



The impact of the COVID-19 pandemic on productivity dynamics by industry

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Getting beyond the noise of quarterly productivity estimates

- Quarterly productivity figures look noisy, especially during times of crisis:
 - Output and inputs show large variations making productivity figures highly volatile
 - Large data revisions are likely
 - Shock in one period causes large rebound effects in subsequent periods
 - Government interventions (e.g. stimulus and furlough programs) affect output and inputs
 - Capacity utilization effects are large, and highly different between industries
- Quarterly productivity estimates are valuable when analyzing in more detail:
 - Separate industry reallocation effects from within-industry effects
 - Look at different impacts on sectors and industries using variety of taxonomies (e.g. digital intensity, skill intensity of work, from home)
 - Analyse quarterly dynamics relative to long-term trend – how quickly can it adjust?

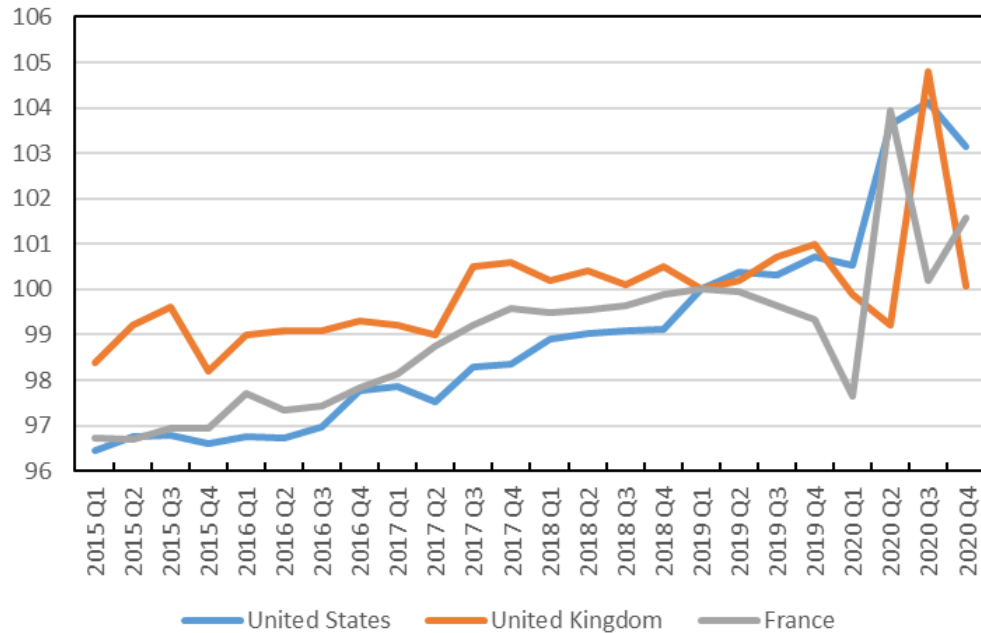
Our research questions

1. Adjusting for industry reallocation effects, do we see the greater productivity impacts from digital producing and intensive digital-using industries, as observed before the pandemic (van Ark et al, 2020) continue?
2. Does the acceleration in work from home (WFH) enhance productivity, and is it aligned with intensive digital-using industries?
3. **[not in this presentation]** Is there evidence of different trade-offs between output and employment at industry level?
 - For example, intensive digital-using industries experience faster productivity growth at the expense of a weaker rebound in employment, because of digital-biased technological change (Acemoglu & Restrepo, 2020; Autor, 2015)
 - Are intensive WFH industries able to recover productivity better without a large trade-off in employment?

AGGREGATE AND INDUSTRY ESTIMATES 2020

Temporary boost to productivity reflects rapid adjustment to working hours due to layoffs and furlough programmes

Real GDP per hour worked (2019Q1=100)

