Taxes, Subsidies, and Productivity Measurement in the Covid Era

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September 26, 2022

ABSTRACT

Taxes on production and imports, less subsidies, represents roughly 8% of U.S. GDP but not all of its value is captured in the input costs used to estimate U.S. Bureau of Labor Statistics (BLS) productivity measures. This is due to the well know empirical issue of how best to allocate taxes to factors of production. In this paper, we compare four approaches to the distribution of net taxes on production among primary factor inputs and evaluate the impact of each approach on BLS productivity and related measures for the U.S. private business sector and 61 National Income and Product Account (NIPA) industries. We find that while each approach has minimal effect on private business productivity, the effects vary at the industry level. With the goal of finding a method that does not bias productivity measures, we ultimately suggest using capital and labor shares to distribute taxes to factors of production. Before estimating these alternative productivity models, we consider the unprecedented expenditure of covid-relief funding by the U.S. government in response to the pandemic, how these funds are reflected in the national accounts and implications for the data used in productivity measurement.

The authors would like to express their appreciation to Lucy Eldridge, Matt Russell, Chris Sparks, and Jay Stewart of the Bureau of Labor Statistics Office of Productivity and Technology for helpful comments. All views expressed in this paper are those of the authors and do not necessarily reflect the views or policies of the U.S. Bureau of Labor Statistics.

I. Productivity, Output, and Taxes on Production and Imports

Total factor productivity (TFP) is a measure of the efficiency with which an economy converts inputs into output. TFP may be measured by relating gross, sectoral, or value-added measures of output to the corresponding set of inputs. Depending on the measure of output used, inputs to production may include the primary inputs of capital and labor as well as intermediate inputs such as energy, materials, and purchased business services. By accounting for capital and other inputs, total factor productivity measures reflect the effects of technical change that are not captured in measured input growth, such as increases in general knowledge (for example, new scientific findings), adoption of better management techniques, and improved organizational Structure.

$$(1) \qquad TFP\ growth = \ Output\ growth - \sum_i s_i \ \ Input\ growth_i$$

where s_i are cost share weights for each input i and the sum of all cost shares will equal one. For the purposes of this paper, we are going to focus on value-added output and the primary inputs of capital and labor.[1] More specifically, we are going to focus on how best to distribute net taxes on production and imports between the costs of each of these inputs so that we hold true the fundamental rule that output cost is equal to input cost. [2]

[1] For the purpose of TFP measurement, BLS labor input is measured as a Tornqvist aggregation of the hours at work by all persons, classified by education, work experience, and gender with weights determined by their shares of labor compensation in each industry. By comparison, BLS labor productivity is defined as output per hour worked, where hours worked is measured as the total number of hours worked of all persons, including wage and salary workers, unincorporated self-employed workers, and unpaid family workers. Using the hours worked by all persons definition allows labor productivity growth to be decomposed into the contribution of total factor productivity growth, the contribution resulting from capital/ labor substitution (capital deepening) and the contribution of the labor composition effect. See U.S. Department of Labor, Bureau of Labor Statistics, Handbook of Methods, (Washington DC: U.S. Government Printing Office) September 1983, Chapter 10, p. 89-92. BLS Handbook of Methods: Chapter 10. Productivity Measures: Business Sector and Major Subsectors

[2] Taxes on production and imports (TOPI) are defined as taxes payable on products when they are produced, delivered, sold, transferred, or otherwise disposed of by their producers (such as federal excise taxes, custom duties, and state and local sales taxes). TOPI also includes other taxes on production, such as taxes on ownership of assets used in production (for example, local real estate taxes, motor vehicle licenses, severance taxes, and special assessments). It does not include personal and corporate income taxes and personal property taxes. See U.S. Department of Commerce, Bureau of Economic Analysis, Concepts and Methods of the U.S. National Income

Output and Inputs

Current dollar values of output are available in the U.S. national accounts. Gross domestic product (GDP) reflects "the market value of the goods, services, and structures produced by the nation's economy in a particular period less the value of the goods and services used up in production."[3] GDP can be measured using information on production, income, or expenditures.[4] Under the income approach, output is the sum of incomes accruing to the owners of the factors of production and to governments, i.e., the sum of employee compensation, taxes on production and imports less subsidies, and gross operating surplus.[5] Referred to as gross domestic income (GDI), the income approach assumes market prices reflect the incomes earned and costs incurred in production.[6] Because the national accounts assume income earned from production equals the value of goods and services produced, GDP is equal to GDI and Gross Value-Added.[7] The national accounts similarly include data on the value of inputs used in production, obtained from a wide variety of sources.[8]

and Product Accounts (Chapters 1–13), December 2021, Glossary: National Income and Product Accounts (Updated: November 2019), p. 32. https://www.bea.gov/resources/methodologies/nipa-handbook/pdf/all-chapters.pdf

[3] Ibid., p. 14.

[4] Note that gross output and value-added output in the national accounts are valued at producers' prices while intermediate inputs are valued at purchasers' prices. For further discussion of gross output, see U.S. Department of Commerce, Bureau of Economic Analysis, Concepts and Methods of the U.S. National Income and Product Accounts (Chapters 1–13), December 2021, p. 2-9.

[5] U.S. Department of Commerce, Bureau of Economic Analysis, Measuring the Economy: A Primer on GDP and the National Income and Product Accounts," December 2015, p. 3-4.

[6] Under the production or value-added approach, GDP is measured as gross output less intermediate inputs, i.e., the sum of the value-added during the production process. The expenditure approach measures GDP as the sum of purchases by final users including personal consumption expenditures, gross private domestic fixed investment, the change in private inventories, government consumption expenditures and gross investment, and net exports. U.S. Department of Commerce, Bureau of Economic Analysis, Concepts and Methods of the U.S. National Income and Product Accounts (Chapters 1–13), December 2021, Glossary: National Income and Product Accounts (Updated: November 2019), p. 2-7 – 2-11. https://www.bea.gov/resources/methodologies/nipa-handbook/pdf/all-chapters.pdf

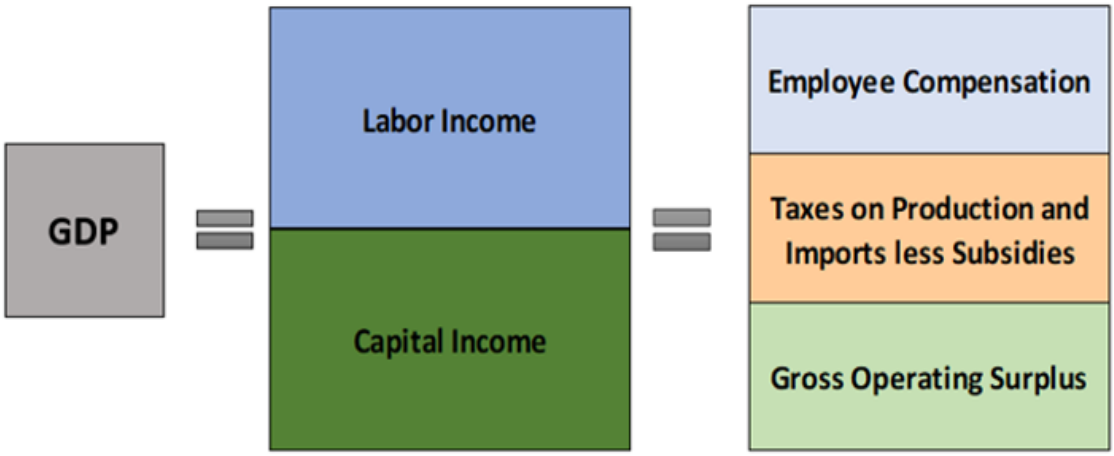
[7] U.S. Department of Commerce, Bureau of Economic Analysis, Measuring the Economy: A Primer on GDP and the National Income and Product Accounts," December 2015, p. 2.

[8] For example, compensation of employees includes wages and salaries and supplements to wages and salaries. National accounts data on wages and salaries is obtained primarily from the Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages (QCEW) survey. Many additional data sources are used to obtain data on supplements to wages and salaries, including statistical reports from the Department of the Treasury, federal budget publications and other administrative and regulatory agency reports, and reports from private organizations (such as trade associations). Additional information on the sources of data used in the U.S. national

Taxes on Production and Imports: A Practical Problem

In the Solow productivity model, we know that the value of output is equal to the value of inputs. That is, GDP is equal to the value of capital and labor inputs. We also know that GDP can be measured as the sum of employee compensation, taxes on production and imports less subsidies, and gross operating surplus, as illustrated in Figure 1 below. [9]

Figure 1. Relationship of GDP to Capital and Labor Incomes and Expenditures of Produced Value



This equivalence presents productivity analysts with the issue of how best to attribute output value among inputs. A commonly used approach is to assign output value to factors of production based on the relevant income earned by each factor. Employee compensation, for

accounts is provided in detail in the NIPA Handbook. See U.S. Department of Commerce, Bureau of Economic Analysis, Concepts and Methods of the U.S. National Income and Product Accounts (Chapters 1–13), December 2021, p. 10-7 – 10-25. NIPA Handbook: Concepts and Methods of the U.S. National Income and Product Accounts | U.S. Bureau of Economic Analysis (BEA)

[9] Gross operating surplus is defined as "a profits-like measure that shows gross private and government enterprise income after subtracting compensation of employees and 'taxes on production and imports less subsidies' from gross value-added, but before subtracting consumption of fixed capital, financing costs (such as net interest), and other payments (such as business current transfer payments). It is equal to net operating surplus plus consumption of fixed capital." Gross operating surplus includes consumption of fixed capital, proprietor's income, corporate profits, and business net current transfer payments. U.S. Department of Commerce, Bureau of Economic Analysis, Concepts and Methods of the U.S. National Income and Product Accounts (Chapters 1–13), December 2021, Glossary: National Income and Product Accounts (Updated: November 2019), p. 16. https://www.bea.gov/resources/methodologies/nipa-handbook/pdf/all-chapters.pdf

instance, is income earned from labor inputs, and gross operating surplus captures income earned by capital inputs. How to attribute the value of the final piece of GDP expressed in terms of its' income components - taxes on production and imports, adjusted to remove the value of subsidies - to capital and labor inputs is less clear.[10]

In the NIPAs, taxes on production and income (TOPI) and subsidies exist as separate categories. Taxes on production and imports are defined as taxes payable on products when they are produced, delivered, sold, transferred, or otherwise disposed of by their producers (such as federal excise taxes, customs duties, and state and local sales taxes). This includes other taxes on production, such as taxes on ownership of assets used in production (for example, local real estate taxes, motor vehicle licenses, severance taxes, and special assessments). Personal and corporate income taxes and personal property taxes are not included.[11] Because subsidies are payments by government agencies to private businesses and government enterprises to support their current operations, their value does not represent an income paid due to production.[12] When GDP and GDI are calculated, the value of subsidies is, as a result, subtracted out to remove the non-production value of subsidies. To accomplish this, a third

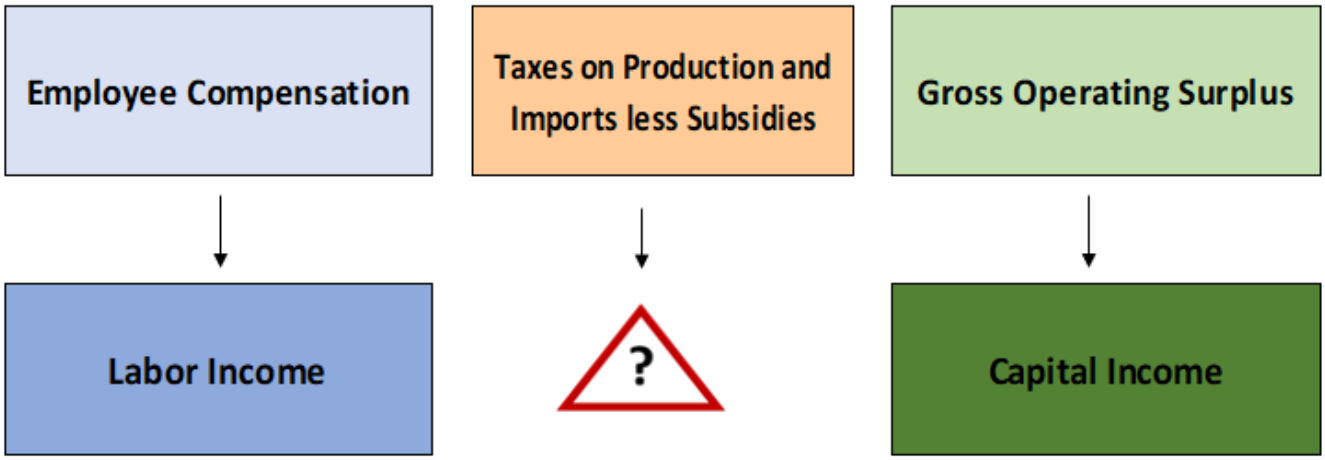
[10] Subsidies include "payments from government agencies to private business (for example, federal subsidies to farmers) and to government enterprises (for example, federal subsidies to state and local public housing authorities) to support their current operations. In contrast, payments associated with the acquisition or disposal of assets are classified as capital transfers."[10] Subsidies may be direct or indirect in form. Direct subsidies involve an actual payment of funds toward a particular individual, group, or industry, while indirect subsidies do not have a predetermined monetary value or involve actual cash outlays. Instead, they may take the form of price reductions for required goods or services that are government-supported. This allows the needed items to be purchased below the current market price, resulting in savings for those the subsidy is designed to help. Examples of subsidies to individuals include welfare payments, unemployment benefits, and subsidized student loans; while subsidies to industries may include direct payments to airlines or milk price supports for the farm sector. Investopedia, Types of Subsidies, 2021 online article Subsidy Definition (investopedia.com)

[11] See "Appendix: Summary National Income and Product Accounts," p. 2, in U.S. Department of Commerce, Bureau of Economic Analysis, Concepts and Methods of the U.S. National Income and Product Accounts (Chapters 1–13), December 2021.

[12] U.S. Department of Commerce, Bureau of Economic Analysis, Concepts and Methods of the U.S. National Income and Product Accounts (Chapters 1–13), December 2021, p. 2-10. The private business sector is comprised of all corporate and noncorporate private entities organized for profit and certain other entities that are treated as businesses in the national income and product accounts (NIPAs), including mutual financial institutions, private noninsured pension funds, cooperatives, nonprofit organizations that primarily serve businesses, Federal Reserve banks, federally sponsored credit agencies. See U.S. Department of Commerce, Bureau of Economic Analysis, Concepts and Methods of the U.S. National Income and Product Accounts (Chapters 1–13), December 2021, Glossary: National Income and Product Accounts (Updated: November 2019), p. 27. https://www.bea.gov/resources/methodologies/nipa-handbook/pdf/all-chapters.pdf

NIPA "net taxes" or "TOPI less subsidies" category is calculated on the basis that subsidies are transfer payments rather than payments to production.[13] With subsidies removed from TOPI, the remaining value of TOPI is produced value that, in theory, may be attributed to factors of production. However, in practice it is difficult if not impossible to assign these taxes to a specific input due to the general nature of the taxes, fees, and assessments included in TOPI, as illustrated in Figure 2.

Figure 2. Distribution of GDP Components Between Capital and Labor Inputs



BLS Current Distribution of GDP Among Inputs

In the BLS total factor productivity program, employee compensation is assigned to labor cost and gross operating surplus is assigned primarily to capital cost, with a small portion, determined to be proprietor labor compensation, assigned to labor. [14] TOPI less subsidies is

[13] This implies that the value of subsidies is offset or sourced from taxes on production; in effect, subsidies are a negative tax by government.

[14] Mixed income, i.e., noncorporate income is allocated to labor and capital in each year using the following procedure: an initial estimates of proprietors' labor compensation is made by assuming that proprietors earn the same average hourly compensation as employed workers. That compensation per hour estimate is multiplied by the number of proprietors to arrive at an independent measure of proprietors' labor. In addition, BLS assumes that the proprietors' capital rate of return is the same rate of return as their industry corporate counterparts allowing for an independent measure of capital income for the proprietors' piece of capital income. After these two independent measures are computed, BLS scales the sum to the mixed income figure reported by BEA, evenly

more difficult to assign directly. During early development of the BLS total factor productivity measurement program, the nature of the value included in TOPI less subsidies was investigated. After reviewing the national accounts data available for taxes on production and imports, it was found that some taxes included in TOPI, such as motor vehicle license fees and business property taxes, are clearly related to capital while other taxes such as sales and excise taxes imposed on specific goods may relate more to the output of the paying industry.

The value of TOPI less subsidies, or net TOPI, then, includes both the value of factor specific taxes, such as the motor vehicle and property taxes found to be associated directly with capital income, and the value associated with the remaining components of net TOPI. It is this remaining value, which we refer to as net nonfactor or indirect taxes, that is difficult to associate with specific inputs. Because net nonfactor taxes consist of income from current production not accruing specifically to labor or capital inputs, attributing this income to either capital or labor is problematic. For example, customs duties may be absorbed fully by a producer or partially or fully passed on to the product consumer.[15]

To avoid incorrectly assigning net nonfactor specific tax value to capital or labor income, a methodological decision was made at the onset of the BLS total factor productivity measurement program to include only "a portion of indirect business taxes," i.e., the value that can be directly assigned to capital, in capital income. [16] It was deemed better to simply remove the value of net nonfactor taxes from total income, rather than risk imposing a bias on the resulting capital rental prices, capital shares, capital services, and productivity measures by

distributing any residual. See U.S. Department of Labor, Bureau of Labor Statistics, Handbook of Methods online, 2022, https://www.bls.gov/opub/hom/msp/concepts.htm.

