Creative Industries Policy and Evidence Centre

Led by Newcastle University with RSA

A State of the Nations report

UK Trade in a Global Creative Economy

Supplementary Materials

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Online Supplementary Materials

Appendix A. Supplementary material for Section 2

Methodology for international creative trade statistics

Services exports data is obtained from UNCTAD Statistics on International Trade in Services according to total services (category S) and creative services. Creative services are included based on Electronic Balance of Payment (EBOPS) 2010 categories listed by Du et al. (2023) as Creative Industry Categories that include SH4 (Licences & Distribution of Audio-Visual Products & Licences to reproduce and/or distribute audio-visual and related products), SI2 (Computer services), SJ22 (Advertising, market research, and public opinion polling services), SJ311 (Architectural services), and SK1 (Audio-visual and related services). The UK-RCA values for Japan prior to 2014 are excluded from the graph due to very high values (>280). The value of creative services exports in 2020 for China are replaced by experimental UNCTAD Statistics on international trade in creative services. The value of creative services exports in 2013 for Ireland is calculated in combination with OECD Statistics on EBOPS 2010 Trade in Services on Telecommunications services exports.

Goods exports data is obtained from UNCTAD Statistics on annual merchandise trade and annual creative goods exports. UNCTAD definition for creative goods: 197 goods at the HS 6-digit level categorised as art crafts (carpets, products related to celebration, other crafts, paperware, wickerware, and yarn); audio-visuals (films and CDs, DVDs and tapes); design (architecture, fashion, glassware, interior, jewellery, and toys); new media (recorded media and video games); performing arts (musical instruments and printed music); publishing (books, newspapers, and other printed matter); and visual arts (antiques, painting, photography, and sculpture) – UNCTAD specifies in the Creative Economy Outlook 2022 that given current definition, creative products categorised as design may include goods whose production is not dominated by design.

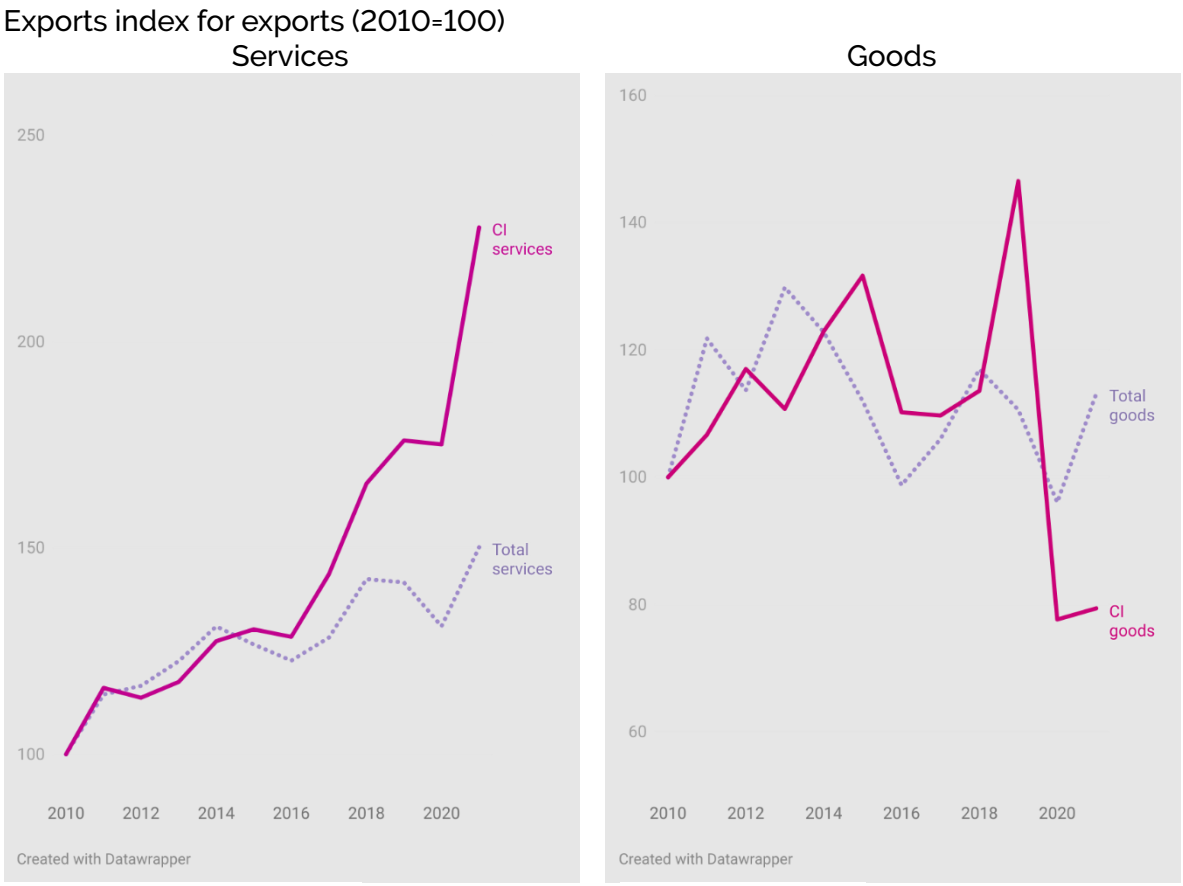
Table A1. Comparison table for included categories in creative services exports and imports

EBOPS item	Name	UNCTAD regrouping	Du et al. (2023) grouping
SH2	Licences for the use of outcomes of research and development	Research and development	
SH3	Licences to reproduce and/or distribute computer software	Software	
SH4	Licences to reproduce and/or distribute audio-visual and related products	Audio-visual	Licences for the use of outcomes of research and development
SI2	Computer services		Computer services
SI21	Computer services, software	Software	
SI3	Information services	Information	
SJ1	Research and development	Research and development	
SJ22	Advertising, market research, and public opinion polling services	Advertising, market research, and architecture	Advertising, market research, and architecture
SJ311	Architectural services	Advertising, market research, and architecture	Architectural services
SK1	Audio-visual and related services	Audio-visual	Audio-visual and related services (Music, performing and visual arts; Film, TV, video)
SK22	Other personal, cultural, and recreational services, heritage and recreational services	Cultural, recreational, and heritage services	

Source: UNCTAD, Du et al. (2023)

Additional Figures

Figure A1. UK's creative vs total exports in goods and services (UNCTAD data) between 2010 and 2021 (Index numbers, 2010=100)



Source: Authors' calculations for the left panel are based on UNCTAD Statistics on International Trade in Services according to total services (category S) and creative services. Creative services are included based on Electronic Balance of Payment (EBOPS) 2010 categories listed by Du et al. (2023) as Creative Industry Categories that include SH4 (Licences & Distribution of Audio-Visual Products & Licences to reproduce and/or distribute audio-visual and related products), SI2 (Computer services), SJ22 (Advertising, market research, and public opinion polling services), SJ311 (Architectural services), and SK1 (Audio-visual and related services).

Authors' calculations for the right panel are based on UNCTAD Statistics on annual merchandise trade and annual creative goods exports. UNCTAD definition for creative goods: 197 goods at the HS 6-digit level categorised as art crafts (carpets, products related to celebration, other crafts, paperware, wicker ware, and yarn); audio-visuals (films and CDs, DVDs and tapes); design (architecture, fashion, glassware, interior, jewellery, and toys); new media (recorded media and video games); performing arts (musical instruments and printed music); publishing (books, newspapers, and other printed matter); and visual arts (antiques, painting, photography, and sculpture) – UNCTAD specifies in the Creative Economy Outlook 2022 that given current definition, creative products categorised as design may include goods whose production is not dominated by design.