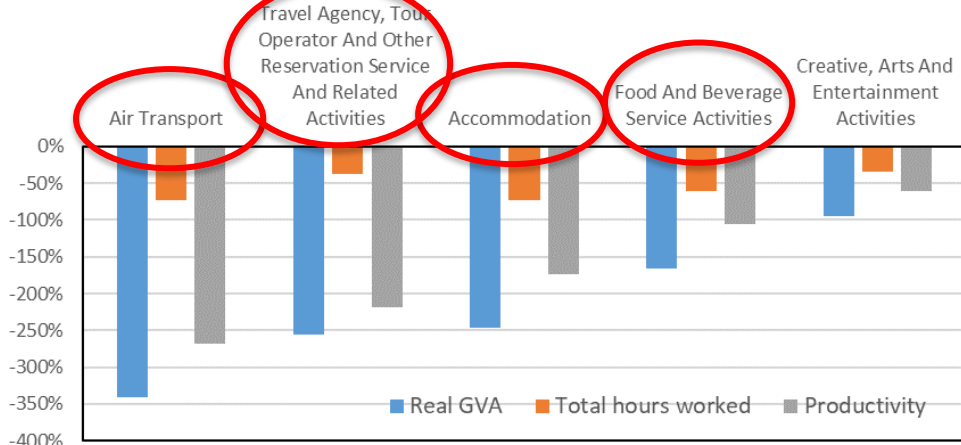


Q/Q %, non-annualized		2020Q1	2020Q2	2020Q3	2020Q4	2020
United Kingdom	Real GDP	-2.9%	-19.1%	16.1%	1.0%	-10.0%
	Total hours worked	-2.0%	-18.2%	9.9%	5.8%	-10.3%
	<u>Labor productivity</u>	<u>-0.9%</u>	<u>-1.1%</u>	<u>5.7%</u>	<u>-4.5%</u>	<u>0.3%</u>
United States	Real GDP	-1.3%	-9.0%	7.5%	1.0%	-3.5%
	Total hours worked	-1.2%	-11.6%	6.8%	2.0%	-5.9%
	<u>Labor productivity</u>	<u>-0.1%</u>	<u>2.9%</u>	<u>0.6%</u>	<u>-0.9%</u>	<u>2.6%</u>
France	Real GDP	-5.9%	-13.5%	18.5%	-1.4%	-8.2%
	Total hours worked	-4.2%	-18.7%	22.9%	-2.8%	-9.1%
	<u>Labor productivity</u>	<u>-1.7%</u>	<u>6.4%</u>	<u>-3.6%</u>	<u>1.4%</u>	<u>1.1%</u>

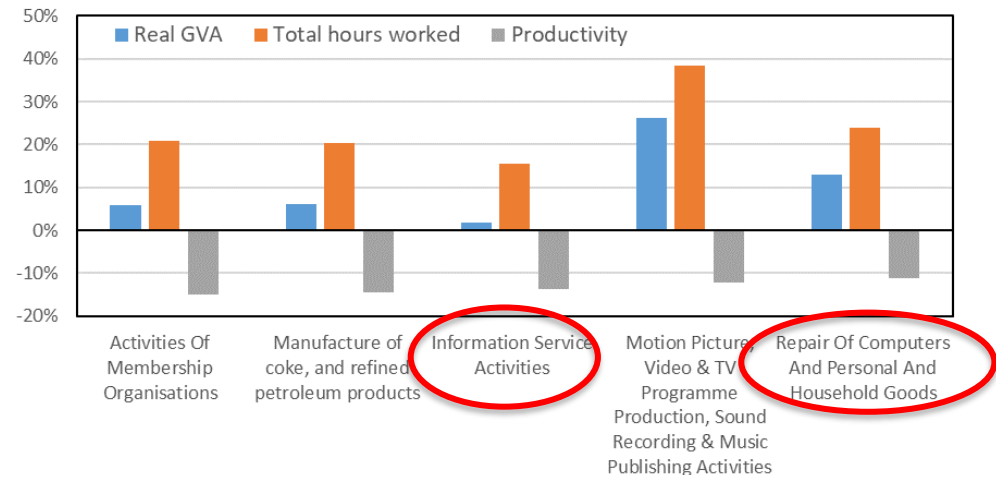
Sources: Eurostat, BEA, BLS, ONS

UK: Large changes in output and employment causes even larger divergence in productivity growth rates; Q3 shows almost the reverse picture of Q2

