# Labor Share Decline and Intellectual Property Products Capital: A Different Measurement Perspective*

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**Abstract**

Koh et al. (2020, *Econometrica*) attribute the decline in the labor share over the last 90 years to the capitalization of intellectual property in the national income and product accounts. We document that these findings are limited to the *Gross* labor share; the *Net* labor share trend is unrelated to the capitalization of intellectual property. This distinction is important because *Net* labor share is a more direct measure of income distribution between labor and capital. In addition, over the past four decades, both *Gross* and *Net* labor shares for the corporate sector exhibit a declining trend irrespective of the accounting treatment of intellectual property. These findings extend to international settings. In sum, the capitalization of intellectual property has little effect on the inferences about the shift in income distribution between capital and labor.

*Keywords*: Gross Labor Share, Net Labor Share, Intellectual Property Products, NIPA Accounting, BEA Revisions, Capitalization, Expensing, Accounting for Intellectual Property
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## 1. Introduction

The stability in the labor share of national income is a stylized fact (Kaldor 1961) embedded in macroeconomic theory. Yet extensive literature documents a significant decline in the labor share over the last forty years (e.g., Elsby et al. 2013; Karabarbounis and Neiman 2014a; Autor et al. 2020; Barkai 2020).[1] The declining trend in labor share has implications for research on income and wealth inequality, macroeconomic dynamics, and growth accounting, as well as tax policy and federal budgeting (Neiman 2013).

A recent paper by Koh et al. (2020) attributes the secular decline in the labor share to an accounting treatment of intellectual property products (IPP) in the national income and product accounts (NIPA).[2] NIPA currently treats IPP spending as a durable capital investment (i.e., IPP spending is *capitalized*). Previously, business IPP spending was part of intermediate inputs to production (i.e., IPP spending was *expensed*).[3] Koh et al. find that the significant downward trend in the fraction of labor compensation in gross value added is present only under the current accounting treatment of IPP. They conclude that the decline in the labor share is "entirely" driven by the capitalization of IPP.

Setting aside the question of whether IPP spending *should* be treated as durable capital investment, we note that the accounting treatment of IPP has a mechanical effect on the *Gross* labor share (the fraction of gross value added that accrues to labor as compensation). Switching from expensing to capitalizing has no effect on the labor compensation, but it increases the gross value added by the amount of business IPP spending. As a result, labor compensation drops as a fraction of the gross value added, and the drop is greater in recent years when IPP spending is higher.

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[1] A review of this literature can be found in Grossman and Oberfield (2021).

[2] The current treatment of IPP spending was introduced through three comprehensive revisions of 1999, 2013, and 2018.

[3] The reclassification has a different effect for the non-profit and government sectors; see section 2 for more details.

In this paper, we point out that this mechanical effect is limited to the *Gross* labor share; it may not apply to the *Net* labor share (the fraction of *net value added* that accrues to labor as compensation).[4] The *Net* labor share differs from the *Gross* labor share in the treatment of depreciation.[5] The *Net* share accounts for the fact that depreciation, which is the allowance for keeping the capital stock intact, cannot be consumed without reducing future consumption (Triplett 1996; Krusell and Smith 2015). The distinction between the *Gross* and *Net* shares is important because they serve different purposes (Hulten 1992; Rognlie 2016; Grossman and Oberfield 2021). The *Gross* share reflects the production structure, and it is more suitable for examining total factor productivity and technological growth. The *Net* labor share reflects the distribution of total income available for consumption between the labor and capital owners; hence it is relevant to discussions of aggregate welfare (Weitzman 1976; Hulten 1992; Diewert and Fox 2005; Rognlie 2016; Bridgman 2018). Whether the Koh et al. conclusions extend to the *Net* labor share has implications for the debate on the causes of the changing distribution of income between labor and capital (e.g., Karabarbounis and Neiman 2014a; Piketty and Zucman 2014; Karabarbounis and Neiman 2019; Autor et al. 2020; Barkai 2020; Kehrig and Vincent 2020).

The effect of IPP treatment on the *Net* labor share is ambiguous. The *Net* labor share is the fraction of the net value added that accrues to labor as compensation. Switching from expensing to capitalizing IPP does not affect labor compensation; it may either decrease or increase the net value added, depending on whether the IPP investment exceeds the IPP depreciation. Therefore, unlike the *Gross* labor share, the *Net* labor share does not mechanically decrease when IPP spending is capitalized. Hence, growth in IPP spending does not necessarily translate into a downward trend in the *Net* labor share.

Our results suggest that Koh et al.'s (2020) findings do not extend to the *Net* labor share.[6] Keeping their sample and research design constant, we find that the trends in the *Net* labor share

[4] Net value added is the gross value added minus the depreciation.

[5] Depreciation is referred to as fixed capital consumption in the NIPA.

[6] We use Koh et al.'s (2020) data, to which we add IPP and disaggregated depreciation data. Our analysis first replicates Koh et al.'s (2020) findings using their data and methodology from 1929 to 2018. The reclassification of IPP spending has an immediate mechanical effect on the magnitude and the trend in the *Gross* labor share. When

are not sensitive to the accounting treatment of IPP spending. Over the 1929-2018 period, the U.S. *Net* labor share does not exhibit a significant trend under either accounting method. We find similar results within broad institutional sectors, including domestic corporations and non-financial corporate businesses.

Recent research (e.g., Karabarbounis and Neiman 2014a; Caballero, Farhi, and Gourinchas 2017; Autor et al. 2020; Barkai 2020) focuses primarily on the changing income shares within the corporate sector over the last four decades. [7] When we restrict the sample to the 1975-2018 period, the *Net* labor share for the corporate sector has a significant downward trend under both accounting methods. In fact, over this period, the *Gross* labor share for the corporate sector also exhibits a significant downward trend under both accounting methods, although the rate of decline is smaller (and more similar to the *Net* labor share) under the pre-1999 expensing treatment of IPP.[8] Overall, the accounting treatment of IPP spending has little effect on the *Net* labor share trend estimates in the U.S., and IPP capitalization does not entirely explain the decline in the *Gross* labor share over the last four decades.

These results also hold internationally. Koh et al. (2020) consider five countries with a recent change in accounting for IPP spending and sufficiently long time-series of data: Canada, France, Denmark, Sweden, and Japan. Our analyses require disaggregated depreciation estimates; these are unavailable for Sweden and Japan, which limits our analysis to the remaining countries. We replicate Koh et al.'s (2020) finding that declining *Gross* labor share is entirely attributable to the capitalization of IPP spending, using their methodology that imputes and backfills missing data. However, when we use *Net* labor share and publicly available data, we find that *Net* labor share is

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IPP is treated as intermediate consumption, the *Gross* labor share has no significant trend in the U.S. economy. Reclassifying IPP into investment lowers the *Gross* labor share and generates a significant downward trend. Overall, the growth in IPP investment entirely explains the declining trend in *Gross* labor share.

[7] Focusing on the corporate sector alleviates the measurement issues arising from the allocation of mixed income between labor and capital (e.g., Gollin 2002; Rognlie 2016; Smith, Yagan, Zidar, and Zwick 2021). The mixed income is zero for corporations.

[8] Barkai (2022) makes a similar observation for the non-financial corporate sector: the gross labor share declines over the periods considered in prior research (1980-2014 or 1975-2011) regardless of the accounting treatment of IPP. However, we find that the Koh et al. inferences extend to the later sample period (1975-2018) for the economy-wide analysis: the economy-wide gross labor share decline is significant only when IPP is capitalized.

declining irrespective of the accounting treatment of IPP.[9] Furthermore, for two out of three countries, *Gross* labor share exhibits a significant declining trend under both accounting methods as long as we restrict the sample to publicly available data.

