

PROJECTIONS OF NATIONAL HEALTH EXPENDITURES: METHODOLOGY AND MODEL SPECIFICATION

The Office of the Actuary (OACT) in the Centers for Medicare & Medicaid Services (CMS) produces short-term (10-year) projections of health care spending for categories in the National Health Expenditure Accounts (NHEA) on an annual basis.¹

The National Health Expenditure (NHE) projections consist of time series for all of the major spending categories in the NHEA. These categories include trends in aggregate medical spending, medical services consumed, sources of payment, and sources of financing. Detailed tables for the historical and projected NHEA are available online.² In addition, an article describing these results is published in the journal *Health Affairs*.³

The modeling methodology for the NHE projections has evolved in response to the passage and implementation of the Affordable Care Act (ACA). In previous projections that we prepared after the passage of the ACA, we utilized a two-stage modeling process. In the first stage, we used our standard NHE Econometric Model, which combines econometric models and exogenous actuarial projections of Medicare, Medicaid, and the Children's Health Insurance Program (CHIP) to generate a counter-factual pre-ACA projection. Then, in the second stage, we layered on the effects of health reform, which we estimated using the Office of the Actuary Health Reform Model (OHRM) and detailed actuarial cost estimates prepared by OACT. However, since the ACA has been in effect since 2010, it is no longer possible to explicitly determine how all of its provisions have affected historical NHE estimates, relative to a scenario in which the legislation hadn't taken effect. Further, we now have historical data on the actual effects of the ACA, as its most significant effects are now incorporated in the historical NHE accounts, including the major coverage expansions of 2014. For these reasons, the effects of the ACA are no longer projected separately using the OHRM. For the current spending projections, we primarily utilize our standard NHE Econometric Model, as was our method prior to the passage and enactment of the ACA, with adjustments to model projections for specific effects as needed.⁴

Given that the NHE Projections are constructed using a current-law framework, they do not assume potential legislative changes over the projection period, nor do they attempt to speculate on possible deviations from current law.⁵ While there is currently significant debate involving potential future health-sector policy changes, the scope, timing, and impact of such possible degree to which health policy is

¹ The current NHE Projections release (published online in February 2017) marks a change in the timing of the annual publication release (from summer to winter) in order to follow more closely on the release of updated data for the historical National Health Expenditures Accounts. Concurrent with this change, our projections horizon has been shortened from 11 years to 10 years (2016-2025).

² Centers for Medicare & Medicaid Services. National Health Expenditure Data: Projected. Available at <https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsProjected.html>.

³ Keehan, Sean P., *et al.* "National Health Expenditure Projections, 2016-25." *Health Affairs*, 36, no.3 (2017). (Published online 15 Feb 2017.)

⁴ We maintain projections of health insurance enrollment by source of coverage that continue to reflect specific adjustments for the effects of the ACA. Spending projections are monitored and adjusted to ensure that implications for growth in private health insurance spending are reasonable on a per enrollee basis.

⁵ One exception is that the projections assume that the level of funding for the Children's Health Insurance Program does not expire throughout the projection period.

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altered, the timing of which those changes may take place, and the impact on health spending and health insurance coverage are all indeterminate at this time.

The NHE projections are inherently subject to uncertainty and are best viewed with this caveat. The models used to project trends in health care spending are estimated based on historical relationships within the health sector, and between the health sector and macroeconomic variables. Accordingly, the spending projections assume that these relationships will remain consistent with history, except in those cases in which adjustments are explicitly specified. These projections also rely on assumptions about future trends in exogenous inputs to the model, such as macroeconomic conditions. The degree of uncertainty associated with the projections increases with the projection horizon.

This paper describes the methodology for the NHE Econometric Model. The discussion is organized as follows:

1) OVERVIEW OF THE NHE ECONOMETRIC MODEL

2) DATA SOURCES AND EXOGENOUS INPUTS TO THE NHE ECONOMETRIC MODEL

a) Historical data sources

- i) NHE data*
- ii) Medical price indexes*
- iii) Insurance coverage data*

b) Exogenous inputs to the NHE Econometric Model

3) NHE ECONOMETRIC MODEL SPECIFICATION

a) Aggregate model for private personal health care (PHC) spending

- i) Relationship between macroeconomic trends and PHC spending*
- ii) Structure of the private PHC spending model*
- iii) Disposable personal income*
- iv) Lagged health share of Gross Domestic Product (GDP)*
- v) Relative medical price inflation*
- vi) Real per capita public PHC spending*

b) Non-PHC health care spending

- i) Government administration and the net cost of private health insurance (PHI)*
- ii) Non-commercial research*
- iii) Government public health*
- iv) Structures and equipment*

c) Submodels for sector, sources of funds, and sponsors of payment

- i) Models for health care spending by type of service*
- ii) Sector model: hospital services*
- iii) Sector model: physician and clinical services*
- iv) Sector model: prescription drugs*
- v) Models for health care spending by source of funds (direct payer)*
- vi) Spending projections for Department of Defense (DOD) and Department of Veterans Affairs (VA) health insurance programs*
- vii) Models for spending by sponsor of payment*

d) Private health insurance enrollment and uninsured population models

- i) Employer-sponsored insurance*
- ii) Individually purchased insurance (excluding Medicare supplement insurance)*
- iii) Individually purchased insurance (Medicare supplement insurance)*
- iv) Uninsured population*

4) CONCLUDING NOTE

1) OVERVIEW OF THE NHE ECONOMETRIC MODEL

The NHE Econometric Model is based on a multi-equation structural econometric model that reflects relationships in historical time-series data and encompasses the health system as a whole. The primary focus of the NHE Econometric Model is to produce projections of future health care spending by private health insurers, by consumers on an out-of-pocket basis, and by other private payers that are consistent with exogenous projections for Medicare, Medicaid, CHIP, and key macroeconomic variables.

Key exogenous inputs to the model include the most recent available macroeconomic and demographic assumptions from the Social Security Administration (SSA), as well as actuarial projections for Medicare, Medicaid, and CHIP spending and enrollment. We also project residual spending for other government programs (excluding the programs mentioned above) to provide a comprehensive projection of all spending within the NHEA.

Sections 2-3 of this methodology paper present the inputs and structure of the NHE Econometric Model, with discussion of the data, assumptions, and model specification used to produce the forecast.

2) DATA SOURCES AND EXOGENOUS INPUTS TO THE NHE ECONOMETRIC MODEL

a. Historical data sources

i. NHE data

Historical NHE estimates, compiled by OACT, are used as the historical time series for health expenditures. These estimates provide a national level matrix of health spending data by type of service, source of funding, and sponsor of health care.⁶

Classification of spending by type of service, source of funding, and sponsor projected in our model is consistent with NHEA classification and is presented in the tables below.⁷ Payer categories track the source of direct payment for health care consumption, such as Medicare or private health insurance (PHI), but do not consider who is ultimately paying for each form of coverage—whether payment is made via taxes or premium payments, for example. Health spending by sponsor of spending is defined as the underlying source of financing for the sources of funding: businesses, households, and governments.⁸

For purposes of model estimation, we rely on data categorized by direct payer rather than by sponsor. This is a distinction that has become more important with the onset of public subsidies for the purchase of private health insurance plans under the ACA; NHEA classification by payer defines such subsidies as private spending, while classification by sponsor of spending allocates these payments to government sources. Projections of spending by sponsor then reallocate spending associated with ACA subsidies from private to public spending, producing two different perspectives for public/private roles in healthcare financing.

⁶ Information on the methodology used in producing the historical NHE estimates can be found in our NHEA methodology paper, available at <http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Downloads/dsm-15.pdf>.

⁷ Ibid.

⁸ Ibid.

TYPES OF SERVICE

National Health Expenditures

- Health Consumption Expenditures
 - Personal Health Care
 - Hospital Care
 - Professional Services
 - Physician and Clinical Services
 - Other Professional Services
 - Dental Services
 - Other Health, Residential, and Personal Care
 - Nursing Care Facilities and Continuing Care Retirement Communities and Home Health Care
 - Nursing Care Facilities and Continuing Care Retirement Communities
 - Home Health Care
 - Retail Outlet Sales of Medical Products
 - Retail Prescription Drugs
 - Durable Medical Equipment
 - Other Non-Durable Medical Products
 - Government Administration
 - Net Cost of Health Insurance
 - Government Public Health Activities
- Investment
 - Structures
 - Equipment
 - Research

PAYER

National Health Expenditures

- Out-of-Pocket
- Health Insurance
 - Private Health Insurance
 - Medicare
 - Medicaid
 - Children's Health Insurance Program (CHIP)
 - Department of Defense
 - Department of Veterans Affairs
- Other Third-Party Payers and Programs
 - Other Federal Programs
 - Other State and Local Programs
 - Other Private Expenditures

SPONSORS OF PAYMENT

National Health Expenditures

Businesses, Households, and Other Private

Private businesses

Employer contributions to private health insurance premiums

Other

Household

Household private health insurance premiums

Medicare payroll taxes and premiums

Out-of-pocket health spending

Other private revenues

Governments

Federal government

Employer contributions to private health insurance premiums

Employer payroll taxes paid to Medicare hospital insurance trust fund

Medicare

Medicaid

Other programs

State and local governments

Employer contributions to private health insurance premiums

Employer payroll taxes paid to Medicare hospital insurance trust fund

Medicaid

Other programs

ii. Medical price indexes

Consistent with overall NHEA methodology, the Producer Price Indexes (PPIs) and Consumer Price Indexes (CPIs) published by the Bureau of Labor Statistics (BLS) are the primary data sources for medical price indexes. Our price measure for total PHC spending is a chain-weighted deflator based on the indexes in the table below, with the weight for each index set equal to the share of PHC spending accounted for by that type of service.

