

10<sup>TH</sup>

IMF  
Statistical  
Forum

META  
VERSE

TRADE  
MARK



# Data, Intangible Capital and Productivity

OCTOBER 30, 2022

Carol Corrado  
The Conference Board and  
Center for Business and Public Policy,  
Georgetown University

DATA

0101  
10

NFT

T

BRANDS

CLOUD

# MEASURING

THE TANGIBLE BENEFITS  
OF INTANGIBLE CAPITAL

10<sup>TH</sup>

IMF  
Statistical  
Forum

META  
VERSE

TRADE  
MARK

0101  
1011

NFT



T

BRANDS

CLOUD

# MEASURING THE TANGIBLE BENEFITS OF INTANGIBLE CAPITAL



STATISTICS

Based on a paper co-authored with

Jonathan Haskel, Imperial College and Bank of  
England

Massimiliano Iommi, ISTAT and LUISS

Cecilia Jona-Lasinio, ISTAT and LUISS

Filippo Bontadini, LUISS

Funding from the OECD and European Commission is  
gratefully acknowledged.

# Overview of paper

- Paper considers how the increased use of *data* in economies has affected productivity growth
- Data assets are intangible assets
  - ▶ Use the intangible capital framework (Corrado, Hulten and Sichel 2005, 2009) to analyze the impact of the increased use of data by businesses in economies
  - ▶ Considers data assets both conceptually and empirically and finds
  - ▶ ... data assets to be a subset of intangible capital
- Analyzes productivity implications and finds that the recent TFP slowdown (Europe and US) is not necessarily due to slowing technological change
  - ▶ Changes in the properties of intangible capital due to rise of *proprietary* data use are limiting the diffusion of data-derived knowledge, i.e., fewer productivity spillovers.

# Policy implications

## Statistical

- The approach to measuring data assets under consideration for the SNA seems too narrow

## Consumer privacy

- Industry data sharing a good thing for productivity (Jones and Tonetti 2019)
  - ▶ Long-standing examples of data sharing in financial lending (FICO scores, CARFAX)
  - ▶ Newer variants (Open Banking in the UK) that discourage lock-in effects

## Competition and macro

Intangibles as a factor of production may operate as a short-run substitute for labor

- Markup and ROR calculations must include intangibles
- Aggregate price mechanism possibly altered (effects of output variations muted)