[15] See System of National Accounts, 1993, pp. 209-216 for a detailed description of the components included in taxes on production and imports and in subsidies.

[16] See US Department of Labor, Bureau of Labor Statistics. *Trends in Multifactor Productivity, 1948-81*. Bulletin 2178: Washington DC, September 1983, p. 52. This issue is also described in Organisation for Economic Co-Operation and Development, *Measuring Productivity: Measurement of Aggregate and Industry-Level Productivity Growth* (Paris: Organisation for Economic Co-Operation and Development, 2001), p. 79-81, http://www.oecd.org/sdd/productivity-stats/2352458.pdf and Commission of the European Communities-Eurostat, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations and World Bank, Brussels/Luxembourg, "System of National Accounts 1993", New York, Paris, Washington, 1993, pp. 209-210. https://unstats.un.org/unsd/nationalaccount/docs/1993sna.pdf

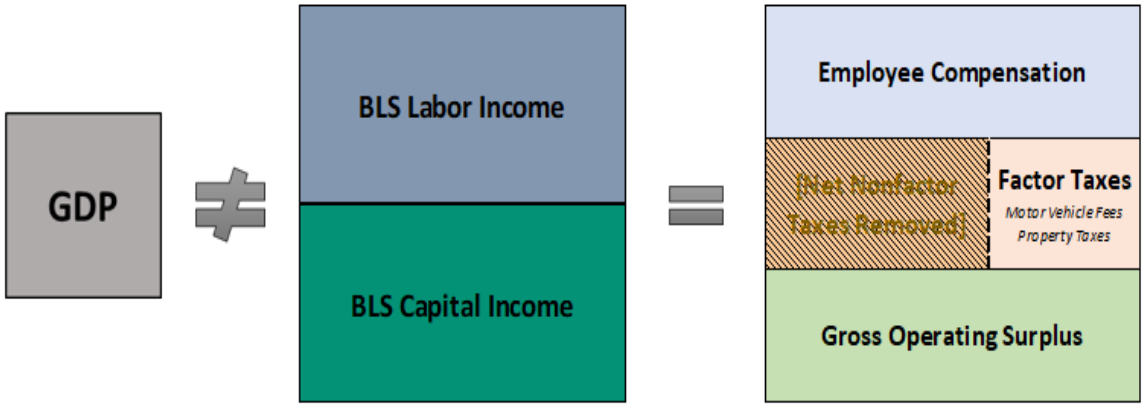
attributing these charges either to capital or labor factors with little supportive evidence. [17] The recommendation adopted was that "only those taxes…which provide incentives to employ more or less capital should be included in our definition of property income."[18] On conceptual grounds, as a result, most indirect taxes were excluded from capital (or labor) costs because they could not be shown to directly influence the use of capital or labor inputs. This neutral treatment of nonfactor taxes has continued to date.

As a result, in order to avoid imposing a bias on our measures of either capital or labor cost, the remaining value of TOPI less subsidies, i.e., net nonfactor taxes, is removed from input costs, as shown in Figure 3. On the other hand, the value of net nonfactor taxes is not removed on the output side. Removing the value of net nonfactor taxes generally had only a slight impact on the value of capital and labor shares. As a result, also removing the equivalent output value was determined to be unnecessary and potentially to have a larger impact given the minor effect on input shares. This adjustment to total input cost only then leads to a breakdown of the fundamental rule that output equals inputs:

[17] BLS computes capital income as gross operating surplus (GOS) less current surplus of government enterprises, government consumption of fixed capital, and net current business transfer payments. Net nonfactor taxes are defined as taxes on production and imports (TOPI) less subsidies less factor specific TOPI.

[18] In a March 21, 1989, email, "Components of Indirect Taxes," to former BLS Associate Commissioner for Productivity and Technology Edwin R. Dean, Michael J. Harper summarizes an examination of BEA data available on indirect taxes by Steve Rosenthal and himself and the reasons for their resulting recommendations for the inclusion and exclusion of specific indirect taxes and subsidies. BLS is currently investigating whether additional information is now available by industry on the types of taxes included in taxes on production and imports.

Figure 3. GDP Compared to BLS Capital and Labor Incomes and BLS Measures of Expenditures



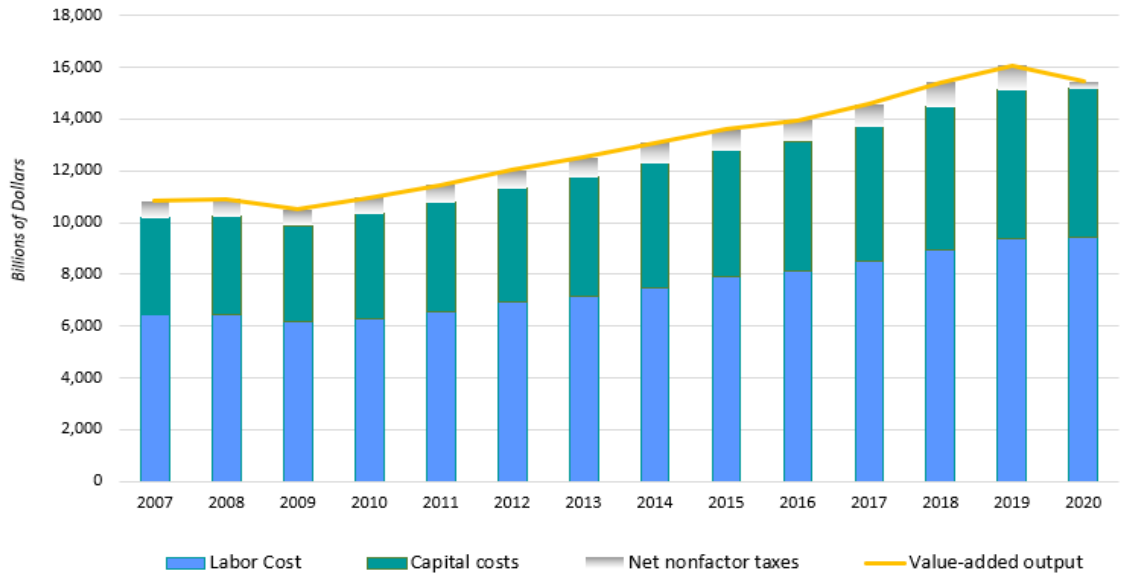
This asymmetry between the value of output and inputs - with output value in excess of input value – was adopted as a solution to the issue of assigning net TOPI value to factors of production when BLS TFP measures were first introduced in 1983.

As productivity measurement has matured, however, calculating industry contributions to aggregate levels of productivity growth has become a valuable tool for economic growth analysis. With greater interest in understanding the productivity contributions of individual industries to aggregate sector productivity, finding the best solution to distribution of net nonfactor taxes has become increasingly important. Using a measurement framework that handles the issue of taxes on production by dropping the unattributable portion of their value, resulting in total input costs that are less than the value of output, may now be problematic and interfere with the ability to accurately weight up industry contributions to aggregate productivity growth.[19] Developing a new approach to how nonfactor taxes are handled in the measurement framework is particularly important to BLS for this reason.

[19] For further discussion, see Organisation for Economic Co-Operation and Development, *Measuring Productivity: Measurement of Aggregate and Industry-Level Productivity Growth* (Paris: Organisation for Economic Co-Operation and Development, 2001), p. 81, http://www.oecd.org/sdd/productivity-stats/2352458.pdf.

For the private business sector, this means that for BLS the summed value of capital and labor costs is less than the value of output by an amount equal to net nonfactor taxes, as shown in Figure 4 below.

Figure 4. Private Business Value-Added Output, Input Costs, and Net Nonfactor Taxes



Distribution Across Industries: TOPI and Subsidies

Before examining our simulation models using alternative approaches to the treatment of net nonfactor taxes, we first review the impact of taxes and subsidies for the 61 NIPA industries and the private business sector. The top ten industries by share of taxes on production and imports relative to GDP, as shown in Table 1, include:

Table 1. Taxes on Production and Imports Relative to GDP, 2019, Top Ten Industry shares

NAICS Code	Industry	TOPI/GDP
42	Wholesale trade	21.9%
44, 45	Retail trade	21.5%
22	Utilities	19.9%
211	Oil and gas extraction	19.9%
481	Air transportation	19.5%
721	Accommodation	18.0%
713	Amusements, gambling, and recreation industries	14.6%
722	Food services and drinking places	12.8%
531	Real estate	12.6%
311, 312	Food and beverage and tobacco products	10.4%

For this research, we are concerned with how best to treat that value of TOPI that remains in GDI after first netting out any subsidies received by an industry or sector, or TOPI less subsidies. TOPI less subsidies includes taxes we attribute to specific factors, including motor vehicle and property taxes, and the remaining value of nonfactor taxes after adjusting for subsidies, or net nonfactor taxes. Our control and simulation runs include the value of factor specific taxes (motor vehicle licenses and business property taxes) in capital income. The value of net nonfactor taxes is then either omitted from capital and labor income as in the control run or distributed in alternative ways in the simulation runs. The industries most impacted by how we distribute net nonfactor taxes include the ten with the highest shares of net nonfactor taxes relative to GDP in 2019, presented in Table 2 below:

Table 2. Net Nonfactor Taxes Relative to GDP, 2019, Top Ten Industry Shares

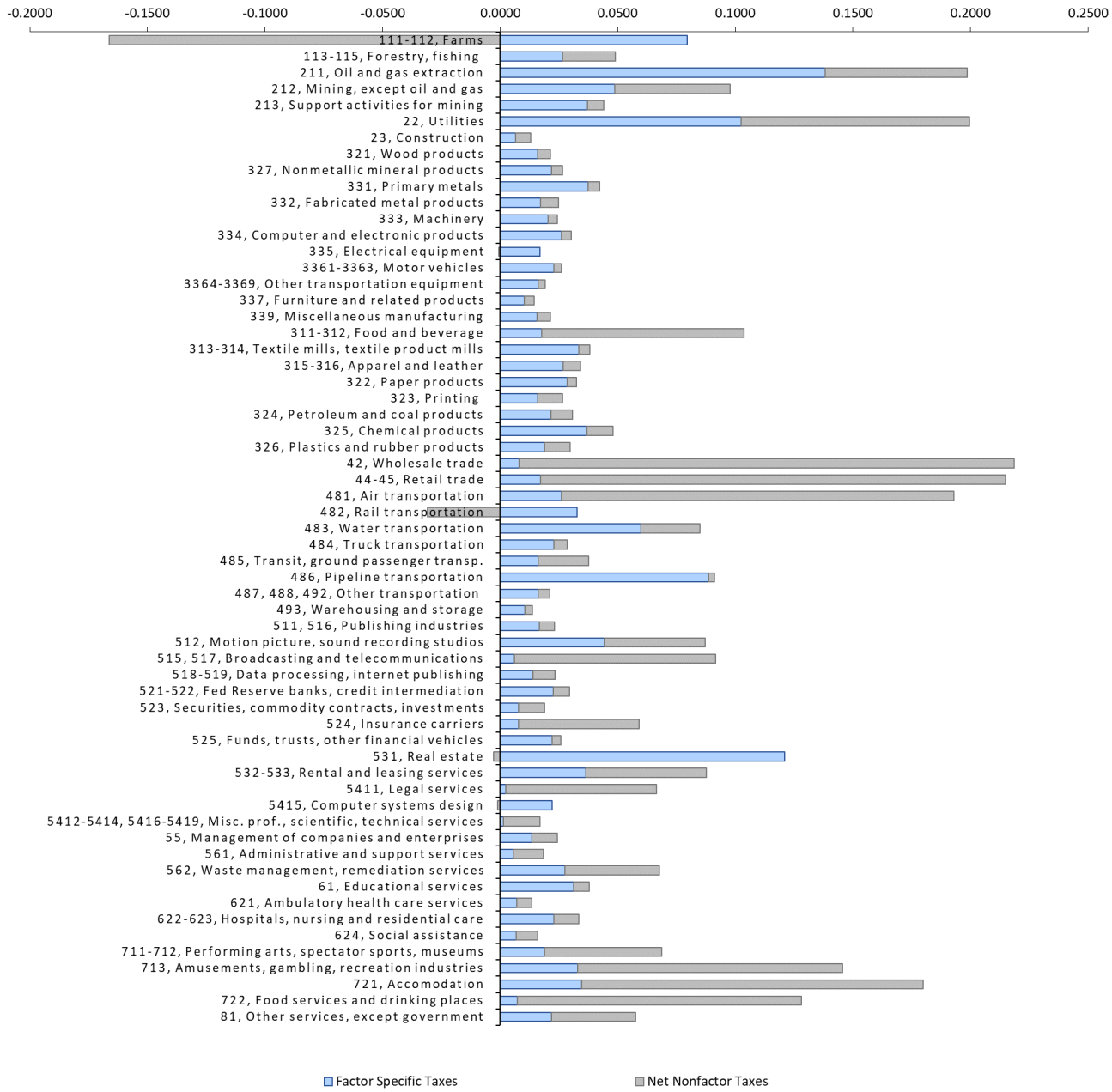
NAICS Code	Industry	Net Nonfactor Taxes/GDP
42	Wholesale trade	21.1%
44, 45	Retail trade	19.8%
481	Air transportation	17.5%
721	Accommodation	14.6%
722	Food services and drinking places	12.2%
531	Real estate	11.6%
713	Amusements, gambling, and recreation industries	11.3%
22	Utilities	9.2%
311, 312	Food and beverage and tobacco products	8.6%
515, 517	Broadcasting and telecommunications	8.6%

Finally, it is worth noting that subsidies are present in only 11 of the 61 NIPA industries in 2019, with NAICS 111-112, Farms (16.6%); NAICS 482, Rail Transportation (5.2%); and NAICS 531, Real Estate (0.8%) receiving the largest shares of subsidies relative to GDP. Appendix Table A-1 presents subsidies as a share of GDP for all industries.

While net nonfactor taxes represent roughly 5 percent of the nation's GDP in the Private Business sector, the distribution of net nonfactor taxes relative to GDP across industries varies widely, as shown in Figure 5 below.[20]

[20] See Section I in the Appendix for a list of NAICS Codes and Industry Titles.

Figure 5. TOPI less Subsidies Components: Factor Specific and Net Nonfactor Taxes Relative to GDP for 61 NAICS Industries, 2019



Data Concerns: Covid-19 and National Accounts Subsidies

The global COVID-19 pandemic has created historic trends in many data series, including output, hours, and prices, creating enormous measurement challenges for statistical agencies world-wide. The impact of unprecedented subsidies used to stabilize the US economy have been particularly challenging to the measurement of TFP.[21] As a result, before proceeding with our simulation runs to assess different treatments of net TOPI, we first consider the impact of the historically unprecedented use of subsidies to address the economic fallout from the Covid-19 pandemic.[22] Figure 6 below provides historical perspective on the share of TOPI, subsidies, and net TOPI in GDP in 2020 compared to the pre-pandemic years of 1998-2019. TOPI on average comprised 7.14 percent of GDP over the 1987-2019 period. By comparison, subsidies made up .42 percent of GDP over the same period and were relatively stable over time, with a low of .31 percent in 2017 and a high of .63 percent in 1987. TOPI less subsidies was also quite steady, averaging 6.72 percent of GDP during this period.

These smooth trends were upended, however, as government interventions to stabilize the economy were put into place in 2020. The 2020 subsidies category includes both "normal" or traditionally provided subsidies, such as federal subsidies to farmers, and the quite massive COVID relief subsidies. The value of subsidies in 2020 increased by over ten times the 2019

[21] The Paycheck Protection Program (PPP) provided forgivable loans to small businesses and nonprofits of up to $10 million. The Air Carrier Worker Support Program (ACWSP), the Employee Retention Tax Credit, and the Sick Leave Tax Credit also assisted businesses by providing funds to support their employees during the pandemic. Another program, the Provider Relief Fund, provided funds to reimburse eligible health care providers for health care related expenses or lost revenues that are attributable to coronavirus. The Coronavirus Food Assistance Program provided financial assistance to agricultural producers facing market disruptions, reduced farm-level prices, and additional production and marketing costs related to Covid-19. The Economic Injury Disaster Loan (EIDL) program provided low interest loans to small businesses that suffered a loss in revenue because of the coronavirus pandemic. More recently, the Consolidated Appropriations Act of 2021 appropriated funding for the Coronavirus Economic Relief for Transportation Services (CERTS) program to provide eligible transportation service companies with resources to maintain payroll, rehire employees who were laid off, and cover eligible overhead and operational expenses.

[22] For an overview of U.S. spending related to the Covid-19 pandemic, see Alicia Parlapiano, Deborah B. Solomon, Madeleine Ngo and Stacy Cowley ,"Where $5 Trillion in Pandemic Stimulus Money Went," New York Times, March 11, 2022. https://www.nytimes.com/interactive/2022/03/11/us/how-covid-stimulus-money-was-spent.html

value, representing 3.61 percent of GDP. This unprecedented increase in subsidies, combined with an unusually slow growth in TOPI from 2019 to 2020 of .16 percentage points, results in a related, dramatic decrease in net TOPI as a share of GDP. In 2020, the value of net TOPI was at an historic low, making up 3.67 percent of GDP compared to 6.81 percent in 2019.