COMPONENTS OF PHC EXPENDITURE CHAIN-TYPE ANNUAL-WEIGHTED PRICE INDEX

Industry/Commodity or Service	Price proxy	2015 weight
PHC		100.0
Hospital Care	PPI hospitals*	38.1
Physician and Clinical Services	Composite Index: PPI for Office of Physicians and PPI for medical & diagnostic laboratories	23.4
Other Professional Services	CPI services by other medical professionals	3.2
Dental Services	CPI dental services	4.3
Home Health Care	PPI home health care services	3.3
Other Health, Residential, and Personal Care:		6.0
Other (School Health, Worksite Health Care, Other Federal, Other State & Local, etc.)	CPI physicians' services	
Home and Community-Based Waivers (HCBW)	CPI care of invalids & elderly at home	
Ambulance	CPI-U All Items	
Residential Mental Health & Substance Abuse Facilities	PPI residential mental retardation facilities	
Nursing Care Facilities and Continuing Care Retirement Communities	PPI nursing care facilities	5.8
Prescription Drugs	CPI prescription drugs	11.9
Other Non-Durable Medical Products	CPI internal & respiratory over-the-counter drugs	2.2
Durable Medical Equipment	Composite Index: CPI for eyeglasses and eye care and CPI nonprescription medical equipment and supplies	1.8

*Producer Price Index for hospitals, U.S. Department of Labor, Bureau of Labor Statistics. Used beginning in 1994. Indexes for 1960-93 are based on a CMS-developed output or transaction price index.

iii. Insurance coverage data

As with spending, historical enrollment estimates are drawn from historical NHE data. The estimates cover total private health insurance (PHI; comprised of individually purchased and employer-sponsored plans), public insurance programs (including Medicare and Medicaid), and the uninsured. Estimates of total PHI enrollment are available from 1960 forward. Medicare and Medicaid enrollment estimates are available from 1966 forward; however, all other enrollment categories (including the more detailed estimates for individually purchased and employer-sponsored insurance) are only available from 1987 forward.^{9, 10}

b. Exogenous inputs to the NHE Econometric Model

Exogenous inputs to the NHE projections include macroeconomic assumptions for projections of real Gross Domestic Product (GDP) growth, economy-wide inflation, labor market indicators, input price indexes for medical care, and demographic projections of the population by age and gender. Projections for macroeconomic and demographic assumptions are based on the annual projections of the Board of Trustees for Federal Old-Age, Survivors, and Disability Insurance (OASDI), which are produced annually by SSA.¹¹ The projections were updated to reflect additional macroeconomic data and research available through May 2016.¹²

Projections for personal income (PI) and disposable personal income (DPI), consistent with the economic assumptions from the 2016 Medicare Trustees Report, are generated using the University of Maryland Long Term Interindustry Forecasting Tool (LIFT).¹³

The Boards of Trustees for Medicare report annually to the Congress on the actuarial status of the Hospital Insurance and Supplementary Medical Insurance trust funds.¹⁴ Projections of Medicare spending generated for this report, as well as projections of Medicaid and CHIP spending, are produced by OACT and are also consistent with macroeconomic and demographic assumptions included in the OASDI Trustees Report. The July 2016 release of the NHE projections incorporates projections from the 2016 OASDI and Medicare

⁹ Additional details on historical NHE enrollment estimates are available in our NHEA methodology paper for 2014, available at <https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Downloads/DSM-15.pdf>

¹⁰ Truffer, Christopher J., Wolfe, Christian J., and Rennie, Kathryn E. *2016 Actuarial Report on the Financial Outlook for Medicaid*. Baltimore (MD): Centers for Medicare & Medicaid Services, Forthcoming. Available at <https://www.medicaid.gov/medicaid/financing-and-reimbursement/downloads/medicaid-actuarial-report-2016.pdf>

¹¹ Board of Trustees, Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds. *The 2016 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds*, 22 June 2016. Available at <http://www.socialsecurity.gov/OACT/TR/2016/>.

¹² The updated macroeconomic forecast is derived from the January 2017 publication of the Blue Chip Economic Indicators, a survey of 50 of the top forecasts by different private companies and academic institutions. More information on this report can be found at <http://www.aspenpublishers.com/blue-chip-publications.htm>.

¹³ Projections of PI and GDP are available from Table 1 of the CMS projected NHE data, available at <http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsProjected.html>.

¹⁴ Boards of Trustees, Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Funds. *The 2016 Annual Report of the Boards of Trustees of the Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Funds*, 22 June 2016. Available at <http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/ReportsTrustFunds/Downloads/TR2016.pdf>.

Trustees Reports (issued in June 2016) and the 2016 Medicaid Actuarial Report.

Projections for input price indexes in each sector are based on projections from IHS Global Insight, Inc., which rely on macroeconomic assumptions for aggregate wage and price growth that differ from those incorporated in the OASDI Trustees Report. Accordingly, price and wage proxies included in these indexes are adjusted for consistency with OASDI macroeconomic assumptions on economy-wide wage and price inflation.

3) NHE ECONOMETRIC MODEL SPECIFICATION

a. Aggregate model for private personal health care (PHC) spending

The NHE Econometric Model is composed of a set of econometric equations that define the relationship of trends in spending growth for private PHC sources of funding¹⁵ (and for other government programs) relative to the exogenous inputs to the model, which consist of assumptions for key macroeconomic variables and the actuarial projections for Medicaid, Medicare, and CHIP spending. The specifications of the model draw on standard economic theory and the broader health economics literature. The equations in the model are re-estimated annually following the release of updated historical NHE data, and the fit and appropriateness of model specifications for individual series are reviewed and revised at this time.

Spending for medical care provided to patients, or PHC, accounts for about 85 percent of total national health spending. The drivers of growth in spending for different types of personal health care goods and services tend to be broadly similar, since these are all consumer goods that are provided by medical practitioners. As a result, projections are generated for PHC (in total and for individual goods and services).

The remaining 15 percent of national health spending includes additional costs such as the net cost of PHI, government administration, non-commercial research spending, public health spending, and investment. These categories are heterogeneous in nature and are, in many cases, more volatile and unpredictable. In addition, the drivers of growth for the non-PHC categories are quite different from those for PHC. As a result, projections for the non-PHC categories are based on separate models with differing specifications.

i. Relationship between macroeconomic trends and PHC spending

The key dynamic in econometric models for PHC spending is the relationship between health spending growth and macroeconomic variables. Spending growth for private PHC exhibits a strong relationship to the macroeconomic business cycle. Growth cycles in health care spending can be extended in duration, lasting over a decade or more from peak to trough. However, this causal link between private PHC spending and macroeconomic growth is not immediately obvious when looking at the health share of GDP because of two key factors. Most importantly, the transmission of the effect occurs over a period of several years

¹⁵ It should be noted that “private sources of funding” in this context include all private health insurance spending, which in turn, includes government subsidies for Marketplace premiums. As such, this spending is defined as private from the perspective of direct payment for care (a ‘Payer’ basis), rather than on the ultimate source of funding for coverage (a ‘Sponsor-of-payment’ basis). For purposes of econometric modeling and discussion in this paper, all private health insurance spending, out-of-pocket spending, and other private revenues are grouped together as “private spending.” To obtain sponsor-based delineations of public and private spending, we incorporate models that reallocate spending from direct payer basis to sponsor-based categories (discussed later in this paper).

following the macroeconomic business cycle. Secondly, there is a negative short-term relationship between trends in private and public spending growth, which tends to obscure the link between private spending and economic growth. This effect contributes to volatility in growth when private spending is considered separately from public spending. It is important to note, however, that the negative correlation between private and public payer spending growth applies only to the short term. Over the long term, spending growth for both public and private payers is dominated by supply-side drivers and tends to be positively correlated.

Although the causal link between aggregate income growth and health spending is clearly strongest in private PHC spending, the same relationship can be observed on a more muted scale in the aggregated data for spending across all sources of funds.

