An occupation and asset driven approach to capital utilisation adjustment in productivity statistics

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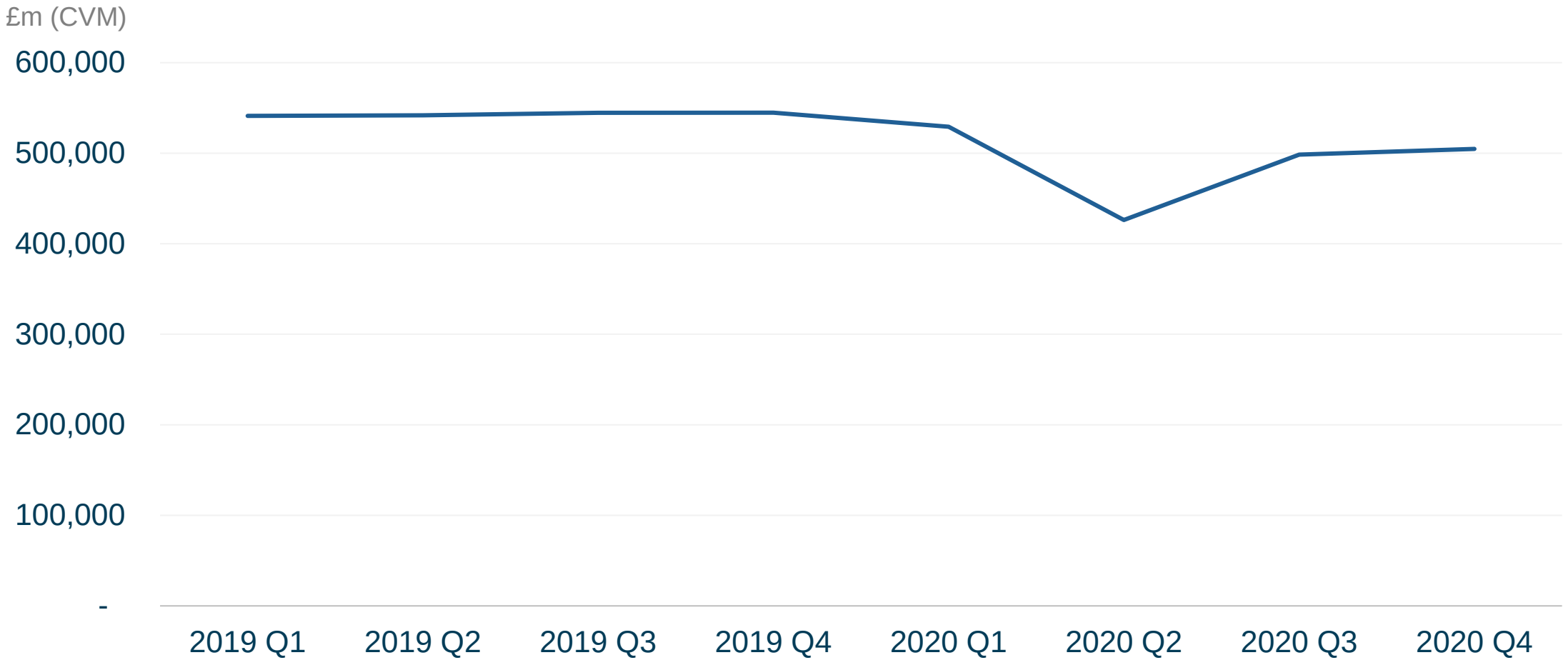
Overview

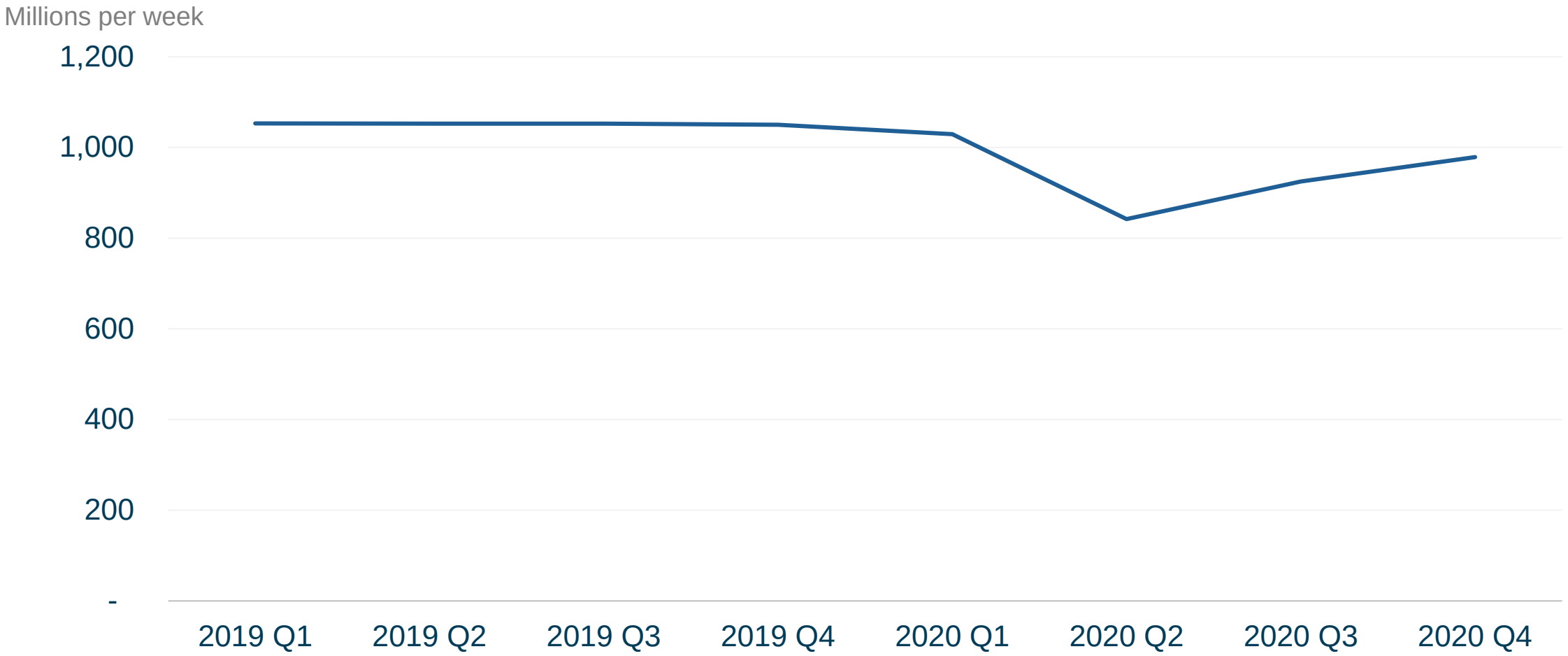
- Problem
- Approaches in the literature
- Our method
- Results