Table A2. Grouping of economic activities in OECD TiVA data

Group name in report	TiVA Grouping code	Group code (3-digit)	OECD Group name (level 3)
Publishing, audiovisual and broadcasting activities	J58T60	581	Publishing of books, periodicals and other publishing activities
		582	Software publishing
		591	Motion picture, video and television programme activities
		592	Sound recording and music publishing activities
		601	Radio broadcasting
		602	Television programming and broadcasting activities
Computer programming, consultancy and information services activities	J62_63	620	Extraction of natural gas
		631	Data processing, hosting and related activities; web portals
Professional, scientific and technical activities	M	691	Legal activities
		692	Accounting, bookkeeping and auditing activities; tax consultancy
		701	Activities of head offices
		702	Management consultancy activities
		711	Architectural and engineering activities and related technical
		712	Technical testing and analysis
		721	Mining of uranium and thorium ores
		722	Research and experimental development on social sciences and humanities
		731	Advertising
		732	Market research and public opinion polling
		741	Specialized design activities
		742	Photographic activities
		749	Other professional, scientific and technical activities n.e.c.
		750	Veterinary activities
Arts, entertainment and recreation	R	900	Creative, arts and entertainment activities
		910	Support activities for petroleum and natural gas extraction
		920	Gambling and betting activities
		931	Sports activities
		932	Other amusement and recreation activities

Simple Gravity Model for Section 2.4

The gravity model is specified in the following equation:

$$X_{ict} = exp\Big(\alpha + \beta_1 ln(Y_i) + \boldsymbol{\gamma_t} Year_t + \rho_1 EU + \rho_2 NAFTA + \boldsymbol{\varepsilon_i} CountryCode_i + \boldsymbol{\delta_{1,t}}(Year_t \times EU) + \boldsymbol{\delta_{2,t}}(Year_t \times NAFTA)\Big) + v_{ict} \qquad \text{(Equation A-1)}$$

Where i represents the country of UK's export destination, c represents the creative sub-sector. X represents UK's exports in million pounds (at current prices). EU and NAFTA are dummy variables indicating the destination country's membership as of 1 January 2020. Using bilateral trade data from DCMS Sectors Economic Estimates, regression based on Equation A-1 is conducted on UK's bilateral export values – of trade in goods and services, separately – using State command *ppmlfe* in order to control for export partner fixed effects, export partner GDP, sub-sector dummies, as well as trade bloc dummies (EU, NAFTA).

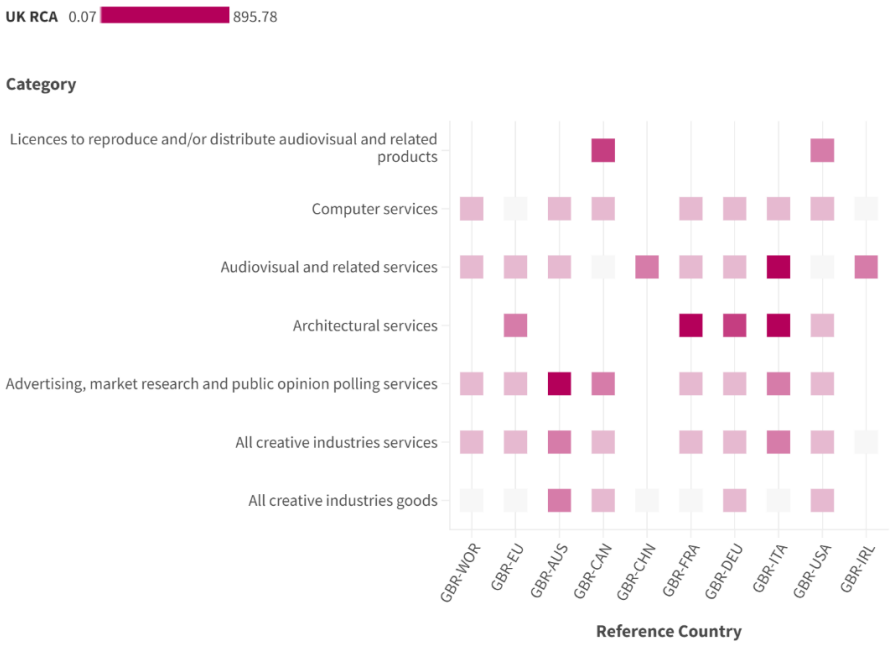
RCA analysis

UK RCA for goods is computed from $\frac{\left(\frac{X_{UK,CI\ Goods}}{X_{UK,Total}}\right)}{\left(\frac{X_{Ref,CI\ Goods}}{X_{Ref,Total}}\right)}$.

UK RCA for services is computed from $\frac{\left(\frac{X_{UK,CI\ Services}}{X_{UK,Total}}\right)}{\left(\frac{X_{Ref,CI\ Services}}{X_{Ref,Total}}\right)}$.

UK RCA for a category is computed from $\frac{\left(\frac{X_{UK,Category}}{X_{UK,Total}}\right)}{\left(\frac{X_{Ref,Category}}{X_{Ref,Total}}\right)}$.

Figure A2. Revealed Comparative Advantage Index of UK creative exports vs selected comparator countries in 2021



Source: Authors' calculation based on exports data on goods and services. See Appendix A for definition of creative exports. Colour thresholds are at UK RCA values of 1,5,10, and 15. Created in flourish.studio

Table A3. Exporter abbreviation used in the UK RCA analysis

Exporter abbreviation	Country/Nation
AUS	Australia
CAN	Canada
CHN	China
DEU	Germany
FRA	France
GBR	United Kingdom (UK)
IRL	Ireland
ITA	Italy
USA	United States of America or United States (US)
EU	European Union
WOR	World

Appendix B. Supplementary material for Section 3

Firm-level evidence from FAME data

The FAME dataset has information on both active and non-active ('dissolved' or 'in liquidation') companies.[1] In November 2023, when the dataset was accessed, there were over 5.5 million active companies in the UK, which is in line with the UK business population estimates for 2022 (Department for Business, Energy and Industrial Strategy, 2022; Mahoney and Martin, 2022). Comparisons with other estimates of UK businesses such as the Inter-Departmental Business Register (IDBR), which is the main sampling frame used by the Office for National Statistics and UK government for statistical purposes, is however not straightforward given the differences in these data with, for example, the IDBR not including low turnover non-employing businesses (ONS, 2023).[2] Notwithstanding the above, comparisons of the proportion of companies/businesses that are in the creative industries give comparable results in both FAME and the IDBR, with the proportion of firms in the UK creative industries at 10% (DCMS, 2023).

FAME reports information relating to balance sheet data as well as financial information on the profit-loss account, although for the latter this is only a requirement for the relatively larger firms in the database. More specifically, exemptions for delivering a profit and loss account to Companies House are available for small companies and micro entities.[3] The size distribution of firms in FAME for all companies, as well as for the creative industries, gives an overwhelming majority of firms as being micro and small companies (conditional on information on total assets, employment and turnover). Further, firms in the creative industries are relatively more concentrated in the lower size bands, as is a feature of these industries (Beckett and Easton, 2022).

To identify those firms that export then use must however be made of the turnover data and specifically information relating to overseas turnover, where the latter determines if a firm exports in a given year, i.e., is an exporter, and non-exporters are defined as those with no overseas turnover but for which overall or total turnover is known. For those firms for which turnover is not known there is no information to identify if they are exporters or non-exporters. Turnover data is only known for 4% of companies in FAME, but this captures predominately the large and medium sized enterprises and hence those firms towards the upper end of the size distribution that account for the majority of economic activity in the creative industries. For example, firms for which turnover is known made up over 60% of total assets and over half of all employees in the creative industries in

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[1] Information on access to FAME can be found at https://www.bvdinfo.com/en-gb/our-products/data/national/fame

[2] The IDBR is a register of businesses that must employ at least one person through a Pay As You Earn (PAYE) tax scheme and/or earn turnover above the VAT threshold (Mahony and Martin, 2022).