Because of the magnitude and length of the growth cycles that characterize private PHC spending, it is difficult to examine trends over periods covering less than two decades without understanding the cyclical and macroeconomic context. For example, our models and the most recent available historical data suggest that growth in private PHC spending reached a cyclical peak in approximately 2002 and, following more than a decade of slowing growth, reached a cyclical trough in 2010.¹⁶ Since the trend for private PHC spending growth over 2002-2010 is effectively a peak-to-trough movement, the pattern of growth over this interval cannot provide a characterization of the long-term trend in health care spending. Viewing the pattern in such a way would tend to greatly overstate the deceleration in growth that is likely to be sustained when the role of the growth cycle is fully accounted for. Variation in growth for public PHC spending does not usually track the timing of the cycle for private PHC spending and is strongly influenced by the passage of legislation. However, based on recent data, OACT analysis suggests that public PHC spending growth reached a cyclical trough at approximately the same time as the private sector (in about 2010-2012).

Chart 1 shows the estimated effect of lagged growth in real per capita disposable personal income (DPI)¹⁷ on real per capita private PHC spending growth. The chart illustrates the relationship between this estimated effect of income growth and the actual growth in real per capita private PHC spending. The explanatory power of lagged income growth for aggregate health spending has historically been very strong.

Notably, private PHC spending growth during the economic recession of 2007-2009 was substantially below the model forecast for that period, but it has since bounced back to grow faster than growth projected by the model. This pattern is believed to result primarily from unusually strong movements in PHI enrollments. Prior to this most recent recession, there has been a lag between slowdowns in economic growth and ensuing slowdowns in health spending growth; however, the severity of the 2007-2009 recession had a more immediate impact on health spending because it was associated with a very sharp drop in PHI coverage, which in turn had immediate effects on demand for health care services. Then, in subsequent years, the recovery in PHI coverage contributed to a rebound that was stronger than projected. The effects of the ACA also played a role in driving faster growth in 2011-2015, as people gained private coverage through the newly available Marketplace plans in 2014-15 and, prior to that, through the

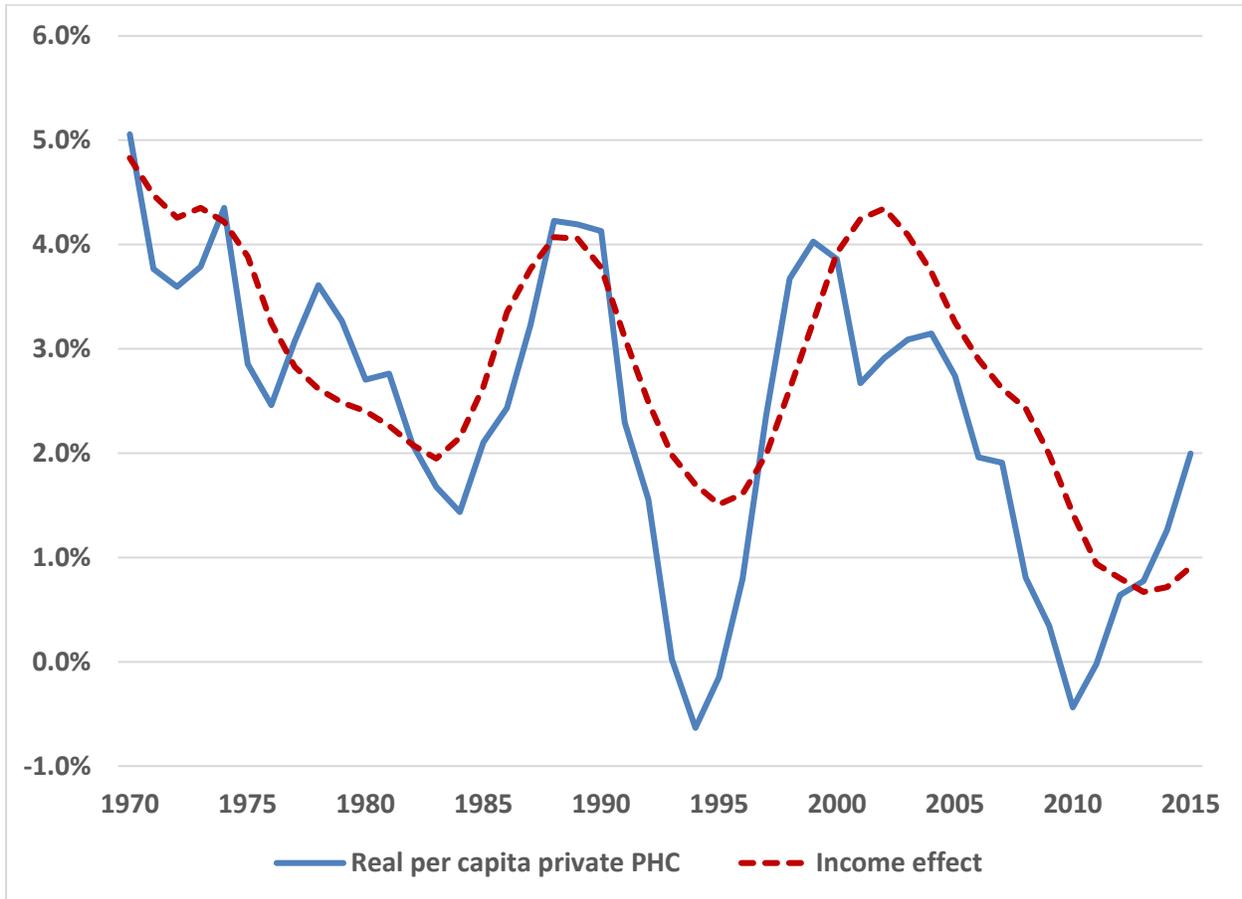
¹⁶ The timing of cyclical peaks and troughs cannot be precise due to annual year-to-year volatility in the health care spending data.

¹⁷ Values shown represent the historical values of DPI applied to the estimated model coefficients in the NHE projection model. They are estimated by fitting a coefficient to each lagged value, constrained to fit along a second degree polynomial. The peak effect of income growth on private PHC spending occurs with a lag of 2 to 3 years.

expansion of parents’ plans to cover adult children under 26 years of age.

Chart 1. Real per capita growth in private PHC spending with estimated cyclical effects of macroeconomic growth, 1970-2014

(3-year moving average growth rates)

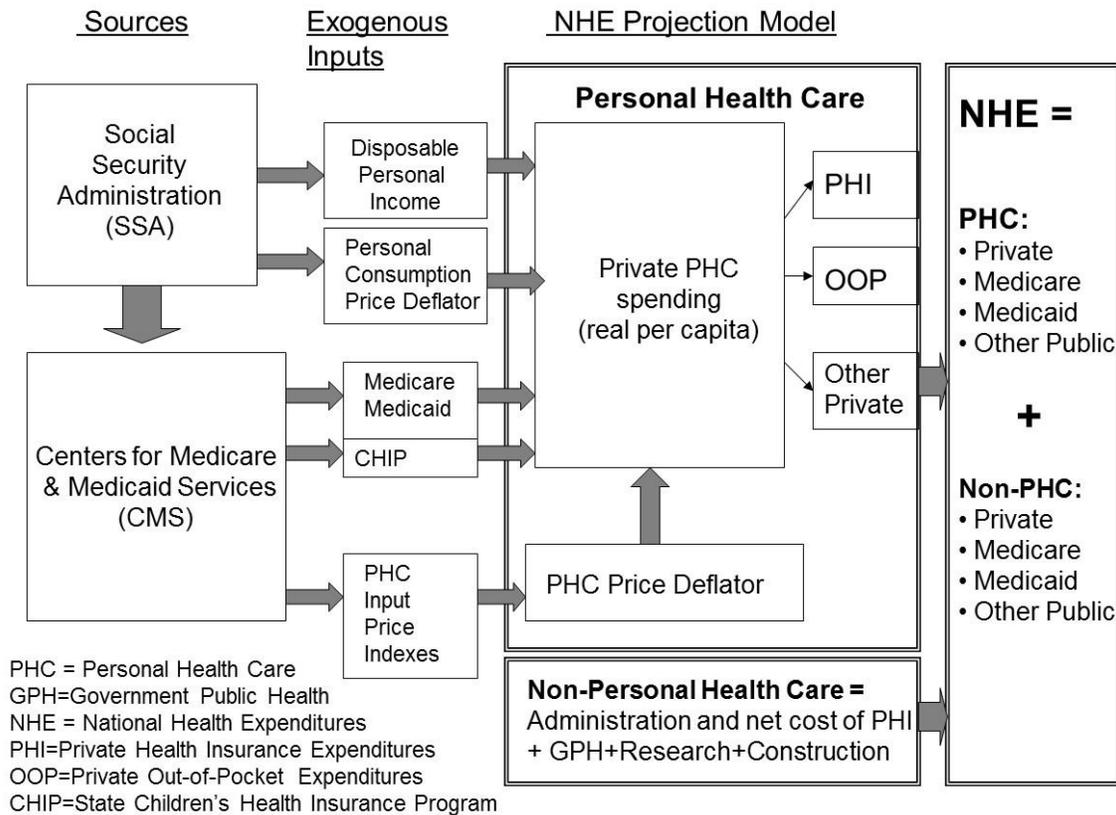


Based on re-estimation with updated data through 2015, the positive impact of the ACA on growth in real per capita private spending has become apparent. The model residuals from the estimation of the model over the 1961-2015 sample period were 1.3 and 2.9 standard deviations above the mean for 2014 and 2015 respectively – well above the cumulative over-prediction for any previous two consecutive years in the estimation interval from 1961 to 2015. This pattern largely reflects rapid growth in PHI enrollment associated with the onset of the major coverage provisions of the ACA in 2014. The impact of the ACA on enrollment in these initial years is therefore a non-recurring effect that is not expected to influence spending growth to a similar degree over the projection. Therefore we adjusted the sample interval for the model estimation to exclude these outlier data points in 2014-15.

ii. Structure of the private PHC spending model

The diagram below provides a schematic view of the aggregate health sector within the NHE Econometric Model and shows the linkages among the data sources, exogenous data, the PHC model, the non-PHC output, and the aggregate NHE projection.