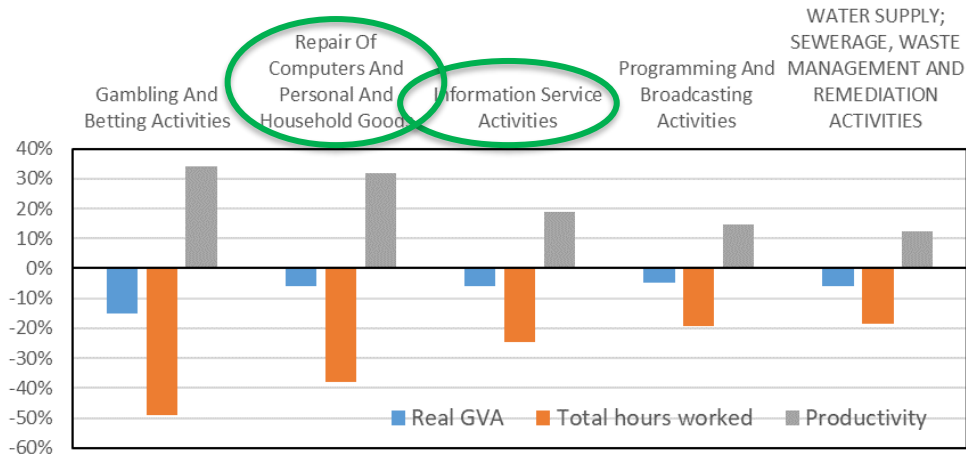
Q2 (bottom-5 on productivity growth)



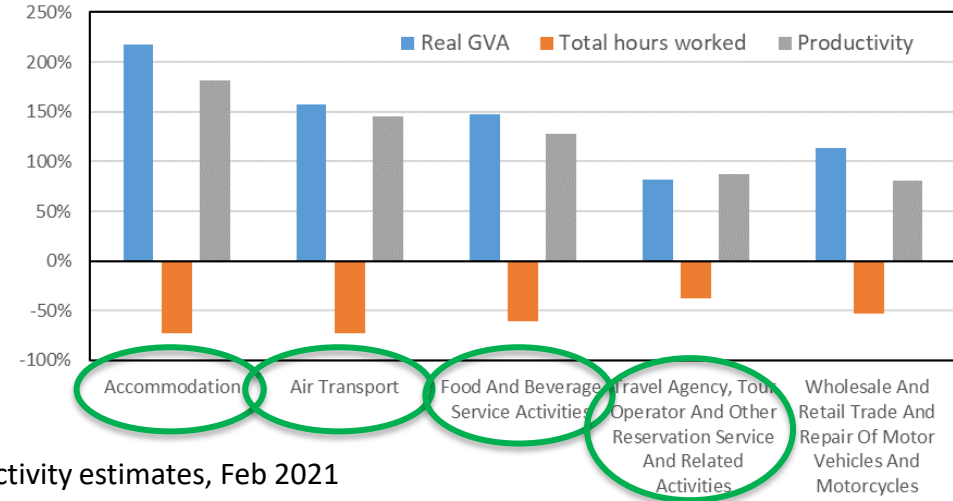
Q3 (bottom-5 on productivity growth)



Q2 (top-5 on productivity growth)



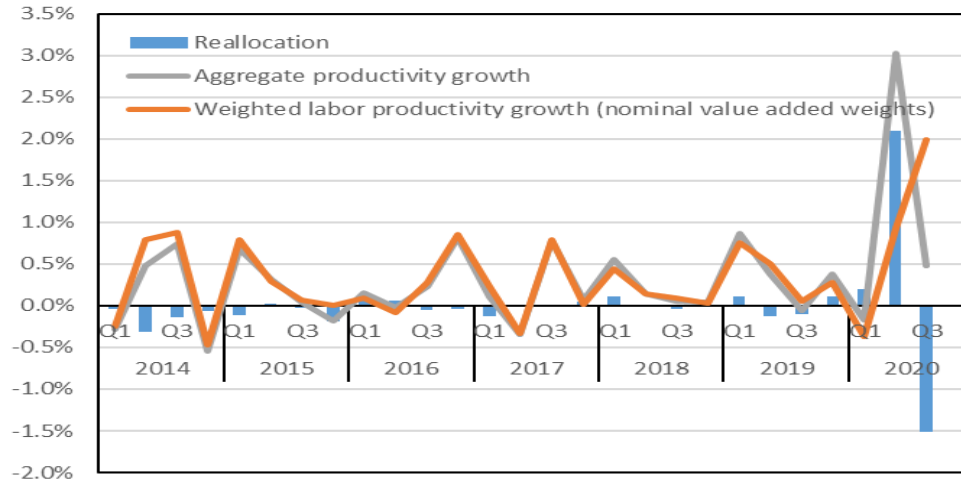
Q3 (top-5 on productivity growth)



