of our current index and whether additional quality adjustment is needed – similar to our previous work on telecoms services[1] and computer hardware products (updated in the 2023 Annual National Accounts publication[2]).

[1] Double deflation methods and deflator improvements to UK National Accounts: Blue Book 2021 - Office for National Statistics (ons.gov.uk)

[2] Deflator improvements to the UK National Accounts: Blue Book 2023 - Office for National Statistics (ons.gov.uk)

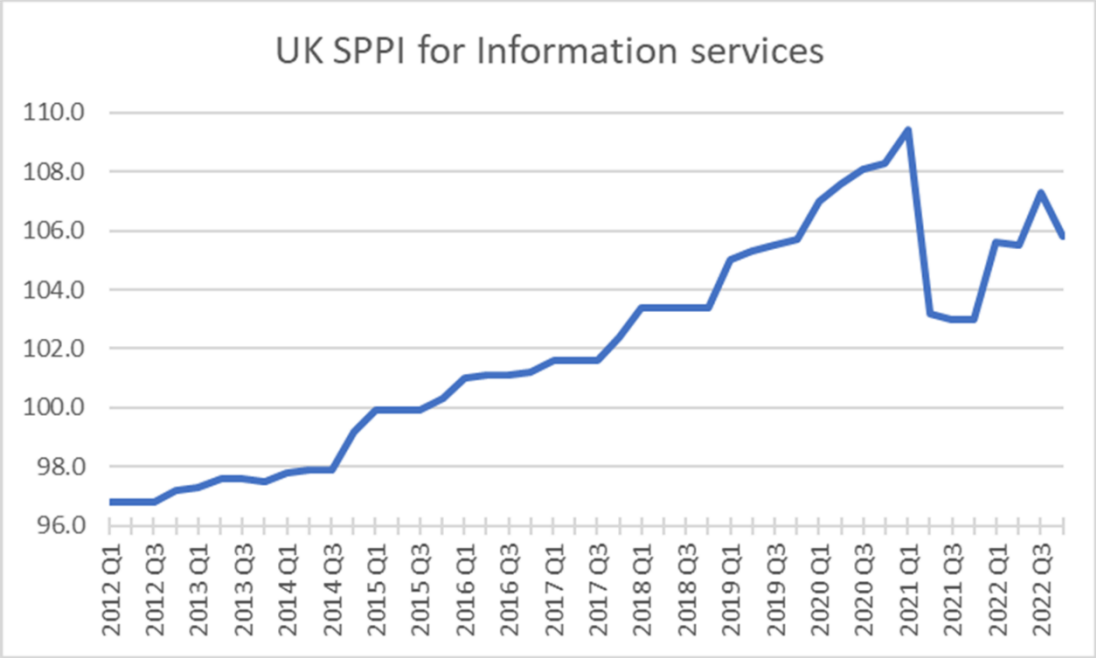


Figure 1 - UK SPPI for Information Service Activities

Figure 1 shows the ONS's current SPPI for CPA J63. The -5.7% drop in Q1-Q2 2021 was caused by a drop in Data processing services (63.11.11) in the absence of upward contributions from the other three indices included.

Currently, our SPPI for J63 only includes items classified under J63.11 (Data processing, hosting and related activities), prompting us to conduct research into the weighting of this section and its adequacy. Additionally, we have also investigated the trends and methods used by other countries in developing their SPPIs with the aim of determining the most suitable method for our own. CPA J63 is defined as Information Service activities; it is further broken down in Table 1. In the UK, in 2022, CPA J63 accounted for 0.4% of GDP(O).

Table 1 - Classification of CPA J63

63			Information service activities	
	63.1		Data processing, hosting and related activities; web portals	
		63.11	Data processing, hosting and related activities	6311
		63.12	Web portals	6312
	63.9		Other information service activities	
		63.91	News agency activities	6391
		63.99	Other information service activities n.e.c.	6399

A key feature of this investigation was understanding where cloud computing services[3] should be classified, and whether they are being included in the current SPPI. We understand that cloud computing services should be mostly captured within CPA J63.11, with some elements (Software as a Service) captured within CPA 58.2 (Pre-packaged software publishing) – discussed in Section 4.2. At present, our SPPI does not explicitly capture the prices of these services.

2.2 M71.1 – Architecture and Engineering Services

The second case study in this paper concerns the SPPI for CPA M71.1 (Architecture and Engineering services). In 2022 the Deflators Research team at the ONS prepared a paper[4] for the Voorburg conference which explored the use of Key Performance Indicators (KPIs), specifically for client and contractor satisfaction, as a proxy for quality. The results of this can be seen in Figure 2, which demonstrates the effect of applying quality adjustment to the SPPI for CPA M71.1; a flatter SPPI, which would correspond to volume measures increasing more steeply.

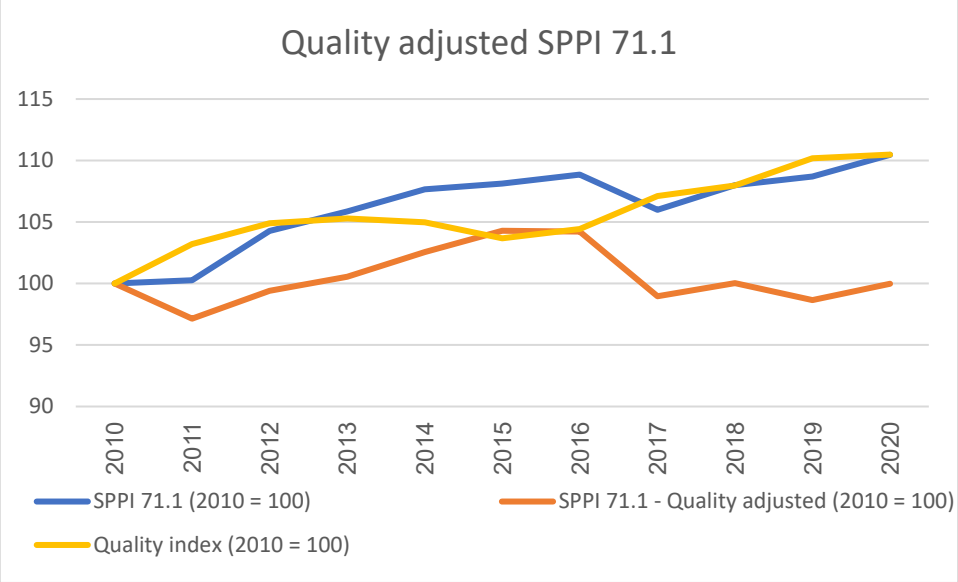


Figure 2: Comparison of ONS's SPPI and experimental quality adjusted index for CPA M71.1, as presented at Voorburg conference 2022

However, there were some limitations to this research, namely that the KPIs used were specific to the construction sector and it was assumed that the architecture and engineering sector have experienced similar change. The KPIs used for this experimental index were client and contractor satisfaction, which were chosen based on the assumption that satisfaction for both the suppliers and clients of the service would increase if quality of the service increased. When discussed at the

[3] "Cloud computing services consist of computing, data storage, software, and related IT services accessed remotely over a network, supplied on demand and with measured resource usage that allows charging on a pay-per-use basis", SNA/M4.22/20 - DZ.8 Measurement of Cloud Computing in National Accounts

[4] 1013.pdf (voorburggroup.org)

conference, some challenges were made to the KPIs chosen, as they are subjective and may not directly correlate to quality.

In the UK, CPA 71 accounts for 1.16% of GDP and in 2015 was estimated to comprise 4.83% of the service sector. The current pricing method used to collect prices for CPA M71.1 – Architecture and Engineering services – is time-based. This pricing method differs from other pricing methods in that the price of the time spent providing a service is used instead of the price of the service provided. Businesses are asked to provide the 'grade, position or category of personnel' of the individuals involved in delivering the services and their corresponding 'standard hourly charge out rate (£)' for the work done. Additionally, the number of chargeable hours worked in the quarter is requested. Using this information, the cost of the service is calculated. However, due to the method of data collection, the exact contracts or work included in the data provided is unknown.

Table 2 details the sample composition of ONS' SPPIs for Architecture and Engineering services.