Diagram - Illustration of the Structure of the Private PHC Model



The NHE Econometric Model can be characterized as a top-down, reduced-form model. It is a reduced form model in that both supply and demand factors are represented as drivers of growth, but without an explicit theoretical model framework. Thus, the coefficients in the model capture the relationships between health sector variables and macroeconomic variables as they occur in equilibrium without attempting to identify the underlying parameters that characterize the dynamics of supply and demand.

It is a top-down model in that spending and pricing trends are modeled at the aggregate PHC level, with underlying trends by sector constrained to aggregate PHC for consistency with the broader picture. Thus, spending projections for all subcategories—types of medical care by sector, direct sources of funding for medical care, and all sponsors of payment—are constrained to equal aggregate projections. Though the ultimate projections for all the subcategories are constrained to the aggregate projection, models for spending by sector, source of funds, and sponsor are also estimated individually—both to maintain any distinctive trends relative to the aggregate trend and also to maintain consistency with exogenous

projections of macroeconomic variables, actuarial projections of spending for the Medicare and Medicaid programs, and additional assumptions specific to the health sector.

The primary reason for the choice of a top-down model is that private PHC spending at the aggregate level is much easier to project than is such spending for each of the individual sectors (such as physician and clinical services) or for the sources of funding (such as private health insurance) within each of the sectors. This is the case due to interrelationships in spending growth across types of care that act as substitutes for each other. In particular, it is critical to account for the effects of shifts in settings for health care delivery if we are to explain historical patterns of growth for the individual sectors. Such shifts often occur in response to changes in government policy or PHI coverage. For example, the shift in setting from inpatient hospital to either outpatient hospital or to physician offices was hastened by the introduction of the prospective payment system for Medicare inpatient care in 1983. The shift from the inpatient hospital setting was then further accelerated by the growth in the 1990s of managed care plans, the design of which tended to discourage the use of more intensive care relative to less intensive care. We cannot fully control for these changes in government policy and PHI coverage, because we have no proxies that can accurately capture the year-to-year impact. Consequently, these event-driven shifts among the sectors are more difficult to project than those at the aggregate level (which subsume the effect of such shifts).

The core of our aggregate model of private PHC spending consists of two equations:

- Real per capita PHC spending
- PHC price inflation

Conceptually, these two equations represent the quantity and price of medical care relative to other consumption goods. All variables are expressed as log differences (growth rates). Our focus on relationships in terms of growth rates, rather than levels, reflects the relatively short forecast horizon of these projections. Models that are estimated on the basis of growth rates are concerned primarily with short-term dynamics and effectively assume that there will be no unsustainable divergences from long-term relationships in levels terms. While underlying relationships in terms of levels are not expected to change very much within the single decade that our projections cover, these relationships ultimately have an effect on the long-term trend in growth rates (particularly when growth is rapid). Thus while we project relationships using our model (in terms of growth rates), we also monitor them on the basis of levels as well and may adjust model projections to maintain relative levels in line with historical patterns where necessary.

The aggregate model for growth in PHC spending incorporates factors that influence both the supply and demand for medical care. Real per capita private PHC is effectively a measure of the quantity of medical care purchased by private payers.¹⁸ In this model, growth in quantity is driven primarily by factors that influence aggregate consumer demand: the effects of changes in aggregate income and in the relative price of medical care. Growth in real per capita public PHC spending is also included as a variable in this model because insurance under Medicaid, Medicare, and CHIP substitutes for private coverage.

Our model for relative medical price inflation is primarily a supply-side model; price is assumed to be a function of the costs of production. We assume that growth in the relative price of medical care will be driven by underlying growth in input costs for medical providers. Relative price growth also reflects trends in relative productivity growth, and these trends are implicitly captured in the historical data. In addition,

¹⁸ The accuracy of real per capita spending as a measure of quantity is dependent on the accuracy of the medical price indexes that are used as deflators.

we include a variable for the share of spending that is made on an out-of-pocket basis by consumers.

The independent variables in our aggregate model of real per capita private PHC spending are as follows:

- Disposable personal income growth (less Medicare and Medicaid, real per capita)
- Lagged health share of Gross Domestic Product (PHC for all sources of funds as a share of GDP)
- Relative medical price inflation (PHC)
- Public spending growth (PHC, real per capita)

We discuss each of these model variables in turn below.

iii. Disposable personal income (DPI)

For the purpose of this model, income is defined as real per capita DPI excluding Medicaid and Medicare payments.¹⁹ The exclusion of Medicaid and Medicare spending reflects the fact that these programs are effectively “in-kind” income (income paid in the form of health care benefits) that accrues to those individuals with public coverage. Since we are attempting to approximate income growth primarily for those with private coverage, we exclude this income from our measure. Additionally, because we focus solely on time-series data for the United States, we cannot control for interaction effects between growth rates in health care spending across time periods (which are largely due to technological changes)—an adjustment that is commonly performed for estimates that have both a cross-sectional dimension (such as countries) and a time-series dimension. As a result, our estimated income elasticity is likely to capture some effects of changing medical technology over time, in addition to a pure income effect.

As discussed at length earlier in the paper, real per capita DPI is a highly influential variable in our model of private PHC spending. While our estimates are based on time-series data for the United States alone and include spending only by private payers, the importance of this variable is consistent with a large body of literature examining the empirical relationship between national income and health spending. A number of studies based on time-series cross-country data for the Organization of Economic Cooperation and Development (OECD) economies confirm the importance of the link between health spending and income.²⁰ It has been repeatedly shown that variations in real per capita GDP (used as a proxy for income due to data availability) account for a substantial share of variation in health spending across countries and time.

In the NHE Econometric Model, income has a lagged effect on health spending. To capture the timing of these lags, the income term in our model of PHC spending is incorporated as a polynomial-distributed lag estimated over 7 years (from 6 previous years through the current period), and our estimates imply that this effect rises to a peak at a lag of about 2 years. The specification of the model with all variables expressed as log-differences (growth rates) implies that coefficients on model variables can be interpreted as price

¹⁹ The objective is to obtain a measure of income that applies to the population that accounts for private spending on medical care. Thus we exclude spending for Medicare and Medicaid, which are included in DPI but accrue to a population that is primarily publicly insured. Since private spending includes out-of-pocket and PHI spending for Medicare beneficiaries, the correspondence cannot be exact.

²⁰ For a review of this literature, see Chernew, Michael E., and Newhouse, Joseph P. “Health Care Spending Growth.” In *Handbook of Health Economics*, vol. 2 (2012). Eds. Pauly, Mark V., McGuire, Thomas G., and Barros, Pedro P. Amsterdam (NLD). Elsevier, Pages 1-43.

and income elasticities, which are constant over time.

Though fluctuations in growth in aggregate income have some immediate effects on growth in private PHC spending, these initial impacts are usually fairly small. The current-period income elasticity in the NHE Econometric Model is only about 0.2, which means that the change in growth for health spending in response to a change in income growth will be about 20 percent as large. The estimated lagged effect of income for private PHC spending growth peaks at a lag of 2 years. The effective long-term income elasticity of private PHC spending (the sum of estimated coefficients over 7 years) is 1.4. This elasticity implies that health care spending rises substantially faster than income growth in the longer term; a 1-percent increase in income growth will result in a cumulative increase in private PHC spending of 1.4 percentage points. The magnitude of this estimated income elasticity is toward the upper end of estimates for macro-level elasticities of approximately 0.8 to 1.6 in the empirical literature.²¹ This relatively higher elasticity reflects characteristics of our model specification that differ from several other published estimates.