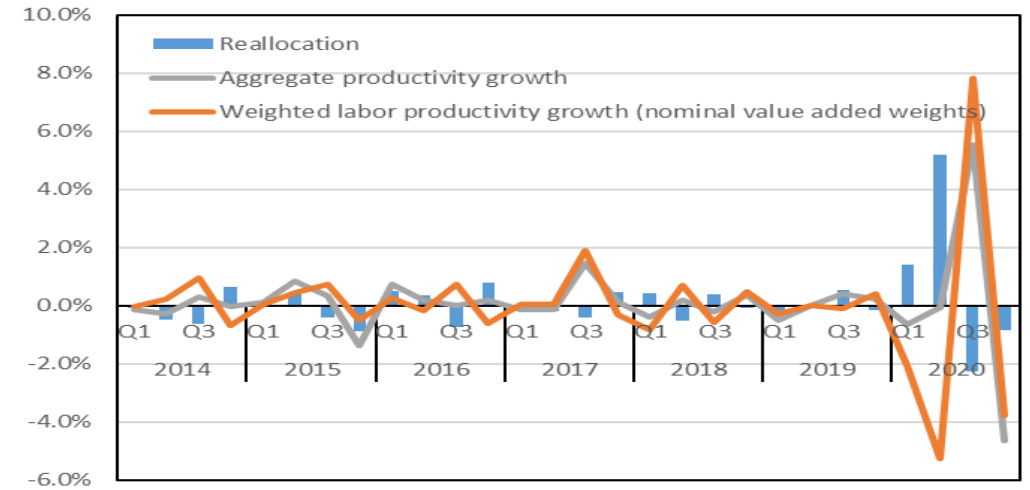
SECTOR REALLOCATION EFFECTS

Aggregate productivity growth in 2020 was distorted by large reallocation effects