Table 2: Architecture and Engineering services

CPA 4 dig	Sample composition	Coverage[5]	CPA 6 dig
Architectural Services (71.11)	38 observations 33 suppliers	19.5% coverage	Building project architectural advisory services (71.11.24)
			Project site master planning services (71.11.33)
			Landscape architectural services (71.11.41)
Engineering Services and Related Technical Consulting Services (71.12)	69 observations 55 suppliers	52.8% coverage	Engineering advisory services (71.12.11)
			Engineering services for building projects (71.12.12)
			Engineering services for industrial and manufacturing projects (71.12.17)

[5] Here coverage refers to the percentage of sales that come from the data collected. For example, data collected for the indices 71.11.24, 71.11.33 and 71.11.41 account for 19.5% of total sales under 71.11

			Project management services for construction projects (71.12.20)
			Geophysical services (71.12.32)

CPA M71 also includes CPA M71.2 (Technical Testing and Analysis); however, this is a small component of CPA M71, only accounting for 6.05% of all businesses in CPA M71 in the UK and is not the focus of this work.

As shown in Figure 3 below, CPA M71 is heavily influenced by engineering services, as evidenced by sample size in Table 2. The SPPI for CPA M71 shows an increase of only 18% from 2009 to 2022 indicating a slow rate of price change during a time where there have been rapid technological advancements. However, we propose that if all the quality change experienced within these services were accounted for, the index should be flatter still, or potentially falling, indicating greater value for money for consumers. This would correspond to more volume growth.

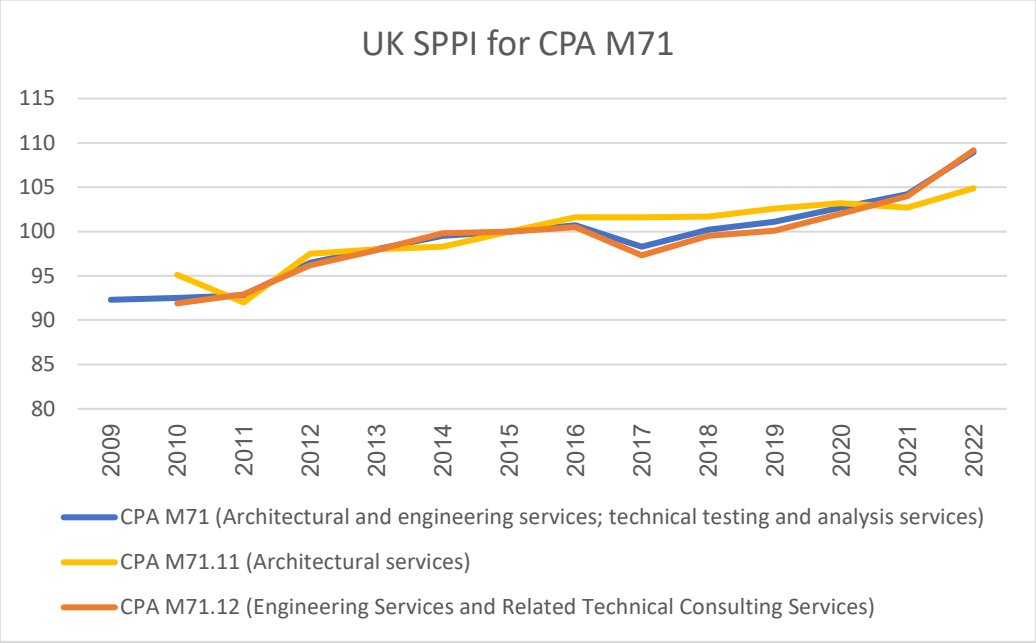


Figure 3: UK SPPI for CPA M71

3 Method of investigation – international comparison

For both case studies, we conducted a thorough investigation to understand the types of quality change that have happened in these services, and how other countries have addressed this.

3.1 J63 – Information Services

In order to gain a deeper understanding of how other countries constructed their SPPIs for Information Services, we contacted several NSIs (National Statistics Institutes). We were fortunate to receive detailed replies from NSIs in Canada, Germany, Ireland, Japan, Norway and USA.

We posed the same five general questions to each country, along with a comparison of our SPPI for J63 and the most closely related index for each country.

From our initial research, Figure 4 shows the comparisons of SPPIs from the countries that we contacted.

From this research, we can establish that there does not appear to be an internationally standard method or trend. It is worth noting that although our SPPI is labelled for CPA J63, only quotes for CPA J63.11 services are included and can therefore be compared with those plotted. In contrast to the trend seen in this plot, we believe that the index, when accounting for technology and quality change, should be falling significantly over the period plotted. Further discussion of the quality change in cloud computing services and our expectations for a falling deflator are covered in Section 5.1.

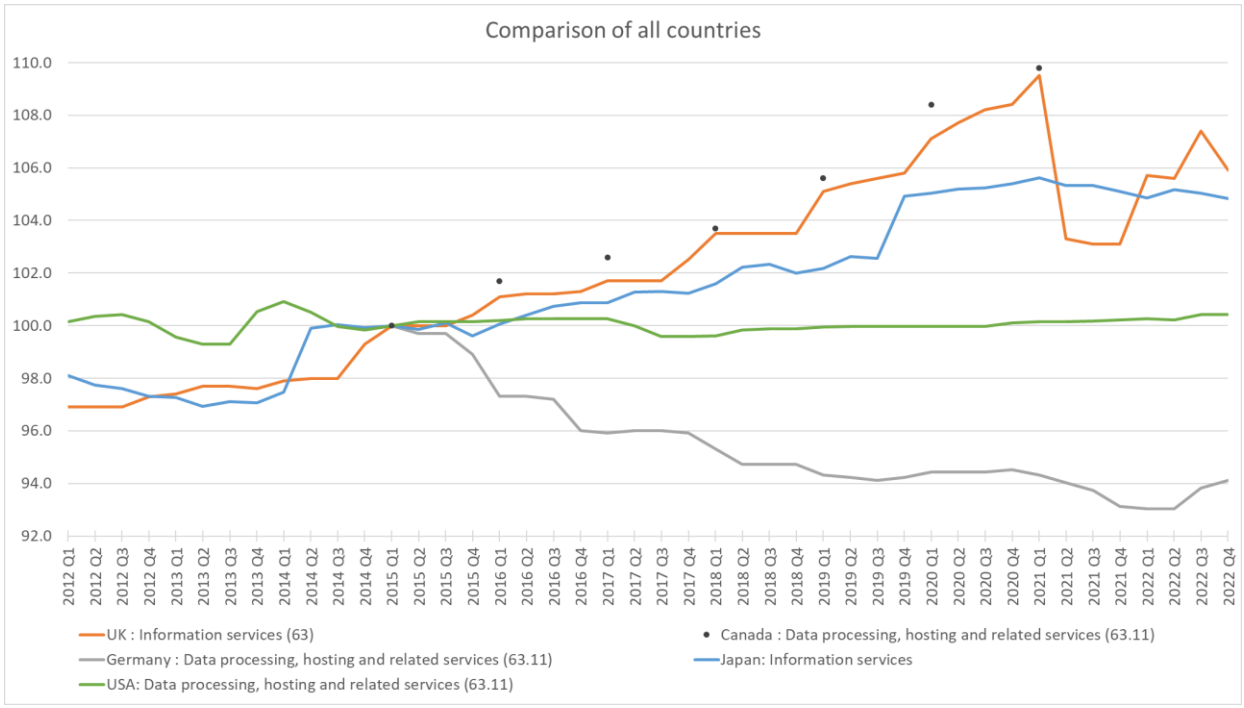


Figure 4: Comparison of SPPIs from contacted countries for CPA J63.

What quality adjustment is used?

Canada	Does not at the moment, planning to quality adjust the cloud computing component of the Information Services index using hedonic methods.
Germany	Price change taken as quality change, Overlap or Direct Price comparison depending on available information.
Ireland	Bridged overlap.
Japan	Does not at the moment, possibility of using some indicators like the number of unique users, page views, and viewing times.
Norway	Firms have the option to replace services that have changed quality and missing prices will be imputed.
USA	Respondents will be asked to provide cost data for quality adjustment.

All countries who provided detail on sampling said they updated weights every five years.