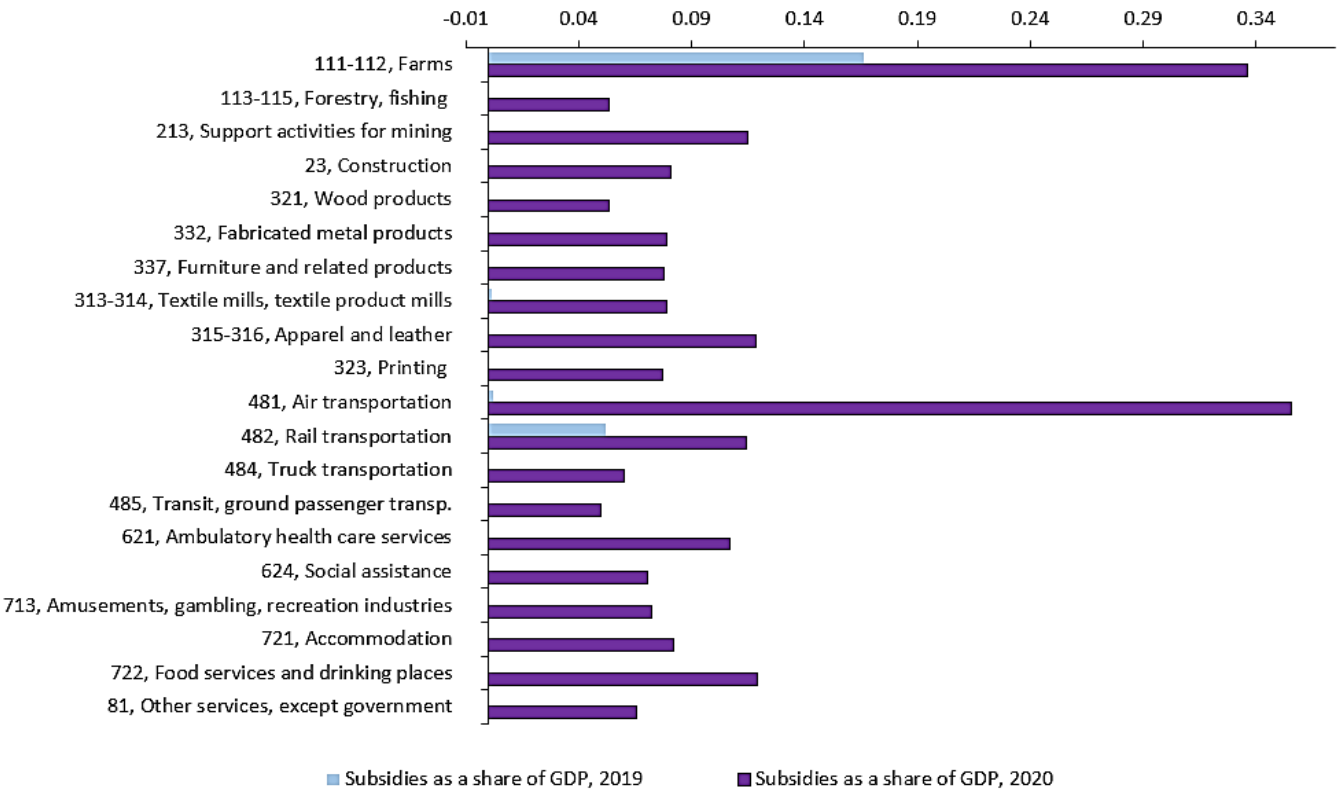
Figure 6. TOPI, Subsidies, and net TOPI Relative to GDP
Private Industries, 1998-2020

As part of the response to Covid in 2020, all 61 NIPA industries received subsidies, with NAICS 481, Air Transportation, NAICS 111-112, Farms, and NAICS 722, Food Services and Drinking Places receiving the largest subsidies relative to industry GDP. Within the original 11 industries receiving subsidies in 2019, the value of total subsidies increased markedly in 2020, particularly for NAICS 622-623, Hospitals and Nursing and Residential Care; NAICS 325, Chemical Products; NAICS 515-617, Broadcasting and Telecommunications; and NAICS 481, Air Transportation.[23]

[23] In the four industries with the largest Covid subsidies, total subsidies increased as follows: 622-623, Hospitals and Nursing and Residential Care increased from 12 million in 2019 to over 26 billion dollars in 2020; NAICS 325, Chemical Products increased from 9 million to 4.4 billion dollars in 2020; NAICS 516-517, Broadcasting and Telecommunications increased from 6 million to 1.9 billion dollars; and NAICS 481, Air Transportation increased from 288 million in 2019 to 21 billion dollars in 2020.

Figure 7 below presents 2019 and 2020 shares of subsidies in industry GDP, for those NAICS industries with the twenty highest share values.

Figure 7. Subsidies Relative to GDP for Selected NAICS Industries, 2019 and 2020



Because this paper uses BEA data on labor and capital costs, understanding how the U.S. national accounts are addressing these data challenges is important. In the U.S., the federal government enacted multiple pieces of legislation to fund programs providing support to people, businesses, the health care system, and state and local governments, appropriating over 4.6 trillion dollars.[24] In order to accurately reflect the impact of this funding on the NIPAs, the Bureau of Economic Analysis carefully reviewed the legislation enacted and the funds

[24] See *Significant Improvements Are Needed for Overseeing Relief Funds and Leading Responses to Public Health Emergencies*, Report to Congressional Committees, GAO-22-105291, U.S. Government Accountability Office, January 2022, p. 14. GAO-22-105291, Accessible Version, COVID-19: Significant Improvements Are Needed for Overseeing Relief Funds and Leading Responses to Public Health Emergencies

provided through this legislation to specific programs.[25] Determining how best to classify these funds in the NIPAs required understanding the type of funding provided by each program and how these funds would be captured by the myriad surveys and other data collection tools used to support the national accounts. This crucial task, necessary to maintain the integrity of the NIPAs, is summarized in Mandel and Ludwick (2021).[26]

[25] The major pandemic related legislation in the U.S. included the following: The initial legislation, the Coronavirus Preparedness and Response Supplemental Appropriations Act, was enacted March 6, 2020, and provided $8.3 billion in emergency funding for public health agencies and coronavirus vaccine research, see Congress.gov. "H.R.6074 - 116th Congress (2019-2020): Coronavirus Preparedness and Response Supplemental Appropriations Act, 2020" http://www.congress.gov/ and Benjamin A. Mandel and Mark S. Ludwick, "Covid-19 Pandemic: Federal Recovery Legislation and the NIPAs", U.S. Department of Commerce, Bureau of Economic Analysis, April 2021, Measuring the Small Business Economy (bea.gov) March 6, 2020. On March 18, 2020, the Families First Coronavirus Response Act was enacted, providing $192 billion of funding for emergency unemployment insurance, increased Medicaid funds, additional support for food-security programs, funding for tax credits in support of employer requirements to provide paid sick leave and family and medical leave, and free coronavirus testing under government health programs. See Congress.gov. "Text - H.R.6201 - 116th Congress (2019-2020): Families First Coronavirus Response Act." March 18, 2020. http://www.congress.gov/ and also What Is the Families First Coronavirus Response Act (FFCRA) (investopedia.com). Additional legislation for pandemic relief included the Coronavirus Aid, Relief, and Economic Security (CARES) Act enacted March 27, 2020, and providing over $2 trillion to address the economic impact of the virus on businesses and households. The CARES Act established the Paycheck Protection Program that provided eight weeks of cash flow assistance to small businesses, expanded pandemic-related unemployment assistance and extended benefits to furloughed workers, gig workers, and freelancers; and provided cash grants to the airline industry to be used for payroll support, among other provisions. For additional information, see Congress.gov. "Text - H.R.6201 - 116th Congress (2019-2020): Families First Coronavirus Response Act." March 18, 2020. http://www.congress.gov/ and also Coronavirus Aid, Relief, and Economic Security (CARES) Act (investopedia.com). An additional $1.9 trillion in relief to assist in U.S. economic recovery from the Covid-19 pandemic was provided by the American Rescue Plan Act of 2021, enacted March 11, 2021. This legislation again extended unemployment compensation, moratoriums on evictions and foreclosures, and increased the Child Tax Credit while making it fully refundable. It included funds to assist kindergarten through eighth grade schools in safely reopening, extended food assistance benefits, subsidized Covid testing and vaccination programs, and provided funds to state and local governments to compensate for lost tax revenue, among other provisions. For additional information, see Congress.gov. "H.R.1319 - 117th Congress (2021-2022): American Rescue Plan Act of 2021." March 11, 2021. http://www.congress.gov/ and also What's in the American Rescue Plan (investopedia.com).

[26] For a summary of pandemic related federal legislation and the impact on the U.S. National Income and Product Accounts, see Benjamin A. Mandel and Mark S. Ludwick, "Covid-19 Pandemic: Federal Recovery Legislation and the NIPAs", U.S. Department of Commerce, Bureau of Economic Analysis, April 2021, Measuring the Small Business Economy (bea.gov).

As recommended by the United Nations System of National Accounts, BEA has recorded government covid relief payments to businesses as subsidies.[27] BEA wages and salaries data continued to be obtained from their normal sources, primarily the BLS Quarterly Census of Employment and Wages (QCEW), during the pandemic years. The QCEW captures the portion of Covid relief funds paid by employers to their employees. However, the normal BEA gross operating surplus data sources did not reflect the covid relief funding received by businesses and so BEA made an adjustment to this data to account for these subsidies. BEA intends to use IRS Statistics of Income (SOI) data to fully capture covid relief funds flowing to businesses during the next annual update. In addition, if administrative data is available to support reclassifying spending as capital transfers rather than subsidies, BEA may consider making this adjustment in a future update.[28] At this time, the BEA national accounts data captures the flow of covid relief funds as well as feasible. Nevertheless, because 2020 was an anomalous year, we have elected to use 2019 as the end point for our data comparisons.

II. An Empirical Investigation: Alternative Treatments of Indirect Taxes

Various solutions have been proposed to resolve this "nonfactor taxes" or "indirect taxes" problem. For example, the Organization for Economic Cooperation and Development (OECD) recommends that net nonfactor taxes be distributed between capital and labor incomes in proportion to capital and labor shares.[29] This is the approach used by the Australian Bureau of

[27] See, for example, "Government Support to Businesses and Households," International Monetary Fund, the Intersecretariat Working Group on National Accounts, May 6, 2020 Government Support to Businesses and Households; "Covid-19: How to Record Government Support to Employers, Self-employed and Households," United Nations Economic Commission for Europe. Compilation of National Accounts in Times of Covid; and United Nations, European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development, and World Bank, System of National Accounts 2008. (New York: United Nations, 2009). System of National Accounts 2008.

[28] For further discussion of capital transfers in the national accounts, see United Nations, European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development, and World Bank, System of National Accounts 2008. (New York: United Nations, 2009), p. 54. System of National Accounts 2008.

[29] See Organisation for Economic Cooperation and Development, "Measuring Productivity: Measurement of Aggregate and Industry-Level Productivity Growth," OECD Publications, 2001, p. 81 and pp. 112-113.

Statistics.[30] Alternatively, Statistics Canada and Statistics Netherland attribute all net nonfactor taxes to capital income.[31] Another approach is to evenly split net nonfactor taxes between capital and labor income. We develop three alternative simulation runs using each of the three alternative treatments mentioned above to estimate productivity and related measures. Finally, the current BLS approach and each of the three alternative treatments are compared.

The Effect of Net Nonfactor Taxes on Productivity

To illustrate the effects of distributing net nonfactor taxes to inputs, we will focus on the simplest model: allocating all of net nonfactor taxes to capital. Adding net nonfactor taxes to capital affects not only capital income but those measures dependent on capital income, including the growth of capital services and ultimately TFP.

An Industry Example: NAICS 42, Wholesale Trade

NAICS 42, Wholesale trade has the largest percentage of GDP removed from inputs due to net nonfactor taxes, with 21%, or $268.5 billion removed in 2019. The following example shows how adding $268.5 billion to capital cost changes capital input and TFP for the industry.
By allocating all of net nonfactor taxes to capital, we increase the cost of capital, and ever so slightly decrease the cost of labor as the estimate of proprietor labor is altered, as shown in Table 3.

[30] See Australian Bureau of Statistics, "Australian System of National Accounts: Concepts, Sources, and Methods, (Commonwealth of Australia, 2021). Australian System of National Accounts: Concepts, Sources and Methods, 2020-21 financial year (abs.gov.au), pp. 368-374 and 511.
[31] See Tarek Harchaoui, Mustapha Kaci, Jean-Pierre Maynard, Desmond Beckstead and Andrée Girard, *The Statistics Canada Productivity Program: Methodology 2000*, (Ottawa, Statistics Canada, 2004), p. 19. The Statistics Canada Productivity Program: Methodology 2000 (publications.gc.ca) and Dirk van den Bergen, Myriam van Rooijen-Horsten, Mark de Haan and Bert M. Balk., "Productivity Measurement at Statistics Netherlands" in *Productivity Measurement and Analysis* (Paris: OECD Publishing, 2009), p. 411. https://doi.org/10.1787/9789264044616-en

Table 3. Capital and Labor Income Effects from Including Net Nonfactor Taxes only in Capital Income, for NAICS 42 (Wholesale Trade), 2019

Industry Costs *(Millions of Dollars)*	**Original Value**	**Value Including Net Nonfactor Taxes**	**Difference**
Capital Cost	431,244	699,833	268,589
Corporate Capital	382,481	620,616	238,136
Noncorporate Capital	48,763	79,216	30,454
Labor Cost	575,269	575,176	-93
Employee Compensation	558,609	558,609	-
Proprietor Compensation [1]	16,660	16,567	-93

[1] Proprietor compensation is altered due to the breakout of proprietor mixed income between capital and labor.

At this point, we have a new capital cost for the industry, but the quantity of capital assets used in production has not changed. The new capital cost leads to a new internal rate of return for the industry, as shown in Table 4, and in this case, increases it.

Table 4. Internal Rate of Return Effect from Including Net Nonfactor Taxes only in Capital Income, for NAICS 42 (Wholesale Trade), 2019

Industry Costs *(Millions of Dollars)*	**Original Value**	**IRR Value Including Net Nonfactor Taxes**	**Difference**
IRR	0.17	0.28	0.11

The rental prices calculated separately for each capital asset and industry pairing are also impacted as the calculation of capital rental prices depends on the value of the industry-specific internal rate of return.[32] Because capital services are constructed by aggregating the various

[32] The internal rate of return for industry i in year t, r_{it}, is calculated by setting capital income equal to the product of capital stock and the rental price of capital. That is, $Y_{it} = K_{it}c_{it}$, where Y is capital income, K is capital stock, and c is the rental price. The rental price of capital, as derived by Hall and Jorgenson (1967) can be expressed as:

$$c_{imt} = \frac{(1 - u_t z_t - e_t)\left(P_{m,t-1} r_{it} + P_{m,t-1} d_{im,t} - \Delta P_{m,t-1}\right)}{1 - u_t} + P_{m,t-1} x_t$$

where u_t is the corporate income tax rate; z_t is the present value of $1 of tax depreciation allowances (usually between .8 and 1.0); e_t is the effective rate of the investment tax credit (zero since 1979); r_t is the nominal (internal) rate of return on capital; d_t is the average rate of economic depreciation; $p_{m,t-1}$ is the deflator for new capital goods (it is not clear how this differs from p_t above); $\Delta p_{m,t-1}$ is the revaluation of assets due to inflation in

types of capital assets using asset-and-industry-specific capital rental prices, the asset composition as well as the overall value of capital input in each industry will be impacted by the different treatments of net nonfactor taxes.

For wholesale trade, this leads to a 0.02 percentage point growth in capital input. Of particular note is that the increased capital value shifts the industry from a labor intensive to a capital-intensive industry, as the capital share increases to 55 percent from 43 percent. Together, all of these effects result in combined inputs increasing 0.31 percentage points and ultimately to TFP declining by almost the same amount, as seen in Table 5 below.

Table 5. Input and TFP Effects from Including Net Nonfactor Taxes only in Capital Income, for NAICS 42 (Wholesale Trade), 2019

Input and TFP Measures *(Annual Growth Rate, 2019)*	**Original Value**	**Value Including Net Nonfactor Taxes**	**Difference**
Capital Growth	3.11%	3.13%	0.02%
Labor Growth	0.53%	0.53%	0.00%
Capital Ratio	43%	55%	12%
Labor Ratio	57%	45%	- 12%
Combined Inputs Growth	1.63%	1.94%	0.31%
TFP	- 2.06%	- 2.36%	- 0.30%

This industry example provides a road map for the chain of effects that results from shifting net nonfactor tax value into capital income alone. An approach that includes net nonfactor tax value in both capital and labor input costs, as is sometimes adopted, will similarly impact those

new goods prices; x_t is the rate of indirect taxes. By substituting this rental price expression into the equivalence expression between nominal capital income and productive capital stock times the rental price of capital in each industry, an implicit industry internal rate of return allocating all capital income to capital assets in the industry in a given year can be derived. This internal rate of return can be described by the expression:

$$r_{it} = \frac{Y_{it} - xK_{it}P_{i,t-1} - K_{it}\left(P_{i,t-1}d_{it} - \Delta P_{i,t-1}\right)(1 - u_t z_t - e_t)/(1 - u_t)}{K_{it}P_{i,t-1}(1 - u_t z_t - e_t)/(1 - u_t)}$$

For further discussion, see the U.S. Department of Labor, Bureau of Labor Statistics, online version of Handbook of Methods, 2022, https://www.bls.gov/opub/hom/msp/concepts.htm.

estimated values that are dependent on the value of capital and labor income, in our productivity measurement framework. In the next section, we compare the current BLS approach to this issue, which we refer to as our "control model," with three alternative approaches.