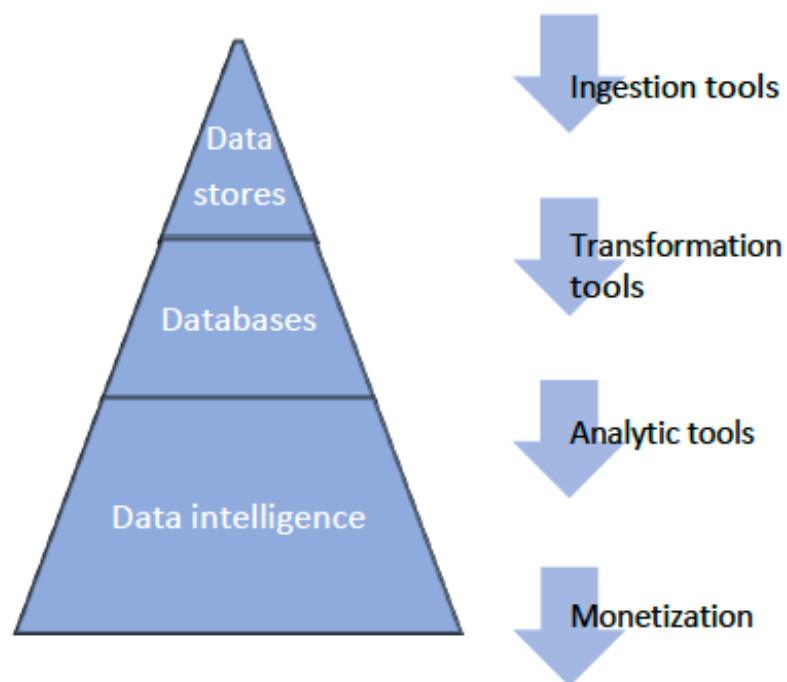
**JEP 2022, Figure 4  
and discussion**

**OECD working  
paper 2022a,  
Box 1**

# **Data and Intangible Capital: Concepts and Empirical Relationships**

# Data value creation: What do technologists and business strategists say?

## Data value chain

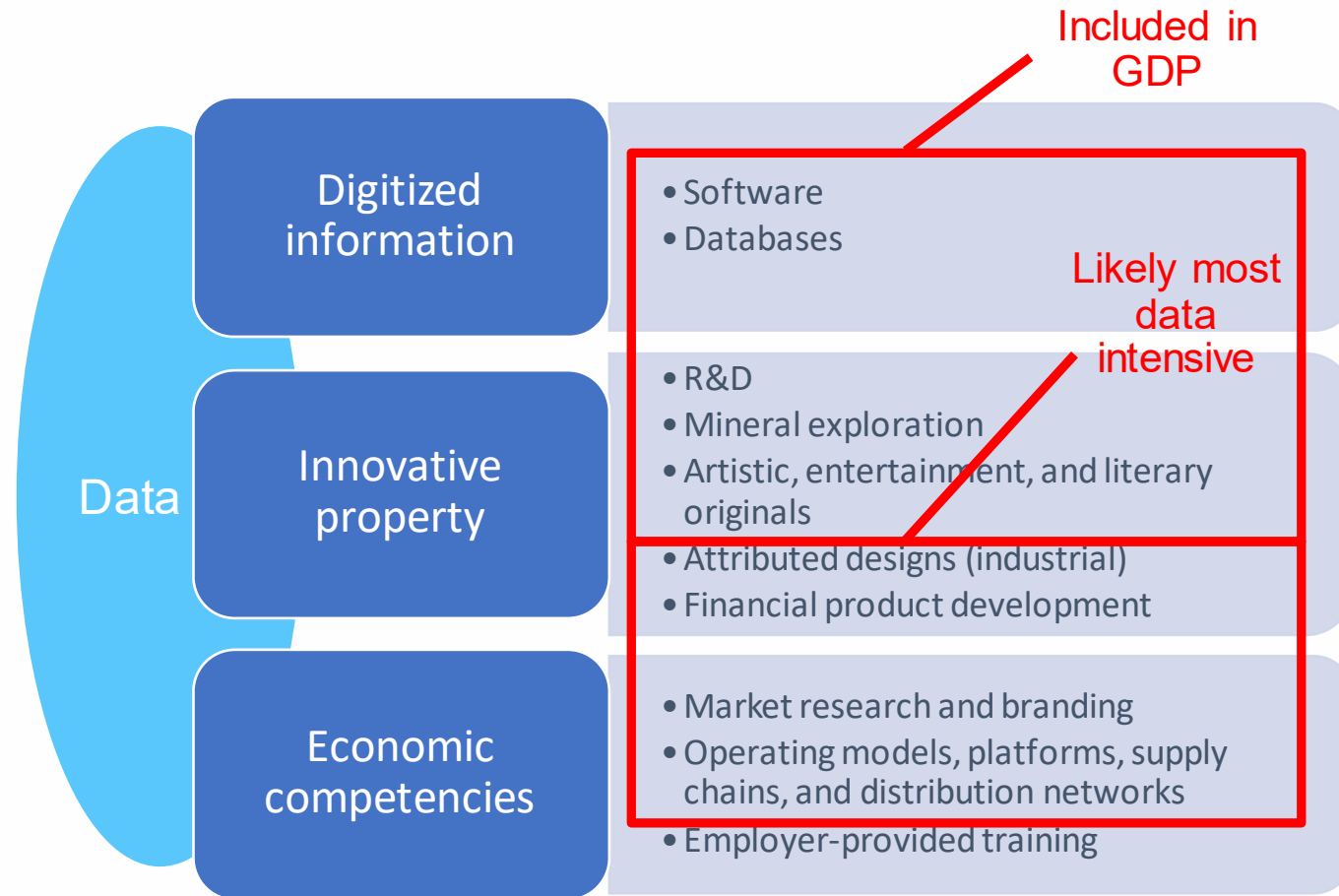


Note. The stack to the left depicts the stages of data asset value creation based on applying layers of tools shown on the right.

- **Data stores** are raw records not yet cleaned, formatted, or transformed for analysis
- **Databases** consist of transformed raw data suitable for some form of data analytics or visualization
- **Data intelligence** reflects the further integration of data with advanced analytic tools—a set of quantitative inputs that provide guidance for decision-makers/solutions to problems
  - ▶ **Most valuable stage of the value chain**
  - ▶ **Takes many forms**, e.g., scientific; computer, engineering & product designs; marketing strategies; and business operations and strategy (i.e., business models and logistics)