We are not the first to suggest that depreciation should not be part of the capital income. For example, Weitzman (1976), Hulten (1992), Diewert and Fox (2005), Rognlie (2016), and Bridgman (2018) advocate for output net of depreciation to measure macroeconomic growth and to estimate the capital and labor shares.[10] However, we are the first to document the effects that switching between accounting methods has on the *Net* labor shares. Our results suggest that the *Net* labor share is not only more conceptually suitable for measuring the distribution of income between capital and labor, but it is also more robust to accounting method changes and more comparable across macroeconomic data vintages. The key insight from our paper is that the alternative accounting methods for measuring IPP spending have little effect on the distribution of income between capital and labor. That is, the declining *Net* labor share in the last four decades is not an artifact of recent changes in NIPA accounting.

Our results also help reconcile the findings in prior research. Karabarbounis and Neiman (2014b) document that the *Net* and *Gross* labor shares move mainly together. Bridgman (2018) concludes that the *Gross* and the *Net* labor shares behave differently and attributes the discrepancy in findings to the difference in sample periods. Our results suggest that the vintage of the macroeconomic data is another factor contributing to conflicting inferences. The *Gross* and the *Net* labor share trends do not differ significantly in the pre-2014 vintages of NIPA, but they diverge significantly in the post-2014 vintages that treat intangibles as a durable investment.

[9] We deviate from Koh et al. in the treatment of missing data. When the data are unavailable for the entire 1929-2018 period, Koh et al. impute and backfill observations. By contrast, we restrict our analysis to publicly available data. As a result, our international sample is constrained to the more recent years where we observe a declining trend in *Net* labor share similar to that of the U.S.

[10] Atkeson (2020) suggests an alternative way of estimating the labor share that treats all capital spending as intermediate consumption that is expensed immediately (see also Barro 2019).

## 2. Labor Share and Accounting Treatment of Intellectual Property

BEA currently treats the expenditures for intellectual property products, including software, R&D, and entertainment, literary, and artistic originals, as durable capital investments. The IPP spending is *capitalized* and adds to the stock of fixed assets. The depreciation of IPP—the reduction in the present value of expected benefits from the IPP investments—is included in the consumption of fixed capital. This treatment is consistent with international guidelines (SNA 2008); it is uniform across private, non-profit, and government sectors, and it extends to both the internally generated and externally acquired IPP.[11] Prior to 1999, the IPP expenditures in the private sector were treated as intermediate consumption, and IPP expenditures in the government and non-profit sectors were treated as final consumption. We refer to this prior treatment as *expensing*, which is a business accounting term relevant to the private sector. The transition from the pre-1999 expensing to the current capitalizing treatment occurred in stages. First, the 11$^{th}$ comprehensive revision in 1999 capitalized software costs. Second, the 14$^{th}$ comprehensive revision in 2013 capitalized the R&D and artistic originals. Finally, the 15$^{th}$ revision in 2018 updated the estimates of own-account software and R&D investments by adding the return to capital to production costs.[12]

The capitalization treatment of IPP requires estimates for both IPP investment and IPP depreciation. Whenever feasible, BEA values IPP investment at market prices. When purchase prices are unavailable, which is the case for the own-account or non-market-use intangible assets, BEA utilizes alternative estimation methods. For own-account R&D, BEA uses the sum of production costs, including cost of labor, material inputs, overhead, and the depreciation of fixed assets engaged in R&D production. The main data sources for the R&D investment estimates are the costs statistics from the National Science Foundation (NSF) surveys and the Census Bureau

[11] European Commission, International Monetary Fund, Organization for Economic Co-operation and Development, United Nations, and World Bank, System of National Accounts 2008.

[12] BEA estimates private own-account software and R&D investment as the sum of production costs, including the depreciation of fixed assets involved in production. The 2018 revision has replaced the depreciation by the capital services measure that includes both the depreciation of fixed assets and the return to capital (Chute, McCulla, and Smith 2018).

data on sales of R&D (Crawford et al. 2014).[13] For entertainment originals, BEA relies on the net present value (NPV) approach—the value of entertainment originals is estimated as the present value of the future royalties or other revenue net of the cost of sales.[14] BEA draws on a combination of Census Bureau data and multiple trade sources to provide inputs for the NPV estimation.

The depreciation of IPP assets reflects their decline in value as they produce diminishing benefits for their owners and eventually become obsolete. The lack of observable market values complicates the estimation of IPP depreciation rates. For the business sector, BEA infers the depreciation rates from the declining contribution of IPP assets to profits. In particular, BEA estimates the relationship between R&D investments and future profits for the individual establishments and firms across ten research-intensive industries. Current-period investment is assumed to contribute to future profits at a geometrically declining rate.[15] Similar calculations derive depreciation rates for the entertainment originals. BEA includes the depreciation of IPP assets as part of the consumption of fixed capital.

Our main analysis focuses on the corporate sector. Table 1 summarizes the differences between various components of gross value added under the pre-revision expensing treatment and the post-revision capitalizing treatment of IPP spending for the corporate sector.[16] The accounting treatment of IPP does not affect employee compensation. Durable capital investment is higher under capitalization treatment by the amount of capitalized IPP spending ($I_{IPP}$). Fixed capital consumption is higher under capitalization treatment by the amount of depreciation on IPP assets ($Dep_{IPP}$). Corporate profits under the two methods differ by the amount of net investment in IPP

[13] BEA treats the funder of R&D as the owner; the R&D that is funded by one entity and produced by another is classified as purchased R&D. When R&D is performed in corporate headquarters or R&D service establishments and transferred to the primary industry of the company, it is also classified as purchased R&D (Crawford et al. 2014).

[14] See "Preview of the 2013 Comprehensive Revision of the National Income and Product Accounts," Survey of Current Business, March 2013.

[15] Depreciation rates for R&D produced by the NPISH sector are assumed to be equal to the business-sector depreciation. Depreciation rates for R&D produced by the government sector rely on a separate estimation that utilizes outcomes other than profits. See Crawford et al. (2014) for more details.

[16] Koh et al. (2020) summarize the differences across all sectors, including government and non-profits. Prior to 2013, R&D expenditures by government and nonprofit institutions were treated as part of the consumption expenditure.

($I_{IPP}$ – $DEP_{IPP}$). In both 1947 and 2018, net investment in IPP was positive and corporate profits under capitalization were higher than under expensing.

The capitalization of IPP unambiguously increases the gross value added (i.e., output less intermediate inputs, minus the net taxes on production) by the amount of IPP investment:[17]

$$GVA_{CAP} = GVA_{EXP} + I_{IPP} \quad (1)$$

The change in accounting treatment of IPP does not affect employee compensation, so the labor share of GVA (i.e., *Gross* labor share) under the *expensing method* ($LS\_Gross_{Pre\text{-}1999}$) is strictly lower than the labor share of GVA under the capitalization method:

$$LS\_Gross_{Pre\text{-}1999} = Comp/GVA_{EXP} \quad > LS\_Gross = Comp/(GVA_{EXP} + I_{IPP}) \quad (2)$$

As $I_{IPP}$ increases over time, the difference between $GVA_{CAP}$ and $GVA_{EXP}$ also grows. As a result, the *Gross* labor share exhibits a steeper decline under the capitalizing accounting method, as shown in Koh et al. (2020).