[3] Small companies are defined as those meeting at least two of the following conditions: annual turnover must be not more than £10.2 million; the balance sheet total must be not more than £5.1 million; the average number of employees must be not more than 50 (Companies House, 2023). The definitions of small, medium and hence large companies that determines reporting information to Companies House can differ from other government definitions, where for example medium-sized companies relate to a balance sheet total less than €53m or turnover less than €43m (Foreign, Commonwealth & Development Office, 2022).

2022 so that although the data misses out on relatively large numbers of smaller firms it does to some extent capture the scale of the creative industries.

The turnover and overseas turnover data can be supplemented with other firm specific variables from the FAME data to investigate the determinants of exporting behaviour of these firms in the creative industries.[4] To do this a Heckman selection model is used to model the overseas turnover of firms and to take into account overseas turnover only being observed for those firms who export. For example, there may be factors that determine whether a firm exports and hence has observed overseas turnover, such as firms that are more productive, firms that have specific assets, or other unobserved factors. If the unobserved factors that affect overseas turnover are also related to unobserved factors that determine exporting status, then there will be an endogenously selected sample and standard regression techniques will be biased.[5] The model is outlined in Equations B-1 and B-2 below, where Equation B-1 relates to the outcome of overseas turnover for the firms and Equation B-2 sets up the selection process (i.e., determinants of being an exporter) into the model of overseas turnover:

$$y_{it} = \mathrm{x}_{it}\beta + v_{1i} + \varepsilon_{1it} \qquad \text{(Equation B- 1)}$$

$$s_{it} = 1(\boldsymbol{z}_{it}\gamma + v_{2i} + \varepsilon_{2it} > 0) \qquad \text{(Equation B-2)}$$

where, y_{it} is the variable relating to overseas turnover, x_{it} are variables modelling the outcome of overseas turnover, v_{1i} is the firm-level random effect, and ε_{1it} is the observation-level error in Equation B-1, while z_{it} are the variables modelling the selection into exporting, v_{2i} is the firm-level random effect, and ε_{2it} is the observation-level error in Equation B-2 so that s_{it} = 1 if we observe y_{it}, i.e. the firm is an exporter, and 0 otherwise.[6] Correlation between either the random effects v_{1i} and v_{2i} or the observation level errors imply that unobserved factors that affect the decision to export also affects the level of overseas turnover and hence endogenous selection must be accounted for in the estimation.

Table B1 provides a description of the variables for inclusion in Equations B-1 and B-2. The variables capture a range of firm characteristics incorporating their size, if they are foreign owned, the age of the firm, if they have multiple CI SIC codes, are involved in R&D activities, a measure of their (labour) productivity and their level of liquidity. For the case of the selection equation, it also includes whether a firm has a recorded measure of intangible assets, which is used as a measure of firm-specific assets and to identify if a firm becomes an exporter (Harris and Li, 2007).

[4] Further, firms are selected that have unconsolidated accounts to avoid double-counting of firms (see Greenaway *et al*., 2007).

[5] The model is estimated in Stata using the *xtheckman* command, which fits a random-effects linear regression model with endogenous sample selection via maximum likelihood estimation and takes into account within-panel correlation and the panel structure of the data.

[6] For full details of the modelling process refer to https://www.stata.com/manuals/xtxtheckman.pdf

Table B1. Variables for determining export behaviour

Variable	Description
Outcome variables:	
ln(overseas turnover)	Natural log of overseas turnover (£)
overseas turnover share	Overseas turnover as share of total turnover
Explanatory variables:	
ln(employees)	Natural log of number of employees
number of companies in group	Number of companies in the firm's corporate group
foreign owned	Dummy variable = 1 if firm has global ultimate owner outside UK
age	Age of firm (years)
age squared	Age of firm (years) squared
multiple creative	Dummy variable = 1 if firm has multiple CI SIC codes
research and development (R&D)	Dummy variable = 1 if firm has positive R&D expenditure
labour productivity	Turnover of firm (£) divided by number of employees
liquidity ratio	Liquidity ratio of firm (%)
intangibles	Dummy variable = 1 if firm has positive measure of intangible assets
time trend	Linear time trend (1 = 2013, ..., 10 = 2022)
Industry dummies:	
advertising/marketing	Dummy variable = 1 if firm in 'advertising and marketing' CI group
architecture	Dummy variable = 1 if firm in 'architecture' CI group
crafts	Dummy variable = 1 if firm in 'crafts' CI group
design	Dummy variable = 1 if firm in 'design' CI group
film, TV, radio	Dummy variable = 1 if firm in 'film, TV, video, radio and photography' CI group
IT, software	Dummy variable = 1 if firm in 'IT, software and computer services' CI group
publishing	Dummy variable = 1 if firm in 'publishing' CI group
museums/libraries	Dummy variable = 1 if firm in 'museums, galleries and libraries' CI group
music	Dummy variable = 1 if firm in 'music, performing and visual arts' CI group

Note: Variables obtained from FAME database. Creative Industry (CI) groups as defined by the UK Department for Digital, Culture, Media and Sport (DCMS, 2021). Overseas turnover and total turnover adjusted to real values (base year = 2022): https://www.gov.uk/government/statistics/gdp-deflators-at-market-prices-and-money-gdp-march-2023-quarterly-national-accounts

The results of Equations B-1 and B-2 are given in Table B2 for the two different measures of the outcome variable for overseas turnover: first, the amount of overseas turnover of the firm and, second, the share of overseas turnover to the total turnover of a firm. Table

B2 also provides estimates for the selection equation, i.e. Equation B-2.[7] For both of the measures of exporting behaviour it shows the vast majority of variables are significant in determining if a firm becomes an exporter. This covers the size of the firm (as measured by (log) employees and number of companies in the firm's corporate group structure), the age of the firm (which has a positive relationship on export status although diminishing for the older firms) and labour productivity (whereby the more productive firms are more likely to become exporters). Further, if a firm has a recorded measure of intangible assets is also a significant factor thereby indicating firm-specific assets are a significant determinant of export status. There is a negative and significant relationship between the liquidity ratio and overseas turnover, so that the results might be read as suggesting surprisingly that access to finance does not adversely impact the levels of exports. However, as we'd expect larger firms to be able to accumulate higher levels of longer-term debt, this coefficient may reflect the larger firms that FAME captures predominately in the sample. The negative time trend highlights the decreasing likelihood of firms becoming exporters over the period. Note that as the correlation between the random effects is significant in the models in Table B2 it implies there is endogenous sample selection so that unobserved firm-level factors that increase the chance of being an exporter also increase the exporting behaviour of firms.

A range of the determinants of exporting behaviour are found to be significant in Table B2. With regards to the (log) size of overseas turnover, firm size as measured by (log) employees and the overall size of the corporate group are both significant as is if the firm is foreign owned. Higher levels of labour productivity also lead to significantly higher levels of exports. Switching focus to the results for the firms share of overseas turnover again a range of firm-level characteristics are found to be significant. Further, in the case of the firm's liquidity, a higher liquidity ratio is significantly associated with higher shares of overseas turnover so that the size of exporting relative to the overall size of the firm as measured by total turnover is linked to firms having fewer financial constraints and thus an important factor for determining firm's exports. Of course, exporters may also have higher liquidity because of higher demand via exporting. Further, firms that have engagement in R&D (i.e., have positive expenditure in R&D) are associated with higher shares of overseas turnover as are more productive firms and those that are foreign-owned. The size of the firm as measured by (log) employees shows that although larger firms have higher levels of overseas turnover their overall share of this turnover relative to their total turnover falls as their size increases, although this may reflect their size in both the domestic and overseas markets. Finally, the positive and significant time trend for both measures of exporting behaviour highlights the increase in both the size of export turnover and firms share of overseas turnover over the period.

