Working Paper

Supply Side Estimates to 2017

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Sean Keehan

Douglas Meade

Ronald Horst

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OVERVIEW

In the January 2019 issue of *Health Affairs*, an annual paper was published reporting that in 2017, the U.S. spent $3.5 trillion on national health expenditures (NHE)[1] or a measurement of "the total annual dollar amount of health care consumption in the U.S., as well as the dollar amount invested in medical sector structures and equipment and non-commercial research."[2] This estimate is the main aggregation of the detailed national health expenditure accounts (NHEA) and is maintained by the Office of the Actuary at the Centers for Medicare & Medicaid Services. However, these estimates reflect the demand side of health care, not the supply side. For example, the NHE does not measure the value added or labor required to furnish health care spending.

Five years ago, a paper was published in the *Survey of Current Business* that found in 2012, the health employment share was 1.5 percentage points greater than the health spending share of Gross Domestic Product (GDP) (18.7 percent and 17.2 percent, respectively).[3] In this working paper, we plan to discuss how the 2012 estimates have changed since that original paper. Then, we will extend the analysis to 2017, which is the most recent year for which historical estimates are published, to see how the health employment share has changed as well as to better understand the breakdown of industries that supply

[1] Martin, Anne et al., "National health care spending in 2017: growth slows to post–Great Recession rates; share of GDP stabilizes." Health Affairs (Millwood). 2019;38(1):96–106.
[2] CMS, National Health Expenditure Accounts: Methodology Paper, 2017 Definitions, Sources, and Methods." December 2018, https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Downloads/DSM-17.pdf.
[3] Werling, Jeffrey et al, "The Supply Side of Health Care." April 2014, https://apps.bea.gov/scb/pdf/2014/04%20April/0414_supply_side_of_health_care.pdf.

health care in the United States. This paper will go more into detail on the supply-side breakdown of the dollars spent on prescription drugs, including the share filled by imported goods.

In addition to revising and updating these estimates, this paper is also intended to show the importance and relevance of this work by using the supply side estimates for discussion of two special topics. First, the major coverage expansions of the Affordable Care Act (ACA) went into place in 2014. How did the implementation of this legislation impact the supply side estimates, including employment in the health sector? For example, what other industries were significantly affected by the coverage expansions in the ACA and why? Second, the national health expenditure accounts record the spending on all types of health care in the United States. However, some of the value added from this domestic spending comes from foreign sources. How significant are imports in furnishing U.S. health care demand and how much has this changed over time?

METHODOLOGY AND CAVEATS

With this effort, a similar process was followed to the previously published estimates. Much of the work at Inforum involves the Long-term Interindustry Forecasting Tool (LIFT)[4], a dynamic interindustry model of the U.S. economy. LIFT is also a macroeconometric model that determines macroeconomic quantities consistent with the underlying industry detail. For this study, we used the model's database that contains a full input-output (I-O) structure populated with time series data that are generally consistent with published Bureau of Economic Analysis (BEA) Input-Output, GDP by Industry, and National Income and Product Accounts (NIPA) data.

[4] Additional information about Inforum, a research center at the University of Maryland, and the LIFT model may be found at www.inforum.umd.edu/services/models/lift.html.

The core of these data is a historic time series of 121 x 121 commodity I-O tables with consumption, investment, government, export, and import final demand data from 1997 through 2017. The I-O tables of the LIFT model are developed from the BEA annual tables and the 2007 benchmark I-O table. The LIFT data set contains more detail for health care demand and supply than is provided by the BEA annual input-output tables. Such detail is essential for our study since it allows for better accounting for such industries as Pharmaceuticals, Electromedical machinery, and Medical equipment and supplies. The LIFT model also features industry output, value added, and employment for the BEA 71 industry classification, together with the annual "make" matrices to link commodity output to industry output. The LIFT model thus is well suited for the present study.

Using the NHE, published data from BEA, and the LIFT model, we translate NHE data into value added and employment for the entire health care sector across industries using a process that is described in much more detail in a technical working paper on the Inforum website.[5] Our method uses data concordances and matrix algebra to convert health care spending estimates into the value added and employment needed to produce that spending. Since the NHE data are reported by type of service and category, we start by reconciling the NHEA with NIPA categories for health care, and then we assign these data to commodity categories in the LIFT model based on the assignment of production commodities to each spending category. Using input-output identities in the LIFT model we then can relate these LIFT commodity categories to BEA's 71 sector industry classification, and then can make use of the LIFT input-output data to determine value added and employment proportions by industry.

[5] Meade, Douglas and Ronald Horst, "The Supply Side of Health Care in a Dynamic Context", August, 2019, http://www.inforum.umd.edu/papers/publishedwork/articles/SupplySideHealthDynamic_Aug2019.pdf.

Any use of I-O analysis in this fashion is subject to several caveats. First, just like any national accounting exercise, the compilation of the BEA input-output accounts involves a myriad of assumptions and imputations to fit data into the accounting framework. The 1997, 2002, and 2007 benchmark I-O tables provide very detailed information by commodity and industry. In order to provide insight into the year-by-year evolution of the economy, however, we use the BEA annual input-output tables from 1997 through 2017 that are themselves interpolations of the benchmark I-O tables, and these tables are based on the Economic Censuses. Since changes in market conditions, technology, and productivity could alter interindustry relationships, the farther away we are from the benchmark year, the less reliable the results.[6] There are many important parameters, such as trade and transport margins, that are not observed in the non-Census years and are therefore estimated by BEA to compile the annual tables.

As indicated above, we use the LIFT model database in order to provide better detail for final demand expenditures and production of health care goods and services. These details are also estimated using the interpolations of the benchmark and annual tables together with other information (mostly from the NIPA). While the various columns and rows are constrained to sum to aggregate figures similar to the published I-O, industry, and national accounts, there is no way to test whether individual table entries coincide with actual but non-observed values. I-O analysis invariably uses numerous industry ratios (e.g., value added over output or imports over domestic demand), which while documented on a national basis, may not necessarily hold in the specific case for which the analysis is applied. Finally, estimates of employment gained by industry may be inaccurate when, for example, large companies

[6] For a detailed description of the major assumptions used to produce BEA's Industry accounts, see page 13 of Streitweiser, Mary and Brian Moyer. "Measuring The Nation's Economy: An Industry Perspective, A Primer on BEA's Industry Accounts," May 2011, https://www.bea.gov/sites/default/files/methodologies/industry_primer.pdf.

serving multiple industries move a portion of their employees from one industry to another that would not be reported in a benchmark I-O table.