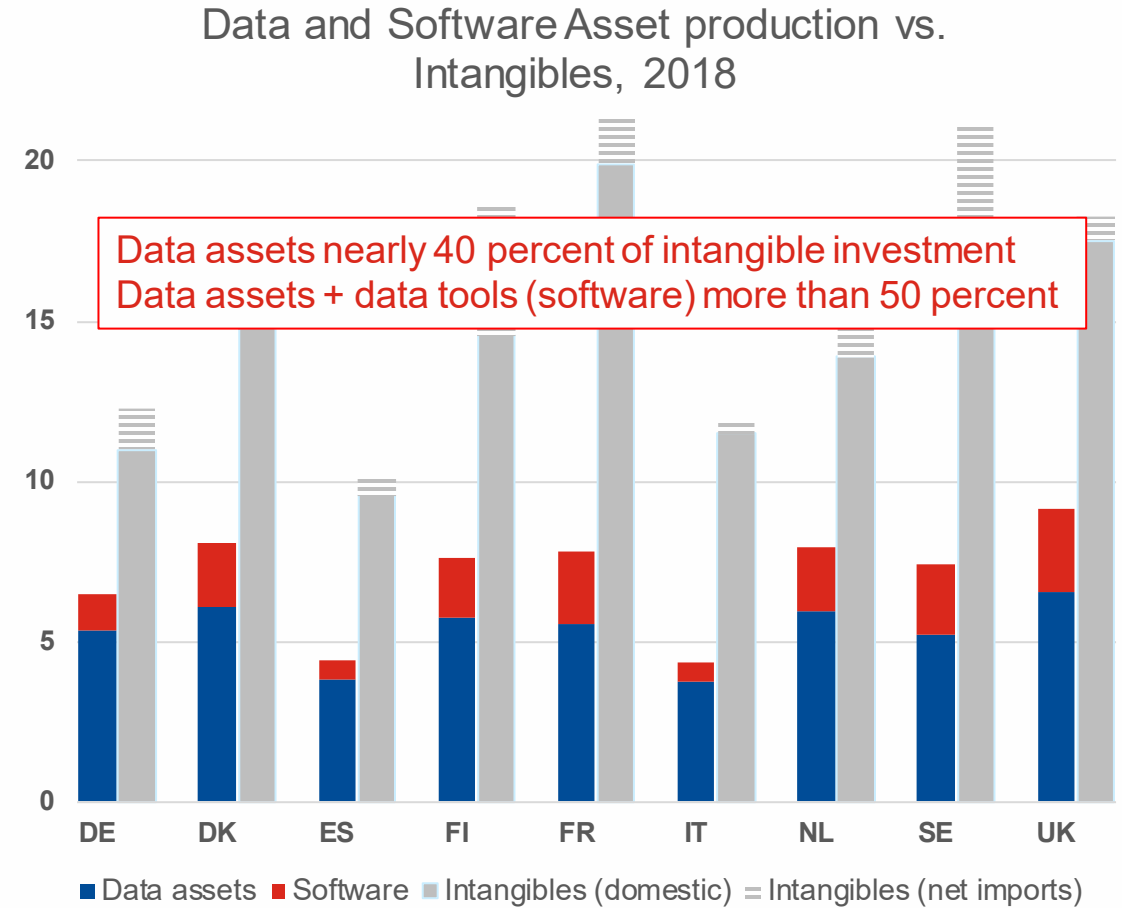
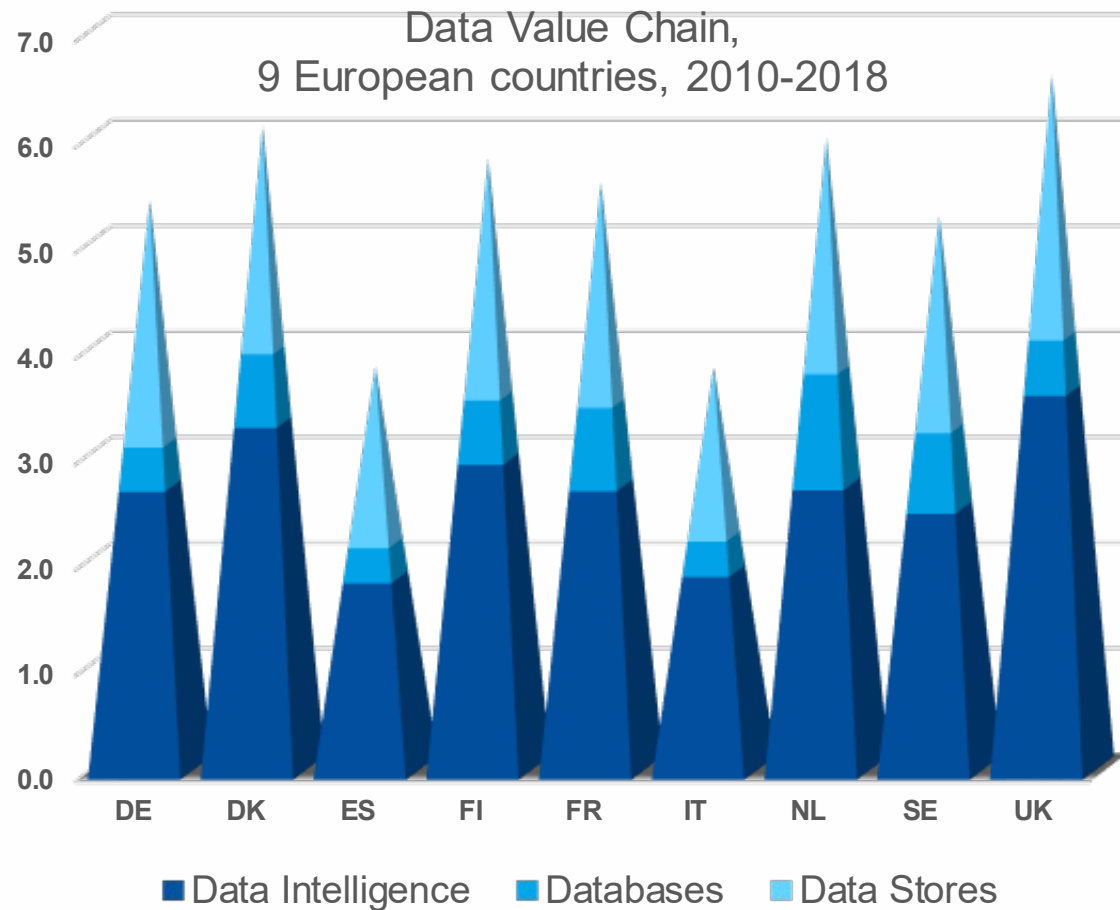
# Data as an intangible asset

- No one-to-one correspondence between components of intangibles and components of data stack
- Intangible investment includes most forms of data intelligence
  - ▶ Also, data tools/apps and databases
- Research strategy of paper:
  - ▶ Develop independent measures of investments in data assets
  - ▶ Compare with intangible investment
  - ▶ Investigate impacts of proprietary nature of intangible capital (via overlap with data assets) on productivity growth



Source: Adaptation of Corrado, Hulten, and Sichel (2005, 2009)