Table B2. Results for determinants of exporting behaviour

	ln(Overseas Turnover)	Overseas Turnover Share
ln(employees)	0.6358424***	-0.0168015***
number of companies in group	0.0002907***	0.00000637
foreign owned	0.8538196***	0.0305663***
age	-0.0029927	-0.004521
age squared	0.0000548	-0.0000198***
multiple creative	0.3365191	0.0016431
R&D	-0.0045207	-0.0045543

[7] The total number of observations in the sample for Table B2 is equal to 34,018, of which 7,994 observations are selected (exporters).

labour productivity	0.0000000148**	0.000000000879
liquidity ratio	-0.0051106	0.0018955***
time trend	0.023672**	0.005097***
Industry dummies:		
architecture	-1.185613***	0.0390653**
crafts	-0.9727976***	-0.0584022
design	0.1689281	0.1378191***
film, TV, radio	0.0356488	0.2846976***
IT, software	-0.7188612***	-0.0042643
museums/libraries	-2.899846***	-0.2444268***
music	-1.296751**	0.0143199
publishing	-0.0920203	0.0582737***
constant	11.72918***	0.4261897***
Selection Equation (s_{it} = 1 if Exporter)		
ln(employees)	0.4321669***	0.3693683***
number of companies in group	0.0006976***	0.0007062***
foreign owned	1.142371***	1.00115***
age	0.0515948***	0.0386293***
age squared	-0.0005119***	-0.0003104***
multiple creative	-0.0409041	-0.2281488
r&d	0.1928779	0.2137493
labour productivity	0.0000000198**	0.0000000238**
liquidity ratio	-0.0207547***	-0.0097924*
intangibles	0.1315909*	0.1604934*
time trend	-0.079932***	-0.0780902***
Industry dummies:		
architecture	-0.7910353***	-0.9886574***
crafts	0.8406136***	0.7778642*
design	-0.6178012***	-0.3526102
film, TV, radio	-0.628843***	-0.4340935**
IT, software	-0.4524183**	-0.233046
museums/libraries	-3.429254***	-3.249628***
music	-2.599761***	-2.526439***
publishing	-0.6156562***	-0.3998594*
constant	-3.147755***	-2.897191***
Correlation (ε_{1it}, ε_{2it})	-0.0517703	0.2477549**
Correlation (v_{1i}, v_{2i})	0.2951813***	0.1158727**
No. of observations	34,018	34,018
Log pseudolikelihood	-20,474.166	-5,758.0139
Wald χ^2	3446.02***	992.45***

Note: Baseline industry dummy = advertising. Results are for firms with a primary SIC code in the creative industries. Year dummies also included in the specification for Equations B-1 and B-2. Firm specific explanatory variables are lagged one year. Standard errors adjusted for clustering at the firm level. *** = 1%, ** = 5%, * = 10% significance levels.

Appendix C. Supplementary material for Section 4

UK's digital trade in creative industries

Methodology for the Digital Trade Experimental Statistics

This section details the methodology followed by Stojkoski et al. (2024) to produce experimental statistics for digital trade. The focus of the data they generated is on digitally delivered services.

The first step involved gathering corporate revenue data (in US$) for digital products from Orbis and Statista. Orbis is one of the largest databases on firm level data with information on more than 400 million firms across the globe (Bajgar et al., 2020; Pinto Ribeiro et al., 2010). Orbis data was used to identify the largest parent firms involved in the trade of digital products (with revenues of US$ 1 billion or more) and their subsidiaries, including important app and game developers. A total of 8,530 firms were identified. The second step was collecting yearly revenues from all the companies on this list and use Statista data[8] to decompose corporate revenues by digital product sectors. These estimates were then combined with country consumption data (in US$) from a mobile market intelligence company tracking the consumption of all applications and games downloaded from the Apple's App Store and Google's Play Store for 60 countries. These datasets were merged by connecting each digital product to its country of origin and to the countries where consumption took place. In order to estimate missing digital product consumption links, Stojkoski et al. (2024) then use a gradient-boosted regression tree, a flexible supervised machine learning method, to extend the consumption data to an additional set of 129 countries (for a total of 189) and 27 additional sectors (for a total of 29). Their model predicts the yearly consumption of a particular digital product brand in a country (e.g., consumption of Google Drive in Chile during 2021). The model's features include brand-level variables, such as the total revenues of the brand (across all countries), and the total consumption of all brands that are in the same sector (e.g., all app revenues or all games revenues across all countries). The model also includes gravity features (used to model traditional international trade flows) that describe the relationship between the country where the product was developed and the country where the product was consumed, such as shared language, borders, common colonisers, the geographic distance between these countries, their respective size in terms of GDP, and their ICT capacities.

The next step involves harmonising the data by ensuring that aggregates match their input variables. For instance, the revenues of a firm across all geographies must equal its total reported revenue and the global revenue of each sector must match its sum across all countries. The model is validated using an out-of-sample test for both country consumption patterns and product revenue patterns, showing that the model explains—on average—around 72% of the variation in country consumption and 63% of the variation in product revenues.

[8] Statista is a business data platform that gathers existing data from over 22,500 sources and conducts its own research to prepare analyses across industries and geographies (Bowman, 2022).

Subsequently, the consumption of a digital product is allocated to a country using an optimal transport procedure that assigns consumption to the revenues of the geographically closest subsidiary (without exceeding the revenue of the subsidiary). For example, Google Cloud consumption in Sweden is first assigned to the cloud revenues of Google Sweden. If these revenues are larger than the revenues of Google Cloud in Sweden, then the excess volume is assigned to the geographically closest subsidiary that has revenues not yet assigned to another country. Because there is no information about the revenue share by sector of subsidiaries (only those of the parent company is known), they are assumed to be the same as those of the parent company (proportional allocation). Optimal transport techniques are used because there is no information about transactions between parent companies and their subsidiaries or a rule guiding how these transactions take place. Transport methods allocate revenues to consumption by minimising the distance between export origin and consumption. This leads to conservative estimates prioritising the allocation of revenues to domestic consumption. To reduce the potential limitation of this assumption, Stojkoski et al. (2024) associate their estimates with upper and lower bounds generated by calculating the 95% confidence intervals for the proportion of domestic consumption of a digital product.

One limitation of these experimental statistics is the difficulty in assigning the corporate revenues to countries, since digital firms sometimes take legal residence in tax havens like the Cayman Islands or Luxembourg (Hazdhieva, 2016; Damgaard et al., 2019; OECD, 2021). So Stojkoski et al. (2024) also calculate alternative estimates assigning all revenues to a company's headquarter. Since neither of these assignment criteria are optimal, because there are genuine subsidiaries located in countries not for tax purposes, and not all product design and development can be imputed to a company's headquarters, for this report we used the dataset with revenues assigned to subsidiaries.

The challenges of measuring digital trade

Digitalisation has made it easier for small firms and households to get involved in international trade, leading to an increase in the low-value trade in goods through digital ordering. This trade may elude traditional methods for gathering data sources, which are often reliant on large firms and statistical methodologies tracking merchandise trade based on higher value thresholds (and using estimates for trade below those thresholds). Macroeconomic statistics have not kept pace with the digitalisation of the economy, because traditional statistics are still designed to track physical goods and are a lot less able to deal with the "ethereal" digital products, in addition to the rapid advances in ICT technologies (like cloud computing) and business models (e.g. paying a subscription to read eBooks on Kindle provided by Amazon instead of buying physical books) (UNCTAD, 2013, 2015a and 2015b). Why such elusiveness? Broadly speaking, while physical books cross borders and pass customs checks, the eBook subscription service can most likely be captured only through household consumption surveys (and being surveys they do not capture the entire population), or through the service provider being mandated to disclose its sales volumes, destination countries of subscribers, and number of 'hits' for each eBook disaggregating possibly by country of origin. It is plain to see how the involvement of digital intermediation platforms (DIPs), like Amazon and Alibaba, compounds these difficulties by adding a third actor to transactions (IMF/OECD/UN/WTO, 2023). Digitalisation is also enabling a greater bundling of goods and services, blurring the line between what is categorised as a good versus a service

for statistical purposes, in addition to raising issues about which trade rules apply: General Agreement on Tariffs and Trade, GATT, or General Agreement on Trade in Services, GATS (López González and Jouanjean, 2017). Different types of goods-services trade configurations (e.g. whether services are embodied in goods, or goods are ancillary to services, or services and goods are complementary) are likely to pose ongoing specific challenges for the determination of value and origin in trade transactions (Aoki et al., 2023).