Problem

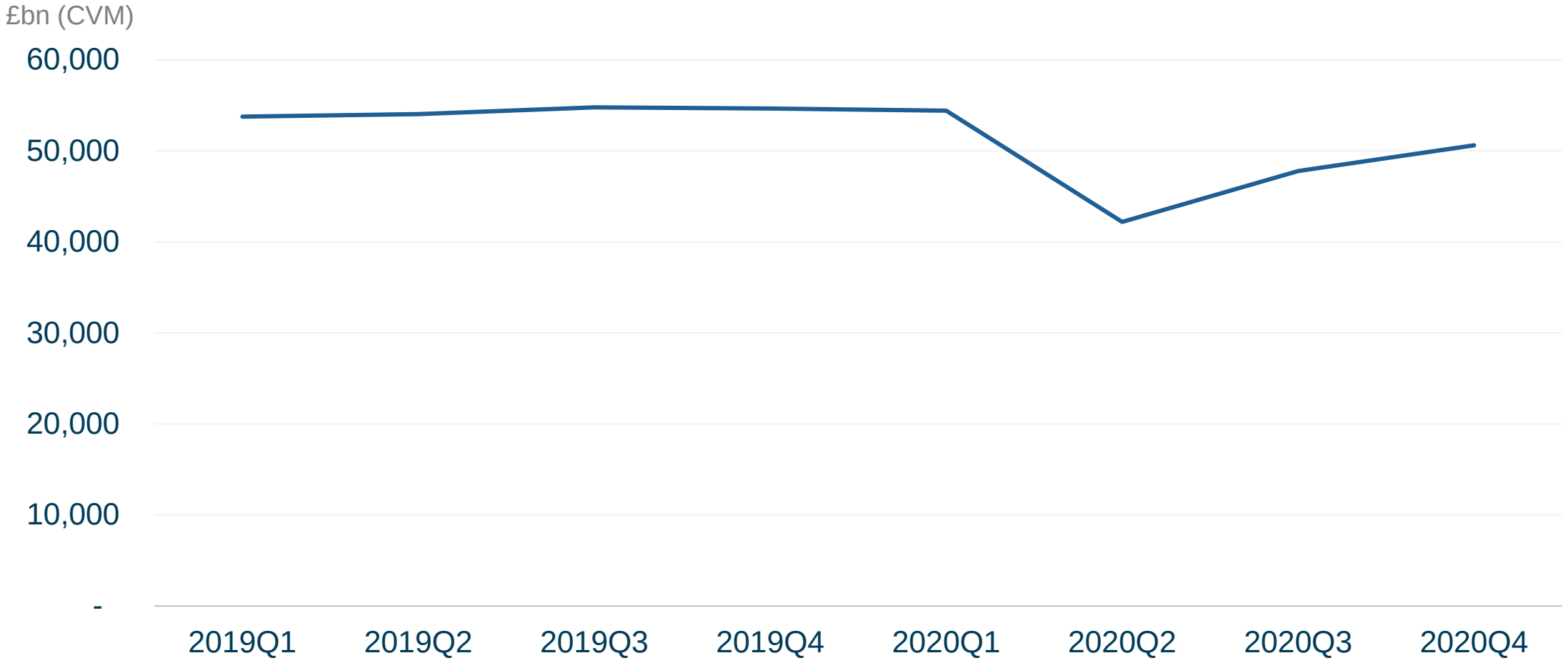
Economic output: GDP, Chained Volume Measure, seasonally adjusted