# Data capital and intangible capital



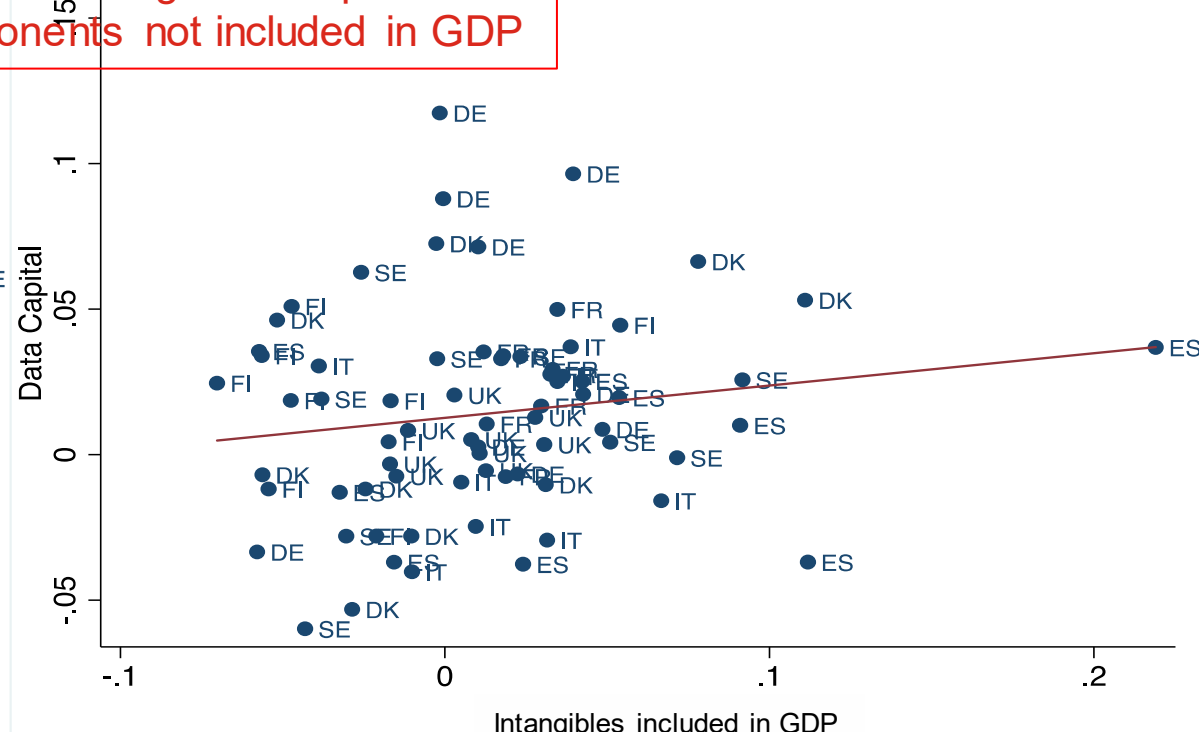
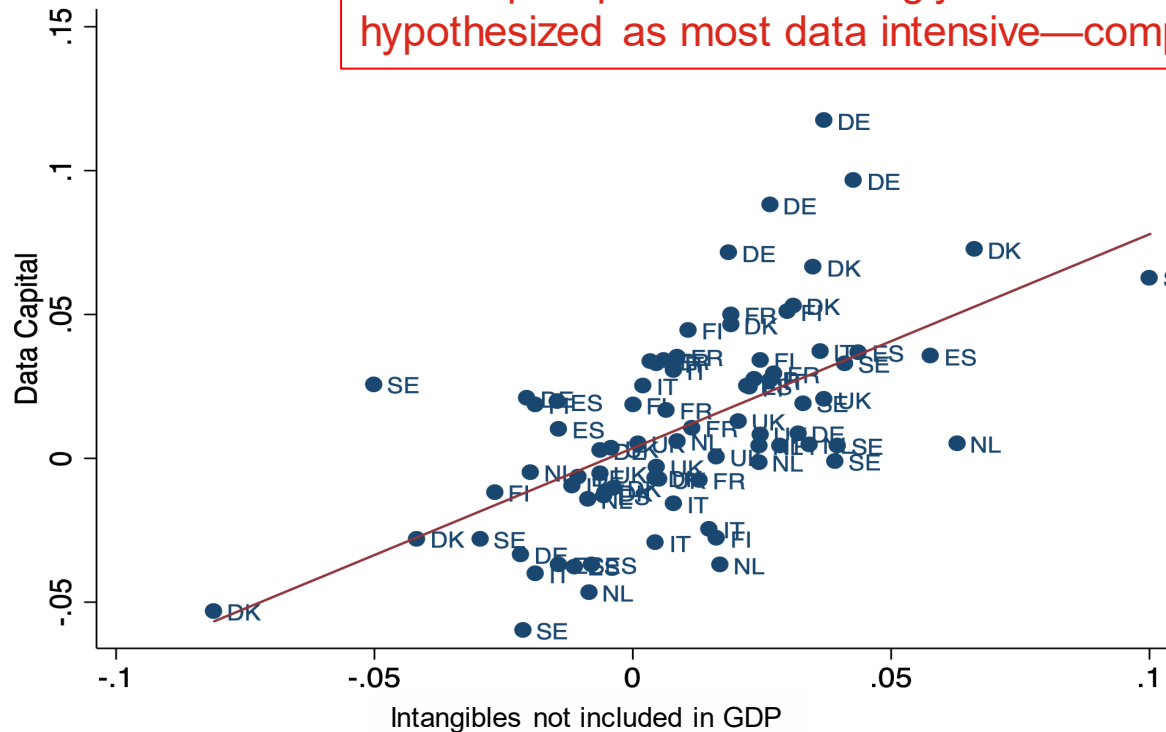
Notes: All series pertain to market sector industries and are plotted as percent of market sector GVA. Data asset production, software asset production, and net imports of intangibles are authors' estimates for market sector industries. Total investment in intangibles are from EUKLEMS & INTANProd (LUISS 2022).