The long lags that are built into this model reflect several important characteristics of markets for health services. In particular, since private insurers or public payers account for the large majority of health expenditures, this spending is largely insulated from contemporaneous changes in household income. Furthermore, consumers generally do not pay for most medical expenses directly at the point of purchase. For the most part, the decisions of insured patients are not immediately affected by changes in income except in those cases in which substantial parts of the expenditure are paid for out-of-pocket. However, some immediate effects can be expected in response to cost sharing requirements in PHI plans or the loss of employment with the associated loss of employer-sponsored health insurance. As mentioned previously, the response to the economic recession in 2007-2009 appears to have been unusually large because of the concurrent substantial decline in employment that resulted in large losses of employer-sponsored coverage.

Out-of-pocket costs vary quite a bit across sectors and over time. A higher share of services paid for on an out-of-pocket basis can be expected to shorten the lag structure of the income effect. This anticipated outcome implies that rising deductibles and other forms of cost sharing relative to household incomes might be expected to gradually increase the sensitivity of consumer demand to current fluctuations in income and relative medical prices. Trends in out-of-pocket spending also depend on the level of data aggregation. Overall out-of-pocket spending for health care has grown modestly relative to disposable personal income, according to recent data. In addition, out-of-pocket spending continues to grow at a pace slightly below that observed for private health insurance spending at the national level, resulting in a diminishing out-of-pocket share of spending over time. Consequently, most of the aggregate impact on health spending occurs through the changes in the structure of health insurance coverage and the public regulatory environment that constrains this coverage. However, because this share reflects an average across all households, the experience for subpopulations within this average will be quite different, especially given the proliferation of high-deductible health plans and increases in cost-sharing implemented over the last several years.²²

The other critical element captured by the lag in the impact of income growth on private PHC spending is the role of multiple intermediaries between consumers and medical providers. These intermediaries consist

²¹ Chernew, Michael E., and Newhouse, Joseph P. "Health Care Spending Growth." In *Handbook of Health Economics*, vol.2. (2011). Eds. Pauly, Mark V., McGuire, Thomas G., and Barros, Pedro P. Amsterdam (NLD). Elsevier. Pages 19-20.

²² Henry J. Kaiser Family Foundation, Health Research and Educational Trust. *2016 Employer Health Benefits Survey* [Internet]. Menlo Park (CA): KFF; 2016 September 14. Available at <http://kff.org/health-costs/report/2016-employer-health-benefits-survey/>.

of employers or unions, who negotiate on behalf of pools of employees, and governments at the Federal and state level, which determine the nature of coverage and methods of payment for Medicare and Medicaid, as well as the regulations that constrain private employers and insurers. The intermediaries' determinations may result in changes in coverage and methods of payment, which can then affect providers' decisions on behalf of individual patients. Many such decisions are determined contractually or by regulations. Consequently, substantial delays may be required to implement any response to changes in underlying consumer preferences, both to negotiate any changes to contracts and regulations, and to implement such changes in a way that would influence choices of medical treatment in practice. In addition, in response to any modifications in the design of their health plans, employees may take time to respond to changes in incentives under the conditions of insurance coverage by gradually changing their patterns of health care consumption over time. Further, doctors and other medical providers may also respond gradually to changes put in place by payers. In the long run, responses could include altering treatment protocols in response to the incentives inherent in methods of payment for care and in response to constraints on coverage imposed by insurers. Because of these interactions among intermediaries, consumers, and providers, it is reasonable to expect that the response of the system to changes in income growth will extend over a period of years.

iv. Lagged health share of Gross Domestic Product (GDP)

Though our models are expressed in terms of relative growth rates, short-term growth in private PHC spending is not independent of underlying relationships in spending levels. In particular, the relationship between current growth in private PHC spending and aggregate growth in DPI can be expected to change as health spending accounts for a rising share of consumption. As the aggregate health share of consumption increases, demand will tend to become more responsive to rising relative medical prices. The income elasticity of demand for health care must ultimately decline towards a value of one over the long run, where health spending grows at the same pace as income. As this adjustment in consumer preferences occurs, the rate of increase in the share of income allocated to health care can be expected to slow down compared to other goods and services. Given the dominant role of insurance as a direct payer for health care, we can expect this effect to influence growth at the aggregate level for the pool of health consumers covered by insurance.

The model specification includes a variable intended to explicitly capture the impact of the rising health share of consumption on health care spending growth. This variable is defined as the lagged ratio of total PHC spending to GDP. Its estimated impact is negative and significant, but fairly small in magnitude compared with the year-to-year variation in real per capita private PHC spending. Despite the small magnitude of its effect, the ratio is important to include in the model specification, because it ideally controls for structural changes in the long-term relationship between health spending growth and the other variables included in the model specification.

In defining this variable, we use aggregate spending on medical care by all payers (not solely private payers), and we use GDP rather than income or consumption for this measure. This definition reflects the theoretical basis for the effect.²³ Like any other form of consumption, health spending is fundamentally subject to a budget constraint, but in cases in which insurance coverage severs the connection between individual decision-making and individual income, the budget constraint for health spending is binding at

²³ Getzen, Thomas E. "Health Care Is an Individual Necessity and a National Luxury: Applying Multilevel Decision Models to the Analysis of Health Care Expenditures." *Journal of Health Economics*, 19, no. 2 (2000): 259-270.

the level of the insurance pool.

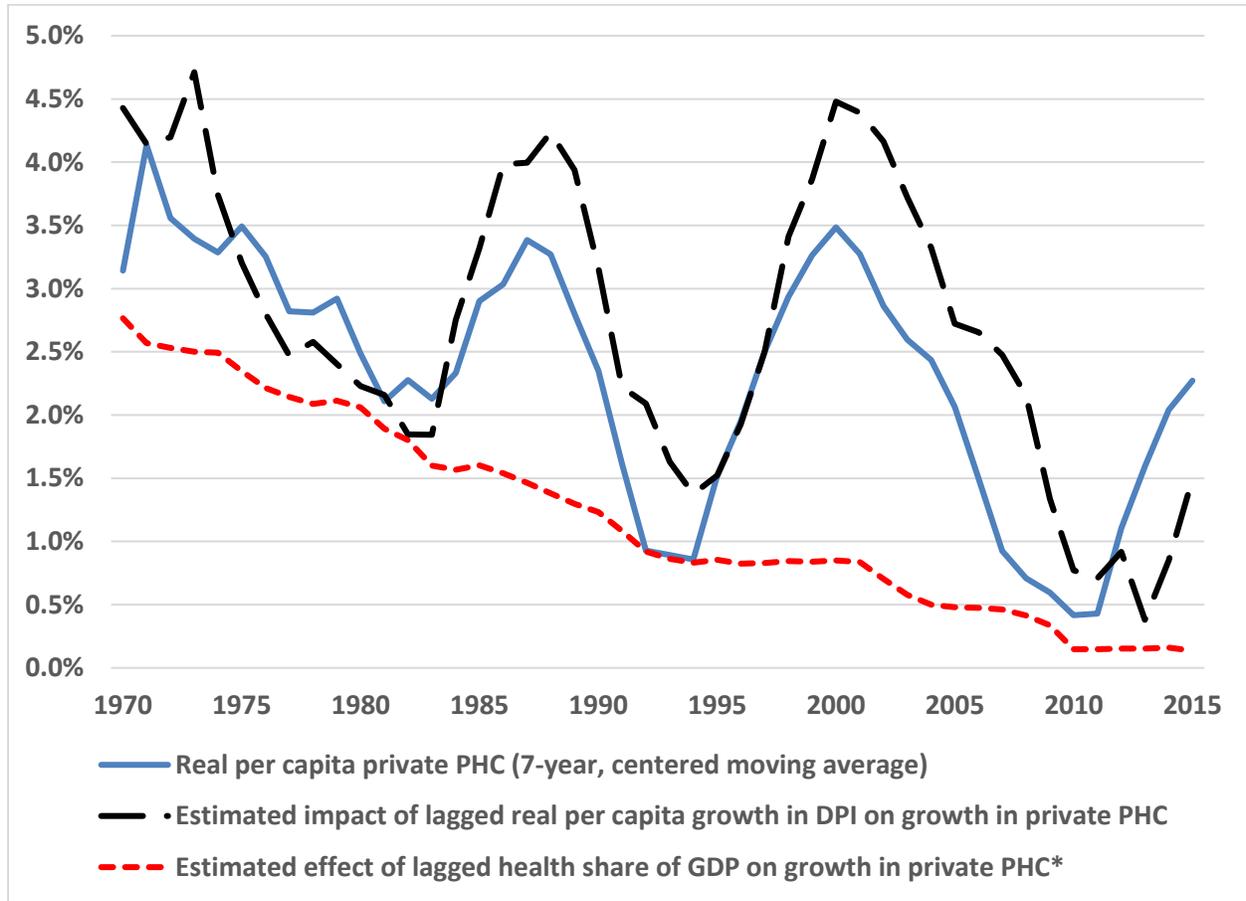
The binding budget constraint that is applicable is defined at the level of a population pool that is relevant for those decision-making processes influencing the delivery of health care within our current system.²⁴ Decisions with systemic implications for the delivery of medical care are made by both private and public insurers. Medicare and Medicaid policies influence private insurers, particularly through the structure of payment rates for medical providers. Thus the appropriate definition of the pool that is relevant to the definition of a binding budget constraint is national in scope. We use GDP (rather than DPI) because, for the domestic economy as a whole, GDP is a measure of the total value of output of the economy. It therefore dictates the budget for aggregate national health spending, which is the ultimate long-term constraint on health spending growth.²⁵ While we can expect consumers to form short-term preferences on health versus non-health consumption based on short-term fluctuations in their own income, the long-term budget constraint on payment for health care (for both public and private payers) cannot exceed growth in GDP.