Alternative Methodologies

After reviewing some of the practices used by other statistical agencies, we selected three alternative methodologies for use in constructing simulations for comparison with the current BLS productivity measurement methodology. In each of these three methodologies, the value of the factor specific taxes, motor vehicle licenses and business property taxes, remain included in capital income as is done in the control model.

All Capital

As with our example above, our first simulation designates all net nonfactor taxes as capital income. This simulation is similar to[33] Statistics Netherland similarly follows this method, although noting that subsidies strictly applying to wages are included in labor income: "A pragmatic solution is to attribute all taxes-less-subsidies on production to capital, with the exception of wage subsidies, which are of course attributed to labour[34]" This "all capital" simulation also assigns the factor specific charges of motor vehicle licenses and business property taxes to capital income.

[33] The Statistics Canada methodology is discussed in Tarek Harchaoui, Mustapha Kaci, Jean-Pierre Maynard, Desmond Beckstead and Andrée Girard, *The Statistics Canada Productivity Program: Methodology 2000*, (Ottawa, Statistics Canada, 2004), p. 19. The Statistics Canada Productivity Program: Methodology 2000 (publications.gc.ca). See also Tarek Harchaoui, Mustapha Kaci, Jean-Pierre Maynard, "Appendix 1 – The Statistics Canada Productivity Program: Concepts and Methods," in John R. Baldwin, Desmond Beckstead, Naginder Dhaliwal, René Durand, Valérie Gaudreault, Tarek M. Harchaoui, Judy Hosein, Mustapha Kaci, and Jean-Pierre Maynard, *Productivity Growth in Canada*, Appendix 1 (Ottawa, Statistics Canada, January 2001), p. 156-157. 15-204-x1999000-eng.pdf (statcan.gc.ca).

[34] For a discussion of the Statistics Netherland methodology, see Dirk van den Bergen, Myriam van Rooijen-Horsten, Mark de Haan and Bert M. Balk., "Productivity Measurement at Statistics Netherlands" in *Productivity Measurement and Analysis* (Paris: OECD Publishing, 2009), p. 411. https://doi.org/10.1787/9789264044616-en

Shares Split

In our second simulation, nonfactor taxes are split proportionally between capital and labor incomes, where the proportion is based on the shares of labor and capital in total income of the control model (i.e., with net nonfactor taxes removed from inputs). The labor and capital shares also reflect current BLS practice for the treatment of mixed income. [35] Separate estimates of mixed income attributable to labor and mixed income due to capital are first constructed. These two independent estimates are then reconciled and used to produce new capital and labor shares.[36] These final shares are then used to distribute the value of net nonfactor taxes between capital and labor incomes. In this "shares" simulation, factor specific charges including motor vehicle licenses and business property taxes again remain assigned to their associated factors, i.e., capital income. As mentioned above, this is the approach used by the Australian Bureau of Statistics (ABS).

Even Split

Finally, our third simulation assigns net nonfactor taxes by evenly splitting their value among labor and capital inputs. Output value as a result is now equal to input value. The impact of this treatment of nonfactor taxes potentially will show up in the internal rate of return (IRR) for capital in each industry, the external rate of return (ERR) for the private sector, capital and labor income and shares, and capital input for each industry and the private sector. While this model does not appear to be in use by major statistical agencies, we have included it as a step in the continuum of solutions: the current approach of simply dropping net nonfactor taxes, splitting net nonfactor taxes evenly between capital and labor, splitting net nonfactor taxes based on capital and labor shares, and assigning all net nonfactor taxes to capital. We use this

[35] Mixed income is "a measure of the income of unincorporated businesses that cannot be separated from the income accruing to the labor of the business's owners." See U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, Stephanie H. McCulla, Karin E. Moses, and Brent R. Moulton, "The National Income and Product Accounts and the System of National Accounts 2008: Comparison and Research Plans," June 2015, p. 5.

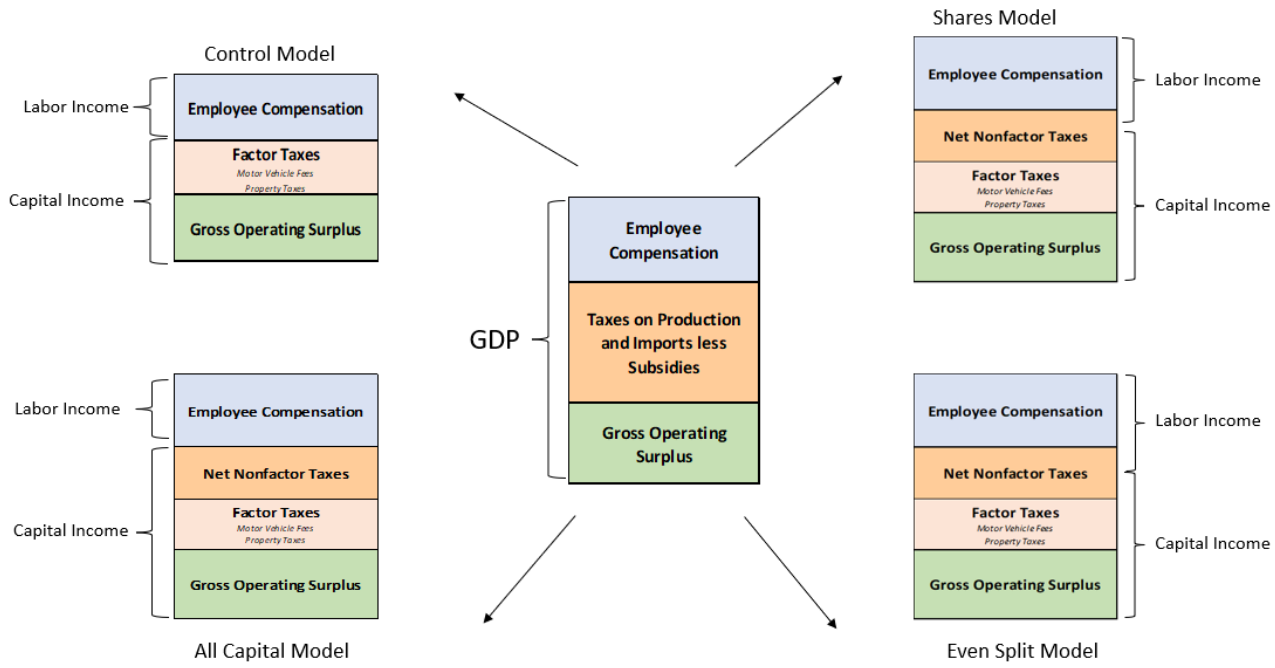
[36] This approach is also discussed in OECD (2001), p. 112.

"even split" simulation to assess whether a simple split of the value of net nonfactor taxes between capital and labor inputs is as effective as a more sophisticated approach using a proportional split of net nonfactor taxes based on capital and labor shares.

The control model and the three simulation models, depicted in Figure 8 below, are estimated for the private business sector and 61 NAICS industries, over the 1987-2020 period. In each of these models, we continue the current BLS practice of including the value of TOPI that is known to relate to specific factors in the income of those factors. That is, we include the value of motor vehicle licenses and business property tax in capital income.[37] For the control model, we treat the remaining value of TOPI less subsidies - net nonfactor taxes – as it is treated in the current BLS methodology, by dropping this value from total income of capital and labor, resulting in an output value in excess of total input value.

[37] In the current methodology, BLS capital income for private industries is constructed by adjusting gross operating surplus data from BEA to remove the value of current surplus of government enterprises, government consumption of fixed capital, and net business current transfer payments. In addition, the value of taxes on production and imports less subsidies that is not directly attributable to a specific input is removed. Note, therefore, that most of the value of nonfactor charges, which include net business current transfer payments, taxes on production and imports, and the current surplus of government enterprises less subsidies, is removed from BLS capital income with the exception of the factor specific portion of taxes on production and imports. See U.S. Department of Commerce, Bureau of Economic Analysis, online glossary https://www.bea.gov/help/glossary/nonfactor-charges Also, U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, Eugene P. Seskin, "Annual Revision of the National Income and Product Accounts," August 1998, p. 21.

Figure 8. Allocation of GDP Components to Labor and Capital Income in the BLS Control Model and the Simulated Models



Each model is estimated using the same underlying set of output and input data that is consistent with the BLS productivity measurement program. For both the highly aggregated private business sector and the less aggregated 61 NAICS industries, we use a value-added output framework to estimate productivity.[38] At the private business sector level, productivity and related measures are estimated using a "research" value-added output measure that reflects experimental BLS industry value-added output measures, and capital and labor input measures consistent with the BLS productivity measurement program.[39] BLS practice is to

[38] This compares to the approach used for BLS published TFP measures which use a value-added output framework to estimate major sector TFP and a sectoral output framework to estimate industry level TFP. For further discussion of the current BLS productivity measurement program, see U.S. Department of Labor, Bureau of Labor Statistics, Handbook of Methods online, 2022, https://www.bls.gov/opub/hom/msp/concepts.htm.

[39] This "research" measure of private business sector value-added output is constructed as a Tornqvist aggregate of experimental value-added output measures developed for each of the 61 NAICS industries. BLS experimental value-added output measures for each NAICS industry are created by obtaining the most appropriate measure of gross output available for each industry and then removing the value of the intermediate inputs used in that industry. For the nineteen manufacturing industries and ten of the thirty-two nonmanufacturing industries, output data is derived from Census Annual Survey of Manufacturers data or other industry specific data sources such as the Bureau of Transportation Statistics, Surface Transportation Board, United States Geological Service, Energy Information Administration, Mining Safety and Health Administration, and Census Service Annual Survey. For the remaining thirty-two nonmanufacturing industries, output is derived from the BEA national accounts. Data on cost

measure capital input as the flow of capital services from physical capital stock and intellectual property assets.[40] For TFP measures, BLS labor input is defined as hours worked adjusted for differences in age, education, and gender.[41] While the control model and the three simulation models use the same private business sector output measure, each model incorporates a different treatment for nonfactor taxes. Using different methodologies to incorporate nonfactor taxes impacts capital measurement components, capital and labor incomes, capital and labor shares, and TFP in each model. In the sections below, we compare the productivity and related measures from the control model and each simulation.

and quantity of intermediate inputs for each industry is also obtained from the BEA national accounts. For a complete description of underlying source data by industry, see https://www.bls.gov/productivity/sources. Note that gross output and value-added output in the national accounts are valued at producers' prices while intermediate inputs are valued at purchasers' prices.

[40] There are 90 asset types for fixed business equipment, structures, inventories, land, and intellectual property products. The aggregate capital services measures are obtained by Tornqvist aggregation of the capital stocks for each asset type within each of the nineteen manufacturing NAICS industry groupings using estimated rental prices for each asset type. Each rental price reflects the nominal rate of return to all assets within the industry and rates of economic depreciation and revaluation for the specific asset; rental prices are adjusted for the effects of taxes. Data on investment for fixed assets are obtained from BEA. Data on inventories are estimated using data from BEA and additional information from IRS Corporation Income Returns. Data for land in the farm sector are obtained from USDA. Nonfarm industry detail for land is based on IRS book value data. Current-dollar value-added data, obtained from BEA, are used in estimating capital rental prices.

[41] The primary source of hours and employment data is the BLS Current Employment Statistics (CES) program. As described in the BLS Handbook of Methods, this program provides monthly survey data on employment and average weekly hours in nonagricultural establishments. CES data on the number of jobs held by wage and salary workers in nonfarm establishments are supplemented with data from the Current Population Survey (CPS) on self-employed and unpaid family workers to estimate total worker hours for each industry. CES data on the average weekly hours paid of workers are supplemented with CPS data on hours of nonproduction, self-employed, and unpaid family workers. Ratios of hours worked to hours paid are developed using data from the National Compensation Survey (NCS) and the BLS Hours at Work Survey. Also as described in the Handbook of Methods, current dollar labor compensation measures are prepared using employee compensation data from the BEA. Compensation data includes wage and salary accruals (including executive compensation), commissions, tips, bonuses, and payments in kind representing income to the recipients—and supplements to these direct payments. Supplements consist of employer contributions to funds for social insurance, private pension and health and welfare plans, compensation for injuries, etc. For labor productivity, self-employed compensation per hour is assumed to be equal to employee compensation per hour." See U.S. Department of Labor, Bureau of Labor Statistics, Handbook of Methods online, 2022, https://www.bls.gov/opub/hom/msp/concepts.htm.

III. Empirical Results: Effects of Net Nonfactor Tax Treatments on Productivity and Related Measures

Effects of Alternative Nonfactor Tax Treatments by Industry

From our above discussion, we know that net nonfactor taxes have a disparate distribution across industries. We anticipate seeing the greatest impact from including net nonfactor tax value using various distribution schemes in our simulation runs in those industries where net nonfactor taxes are the largest. In particular, including some or all of the value of net nonfactor costs in capital income will result in changes to several variables calculated using capital income. These variables include the industry internal rate of return as well as the sector level external rate of return that is used in place of internal rates of return when necessary.[42] The rental prices calculated separately for each capital asset and industry pairing will also be impacted as the calculation of capital rental prices depends on the value of the industry-specific internal rate of return.[43] Because capital services are constructed by aggregating the various

[42] The internal rate of return is estimated at the industry level because BEA data on capital income is available only at the NIPA industry level, and only for the corporate sector. Currently, external rates of return are used in place of industry internal rates of return exclusively in 17 of the 61 NAICS industries and for a subset of years in an additional 11 industries. The external rate of return is computed as the average private business internal rate of return minus the average private business capital gains. Issues with industry internal rates of return, capital income, capital composition effects, and rental prices each year for an industry in any given year may result in a need to replace the industry specific internal rate of return with an external rate of return based on sector level data. For example, finding unusually high internal rates of return, abnormally low capital income, large capital composition effects, and large year-to-year changes in rental prices for an industry in any given year may suggest the use of an external rate of return. In most cases negative internal rates of return set off the need for an external rate of return.

[43] The internal rate of return for industry i in year t, r_{it}, is calculated by setting capital income equal to the product of capital stock and the rental price of capital. That is, $Y_{it} = K_{it}c_{it}$, where Y is capital income, K is capital stock, and c is the rental price. The rental price of capital, as derived by Hall and Jorgenson (1967) can be expressed as:

$$c_{imt} = \frac{(1 - u_t z_t - e_t)\left(P_{m,t-1} r_{it} + P_{m,t-1} d_{im,t} - \Delta P_{m,t-1}\right)}{1 - u_t} + P_{m,t-1} x_t$$

where u_t is the corporate income tax rate; z_t is the present value of $1 of tax depreciation allowances (usually between .8 and 1.0); e_t is the effective rate of the investment tax credit (zero since 1979); r_t is the nominal (internal) rate of return on capital; d_t is the average rate of economic depreciation; $p_{m,t-1}$ is the deflator for new capital goods (it is not clear how this differs from p_t above); $\Delta p_{m,t-1}$ is the revaluation of assets due to inflation in new goods prices; x_t is the rate of indirect taxes. By substituting this rental price expression into the equivalence expression between nominal capital income and productive capital stock times the rental price of capital in each

types of capital assets using asset-and-industry-specific capital rental prices, the asset composition as well as the overall value of capital services in each industry will be impacted by the different treatments of net nonfactor taxes. Changes to capital and labor income that occur because of alternative treatments of net nonfactor taxes will alter capital and labor share values. Allocating some part of net nonfactor tax value to capital and labor incomes thus results in changes that ultimately modify our measures of TFP in each industry by altering both capital services growth rates and capital and labor share values. Using our simulation runs, we hope to learn whether the choice of treatment of net nonfactor taxes has a minor or significant impact on these measures in each industry and in the private business sector overall.

Finally, net nonfactor taxes may be negative in value when subsidies exceed the value of taxes on production plus factor specific taxes.[44] We see from Figure 9 below that only five industries had negative net nonfactor taxes in 2019, including NAICS 111-112, Farms; NAICS 335, Electrical Equipment, Appliances, and Components; NAICS 482, Rail Transportation; NAICS 531, Real Estate; and NAICS 5415, Computer System Design and Related Services. With the addition of Covid-related subsidies in 2020, net nonfactor taxes increased in these five industries while also appearing in thirty-six additional industries. The top five industries with the largest negative net nonfactor values relative to industry GDP in 2020 include NAICS 111-112, Farms; NAICS 481, Air Transportation; NAICS 315-316, Apparel and Leather and Allied Products; NAICS 213, Support Activities for Mining; and NAICS 621, Ambulatory Health Care Services.

