

# Enterprise Information and Communications Technology Software - Pricing and Developer Productivity

This research paper challenges conventional methods of measuring software prices and analyses the complex interplay of factors affecting software cost and productivity. It explores changes in US business sector software prices and their impact on the Information and Communication Technology (ICT) function within the business sector. It also introduces the concept of a shadow price for ICT services and examines its implications on GDP growth and software spending.

The introduction of enterprise software (software used by organisations rather than individual users) and services spending in the US National Income and Product Accounts (NIPAs), more than 20 years ago, represented one of the first successful measures of intangible asset investment. The

innovation was a recognition that the global technology sector had made a meaningful contribution to productivity improvement. However, over more recent decades, much has changed.

The emergence of Artificial Intelligence (AI), cloud computing, software-as-a-service, and open-source software has revolutionised ICT capabilities, offering new value sources for businesses and government sectors. The inclusion of business sector software spending in National Income and Product Accounts signified a milestone in intangible asset investment measurement. However, economic measurement has struggled to keep pace with the rapidly evolving ICT landscape.

## Key Findings

- 1. Underestimated price declines** Current methods for measuring business sector software prices have consistently underestimated the extent of price declines. This oversight has significant implications for economic analysis and policy formulation.
- 2. Diverse ICT choices** The business sector ICT function now boasts a wide array of choices, including software-as-a-service, open-source software, cloud services, and global developer resources. These choices impact the software production function and contribute to the cost-effectiveness of business sector software.
- 3. Complex value creation** Software developer labour and multi-factor productivity emerge as pivotal sources of value creation. These factors can either offset or add to changes in resource costs, making measurement challenging.
- 4. Shadow price of ICT services** Due to the absence of an open market for business sector ICT services, a shadow price for these services has been developed to better understand their economic impact. Using US NIPA data, this estimation reveals that software price declines have been underestimated by 6.5 percentage points (ppt) between 2015-2020.
- 5. GDP Growth Impact** The underestimation of software price declines results in a 0.1 ppt underestimate of US GDP growth and a notable increase in software spending from 19.1% to 25.5% of non-residential fixed investment.

## Future Research

This research underscores the importance of re-evaluating methods for measuring business sector software prices, given the profound changes in the ICT landscape. Accurate measurement is critical for informed policy decisions and economic analysis, especially in an era of rapid technological advancement. Future research should focus on:

### 1. Changing Landscape of Software

**Development** With a growing reliance on cloud computing, software-as-a-service, and other software sector capabilities, future research should examine the evolving nature of software production in the business sector, especially among smaller organisations.

**2. Impact of Artificial Intelligence** The diffusion of Artificial Intelligence can substantially influence business software development, potentially increasing software developer productivity and creating new value sources from third-party providers.

**3. Open-Source Software** The rise of open-source software represents a significant source of downward price pressure in the software sector. However, measuring its impact remains challenging and warrants further investigation to better understand its implications for the industry and the broader economy.

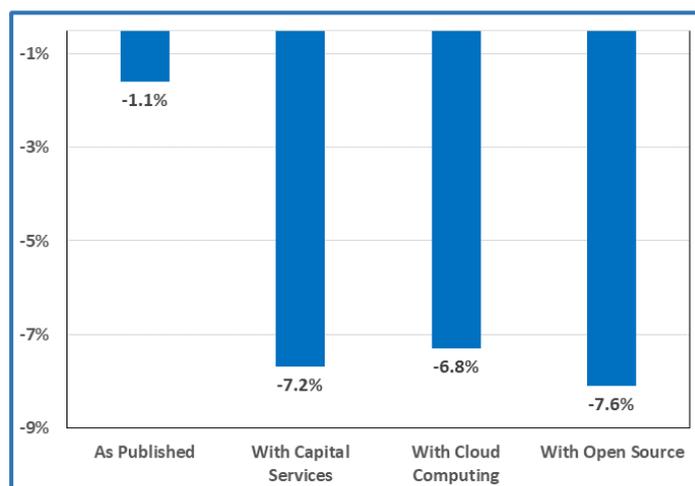


Figure 24: Business Sector ICT Function Price Index 2015 to 2020 % CAGR

**Shadow price** - The monetary value assigned to an abstract or intangible commodity which is not traded in the marketplace.

**Multi-factor productivity (MFP)** - This is a measure of economic performance that examines the overall efficiency with which labour and capital inputs are used together in the production process. Also known as Total Factor Productivity, it is a part of GDP growth that cannot be explained by changes in labour and capital inputs.