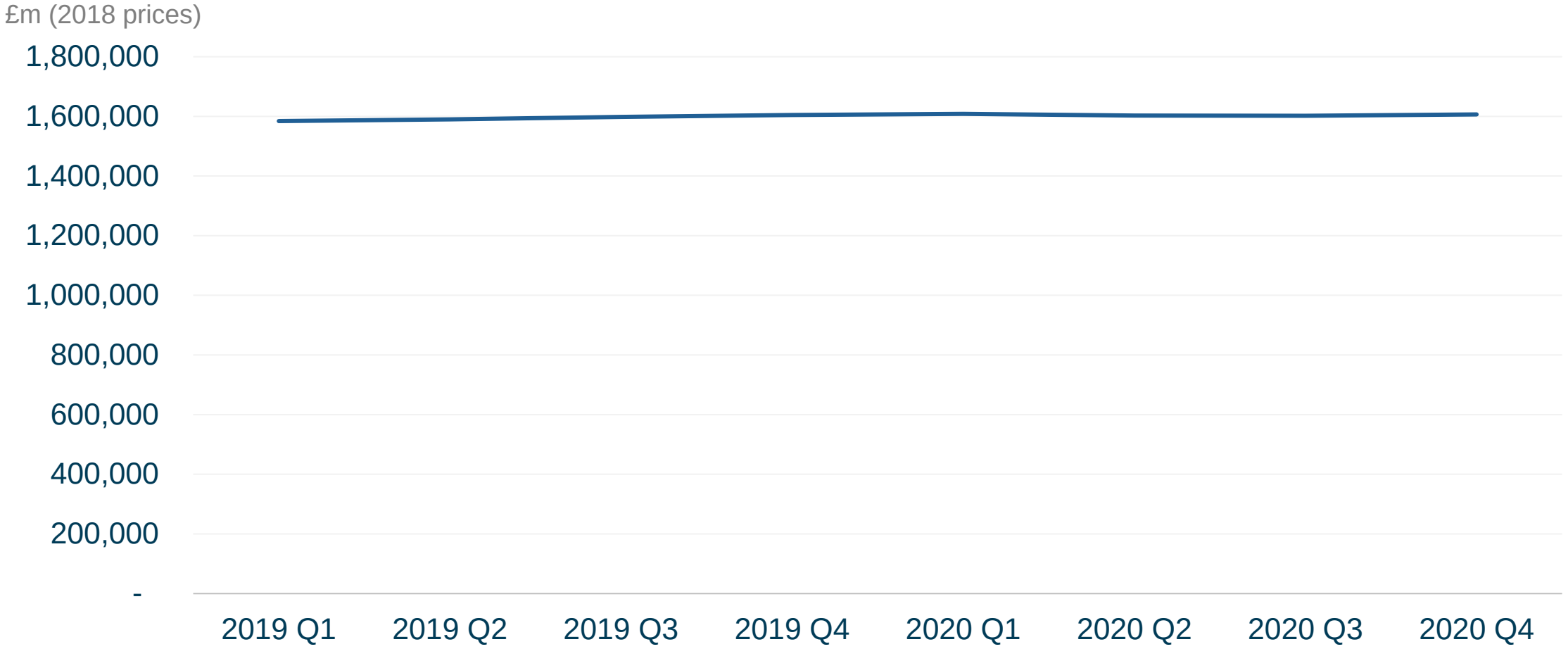
Hours worked: Total actual hours worked, whole economy, seasonally adjusted



Business investment: Chained Volume Measure, seasonally adjusted



Capital stock: Market sector, constant prices, not seasonally adjusted



Adjusting for capital utilisation

Change in the Capital Services Measure

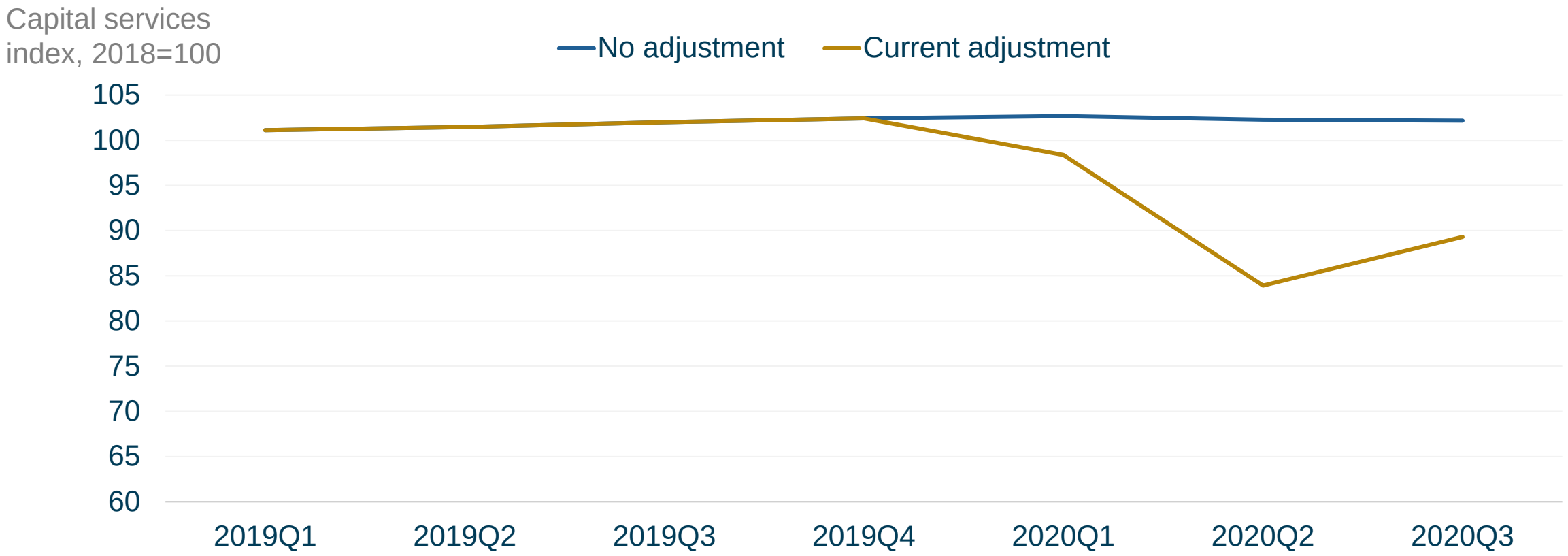
User cost of capital share for asset a, industry i, time t

$$dK = \sum dPS_{i,a,t} \times dUtil_{i,a,t} \times \left(\frac{UCS_{i,a,t} + UCS_{i,a,t-1}}{2} \right)$$

Change in the productive stock of asset a, industry i, time t

Change in the Utilisation factor for asset a, industry i, time t

Capital services index with and without current capital utilisation adjustment



Literature

Literature Review

- **Model capital utilisation**: Burnside and Eichenbaum (1994), Larsen, Neiss and Shortall (2001)
- **Using labour hours worked**: Foss (1981), Basu and Kimball (1997), Basu et al (2006), Gorodnichenko and Shapiro (2011), Fernald (2013)
- **Using inputs**: Burnside, Eichenbaum and Rebelo (1995), Basu (1995)
- **Survey based measures**: Comin et al (2020)
- **'Do nothing' philosophy**: Berndt and Fuss (1986) and Hulten (1986)