3.2 M71.1– Architecture and Engineering Services

As part of our research of CPA M71.1, we undertook an in-depth international comparison across seven countries: Germany, The Netherlands, USA, Canada, Japan, Australia, and New Zealand. We selected these countries based on their architecture and engineering industries, which were anticipated to be comparable to the UK's. Additionally, we considered their SPPIs, which showed notable variations from the UK's. We gathered information from a variety of reliable online sources and through direct communication with NSIs to address aspects such as classification, sampling and pricing methods, frequency of price collection, resampling of respondents, sample composition, and most importantly, whether quality change as a result of technological improvements were captured in their index.

Our findings were that none of the countries examined explicitly account for quality change in their index. Instead, the majority of these countries utilise model pricing, which implicitly accounts for quality change and is considered an A method by Eurostat, either exclusively or in conjunction with other pricing methods. From these findings, it can be assumed that the NSIs of these countries might not view quality change as a significant concern in the context of the architecture and engineering industry. This suggests that the implicit incorporation of quality change through model pricing appears to be deemed sufficient in capturing changes in the industry. Appendix A contains the plots of other countries' SPPI for architecture and engineering services against the UK's. These plots clearly demonstrate that, apart from Canada, all other countries experience a substantial increase in their SPPI compared to the UK, especially Germany and Japan. In contrast, the UK's SPPI

remains relatively flat over the same time period. Understanding the source of these differences is an area of ongoing research.

Table 3: Summary of international methods

Country	Pricing method	Sampling method	Quality adjustment
Germany	Scale of fees called HOAI which determines fees based on the building's value Model pricing	Stratified sample based on turnover	Not explicitly accounted for Overlap method used to replace old price report (without technical innovation) for new (with technical innovation)
The Netherlands	Model pricing Contract pricing Direct use of repeated services	Sample of 397 suppliers, each reporting three services	Not explicitly accounted for If a description of a services is outdated, a quality correction is made. Reporter then provides an updated service description with T-1 and T prices
USA	Model pricing		Quality adjustment only made if the output has fundamentally changed. Use of technology to provide the same output more efficiently is not considered a quality improvement
Canada	Model pricing	Small businesses comprising the bottom 10 percentile by revenue are excluded Sample allocated based on revenue Target sample is 700	Not explicitly accounted for Respondents can supply additional information and reasoning for changes in price

Japan	Model pricing Direct use of repeated services Unit value method Time-based method List price method	Sample allocated based on turnover	Quality adjustment only made if the output has fundamentally changed. Use of technology to provide the same output more efficiently is not considered a quality improvement
Australia	Wage rates or set services	Non-random sampling	ABS apply a clerical adjustment method This involves breaking the service down into individual components and comparing the new service to the old service, to eliminate the influence of a new technology
New Zealand	Wage rates or set services		If a respondent, reports a change in wages because of quality reasons, a price increase is not show. A price increase is also not shown if the product/service changes and a new one is provided. Instead, the previous quarters price is carried forward and they start again

4 Common challenges

4.1 Sample size

4.1.1 J63 – Information Services

Our sample size for CPA J63 is small, with 26 businesses active in the sample (8450 businesses were recorded under SIC 63 in the IDBR, 2023). Our primary concern is that only J63.11 has quotes included in the SPPI for J63. Therefore, whilst J63.11 has a coverage of 94.6%, the other components of CPA J63 have 0% coverage.

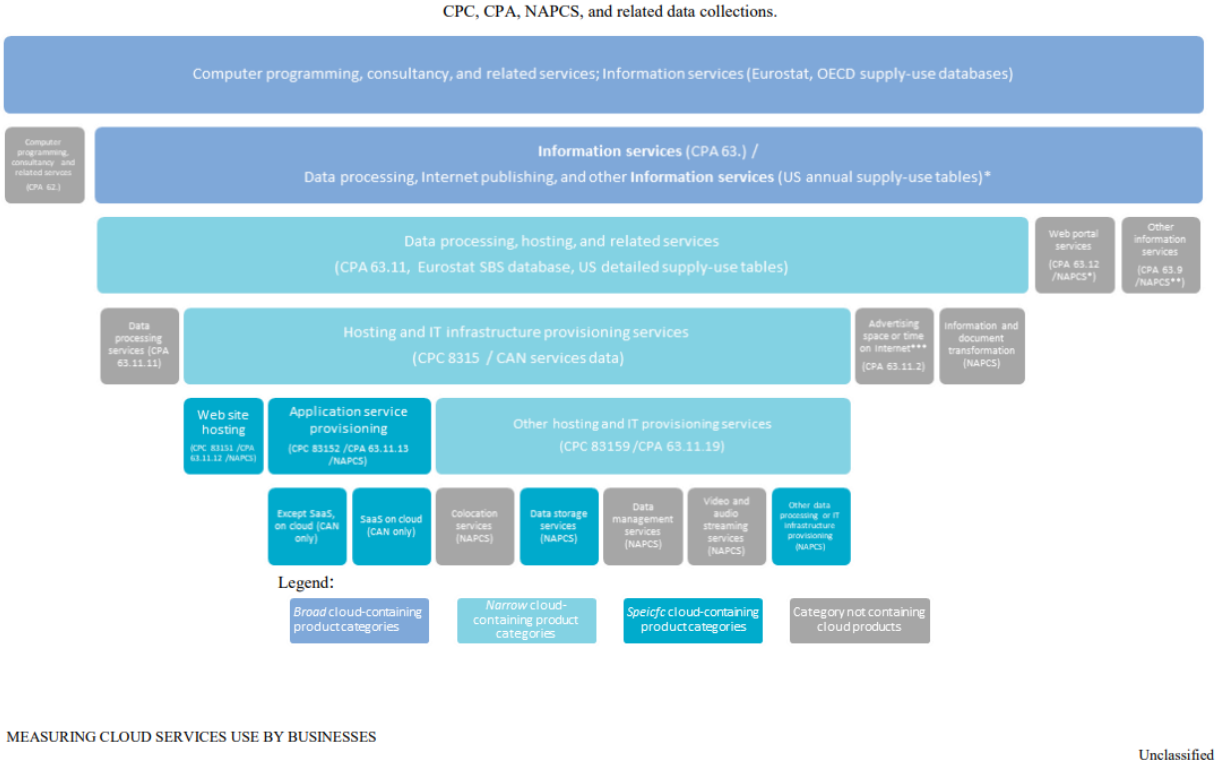
M71.1– Architecture and Engineering Services

As mentioned above, a key improvement to our measurement of prices of Architectural and Engineering services is likely to be the move to a model pricing method. In addition, it's necessary to improve both our sample coverage and size – but with recognition that the sampling method used by the ONS means that a sample the size of that of the Netherlands or Canada will not be necessary. ONS is currently investigating the necessary sample size across its Business Prices and will be looking to make improvements as part of that work.

4.2 Change in services being provided over time

4.2.1 J63 – Information Services

Figure 5: Hierarchy of cloud-containing Information Service product categories



Cloud computing services are conventionally classified into Software as a Service (SaaS), Infrastructure as a Service (IaaS), Business Processes as a Service (BPaaS) and Platform as a Service (PaaS). Figure 5, taken from the OECD Working Party on Measurement and Analysis of the Digital Economy: Measuring Cloud Services use by businesses, 2021[6], illustrates where cloud computing services may be classified within CPA J63. It suggests that CPA J63.11 should include elements of cloud computing, and that within that it should then fit into CPA J63.11.12, J63.11.13 and J63.11.19.

Cloud computing services have been expanding in Europe since the late 2000s, and in the UK since the mid-2010s, with AWS (Amazon Web Services) opening their first European data centre in Dublin in 2007, and their first in the UK in London in 2016.

The cloud market in the UK was estimated to be worth over £35 billion by 2023 – a 73% rise from 2019. Within that, IaaS is estimated to be 28% of the UK market, PaaS 9%, and SaaS 63%[7].

[6] pdf (oecd.org), pg 19
[7] https://researchbriefings.files.parliament.uk/documents/POST-PN-0629/POST-PN-0629.pdf

More information on the expansion of cloud services in the UK is included in Appendix B.