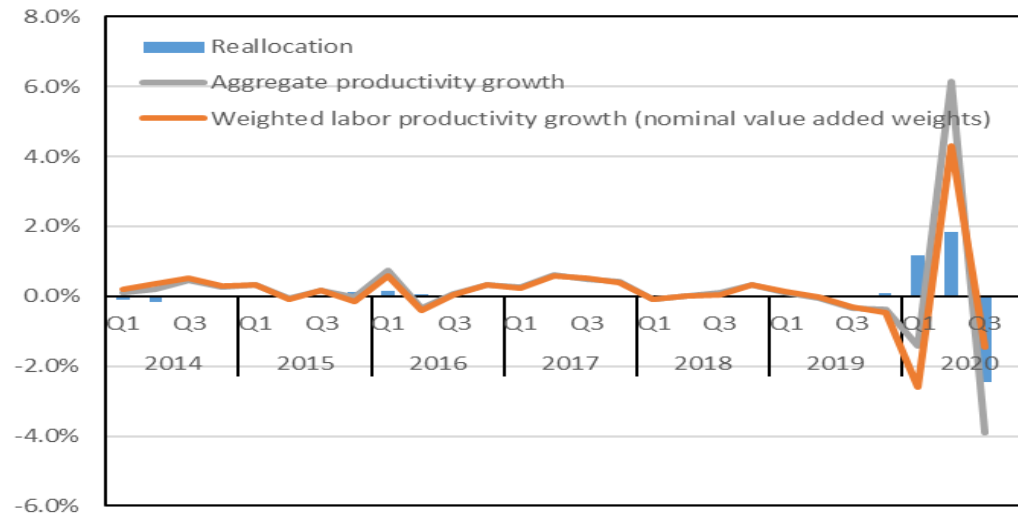
United States



United Kingdom



France



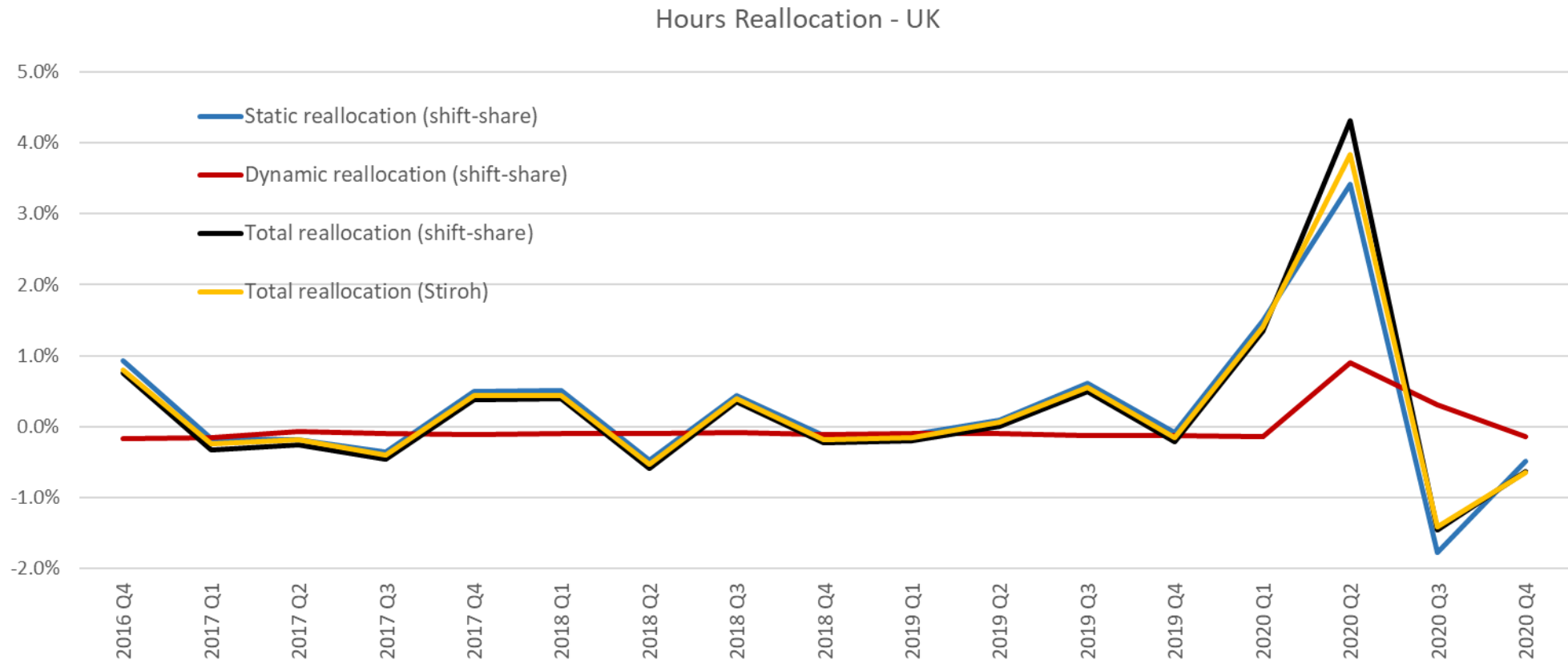
Different decomposition to identify reallocation effects

- Two methods to identify reallocations between sectors:

- Stiroh reallocation (2002):** $(\sum \bar{v}_{i,t} \cdot \Delta \ln Y_{i,t} - \Delta \ln H_t) = \Delta \ln y_t = \sum \bar{v}_{i,t} \cdot \Delta \ln y_{i,t} + (\sum \bar{v}_{i,t} \cdot \Delta \ln H_{i,t} - \Delta \ln H_t)$
 Agg. labor productivity growth = Tornq. VA weig. ind. Prod. growth + Hours reallocation effect
- Shift-share re-allocation:** $\Delta \left(\frac{Y_t}{H_t} \right) = \Delta y_t = \sum s_{i,t-1} \cdot \Delta y_{i,t} + \sum y_{i,t-1} \cdot \Delta s_{i,t} + \sum \Delta y_{i,t} \cdot \Delta s_{i,t}$
 Agg. prody difference = base-year hour weighted ind. prody difference + initial prody. Level weighted ind. hour share difference + diff. in ind.emp share & diff. in prody level.

