Manual for "Measuring US Industry-Level Productivity Between 1947 and 2023"*

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1 Introduction

We combine data from Jorgenson et al. (2017), Eldridge et al. (2020) and Garner et al. (2025) to extend US industry-level production accounts up until 2023. Additionally, we apply the methodology in Jorgenson et al. (2007) to produce industry-level measures of labor productivity and total factor productivity (TFP) for the corresponding time period. Our dataset covers 63 industries between 1963 and 2023 and 44 industries between 1947 and 2023. To the best of our knowledge, our dataset offers productivity measures with the most extensive temporal coverage and the highest degree of industry disaggregation for the entire US economy currently available.

2 Data

To compute productivity measures between 1947 and 2023, we rely on 3 underlying datasets:

[1] **prod_accounts_1947to2014:** This is produced by Jorgenson et al. (2017) and contains nominal and real values for gross output, capital, labor and intermediate inputs for 65 industries between 1947 and 2014. [DATA LINK]

[2] **prod_accounts_1947to2016:** This is produced by Eldridge et al. (2020) and contains nominal values and quantity indices of output and intermediate inputs as well as nominal values and quantity indices of different types of capital and labor services. This is in addition to the number of hours worked in each industry. The data covers 63 industries between 1963 and 2016. The dataset also covers the period between 1947 and 1963 for 44 industries. [DATA LINK]

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[3] **prod_accounts_1997to2023:** This dataset produced by Garner et al. (2025) contains nominal values and quantity indices for output as well as different intermediate inputs, capital services, labor services and hours worked for 63 industries between 1997 and 2023. [DATA LINK]

For the version of our dataset covering 63 industries between 1963 and 2023, we obtain nominal values for gross output and factor compensation between 1963 and 2014 from [1] and extend these with nominal values for gross output and factor compensation for the period between 2015 and 2023 from [3]. We use the quantity indices from [2] for the period between 1963 and 1997 and supplement these with the quantity indices from [3] for the period between 1998 and 2023. Data on total hours worked is obtained from [2] for the period between 1963 and 1997 and from [3] for the period between 1998 and 2023.

Although [1] offers the nominal gross output and factor compensations for the all 63 industries from 1947 to 2014, the underlying historical quantity indices from the period between 1947 and 1963 that is needed to produce productivity indices for the corresponding time range only covers 44 industries. We can therefore only cover 44 industries in our productivity measurements between 1947 and 2023.

The list of 44 industries groups some of the 63 industries together rather than creating an entirely new industry classification system. This means that we can aggregate nominal output and factor compensation values across the relevant industries using the underlying data in [1] (for the period between 1947 and 2014) and [3] (for the period between 2015 and 2023) to produce a complete account of nominal output and factor compensation values for the 44 industries between 1947 and 2023. To create the accompanying input quantity and productivity indices, we use the underlying data for the 44 industries between 1947 and 1963 in [2]. Since the 44 industries aggregate some of the 63 industries together, we can extend the input quantity and productivity growth rates in time for the 44 industries by aggregating the growth rates by industry using the growth rates that we compute for the 63 industries between 1963 and 2023. Aggregation is by Törnqvist-weighted industry value add shares.

3 Methodology

The output of each industry (Q) is produced by combining three factors of production. These are capital services (K), labor services (L) and intermediate inputs (I). In this section, we discuss how we compute quantity indices for these three types of inputs for each industry, and how we use these to create output- and value-add productivity measures. We follow a similar productivity measurement strategy as Jorgenson et al. (2007).

3.1 Input Quantity Growth

Not all labor services are the same. Labor services provided by college-educated individuals will differ from the labor services provided by non-college-educated individuals. Likewise, capital services and intermediate inputs are also an aggregation of different types of capital services (think IT equipment capital vs software capital) and intermediate inputs (think energy vs materials), respectively. Hence, it is necessary to introduce notation to represent the different types of various factors of production. Let subscript k

denote the type of capital such that $k \in \{1, ..., \mathcal{K}\}$. Similarly, let the types of labor services and intermediate inputs be denoted by $l \in \{1, ..., \mathcal{L}\}$ and $i \in \{1, ..., \mathcal{I}\}$, respectively. Finally, let subscript t denote the year.

To compute the growth rate of capital, labor and intermediate input quantities used to produce output in a given industry, it is necessary to aggregate the quantity growth rates of the different types of capital services, labor services and intermediate inputs, respectively. This implies

$$\Delta lnK_t = \sum_k \bar{\omega}_{k,t} \Delta lnK_{k,t}$$

$$\Delta lnL_t = \sum_l \bar{\omega}_{l,t} \Delta lnL_{l,t}$$

$$\Delta lnI_t = \sum_i \bar{\omega}_{i,t} \Delta lnI_{i,t}$$

Letting the price of each type of capital, labor, and intermediate input be denoted by P_k, P_l and P_i, respectively, the growth rate of each type of capital, labor and intermediate input is weighted by the two-period average nominal share (hereafter referred to as Törnqvist weight) of total factor compensation paid to each type of factor

$$\bar{\omega}_{k,t} = 0.5 \times (\omega_{k,t} + \omega_{k,t-1}) \quad \text{where} \quad \omega_{k,t} = \frac{P_{k,t}K_{k,t}}{\sum_k P_{k,t}K_{k,t}}$$

$$\bar{\omega}_{l,t} = 0.5 \times (\omega_{l,t} + \omega_{l,t-1}) \quad \text{where} \quad \omega_{l,t} = \frac{P_{l,t}L_{l,t}}{\sum_l P_{l,t}L_{l,t}}$$

$$\bar{\omega}_{i,t} = 0.5 \times (\omega_{i,t} + \omega_{i,t-1}) \quad \text{where} \quad \omega_{i,t} = \frac{P_{i,t}I_{i,t}}{\sum_i P_{i,t}I_{i,t}}$$

These growth rates are then chained to produce the input quantity indices.