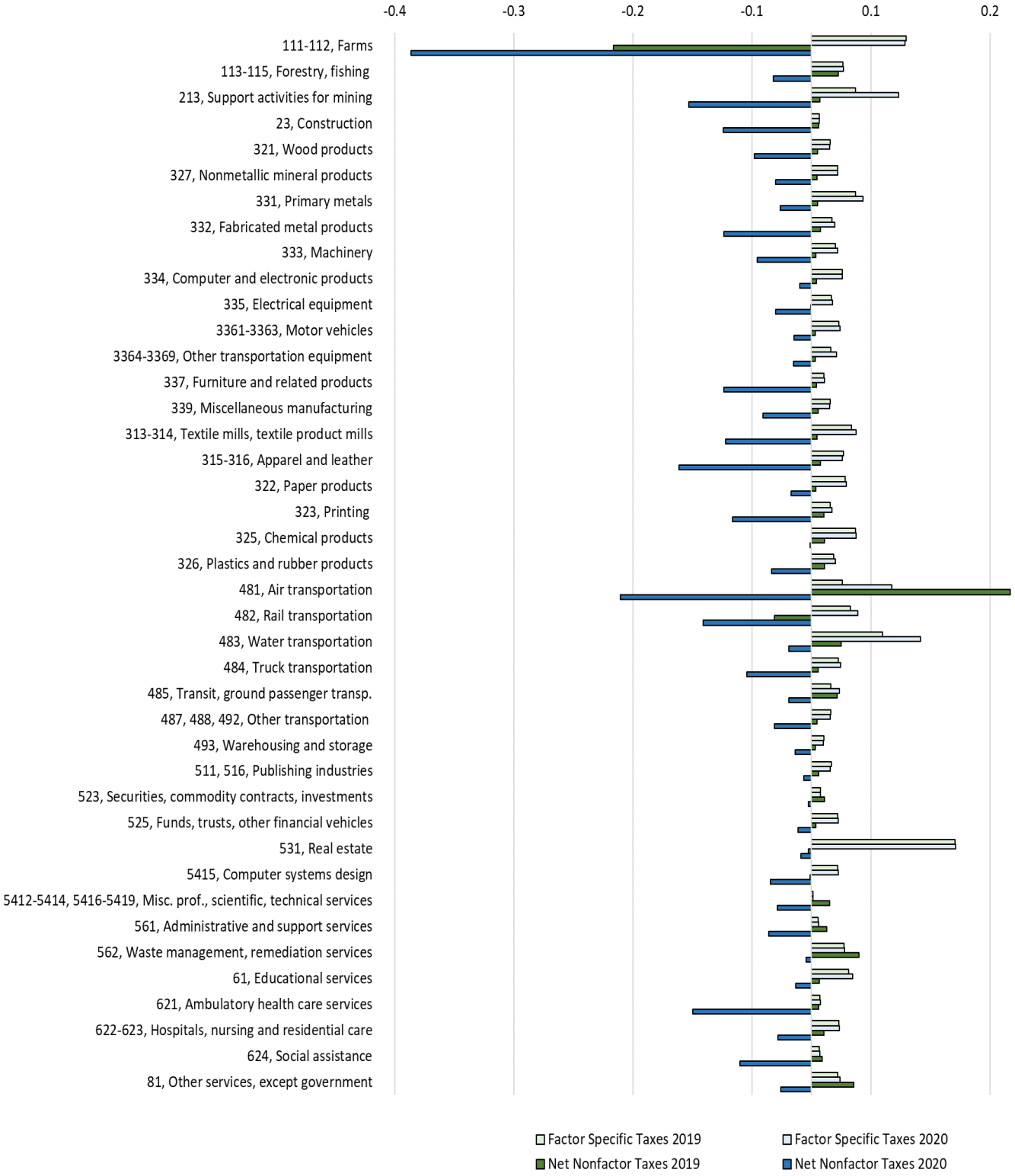
industry, an implicit industry internal rate of return allocating all capital income to capital assets in the industry in a given year can be derived. This internal rate of return can be described by the expression:

$$r_{it} = \frac{Y_{it} - xK_{it}P_{i,t-1} - K_{it}\left(P_{i,t-1}d_{it} - \Delta P_{i,t-1}\right)(1 - u_t z_t - e_t)/(1 - u_t)}{K_{it}P_{i,t-1}(1 - u_t z_t - e_t)/(1 - u_t)}$$

For further discussion, see the U.S. Department of Labor, Bureau of Labor Statistics, online version of Handbook of Methods, 2022, https://www.bls.gov/opub/hom/msp/concepts.htm.

[44] See Appendix X for industry example.

Figure 9. TOPI net of Subsidies: Decomposition into Factor Specific Taxes and Net Nonfactor Taxes Relative to GDP, Selected Industries, 2019 and 2020



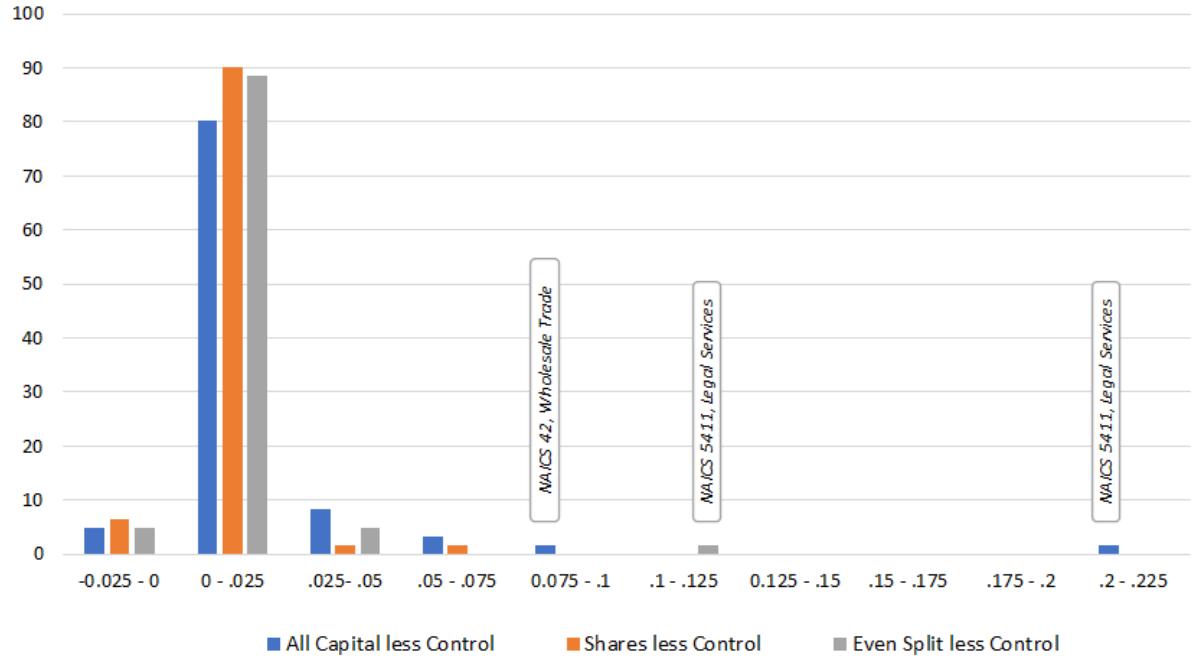
Industry Internal Rates of Return

As the capital income associated with each model changes, the internal rates of return for each industry also change. In addition, the internal rate of return is in some industries and years unsuitable and replaced with an external rate of return. The external rate of return, estimated at the Private Business sector level, also is impacted by the method used to incorporate the value of net nonfactor taxes into capital income. We discuss the impact of each simulation on the estimation of the external rate of return in our Private Business section below.

For the majority of industries, including some or all of net nonfactor taxes in input cost has a minimal effect on the industry's rate of return. Figure 10 below shows that for at least eighty percent of industries, distributing net nonfactor taxes either between capital and labor income or solely in capital income results in less than a .025 difference in the average internal rate of return over the 1987-2019 period.[45]

Figure 10. Distribution of Percentage Point Differences in IRR for 61 NAICS Industries

Compound Growth Rates, 1987-2019



[45] The internal rate of return differences between each simulation model and the control model for all industries, in the 19897-2019 period, are available in Table A-2 of the Appendix.

Using the “All Capital” model results in 80 percent of industries having less than a .025 percentage point difference in the industry’s average IRR over the 1987-2019 period. By contrast, NAICS 5411, Legal Services, has a 0.2 percentage point increase in the average 1987-2019 IRR and NAICS 42, Wholesale Trade sees a 0.1 percentage point increase in the average IRR in the same period. The two industries experiencing the largest change in IRR from including all net nonfactor taxes in capital income are NAICS 5411, Legal Services and NAICS 42, Wholesale Trade, as shown in Table A-2 in the appendix.

Similarly, Figure 10 illustrates the differences in the average 1987-2019 internal rate of return by industry when net nonfactor tax value is distributed using capital and labor shares. While again we find most industries have a minimal change of .025 percentage points or less in their average IRR as a result of including net nonfactor taxes in capital and labor income in proportion to capital and labor shares, the internal rates of return for NAICS 5411, Legal Services and NAICS 42, Wholesale Trade have a larger impact.

When we split net nonfactor taxes evenly between capital and labor income, we again see a clustering of most industries with changes to their 1987-2019 average IRR in the range of -.025 percentage points or less. NAICS 5411, Legal Services, and NAICS 42, Wholesale Trade are again the outlier industries, with a moderate impact falling between the more extreme impact of the “All Capital” model and the lesser impact of the “Shares” model, as shown in figure 10 above. From Figure 5 above, we see that net nonfactor taxes are 20 percent of GDP in the Wholesale Trade industry and 6 percent of GDP in Legal Services in 2019. Because net nonfactor taxes are a large share of GDP in the Wholesale Trade industry, including net nonfactor taxes in this industry’s capital income results in a large increase in the overall value of capital income regardless of whether all or a portion of net nonfactor taxes is added to capital income. This drives the large change in the average internal rate of return for Wholesale Trade over this period. The Legal Services industry, on the other hand, routinely has an unreasonably high internal rate of return, and as a result BLS typically substitutes an external rate of return for this industry’s internal rate of return. This finding of a large change in the average internal rate of

return for Legal Services is understandable given the routine difficulties encountered in estimating a value for this industry.

Industry Capital Services Measures

Within the productivity measurement framework, BLS measures capital input as the flow of capital services from productive capital stock.[46] Capital services are assumed to be proportional to capital stock and are estimated at the asset level as the rental price of the capital asset multiplied by the assets' capital stock. Measuring capital services requires estimates of both capital stocks and rental prices at the asset level. BLS estimates productive capital stock using a perpetual inventory method approach (also known as *vintage aggregation*) that cumulates past vintages of investment while adjusting for deterioration in the capital stock over time. BLS constructs productive capital stock using BEA real gross investment data and assumptions about capital asset deterioration.[47] Changes in the treatment of net nonfactor taxes as a result will not impact BLS capital stock measures.

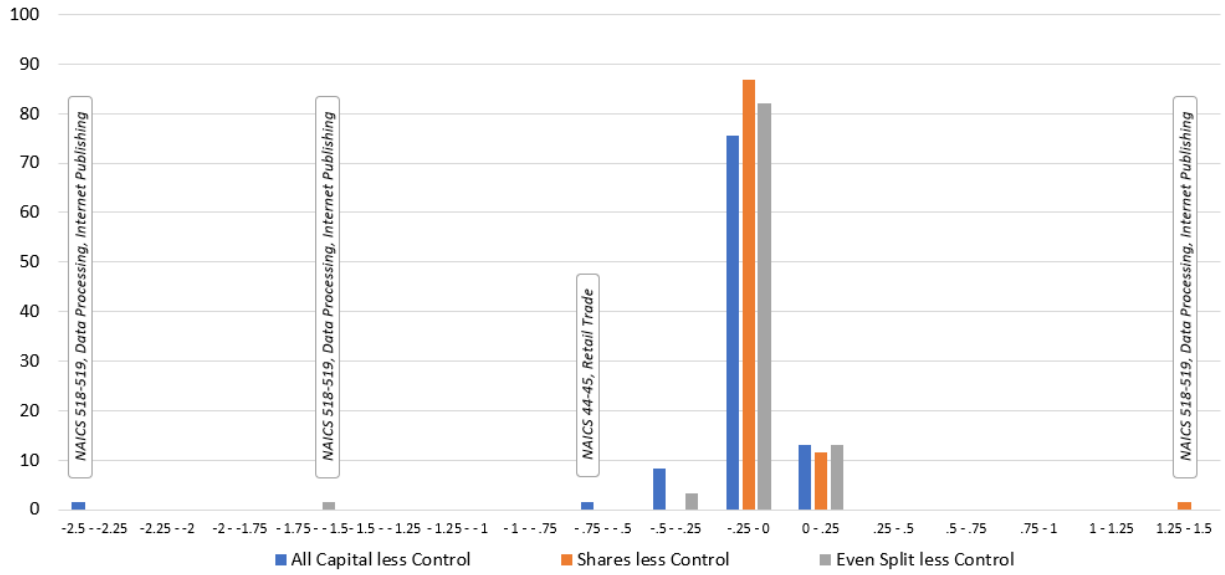
Capital stock measures are Tornqvist aggregated into capital services measures using asset level rental prices as weights. Assuming that the purchase price of a capital asset equals the discounted stream of future value from the asset, the rental price of the asset in a specific time period represents the value of the current flow of services from this asset. Because rental prices for specific capital assets are rarely available, BLS estimates asset rental prices using estimated internal rates of return at the industry level along with asset specific tax, depreciation, and capital gains data. Using different treatments for net nonfactor taxes impacts capital income, estimates of internal rates of return for each industry, the external rate of return at the sector level, and capital rental prices. Changes in asset rental prices, flowing from changes in industry level internal rates of return and sector level external rates of return, will have an impact on capital inputs and the underlying asset composition of capital input.

[46] For further information, see the U.S. Department of Labor, Bureau of Labor Statistics, online version of Handbook of Methods, 2022, https://www.bls.gov/opub/hom/msp/concepts.htm.
[47] Ibid.

In Figure 11 below we present differences in capital services growth rates for the "All Capital" model, the "Shares" model, and the "Even Split" model relative to our control model.[48]
In the 1987-2019 period, only seven of the sixty-one NIPA industries have capital services growth rates that are .25 percentage points greater than in the control model when the full value of net nonfactor taxes is included in capital income. NAICS 518-519, Data Processing, Internet Publishing, and Other Information Services, has the largest decrease in capital services growth, with a - 2.25 percentage point difference. NAICS 44-45, Retail Trade, has a .65 percentage point decrease in capital services growth, while NAICS 81, Other Service except Government; NAICS 524, Insurance Carriers and Related Activities; NAICS 561, Administrative and Support Services; NAICS 515-517, Broadcasting and Telecommunications; and NAICS 42, Wholesale Trade have decreases in capital services growth ranging from .28 to .32 percentage points. After further investigation, we found that NAICS 518-519, Data Processing, Internet Publishing, and Other Information Services encountered data issues in years around the Dot Com Bubble (1995-2001) resulting in unusually large changes in growth rates between the control and "All Capital" model that explain the large differences in capital services growth rates found in these three time periods.[49] As a result, we disregard the NAICS 518-519 outlier values.

[48] The capital services growth rate differences between each simulation model and the control model for all industries, in the 19897-2019 period, are available in Table A-3 of the Appendix.
[49] Estimating capital services measures is subject to numerous potential data fragilities. In 1999, for example, gross operating surplus for NAICS 518-519 was negative and resulted in a negative estimate of the internal rate of return. Capital rental prices for most assets were as a result also negative, as was capital income for all models. However, one equipment asset, computers, had a positive rental price and large share value in equipment in the control model. Adding the value of net nonfactor taxes to capital income in this industry had the perverse effect of dramatically reducing the share value weight used for the computer asset and as a result, growth in capital services.

Figure 11. Distribution of Percentage Point Differences in Capital Services Growth Rates for 61 NAICS Industries
Compound Growth Rates, 1987-2019



Using capital and labor shares to distribute net nonfactor taxes between capital and labor income resulted in a smaller increase in capital income than in the "All Capital" model. In the "Shares" model, NAICS 518-519, Data Processing is again an outlier in 1987-2019 although with faster capital services growth than in the Control model. Other industries with a difference in capital services growth of .2 percentage points or higher in the 1987-2019 period include NAICS 44-45, Retail Trade (-.24) and NAICS 515, 517, Broadcasting and Telecommunication (-.20).

When net nonfactor taxes are evenly split between capital and labor income, the value-added to capital income, for many industries and years, is very close to the value-added when net nonfactor taxes are distributed using capital and labor shares. Consequently, a similar set of industries show differences in capital services growth rates. Setting aside NAICS 518-519 as an outlier which can be discounted due to data issues, we again find decreases in capital services growth rates for 1987-2019 in excess of .2 percentage points in NAICS 44-45, Retail Trade (-.43) and NAICS 81, Other Services except Government (-.26). NAICS 42, Wholesale Trade (-.19), NAICS 561, Administrative and Support Services (-.17) and NAICS 515-517, Broadcasting and Telecommunications (-.16) also have larger decreases in the rate of capital services growth over the 1987-2019 period compared to the Control model.

From these comparisons, not surprisingly, we see that the effects on capital services growth rates from moving the value of net nonfactor taxes into capital income are largest in the "All Capital" model, where the increase in capital income is the greatest, and most restrained in the "Shares" model. While looking at how choices about the treatment of net nonfactor taxes impact capital services at the industry level is of interest, it may also be helpful to understand the mechanisms underlying these effects at the asset level.