# Data asset production and intangible sub-components

Data capital production vs intangible investment components not included in GDP (left) vs those that are included (right)

Data capital production strongly correlated with intangible components hypothesized as most data intensive—components not included in GDP



Note: Growth rates

Note: Growth rates

Note. Points plotted are growth rates of production or investment rates, 2010 to 2018

# **Productivity and the Rise of Proprietary Data**

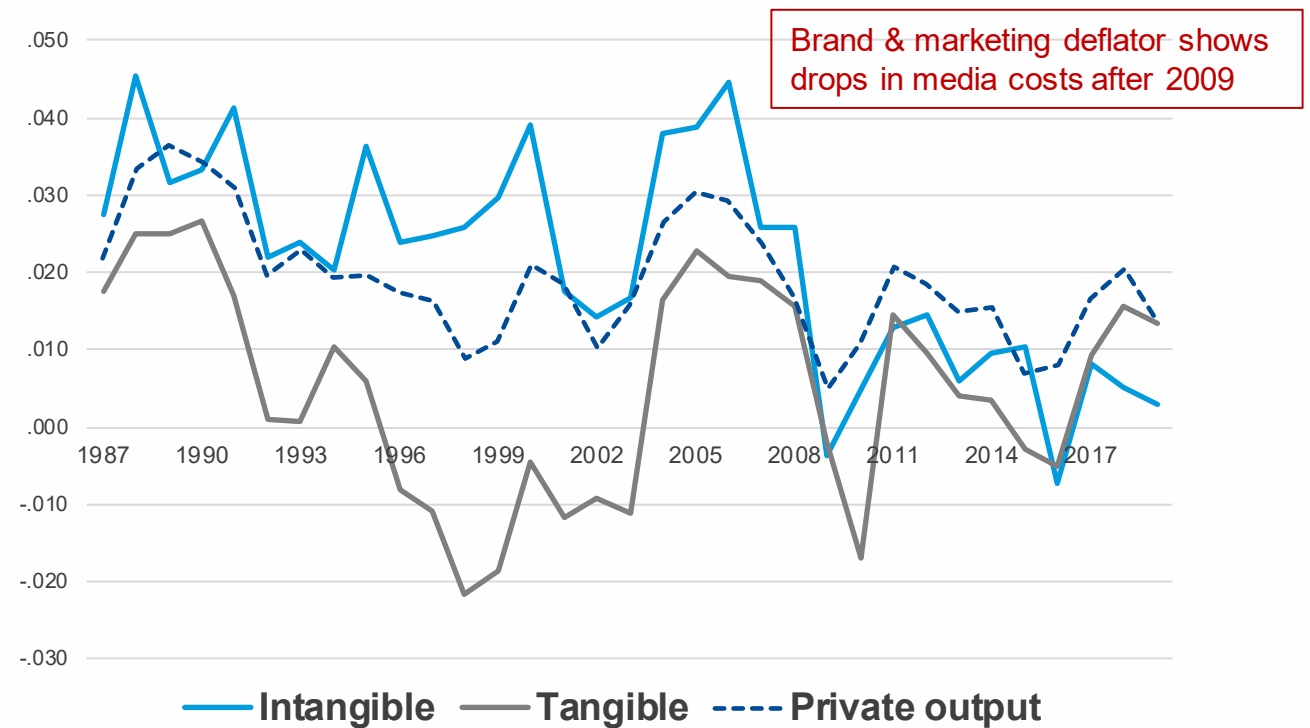
# Data-driven knowledge

- Model illustrates how data capital gives rise to opposing forces on TFP growth
- Proprietary data typically is neither disclosed nor shared, like a trade secret
  - ▶ This implies fewer productivity spillovers/weaker knowledge diffusion from intelligence derived from proprietary data
    - Fewer spillovers => weaker total factor productivity growth
    - Less knowledge diffusion => increased productivity dispersion, increased concentration, and possibly increased market power
- Data and data tools as an “innovation in the method of innovation”
  - ▶ Efficiency of innovation-producing activities (i.e., intangible investments) improves due to AI adoption and availability of open-source software