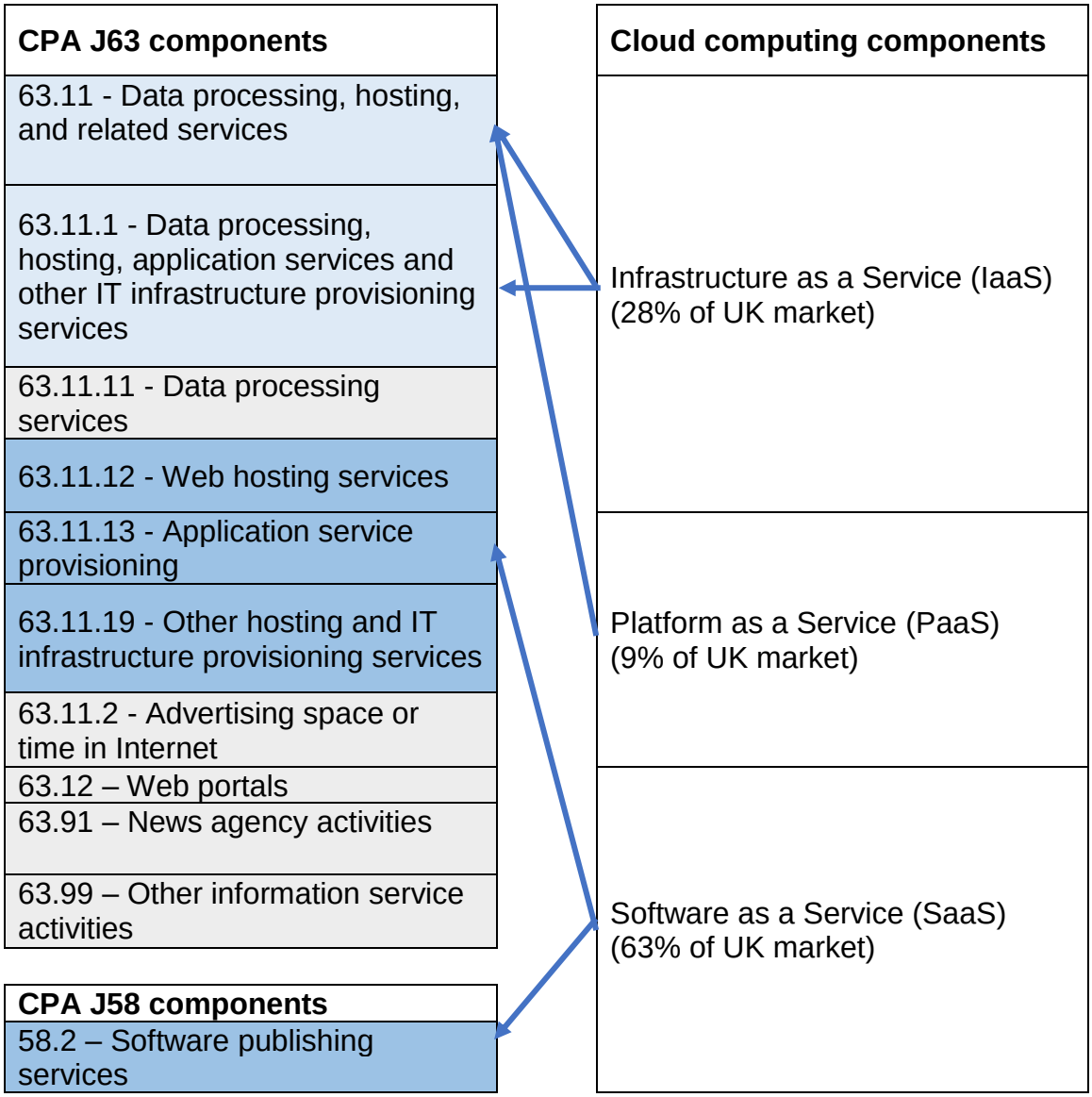


Figure 6: mapping cloud computing services onto CPA J63 and J58

Figure 6 illustrates where specific types of cloud computing services may align with the CPA.

The colours of the CPA components in Figure 6 have been decided based on the OECD diagram in Figure 5

- The darkest blue elements definitely have some element of cloud computing included
- The light blue elements indirectly have some cloud computing i.e., these are the higher level services
- The grey elements are not expected to have any cloud computing components

More detail on the reasoning for assigning the cloud computing components in this way can be found in Appendix C.

4.2.2 M71.1 – Architecture and Engineering Services

This change in services being provided is also notable in the architecture and engineering industry as services are inherently subjective, as they are often highly customised to meet the needs and preferences of each client. The development of technology has also brought significant changes to architectural and engineering services over the years, for example, transitioning from traditional hand drawn sketches to advanced Building Information Modelling (BIM). The collaborative nature of BIM also allows disputes between businesses and clients to be picked up early on and resolved before construction begins. Other recent technological advancements, such as the use of drones and digital twins have transformed the architecture and engineering industry, leading to increased productivity and lowered costs. For example, the use of drones in surveying can improve accuracy, while digital twins, which are digital representations of physical assets, enable real time monitoring leading to early detection and resolution of issues, ultimately reducing disputes and delays.

5 Potential solutions

5.1 J63 – Information Services

Earlier this year, Ofcom (the UK's communications regulator) began a consultation exercise into competition in the cloud services market. The initial responses to this consultation from a number of cloud service providers (such as AWS, Microsoft and others) were published in July 2023. We are using these findings as context around our work – and await to see if regulation of cloud services is recommended, as this may have implications for prices.

In June 2023, ONS's deflators team met with a couple of experts in the area, to draw on their expertise in these areas. The main discussion points can be summarised as follows:

- When asked about including quality adjustment, they thought that the more important issue for the ONS would be to address coverage such that all of CPA J63 is covered.
- They were very surprised by the upward trend of our SPPI.
- They were surprised by the way that cloud computing services are classified, specifically them not being explicitly mentioned in the CPA as it stands, leading to a conversation on potentially deflating the cloud computing component of J63 separately.
- They suggested that the period from approximately 2007 onwards would be most important to account for cloud computing.

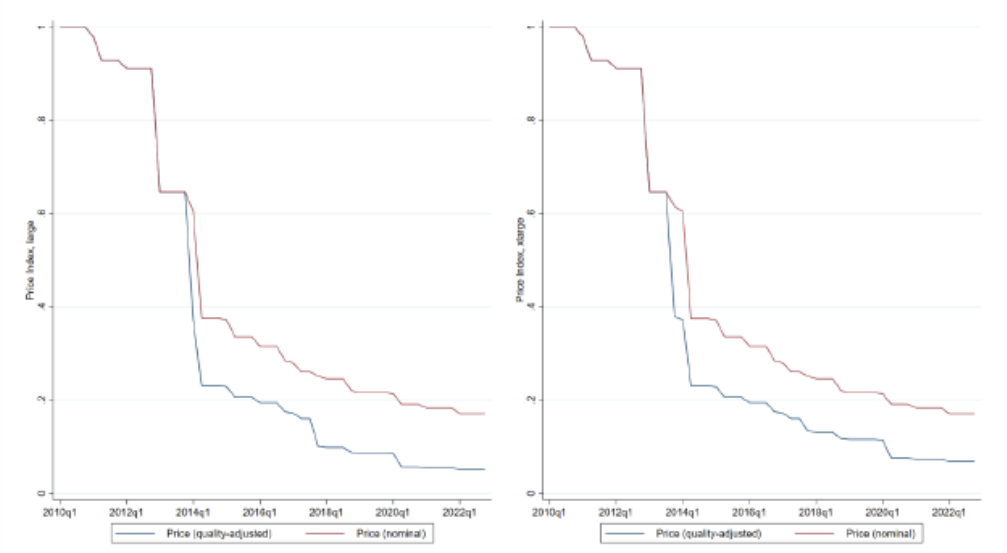
5.1.1 Coyle and Nguyen (2018) data

We also spoke to Professor Diane Coyle, who suggested using the data derived from her work with David Nguyen - Cloud Computing and National Accounting, 2018[8], constructing a price index for cloud computing services.

Coyle and Nguyen used AWS list prices available online to calculate an index of nominal prices of standard services. Products were grouped by instance classes (large (L) and extra-large (XL)) and quality adjusted using processing power (ECU, EC2, Computing Units).