A final difficulty with digital trade measurement in general is the current absence of measurements for the non-monetary value of free subscriptions like the free basic access to Spotify, or the access to free eBooks, free app and mobile games, or free cloud storage (for a study estimating the value of a range of free digital goods in the UK see Coyle and Nguyen (2020), whilst for the US see Brynjolfsson, Collis and Eggers (2019), Brynjolfsson et al. (2019), Brynjolfsson et al. (2020), and Brynjolfsson and Oh (2012)). These free digital services are sometimes financed by revenue from advertising or revenue streams generated by data, but they are still invisible in official statistics. The OECD Committee on Statistics and Statistical Policy (CSSP) is working on improving this situation with the establishment of the OECD Informal Advisory Group on Measuring GDP in a Digitalised Economy (the Advisory Group), created in 2017 and comprising both OECD and non-OECD countries. Focus of the Advisory Group's work has been to increase the visibility of digitalisation within the national accounts. To achieve this, the Advisory Group developed the Digital Supply and Use Tables (Digital SUTs) framework (Mitchell, 2021) which is now beginning to be implemented in several countries (OECD 2023).

Which sources of data exist for digital trade?

Information and communications technology (ICT) surveys among businesses have long been used to measure e-commerce for business transactions, whereas to capture e-commerce transactions among individuals there is a need to resort to household and/or travel surveys, in addition to card payment data and administrative data from customs authorities or information from postal and courier agencies. Clearly, there is a need to combine information from several sources to estimate the digitally ordered imports and exports, as no single source can offer a comprehensive measure for the whole economy (IMF, OECD, UN, and WTO, 2023).

Based on the assumption that all trade that is digitally deliverable is indeed delivered digitally, digitally delivered trade can be proxied using trade in ICTs services and trade in other digitally deliverable services (e.g. financial services, business services) offering an upper-bound estimate of digitally delivered trade (López-Gonzalez et al., 2023). Such estimates can be refined by relating the concepts of digital delivery to the cross-border service supply (i.e. Mode 1)[9], meaning that, for the digitally deliverable services, cross-border supply can be considered equivalent to digital delivery. Consequently, shares derived from the measurement of trade in services by mode of supply can provide reasonable estimates for digitally delivered trade. (IMF, OECD, UN and WTO, 2023). The problem is that most countries are only just beginning to measure trade in services by

[9] Services can be delivered in four modes: cross-border trade (Mode 1), consumption abroad (Mode 2); commercial presence (Mode 3) and presence of natural persons (Mode 4). For further details and examples see the WTO webpages.

modes of supply, and where this measurement is already undertaken, it does not offer a breakdown along creative industries – see for example the experimental dataset on Trade in Services by Mode of Supply (TiSMoS) developed by Wettstein et al. (2017) with the support of the European Commission. In the future both business surveys like the International Trade in Services (ITS) surveys and household consumption surveys by the ONS should be strengthened to obtain direct estimates of digitally delivered services trade. This should allow to also cover the other modes of delivery beyond Mode 1.

Table C1. Estimated value of Creative Digital trade exports for the UK in 2016 and 2021 (in US$)

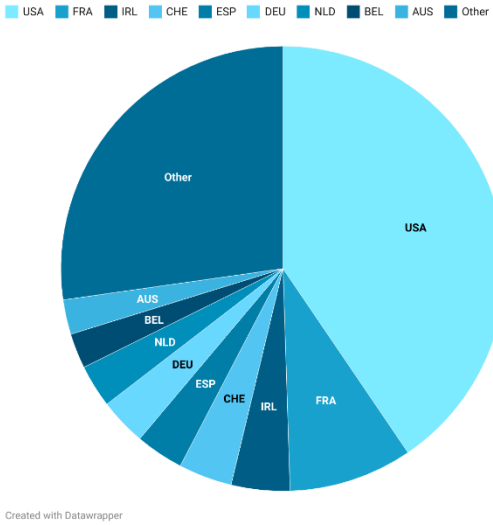
Category name	Large category	2016	2021
Administrative Software	IT Software	-	31,862,099
Apps	IT Software	84,635,764	694,280,142
Business Intelligence Software	IT Software	-	8,788,400
Cloud Computing	IT Software	1,522,021,312	3,263,721,523
Creative Software	IT Software		7,502,488
Customer Relationship Management Software	IT Software	557,986,439	1,523,507,591
Cybersecurity	IT Software	1,146,335	65,894
Data Licensing	IT Software	5,065,717	1,793,863,548
Digital Advertising	Digital Advertising	85,817,912	1,135,859,625
eBooks	eBooks	304,638,481	575,535,673
Games	Games	3,388,122,414	8,770,083,467
Office Software	IT Software	-	560,605,613
Operating System	IT Software	-	335,209,583
Other Enterprise Software	IT Software	2,387,269	1,943,536
Supply Chain Management Software	IT Software	109,590,206	64,721,915
Web-Hosting	IT Software	33,395,887	125,425,393
Total		6,094,807,735	18,892,976,492

Authors' calculations based on dataset of Stojkoski et al. (2024)

Table C2. Exporter abbreviation used in the original dataset

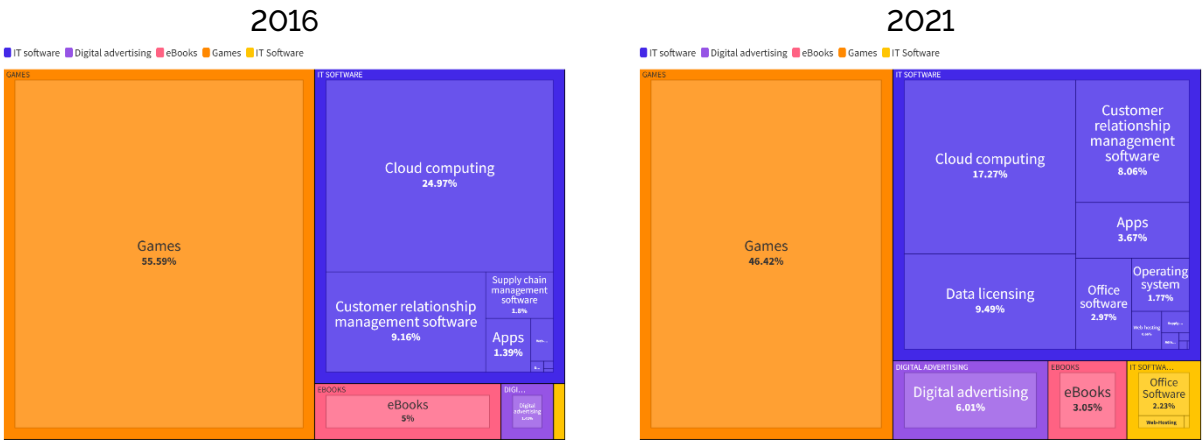
Exporter abbreviation	Country/Nation
AUS	Australia
BEL	Belgium
CHE	Switzerland
CHN	China
DEU	Germany
ESP	Spain
FIN	Finland
FRA	France
GBR	United Kingdom (UK)
HKG	Hong Kong
IRL	Ireland
ISR	Israel
JPN	Japan
KOR	South Korea
MLT	Malta
NLD	Netherlands
SGP	Singapore
USA	United States of America or United States (US)