RESULTS

Table 1 provides the NHE data by type of service for selected years, including the 2 years highlighted in our last paper, as well as the most recent year for which historical NHE estimates are available. Table 2 shows the conversion of the NIPA health data, after reconciling with NHE, to the LIFT commodities (including imports) ranked by how much of health spending is used to purchase these commodities in 2017. As an example of how to interpret these data, in 2017, roughly $34.7 billion of the $3.5 trillion in

Table 1. National Health Expenditures, 1960-2017

	Billions of U.S. dollars					Annual percent growth		
	1960	1980	1998	2012	2017	1960-2017	1998 - 2017	1998 - 2012
Gross domestic product (GDP)	542.4	2,857.3	9,062.8	16,197.0	19,485.4	6.5	4.1	4.2
National health expenditures (NHE)	27.2	255.3	1,201.5	2,798.0	3,492.1	8.9	5.8	6.2
NHE as percent of GDP	5.0	8.9	13.3	17.3	17.9	2.3	1.6	1.9
Personal health care	23.3	217.0	1,025.6	2,367.4	2,961.0	8.9	5.7	6.2
Hospital care	9.0	100.5	374.9	902.5	1,142.6	8.9	6.0	6.5
Physician and clinical	5.6	47.7	256.5	557.1	694.3	8.8	5.4	5.7
Dental services	2.0	13.3	53.6	109.7	129.1	7.6	4.7	5.2
Other professional services	0.4	3.5	33.4	76.4	96.6	10.1	5.7	6.1
Home health care	0.1	2.4	34.1	78.3	97.0	13.9	5.7	6.1
Nursing home care	0.8	15.3	79.1	147.4	166.3	9.8	4.0	4.5
Other health services	0.4	8.4	55.6	139.1	183.1	11.2	6.5	6.8
Prescription drugs	2.7	12.0	88.5	259.2	333.4	8.8	7.2	8.0
Other nondurables	1.6	9.8	28.6	53.9	64.1	6.7	4.3	4.6
Durable medical products	0.7	4.1	21.4	43.7	54.4	7.8	5.0	5.2
Net cost of private health insurance	1.0	9.3	49.9	166.1	229.5	10.0	8.4	9.0
Government administration	0.1	2.8	13.3	34.2	45.0	12.5	6.6	7.0
Public health activities	0.4	6.4	37.5	77.2	88.9	10.1	4.7	5.3
Research	0.7	5.4	21.5	48.4	50.7	7.8	4.6	6.0
Equipment	0.3	5.8	29.9	55.2	61.3	9.6	3.9	4.5
Structures	1.5	8.6	23.7	49.5	55.6	6.6	4.6	5.4

Source: Center for Medicare and Medicaid Services, National Health Accounts, Accessed at https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsHistorical.html

overall health spending was used to purchase medical and laboratory services. The largest category of commodities is Hospitals (33 percent), while the next two largest categories, Offices of physicians (14 percent) and Pharmaceuticals (8 percent), are well behind the hospital share. In our last paper, the physician share was 21 percent in 2012. However, the 7 percentage-point difference is almost completely explained by an expansion of the number of commodities in the 2007 I-O table from BEA. Physicians were previously included in the commodity labeled Offices of physicians, dentists, other practitioners but currently, this commodity has been disaggregated into Offices of physicians, Offices of dentists and Offices of other health practitioners. When all three of these categories are summed together, they represent 21 percent of overall health spending in 2017, similar to 2012.

In Table 2, the Pharmaceuticals commodity final demand in 2017 is shown as $267.1 billion, which is about 80 percent of the $333.4 billion shown for the Pharmaceuticals line in the NHEA, as shown in Table 1. This difference between these two numbers is largely accounted for by wholesale, retail and transportation costs. For example, this would include the payments to pharmacies and other retail drug distribution channels, wholesalers, and insurers (including pharmacy benefit managers, if applicable), in addition to air, truck and rail transportation costs.[7] When the spending goes through the rest of the process of accounting for the value added in each stage of production, then the industry breakdown is not as detailed.

[7] Sood, Neeraj et al, "The Flow of Money Through the Pharmaceutical Distribution System." https://healthpolicy.usc.edu/wp-content/uploads/2017/06/USC_Flow-of-MoneyWhitePaper_Final_Spreads.pdf.