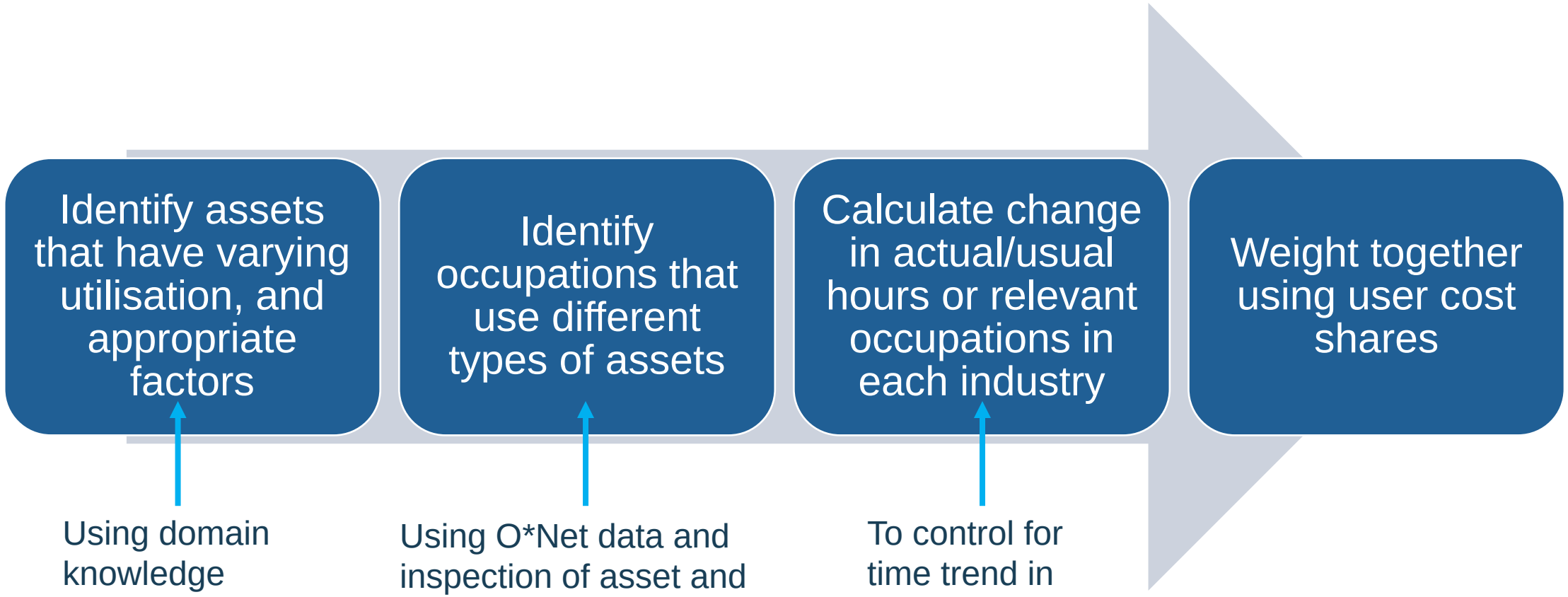
Problems with the standard hours-based approach

The hours approach follows the concept that workers are needed to work capital, and so if labour works less, the capital will work less hence its use as a proxy for capital utilisation. However, problems exist with this measure:

- Doesn’t reflect industry variation
- Doesn’t reflect person variation
- Doesn’t reflect types of capital
    - (Assumes all labour uses all capital equally)
- No baseline

Our approach

Our approach – Modified hours



Assets and associated occupations

Asset	Occupations	Comments
Other buildings	All	All workers in business owned buildings, hence office-hours only
Structures	All	This class includes roads and a range of public infrastructure, used indirectly by most workers
“Heavy” other machinery and equipment (OME)	A range that use agricultural, manufacturing, construction or other substantial machinery or equipment	See text for more details
“Light” other machinery and equipment (OME)	All	“Light” OME encompasses office furniture, shelving, etc. and it is difficult to think of any occupations that use none of these types of capital
IT hardware and telecoms equipment	Primarily office-based occupations, and other occupations that use ICT equipment	
Transport equipment	Drivers, pilots, etc. and all occupations where transport equipment is integral to their role.	Heavily concentrated in certain industries
Cultivated assets	N/A	No variation
Software and databases	As for IT hardware and telecoms equipment	
Entertainment, literary and artistic originals	N/A	No variation
Research and development	N/A	No variation
Mineral exploration and evaluation	All	Only present in the mining and quarrying industry, where utilisation of the asset reflects the degree of activity.

Why does capital depreciate?

- Wear and tear – physical (use-based) depreciation
  - e.g. a machine with repeated use

- Obsolescence – time-based depreciation
  - e.g. a computer once newer models come out
  - In the extreme, intangible assets

Use-based deterioration factors by asset

Asset	Typical depreciation rate	Use-based deterioration factor	Rationale
Other buildings	~5%	20%	Depreciation mainly due to obsolescence and weathering over time. Continues to provide services in the form of shelter/storage even when not used.
Structures	2-5%	50%	Clearly some depreciation of roads and other public infrastructure through repeated use. Given long assets lives, much of the depreciation is also due to obsolescence and weathering over time.
Transport equipment	15-20%	80%	Deterioration mostly due to use, since many mechanical parts that wear out through repeated use.
Other machinery and equipment	10-15%	80%	Mostly due to use, since many mechanical parts that wear out through repeated use. As with all assets, some obsolescence and weathering over time.
Telecoms equipment	~20%	20%	Relatively short asset lives, mostly due to high rates obsolescence due to technological change. Use largely due to consumers rather than producers, and many assets will be automated.
IT hardware	~40%	20%	Have relatively short asset lives, mostly due to high rates obsolescence due to technological change. Strain on processors from use can lead to failure of components, although more likely due to time. Assets can be fragile.