The net value added deducts the consumption of fixed capital from the gross value added. The capitalization treatment of IPP increases the fixed capital consumption by the amount of depreciation on IPP assets ($Dep_{IPP}$). As a result, capitalization of IPP changes the net value added for the business sector by the difference in the newly invested IPP capital and the depreciation of IPP capital already in place:[18]

$$NVA_{CAP} = NVA_{EXP} + I_{IPP} - Dep_{IPP} \quad (3)$$

The $NVA_{CAP}$ (NVA under capitalization treatment) may be either higher or lower than $NVA_{EXP}$ (NVA under expensing treatment) depending on the magnitude of $I_{IPP}$ relative to $Dep_{IPP}$. In other words, IPP capitalization increases the net value added *only* when IPP investments exceed the depreciation of IPP assets in place, i.e., when there is growth in the net value of IPP assets. As

[17] The gross output increases by the amount of own-account IPP and the intermediate consumption decreases by the amount of sold IPP. As a result, GVA increases by the sum of own-account and sold IPP, i.e., by the total amount of capitalized IPP. See Koh et al. (2020) for a detailed discussion.

[18] Alternatively, consider the effects of IPP capitalization on the components of GVA. First, the corporate profits increase by the net investment amount ($I_{IPP}$ - $D_{IPP}$) because IPP outlays are no longer expensed, which increases the profits, but there is an additional IPP depreciation expense that decreases the profits. Second, fixed capital consumption increases by the amount of IPP depreciation. In other words, $GVA_{CAP} = GVA_{EXP} + (I_{IPP} - DEP_{IPP}) + D_{IPP}$, where the second component of the left-hand sum is the effect of capitalization on the profits, and the third component of the left-hand sum is the effect of capitalization on the fixed capital consumption.

a result, the labor share of NVA (i.e., *Net* labor share) under the expensing method ($LS\_Net_{Pre\text{-}1999}$) may be either higher or lower than the labor share of NVA under the capitalization method:

$$LS\_Net_{Pre\text{-}1999} = Comp/NVA_{EXP} \quad > \quad LS\_Net = Comp/(\ NVA_{EXP} + I_{IPP} - Dep_{IPP})$$
$$iff\ I_{IPP} > Dep_{IPP} \tag{4}$$

To explain a significant decline in the labor share, the difference between $LS\_Net_{Pre\text{-}1999}$ and *LS_Net* should exhibit a significant upward trend. In both 1947 and 2018, the *Net* labor share is higher under the expensing treatment than under the capitalization treatment, but the magnitudes of the differences are much smaller than for the *Gross* labor share. The difference between $LS\_Net_{Pre\text{-}1999}$ and *LS_Net* rounds up to zero in 1947 and equals one percentage point in 2018; in the next section, we formally test whether this modest increase can explain the trend in the *Net* labor share.[19]

## 3. The Gross and the Net Labor Shares

Our primary dataset comes from Koh et al. (2020).[20] We supplement it with IPP investment and disaggregated depreciation data for the international sample.[21] By restricting our analysis to the Koh et al. (2020) main dataset, we keep the vintage of macroeconomic data constant and facilitate the comparability of key takeaways across papers.

### 3.1 Depreciation and Net Investment

The difference between the *Gross* and *Net* labor shares is in the treatment of depreciation. We plot depreciation relative to the gross value added in Figure 1. Over the period 1929 to 2018,

[19] Our paper also differs from Koh et al. in the treatment of capital income. Koh et al. (2020) consider profits and capital consumption as part of capital income. In that case, moving from expensing IPP to capitalizing IPP increases capital income by $I_{IPP}$ for the business sector. However, capital owners cannot consume the depreciation portion of gross income without reducing future consumption. When we exclude depreciation from capital income, the capital income under IPP capitalization exceeds the capital income under IPP expensing by the amount of net IPP investment ($I_{IPP}$ - $DEP_{IPP}$).

[20] We thank Dongya Koh, Raul Santaeulalia-Llopis, and Yu Zheng for making the dataset and programs available in the public domain (https://github.com/dongyakoh/IPP_USLS).

[21] We obtain data for Canada from the Statistics of Canada website: IPP data; disaggregated depreciation data. We obtain data for Denmark from the Statistics Denmark website: IPP data; disaggregated depreciation data. We obtain data for France from the Insee website: IPP data; disaggregated depreciation.

the share of depreciation in gross value added has increased dramatically. The linear trend for the economy-wide depreciation for all fixed assets in Figure 1a translates into an annual rate of increase of 0.07% of gross value. In 1929, depreciation accounted for 10.6% of the gross value added; by 2018, this fraction had increased to 17.1%.

The increasing trend in total depreciation is primarily attributable to IPP assets. In 1929, the depreciation of IPP assets was 0.3% of gross value added; by 2018, this share had increased to 5.17%. On average, IPP depreciation increased at an annual rate of 0.06% of gross value added between 1929 and 2018. By contrast, the depreciation of non-IPP assets has remained relatively stable, ranging from 10.3% in 1929 to 11.9% in 2018, with a linear trend implying an average annual increase of 0.01% of gross value added. We observe similar trends in corporate-sector depreciation and its components, as plotted in Figure 1c.

The increasing share of IPP depreciation is a direct consequence of the growth in IPP investment (e.g., Koh et al. 2020; Farhi and Gourio 2018). As long as IPP investment is growing as a share of gross value added, capitalizing IPP spending results in a downward trend in the *Gross* labor share. IPP capitalization's effect on the *Net* labor share depends on the magnitude of IPP depreciation relative to IPP investment. We plot IPP depreciation, IPP investment, and net IPP investment (IPP investment minus IPP depreciation) over gross value added for the entire U.S. economy in Figure 1b. The rapid depreciation of intellectual property assets largely offsets IPP investment's growth. Over the entire period, 1929-2018, the linear trend in net IPP investment is statistically significant but nearly flat – the total trend-implied increase in the share of net IPP investment rounds up to 0.39 percent of gross value added. The trends are similar for the corporate sector, represented in Figure 1d.

Overall, depreciation in IPP increases over time and largely offsets the growth in IPP investment. If we adjust for IPP depreciation, the net value added should be less affected by the accounting treatment of IPP. As a result, the trend in the *Net* labor share should be less sensitive to a shift to capitalization of IPP assets.

### 3.2 Trends in Economy-wide Labor Shares: U.S. Analysis

Before investigating the trends in *Net* labor share, we replicate the findings of Koh et al. (2020) using their data and methodology.[22] In particular, following Koh et al. (2020), we estimate the benchmark economy-wide *Gross* labor share as:

$$LS\_Gross = COMP / (GDP_{CAP} - Taxes + Subsidies - PI) \quad (5)$$

where *LS_Gross* is the economy-wide *Gross* labor share under the IPP capitalization method, *COMP* is the compensation of employees, and $GDP_{CAP}$ is the GDP under the IPP capitalization method as reported by the BEA. Following Koh et al. (2020), we adjust the denominator for the income that cannot be unambiguously allocated to capital and labor: taxes on production and imports (*Taxes)*, subsidies on production and imports (*Subsidies)*, and proprietors' income (*PI*).

To evaluate the effect of IPP accounting treatment on the labor share trends, we estimate the counterfactual labor share based on the "expensing" treatment of IPP spending prior to the 1999 BEA methodology revision:

$$LS\_Gross_{pre\text{-}1999} = COMP / (GDP_{EXP} - Taxes + Subsidies - PI) \quad (6)$$

where $LS\_Gross_{pre\text{-}1999}$ is the *Gross* labor share under the pre-1999 IPP measurement rules, *COMP* is the compensation of employees, and $GDP_{EXP}$ is the counterfactual GDP estimate under the pre-1999 IPP treatment. $GDP_{EXP}$ is the 2019 vintage GDP ($GDP_{CAP}$) minus the sum of IPP investment by the business sector and IPP capital depreciation of nonprofit institutions serving households and government. All other variables are as defined above.