Table 2. Direct National Health Expenditures Final Demand by LIFT Commodity

	Billions of Dollars									Annual Percent Growth					
	1998			2012			2017			1998 - 2012			1998 - 2017		
	Health care direct demand	Direct imports	Domestic direct demand	Health care direct demand	Direct imports	Domestic direct demand	Health care direct demand	Direct imports	Domestic direct demand	Health care direct demand	Direct imports	Domestic direct demand	Health care direct demand	Direct imports	Domestic direct demand
Total national health expenditures	1,201.5	21.4	1,180.1	2,798.0	96.5	2,701.5	3,492.1	123.1	3,369.0	6.2	11.4	6.1	5.8	9.7	5.7
LIFT Commodity															
103 Hospitals	374.9	1.2	373.7	902.5	3.1	899.5	1,142.6	3.8	1,138.8	6.5	7.0	6.5	6.0	6.3	6.0
96 Offices of physicians	187.3	0.0	187.3	398.9	0.0	398.9	492.7	0.0	492.7	5.5		5.5	5.2		5.2
26 Pharmaceuticals	80.0	13.8	66.2	199.6	66.6	133.0	267.1	88.8	178.3	6.8	11.9	5.1	6.6	10.3	5.4
104 Nursing and residential care facilities	109.3	0.0	109.3	221.8	0.0	221.8	254.2	0.0	254.2	5.2		5.2	4.5		4.5
80 Insurance	49.9	1.0	49.0	166.1	11.3	154.8	229.5	11.0	218.5	9.0	19.1	8.6	8.4	13.6	8.2
62 Other retail	46.4	0.0	46.4	109.3	0.0	109.3	134.0	0.0	134.0	6.3		6.3	5.7		5.7
99 Outpatient care centers	51.6	0.0	51.6	103.6	0.0	103.6	133.8	0.0	133.8	5.1		5.1	5.1		5.1
97 Offices of dentists	54.3	0.0	54.3	111.0	0.0	111.0	130.9	0.0	130.9	5.2		5.2	4.7		4.7
58 Wholesale trade	23.7	-0.6	24.3	98.0	-2.4	100.3	122.4	-3.2	125.6	10.7	10.2	10.7	9.0	9.1	9.0
101 Home health care services	40.7	0.0	40.7	95.0	0.0	95.0	119.0	0.0	119.0	6.2		6.2	5.8		5.8
98 Offices of other health practitioners	49.3	0.0	49.3	88.7	0.0	88.7	111.6	0.0	111.6	4.3		4.3	4.4		4.4
117 Federal government nondefense	26.5	0.0	26.5	61.9	0.0	61.9	71.7	0.0	71.7	6.2		6.2	5.4		5.4
56 Medical equipment and supplies, dental labs, ophthalmic goods	14.7	1.6	13.2	33.5	6.3	27.2	37.8	8.6	29.2	6.1	10.5	5.3	5.1	9.4	4.3
118 State and local general government	14.8	0.0	14.8	31.1	0.0	31.1	37.3	0.0	37.3	5.4		5.4	5.0		5.0
100 Medical and diagnostic laboratories	12.8	0.0	12.8	27.9	0.0	27.9	34.7	0.0	34.7	5.7		5.7	5.4		5.4
102 Other ambulatory health care services	10.2	0.0	10.2	27.8	0.0	27.8	33.7	0.0	33.7	7.4		7.4	6.5		6.5
13 New construction	13.1	0.0	13.1	29.8	0.0	29.8	33.5	0.0	33.5	6.0		6.0	5.1		5.1
44 Electromedical and electrotherapeutic apparatus	10.0	1.7	8.4	21.4	4.8	16.6	27.3	6.5	20.8	5.6	7.8	5.0	5.4	7.4	4.9
60 Food and beverage stores	4.6	0.0	4.6	13.0	0.0	13.0	15.7	0.0	15.7	7.6		7.6	6.6		6.6
61 General merchandise stores	1.9	0.0	1.9	7.4	0.0	7.4	8.4	0.0	8.4	10.0		10.0	8.0		8.0

Source: NHE and LIFT model calculations

Of the LIFT commodities shown in Table 2, Pharmaceuticals has the highest share satisfied by imports. Table 2a shows the relation of imports to total final demand and total domestic output of Pharmaceuticals. The first 3 lines of Table 2a show the total health care direct demand, direct imports, and domestic direct demand. In addition to direct demand, there are another $26 billion of indirect demand for Pharmaceuticals provided domestically in 2017, to bring total domestic output for Pharmaceuticals to $204 billion. In addition to the direct imports of $88.8 billion in 2017, another $18.1 billion of imports are used to satisfy indirect demand, so that total imports for NHE are $106.9 billion. Imports are calculated using the average import share for each commodity, which is the ratio of imports to total supply (domestic plus imports). The last line of table 2a shows the import share for Pharmaceuticals, which nearly doubled between 1998 and 2012, but declined slightly by 2017[8].

Table 2a. Pharmaceuticals Supply, Domestic and Imported

	1998	2012	2017
Health care direct demand	80.0	199.6	267.1
Direct imports	13.8	66.6	88.8
Domestic direct demand	66.2	133.0	178.3
Indirect domestic output	24.1	19.6	26.0
Total domestic output	90.2	152.6	204.3
Indirect imports	7.1	13.7	18.1
Total imports	20.9	80.3	106.9
Import share (percent)	17.3	33.4	33.2

Source: LIFT model calculations

Table 3 shows the results of translating LIFT final demand by commodity into direct and indirect gross output requirements for supplying health care. The direct gross output is inclusive of all intermediate

[8] Imported intermediate requirements are treated in more detail in the discussion section.

costs and the value added generated by the commodity production. Indirect output is the materials and services that are purchased for immediate use in the production of health care commodities. An example of significant use of indirect output is the insurance commodity. In 2017, there was $218.5 billion of direct domestic output from, for example, the services of medical underwriters and claims processing.

However, there was also a significant amount of indirect output ($257.6 billion in 2017) in this commodity and an example of this could be the employees who work to support the medical underwriters and claims processors in jobs like payroll, printing, and administrative support services. The largest health care sectors have minimal indirect output, but indirect outputs make up the vast majority of health care total domestic output for commodities such as Other real estate ($248.8 billion of indirect output in 2017), Administrative and support services ($192.1), Management of companies and enterprises ($133.0), and Other professional scientific and technical services ($114.9).