Chart 2 below expands on the discussion of cycles presented in chart 1, showing growth in real per capita private PHC along with the estimated effect of growth in real per capita DPI and the estimated negative impact on real per capita private PHC growth of the lagged, rising health share of GDP. Note that the negative effect of the rising health share tends to vary in response to recent experience; a period of slower health spending growth tends to relieve some pressure from the system. As the trend in the health share of GDP flattens, this reduces the negative effect on current-period private spending growth attributable to the national budget constraint.

²⁴ Ibid.

²⁵ Ibid.

Chart 2: Real per capita growth in private PHC spending with estimated effects of the health share of GDP



*Values shown were re-scaled by the model's constant term for illustration purposes. The rescaling was calculated by subtracting the value of the estimated constant in the model from the annual value of the estimated impact of the lagged health share of GDP.

v. *Relative medical price inflation*

Economic theory predicts that consumers adjust their spending on different goods and services in response to variations in the relative price of these alternatives. However, the existence of third-party payers for medical care complicates the response to price variation. Consumers bear only a fraction of the actual price of medical services at the time of purchase. Thus, in short-term consumption decisions, they respond to the marginal out-of-pocket price rather than to the actual price, which is generally determined by a combination of deductibles, cost-sharing requirements, and out-of-pocket maximums.²⁶

However, the effects of out-of-pocket prices on consumer choices are only one potential avenue for price effects in health care markets. Medical prices also influence demand for care in two other ways. First, the price of health insurance is effectively the price of the bundle of medical goods and services an enrollee is expected to consume (plus administrative costs and profits); consumers' decisions to purchase private health insurance and the generosity of the coverage selected, are therefore influenced by the relative price of medical care. Second, the relative price of care affects demand for services through the price sensitivity to health insurers' coverage, through provider selection decisions, and in some cases through the design of cost-sharing requirements (as with tiered copays).

Within our model, relative medical price inflation has a significant negative coefficient, as we would expect. The price elasticity of demand for private PHC in our model is -0.4 , which is above micro-level estimates of price elasticity of demand for medical care (-0.1 to -0.2 based on the Rand Health Insurance Experiment).²⁷ This difference reflects the use of individual-level data in micro-based studies to analyze the relationship between an individual's out-of-pocket spending and effective prices paid for services (accounting for coinsurance rates), compared to our use of macro-level national health spending data and price indexes from the Bureau of Labor Statistics. The difference also reflects the relatively short time frame used in micro-level studies compared to our analysis, which spans more than five decades.

Medical price inflation is an endogenous variable in our model (that is, it is determined within the NHE Econometric Model). The dependent variable is OACT's price deflator for PHC spending, which is estimated as a function of input price inflation for medical goods and services and the out-of-pocket share of private health spending.²⁸

Our measure of input price inflation is based on the expenses of health providers as estimated in input price indexes by type of medical providers. The effect of each component of provider costs is represented by a proxy series that is selected to track the input prices of each individual service and commodity. Due to data limitations, this input price index has historically omitted compensation for self-employed workers (a substantial fraction of whom are physicians). Accordingly, true input price inflation will be under- or overstated depending on the growth differential between compensation for employed workers and that for

²⁶ The price to consumers can be roughly approximated by the fraction of total costs paid out-of-pocket multiplied by the actual price. This approximation is flawed; for decision-making purposes, the important question is the marginal price, which is the amount that the consumer pays for an additional dollar of medical care. Because of the broad use of copayments, deductibles, and out-of-pocket maximums, combined with the fact that the majority of health care consumption is accounted for by high-cost cases, the marginal price paid by consumers is most often zero.

²⁷ Manning, Willard G., *et al.* "Health Insurance and the Demand for Medical Care: Evidence from a Randomized Experiment." *American Economic Review*, 77, no. 3 (1987): 251-277.

²⁸ The input price index used is a weighted average of OACT's input price indexes for hospital services, physician services, home health services, nursing home services, and pharmaceuticals.

self-employed workers. For this reason, in our model we include growth in physician income as a proxy for supervisory and self-employed provider compensation not covered by our input price indexes²⁹—a strategy that substantially improves the fit of the model. The effects of other factors (economy-wide price inflation, productivity growth, and industry profitability) are captured indirectly through their influence on input price inflation.

Physician income is projected based on the assumption that rates of increase in such income will tend to follow a similar trajectory as rates of compensation for alternative occupations over long periods of time. (We use the BLS employment cost index (ECI) as a proxy for income of all professional and technical workers.) We also include real private physician spending as a proxy for approximate change in the volume of services that are reflected in our measure of physician income, in order to approximate a wage measure.

In addition to variables that capture the growth in input prices, the model for relative medical price inflation includes a demand-side variable: the growth in the share of out-of-pocket spending as a share of total private spending. The basis for this inclusion is that the out-of-pocket share influences the price elasticity at the point of purchase. While we would expect to see a portion of this effect reflected in the price coefficient in the model for real per capita medical spending, recent data suggest that providers are reacting to the increasing cost sharing requirements of PHI plans in their price-setting decisions. Medical providers may be restraining rates of price increases in response to consumers' growing price sensitivity, which is attributable to the increasing prevalence of insurance coverage that includes substantial deductibles and other cost-sharing requirements. Growth in the out-of-pocket share of spending thus acts as a constraint on the ability of providers to charge higher prices to consumers for services. Based on the estimated contribution from this variable, the relatively faster growth in out-of-pocket costs from 2008 through 2015 has played a role in restraining growth in medical price inflation.

²⁹ We estimated a historical physician income series index through 2014. Data from the Internal Revenue Service (IRS) Statistics of Income (SOI), the Bureau of Labor Statistics (BLS), and the Medical Group Management Association (MGMA) constitute the source data for this index. The growth in this estimated index tracks the growth in historical physician income from other sources fairly closely.

vi. Real per capita public PHC spending

The use of the total population (rather than private health insurance enrollment) as the denominator for real per capita private PHC spending implies that the relationship relative to real per capita public PHC spending will be negative. This negative coefficient primarily captures the effects on private spending of shifts in the insured population between public and private forms of coverage. However, in addition to the effects of shifts in enrollment, the negative coefficient on public spending can be expected to capture the impacts on private PHC spending growth of any cost-shifting (private to public, or public to private) that may occur.³⁰

b. Non-PHC health care spending

For non-PHC health care spending, models are estimated for each of the four categories: (1) government administration and the net cost of private health insurance (PHI), (2) non-commercial research, (3) government public health, and (4) structures and equipment.

i. Government administration and the net cost of PHI

Administrative costs include government administrative costs and the net cost of PHI. These two categories are projected separately. Government administration spending is projected based on available budgetary information, with trend-based econometric models for the remaining categories.

The net cost of PHI is a category of spending that is composed of two parts: the costs associated with administering PHI and the profit margins that accrue to private health insurers. Net costs for all private coverage are included, both for employer-sponsored-insurance (ESI) and for Individual policies. Since the major coverage expansions under the ACA, Individual coverage is comprised of Marketplace coverage, and a declining share of coverage that is purchased on an individual basis apart from the Marketplace.

Since administrative costs tend to be fairly stable, most of the time-series variation in this category is attributable to profit margins, which have historically tended to move in cyclical patterns. (This phenomenon is known as the underwriting cycle.) The importance of this cyclical pattern has diminished greatly in recent years as information technology has improved the ability of insurers to track medical claims in real time and as the consolidation of the industry has reduced variation in premiums due to insurers' entry into and exit from markets. As a result of the passage of the ACA and the establishment of the minimum loss ratio requirements, the amplitude of this cycle is ultimately anticipated to diminish further over the projection period. Thus, in the long run, profit margins are expected to stabilize, varying relatively

³⁰ The choice of denominator reflects consistency issues in the underlying enrollment data for PHI, as well as cyclical fluctuations in the demographic mix of those individuals with public versus private coverage. While it would be conceptually preferable to estimate a model based on growth in spending per enrollee, there are serious flaws in the available data for this purpose. Data for private enrollment are defined to comprise all persons with private coverage, including Medicare beneficiaries with private supplementary coverage, so that there is substantial portion of PHI enrollees that also have Medicare coverage. Since private spending reflects only the supplementary share of spending for these Medicare beneficiaries, PHI per enrollee trends tend to become distorted. In addition, the history for PHI enrollment stems from multiple sources. Data prior to 1987 are subject to inconsistencies over time due to variations in survey questions. Another issue concerns the effect of linked fluctuations in Medicaid and PHI enrollment over the business cycle. Slower economic growth can lead to an influx of a population (for example, children and non-disabled adults) that is relatively low-cost compared to the existing Medicaid population (which is weighted relatively heavily towards the institutionalized). This shift distorts per enrollee growth for both private spending and Medicaid.

little. However, for the first two to three years of the projection, we do expect to see some variation in net costs of PHI. This variation is expected to be largely concentrated in the relatively small market for Individual coverage, as the changes in insurance markets associated with the ACA play out and private insurers adjust premiums to reflect realized claims experience with a changing enrollment pool.