In their work, Coyle and Nguyen discuss the challenges of calculating a price index in this way. They highlight several challenges, such as the presence of a number of suppliers, each offering a large variety of services that can be difficult to compare. Moreover, there is also rapid quality change due to the growth and competitiveness of the market. Additionally, the lack of readily available data to estimate weights for the various services offered result in the index calculated being regarded as a "crude" measure of the prices.

Though the method for Professor Coyle's price index was laid out in Coyle and Nguyen (2018), the graphs shown below (Figure 7), showing the price indices, are taken from a more recent paper, Coyle & Hampton (2023)[9], in which Professor Coyle updated the figures:



Notes: This figure shows nominal and quality-adjusted prices of AWS EC2 large and xlarge instances for Linux. Prices are hourly on-demand rates deflated by the aggregate price index. In blue, prices are also quality-adjusted for performance improvements.

Source: AWS API price lists (https://docs.aws.amazon.com/awsaccountbilling/latest/aboutv2/price-changes.html) for prices, AWS press release for performance improvements, and pre-2019 data from Coyle and Nguyen (2018).

Figure 7: Cloud price index, Linux (Q1-2010 – Q4-2022)

[8] ESCoE-DP-2018-19.pdf (escoe-website.s3.amazonaws.com)

[9] "Twenty-first century progress in computing", https://www.bennettinstitute.cam.ac.uk/wp-content/uploads/2023/07/Progress-of-computing-WP.pdf

In these graphs the index for large instances is shown on the left, and the index for xlarge instances is shown on the right. In both graphs, the (higher) red line displays the index without quality adjustment and the (lower) blue line shows the index after adjusting for quality.

As illustrated in these graphs, Coyle and Hampton's indices show a consistent and significant decline in price, with an especially dramatic drop in price between 2010 and 2014. This agrees with our understanding of the industry, and contrasts distinctly with the rising trend seen in our current SPPI for CPA J63.

However, not all of CPA J63 relates to cloud computing. As an initial estimate of the potential changes, we calculated an index using Coyle and Hampton's index and our current SPPI, weighted according to the number of businesses included in each of the constituent parts of CPA J63. This was chosen for the purpose of this experiment as we did not have output information at an appropriate level – were we to introduce this method, we would further investigate the appropriate weight to apply. Inter-Departmental Business Register (IDBR[10]) data shows the weightings of the constituent parts of CPA J63 (based on number of businesses) as follows:

Table 4 - Average weightings of components in CPA J63, taken from the IDBR

		Average weight (%)
6311	Data processing; hosting and related activities	35
6312	Web portals	18
6391	News agency activities	6
6399	Other information service activities n.e.c.	41

Based on Figures 5 and 6, it appears likely that much of the content of J6311 may relate to cloud computing services and so for initial analysis we assume that cloud computing services may make up around 35% of CPA J63.

We are therefore proposing that, to better represent the price changes in cloud computing in our index for CPA J63, a new index could be produced, comprised of (for example) 35% Coyle and Hampton's index for cloud computing and 65% our existing SPPI for CPA J63. As this work continues, we recognise the need for alternative weighting information based on turnover (which could ideally be updated annually).

The following graph (Figure 8) shows a comparison of our current SPPI and Coyle and Hampton's indices.

Our current SPPI begins in 2012 – therefore the figures included for the years prior to 2012 are derived from the proxy index created using AWE and CPIY[11] which was used before the creation of the SPPI, some more detail is included in Appendix D.

[10] The IDBR is a list of UK businesses used by the government for statistical purposes.

[11] AWE = Average Weekly Earnings
CPIY = CPI excluding indirect taxes

Coyle and Hampton's non-quality adjusted price indices for large and xlarge are very similar and so the xlarge index is hidden behind the large index in this graph.

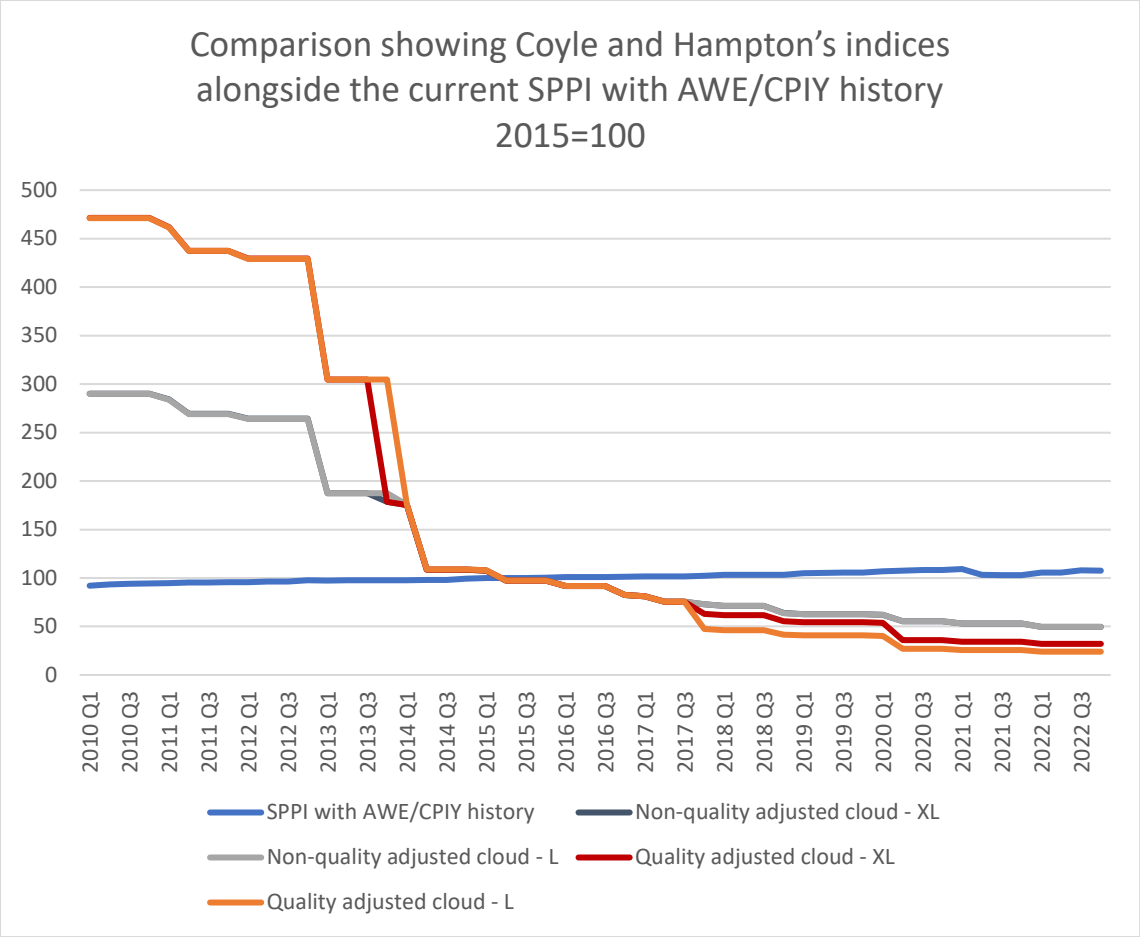


Figure 8: Comparison of Coyle and Hampton's *price indices for cloud computing and our SPPI for CPA J63*

In contrast to the slight upward trend in our SPPI, all of Coyle and Hampton's indices show a substantial decrease. Coyle and Hampton's quality adjusted indices show the greatest decline, especially the quality adjusted large instance index.

Figure 9 shows what a new index, comprising 35% Coyle and Hampton's index for cloud computing and 65% our current SPPI could look like. This graph includes potential options using both Coyle and Hampton's quality adjusted and non-quality adjusted indices, so that we can see how quality adjustment also affects this index. Since the non-quality adjusted price indices for large and xlarge are so similar, we have only included one of these (the large instances index).