Table 3. Total, Direct and Indirect Gross Output Requirements for Supplying NHE

	Billions of dollars									Annual percent growth					
	1998			2012			2017			1998-2012			1998-2017		
	Direct domestic output	Indirect output	Health care total domestic output	Direct domestic output	Indirect output	Health care total domestic output	Direct domestic output	Indirect output	Health care total domestic output	Direct domestic output	Indirect output	Health care total domestic output	Direct domestic output	Indirect output	Health care total domestic output
Gross commodity output	1,180.1	747.8	1,927.9	2,701.5	1,650.4	4,351.9	3,369.0	2,117.5	5,486.5	6.1	5.8	6.0	5.7	5.6	5.7
Multiplier			1.6			1.6			1.6						
LIFT Commodity															
103 Hospitals	373.7	0.2	373.9	899.5	0.5	899.9	1,138.8	0.6	1,139.4	6.5	6.8	6.5	6.0	6.4	6.0
96 Offices of physicians	187.3	0.0	187.3	398.9	0.0	398.9	492.7	0.0	492.8	5.5	6.8	5.5	5.2	5.6	5.2
80 Insurance	49.0	53.1	102.0	154.8	181.7	336.5	218.5	257.6	476.1	8.6	9.2	8.9	8.2	8.7	8.4
104 Nursing and residential care facilities	109.3	0.1	109.4	221.8	0.4	222.3	254.2	0.4	254.6	5.2	8.1	5.2	4.5	5.1	4.5
83 Other real estate	0.1	67.5	67.6	0.2	179.4	179.6	0.3	248.8	249.1	6.5	7.2	7.2	6.0	7.1	7.1
58 Wholesale trade	24.3	44.1	68.5	100.3	65.6	166.0	125.6	83.5	209.1	10.7	2.9	6.5	9.0	3.4	6.1
26 Pharmaceuticals	66.2	24.1	90.2	133.0	19.6	152.6	178.3	26.0	204.3	5.1	-1.4	3.8	5.4	0.4	4.4
93 Administrative and support services	0.1	56.9	57.0	0.2	133.7	133.9	0.3	192.1	192.3	5.6	6.3	6.3	5.5	6.6	6.6
62 Other retail	46.4	0.6	47.1	109.3	1.2	110.5	134.0	0.7	134.6	6.3	4.4	6.3	5.7	0.1	5.7
99 Outpatient care centers	51.6	0.0	51.6	103.6	0.1	103.6	133.8	0.1	133.9	5.1	6.0	5.1	5.1	5.1	5.1
92 Management of companies and enterprices	0.0	33.8	33.8	0.1	100.4	100.5	0.1	133.0	133.2	8.2	8.1	8.1	7.2	7.5	7.5
97 Offices of dentists	54.3	0.0	54.3	111.0	0.0	111.0	130.9	0.0	130.9	5.2	7.0	5.2	4.7	5.9	4.7
101 Home health care services	40.7	0.0	40.7	95.0	0.0	95.0	119.0	0.0	119.0	6.2		6.2	5.8		5.8
91 Other professional, scientific and technical services	0.1	35.0	35.0	0.1	85.5	85.6	0.1	114.9	115.1	5.5	6.6	6.6	5.2	6.5	6.5
98 Offices of other health practitioners	49.3	0.0	49.3	88.7	0.0	88.7	111.6	0.0	111.7	4.3	5.8	4.3	4.4	5.1	4.4
117 Federal government nondefense	26.5	0.0	26.5	61.9	0.0	61.9	71.7	0.0	71.7	6.2		6.2	5.4		5.4
90 Advertising	0.1	25.8	25.8	0.1	53.9	54.0	0.1	70.1	70.2	4.5		5.4	4.2		5.4
56 Medical equipment and supplies, dental labs, ophthalmic goods	13.2	18.1	31.3	27.2	32.1	59.3	29.2	32.2	61.3	5.3	4.2	4.7	4.3	3.1	3.6
77 Banks, credit cards and finance	0.1	26.8	26.9	0.1	42.9	43.0	0.2	54.7	54.8	2.9	3.4	3.4	2.9	3.8	3.8
102 Other ambulatory health care services	10.2	4.1	14.3	27.8	13.4	41.2	33.7	17.3	51.0	7.4	8.8	7.9	6.5	7.9	6.9
Other commodities	77.7	357.6	435.3	167.8	740.0	907.8	195.8	885.6	1,081.4	5.7	5.3	5.4	5.0	4.9	4.9

Source: Inforum LIFT Model Calculations with BEA IO Data

In addition to direct retail purchases of prescription drugs, a significant amount of intermediate pharmaceutical purchases are used to satisfy final demand in several health care industries. For example, in 2017, $11.5 billion of Pharmaceuticals were purchased by Hospitals and $3.4 billion were purchased by Offices of physicians. Table 3a summarizes the main health care sectors purchasing Pharmaceuticals as indirect demand. This health care indirect demand amounts to about $19 billion in total in 2017. There are an additional $7 billion of indirect purchases from other sources, bringing total domestic output of Pharmaceuticals required for NHE to $204.3 billion. Although examples of indirect purchases of Pharmaceuticals occur in industries such as outpatient care centers and medical diagnostic labs, the vast majority of these additional indirect purchases are sales of Pharmaceuticals within the Pharmaceutical industry.

Table 3a. Distribution of Health Care Indirect Purchases of Pharmaceuticals

Sector	Name	2012	2017
96	Offices of physicians	2.6	3.4
97	Offices of dentists	0.3	0.4
98	Offices of other health practitioners	0.9	1.1
99	Outpatient care centers	0.6	0.8
100	Medical and diagnostic laboratories	0.4	0.5
102	Home health care services	0.4	0.5
102	Other ambulatory care services	0.1	0.2
103	Hospitals	8.5	11.5
104	Nursing and residential care facilities	0.5	0.6
	Subtotal	14.4	19.0
	NHE Pharmaceuticals direct domestic demand	133.0	178.3
	NHE Pharmaceuticals plus health care indirects	147.4	197.4
	Other indirect	5.2	7.0
	Total direct plus indirect	152.6	204.3

Source: NHE and LIFT model calculations

Table 4 shows the results of calculating value added for each industry. These value added estimates represent the labor compensation, capital income, and indirect taxes generated, directly and indirectly,

by industries as they respond to satisfy the demand for health care. That is, the value added estimates reflect each industry's contribution to the production of health care in the United States. As expected, the largest sources of value added in health care are the two industries most directly related to health care. In 2017, the value added of Ambulatory health services was $631.2 billion, or 3.3 percent of GDP, while Hospitals and nursing and residential care facilities generated $607.6 billion of value added, or 3.1 percent of GDP. There are other notable industries that have significant value added to the health sector as well. For instance, Finance, insurance, real estate, rental and leasing contributed $479.4 billion of value added to health care in 2017. Also, Professional and business services accounted for $373.4 billion in value added in 2017 and Manufacturing contributed $248.6 billion, of which a significant portion was pharmaceutical manufacturing. Finally, the combination of Wholesale and Retail trade had $287.7 billion of value added associated with health care provision in 2017 with Wholesale trade accounting for 53 percent of this total.