Use-based deterioration factors by asset (continued)

Asset	Typical depreciation rate	Use-based deterioration factor	Rationale
Cultivated assets	~40%	0%	Assets will continue growing and developing over time regardless of harvesting. Effective management and use (harvesting) may even reduce deterioration.
Software and databases	~40%	20%	As an intangible, no physical wear and tear is possible, but the rate of obsolescence could be linked to use – since reduced use might delay the extraction of value from database assets. Utilisation could also vary, as some software and database assets will be actively used by workers.
Mineral exploration and evaluation	~20%	20%	As an intangible, no physical wear and tear is possible, but the rate of obsolescence could be linked to use – since reduced use might delay the extraction of value from the information assets.
Entertainment, literary and artistic originals	~20%	0%	Depreciation based solely on obsolescence over time, linked to royalties from, and sales of, licenses to use and copies of the asset. Driven by demand and consumers, rather than owners.
Research and development	20-30%	0%	Depreciation based solely on obsolescence over time, linked to product cycles of relevant products. Driven by demand and consumers, rather than owners.

Buildings utilisation = 1 – homeworking hours

Homeworking status	Proportion of hours assumed to be worked at home	Comments
Mainly work at home	90%	Equivalent to one day a week in the office every other week, on average
Recently worked from home	25%	Equivalent to one day a week at home for most, and some for a little longer, on average
Occasionally work at home	5%	Equivalent to one day at home a month, on average
Never work at home	0%	

Based on ONS (2021), Felstead and Reuschke (2020)

Summary

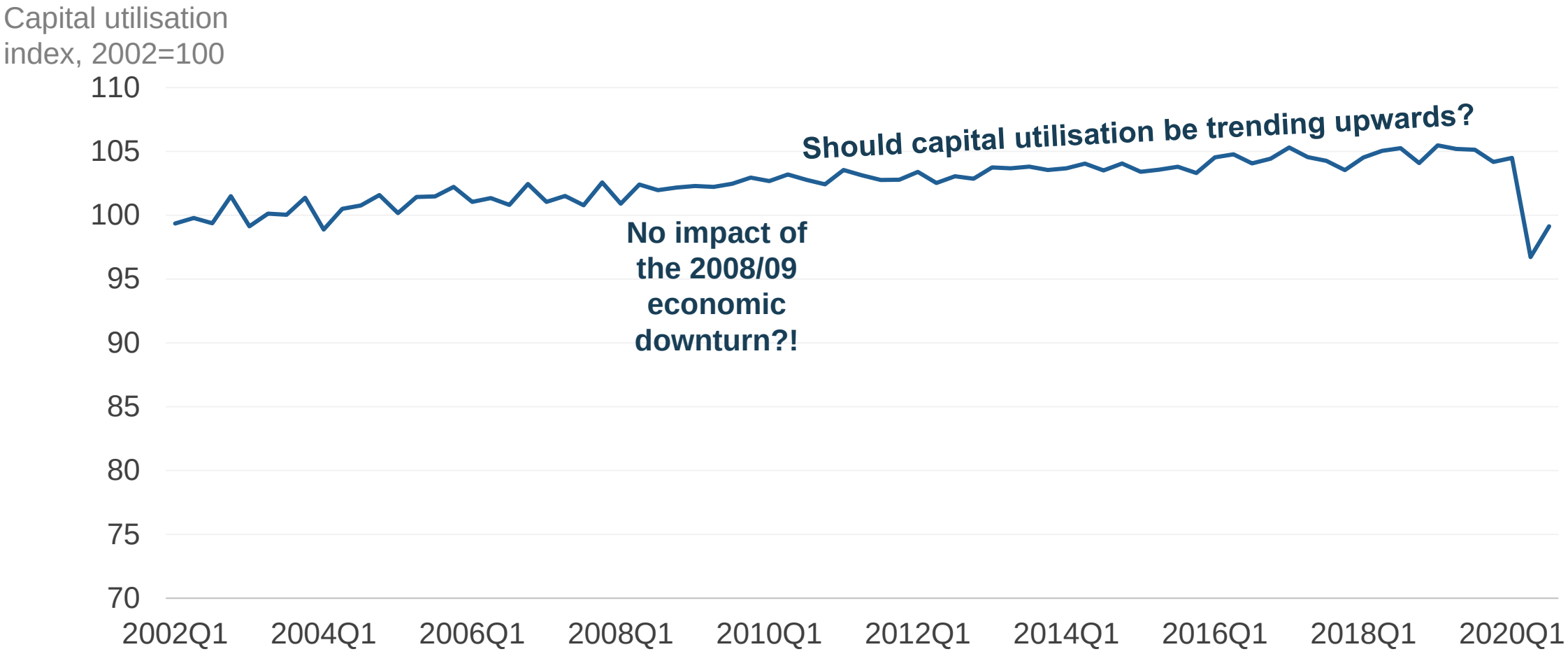
Calculate actual/usual hours, for relevant occupations, by industry

Multiply by asset-specific factor (the degree to which capital services depend on use)

Aggregate by user cost shares (across assets and industries)