Figure C1. Country of Destinations for UK's Creative Digital Exports in 2021



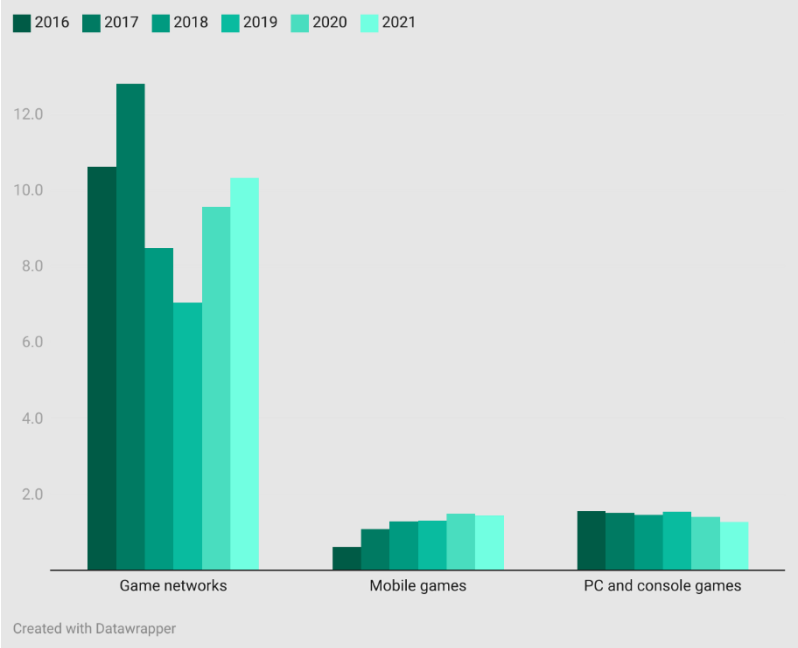
Source: Authors' calculations based on Stojkoski et al.'s (2024) data set.

Figure C2. Creative Digital Products exports (in shares): 2016 versus 2021



Source: Authors' calculations based on Stojkoski et al.'s (2024) data set. Created using flourish.studio

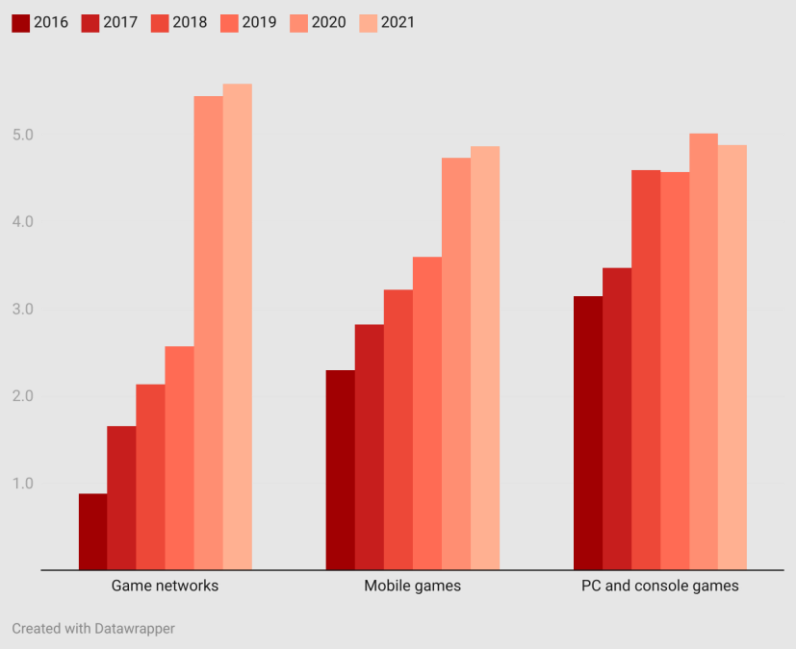
Figure C3. Digital video games exports for Japan (in US$ billion) 2016-2021



Source: Authors' calculations based on Stojkoski et al.'s (2024) data set.

Japan's exports in gaming are shown above. This shows Japan's comparative advantage is in PC and console games with exports averaging in excess of US$8 billion in recent years, by far their biggest export gaming sub-sector.

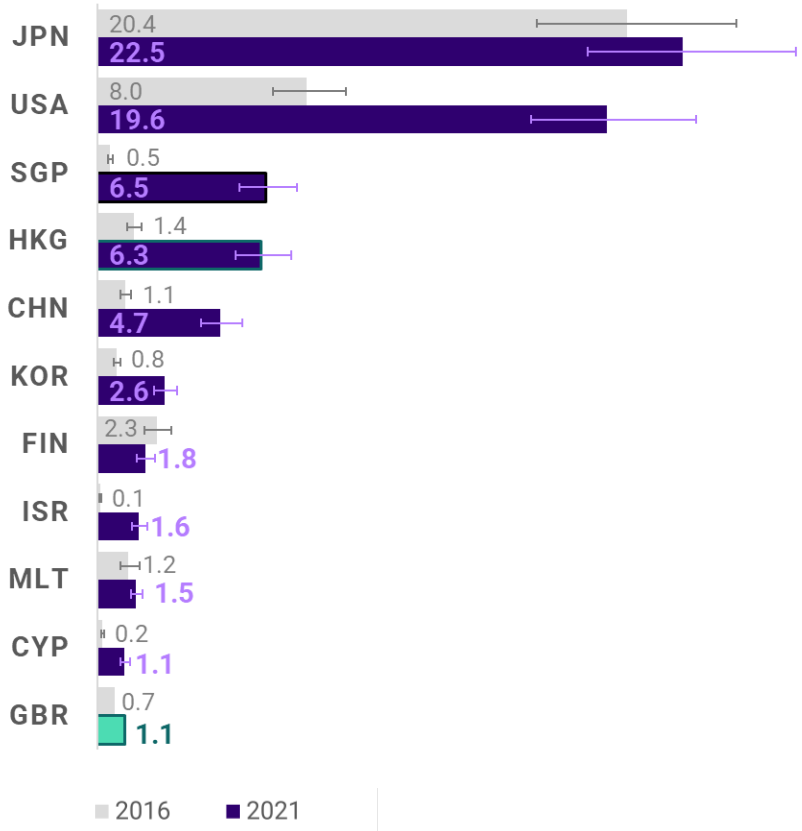
Figure C4 Digital video games exports for the USA (in US$ billion) 2016-2021



Source: Authors' calculations based on Stojkoski et al.'s (2024) data set.

The USA's gaming exports are shown above. The COVID-19 pandemic seems to have impacted positively on the exporting activities of the USA's games producers and, like the UK, the USA had a rebound effect in 2021, particularly for PC and console games.

Figure C5. Digital trade exports of Games, top 11 exporters (in US$ billion) in 2016 and 2021 (based on locations of parent company)



Source: Authors' calculations based on Stojkoski et al.'s (2024) data set.