- [Van Ark et al. \(2020\)](#) uses the first component of Stiroh, with no focus on reallocation.
- We proceed with the shift-share analysis because:
 - the within- and between-industry components add up to the unweighted aggregate labor productivity growth.
 - in times of heightened volatility, the dynamic component in the shift-share reallocation can be large.
- Empirically, the reallocation effects are similar between methods except during volatile times.
- We zoom in on the industry productivity contributions in the within-component which are most informative with regard to the “true” productivity effects

Empirically, the measured “Stiroh reallocation” and shift-share effects are almost identical



Note: data for UK; data for France and US see appendix tables

DECOMPOSITION BASED ON DIFFERENT TAXONOMIES



Three taxonomies:

1. Major sectors

- Manufacturing
- Hospitality and culture
- Markets services excl. hospitality and culture
- Non market services
- Other (agr., constr., mining)

2. Work from Home (WFH) (BLS, American Time Use Survey, based on data prepared by Hensvik, Barbanchon & Rathelot, 2020)

- Lowest quartile
- 2nd and 3 quartile
- Top quartile

3. Digital production/intensity (van Ark et al., 2020)

- Digital producing
- Intensive digital-using (median)
- Less-intensive digital-using (median)

ISIC rev.4	Sector denomination	SECTORS	WFH	ICT
A 01-03	Agriculture, forestry, fishing	Other industry (including agriculture)	High WFH	Least digital intensive using
B 05-09	Mining and quarrying	Other industry (including agriculture)	Low WFH	Least digital intensive using
C 10-12	Food products, beverages and tobacco	Manufacturing	Medium WFH	Least digital intensive using
C 13-15	Textiles, wearing apparel, leather	Manufacturing	High WFH	Least digital intensive using
C 16-18	Wood and paper products, and printing	Manufacturing	Medium WFH	Most digital intensive-using
C 19	Coke and refined petroleum products	Manufacturing	Low WFH	Least digital intensive using
C 20	Chemicals and chemical products	Manufacturing	Low WFH	Least digital intensive using
C 21	Pharmaceutical products	Manufacturing	Medium WFH	Least digital intensive using
C 22-23	Rubber and plastics products	Manufacturing	Medium WFH	Least digital intensive using
C 24-25	Basic metals and fabricated metal products	Manufacturing	Low WFH	Least digital intensive using
C 26	Computer, electronic and optical products	Manufacturing	High WFH	Digital Producing
C 27	Electrical equipment	Manufacturing	Low WFH	Digital Producing
C 28	Machinery and equipment n.e.c.	Manufacturing	Medium WFH	Most digital intensive-using
C 29-30	Transport equipment	Manufacturing	Low WFH	Most digital intensive-using
C 31-33	Furniture; other manufacturing; repairs of computers	Manufacturing	Medium WFH	Most digital intensive-using
D 35	Electricity, gas, steam and air cond.	Other industry (including agriculture)	Medium WFH	Least digital intensive using
E 36-39	Water supply; sewerage, waste management	Other industry (including agriculture)	Low WFH	Least digital intensive using
F 41-43	Construction	Other industry (including agriculture)	Medium WFH	Least digital intensive using
G 45-47	Wholesale and retail trade, repair	Market services (excluding hospitality and culture)	Medium WFH	Most digital intensive-using
H 49-53	Transportation and storage	Market services (excluding hospitality and culture)	Low WFH	Least digital intensive using
I 55-56	Accommodation and food service activities	Hospitality and culture	Low WFH	Least digital intensive using
J 58-60	Publishing, audiovisual and broadcasting	Market services (excluding hospitality and culture)	High WFH	Digital Producing
J 61	Telecommunications	Market services (excluding hospitality and culture)	Medium WFH	Digital Producing
J 62-63	IT and other information services	Market services (excluding hospitality and culture)	High WFH	Digital Producing
K 64-66	Finance and insurance	Market services (excluding hospitality and culture)	Medium WFH	Most digital intensive-using
L 68	Real estate	Market services (excluding hospitality and culture)	High WFH	Least digital intensive using
M69-71	Legal and accounting activities, etc.	Market services (excluding hospitality and culture)	Medium WFH	Most digital intensive-using
M72	Scientific research and development	Market services (excluding hospitality and culture)	Medium WFH	Most digital intensive-using
M73-75	Advertising and market research; other business services	Market services (excluding hospitality and culture)	High WFH	Most digital intensive-using
N 77-82	Administrative and support service activities	Market services (excluding hospitality and culture)	Medium WFH	Most digital intensive-using
O 84	Public administration and defence	Non-Market services	Medium WFH	Most digital intensive-using
P 85	Education	Non-Market services	High WFH	Least digital intensive using
Q 86	Human health activities	Non-Market services	Medium WFH	Least digital intensive using
Q 87-88	Residential care and social work activities	Non-Market services	Medium WFH	Least digital intensive using
R 90-93	Arts, entertainment and recreation	Hospitality and culture	High WFH	Most digital intensive-using
S 94-96	Other service activities	Market services (excluding hospitality and culture)	Medium WFH	Most digital intensive-using