# Data as a driver of innovation (as well as a possible locus of market power)

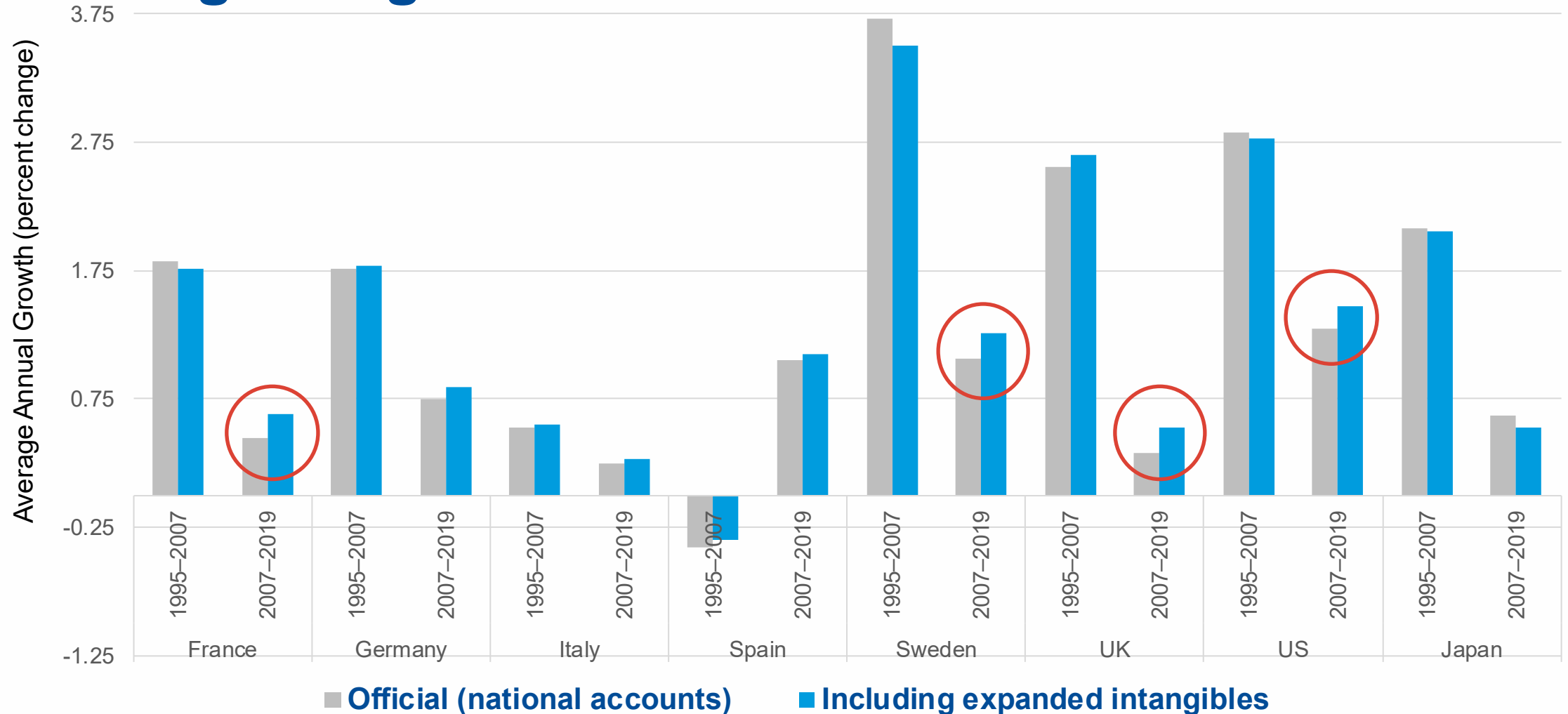
- Statisticians that estimate data assets
  - ▶ Tend to neglect the implications of how data/AI improves the efficiency of innovation-producing activities (intangible investments)\*
  - ▶ ...though, note, impacts are offset to the degree innovators retain abnormal profits
- Net effect manifest in the relative price of intangible assets...which turns disinflationary after 2009\*
  - ▶ ...and boosts growth of output per hour

Intangible and Tangible Investment Price Change, United States  
(private nonresidential investment, log point differences)



Source: Corrado (2022)