Expectations for growth in the net cost of PHI for the near term of the projection period are primarily based on exogenous data rather than econometric models. Such data include estimated net costs of individual policies purchased through the ACA Marketplace. Near-term projections also reflect recent and expected industry profitability for the top five private health insurers. Beyond the first two years of the projection, it is assumed that the ratio of net costs of PHI to PHC spending will converge to a constant over the balance of the projection period that is based on the mean net cost ratio over the most recent ten years of data.

ii. Non-commercial research

Non-commercial research spending growth is projected based on relationships to economic growth as represented by a 4-year lagged moving average of growth in real per capita GDP. Specific adjustments are made in cases in which Federal budgetary information is available.

iii. Government public health

Government public health spending growth is extrapolated based on historical trends, with specific adjustments made in cases in which budgetary information is available.

iv. Structures and equipment

Spending on health system structures is dominated by hospital construction and is therefore projected as a function of growth in hospital spending. Any additional information that becomes available (such as surveys of hospital construction) is incorporated via adjustments into the projection. Equipment purchases are projected as a function of spending on health system structures to capture concurrent equipment spending that occurs with medical real estate investments and as a function of relative prices of new equipment purchases compared with other health care prices.

c. Submodels for sectors, sources of funds, and sponsors of payment

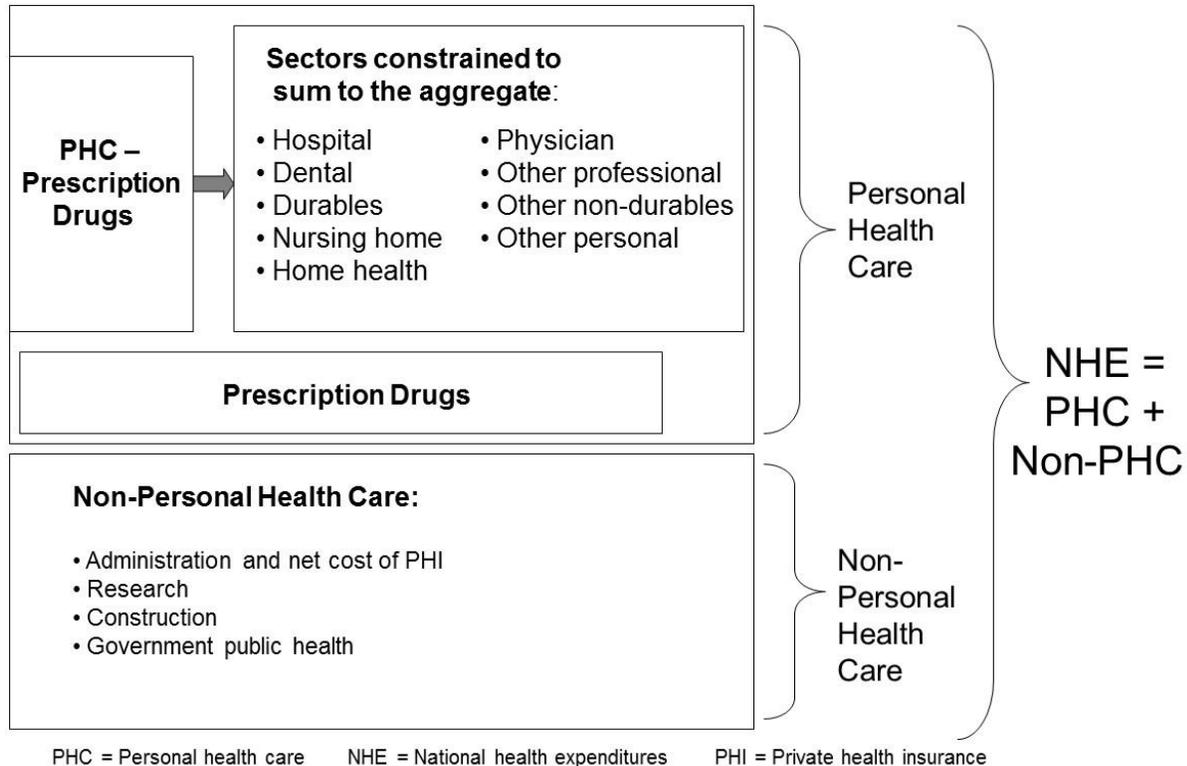
Spending projections are estimated for three underlying subcategories of health care spending:

- Type of service (sector)
- Source of funds (direct payer)
- Sponsor of payment (ultimate payer)

i. Models for health care spending by type of service

Models for real per capita private spending growth and price inflation for individual types of medical services are similar in specification to the aggregate model. Spending projections generated for each of the types of services are then constrained for consistency with the aggregate spending projection. Our choice of this model structure reflects our finding that the model is substantially more robust at the aggregate level due to the impact of event-driven shifts in the provision of medical care across sectors (e.g. hospital inpatient), the growth effects of which cannot be accurately captured at the level of individual types) of service (as discussed earlier in the paper).

Composition of NHE Projection Model by Sector



For the most part, key variables in the sector models follow the specification of the aggregate model for PHC spending growth. Major variables in the sector models include the following:

- Disposable personal income (excluding Medicare and Medicaid, real per capita)
- Relative medical price inflation
- Public spending growth (real per capita)

The parallel structure of the sectors within PHC allows income and price elasticities, and sensitivity to variation in public spending growth, to vary relative to the aggregate, with the constraint that the sum across all sectors must be equal to the projection generated by the aggregate model. Dissimilarities across the models for different types of services include varying lag structures for the income effect, the relative importance of the three variables, and the inclusion of dummy variables to capture phenomena specific to the sector. In a few cases in which relevant data are available, additional independent variables are included that are specific to the individual sector.

For each type of service, the lag on the income term in the models generally tends to vary with the share of spending that is accounted for by consumers' out-of-pocket expenses; that is, the greater the out-of-pocket share, the shorter the lag, as consumers respond more quickly to changes in their income.

The table below summarizes the independent variables used to model real per capita spending growth for each of the PHC sectors. We have provided additional descriptive information about the models for those

sectors that represent the greatest shares of health spending.

SECTOR	DEPENDENT VARIABLE	INDEPENDENT VARIABLES
Hospital services	Real private hospital services per capita	Real disposable personal income (PDL, 7 years) (+) Relative price (-) Real per capita public spending growth (-) Dummy, 1984-2015 (-) Dummy, 1984-2015 * time trend (+) Time trend (-)
Physician and Clinical services	Real private physician services per capita	Real disposable personal income (Moving Average of lags, 4 years) (+) Real per capita public spending growth (-) Relative price (-) Dummy, 1983-85 (+) Dummy, 2007-2010 (-) Dummy, 1960-92*time trend (+)
Prescription Drugs	Real aggregate drug spending per capita*	Real disposable personal income (3-year moving average) (+) Relative drug price * Share paid out-of-pocket (3-year moving average) (-) New drug introductions (-) Generic dispensing rate (-)
Dental services	Real private dental services per capita	Real disposable personal income (PDL, 3 years) (+) Relative price (-) Real per capita Medicaid and CHIP spending growth (3-year moving average) (+) Dummy, 1981 (+) Dummy, 1960-1992 (+)
Nursing Care Facilities and Continuing Care Retirement Communities	Real private nursing home services per capita	Real disposable personal income (PDL, 3 years) (+) Real per capita public spending (-) Relative price (-) Dummy, 1990 (+) Dummy, 1995 (+) Autoregressive term (+) Moving-average term (-)
Other Professional services	Real private other professional services per capita	Real disposable personal income (+) Real per capita public spending growth (-) Dummy, 1992-2015(-) Dummy, 1992-2015*Real disposable personal income (-) Dummy, 1992-2015*Real per capita public spending growth (+) Autoregressive term (-)
Over-the-Counter Drugs and Other Nondurables	Real private other nondurables spending per capita	Real disposable personal income (2-year moving average) (+) Relative price (-) Lagged dependent variable (+)
Durables	Real private durables spending per capita	Real disposable personal income (PDL, 2 years) (+) Relative price (-) Public spending growth (-)
Home Health services	Real private home health services per capita	Real disposable personal income (PDL, 2 years) (-) Dummy, 1999-2015* Real per capita Medicaid spending growth (-) Real per capita Medicare spending growth (+)