Results

Capital utilisation series, UK market sector, indexed to 2002 = 100



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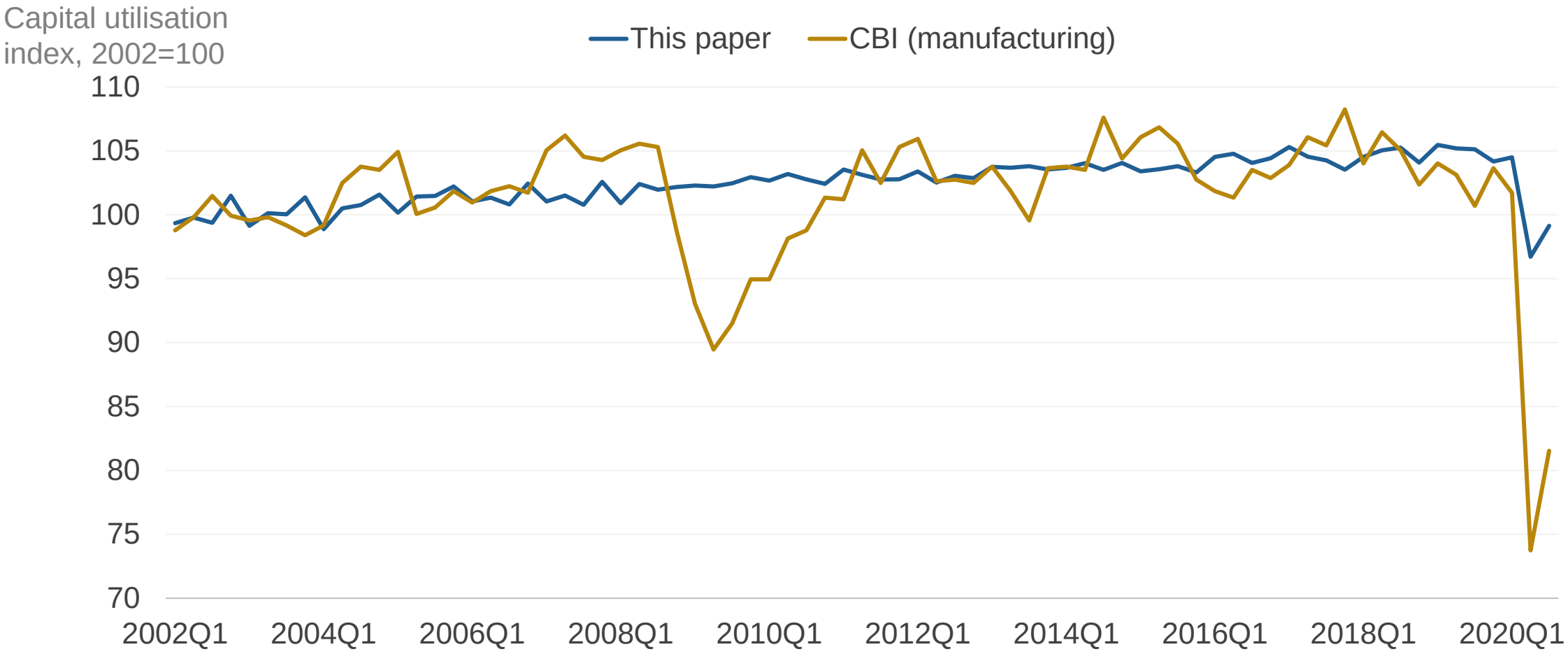
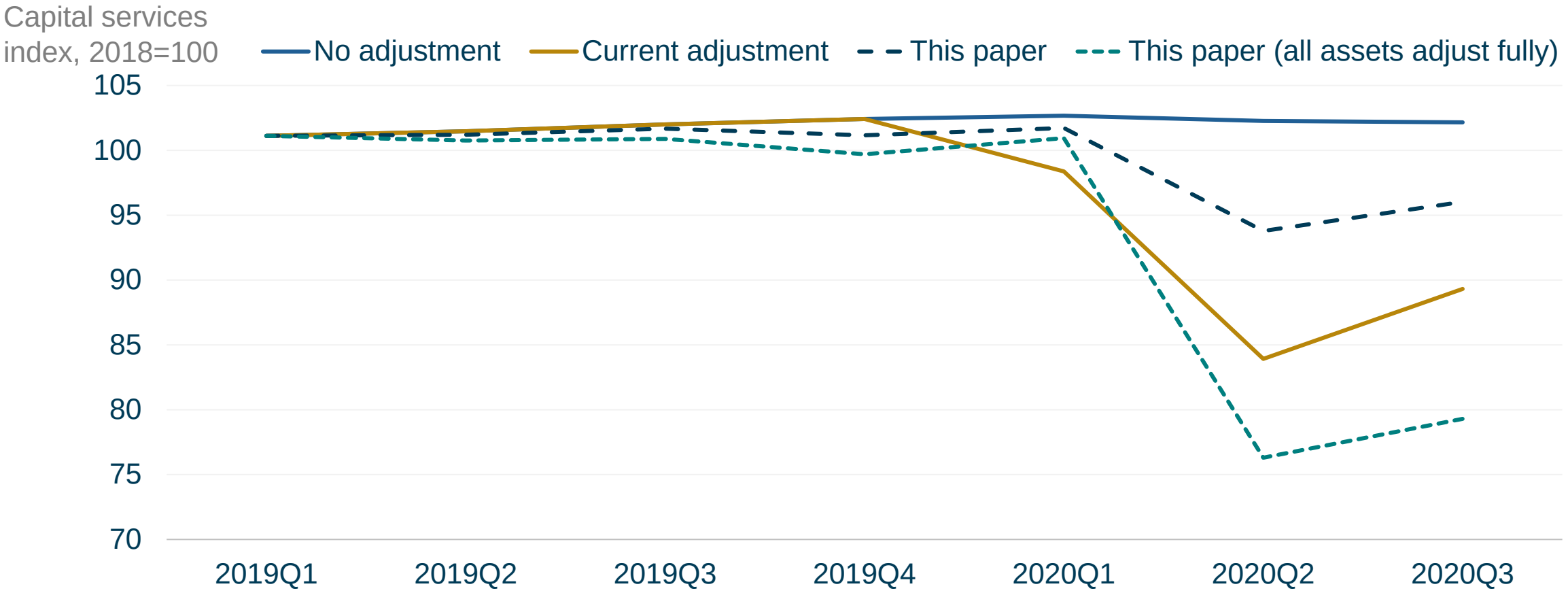
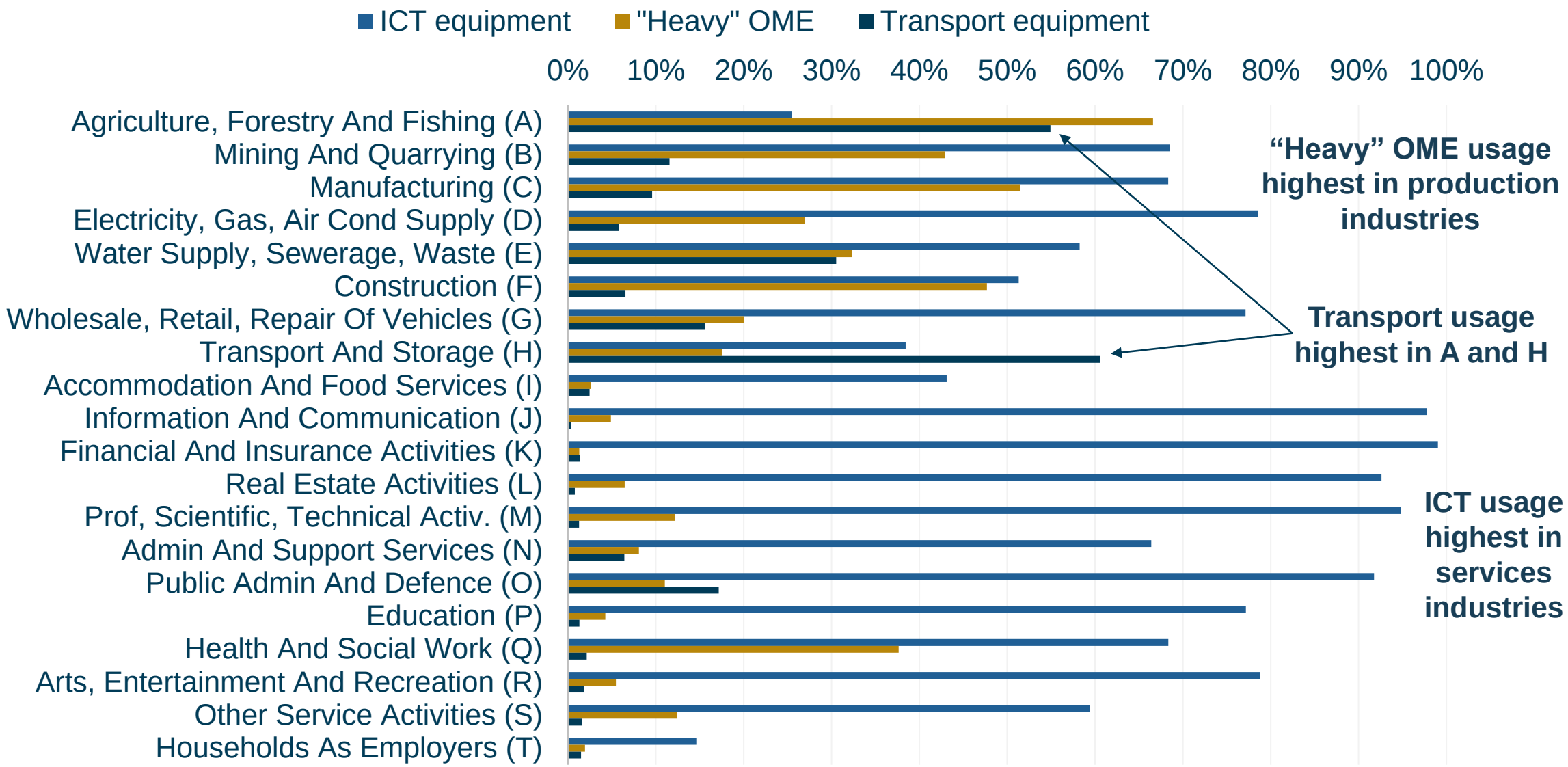