Table C3. Digital trade sectors: creative vs non-creative

Creative	Non-creative[10]
1 – Digital advertising	8 – Online gambling
2 – eBooks	9 – Online dating
3 – Video on demand	10 – Online education
4 – Games: 4.1 – gaming networks 4.2 – PC and console games 4.3 – mobile games	11 – Online food ordering
	12 – Online marketplace
	13 – Payment service
	14 – Online accommodation
	15 – Online ride-hailing
5 – Digital music streaming and downloads	
6 – IT, software and computer services 6.1 – Cloud computing 6.2 – Cybersecurity 6.3 – Data licensing 6.4 – File hosting services 6.5 – Mobile applications 6.6 – Operating system 6.7 – Web hosting 6.8 – Business Intelligence Software 6.9 – Creative Software 6.10 – Customer Relationship Management Software 6.11 – Enterprise Resource Planning Software 6.12 -Other Enterprise Software 6.13 – Supply Chain Management Software 6.14 – Administrative Software 6.15 – Collaboration Software 6.17 – Office Software	

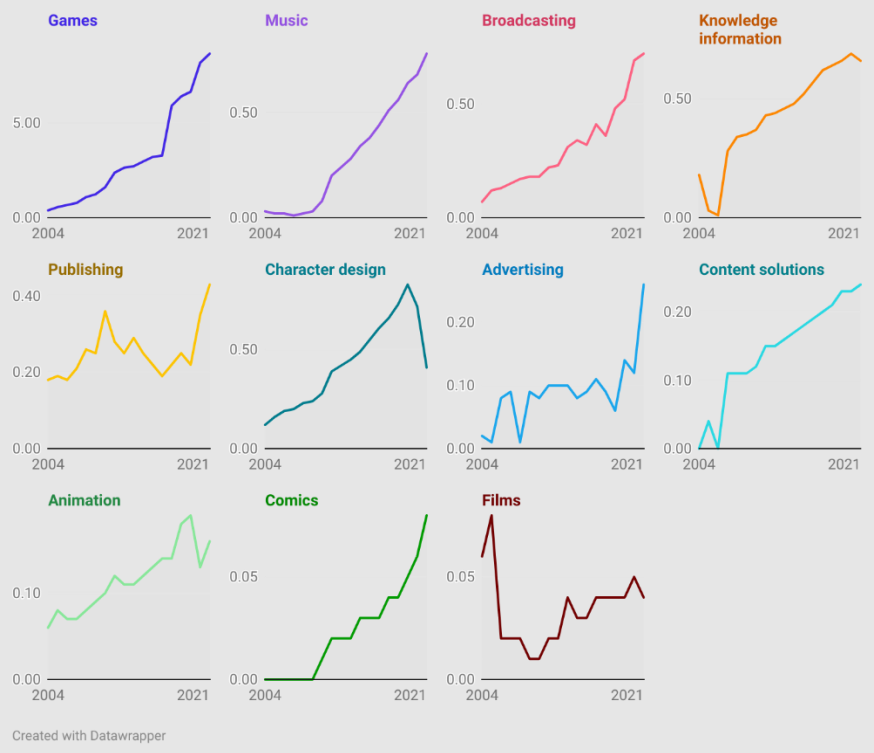
Authors' classification. For a description of each digital product see the Glossary. For a correspondence of each product to the EBOPS and the ISIC codes see the paper by Stojkoski et al. (2024).

[10] The value of digital trade for the marketplaces (online food ordering and online marketplace) includes only fees from merchants/customers to use the service, not the value of the food and merchandise sold through them, reason for which the data are to be considered digitally-delivered services and not digitally-ordered goods and services. The merchandise ordered through the marketplace could of course be from creative industries, e.g. online concert ticketing.

Appendix D. Supplementary material for Section 5

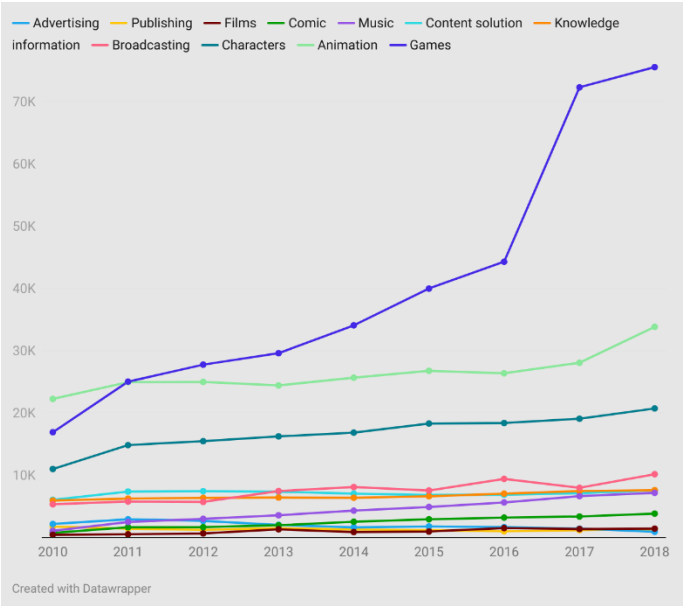
Additional figures

Figure D1. South Korea's content industry exports value by sub-sector (2004-2021) (in US$ billion)



Source: Chart was created using data from South Korea MCST (2022)

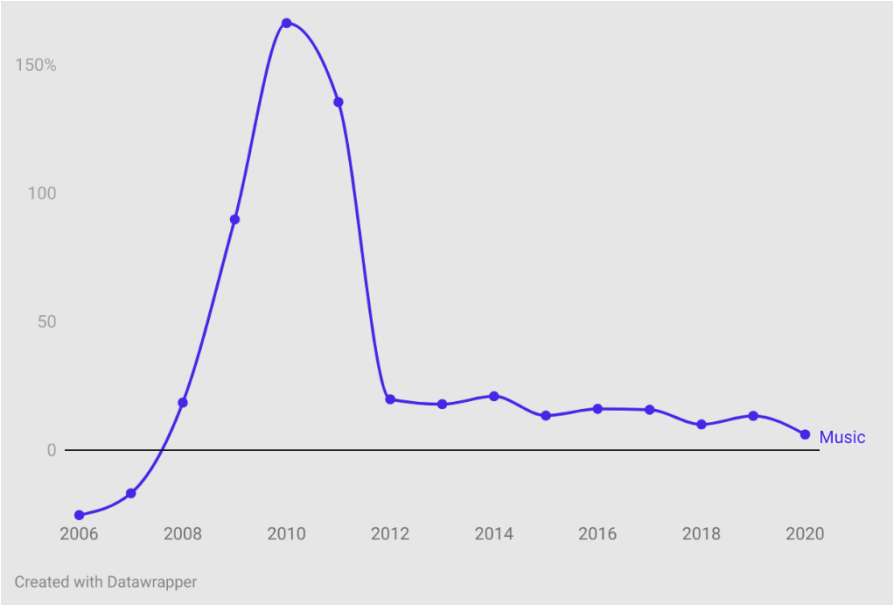
Figure D2. Exports value per employment (in US$), by content industry sub-sector



Source: Author's calculations based on data from South Korea MCST (2022)

Additional information for Section 5

Figure D3. Growth of South Korea's music exports value 2006-2020



Source: Authors' calculations based on data from South Korea MCST (2022)

Table D1. Notable milestones of K-pop music

Year	Milestone
2000	First generation K-pop idol H.O.T. makes debut.
2009	Wonder Girls' "Nobody" became the first K-pop song to enter Billboard Hot 100 Chart
2012	Psy's "Gangnam Style" became the first YouTube video with one billion views
2021	K-pop boy band BTS: 1) Became the first Asian group won top honour at the American Music Awards and achieved six No. 1 spots on the Billboard Hot 100 in just over a year – an achievement only attained by The Beatles in the 1960s. 2) Achieved number one in 2021 as the most popular and best-selling global artist by IFPI (International Federation of the Phonographic Industry). 3) Was appointed as special envoys by South Korean President at the 76th UN General Assembly session in New York and their video clip played.
2023	King Charles presented honorary MBEs to BLACKPINK members.