Regarding prescription drugs, domestic health care value added for Nondurable manufacturing of $164.5 billion in 2017 is dominated by chemical products, which accounts for $123.6 billion or 75.1 percent of this total. Using commodity output shares, we can break down this total among 7 chemical categories of which 80-percent is accounted for by pharmaceuticals. The other 20 percent is accounted for by other chemicals such as resin and synthetic rubber. Finally, a significant amount of domestic value added in the prescription drug industry can be found in the wholesale trade, retail trade, and transportation industries.

Table 4. Domestic Health Care Value Added by Industry

	Health care value added by industry							
	1998		2012		2017		1998 - 2012	1998 - 2017
	Billions of dollars	Percent of GDP	Billions of dollars	Percent of GDP	Billions of dollars	Percent of GDP	Growth rate	
Gross domestic product	9,089.2	100.0	16,155.3	100.0	19,390.6	100.0	4.2	4.1
National health expenditures	1,201.5	13.2	2,798.0	17.3	3,492.1	18.0	6.2	5.8
Total domestic health care value added	1,138.0	12.5	2,520.5	15.6	3,155.9	16.3	5.8	5.5
Industry								
Agriculture, forestry and fishing	3.3	0.0	6.9	0.0	7.7	0.0	5.5	4.7
Mining	2.9	0.0	14.5	0.1	12.2	0.1	12.3	7.9
Utilities	11.6	0.1	20.3	0.1	25.0	0.1	4.1	4.1
Construction	15.3	0.2	36.0	0.2	43.3	0.2	6.3	5.6
Manufacturing	111.1	1.2	194.9	1.2	248.6	1.3	4.1	4.3
Durable manufacturing	39.2	0.4	73.1	0.5	84.2	0.4	4.5	4.1
Nondurable manufacturing	71.8	0.8	121.8	0.8	164.5	0.8	3.8	4.5
Wholesale trade	49.5	0.5	111.4	0.7	152.7	0.8	6.0	6.1
Retail trade	50.3	0.6	109.6	0.7	135.0	0.7	5.7	5.3
Transportation	16.3	0.2	34.3	0.2	48.0	0.2	5.4	5.8
Information	25.2	0.3	51.3	0.3	70.6	0.4	5.2	5.6
Finance, insurance, real estate, rental and leasing	122.1	1.3	326.0	2.0	479.4	2.5	7.3	7.5
Insurance carriers and related activities	62.7	0.7	178.8	1.1	297.0	1.5	7.8	8.5
Professional and business services	105.9	1.2	272.2	1.7	373.4	1.9	7.0	6.9
Education, health care and social assistance	493.3	5.4	1,080.1	6.7	1,242.5	6.4	5.8	5.0
Ambulatory health services	254.4	2.8	538.2	3.3	631.2	3.3	5.5	4.9
Hospitals	168.7	1.9	402.4	2.5	458.5	2.4	6.4	5.4
Nursing and residential care facilities	69.0	0.8	136.5	0.8	149.1	0.8	5.0	4.1
Arts and recreation	2.5	0.0	5.8	0.0	7.7	0.0	6.2	6.1
Accommodation and food services	8.3	0.1	19.4	0.1	26.6	0.1	6.3	6.4
Other services, except govt	12.9	0.1	21.9	0.1	27.2	0.1	3.8	4.0
Government administration and enterprises	107.8	1.2	215.9	1.3	256.1	1.3	5.1	4.7
Federal general government	23.1	0.3	49.3	0.3	57.6	0.3	5.6	4.9
State and local general government	76.4	0.8	153.9	1.0	181.8	0.9	5.1	4.7

Source: Inforum LIFT Model Calculations with BEA IO Data

Table 5 shows the estimates of the number of workers used to produce U.S. health care for all major industries and its largest sub-industries. The aggregate number of health care associated jobs was 31.6 million in 2017, up from 28.4 million in 2012. From 1998 to 2017, health care employment grew by an annual average of 2.1 percent compared to 0.7 percent for general employment. The health care share of employment rose from 15.1 percent in 1998 to 19.6 percent in 2017. Combined, Ambulatory health services and Hospitals and nursing and residential care facilities accounted for about 16.6 million jobs in 2017, or 10.3 percent of total employment with the latter category accounting for 54 percent of this total. In 2017, there were 3.8 million Professional and business services jobs supporting health care

expenditures. Government administration and enterprises employment devoted to health care was 2.6 million in 2017; most of those related to public health activities, particularly state and local hospitals. Finance, insurance, real estate, rental and leasing accounted for 2.1 million jobs supporting health spending in 2017 while Retail trade was 2.0 million in 2017. Finally, Manufacturing accounted for 1.1 million jobs related to national health expenditures in 2017.