Figure 2a presents the alternative labor share measures over 1929-2018. We reproduce the Koh et al. (2020) result for the *Gross* labor share. The *Gross* labor share exhibits a statistically significant downward trend under the IPP capitalization regime (*LS_Gross*). The downward trend implies an average yearly decline of 0.05% of gross value added. By contrast, the counterfactual labor share based on the pre-1999 *Gross* labor share ($LS\_Gross_{pre\text{-}1999}$) does not exhibit any significant trend. Taken together, the results show that the capitalization of IPP entirely explains the declining trend in *Gross* labor share.

[22] Unless explicitly stated in the paper, we restrict our analysis to Koh et al.'s (2020) data and methodology.

To examine the *Net* labor share, we keep the sample and research design constant and replace the gross value added by the net value added in the denominator (i.e., we subtract depreciation from gross value added). The benchmark economy-wide *Net* labor share measure under the IPP capitalization method becomes:

$$LS\_Net = COMP / (GDP_{CAP} - Taxes + Subsidies - PI - DEP_{CAP}) \quad (7)$$

where *COMP* is the compensation of employees, $GDP_{CAP}$ is the GDP under the IPP capitalization method as reported by the BEA, and $DEP_{CAP}$ is the depreciation under the IPP capitalization method.

The counterfactual *Net* labor share based on the "expensing" treatment of IPP spending prior to the 1999 BEA methodology revision becomes:

$$LS\_Net_{pre\text{-}1999} = COMP / (GDP_{EXP} - Taxes + Subsidies - PI - DEP_{CAP}) \quad (8)$$

where all variables are as defined above.

Figure 2b plots *Net* labor share measures from 1929 to 2018. The switch from expensing to capitalization has a modest effect on the average *Net* labor share: the mean *LS_Net* is 77.45%, and the mean $LS\_Net_{pre\text{-}1999}$ is 77.89%. Strikingly, the *Net* labor share exhibits almost identical trends under the capitalization and expensing IPP methods. The full-sample trend estimates for *Net* labor share are not statistically significant under either accounting method. We examine the trends in the most recent decades in section 3.4. Overall, the *Net* labor share estimates are insensitive to the change in NIPA treatment of intangible assets.[23]

### 3.3 Trends in the Labor Share: U.S. Institutional Sector–level Analysis

One of the challenges in measuring the labor share is allocating mixed income, such as income earned by sole proprietors, entrepreneurs, and unincorporated businesses, between labor and capital (Gollin 2002; Elsby et al. 2013; Rognlie 2016). To circumvent this issue in the economy-wide analyses, we follow Koh et al. (2020) and deduct mixed income from the denominator of the labor

[23] Koh et al. report the trends in the economy-wide *Net* labor share for the 1947-2018 period in their online appendix in Figure D-2. They do not compare the *Net* labor share trends between the capitalizing and expensing IPP methods. They instead compare *Gross* labor shares to *Net* labor shares within the same IPP accounting treatment.

share. An alternative approach is to focus on the corporate sector that does not have mixed income (e.g., Karabarbounis and Neiman 2014; Autor et al. 2020; Barkai 2020). To alleviate the measurement concerns and to offer additional insights, we plot the labor share for the domestic corporate sector in Figures 2c and 2d. As in the economy-wide labor share results, the *Gross* labor share trends are sensitive to capitalizing the IPP spending, but the *Net* labor share trends do not vary significantly between the pre-1999 counterfactual expensing treatment of IPP and the current capitalizing treatment. Similar results obtain for the non-financial corporate business sector in Figures 2e and 2f.

### 3.4 Trends in the Labor Share over the Last Four Decades: U.S. Analysis

The research documenting changes in the labor share has focused primarily on the recent period starting from 1975 or later (see Karabarbounis and Neiman 2014; Caballero, Farhi, and Gourinchas 2017; Autor et al. 2020; Barkai 2020). This period has experienced the emergence of the knowledge economy, the rise in information technology, and the advent of computers. These factors have been proposed as drivers of the drop in the labor share of national income. In Figure 3, we plot the labor share measures for the entire economy and broad institutional sectors for the period 1975-2018.

Our primary inferences for the entire economy remain similar in this subperiod. *Gross* labor share exhibits a declining trend under the post-2013 capitalization treatment for the IPP spending, but the trend is flat and not statistically significant under the pre-1999 expensing treatment (see Figure 3a). In other words, the capitalization of IPP spending fully explains the declining *Gross* labor share, as in Koh et al. (2020). The *Net* labor share exhibits parallel trends using the alternative accounting treatment for the IPP spending (see Figure 3b). In other words, capitalization of IPP has an insignificant effect on the rate of change in the *Net* labor share. The linear trend implies a decline in the *Net* labor share of approximately 0.02% of net value added per year under either accounting treatment of IPP.[24]

[24] By contrast, the *Net* labor share over the entire 1929-2018 period in Figure 1 has no significant trend.

For the corporate sector, the recent-period results diverge from Koh et al.'s findings. The corporate-sector labor share estimates in Figures 3c – 3f exhibit significant declining trends irrespective of the accounting treatment of the IPP spending for both the *Gross* and *Net* labor share measures. The downward trend in the *Gross* labor share under the pre-1999 expensing treatment is statistically significant. These results differ from those of Koh et al. (2020) and suggest that their inferences do not carry over to the more recent period. The trends in the *Net* labor share are parallel under the two accounting regimes, and hence our conclusions regarding the insensitivity of *Net* labor share to NIPA treatment of IPP spending remain unchanged.

Overall, our evidence suggests that the capitalization of IPP spending does not entirely explain the decline of the labor share. Koh et al.'s (2020) findings are sensitive to the time period and the type of the labor share measure. Moreover, their findings do not apply to the corporate sector, which is essential to consider to alleviate measurement concerns.

### 3.5 Trends in the Labor Share: International Analysis

Next, we investigate the effects of alternative accounting treatments of IPP on the *Gross* and *Net* labor share trends in international data. We reproduce the findings of Koh et al. (2020) using their data and methodology and restrict our analysis to the countries with long time-series of available data: Canada, France, Denmark, Sweden, and Japan. We further impose two additional restrictions. First, we require depreciation for all fixed assets and IPP assets to estimate *Net* labor share measures. These data are unavailable for Sweden and Japan. Second, we use only publicly available data and do not impute and backfill the missing data to cover the entire sample period of 1929 to 2019, as Koh et al. do. Our analysis thus avoids researcher-specific methodology choices.

We plot the labor share estimates for Canada, France, and Denmark in Figure 4. The expensing treatment corresponds to the pre-SNA93 labor share measures, and the current treatment of IPP spending across all countries is capitalization. In untabulated results, we reproduce the Koh et al. (2020) finding that the declining *Gross* labor share is entirely attributable to the capitalization of IPP spending. However, when we restrict the analysis to publicly available data, our benchmark

results diverge from those of Koh et al. For example, *Gross* labor share exhibits a declining trend for Canada (Figure 4a) and France (Figure 4e), irrespective of the IPP accounting treatment.

Our inferences regarding the insensitivity of the *Net* labor share to IPP capitalization hold in the international setting. The *Net* labor share declines significantly over the considered sample periods for all three countries, irrespective of the accounting treatment of IPP spending (see Figures 4b, 4d, and 4f). Overall, the *Net* labor share declines significantly across all considered countries within the more recent sample periods. The decline is significant and is not an artifact of the national accounting for the IPP spending.

## 4. Conclusions

We document that Koh et al.'s (2020) striking result – that the decline in labor share is entirely explained by the capitalization treatment of IPP in NIPA – is restricted to *Gross* labor share and does not extend to *Net* labor share. The trends in *Net* labor share are not sensitive to the accounting treatment of IPP. Hence, from the perspective of understanding the distribution of income between labor and capital, the accounting treatment of IPP expenditures has little effect on the inferences. We find similar results within broad institutional sectors, including domestic corporations and non-financial corporate businesses.