Capital Composition

Industry level capital services measures are constructed as Tornqvist aggregates of detailed asset capital stocks using asset specific rental price weights, and as detailed in Section III, a change in capital income will affect an industry's rate of return and ultimately each asset's rental price. To see the effect that the change the asset rental price has, we turn to the industry measure of capital composition. As our control model and the three simulations models use the same asset level stocks measures, the change in capital composition will tease out the effects the different rates of return caused by the unique capital income values in each model.

An industry's capital composition measures the portion of change in capital services that is not attributed to the change in capital stock. An increase in the composition index can be interpreted as a shift in composition of capital assets "towards assets with a higher rental price."[50] That is, as described in Dean, Harper and Sherwood 1996, an increase in the capital composition index reflects an increase in the annual rate of service flows from the "average" asset, as a result of a shift in the composition of assets toward assets with higher rental prices.[51]

[50] Ibid.
[51] See also Edwin R. Dean, Michael J. Harper, and Mark S. Sherwood, "Productivity Measurement with Changing-Weight Indexes of Outputs and Inputs," Chapter 7 in Industry Productivity: International Comparison and Measurement Issues, OECD, Paris, 1996, p. 201.
https://www.oecd.org/sti/ind/industryproductivityinternationalcomparisonandmeasurementissues.htm

Looking at the industry with the largest net nonfactor tax value, NAICS 42, Wholesale Trade, we see from Table 6 that in fact the composition of capital services varies for each model. As capital income is increased in each of the three simulations by including a portion of net nonfactor taxes, we see the capital composition indexes fall compared to the Control model.

Table 6. Capital Services and Capital Composition Effects from Including Net Nonfactor Taxes, for NAICS 42 (Wholesale Trade), Average Annual Percent Change by Model, 1987-2019

Measure	Control	All Capital	Shares	Even Split
Capital Services	3.4	3.2	3.3	3.3
Stock	2.6	2.6	2.6	2.6
Capital Composition	0.8	0.5	0.7	0.6

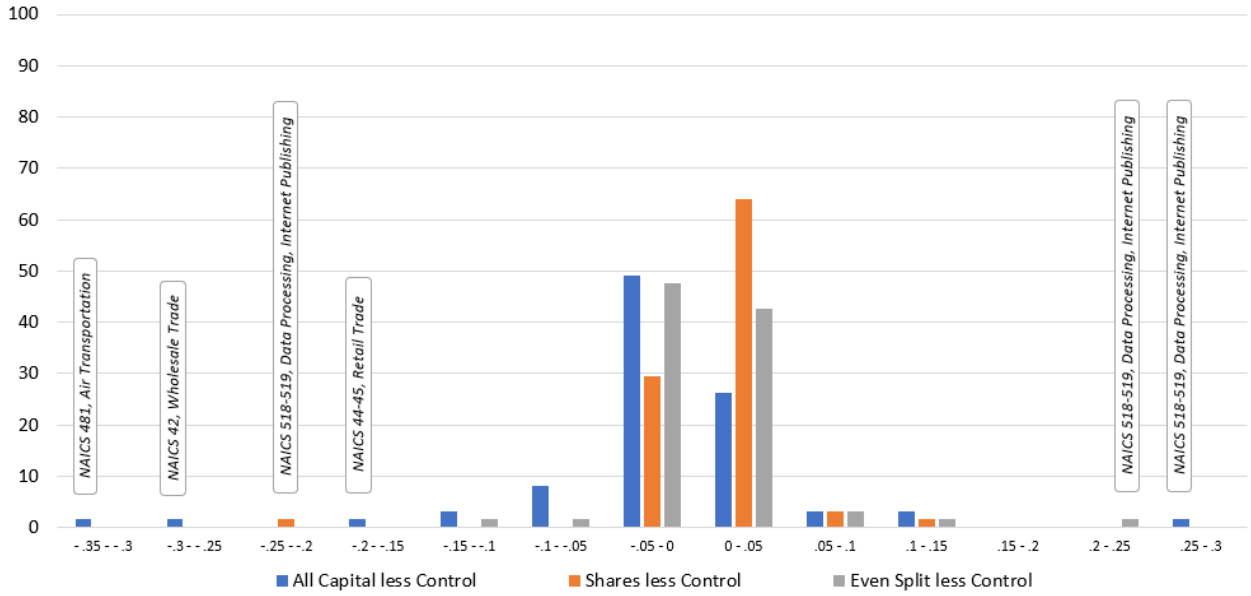
Including all or some portion of net nonfactor taxes in capital income results in a recharacterization of the asset composition underlying the Control model capital services in the Wholesale Trade industry. The decrease in the growth capital composition index indicates a shift away from capital goods with high rental prices towards goods with lower rental prices and service flows. By including some or all of the value of net nonfactor taxes in capital income, the narrative regarding capital composition trends in the Wholesale Trade industry is altered.

Industry TFP Measures

Using our value-added productivity framework, we examine how the choice of a net nonfactor tax treatment impacts TFP measures over the 1987-2019 period. As shown in Figure 12 below, in the “All Capital” model, with all net nonfactor taxes included in capital income, 75 percent of industries have a .05 percentage point or less impact on measured TFP during the 1987-2019 period. Three industries, NAICS 481, Air Transportation (-.31); NAICS 42, Wholesale Trade (-.27); and NAICS 518-519, Data Processing, Internet Publishing, and Other Information Services (.26) and have differences in TFP growth rates exceeding .25 percentage points.

Figure 12. Distribution of Percentage Point Differences in Total Factor Productivity Growth Rates for 61 NAICS Industries

Compound Growth Rates, 1987-2019



Using the "Shares" model, as shown in Figure 12 above, we see an even more moderate impact on TFP, with 93 percent of industries differing from Control model TFP by .05 percentage points or less in the 1987-2019 period. Outliers in this period is NAICS 518-519, Data Processing, Internet Publishing, and Other Information Services (-.24), which we disregard due to the above data issues in this industry; NAICS 531, Real Estate shows some moderate differences in TFP compared to the Control model.

The "Even Split" model results in 90 percent of industries with less than a .05 percentage point difference in TFP growth compared to the Control model. In Figure 12 for the 1987-2019 period, we again see differences in NAICS 518-519, Data Processing, Internet Publishing, and Other Information Services (.22), which we set aside due to data issues, and in NAICS 515, 517, Broadcasting and Telecommunications (.14).

Effects of Alternative Nonfactor Tax Treatments in the Private Business Sector

The inclusion of net nonfactor taxes has minimal effect on private business sector productivity measures in the long run. As can be seen in Table 7 below, in all three simulations capital input

growth decreased compared to the control model, with the All Capital simulation decreasing private business capital input growth by .23 percentage points for 1987-2019. However, the rise in the average share of capital, from 35.8 percent to 41.1 percent, increased capital's contribution to combined inputs growth. This led to an increase in combined inputs under the All Capital simulation. In the other two simulations, combined inputs growth declined. With output the same for the control and simulations, we see the opposite effect in TFP growth, where the All Capital simulation is the only model to decrease TFP growth and the other two simulations increase TFP growth.

Table 7. TFP and Related Measures by Treatment Method, Private Business Sector, 1987-2019

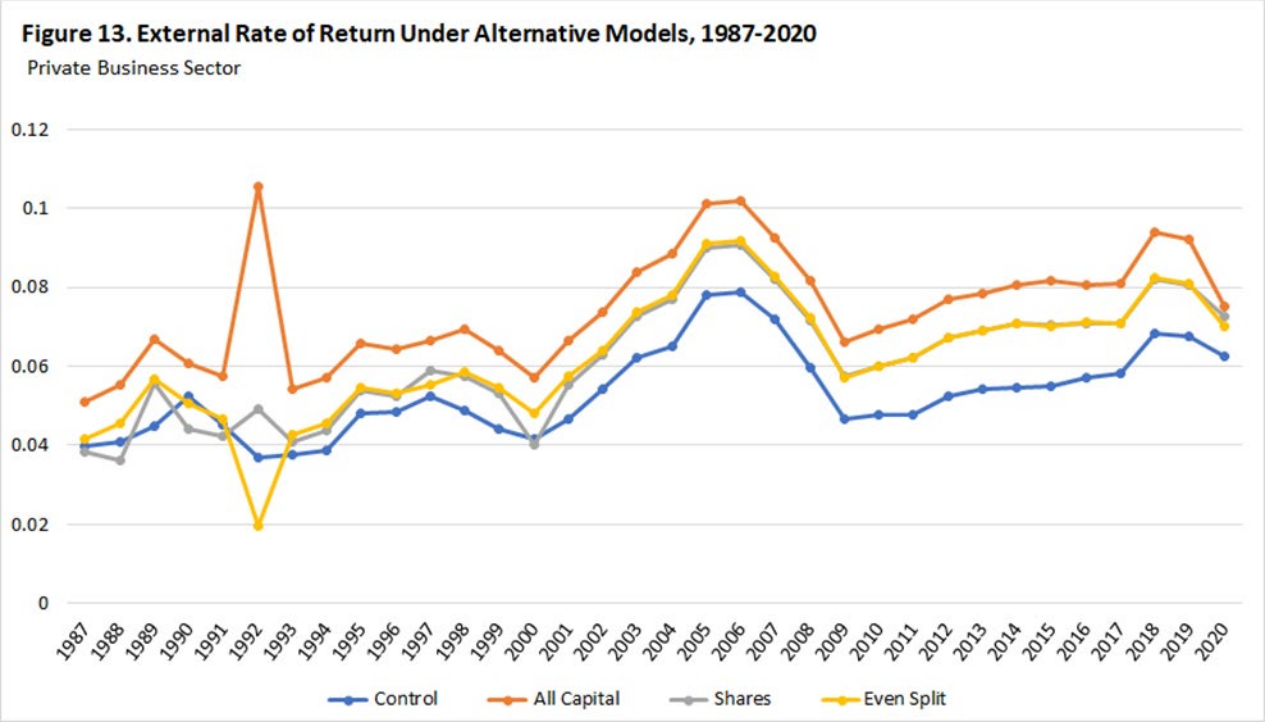
1987-2019	**TFP** *Average annual growth rate*	**Output** *Average annual growth rate*	**Combined Inputs** *Average annual growth rate*
Control	0.69	2.75	2.05
All Capital	0.68	2.75	2.06
Shares	0.71	2.75	2.03
Even Split	0.71	2.75	2.02
	Labor Input *Average annual growth rate*	**Capital** *Average annual growth rate*	**Capital Share** *Capital share of total input cost*
Control	1.33	3.40	35.8%
All Capital	1.33	3.17	41.1%
Shares	1.33	3.33	36.0%
Even Split	1.33	3.27	37.0%

As shown in Table 8 below, it is during the 2000-2007 business cycle that we see the greatest effects of the distribution of net nonfactor charges. During this time period the effect on private business sector TFP ranges from decreasing growth by -0.07 percentage points to increasing growth by .02 percentage points. While capital input growth declines under the All Capital simulation, the capital share increases, resulting in faster growth in combined inputs and a slower TFP growth rate under this simulation.

Table 8. TFP and Related Measures by Treatment Method, Private Business Sector, 2000-2007

2000-2007	TFP *Average annual growth rate*	Output *Average annual growth rate*	Combined Inputs *Average annual growth rate*
Control	1.22	2.68	1.44
All Capital	1.15	2.68	1.51
Shares	1.24	2.68	1.42
Even Split	1.22	2.68	1.44
	Labor Input *Average annual growth rate*	**Capital** *Average annual growth rate*	**Capital Share** *Capital share of total input cost*
Control	0.45	3.40	34.8%
All Capital	0.45	3.22	39.4%
Shares	0.45	3.30	35.5%
Even Split	0.45	3.30	35.9%

Finally, as discussed earlier in the paper, where industry level internal rates of return are unsuitable for use in capital measurement either because they are negative or unusually high, an external rate of return is estimated at the sector level and used in place of the internal rate of return. Figure 14 below shows the external rates of return derived using the Control model and the three simulations. The All Capital model generates the highest external rate of return, followed by the Even Split and Shares models. The Shares model external rate of return is very similar to the Even Split models' external rate of return in most years, particularly from 2001-2020. Each of the simulation models generate a larger external rate of return than the Control model, and the relative size is a function of the increase in capital income resulting from the selected method of distributing net nonfactor taxes.



Conclusion

The BLS original methodology for handling net nonfactor taxes emphasized maintaining a neutral impact on capital and labor inputs when too little information was available to attribute the value of nonfactor taxes to the inputs with confidence. From this analysis, we have learned that although internal rates of return, capital services, and TFP for the majority of industries are little impacted by using one of the three methods of distributing net nonfactor taxes examined here, those industries with high levels of net nonfactor taxes see more significant changes in the values of these measures.

Our results suggest that including net nonfactor taxes in capital and labor income without knowing if the value is related to capital or labor input decisions comes at the cost of potentially biasing productivity and related measures in specific industries with high values of net nonfactor taxes. In the U.S., these industries include NAICS 22, Utilities; NAICS 42, Wholesale Trade; NAICS 44-45, Retail Trade; NAICS 481, Air Transportation; NAICS 515, 517,

Broadcasting and Telecommunications; NAICS 524, Insurance Carriers and Related Activities; NAICS 713, Amusements, Gambling, and Recreation Industries; NAICS 721, Accommodation; and NAICS 722, Food Services and Drinking Places. Together, these industries comprised 20 percent of Private Business sector GDP in 2020.

The simulations also show that the All Capital model, assigning all of net nonfactor taxes to capital, results in the largest changes to capital input and related components and to TFP. Given that our current methodology already assigns motor vehicle and property taxes to capital, which for most industries accounts for the majority of taxes on production, we cannot justify assigning all net nonfactor taxes to capital income until we know more about the make-up of nonfactor taxes. While the Even Split model had more moderate effects on industry internal rates of return, capital services and TFP than the All Capital model, the arbitrary approach of assigning half of net nonfactor taxes to capital and the other half to labor does not help us achieve our goal of not introducing bias into productivity measurement. Thus, we suggest using the Shares model to distribute net nonfactor taxes to capital and labor inputs as it is the approach with the least impact on our measures and minimizes any bias that could occur by assigning an unknown value to either capital or labor.

Where information is available on the composition of taxes on production and imports by industry, using this information to assign the value of net TOPI to capital or labor inputs is, as always, the ideal method. For the remaining value of net TOPI where the distribution between capital and labor inputs is unknown, we suggest a neutral approach that has the least impact on our measures relative to our current method. Our future research plans include reviewing current BEA information on the composition of nonfactor taxes by industry to determine whether or not any additional nonfactor taxes can be identified and associated with specific inputs. Developing additional information on the relationship of nonfactor taxes to specific inputs will allow us to further minimize any impact on our TFP and related measures.

APPENDIX

I. NAICS CODES and INDUSTRY TITLES

NAICS	Industry Title	NAICS	Industry Title
111, 112	Crop & animal production (Farms)	484	Truck transportation
113-115	Forestry, fishing, and related activities	485	Transit and ground passenger transportation
211	Oil and gas extraction	486	Pipeline transportation
212	Mining, except oil and gas	487, 488, 492	Other transportation and support activities
213	Support activities for mining	493	Warehousing and storage
22	Utilities	511	Publishing industries, except internet (includes software)
23	Construction	512	Motion picture and sound recording industries
321	Wood products	515, 517	Broadcasting and telecommunications
327	Nonmetallic mineral products	518, 519	Data processing, internet publishing, and other information services
331	Primary metal products	521, 522	Federal reserve banks, credit intermediation, and related activities
332	Fabricated metal products	523	Securities, commodity contracts, and other financial investments and related activities
333	Machinery	524	Insurance carriers and related activities
334	Computer and electronic products	525	Funds, trusts, and other financial vehicles
335	Electrical equipment, appliances, and components	531	Real estate
3361-3363	Motor vehicles, bodies and trailers, and parts	532, 533	Rental and leasing services and lessors of nonfinancial and intangible assets
3364-3369	Other transportation equipment	5411	Legal services
337	Furniture and related products	5415	Computer systems design and related services
339	Miscellaneous manufacturing	5412-5414, 5416-5419	Miscellaneous professional, scientific, and technical services
311, 312	Food and beverage and tobacco products	55	Management of companies and enterprises
313, 314	Textile mills and textile product mills	561	Administrative and support services
315, 316	Apparel and leather and applied products	562	Waste management and remediation services
322	Paper products	61	Educational services
323	Printing and related support activities	621	Ambulatory health care services
324	Petroleum and coal products	622, 623	Hospitals and nursing and residential care facilities
325	Chemical products	624	Social assistance
326	Plastics and rubber products	711, 712	Performing arts, spectator sports, museums, and related services
42	Wholesale trade	713	Amusements, gambling, and recreation industries
44, 45	Retail trade	721	Accommodation
481	Air transportation	722	Food services and drinking places
482	Rail transportation	81	Other services, except government
483	Water transportation		

II. Taxes on Production and Imports (TOPI) and Subsidies relative to GDP, by NAICS Industry, 1998-2020

Table A-1. Taxes on Production and Imports (TOPI) and Subsidies relative to GDP, by NAICS Industry, 1998-2020