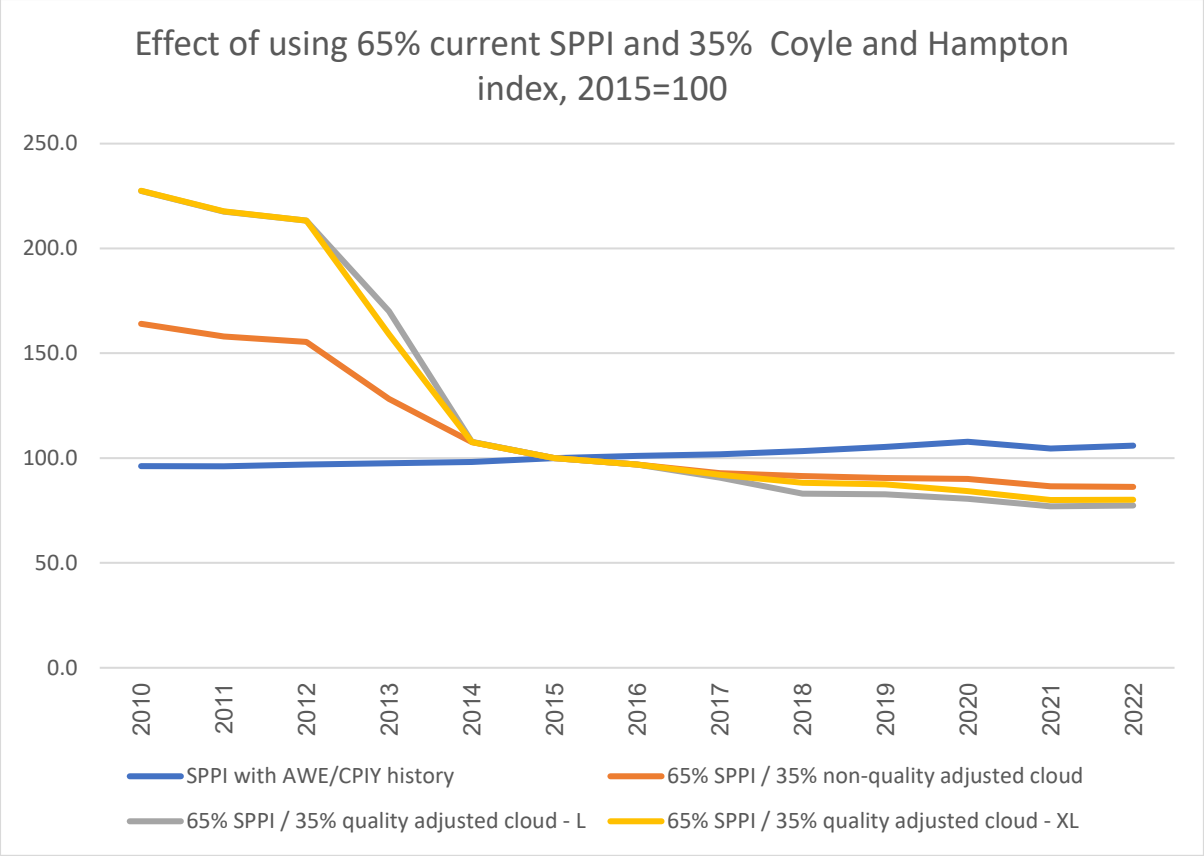


Figure 9: Experimental cloud computing indices and SPPI for CPA J63

This graph (Figure 9) shows that whichever of Coyle and Hampton's indices were used, a new deflator comprised of 65% our current SPPI and 35% Coyle and Hampton's index, would completely change the overall trend in the deflator for CPA J63, resulting in an overall decline in price over this time period. As expected, using the quality adjusted indices causes a steeper decline in the overall combined index than using the non-quality adjusted index. As was outlined in our previous work on telecoms and computer hardware, a fall in the price index in this way is reflective of both the fall in price for these services and the quality of service increasing – as we'd expect for these services. As mentioned, we would conduct further analysis into the appropriate weighting of Coyle and Hampton's index with our SPPI; additionally, the primary focus for development is increasing the sample size and coverage of our SPPI.

5.2 M71.1– Architecture and Engineering Services

Another limitation with our current methodology for our SPPI for M71.1, alongside our sample size, is the pricing method used. According to Eurostat, due to the majority of architectural and engineering services being unique, '*it is difficult to define an A method based on the collection of actual prices. Model prices seems to be a method that potentially could give an A method'*[12]. Our current pricing method, time-

[12] Handbook on prices and volume measures in national accounts (europa.eu)

based pricing, can be considered a B method. Model pricing is typically used when measuring services that are unique. Respondents are asked to construct a model service that accurately reflects their business or select a representative service that was recently transacted and to reprice this service in each subsequent reporting period. The main advantage of model pricing, making it a popular choice for many countries, is that there is no need for separate quality adjustment. However, it can be difficult for models to remain representative and may need to be frequently adjusted. There could also be significant burden on respondents to provide prices and some may be unwilling to provide enough detail.

Although model pricing is considered one of the theoretically superior methods by Eurostat, it is worth noting that Canada, which exclusively utilises this method and has a significantly larger sample size, still exhibits an SPPI that closely resembles the UK's, suggesting that other factors might have a more substantial influence on the index. This raises the question of whether it is necessary to change the current pricing method, especially when a similar outcome can be achieved with a simpler pricing method and smaller sample size. We would want to do further investigation into how other countries address the challenges raised above and whether they perceived a benefit to using model pricing.

After presenting our findings in a peer group discussion with experts within ONS, where we outlined several potential options for improving our current methodology, we reached an agreement on the most effective. The options presented included implementing model pricing, exploring a proxy approach to quality adjustment similar to the one discussed in last year's paper, and prioritising improvements in sample size and sampling methodology. The outcome of the discussion was to initially focus on enhancing our sample size and sampling methodology and subsequently consider implementing model pricing. By prioritising our sample size and sampling methodology, we aim to increase the accuracy of our data and ensure it is representative of the architecture and engineering industry. This will involve increasing our sample size and coverage as well as improving our sample selection process. Once we have implemented these improvements, we can then consider implementing model pricing. Model pricing holds promise as a theoretically more appropriate pricing method which could provide more accurate and reliable information. We would first look to implement model pricing for smaller firms whilst continuing to use our current time-based method for larger firms. By making these changes we hope to improve our current methodology and better capture quality change within the architecture and engineering industry.

6 Overall summary

The primary challenge currently at ONS to our accurate measurement of SPPIs in services experiencing quality change is maintaining a representative sample. In addition to improving the existing sample and coverage, ONS plans to review its sample to ensure it is representative following the change from SPPIs measuring Business-to-Business prices to Business-to-All. A further difficulty is due to the services provided changing over time without corresponding updates to the

classification systems used. We consider this to be concept drift, where the service provided evolves over time into a service that may bear little resemblance to the original services measured.

We are aware of an upcoming ISIC update[13], which will make changes to the classification of Section J, with Section J being split into two sections, with most of the current J63 moved into the new Section K "Telecommunications, computer programming, consultancy, computing infrastructure, and other information service activities" and its scope being revised. We anticipate this may make it easier to capture prices for the aspects of J63 which have recently experienced significant quality change.

One potential option until the ISIC revisions are implemented that we are currently considering is to deflate the cloud computing components of J63 separately to the rest (with a reliance on suitable deflators being available). This would allow us to better capture the rapid improvements in cloud computing services.