Perhaps equally important, over the last four decades (1975-2018), a time period that has been a focus of recent research, we find that both *Gross* and *Net* labor shares for the corporate sector exhibit a declining trend irrespective of the IPP accounting treatment.

Overall, the accounting treatment of IPP spending has little effect on the *Net* labor share trend estimates in the U.S., and IPP capitalization does not entirely explain the decline in the *Gross* labor share over the last four decades. Our findings extend to international settings.

## Figure 1: Depreciation and Intellectual Property, 1929-2018

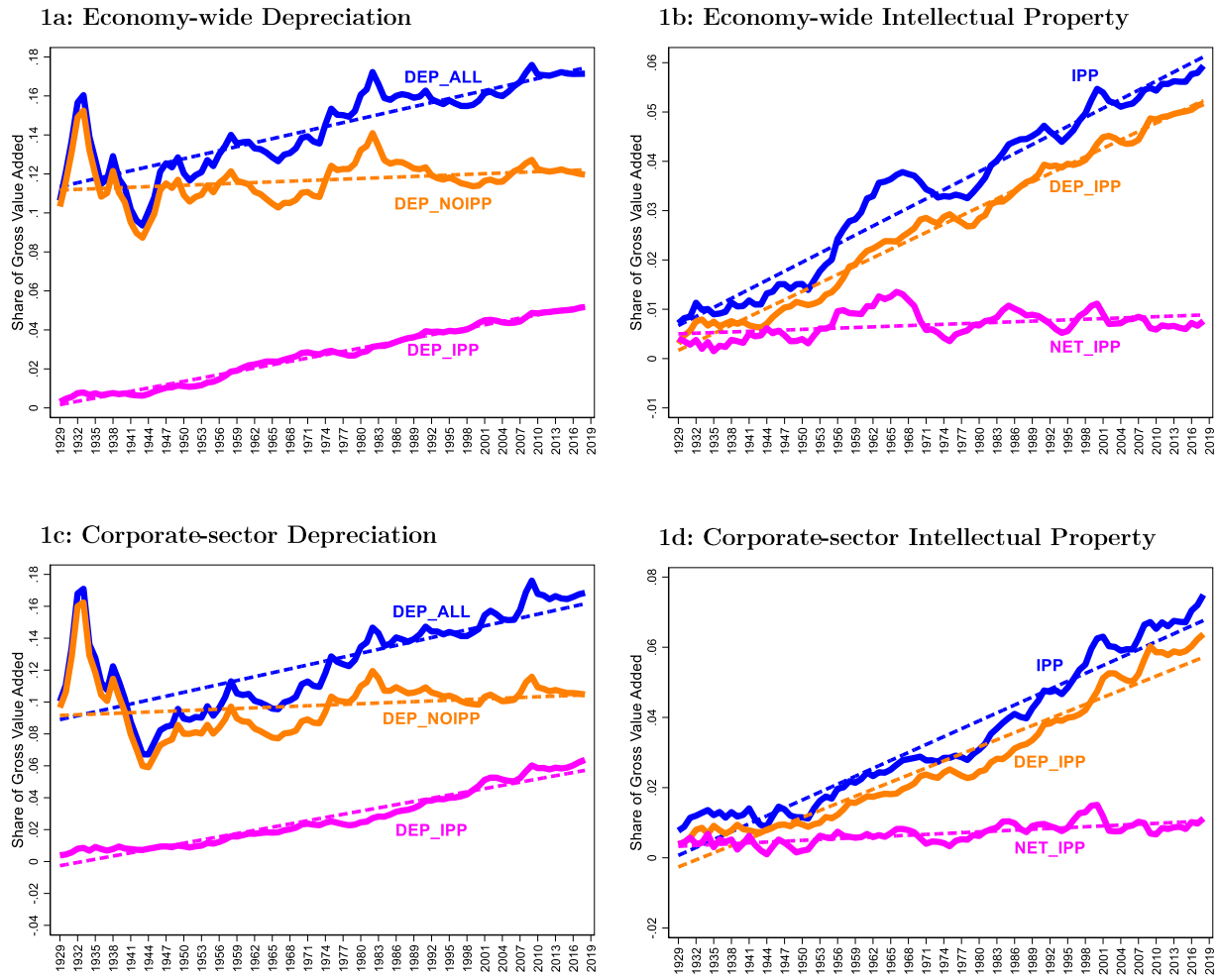



Figure 1 plots depreciation and intellectual property capital over 1929-2018. *DEP_ALL* is depreciation (fixed capital consumption) for all assets. *DEP_NOIPP* is depreciation excluding IPP assets. *DEP_IPP* is the depreciation expense of IPP assets. *IPP* is the IPP investment. *NET_IPP* is the net IPP investment (IPP spending less the depreciation). Dotted lines show linear trends. Figures 1a and 1b represent the entire U.S. economy. Figures 1c and 1d represent the U.S. corporate sector.

## Figure 2: U.S. Labor Share, 1929-2018

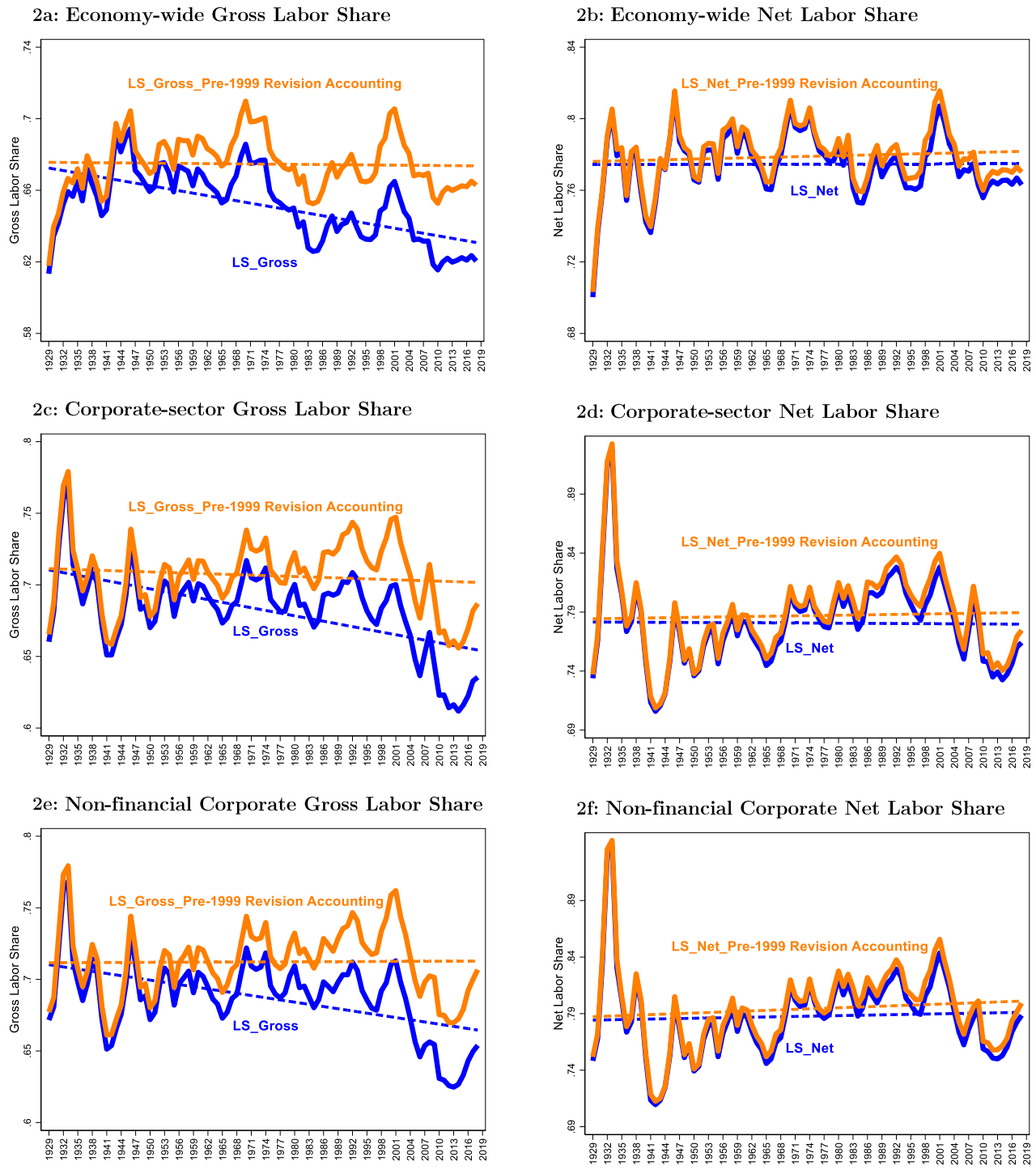
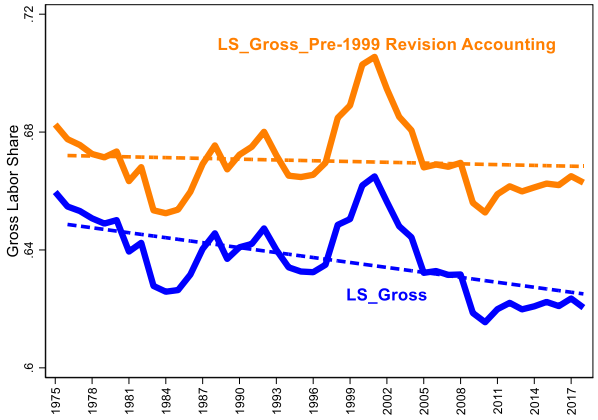