# Impact on output per hour of including all CHS intangibles greater after 2007

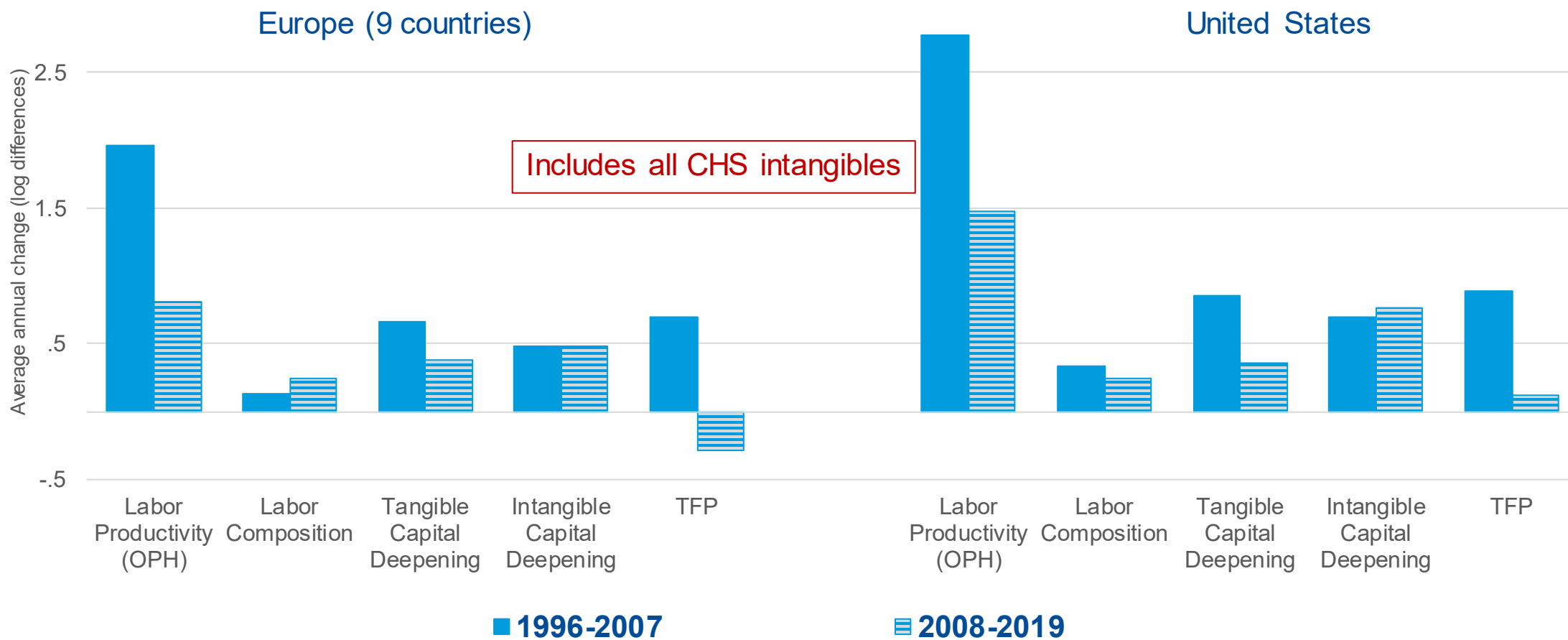


Note: Market sector industries. Excludes agriculture in all countries except Japan.  
 Source: Elaboration of EUKLEMS & INTANProd estimates (LUISS 2022).

# Total factor productivity estimates

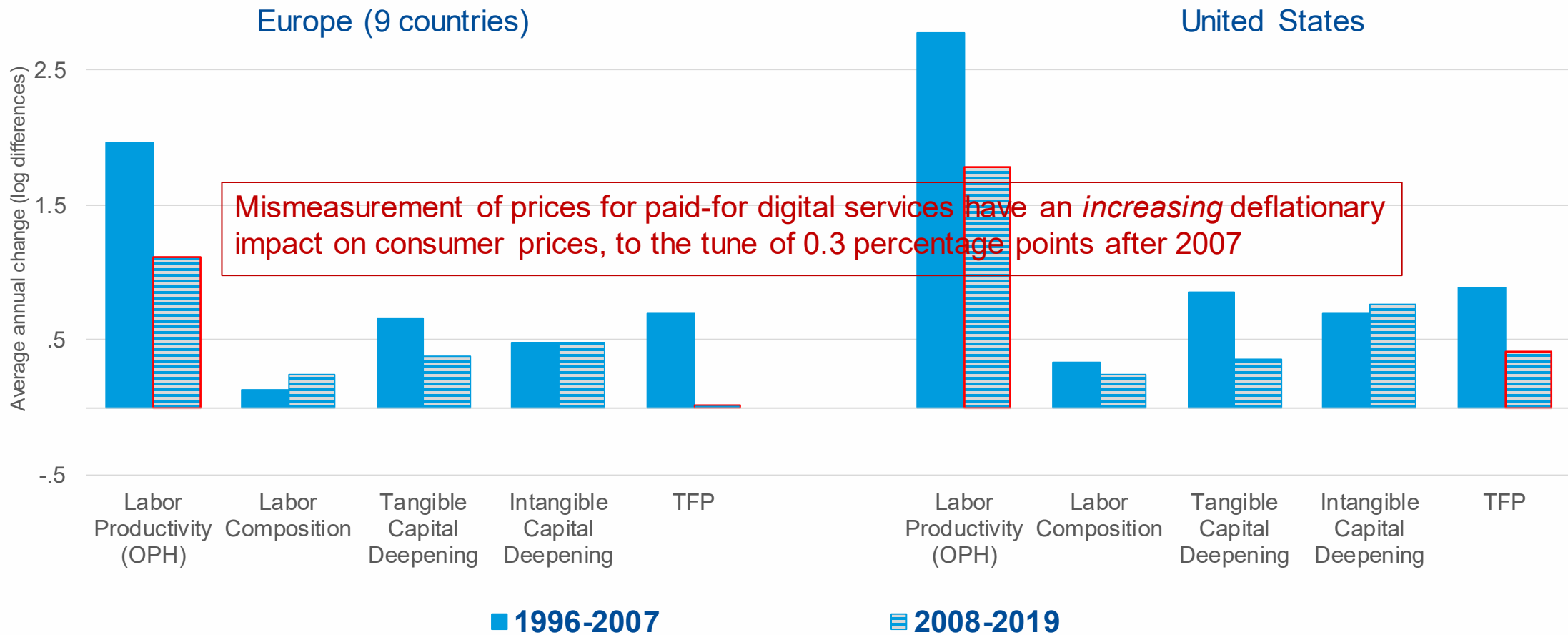
- Intangible investment estimates now available via EUKLEMS & INTANProd project
  - ▶ Estimates cover EU countries, UK, US, and Japan
  - ▶ EU estimates include full coverage of own-account components for the first time. For further information, see Bontadini et al. (2022) on project portal:  
<https://euklems-intanprod-ilee.luiss.it>
- Using these estimates, productivity decompositions were calculated for the US and a European aggregate covering the 9 countries with data production estimates shown on the previous slides.
- Real intangible capital figures for all countries use deflators for marketing assets based on harmonized media cost price indexes.

# Productivity decompositions: OPH, tangible capital deepening, TFP down .... intangible capital deepening well maintained



Note: Nonagricultural market sector industries. The 9 European countries are DE, DK, ES, FI, FR, IT, NL, SE and UK.  
 Source: Elaboration of EUKLEMS & INTANProd estimates (LUISS 2022)—preliminary.