Table 5. Health Care Employment by Industry

	Health care employment by industry							
	1998		2012		2017		1998-2012	1998-2017
	Jobs (thousands)	Percent of employment	Jobs (thousands)	Percent of employment	Jobs (thousands)	Percent of employment	Growth rate	
Total U.S. civilian & military employment	141,902	100.0	148,481	100.0	160,774	100.0	0.3	0.7
Total domestic health care employment	21,435	15.1	28,396	19.1	31,583	19.6	2.0	2.1
Industry								
Agriculture, forestry and fishing	77	0.1	79	0.1	93	0.1	0.2	1.0
Mining	19	0.0	20	0.0	19	0.0	0.6	0.1
Utilities	43	0.0	43	0.0	46	0.0	-0.1	0.4
Construction	321	0.2	450	0.3	466	0.3	2.4	2.0
Manufacturing	1,151	0.8	1,010	0.7	1,103	0.7	-0.9	-0.2
Durable manufacturing	544	0.4	543	0.4	561	0.3	0.0	0.2
Nondurable manufacturing	607	0.4	467	0.3	542	0.3	-1.9	-0.6
Wholesale trade	508	0.4	674	0.5	794	0.5	2.0	2.4
Retail trade	1,321	0.9	1,834	1.2	1,953	1.2	2.4	2.1
Transportation	287	0.2	378	0.3	499	0.3	2.0	3.0
Information	200	0.1	198	0.1	215	0.1	-0.1	0.4
Finance, insurance, real estate, rental and leasing	1,150	0.8	1,756	1.2	2,083	1.3	3.1	3.2
Insurance carriers and related activities	635	0.4	1,113	0.7	1,364	0.8	4.1	4.1
Professional and business services	2,190	1.5	3,146	2.1	3,785	2.4	2.6	2.9
Education, health care and social assistance	11,336	8.0	15,224	10.3	16,605	10.3	2.1	2.0
Ambulatory health services	4,569	3.2	6,558	4.4	7,511	4.7	2.6	2.6
Hospitals	3,923	2.8	5,154	3.5	5,578	3.5	2.0	1.9
Nursing and residential care facilities	2,784	2.0	3,424	2.3	3,416	2.1	1.5	1.1
Arts and recreation	56	0.0	76	0.1	94	0.1	2.2	2.8
Accommodation and food services	341	0.2	551	0.4	700	0.4	3.5	3.9
Other services, except govt	393	0.3	482	0.3	512	0.3	1.5	1.4
Government administration and enterprises	2,045	1.4	2,475	1.7	2,617	1.6	1.4	1.3
Federal general government	228	0.2	286	0.2	303	0.2	1.6	1.5
State and local general government	1,684	1.2	2,034	1.4	2,147	1.3	1.4	1.3

Source: Inforum LIFT Model Calculations with BEA IO and NIPA Data

Using our methods, we can determine the main types of jobs that create the output of the Pharmaceuticals industry. Interestingly, none of these jobs would be considered health care employment using a direct health definition (see the Discussion section below). In addition to jobs in the chemical manufacturing industry, there are several other types of jobs that contribute to total prescription drug spending including other types of manufacturing, wholesale trade, retail trade,

transportation, ambulatory health services, and hospitals. In fact, these types of jobs are consistent with the occupational matrix for Pharmaceuticals that BLS published recently for 2016.[9] Table 5a shows that in 2017 there were roughly 290 thousand jobs that supported the pharmaceutical industry, and that the main types of jobs were chemists, life scientists, machine operators, office support, maintenance & repair, management, and top executives. As in most industries, the employment by occupation in the Pharmaceutical industry is very concentrated, as the top 20 occupational categories accounted for roughly 80 percent of total employment.

Table 5a. Pharmaceuticals Employment by Top Occupations
Thousands of Jobs

Rank	Occupational Title	1998	2012	2017
1	Packaging, filling, coating and spraying workers	22.2	24.3	26.1
2	Office and administrative support occupations	21.5	23.6	25.3
3	Business operations specialists	16.3	17.9	19.2
4	Chemists	14.4	15.8	17.0
5	Life scientists	13.4	14.7	15.8
6	Mixing and blending machine setters, operators, and tenders	12.2	13.3	14.3
7	Inspectors, testers, sorters, samplers, and weighers	11.4	12.5	13.4
8	Life, physical, and social science technicians	11.1	12.2	13.1
9	Installation, maintenance, and repair occupations	10.8	11.8	12.7
10	Chemical equipment operators and tenders	9.2	10.0	10.8
11	Other management occupations	8.9	9.7	10.5
12	First-line supervisors of production and operating workers	8.4	9.2	9.9
13	Industrial engineers	5.4	6.0	6.4
14	Top executives	4.8	5.3	5.7
15	Industrial production managers	4.3	4.7	5.1
16	Other operations specialties managers	4.0	4.4	4.7
17	Sales and related occupations	4.0	4.4	4.7
18	Financial specialists	3.8	4.2	4.5
19	Laborers and freight, stock, and material movers, hand	3.8	4.2	4.5
20	Chemical plant and system operators	3.1	3.4	3.7
	Other	54.2	59.4	63.8
	Total	**247.2**	**271.0**	**291.1**

Similar to the last time we published estimates of health care employment, we have, in 2017, a larger share of health employment (19.6 percent) as a percentage of total employment than national health

[9] BLS, "Industry-occupation matrix data, by industry." October 2017, https://www.bls.gov/emp/tables/industry-occupation-matrix-industry.htm.

expenditures as a share of gross domestic product (17.9 percent). A more detailed industry breakdown of employment supporting health care suggests that a majority of jobs related to health care spending are not highly paid. In comparison to the few highly paid jobs of surgeons and insurance executives, a significant share of jobs in health care are comprised of technicians and assistants, who would have an annual salary below that of the average U.S. worker.

This finding is also counter to other findings on health care employment. The main explanation for this is that we strived to account for every job that contributed to the demand-side estimate of national health expenditures. This was done using the methodology more fully described in the technical appendix. On the other hand, the Altarum Institute recently published an estimate that health care employment was 10.75 percent of total employment in December 2017.[10] What accounts for the difference of roughly 9 percentage points in 2017? This is explained by the fact that our health employment estimates are coming from both direct and indirect sources. The Altarum method calculates their health care employment share based only on two lines from Table 5 of Ambulatory health services and Hospitals and nursing and residential care facilities. Direct health care employment is an important statistic to know and it is able to be updated monthly. However, our method estimates the health employment jobs coming from indirect sources such as the manufacturing and insurance industries.

[10] Altarum, "Health Sector Economic Indicators, Labor Brief, January 2019, https://altarum.org/sites/default/files/uploaded-publication-files/SHSS%20Labor-Brief_January_2019.pdf.

DISCUSSION

As mentioned earlier, these estimates can shed light on a variety of different topics. In this section, we explore the topics of (1) the impact of the ACA and (2) the impact of imports, most visible in the supply side estimates of the prescription drug sector.