Source: Coughlan (2023), Herman (2018), Lopes et al. (2023)

Regression analysis for Section 5

Due to the targeted marketing of K-pop music, K-pop groups are often formed by producers for relatively defined markets. These market definitions can be governed by national boundary, language, culture, or age groups. Beginning from the loosely defined "2nd generation" K-pop groups, producers have included international talents as part of new K-pop groups to increase exposure to the neighbouring markets, namely China and Japan. These groups also include some level of Mandarin or Japanese language in their product offering.

This simple analysis aims to measure the impact of recruiting an international talent as part of the K-pop group on the likelihood of performing internationally. It can be argued that, since the K-pop groups were formed before the major tours occurred, the presence of any international member in a group is more likely to determine its future major tour locations than the other way around. However, it is also likely that the K-pop groups were formed with international markets in mind, such as likely to indicated if there was data on specific language trainings provided to each K-pop group.

Data are compiled by authors from various sources for 1,044 live shows of major tours in 2015-2023 across 35 countries (including South Korea) for 17 K-pop groups in Spotify's Top 20 K-Pop groups of 2022. K-pop groups are then matched with K-pop member nationalities from an informal online K-pop database (K-Pop Database, 2019).

Table D2. Summary of K-pop groups in the data (ranked according to Spotify 2022)

Group name	Number of shows in major tours			Producer	Spotify followers (million)	Spotify 2022 rank
	South Korea	Overseas	Total			
BTS	37	103	140	Big Hit	71.0	1
BLACKPINK	6	104	110	YG	46.8	2
TWICE	7	55	62	JYP	19.2	3
Stray Kids	7	45	52	JYP	13.4	4
SEVENTEEN	23	129	152	Pledis	10.5	5
TXT	4	42	46	Big Hit	9.0	6
ENHYPEN	4	31	35	CJ ENM Hybe	7.0	7
ITZY	2	18	20	JYP	6.2	8
(G)I-DLE	5	40	45	Cube	7.8	9
Red Velvet	7	30	37	SM	8.9	10
aespa	2	29	31	SM	4.0	11
IVE	2	10	12	Starship	3.1	12
ATEEZ	9	70	79	KQ	3.3	14
NCT 127	2	43	45	SM	7.2	15
EXO	31	106	137	SM	9.8	16
TREASURE	2	28	30	YG	3.1	17
LE SSERAFIM	2	9	11	Source	3.5	18
Total	152	892	1044			

To estimate the likelihood of an international performance (of a major concert tour) by a K-pop group in the sample, we employ logistic regression analysis. The log odds equation is:

$$\log odds\ [Y = 1|\boldsymbol{X}] = ln\left[\frac{P(Y=1|\boldsymbol{X})}{1-P(Y=1|\boldsymbol{X})}\right] = \beta_0 + \beta_1\boldsymbol{X}$$

(Equation D-1)

To investigate the chances of a major concert's show being held live in an international venue, Y is replaced by the dummy variable *IntlShow* that takes the value of 1 if the show is held at an international venue and 0 if in South Korea. The logistic regression equation then becomes:

$$logistic(IntlShow) = \beta_0 + \beta_1 IntlMember + \beta_2 FourthGen + \beta_3 Post2020 + \varepsilon$$ (Equation D-2)

where *IntlMember* and *FourthGen* dummy variables only vary by group and do not vary across time as all the groups are assumed to have the same members during the period 2015-2023.

To investigate the chances of a major concert's show being held live in a venue in Japan, Y is replaced by the dummy variable *JpnShow* that takes the value of 1 if the show is held in Japan and 0 otherwise. The logistic regression equation then becomes:

$$logistic(JpnShow) = \beta_0 + \beta_1 IntlMember + \beta_2 FourthGen + \beta_3 Post2020 + \delta_1 Japanese + \delta_2 Chinese + \delta_3 Taiwanese + \delta_4 Australian + \delta_5 Canadian + \delta_6 Thai + \delta_7 American + \varepsilon$$ (D-3)

Where additional variables (*Japanese, Chinese, Taiwanese, Australian, Canadian, Thai, American*) indicate the number of members in the group with non-Korean nationalities. Therefore, their coefficients capture how the number of specific nationalities affect the likelihood of the show being held in Japan.

Equations D-2 and D-3 are estimated in Stata using the *logistic* command, which fits dichotomous logistic models via maximum likelihood estimation.

The regression results show that having an international member in the group increases the odds ratio of an international venue during a major tour by 1.7, after controlling for group generation and post pandemic trend.

Table D3. Results of logistic regression – International performance

Dependent binary variable: Performed internationally (outside South Korea)	
Independent variable	Odds ratio
Having at least one international member	1.712206***
4th generation K-pop group	1.418653
Post 2020 (COVID-19 pandemic)	1.298743
Constant (baseline odds)	3.250834***
No. of observations (N): 1,044	
Log likelihood = -425.03268	
Pseudo R2 = 0.0190	
LR chi2(3) = 16.43	

Note: Baseline generation dummy = 3rd generation K-pop group.
*** = 1%, ** = 5%, * = 10% significance levels.

K-pop groups have also been known to tailor groups and their content to their target markets. Korea and Japan have long shared a sensitive history that continues to shape bilateral relations. Having an additional Japanese member in the group increases the odds ratio of a show in Japan as part of a major tour by 1.5, after controlling for group generation, post pandemic trend, and presence of other nationalities in the group.

Table D4. Results of logistic regression – Japan performance

Dependent binary variable: Performed in Japan	
Independent variable	Odds ratio
Having at least one international member	1.477462
No. of members with nationality:	
Japan	1.487242***
China	0.827713
Taiwan	0.8241381
Australia	0.8182483
Canada	0.9842701
Thailand	0.4092633***
USA	1.460174**
4th generation K-pop group	0.7794215
Post 2020 (COVID-19 pandemic)	0.6306713**
Constant (baseline odds)	0.3887563***
No. of observations (N): 1,044	
Log likelihood = -595.41561	
Pseudo R2 = 0.0722	
LR chi2(3) = 92.68	

Note: Baseline generation dummy = 3rd generation K-pop group.
*** = 1%, ** = 5%, * = 10% significance levels.

Table D5. Summary of K-pop groups in the data

					No. of members with foreign nationality							
K-pop group name	Producer	Gen	Debut year	Total number of foreign members	Australia	Canada	China	Japan	Taiwan	Thailand	USA	Vietnam
(G)I-DLE	Cube	4	2018	3			1		1	1		
aespa	SM	4	2020	2			1	1				
ATEEZ	KQ	4	2018	0								
BLACKPINK	YG	3	2016	1						1		
BTS	Big Hit	3	2013	0								
ENHYPEN	CJ ENM Hybe	3	2020	1				1				
EXO	SM	3	2012	1			1					
ITZY	JYP	4	2019	0								
IVE	Starship	4	2021	1				1				
LE SSERAFIM	Source	4	2022	2				2				
NCT 127	SM	3	2016	3		1	1	1			1	
NCT DREAM	SM	3	2016	3		1	2					
NewJeans	ADOR	4	2022	1								1
Red Velvet	SM	3	2014	0								
SEVENTEEN	Pledis	3	2015	4			2				2	
STAYC	High Up	4	2020	0								
Stray Kids	JYP	4	2017	1	1							
TREASURE	YG	4	2020	4				4				
TWICE	JYP	3	2015	4				3	1			
TXT	Big Hit	4	2019	1							1	

Source: K-Pop Database (2019) and other sources.
Note: Empty cells indicate zero. STAYC and NewJeans did not have major tours during the period. Major tour by NCT DREAM was not included in the data.

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Data Statement

All the data used for this report is freely available from the original sources listed in the Data Reference List. Motivated requests to access the data sets used in the report can be made to the authors.

An exception applies to proprietary data from Bureau van Dijk obtained under a licence agreement: FAME and ORBIS. The authors are not at liberty to share this data but are happy to consider requests for collaboration by interested researchers and organisations.

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