3.2 Output-Based Productivity Growth

We produce 2 output-based measures of productivity: output per hour worked and output TFP. This subsection describes how we compute the growth rates of each of these productivity measures which we later chain to produce the indices.

Starting with the growth rate of output quantity per hour worked, this is simply

$$\Delta ln\left(\frac{Q_t}{H_t}\right) = \Delta lnQ_t - \Delta lnH_t$$

where H_t are the total number of hours worked by college- and non-college-educated workers to produce output Q_t. Meanwhile, the growth rate of output TFP is

$$\Delta lnTFP_t^Q = \Delta lnQ_t - \bar{\omega}_{K,t}\Delta lnK_t - \bar{\omega}_{L,t}\Delta lnL_t - \bar{\omega}_{I,t}\Delta lnI_t$$

using Törnqvist-weighted factor compensation shares of total expenditure

$$\bar{\omega}_{K,t} = 0.5 \times (\omega_{K,t} + \omega_{K,t-1}) \quad \text{where} \quad \omega_{K,t} = \frac{P_{K,t}K_t}{P_{K,t}K_t + P_{L,t}L_t + P_{I,t}I_t}$$

$$\bar{\omega}_{L,t} = 0.5 \times (\omega_{L,t} + \omega_{L,t-1}) \quad \text{where} \quad \omega_{L,t} = \frac{P_{L,t}L_t}{P_{K,t}K_t + P_{L,t}L_t + P_{I,t}I_t}$$

$$\bar{\omega}_{I,t} = 0.5 \times (\omega_{I,t} + \omega_{I,t-1}) \quad \text{where} \quad \omega_{I,t} = \frac{P_{I,t}I_t}{P_{K,t}K_t + P_{L,t}L_t + P_{I,t}I_t}$$

3.3 Value Add-Based Productivity Growth

We produce 2 value add-based measures of productivity: value add quantity per hour worked and value add TFP. To compute these, we must start by computing a measure value add quantity growth. This is

$$\Delta lnVAQ_t = \frac{(\Delta lnGO_t - \bar{\omega}_{I,t}\Delta lnI_t)}{\bar{\omega}_{VA,t}}$$

using Törnqvist-weighted nominal value add share of output

$$\bar{\omega}_{VA,t} = 0.5 \times (\omega_{VA,t} + \omega_{VA,t-1}) \quad \text{where} \quad \omega_{VA,t} = 1 - \omega_{I,t}$$

With this, we can compute the growth rate of value add quantity per hour worked as

$$\Delta ln\left(\frac{VAQ_t}{H_t}\right) = \Delta lnVAQ_t - \Delta lnH_t$$

and the growth rate of value add TFP as

$$\Delta lnTFP_t^{VA} = \Delta lnVAQ_t - \bar{\omega}_{K,t}^{VA}\Delta lnK_t - \bar{\omega}_{L,t}^{VA}\Delta lnL_t$$

using Törnqvist-weighted nominal capital and labor value add share

$$\bar{\omega}_{K,t}^{VA} = 0.5 \times (\omega_{K,t}^{VA} + \omega_{K,t-1}^{VA}) \quad \text{where} \quad \omega_{K,t}^{VA} = \frac{P_{K,t}K_t}{P_{K,t}K_t + P_{L,t}L_t}$$

$$\bar{\omega}_{L,t}^{VA} = 0.5 \times (\omega_{L,t}^{VA} + \omega_{L,t-1}^{VA}) \quad \text{where} \quad \omega_{L,t}^{VA} = \frac{P_{L,t}L_t}{P_{K,t}K_t + P_{L,t}L_t}$$

References

Eldridge, L. P., Garner, C., Howells, T. F., Moyer, B. C., Russell, M., Samuels, J. D., Strassner, E. H. & Wasshausen, D. B. (2020), Toward a bea-bls integrated industry-level production account for 1947–2016, *in* 'Measuring economic growth and productivity', Elsevier, pp. 221–249.

Garner, C., Harper, J., Russell, M. & Samuels, J. (2025), Integrated bea-bls industry-level production account, 1997–2023: The sources of u.s. economic growth in the aftermath of the covid-19 recession, Technical report, Bureau of Economic Analysis and Bureau of Labor Statistics.

Jorgenson, D. W., Ho, M. S. & Samuels, J. D. (2017), Educational attainment and the revival of us economic growth, *in* 'Education, Skills, and Technical Change: Implications for Future US GDP Growth', University of Chicago Press, pp. 23–60.

Jorgenson, D. W., Ho, M. S., Samuels, J. D. & Stiroh, K. J. (2007), 'Industry origins of the american productivity resurgence', *Economic systems research* **19**(3), 229–252.