Impact of the Affordable Care Act

In 2014, the major coverage expansions of the Affordable Care Act took effect. The provisions of this legislation have been found to be the main reasons for increased private health insurance (PHI) enrollment, especially in the direct purchase market, and Medicaid enrollment. Mainly as a result of this expansion in coverage, the uninsured population decreased from 44.7 million in 2012 to 29.7 million in 2017.[11] By comparing the results of the supply side estimates in 2012 and 2017, we can determine how the distribution of costs to provide health care has changed, in part, as a result of the ACA.

The biggest impact from the ACA appears to be growth in the insurance market. On Table 2, the insurance commodity grew from $166.1 billion in 2012 to $229.5 billion in 2017, which reflected average annual growth in the 5-year period of 6.7 percent. In contrast, total NHE growth only averaged 4.5 percent during the same period. Other spending impacts as a result of the ACA are more difficult to decipher. For example, the ACA mandated that all health plans completely cover preventive services like immunizations and cancer screening.[12] However, the impacts for the related lines on Table 2 grow

[11] Martin, Anne et al., "National health care spending in 2017: growth slows to post–Great Recession rates; share of GDP stabilizes." Health Aff (Millwood). 2019;38(1):96–106.
[12] Gruessner, Vera, "How the Affordable Care Act Changed the Face of Health Insurance." December 2016, https://healthpayerintelligence.com/features/how-the-affordable-care-act-changed-the-face-of-health-insurance.

at similar rates to overall NHE. As a result, no definitive conclusion can be formed based on this provision of the ACA.

Another important metric that is widely discussed and debated is the impact on employment from the passage of the ACA. A recent study concluded that from 2014 to 2016, roughly 240,000 health services jobs were created solely because of the coverage expansion in the ACA.[13] This study arrived at this finding by concluding that the growth in health service jobs in 2015 & 2016 (averaging 2.5%) over and above the growth in the previous 4 years, when growth averaged 1.7%, could be designated as occurring as a result of the coverage expansions in the ACA. Under the assumption that providers might be cautious initially before starting to hire, this method can be extended into 2017. Since the growth in health services jobs in 2017 was 2.0% (or 0.3 percentage point above the relevant average of 1.7%), health services employment increased by roughly 41,000 in 2017 as a result of the ACA coverage expansions.[14] This would bring the increase in the total estimated health services jobs for the 2012-17 period to 281,000. However, as stated earlier, an analysis like this would only pick up the direct health care jobs from the 2 lines in Table 5 of Ambulatory health services and Hospitals and nursing and residential care facilities. Once the health employment jobs coming from indirect sources such as the manufacturing and insurance industries are considered, the amount of health employment created as a result of the ACA would increase significantly.

[13] Incidental Economist, "Expanded coverage has pushed health services employment up by roughly 240,000 jobs." April 2017, https://theincidentaleconomist.com/wordpress/expanded-coverage-has-pushed-health-services-employment-up-by-roughly-240000-jobs/.

[14] Using data from BLS (https://www.bls.gov/bls/employment.htm), direct health services employment increased 2.0% to 15.717 million in 2017, from 15.414 million in 2016. The level of health services employment would have been 15.676 million in 2017 if growth was 1.7%. As a result, the difference between these 2 levels (15.717-15.676, or 41,000) could be considered to be related to the coverage expansions in the ACA.

Table 5b. Health Care Employment by Industry, Additional Detail
Thousands of Jobs

	Employment Change, 2012-2017	
	Total Health Employment Change	Related to ACA Coverage Expansions
Ambulatory health services	952	195
Hospitals and nursing and residential care facilities	417	86
Professional and business services	640	84
Insurance carriers and related activities	250	51
State and local general government	112	23
Retail trade	119	14
Wholesale trade	119	14
Manufacturing	93	11
All Other	485	36
Total domestic health care employment	3,187	515

Source: Inforum LIFT Model and Authors' Calculations

We have concluded that approximately 16 percent of the increase in health employment from 2012 to 2017 (or roughly 515,000 out of 3.2 million) can be reasonably attributed to the coverage expansions of the ACA (Table 5b). This method is based on the assumption that without the ACA, employment growth would have continued at the rate of the average of the previous 4 years. Although this assumption could be considered to be conservative and reasonable, it may not align completely with the actual experience that occurred between 2012 and 2017. To complete this estimate, we applied the same method used to estimate direct health service jobs in order to estimate the increase in health employment from indirect sources. We analyzed the major types of jobs created during this period and determined the share of jobs that could reasonably be attributed to the coverage expansions in the ACA. As fully described by Vera Gruessner[15], the ACA had an enormous impact on the health insurance

[15] Gruessner, Vera, "How the Affordable Care Act Changed the Face of Health Insurance." December 2016, https://healthpayerintelligence.com/features/how-the-affordable-care-act-changed-the-face-of-health-insurance.

industry and therefore led to the addition of numerous jobs in the insurance carriers and related activities industry. Because most of the expansion in Medicaid coverage was in private managed care plans, insurers needed to hire more employees to determine if this expanded line of business was profitable in addition to pricing and managing these plans. Also, by not being able to exclude people with pre-existing conditions, the ACA dramatically changed how insurers created and marketed to the individual insurance market. The ACA also led to more jobs in government, especially state & local governments, for tasks such as insurance administration and information technology. Both insurers and governments hired more consultants, especially at certain times of the year, to assist them with tasks that they were not able to complete themselves and advocates working in non-profit organizations also hired more consultants due to the ACA. In addition, legal action taken by different entities in the health care system led to the hiring of more lawyers specializing in health law. As a result, consultants and lawyers make up the bulk of the ACA-related job gains in the Professional and business services industry. The increase in health spending attributed to the ACA led to an increase in jobs in the pharmaceutical industry (manufacturing) as well as Retail and Wholesale trade, which would not be picked up using a direct health service job metric. Finally, the All Other category represents the sum of smaller contributions from the other lines in Table 5 (not shown in Table 5b) for smaller ACA-related job gains in industries such as Federal government and Transportation.