NAICS Industry	INDUSTRY	Value as a Percent of GDP, 2019						Value as a Percent of GDP, 2020					
		TOPI	Factor Specific Costs		Gross NonFactor Specific Costs	Subsidies	Net Nonfactor Specific Costs	TOPI	Factor Specific Costs		Gross NonFactor Specific Costs	Subsidies	Net Nonfactor Specific Costs
			Motor Vehicle License Fees	*Business Property Taxes*					*Motor Vehicle License Fees*	*Business Property Taxes*			
111-112	Farms	7.94%	0.58%	7.36%	< .01 %	16.63%	-16.63%	7.85%	0.56%	7.29%	< .01 %	33.62%	-33.62%
113-115	Forestry, fishing and related activities	4.90%	0.09%	2.57%	2.24%	0.00%	2.24%	4.84%	0.09%	2.61%	2.14%	5.36%	-3.22%
211	Oil and gas extraction	19.86%	0.02%	13.80%	6.05%	0.00%	6.05%	36.17%	0.04%	26.42%	9.70%	0.86%	8.84%
212	Mining, except oil and gas	9.78%	0.05%	4.83%	4.90%	0.00%	4.90%	9.66%	0.05%	5.16%	4.45%	1.88%	2.57%
213	Support activities for mining	4.39%	0.13%	3.57%	0.69%	0.00%	0.69%	8.54%	0.21%	7.11%	1.22%	11.50%	-10.28%
22	Utilities	19.95%	0.02%	10.22%	9.71%	0.00%	9.71%	19.70%	0.02%	10.21%	9.47%	0.50%	8.97%
23	Construction	1.29%	0.12%	0.52%	0.64%	0.00%	0.64%	1.35%	0.13%	0.54%	0.67%	8.06%	-7.39%
321	Wood products	2.13%	0.03%	1.56%	0.54%	0.00%	0.54%	2.07%	0.03%	1.51%	0.53%	5.35%	-4.81%
327	Nonmetallic mineral products	2.66%	0.04%	2.15%	0.46%	0.00%	0.46%	2.64%	0.04%	2.15%	0.45%	3.44%	-2.98%
331	Primary metals	4.24%	< .01 %	3.72%	0.51%	0.00%	0.51%	4.92%	< .01 %	4.33%	0.59%	3.20%	-2.61%
332	Fabricated metal products	2.48%	0.02%	1.70%	0.76%	0.00%	0.76%	2.52%	0.02%	1.94%	0.56%	7.91%	-7.36%
333	Machinery	2.42%	0.01%	2.02%	0.39%	0.00%	0.39%	2.63%	0.01%	2.20%	0.42%	4.96%	-4.54%
334	Computer and electronic products	3.01%	< .01 %	2.60%	0.41%	0.00%	0.41%	2.98%	< .01 %	2.59%	0.39%	1.36%	-0.97%
335	Electrical equipment, appliances, and components	2.10%	< .01 %	1.68%	0.42%	0.47%	-0.05%	2.20%	< .01 %	1.76%	0.44%	3.47%	-3.03%
3361-3363	Motor vehicles, bodies and trailers, and parts	2.59%	0.02%	2.26%	0.31%	0.00%	0.31%	2.70%	0.02%	2.38%	0.30%	1.76%	-1.45%
3364-3369	Other transportation equipment	1.91%	< .01 %	1.60%	0.30%	0.00%	0.30%	2.48%	< .01 %	2.08%	0.39%	1.89%	-1.50%
337	Furniture and related products	1.44%	0.02%	1.02%	0.40%	0.00%	0.40%	1.51%	0.02%	1.07%	0.42%	7.79%	-7.37%
339	Miscellaneous manufacturing	2.13%	< .01 %	1.56%	0.57%	0.00%	0.57%	1.97%	< .01 %	1.53%	0.43%	4.51%	-4.08%
311-312	Food and beverage and tobacco products	10.37%	0.01%	1.76%	8.60%	0.00%	8.60%	9.79%	0.01%	1.73%	8.05%	2.74%	5.31%
313-314	Textile mills and textile product mills	3.97%	< .01 %	3.35%	0.62%	0.16%	0.46%	4.46%	< .01 %	3.77%	0.69%	7.92%	-7.23%
315-316	Apparel and leather and allied products	3.42%	0.01%	2.67%	0.74%	0.00%	0.74%	3.35%	0.01%	2.59%	0.75%	11.86%	-11.11%
322	Paper products	3.24%	< .01 %	2.85%	0.38%	0.00%	0.38%	3.32%	< .01 %	2.92%	0.40%	2.12%	-1.72%
323	Printing and related support activities	2.65%	0.01%	1.59%	1.05%	0.00%	1.05%	2.81%	0.01%	1.70%	1.10%	7.72%	-6.62%
324	Petroleum and coal products	3.07%	0.01%	2.15%	0.91%	0.00%	0.91%	4.34%	0.02%	3.17%	1.16%	0.51%	0.64%
325	Chemical products	4.79%	0.01%	3.69%	1.09%	< .01 %	1.09%	4.78%	0.01%	3.75%	1.03%	1.13%	-0.10%
326	Plastics and rubber products	2.97%	0.01%	1.87%	1.08%	0.00%	1.08%	2.65%	0.01%	1.99%	0.64%	3.97%	-3.33%
42	Wholesale trade	21.86%	0.08%	0.72%	21.06%	0.00%	21.06%	21.19%	0.08%	0.75%	20.36%	2.77%	17.59%
44-45	Retail trade	21.49%	0.07%	1.64%	19.78%	0.00%	19.78%	21.35%	0.07%	1.63%	19.66%	4.97%	14.68%
481	Air transportation	19.50%	0.01%	2.60%	16.89%	0.20%	16.69%	26.26%	0.03%	6.72%	19.51%	35.55%	-16.05%
482	Rail transportation	5.34%	0.01%	3.25%	2.08%	5.17%	-3.09%	6.22%	0.01%	3.86%	2.34%	11.44%	-9.09%
483	Water transportation	8.60%	0.01%	5.95%	2.63%	0.11%	2.52%	11.98%	0.02%	9.15%	2.81%	4.71%	-1.89%
484	Truck transportation	2.85%	1.01%	1.26%	0.58%	0.00%	0.58%	3.04%	1.07%	1.36%	0.62%	6.02%	-5.40%
485	Transit and ground passenger transportation	3.75%	0.45%	1.17%	2.14%	0.00%	2.14%	5.45%	0.65%	1.72%	3.08%	5.00%	-1.92%
486	Pipeline transportation	9.10%	0.07%	8.80%	0.23%	0.00%	0.23%	9.76%	0.07%	9.47%	0.21%	0.22%	-0.01%
487, 488, 492	Other transportation and support activities	2.10%	0.20%	1.42%	0.48%	0.00%	0.48%	2.06%	0.21%	1.38%	0.47%	3.59%	-3.11%
493	Warehousing and storage	1.36%	0.04%	1.01%	0.32%	0.00%	0.32%	1.33%	0.04%	0.98%	0.31%	1.66%	-1.35%
511, 516	Publishing industries, except internet (includes software)	2.31%	< .01 %	1.67%	0.64%	0.00%	0.64%	2.17%	0.00%	1.57%	0.60%	1.23%	-0.63%
512	Motion picture and sound recording studios	8.71%	< .01 %	4.42%	4.29%	0.00%	4.29%	10.42%	0.00%	5.61%	4.80%	2.32%	2.49%
515, 517	Broadcasting and telecommunications	9.15%	0.01%	0.58%	8.56%	< .01 %	8.56%	8.55%	0.01%	0.59%	7.95%	0.41%	7.54%
518-519	Data processing, internet publishing, and other information services	2.34%	< .01 %	1.39%	0.95%	0.00%	0.95%	2.11%	< .01 %	1.27%	0.83%	0.87%	-0.03%
521-522	Federal Reserve banks, credit intermediation, and related activities	3.01%	0.45%	1.81%	0.75%	0.06%	0.69%	2.82%	0.39%	1.72%	0.71%	0.60%	0.11%
523	Securities, commodity contracts, and investments	1.89%	0.01%	0.77%	1.11%	0.00%	1.11%	1.92%	0.01%	0.76%	1.15%	1.41%	-0.26%
524	Insurance carriers and related activities	5.91%	0.01%	0.77%	5.13%	0.00%	5.13%	8.15%	0.01%	0.76%	7.38%	1.15%	6.22%
525	Funds, trusts, and other financial vehicles	2.57%	< .01 %	2.20%	0.37%	0.00%	0.37%	2.63%	< .01 %	2.27%	0.36%	1.46%	-1.10%
531	Real estate	12.65%	< .01 %	12.08%	0.57%	0.84%	-0.27%	12.65%	< .01 %	12.10%	0.55%	1.44%	-0.89%
532-533	Rental and leasing services and lessors of intangible assets	8.78%	0.95%	2.70%	5.13%	0.00%	5.13%	9.80%	1.07%	3.07%	5.67%	1.30%	4.37%
5411	Legal services	6.65%	0.01%	0.23%	6.42%	0.00%	6.42%	6.91%	0.00%	0.23%	6.67%	4.54%	2.12%
5415	Computer systems design and related services	2.09%	0.03%	2.17%	-0.11%	0.00%	-0.11%	2.10%	0.03%	2.25%	-0.17%	3.27%	-3.44%
5412-5414, 5416-5419	Miscellaneous professional, scientific and technical services	1.69%	< .01 %	0.14%	1.55%	0.00%	1.55%	1.78%	< .01 %	0.15%	1.63%	4.50%	-2.88%
55	Management of companies and enterprises	2.44%	0.01%	1.35%	1.09%	0.00%	1.09%	2.50%	0.01%	1.38%	1.11%	0.83%	0.28%
561	Administrative and support services	1.84%	0.05%	0.51%	1.28%	0.00%	1.28%	1.95%	0.06%	0.54%	1.35%	4.95%	-3.60%
562	Waste management and remediation services	6.76%	0.26%	2.49%	4.02%	0.00%	4.02%	6.72%	0.26%	2.54%	3.92%	4.38%	-0.46%
61	Educational services	3.78%	0.01%	3.11%	0.67%	0.00%	0.67%	4.27%	0.01%	3.48%	0.78%	2.10%	-1.32%
621	Ambulatory health care services	1.35%	0.01%	0.70%	0.64%	0.00%	0.64%	1.49%	0.01%	0.76%	0.72%	10.67%	-9.95%
622-623	Hospitals and nursing and residential care facilities	3.35%	< .01 %	2.28%	1.07%	< .01 %	1.07%	3.44%	0.00%	2.35%	1.09%	3.89%	-2.81%
624	Social assistance	1.60%	0.00%	0.68%	0.92%	0.00%	0.92%	1.77%	0.00%	0.72%	1.06%	7.06%	-6.00%
711-712	Performing arts, spectator sports, museums, and related activities	6.86%	0.01%	1.87%	4.98%	0.00%	4.98%	9.82%	0.02%	3.06%	6.75%	3.93%	2.83%
713	Amusements, gambling, and recreation industries	14.55%	0.01%	3.28%	11.26%	0.00%	11.26%	18.67%	0.01%	4.46%	14.20%	7.21%	6.99%
721	Accomodation	17.99%	< .01 %	3.46%	14.53%	0.00%	14.53%	28.53%	0.00%	5.66%	22.87%	8.21%	14.65%
722	Food services and drinking places	12.81%	0.01%	0.73%	12.07%	0.00%	12.07%	16.12%	0.01%	0.93%	15.18%	11.91%	3.27%
81	Other services, except government	5.76%	0.05%	2.13%	3.57%	0.00%	3.57%	6.37%	0.05%	2.37%	3.95%	6.54%	-2.59%

III. Simulation Comparison Tables by Model: Internal Rate of Return, Capital Services, and Total Factor Productivity

Table A-2. Change in Average Internal Rate of Return, Simulated Model Less Control Model for All Industries, 1987-2019				
NAICS Industry	Rate of Return	Percentage Point Change in Average Rate of Return		
	Control	All Capital	Shares	Even Split
111, 112, Farms	5.77%	-0.005	-0.004	-0.003
113, 114, 115, Forestry, fishing, and related activities	8.64%	0.007	0.003	0.004
211, Oil and gas extraction	4.65%	0.006	0.004	0.003
212, Mining, except oil and gas	4.79%	0.007	0.004	0.004
213, Support activities for mining	2.37%	0.005	0.004	0.001
22, Utilities	7.09%	0.013	0.009	0.006
23, Construction	8.28%	0.002	0.000	0.001
321, Wood products	6.99%	0.001	0.000	0.000
327, Nonmetallic mineral products	7.31%	0.001	0.000	0.000
331, Primary metals	4.37%	0.001	0.000	0.000
332, Fabricated metal products	9.66%	0.001	0.000	0.001
333, Machinery	7.07%	0.001	0.000	0.000
334, Computer and electronic products	2.42%	0.001	0.000	0.000
335, Electrical equipment, appliances, and components	11.15%	0.000	0.000	0.000
3361-3363, Motor vehicles, bodies and trailers, and parts	6.64%	0.001	0.000	0.000
3364-3369, Other transportation equipment	6.16%	0.001	0.000	0.000
337, Furniture and related products	11.31%	0.000	0.000	0.000
339, Miscellaneous manufacturing	9.45%	0.002	0.001	0.001
311, 312, Food and beverage and tobacco products	14.77%	0.038	0.019	0.019
313, 314, Textile mills and textile product mills	3.24%	0.000	0.000	0.000
315, 316, Apparel and leather and allied products	6.61%	0.001	0.000	0.000
322, Paper products	7.92%	0.001	0.000	0.000
323, Printing and related support activities	6.30%	0.001	0.000	0.000
324, Petroleum and coal products	18.10%	0.002	0.001	0.001
325, Chemical products	11.45%	0.002	0.002	0.001
326, Plastics and rubber products	10.32%	0.002	0.001	0.001
42, Wholesale trade	10.70%	0.099	0.033	0.049
44, 45, Retail trade	5.46%	0.050	0.012	0.025
481, Air transportation	1.50%	0.027	0.007	0.014
482, Rail transportation	1.91%	-0.002	-0.001	-0.001
483, Water transportation	3.27%	-0.002	-0.001	-0.001
484, Truck transportation	5.58%	0.003	0.001	0.002
485, Transit and ground passenger transportation	4.22%	0.008	0.001	0.004
486, Pipeline transportation	3.21%	0.000	0.000	0.000
487, 488, 492, Other transportation and support activities	4.14%	0.002	0.000	0.001
493, Warehousing and storage	7.18%	0.001	0.000	0.000
511, 516, Publishing industries, except internet (includes software)	10.43%	0.003	0.001	0.002
512, Motion picture and sound recording industries	1.85%	0.004	0.002	0.002
515, 517, Broadcasting and telecommunications	6.02%	0.020	0.013	0.010
518, 519, Data processing, internet publishing, and other information services	18.33%	0.009	0.004	0.005
521, 522, Federal Reserve banks, credit intermediation, and related activities	14.58%	0.002	0.001	0.001
523, Securities, commodity contracts, and investments	-27.18%	0.019	0.004	0.021
524, Insurance carriers and related activities	29.71%	0.058	0.023	0.029
525, Funds, trusts, and other financial vehicles	27.92%	0.006	0.006	0.003
531, Real estate	6.03%	0.036	0.014	0.016
532, 533, Rental and leasing services and lessors of intangible assets	20.28%	0.019	0.015	0.009
5411, Legal services	73.68%	0.203	0.052	0.101
5415, Computer systems design and related services	-1.61%	0.017	0.002	0.008

Table A-2. Change in Average Internal Rate of Return, Simulated Model Less Control Model for All Industries, 1987-2019				
NAICS Industry	Rate of Return	Percentage Point Change in Average Rate of Return		
	Control	All Capital	Shares	Even Split
5412-5414, 5416-5419, Miscellaneous professional, scientific, and technical services	12.64%	0.009	0.002	0.004
55, Management of companies and enterprises	2.03%	0.003	0.000	0.001
561, Administrative and support services	10.94%	0.019	0.002	0.010
562, Waste management and remediation services	6.39%	0.006	0.002	0.003
61, Educational services	19.39%	0.019	0.008	0.009
621, Ambulatory health care services	9.30%	0.002	0.000	0.001
622, 623, Hospitals and nursing and residential care facilities	15.46%	0.008	0.002	0.004
624, Social assistance	15.24%	0.012	0.003	0.006
711, 712, Performing arts, spectator sports, museums, and related activities	-0.27%	0.017	0.004	0.008
713, Amusements, gambling, and recreation industries	5.95%	0.021	0.007	0.010
721, Accommodation	4.74%	0.016	0.006	0.008
722, Food services and drinking places	6.90%	0.052	0.010	0.026
81, Other services, except government	4.28%	0.029	0.003	0.015