UK: pre-pandemic output and hours shares and productivity levels using taxonomies

Data for the UK, 2019 Q4	Nominal value added share (%)	Hours worked share (%)	Productivity level (1=total economy)
Manufacturing	9%	9%	1.11
Other industry (including agriculture)	11%	11%	1.02
Market services (excluding hospitality and culture)	56%	49%	1.14
Hospitality and culture	5%	8%	0.55
Non-Market services	19%	23%	0.81
High WFH	30%	19%	1.53
Medium WFH	58%	65%	0.88
Low WFH	12%	15%	0.83
Most digital intensive-using	42%	48%	0.88
Least digital intensive using	50%	46%	1.07
Digital Producing	8%	6%	1.40

Source: ONS

UK: Labour productivity growth by main industry

Main insights:

- **SECTORS:** Market services experienced largest productivity decline, especially in Q4—bigger than in hospitality & culture where many hours were furloughed
- **WFH:** High WFH industries suffered less of a productivity decline
- **DIGITAL:** Least digital intensive industries see the largest drop in productivity growth

2020, Q/Q %	Q1	Q2	Q3	Q4 (flash)	2020-q4 vs. 2019-Q4
Total	-0.6%	0.1%	5.5%	-4.6%	0.3%
<u>Industry productivity growth rates using three taxonomies:</u>					
Manufacturing	-0.1%	-0.4%	1.0%	-0.5%	0.2%
Other industry	-0.2%	-0.5%	1.3%	-0.7%	0.0%
Market services (excl. hospitality & culture)	-1.3%	-0.2%	2.0%	-2.2%	-1.3%
Hospitality and culture	-0.2%	-2.1%	2.1%	-1.0%	-0.9%
Non-market services	-0.4%	-2.0%	1.5%	0.6%	-0.5%
High WFH	-1.2%	1.0%	0.3%	-0.5%	-0.4%
Medium WFH	-0.5%	-3.3%	4.7%	-2.1%	-0.7%
Low WFH	-0.3%	-2.9%	2.8%	-1.2%	-0.7%
Most digital intensive-using	-0.6%	-1.6%	3.0%	-1.7%	-0.4%
Least digital intensive using	-1.5%	-3.5%	4.9%	-2.0%	-1.8%
Digital Producing	0.0%	-0.1%	-0.1%	-0.1%	-0.4%

UK: Decomposition of within-industry productivity effects using three taxonomies

Main insights:

- **OVERALL:** Within-industry productivity decline almost outweighs positive reallocation effect to more productive industries
- **SECTORS:** Services contributed most to within-industry productivity decline
- **WFH:** Low WFH industries contributed most to within-industry decline, but high WFH industries don't offset
- **DIGITAL:** Least digital intensive-using industries contributed most to within-industry decline, but most digital intensive-using industries and digital-producing don't outweigh