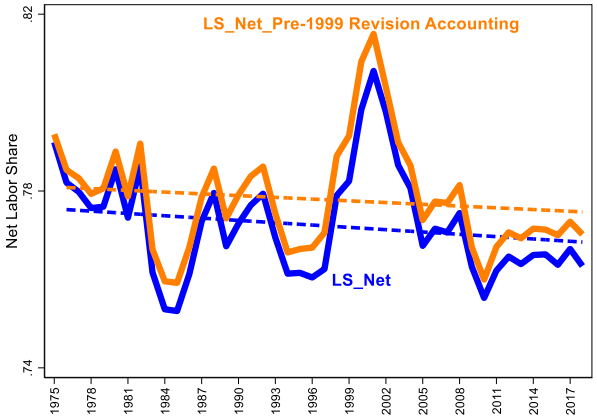

Figure 2 plots labor share over 1929-2018. Blue lines trace the labor shares when IPP is capitalized (*LS_Gross* or *LS_Net*). Orange lines trace the labor shares when IPP is expensed (*LS_Gross_Pre-1999 Revision Accounting* or *LS_Net_Pre-1999 Revision Accounting*). Dotted lines show linear trends. Figures 2a and 2b represent the entire U.S. economy. Figures 2c and 2d represent the U.S. corporate sector. Figures 2e and 2f represent the non-financial U.S. corporate sector.

## Figure 3: U.S. Labor Share, 1975-2018

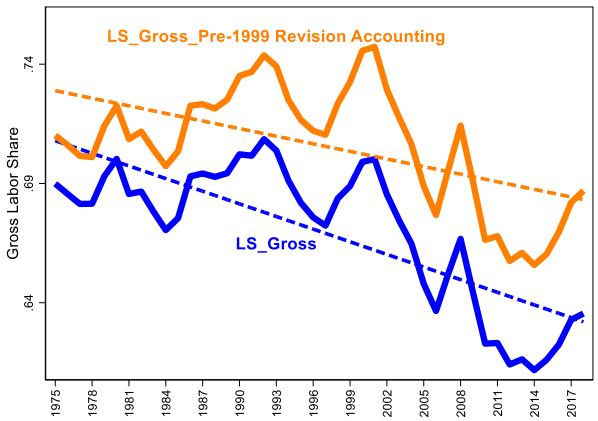
### 3a: Economy-wide Gross Labor Share



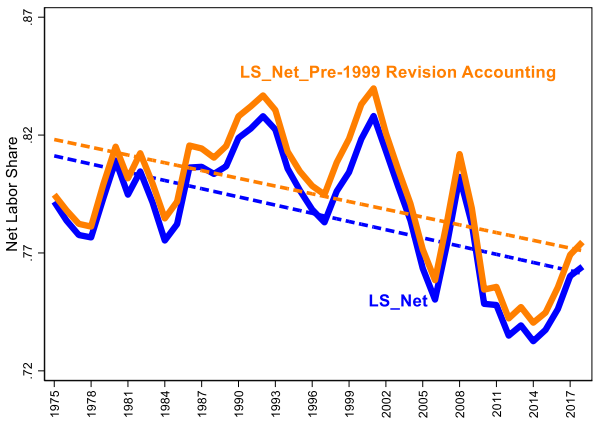

### 3b: Economy-wide Net Labor Share



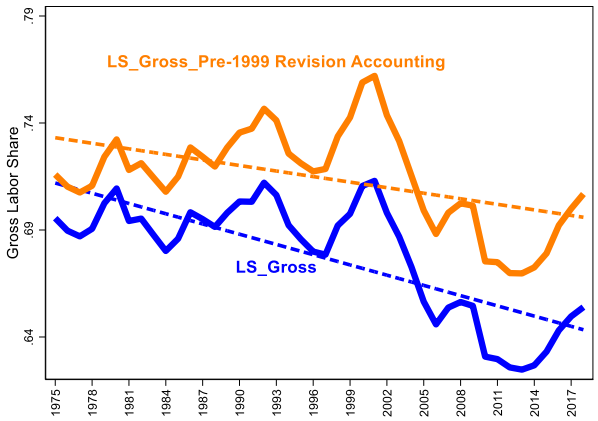

### 3c: Corporate-sector Gross Labor Share




### 3d: Corporate-sector Net Labor Share




### 3e: Non-financial Corporate Gross Labor Share




### 3f: Non-financial Corporate Net Labor Share

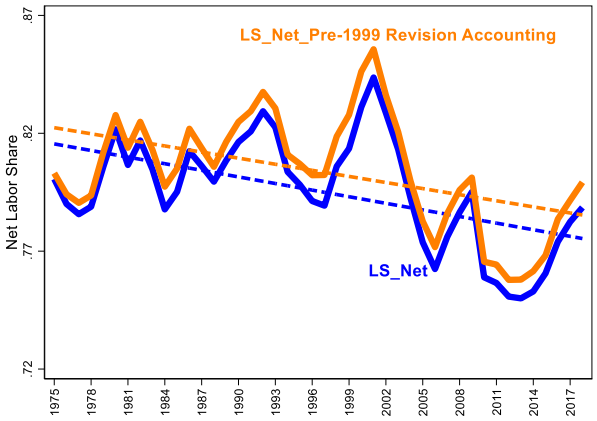
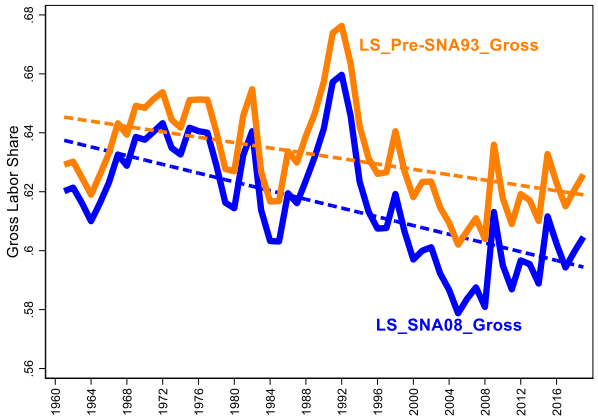