Table A-3. Change in Capital Services Growth Rates, Simulated Model Less Control Model for All Industries, 1987-2019				
NAICS Industry	Average Annual % Change	Percentage Point Change in Average Rate of Return		
	Control	All Capital	Shares	Even Split
111, 112, Farms	0.153	-0.007	-0.044	-0.043
113, 114, 115, Forestry, fishing, and related activities	1.814	-0.030	-0.020	-0.019
211, Oil and gas extraction	-0.275	0.007	0.000	0.000
212, Mining, except oil and gas	0.292	0.219	0.103	0.136
213, Support activities for mining	-0.152	0.022	0.001	-0.002
22, Utilities	1.651	-0.027	-0.020	-0.015
23, Construction	3.012	-0.055	-0.008	-0.028
321, Wood products	0.468	-0.005	-0.001	-0.003
327, Nonmetallic mineral products	1.130	-0.002	0.000	-0.001
331, Primary metals	-0.333	-0.006	-0.003	0.001
332, Fabricated metal products	1.502	-0.005	-0.001	-0.002
333, Machinery	2.126	-0.004	-0.001	-0.002
334, Computer and electronic products	3.838	-0.042	-0.018	-0.023
335, Electrical equipment, appliances, and components	0.867	0.000	0.000	0.000
3361-3363, Motor vehicles, bodies and trailers, and parts	2.317	0.014	0.009	0.009
3364-3369, Other transportation equipment	1.617	-0.018	-0.008	-0.010
337, Furniture and related products	1.714	-0.008	-0.002	-0.004
339, Miscellaneous manufacturing	2.361	-0.009	-0.003	-0.005
311, 312, Food and beverage and tobacco products	1.566	-0.043	-0.023	-0.024
313, 314, Textile mills and textile product mills	-1.222	0.025	0.012	0.018
315, 316, Apparel and leather and allied products	-0.527	0.003	0.003	0.002
322, Paper products	0.063	-0.001	-0.001	-0.001
323, Printing and related support activities	0.654	-0.042	-0.015	-0.014
324, Petroleum and coal products	1.305	-0.007	-0.005	-0.003
325, Chemical products	4.093	-0.011	-0.007	-0.005
326, Plastics and rubber products	1.895	-0.003	-0.001	-0.002
42, Wholesale trade	3.441	-0.281	-0.129	-0.186
44, 45, Retail trade	3.755	-0.647	-0.243	-0.427
481, Air transportation	2.628	-0.023	-0.006	-0.002
482, Rail transportation	-0.040	-0.007	-0.001	0.002
483, Water transportation	0.460	0.012	0.011	0.013
484, Truck transportation	2.909	-0.021	-0.005	-0.011
485, Transit and ground passenger transportation	2.572	-0.196	-0.036	-0.107
486, Pipeline transportation	3.264	-0.077	-0.022	-0.013
487, 488, 492, Other transportation and support activities	0.607	-0.062	-0.023	-0.032
493, Warehousing and storage	2.350	-0.020	-0.004	-0.010
511, 516, Publishing industries, except internet (includes software)	5.354	-0.031	-0.012	-0.016
512, Motion picture and sound recording industries	3.310	-0.040	-0.018	-0.021
515, 517, Broadcasting and telecommunications	5.961	-0.293	-0.196	-0.161
518, 519, Data processing, internet publishing, and other information services	16.278	-2.250	1.387	-1.678
521, 522, Federal Reserve banks, credit intermediation, and related activities	5.252	-0.201	-0.078	-0.077
523, Securities, commodity contracts, and investments	5.717	-0.059	-0.057	-0.115
524, Insurance carriers and related activities	6.091	-0.312	-0.121	-0.108
525, Funds, trusts, and other financial vehicles	0.260	-0.003	-0.003	-0.002
531, Real estate	1.585	-0.138	-0.081	-0.104
532, 533, Rental and leasing services and lessors of intangible assets	7.300	-0.076	-0.020	-0.022
5411, Legal services	5.719	-0.237	-0.092	-0.095

Table A-3. Change in Capital Services Growth Rates, Simulated Model Less Control Model for All Industries, 1987-2019				
NAICS Industry	Average Annual % Change	Percentage Point Change in Average Rate of Return		
	Control	All Capital	Shares	Even Split
5415, Computer systems design and related services	8.412	-0.071	-0.010	-0.023
5412-5414, 5416-5419, Miscellaneous professional, scientific, and technical services	7.324	-0.185	-0.036	-0.063
55, Management of companies and enterprises	2.823	-0.203	-0.099	-0.103
561, Administrative and support services	8.817	-0.323	-0.040	-0.172
562, Waste management and remediation services	1.737	-0.055	-0.022	-0.029
61, Educational services	4.563	-0.047	-0.025	-0.026
621, Ambulatory health care services	4.335	-0.054	-0.008	-0.027
622, 623, Hospitals and nursing and residential care facilities	4.547	-0.015	-0.005	-0.008
624, Social assistance	2.785	-0.096	-0.035	-0.032
711, 712, Performing arts, spectator sports, museums, and related activities	2.320	0.045	0.025	0.026
713, Amusements, gambling, and recreation industries	3.861	-0.239	-0.099	-0.137
721, Accommodation	2.896	-0.096	-0.038	-0.056
722, Food services and drinking places	1.356	-0.203	-0.059	-0.128
81, Other services, except government	2.505	-0.442	-0.059	-0.262

Table A-4. Change in Total Factor Productivity Growth Rates, Simulated Model Less Control Model for All Industries, 1987-2019				
NAICS Industry	Average Annual % Change	Percentage Point Change in Average Rate of Return		
	Control	All Capital	Shares	Even Split
111, 112, Farms	2.495	0.015	0.023	-0.041
113, 114, 115, Forestry, fishing, and related activities	-0.408	-0.018	-0.001	-0.007
211, Oil and gas extraction	2.038	-0.027	0.000	-0.013
212, Mining, except oil and gas	0.759	-0.105	-0.039	-0.036
213, Support activities for mining	3.839	0.000	0.006	0.008
22, Utilities	0.283	-0.043	0.014	0.054
23, Construction	-1.395	0.000	0.001	0.001
321, Wood products	-0.645	-0.005	0.000	-0.002
327, Nonmetallic mineral products	0.632	-0.003	0.000	0.000
331, Primary metals	1.739	-0.003	0.000	-0.001
332, Fabricated metal products	-0.202	-0.002	0.000	0.000
333, Machinery	0.141	-0.004	0.001	-0.001
334, Computer and electronic products	11.972	0.006	0.008	0.007
335, Electrical equipment, appliances, and components	0.589	-0.006	0.000	-0.001
3361-3363, Motor vehicles, bodies and trailers, and parts	-1.677	-0.005	0.000	-0.002
3364-3369, Other transportation equipment	-0.456	0.003	0.003	0.003
337, Furniture and related products	0.236	-0.004	0.000	-0.001
339, Miscellaneous manufacturing	1.612	-0.002	0.001	0.000
311, 312, Food and beverage and tobacco products	-0.923	-0.005	0.011	0.011
313, 314, Textile mills and textile product mills	1.366	-0.011	-0.003	-0.006
315, 316, Apparel and leather and allied products	0.286	-0.008	0.003	-0.002
322, Paper products	0.523	-0.002	0.000	0.000
323, Printing and related support activities	1.496	-0.007	-0.002	-0.005
324, Petroleum and coal products	3.505	0.001	0.004	0.008
325, Chemical products	-1.554	-0.005	0.004	0.008
326, Plastics and rubber products	1.393	-0.004	0.001	-0.001
42, Wholesale trade	1.758	-0.265	0.038	-0.040
44, 45, Retail trade	1.721	-0.195	0.057	-0.031
481, Air transportation	5.148	-0.311	0.008	-0.105
482, Rail transportation	2.106	0.057	0.000	0.013
483, Water transportation	2.271	-0.061	-0.005	-0.008
484, Truck transportation	0.394	-0.003	0.000	-0.001
485, Transit and ground passenger transportation	0.219	0.045	0.007	0.023
486, Pipeline transportation	2.234	0.032	0.013	0.006
487, 488, 492, Other transportation and support activities	-1.704	0.045	0.008	0.012
493, Warehousing and storage	1.975	0.007	0.001	0.003
511, 516, Publishing industries, except internet (includes software)	2.732	-0.007	0.005	0.005
512, Motion picture and sound recording industries	-0.215	0.017	0.012	0.017
515, 517, Broadcasting and telecommunications	1.297	-0.085	0.087	0.138
518, 519, Data processing, internet publishing, and other information services	1.607	0.263	-0.236	0.218
521, 522, Federal Reserve banks, credit intermediation, and related activities	-1.648	0.078	0.036	0.036
523, Securities, commodity contracts, and investments	3.477	-0.008	0.015	0.022
524, Insurance carriers and related activities	0.976	-0.117	0.032	0.010
525, Funds, trusts, and other financial vehicles	-2.617	0.012	0.003	-0.055
531, Real estate	0.546	-0.042	0.146	0.043
532, 533, Rental and leasing services and lessors of intangible assets	-2.376	-0.048	0.004	0.091
5411, Legal services	-0.787	-0.066	-0.001	-0.014

Table A-4. Change in Total Factor Productivity Growth Rates, Simulated Model Less Control Model for All Industries, 1987-2019				
NAICS Industry	Average Annual % Change	Percentage Point Change in Average Rate of Return		
	Control	All Capital	Shares	Even Split
5415, Computer systems design and related services	2.876	0.025	0.007	0.011
5412-5414, 5416-5419, Miscellaneous professional, scientific, and technical services	0.260	-0.052	-0.001	-0.010
55, Management of companies and enterprises	0.175	0.016	0.012	0.010
561, Administrative and support services	0.611	-0.035	0.004	-0.013
562, Waste management and remediation services	-0.278	0.044	0.008	0.014
61, Educational services	-0.043	0.141	0.032	0.000
621, Ambulatory health care services	-0.400	0.004	0.002	0.002
622, 623, Hospitals and nursing and residential care facilities	-1.955	-0.003	0.001	0.000
624, Social assistance	-1.127	0.040	0.006	0.004
711, 712, Performing arts, spectator sports, museums, and related activities	1.361	-0.032	0.004	-0.004
713, Amusements, gambling, and recreation industries	-0.432	-0.036	0.034	0.009
721, Accommodation	0.992	-0.097	0.013	-0.013
722, Food services and drinking places	0.090	0.112	0.011	0.048
81, Other services, except government	-0.410	0.006	0.005	0.006

IV. An Industry Case Study: The Impact of Negative Nonfactor Taxes Due to Covid Subsidies in NAICS 621, Ambulatory Health Care Services, 2020

A Case Study on COVID-19 Subsidies and Net Nonfactor Taxes: NAICS 621, Ambulatory Health Care Services

Subsidies stemming from COVID-19 relief affected a number of industries in 2020, one of which was NAICS 621, Ambulatory Health Care Services. This industry received $78.8 billion in subsidies, a value many times larger than the $11.0 billion in taxes on production incurred in this industry. As a result, taxes on production and imports less subsidies, or net TOPI, was a large negative value, - 67.8 billion, as shown in Table A-5 below.

Table A-5. Components of GDP in NAICS 621, Ambulatory Health Care Services, 2020

Measure	Billions of Dollars
GDP	657.7
Compensation of employees	538.4
Taxes on production and imports less subsidies	-67.8
Gross operating surplus	187.1

The current BLS approach to distributing the value of taxes on production and imports (TOPI) less subsidies is to include the value of the factor specific taxes from motor vehicle license fees (MV) and business property taxes (PRP) in total input cost and omit the value of net nonfactor taxes. Net nonfactor taxes, then, are equal to the value of TOPI – subsidies – MV – PRP. That is, the BLS "control model" measures total input costs as GDP adjusted to remove the value of net nonfactor taxes.

Because of the enormous subsidies received by the Ambulatory Health Care industry during the 2020 pandemic year, the value of net nonfactor taxes in this industry was an unprecedentedly large negative value. As a result, the difference between the industry's GDP and the BLS estimate of the industry's total input costs in 2020 is unusually large. In this case study, we investigate how the unexpectedly large negative nonfactor tax value present in this industry in

2020 affects TFP when the BLS Control model is used, compared to the All Capital, Shares, and Even Split models.

GDP and Input Costs

Under the BLS "control model," net nonfactor tax value is calculated as TOPI less subsidies minus the factor taxes of motor vehicle and property tax, as shown in Table A-6 below.
For the Ambulatory Health Care industry, this results in a net nonfactor tax value of -$73.5 billion in 2020. This negative value is then removed from the industry's GDP of 657,700 million in 2020, resulting in the BLS benchmark value of 731,174 million dollars for the industry's total input cost.

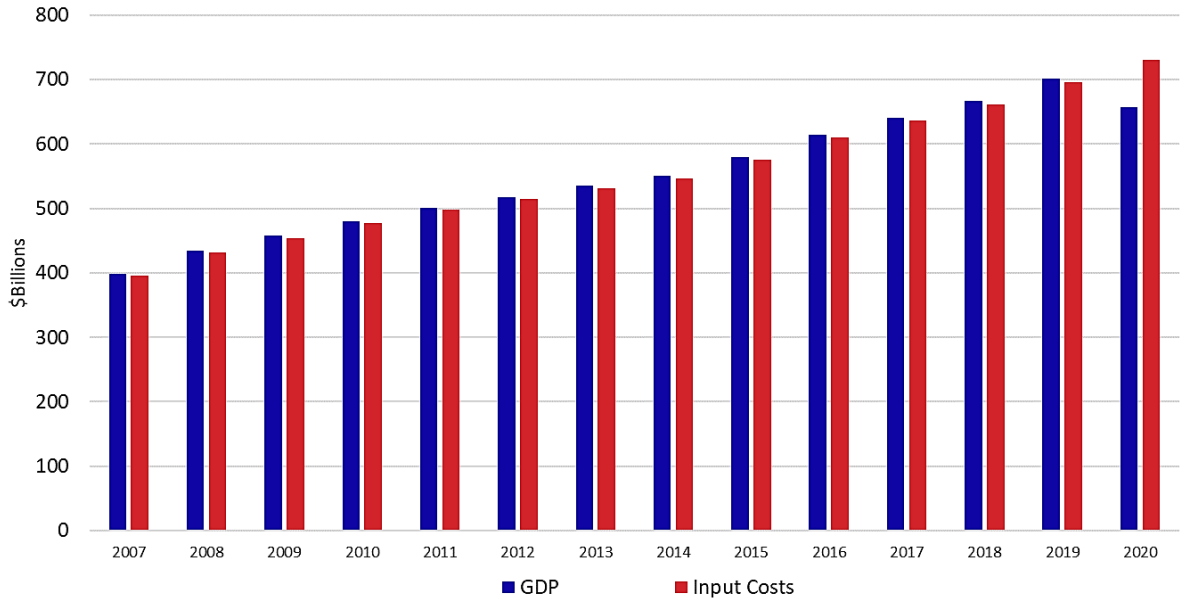
Table A-6. Net Nonfactor Taxes and BLS Total Input Cost Estimation for NAICS 621, Ambulatory Health Care Services, 2020

Measure	Millions of Dollars
TOPI	11,017
Subsidies	78,821
net TOPI (TOPI - Subsidies)	**-67,805**
Factor Taxes	5,669
Net Nonfactor Taxes	**-73,474**
GDP	657,700
BLS Total Input Costs (GDP less net Nonfactor Taxes)	**731,174**

Figure A-1 below illustrates that the offset that occurs between industry GDP and industry input cost in 2020, as a result of the BLS methodology, is an anomaly for this industry. This gap between industry GDP and the estimated benchmark level of industry total costs results solely from the omission of net nonfactor tax value from the BLS estimate of total input costs.

Figure A-1. GDP Compared to BLS Total Input Costs

NAICS 621, Ambulatory Health Care Services, 2007-2020



As discussed in Section II of the paper, our alternative methodologies for the treatment of net TOPI retain the full value of net TOPI in total input costs. That is, both factor and net nonfactor costs are included in total capital and labor costs. Depending on the model selected, the negative net nonfactor taxes experienced in 2020 by the Ambulatory Health Care industry are distributed either fully to capital income (All Capital model) or partially to capital and labor income (Shares and Even Split models). Because net nonfactor taxes are negative in 2020 for this industry, this leads to a decreased value of total input costs that is equal to the industry's GDP. As to be expected, the decrease in capital cost is greatest with the All Capital model with capital cost decreasing almost 50 percent. The Shares and Even Split models result in more modest capital cost decreases of 10 percent and 23 percent, as shown in Table A-7 below.

Table A-7. Impact on GDP and Input Costs: Simulation Models and BLS Control Model, NAICS 621, Ambulatory Health Care Services, 2020

Billions of Dollars

Measure	Control	All Capital	Shares	Even Split
GDP	**657.7**	**657.7**	**657.7**	**657.7**
Net nonfactor taxes	-73.5	-73.5	-73.5	-73.5
Industry Input Costs	**731.2**	**657.7**	**657.7**	**657.7**
Capital Cost	157.8	84.1	141.9	120.9
Corporate Capital	110.0	58.8	99.0	84.4
Noncorporate Capital	47.7	25.3	42.9	36.5
Labor Cost	573.4	573.6	515.8	536.8
Employee Compensation	538.4	538.4	484.3	503.9
Proprietor Compensation	35.0	35.2	31.5	32.9

Model Effects on Final Productivity Measures

Removing value from capital cost results in a decrease of the industry's internal rate of return and an increase in capital services for all three models. This is in contrast to pre-COVID years where the addition of net nonfactor taxes to capital had the opposite effects. However, because the Ambulatory Health Care industry is a labor intensive industry, final measures of combined inputs and TFP growth saw little change for each model compared to the control.

Table A-8. Impact on TFP and Related Measures: Simulation Models and BLS Control Model, NAICS 621, Ambulatory Health Care Services, 2020

Measure	Control	All Capital	Share	50-50 Split
Industry Rate of Return	0.22	0.09	0.20	0.15
Final Measures, % Change				
Capital Growth	3.07	3.22	3.09	3.12
Labor Input Growth	-1.64	-1.64	-1.64	-1.64
Capital Ratio	22%	13%	22%	18%
Labor Ratio	78%	87%	78%	82%
Combined Inputs Growth	-0.75	-0.92	-0.74	-0.81
TFP	-6.97	-6.81	-6.98	-6.92