[13] Microsoft Word - Main changes in ISIC_14 Jan 2022 (un.org)

Appendix A – Plots of architecture and engineering SPPIs of other countries against the UK

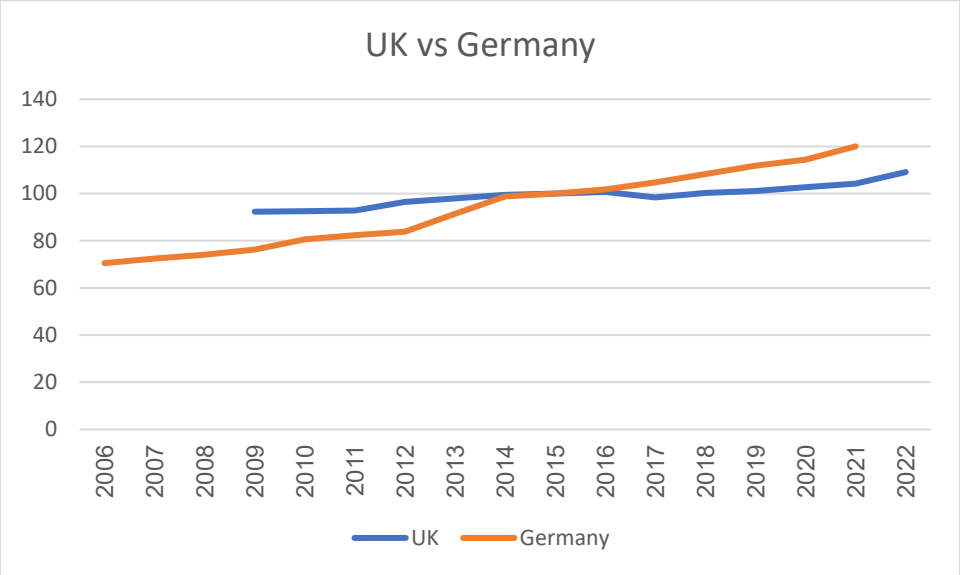


Figure 10: UK SPPI for CPA M71 in comparison to Germany

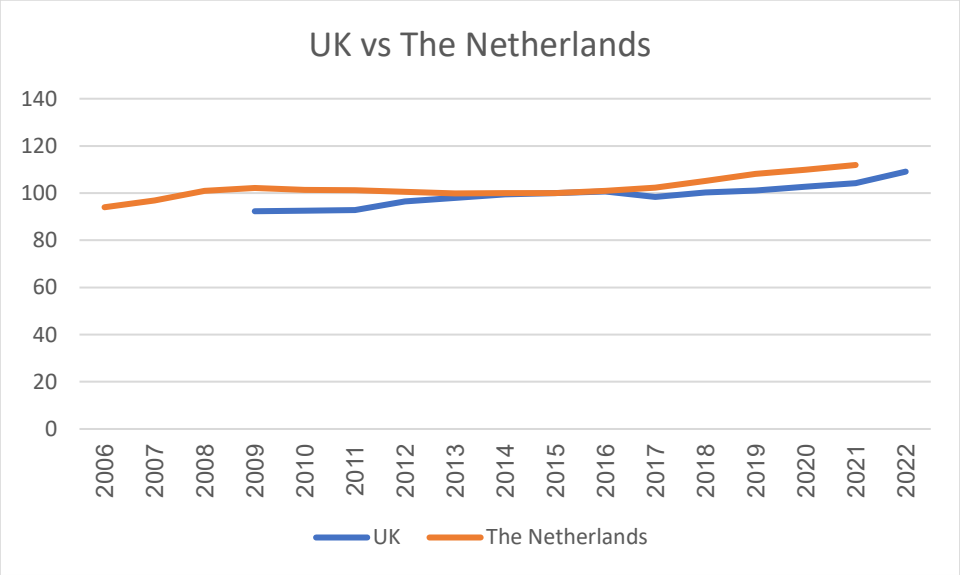


Figure 11: UK SPPI for CPA M71 in comparison to The Netherlands

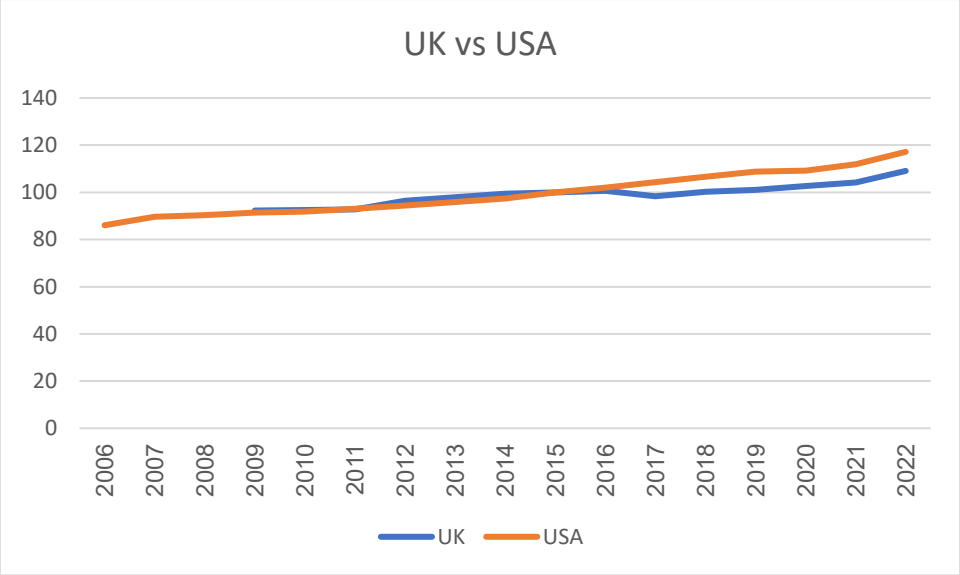


Figure 12: UK SPPI for CPA M71 in comparison to the USA

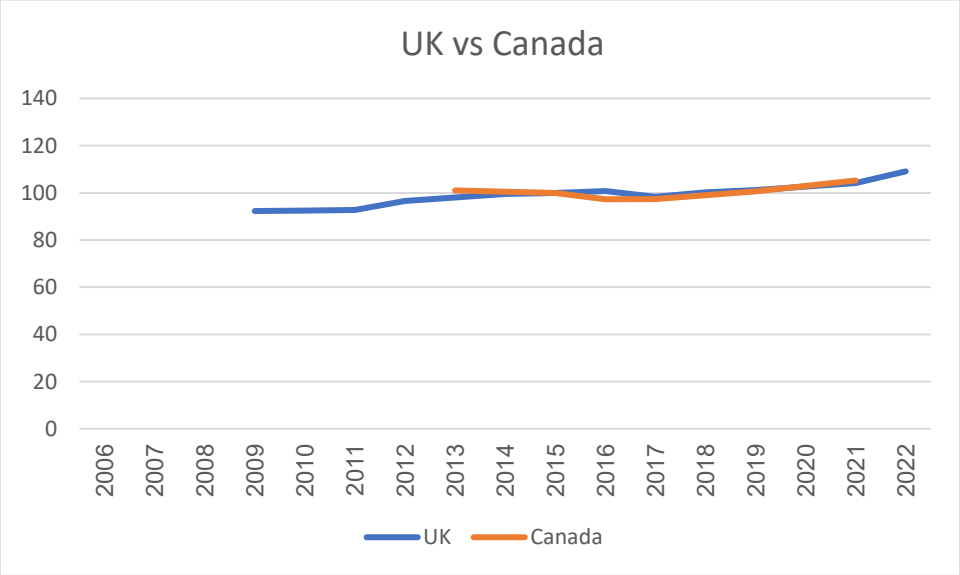


Figure 13: UK SPPI for CPA M71 in comparison to Canada

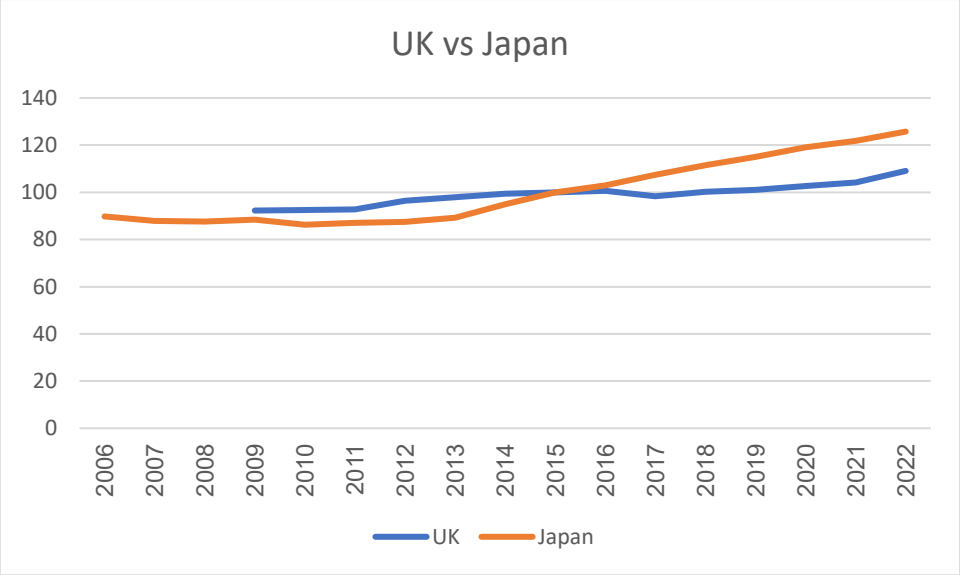


Figure 14: UK SPPI for CPA M71 in comparison to Japan

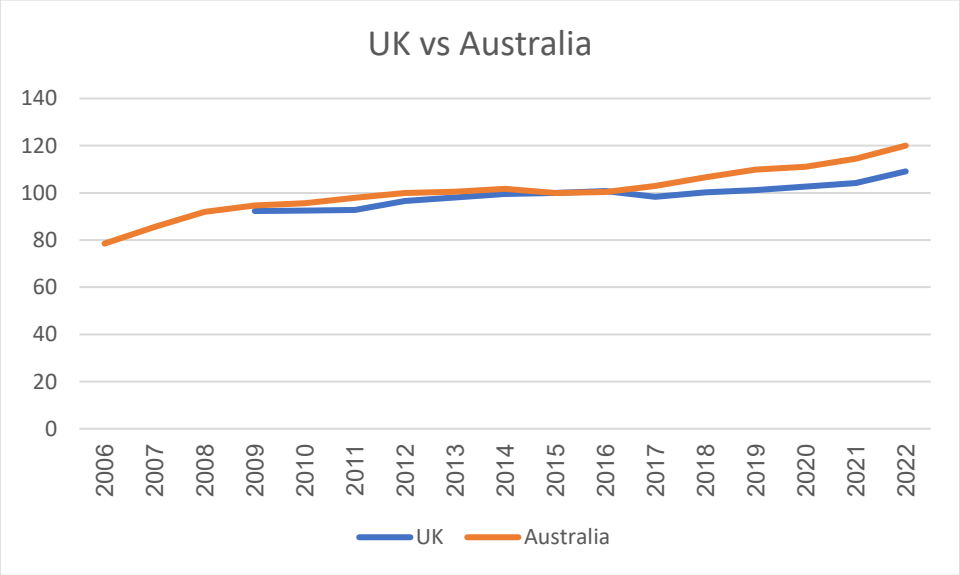


Figure 15: UK SPPI for CPA M71 in comparison to Australia

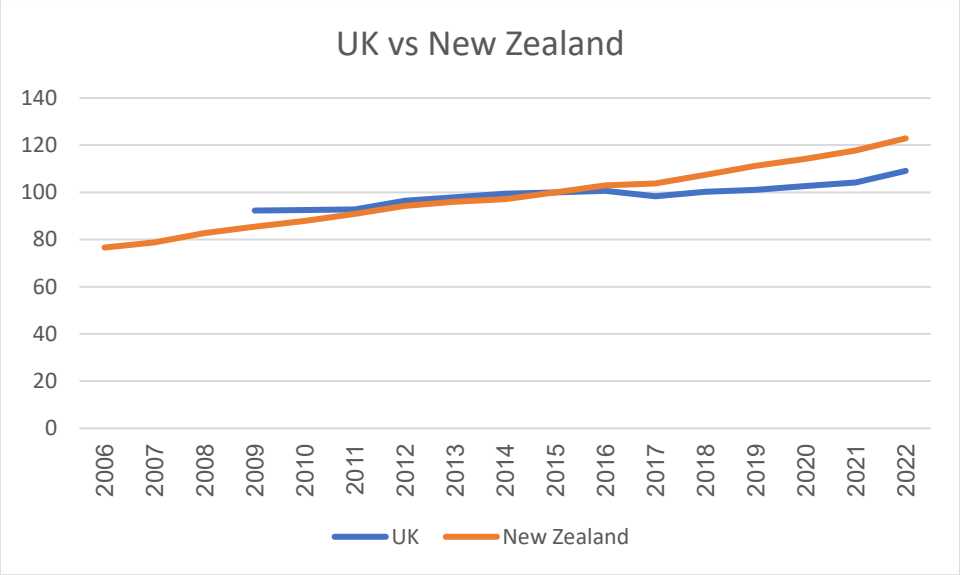


Figure 16: UK SPPI for CPA M71 in comparison to New Zealand

Appendix B – Proportion of UK businesses purchasing cloud computing services over the internet over time

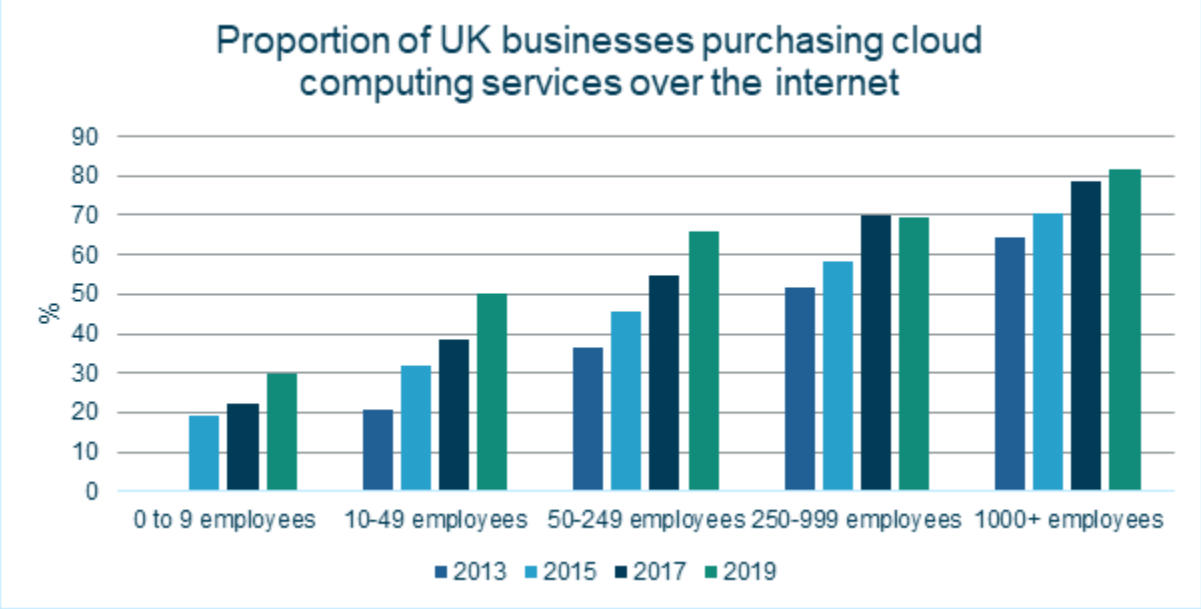


Figure 12 – proportion of UK businesses purchasing cloud computing services over the internet, E-Commerce and ICT Activity, ONS, 2021

Appendix C – More detail relating to the assignment of cloud computing components to CPA

The lines included in Figure 6, from cloud computing services to the relevant CPAs have been determined based on the following sources – quoted from OECD, Working Party on Measurement and Analysis of the Digital Economy, 2021:

- "Tag and Pitkanen (2018), suggest that both PaaS and IaaS might belong to class 63.11 "Data processing, hosting, and related services""
- "While SaaS might be classified to either 58.29.40 "online software" (within software publishing) or 63.11.13 "application service provisioning""
- "Tag and Pitkanen also draw attention to the earlier work of the "Eurostat Task-Force on Price and Volume Measures for Service Activities" (Eurostat, 2018[12]), which, while agreeing that IaaS is likely to be classified within CPA 63.11.1 "Data processing, hosting, application services and other IT infrastructure provisioning services, states that "The supply of SaaS should be classified with other software: CPA 58.2 (Software publishing services)" – seemingly concluding that all SaaS should be classified as "online software" (CPA 58.29.4) rather than in "application service provisioning" (CPA 63.11.13)."

Appendix D – CPA J63 back series information

Our current SPPI for CPA starts in 2012. The back series prior to this point is therefore derived from a proxy index that was in use before the creation of that SPPI. That index was comprised of:

- 50% Average Weekly Earnings for Section J (AWE)
- 50% CPIY (Consumer Prices Index excluding indirect taxes)