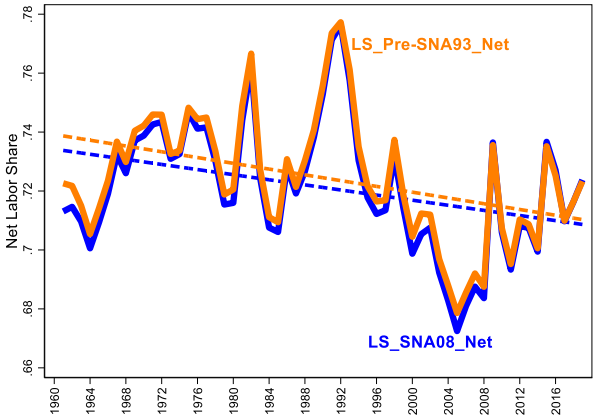

Figure 3 plots labor share over 1975-2018. Blue lines trace the labor shares when IPP is capitalized (*LS_Gross* or *LS_Net*). Orange lines trace the labor shares when IPP is expensed (*LS_Gross_Pre-1999 Revision Accounting* or *LS_Net_Pre-1999 Revision Accounting*). Dotted lines show linear trends. Figures 3a and 3b represent the entire U.S. economy. Figures 3c and 3d represent the U.S. corporate sector. Figures 3e and 3f represent the non-financial U.S. corporate sector.

## Figure 4: International Labor Share

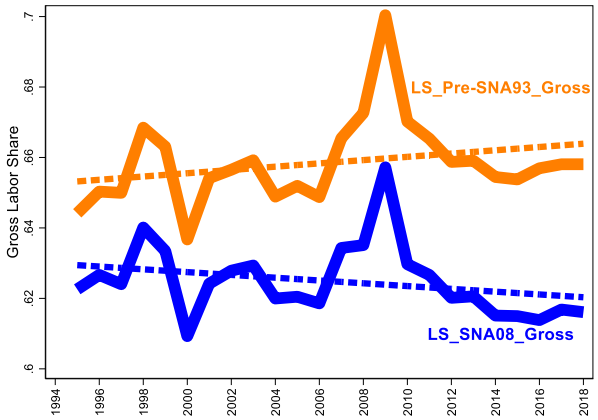
### 4a: Canada: Gross Labor Share



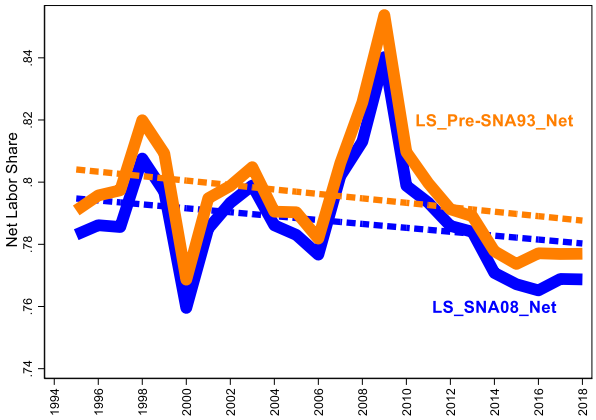

### 4b: Canada: Net Labor Share



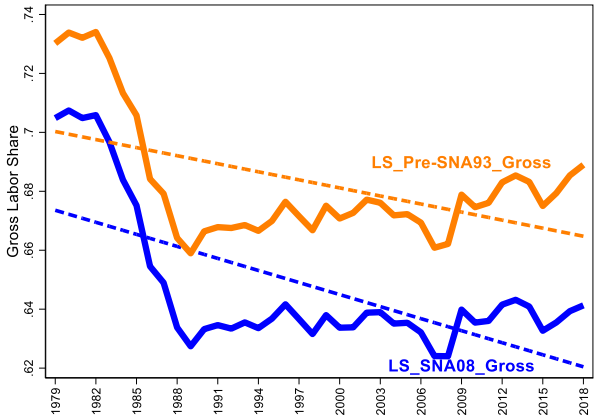

### 4c: Denmark: Gross Labor Share




### 4d: Denmark: Net Labor Share




### 4e: France: Gross Labor Share




### 4f: France: Net Labor Share

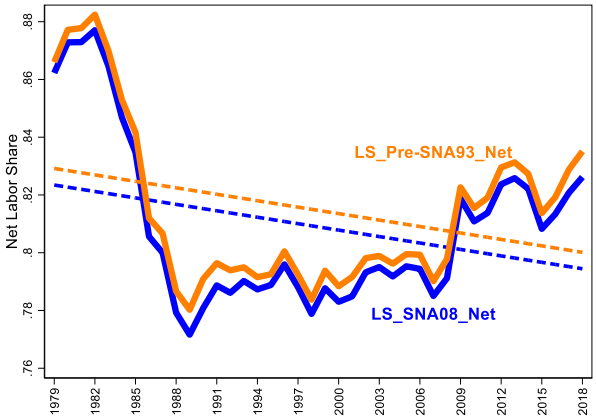



Figure 4 plots economy-wide labor share internationally. Blue lines trace the labor shares when IPP is capitalized (*LS_SNA08_Gross* or *LS_SNA08_Net)*. Orange lines trace the labor shares when IPP is expensed (*LS_Pre-SNA93_Gross* or *LS_Pre-SNA93_Net)*. Dotted lines show linear trends**.** Figures 4a and 4b represent Canada over 1960-2018. Figures 4c and 4d represent Denmark over 1994-2018. Figures 4e and 4f represent France over 1979-2018.

## References


Atkeson, A., 2020. Alternative facts regarding the labor share. *Review of Economic Dynamics*, *37*, pp.S167-S180.

Autor, D., Dorn, D., Katz, L. F., Patterson, C. and Van Reenen, J., 2017. Concentrating on the fall of the labor share. *The American Economic Review* 107, 180–185.

Autor, D., Dorn, D., Katz, L. F., Patterson, C. and Van Reenen, J., 2020. The fall of the labor share and the rise of superstar firms. *The Quarterly Journal of Economics* 135, 645–709.

Barro, R.J., 2021. Double counting of investment. *The Economic Journal*, *131*(638), pp.2333-2356.

Barkai, S., 2020. Declining labor and capital shares. *The Journal of Finance*, *75*(5), pp.2421-2463.

Barkai, S., 2022. The Decline of the Labor Share is not Explained by the Capitalization of Intellectual Property Products. *Working paper*, Boston College.

Bridgman, B., 2018. Is labor's loss capital's gain? Gross versus net labor shares. *Macroeconomic Dynamics*, *22*(8), pp.2070-2087.

Caballero, R.J., Farhi, E. and Gourinchas, P.O., 2017. Rents, technical change, and risk premia accounting for secular trends in interest rates, returns on capital, earning yields, and factor shares. *American Economic Review*, *107*(5), pp.614-20.

Chute, J.W., McCulla, S.H. and Smith, S., 2018. Preview of the 2018 comprehensive update of the national income and product accounts: changes in methods, definitions and presentations. *Survey of Current Business*, *98*(4).

Crawford, M.J., Lee, J., Jankowski, J.E. and Moris, F.A., 2014. Measuring R&D in the national economic accounting system. *Survey of current business*, *94*(11), pp.1-15.