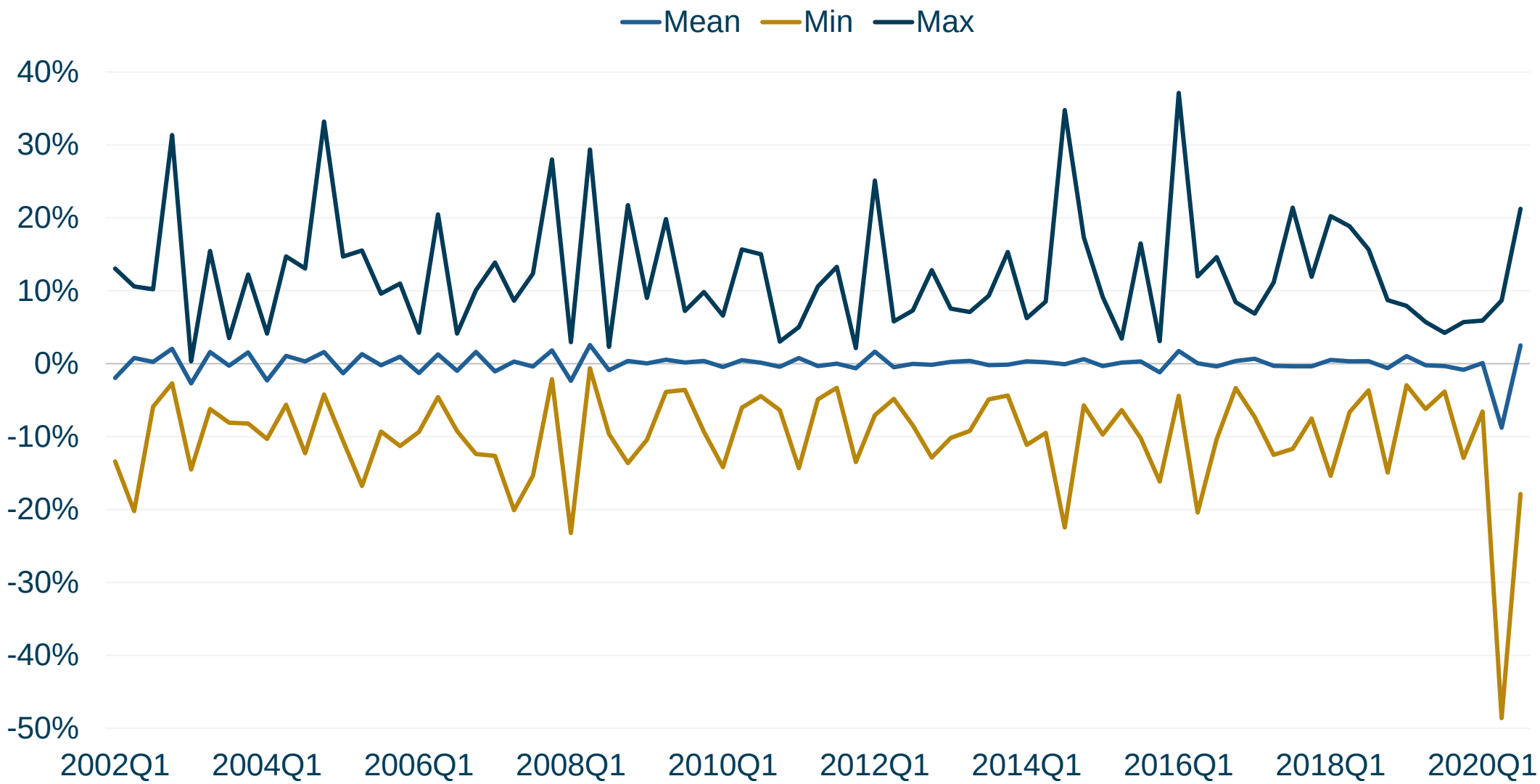
How does this compare?