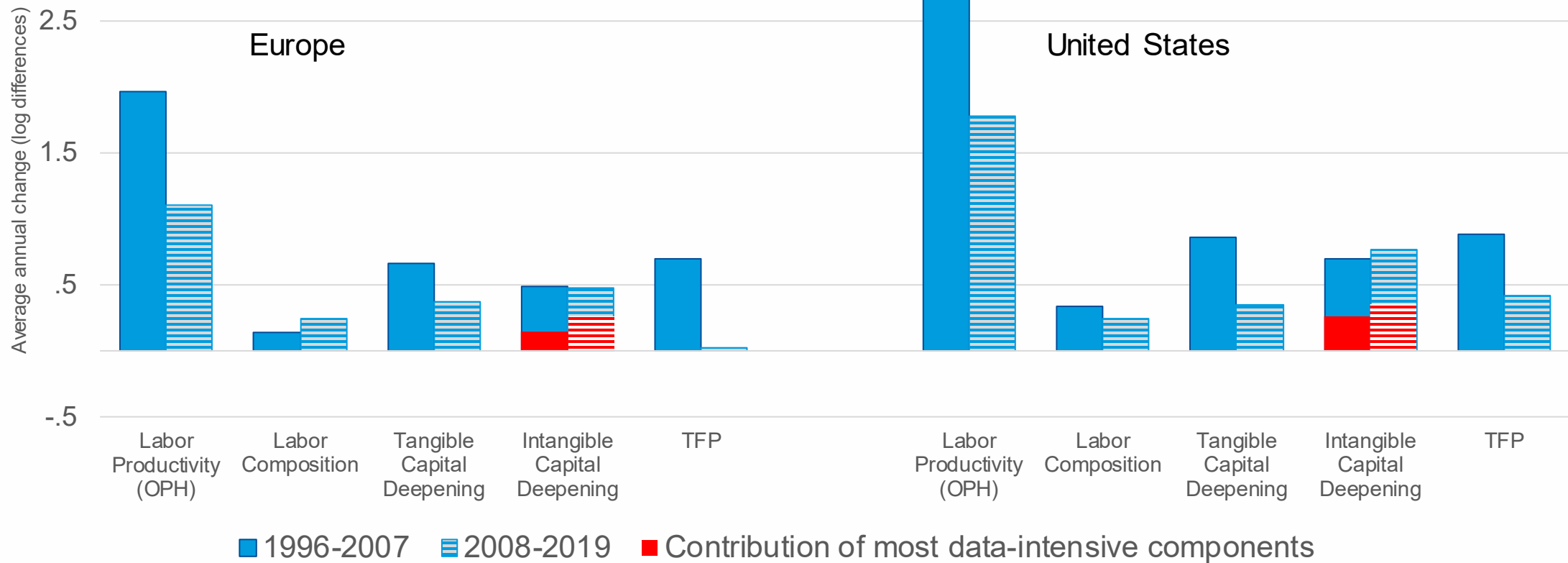
# Correcting for a first-order measurement issue: Overstated prices for consumer digital services



Note: Nonagricultural market sector industries. The 9 European countries are DE, DK, ES, FI, FR, IT, NL, SE and UK.  
 Source: Elaboration of EUKLEMS & INTANProd estimates (LUISS 2022).



# Decline in TFP growth accompanied by a step up in contribution of data intensive components



Note: Nonagricultural market sector industries. The 9 European countries are DE, DK, ES, FI, FR, IT, NL, SE and UK.  
 Source: Elaboration of EUKLEMS & INTANProd estimates (LUISS 2022).

# Implications

- Recent TFP growth (2007 to 2019) slows by about 3/4 percentage point (per year) in Europe\* and the United States based on new EUKLEMS & INTANProd database
- Research indicates that prices for consumer digital services are mismeasured to an increasing degree...and can account for nearly .3 percentage points of this slowing
- The diffusion of commercially valuable knowledge is the primary determinant of TFP in the intangible capital framework.
  - ✓ *If proprietary data has no productivity spillovers*, diminished diffusion could shave another .2 to .3 percentage points off TFP growth\*
  - ✓ Conference version of paper does not update our previous econometric analysis of nonR&D knowledge spillovers (*OxBull* 2017), nor have other developments, e.g., the increased availability of open-source software that potentially *boost* post-2007 productivity spillovers, been examined.

\* *Nine country aggregate. Market sector industries.*

\*\* *Exploits past studies of spillovers, data capital overlap, and growth rates of intangible capital.*

# Summary

- An intangible assets approach is used to address how the increased use of data affects productivity
  - ✓ Data assets were conceptualized and measured using a value chain framework
  - ✓ Production of data assets covers nearly 40 percent of intangible investment, and the most data intensive components of intangibles are not in GDP (nor likely to be under the approach to data assets considered for the SNA)
- Theory predicts that nonrival capital goods create increasing returns in the macroeconomy because they can be copied and replicated at low cost.
  - ✓ Data is fundamentally nonrival, but many data assets tend to be held as trade secrets, which restrains the diffusion of data-derived intelligence across firms and industries.
  - ✓ The breakdown of diffusion leads to much-discussed “winner take all” impacts...
  - ✓ But few empirical studies of this phenomena fully account for intangibles and even fewer (if at all) address how the increased use of data improves the efficiency of intangible investments and affects relative asset prices
- A contribution of this paper is to model and empirically frame these mechanisms in terms of their macroeconomic impact on productivity.

**Thank you.**  
**[carol.corrado@conference-board.org](mailto:carol.corrado@conference-board.org)**