De Loecker, J., Eeckhout, J. and Unger, G., 2020. The rise of market power and the macroeconomic implications. *The Quarterly Journal of Economics* 135, 561–644.

Diewert, W.E. and Fox, K.J., 2005. The new economy and an old problem: Net versus gross output. *University of New South Wales, April*.

Elsby, M.W., Hobijn, B. and Şahin, A., 2013. The decline of the US labor share. *Brookings Papers on Economic Activity*, *2013*(2), pp.1-63.

Farhi, E. and Gourio, F., 2018. Accounting for macro-finance trends: Market power, intangibles, and risk premia (No. w25282). *National Bureau of Economic Research.*

Gollin, D., 2002. Getting income shares right. *Journal of political Economy*, *110*(2), pp.458-474.

Grossman, G.M. and Oberfield, E., 2021. *The elusive explanation for the declining labor share* (No. w29165). National Bureau of Economic Research.

Hulten, C.R., 1992. Growth Accounting When Technical Change is Embodied in Capital. *The American Economic Review*, pp.964-980.

Kaldor, N., 1961. Capital accumulation and economic growth. In *The theory of capital* (pp. 177-222). Palgrave Macmillan, London.

Karabarbounis, L. and Neiman, B., 2014a. The global decline of the labor share. *The Quarterly Journal of Economics* 129, 61–103.

Karabarbounis, L. and Neiman, B., 2014b. *Capital depreciation and labor shares around the world: measurement and implications* (No. w20606). National Bureau of Economic Research.

Karabarbounis, L. and Neiman, B., 2019. Accounting for factorless income. *NBER Macroeconomics Annual*, *33*(1), pp.167-228.

Kehrig, M. and Vincent, N., 2020. The micro-level anatomy of the labor share decline. *The Quarterly Journal of Economics*, *Forthcoming*.

Koh, D., Santaeulàlia-Llopis, R. and Zheng, Y., 2020. Labor share decline and intellectual property products capital. *Econometrica*, *88*(6), pp.2609-2628.

Krusell, P. and Smith Jr, A.A., 2015. Is Piketty's "second law of capitalism" fundamental?. *Journal of Political Economy*, *123*(4), pp.725-748.

*Neiman, B., 2013* "Comment on The Decline of the U.S. Labor Share by Michael Elsby, Bart Hobijn, and Aysegul Sahin", Brookings Panel of Economic Activity, September 2013.

Newey, W. K., West, K. D., 1987. A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. *Econometrica*: *Journal of the Econometric Society* pp. 703–708.

Piketty, T., 2014. Capital in the 21st century. Harvard University Press.

Piketty, T. and Zucman, G., 2014. Capital is back: Wealth-income ratios in rich countries 1700–2010. *The Quarterly Journal of Economics*, *129*(3), pp.1255-1310.

Rognlie, M., 2016. Deciphering the fall and rise in the net capital share: accumulation or scarcity?. *Brookings papers on economic activity*, *2015*(1), pp.1-69.

Smith, M., Yagan, D., Zidar, O.M. and Zwick, E., 2021. *The Rise of Pass-Throughs and the Decline of the Labor Share* (No. w29400). National Bureau of Economic Research.

Triplett, J.E., 1996. Depreciation in production analysis and in income and wealth accounts: Resolution of an old debate. *Economic Inquiry*, *34*(1), pp.93-115.

Weitzman, M.L., 1976. On the welfare significance of national product in a dynamic economy. *The Quarterly Journal of Economics*, *90*(1), pp.156-162.

**Table 1: Effects of IPP accounting methods on the gross value added and net value added for the corporate sector**

USD Bill.

| | Notation | 1947 | 2018 |
|---|---|---|---|
| 1. Compensation, pre-revision, expensing method | $Comp_{EXP}$ | 82.1 | 6750.3 |
| 2. No change | 0 | 0 | 0 |
| 3. Compensation, post-revision, capitalizing method | $Comp_{CAP}$=$Comp_{EXP}$ =COMP | 82.1 | 6750.3 |
| 4. Depreciation, pre-revision, expensing method | $DEP_{EXP}$ | 8.7 | 1112.3 |
| 5. Plus: depreciation of business IPP | $DEP_{IPP}$ | 1.1 | 676.9 |
| 6. Depreciation, post-revision, capitalizing method | $DEP_{CAP}$=$DEP_{EXP}$+$DEP_{IPP}$ | 9.8 | 1789.2 |
| 7. Corporate profits, pre-revision, expensing method | $CP_{EXP}$ | 23.7 | 1955.4 |
| 8. Plus: IPP spending | IPP | 1.6 | 796.1 |
| 9. Less: depreciation of corporate IPP | $DEP_{IPP}$ | 1.1 | 676.9 |
| 10. Corporate profits, pre-revision, capitalizing method | $CP_{CAP}$=$CP_{EXP}$+IPP-$DEP_{IPP}$ | 24.2 | 2074.6 |
| 11. Gross value added, pre-revision, expensing method | $GVA_{EXP}$ | 125.9 | 10780.2 |
| 12. Compensation: No change | 0 | 0 | 0 |
| 13. Plus: depreciation of business IPP | $DEP_{IPP}$ | 1.1 | 676.9 |
| 14. Plus: Increase in corporate profits | IPP-$DEP_{IPP}$ | 0.5 | 119.2 |
| 15. Gross value added, post-revision, capitalizing method | $GVA_{CAP}$ = $GVA_{EXP}$ + IPP | 127.5 | 11576.3 |
| 16. Net value added, pre-revision, expensing method | $GVA_{EXP}$ -$DEP_{EXP}$ | 117.2 | 9667.9 |
| 17. Compensation: No change | 0 | 0 | 0 |
| 18. Plus: Increase in corporate profits | IPP-$DEP_{IPP}$ | 0.5 | 119.2 |
| 19. Net value added, post-revision, capitalizing method | $GVA_{CAP}$ - $DEP_{CAP}$ = $GVA_{EXP}$ - $DEP_{EXP}$ +IPP -$DEP_{IPP}$ | 117.7 | 9787.1 |

**Table 1: Continued.**

| | | | |
|---|---|---|---|
| 20. Gross Labor Share, pre-revision, expensing method | $Comp/GVA_{EXP}$ | 0.65 | 0.63 |
| 21. Numerator: No change | 0 | 0 | 0 |
| 22. Denominator: Plus: IPP spending | IPP | 1.6 | 796.1 |
| 23. Gross Labor Share, post-revision, capitalizing method | $Comp/(GVA_{EXP}+IPP)$ | 0.64 | 0.58 |
| 24. Net Labor Share, pre-revision, expensing method | $Comp/(GVA_{EXP} - DEP_{EXP})$ | 0.70 | 0.70 |
| 25. Numerator: No change | 0 | 0 | 0 |
| 26. Denominator: Plus: Increase in corporate profits | $IPP\text{-}DEP_{IPP}$ | 0.5 | 119.2 |
| 27. Net Labor Share, post-revision, capitalizing method | $Comp/(GVA_{EXP}+IPP\text{-}DEP_{EXP}\text{-}DEP_{IPP})$ | 0.70 | 0.69 |

Table 1 presents the effects of IPP accounting methods on the gross value added and net value added for the corporate sector. Compensation, depreciation, corporate profits, and gross value added are for all corporations. The compensation of employees for all corporations is from NIPA Table 1.14. The depreciation for all corporations is from the BEA fixed assets table (FAT 4.4). The corporate profits for all corporations are from NIPA Table 1.12. The IPP investment for all corporations is from the BEA fixed assets table (FAT 4.7). The gross value added for all corporations is from NIPA Table 1.13.