Imported Intermediate Goods

Table 6 provides a summary of the link between the NHE and supply side accounting using LIFT, including two lines relating to imports. Total nominal NHE grew by an average compound annual rate of 5.8 percent from 1998 to 2017, reaching 17.9 percent of GDP in 2017. Nearly all of this spending was associated with domestic production, though as a proportion of NHE, it fell slightly over this period due to import penetration. The direct demand from imports increased by 9.7 percent per year from 1998 through 2017; as a share of NHE it increased from 1.8 percent in 1998 to 3.5 percent in 2017. As shown in Table 2, in 2017 $88.8 billion of the total direct demand imports ($123 billion), or 72 percent, was accounted for by the Pharmaceuticals commodity. In addition, this table contains a line titled "value added leaked due to imports" and this line shows how much income from the final demand of the health care sector goes to foreign markets. This section discusses the major components of imported goods that furnish health care demand in the United States.

Table 6. National Health Expenditures and Value Added

	Levels (billions of dollars)			Percent change		Share of NHE		
	1998	2012	2017	1998-2012	1998-2017	1998	2012	2017
National health expenditures (NHE)	1,201	2,798	3,492	6.2	5.8	100.0	100.0	100.0
Direct demand imports	21	97	123	11.4	9.7	1.8	3.4	3.5
Direct demand domestic production	1,180	2,702	3,369	6.1	5.7	98.2	96.6	96.5
Value added	1,138	2,521	3,156	5.8	5.5	94.7	90.1	90.4
Ambulatory care, hospitals, nursing homes	492	1,077	1,239	5.8	5.0	41.0	38.5	35.5
Other industries	646	1,443	1,917	5.9	5.9	53.8	51.6	54.9
Value added leaked due to imports	47	194	227	10.6	8.6	3.9	6.9	6.5
Unattributed value added	-5	-13	-14			-0.4	-0.5	-0.4

Source: Inforum LIFT Model Calculations with BEA IO and NIPA Data

The national health expenditure accounts record the spending on all types of health care in the United States. However, intermediate inputs or value added could be provided by foreign sources. These estimates can show how much money is going to foreign countries in order to supply health care in the

United States and if this percentage has been increasing. Since the share of intermediate goods furnished internationally has increased over the last 20 years, an analysis could help give reasons for this trend as well as give indications if this trend might continue in the future.

As previously described, Pharmaceuticals account for nearly three-quarters of total direct demand imports, with Insurance, Medical equipment, and Electromedical and electrotherapeutic apparatus also providing significant direct import shares. For drugs sold in the United States, many are manufactured overseas and a significant amount manufactured in the United States have received key ingredients from foreign suppliers.[16] Similarly, the sales of medical equipment and electromedical and electrotherapeutic apparatus in the United States are sometimes manufactured wholly or partly in foreign countries.[17]

Table 6 also shows that value added leaked due to imports was $227 billion or 6.5 percent of total national health expenditures. The spending in this line measures the income or value added that would have been earned domestically if these goods and services had not been imported. Similar to the paragraph above, the line items with the greatest amount of value added leaked due to imports are Pharmaceuticals, Medical equipment, and Electromedical and electrotherapeutic apparatus. The key questions regarding the significant and growing amount of this line are: Does this spending represent a missed opportunity for U.S. businesses or can the foreign companies who receive this value added provide the intermediate goods to furnish health care spending less expensively than could be done by

[16] Lazarus, David, "Where do prescription drugs come from? Good luck answering that question." Los Angeles Times, May 15, 2018, https://www.latimes.com/business/lazarus/la-fi-lazarus-drugs-country-of-origin-20180515-story.html.
[17] Holtzman, Yair, "The U.S. Medical Device Industry: Challenges at Home and Abroad." July 17, 2012, https://www.mddionline.com/us-medical-device-industry-2012-challenges-home-and-abroad.

U.S. providers? There are no clear and definitive answers to these questions for all types of imported goods that furnish health care demand in the United States. For some manufacturing such as pharmaceuticals, the ability to produce the products at a similar quality, but a lower cost due to lower input costs, especially wages, gives foreign countries a comparative advantage in producing these goods relative to the United States.[18] For goods that can be produced less expensively, the imported value added can be expected if grow if additional opportunities present themselves. However, not all imported value added is a result of less expensive input goods. For some industries like the medical device industry, the foreign supply of these goods might be the result of the innovative talent of foreign labor and/or a less stringent regulatory environment. In this case, the production of these goods overseas represent a missed opportunity that could be taken back with more investments in human capital as well as additional incentives to encourage more spending on research and development. Finally, improvements in the Food and Drug Administration's approval process, and removing of barriers that cause burden in the development and approval process of medical equipment, could result in fewer dollars being lost in value added from imports.[19]

CONCLUSION AND FUTURE RESEARCH

This paper presents an updated historical analysis of the inputs used to furnish health care demand in the United States. The results have mostly confirmed the earlier analysis but also showed a larger impact associated with insurers after the implementation of the major coverage provisions of the

[18] Landsburg, Laruen, "Comparative Advantage." February 5, 2018, https://www.econlib.org/library/Topics/Details/comparativeadvantage.html.
[19] Bergsland, Jacob et al, "Barriers to medical device innovation." National Center for Biotechnology Information, June 2014, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4063798/.

Affordable Care Act. In addition, the new detail on pharmaceutical products and imported intermediate goods provides important implications of analyzing the supply side of health care spending.

Our plan for future research is to use this approach and our annual short-run NHE Projections[20] with the LIFT model projections to evaluate the factor payments and labor needed to support the anticipated health spending over the next 10 years. Currently, these are demand-side projections and the supply-side issues are not explicitly accounted for during the projections process. It is possible that the factor payments and/or employment needed to fulfill the amount of health care spending predicted in the future will be difficult to obtain. As a result, this could either serve as a brake on one or more categories of health care spending or cause wage or resource prices to be bid up in order to acquire the needed resources, which could lead to an acceleration in medical price growth. Finally, looking at the short-run NHE Projections from a supply-side basis will be valuable in order to show the areas for which there could be potential shortages regarding inputs or labor.

[20] Sisko, Andrea et al, "National Health Expenditure Projections, 2018–27: Economic And Demographic Trends Drive Spending And Enrollment Growth." https://www.healthaffairs.org/doi/full/10.1377/hlthaff.2018.05499.