Proportion of hours worked in each occupation-asset group, 2018



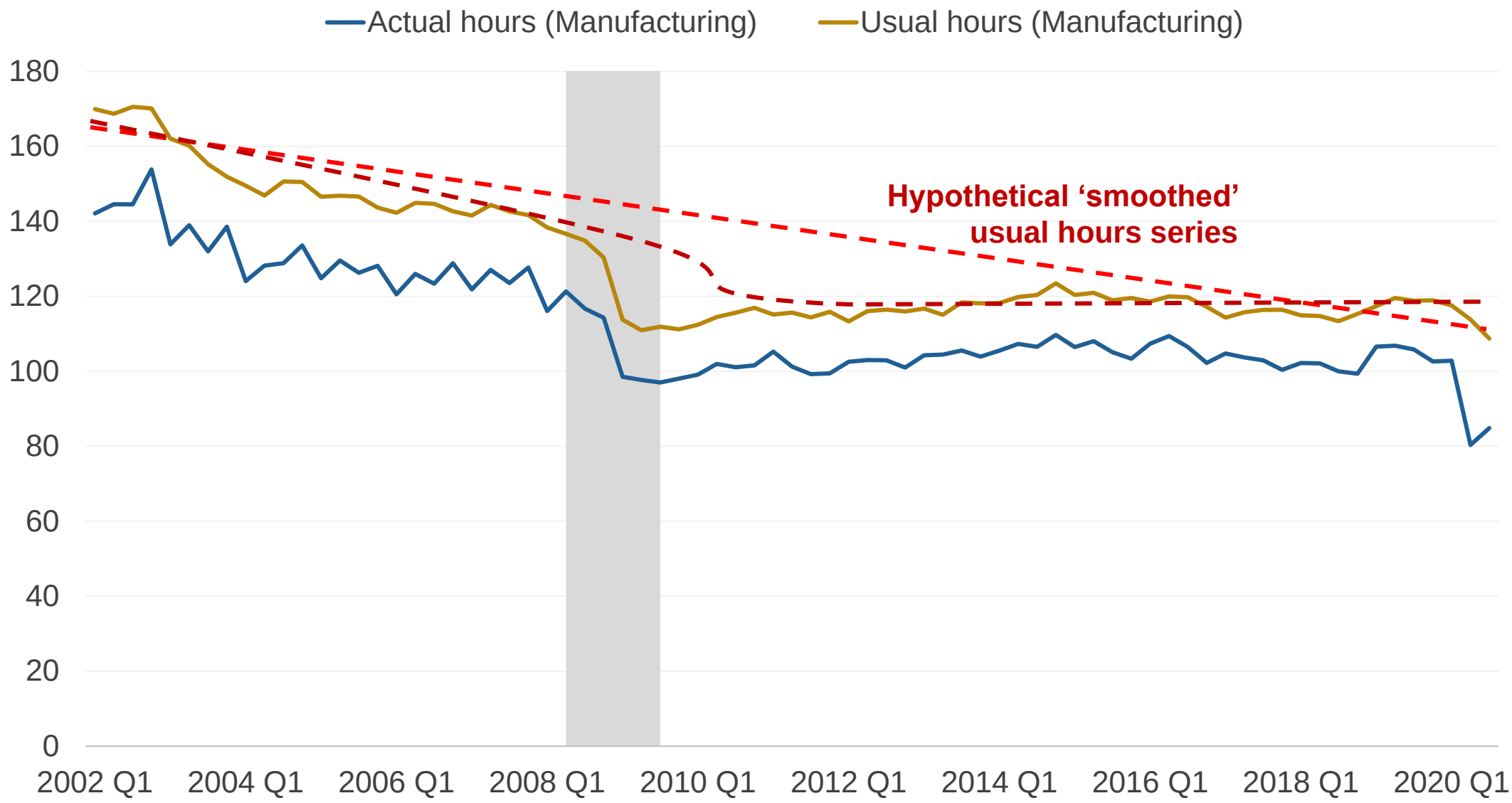
Distribution of quarterly capital utilisation changes by industry



Pros and cons to various implementation approaches in capital services and MFP measures

Approach	Pros	Cons
Implement across full time series	• Clear • No need to decide ‘when counts’	• Variation outside of ‘shocks’ could just be noise – may reduce intelligence of MFP
Implement only during economic downturns (2008/09, pandemic, maybe others)	• Remove some pro-cyclicality in MFP • Avoids introducing noise outside of economic downturns	• Creates internal inconsistency • Requires a decision on what to implement – ‘when counts’?
Implement only during the pandemic period	• Unprecedented shock – not to adjust reduces interpretability of MFP • Avoids introducing noise outside of economic downturns • No major decisions to make on ‘when counts’	• Need to decide when pandemic period starts and ends • Creates internal inconsistency

Actual and usual hours worked, manufacturing, not seasonally adjusted



Next steps

- Account for adjustment time of businesses:
  - By adding usual hours of job leavers from previous quarter
  - By applying a smoother to usual (and actual?) hours
  - By lagging actual or usual hours
- Create a new more robust production code
- Revise based on reviewer comments and submit for publication as an ESCoE DP – May-June 2021 (TBC)

Thanks for listening

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