2020, Q/Q %	Q1	Q2	Q3	Q4 (flash)	2020-q4 vs. 2019-Q4
Total	-0.6%	0.1%	5.5%	-4.6%	0.3%
Static+Dynamic	1.4%	4.3%	-1.4%	-0.6%	2.5%
Within-industry effect	-2.0%	-4.3%	7.0%	-4.0%	-2.2%
<i>Industry contribution to aggregate within-industry productivity growth:</i>					
Manufacturing	-0.1%	-0.4%	1.1%	-0.5%	0.2%
Other industry	-0.2%	-0.5%	1.4%	-0.7%	0.0%
Market services (excl. hospitality & culture)	-1.2%	0.0%	1.9%	-2.3%	-1.0%
Hospitality and culture	-0.2%	-2.0%	1.7%	-1.1%	-1.0%
Non-market services	-0.4%	-1.3%	0.9%	0.5%	-0.4%
Total within effect	-2.0%	-4.3%	7.0%	-4.0%	-2.2%
High WFH	-1.2%	1.0%	0.2%	-0.5%	-0.5%
Medium WFH	-0.5%	-2.6%	4.3%	-2.2%	-0.6%
Low WFH	-0.3%	-2.7%	2.6%	-1.2%	-1.1%
Total within effect	-2.0%	-4.3%	7.0%	-4.0%	-2.2%
Most digital intensive-using	-0.6%	-1.5%	3.0%	-1.8%	-0.2%
Least digital intensive using	-1.4%	-2.7%	4.0%	-2.2%	-1.7%
Digital Producing	0.0%	-0.1%	-0.1%	-0.1%	-0.4%
Total within effect	-2.0%	-4.3%	7.0%	-4.0%	-2.2%

APPENDIX CHARTS

Sources and methods of quarterly industry productivity data

- UK: 65 industries
 - No further estimations needed, output and labor input data are all prepared by ONS
- France: 50 industries
 - Quarterly national accounts productivity data (hours and output) available at 17-sector level
 - Split up into more detailed sectors using annual national accounts data (shares for one year) and short-term business statistics on output and labor input (hours)
- US: 48 industries
 - Quarterly GDP-by-industry from BEA
 - Labor input from BLS, with several imputations:
 - Starting point: monthly CES by detailed industry ('hours paid', employees, nonfarm private only)
 - Use (industry) ratios of hours paid / hours worked to arrive at hours actually worked data (from national compensation survey)
 - Use (industry) ratios of employee/non-employee to arrive at total economy hours worked (from CPS)
 - Add in public sector and farm workers from total economy sector hours data (quarterly)

US comparison between BLS (nonfarm business sector) and total economy (GDP) productivity (quarterly annualized rates)

<u>Q/Q SAAR</u>						
	2020Q1	2020Q2	2020Q3	2020Q4		2020
HOURS						
Total Economy	-4.3%	-39.2%	30.9%	8.2%		-5.8%
Nonfarm business sector	-5.6%	-43.2%	38.3%	10.1%		-6.5%
OUTPUT						
Total Economy (GDP)	-5.0%	-31.4%	33.4%	4.1%		-3.5%
Nonfarm business sector output	-6.4%	-36.8%	44.1%	5.5%		-4.2%
PRODUCTIVITY						
Total Economy	-0.7%	12.9%	2.0%	-3.8%		2.5%
Nonfarm business sector	-0.8%	11.1%	4.2%	-4.2%		2.5%

Source: Non-farm business sector (BLS) and total economy based on BEA/BLS

Stiroh-reallocation vs. shift-share reallocation effects

		2018				2019				2020		
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
United States	Reallocation	0.1%	0.0%	0.0%	0.0%	0.1%	-0.1%	0.0%	0.2%	0.1%	2.1%	-1.5%
	Shift-Share (Static+Dynamic)	0.0%	0.0%	-0.1%	0.1%	0.1%	0.0%	0.0%	0.2%	0.1%	2.4%	-1.6%
United Kingdom	Reallocation	0.4%	-0.5%	0.4%	-0.1%	-0.2%	0.0%	0.5%	-0.2%	1.4%	3.8%	-1.4%
	Shift-Share (Static+Dynamic)	0.4%	-0.6%	0.3%	-0.2%	-0.2%	0.0%	0.5%	-0.2%	1.4%	4.3%	-1.4%
France	Reallocation	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	1.1%	1.6%	-2.2%
	Shift-Share (Static+Dynamic)	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	1.1%	1.6%	-2.5%