*The prescription drug model is based on aggregate expenditures rather than private expenditures, due to complications in projecting shifts in payments associated with the introduction of Medicare Part D prescription drug coverage. See the Prescription Drug section below.

ii. Sector model: hospital services

Real per capita growth in private hospital spending is well explained by the variables in our template model specification. Because hospital services represent the largest share of personal health care spending among the services, we would expect to find a similar relationship between household income and hospital services spending as we observed between household income and overall personal health care spending. In addition, given the low out-of-pocket share, on average, for hospital services (our model captures both inpatient and outpatient settings), we anticipate a longer lag between a change in household income and the time of impact on hospital spending. Our results are consistent with these expectations; we estimate coefficients on lagged income growth with a polynomial distributed lag estimated for the current period and 7 previous years, one year longer than the lag structure for disposable personal income in the aggregate model for private personal health care spending. Additionally, the peak effect of income fluctuations occurs with a lag of 3 to 4 years, slightly longer than the aggregate model. As expected, public real per capita spending has a negative coefficient, capturing shifts in enrollment between private and public coverage as well as any possible short-term cost-shifting effects between private and public payers.

For this sector, the combined effects of managed care expansion and the introduction of the Medicare prospective payment system (PPS) are represented in the current model as a structural change in the relationship of growth to price and income that is largely one-time in nature, beginning in 1984 after the PPS was introduced. The alterations in provider incentives associated with the PPS, coupled with similar pressures from the expansion of managed care in the late 1980s through the 1990s, produced an initial reduction in growth that gradually tapers off. This tapering of the impact of PPS and managed care reflects the diminishing potential for reduced inpatient utilization over time as it becomes more difficult to find additional efficiencies at the margin.

iii. Sector model: physician and clinical services

In the physician model, the estimated effect of the lag of disposable personal income (DPI) extends 4 years. The coefficient of relative price inflation is negative, as expected. Growth in real per capita public spending on physician services has a smaller estimated negative effect than the magnitude estimated in the aggregate model.

In general, our template specification fits real per capita growth in physician spending somewhat less well than it accommodates hospital spending. This reduction in model fit primarily reflects three distinctive periods of growth—1983-1985, 1960-1992, and 2007-2010—that are not well predicted by the model. To capture the period of rapid growth from 1983 through 1985, we have included a dummy variable for these years. Our interpretation of this variable is that it captures a non-recurring substitution effect of professional services for inpatient care. The 1983-1985 period saw a major shift in provider incentives associated with the introduction of the Medicare PPS and the initial surge in managed care enrollments (as described earlier).

Despite substantial volatility, real per capita growth rates exhibit a slight upward trend during the second period, from 1960 through 1992. We have included a trend variable for these years to capture this effect. We interpret this variable as capturing the period of faster growth prior to the dampening effects of constraints from managed care organizations on use and intensity of care for privately insured individuals enrolled in these organizations. Even as the effects of these more stringent utilization constraints diminished in the late 1990s, real per capita growth after 1992 rarely peaked above 3 percent (compared to the period from the 1970s through 1992, when growth was above 4 percent for more than half the years). The result

of the inclusion of this variable is that the effects of the rapid growth prior to 1992 are removed from the other estimated coefficients, thereby moderating projected growth after 1992 in a manner that is more consistent with the history.

We have also included a dummy variable for 2007-2010, over which predicted growth is otherwise overstated. Our interpretation of this variable is that it captures effects from two key factors. The first factor is the rapid growth of high-deductible plans,³¹ the design of which disproportionately depresses physician office and clinic visits related to primary care and preventative services compared to acute care services.³² The high rates of uninsured individuals over 2008-2010 also had a disproportionate effect on the use of preventative care and recommended screenings, as the uninsured were less likely to receive such care compared to other types of health care services.³³ The inclusion of this dummy variable for 2007-2010 allows for a pattern of projected growth for physician services that returns to the trend of maintaining a physician and clinical services share of PHC expenditures that is somewhat stable.

iv. Sector model: prescription drugs

Prescription drugs differ in important ways from other types of medical care. First, since prescription drugs are a product, not a service, the cost structure of the industry differs substantially from that of other sectors (such as hospital, physician, or nursing home), for which labor costs play a critical role in driving price. In contrast, the cost structure of production for prescription drugs is highly capital-intensive, with relatively low marginal costs and a relatively larger role for the introduction of new products. Second, prescription drug spending has had a much larger consumer out-of-pocket share than other types of medical care, so that demand tends to be more sensitive to price. Third, we have access to additional information on supply and demand factors for this sector, in the form of data on new drug introductions, generic dispensing rates, research spending, patent expirations, and direct-to-consumer (DTC) advertising. As a result, our model for prescription drugs is somewhat different from the models developed for other sectors.

As opposed to the other health sectors, the dependent variable in the prescription drug model is real aggregate per capita drug spending (not private only). This decision was made because the start of Medicare drug coverage in 2006 produced a massive shift in the source of payments for drugs, which resulted in a sharp decrease in private drug spending growth in 2006, though it had little estimated effect on overall growth in drug spending. Accordingly, our model projects total prescription drug spending without simulating an explicit effect for Part D. The income variable within the prescription drug model fits with a shorter lag than in our aggregate model; this is the expected result based on the larger share paid on an out-of-pocket basis historically. Relative price inflation has a strong fit. The price variable is defined as the product of the out-of-pocket prescription drug share and the prescription drug price index—a definition that accounts for the trend in consumers' steadily declining out-of-pocket share over the last 20 years. However, available data do not distinguish out-of-pocket spending by the uninsured and by Medicare

³¹ Henry J. Kaiser Family Foundation, Health Research and Educational Trust. *2016 Employer Health Benefits Survey* [Internet]. Menlo Park (CA): KFF; 2016 September 14. Available at <http://kff.org/health-costs/report/2016-employer-health-benefits-survey/>.

³² Fronstin, Paul, *et al.* "Consumer-Directed Health Plans Reduce The Long-Term Use Of Outpatient Physician Visits And Prescription Drugs." *Health Affairs*, 32, no.6 (2013): 1126-1134.

³³ Henry J. Kaiser Family Foundation, Kaiser Commission on Medicaid and the Uninsured. *Key Facts about the Uninsured Population, 2013 Fact Sheet* [Internet]. Menlo Park (CA): KFF; 2013 September 13. Available at <http://kff.org/uninsured/fact-sheet/key-facts-about-the-uninsured-population/>

beneficiaries from the fixed co-payments that are often required within managed care, and thus our ability to capture this declining share is limited. Public spending growth is not included as a variable in this model due to its relatively minor role in the historical period (prior to 2006) and because the dependent variable is overall drug spending and not private drug spending.

Patterns of growth over the most recent 15 to 20 years of data are difficult to explain, as the effects of several different factors must be disentangled. The out-of-pocket share of spending by consumers dropped sharply as privately insured patients moved into managed care plans that generally have lower co-payments. (For the most part, this phenomenon did not apply to Medicare beneficiaries, who continued to pay a relatively large share of drug costs out-of-pocket.) Also, changes to regulations in 1997 eliminated some of the earlier restrictions on television advertising for prescription drugs. In addition to income and relative price terms, our model for real per capita drug spending includes a 4-year moving average of the number of new prescription drugs introduced, as well as the rising generic dispensing rate, which has played an increasing role in depressing growth in prescription drug spending in recent years. In 2014, drug spending growth spiked up partly as a result of the use of new, expensive specialty drugs that were curative treatments for Hepatitis C (growth also increased because of the first year of the ACA major coverage expansion). However, in 2016, the growth rate of prescription drug spending is projected to have decelerated significantly and one major factor is the decline in the use of these expensive Hepatitis C drugs.

v. Models for health care spending by source of funds (direct payer)

Our core econometric models project direct payments (spending) by all private sector payers. This total spending for all private payers can be disaggregated based on the type of payer at a more detailed level. The major types of private payers are private health insurers (PHI), direct payment by consumers on an out-of-pocket basis (OOP), and all other private payments.³⁴ In contrast to our method for modeling total private spending for each of the sectors within PHC relative to aggregate PHC, our model for health care spending by private payer is “bottom-up” in nature; in other words, the private payer trends are projected at the level of individual sectors (hospital, physician, drugs, etc.). Projections for relative growth in PHI, OOP, and all other private spending for each individual sector are then added up and used to generate the projections for the shares of total private spending for the detailed private payer categories at the aggregate level. This process requires an adjustment procedure to maintain aggregate identities (as explained below).

For each sector and its corresponding private payers, we first develop distinct payer projections, which are then used to determine the aggregate payer trends for PHC. This method reflects the fact that the nature of patient cost sharing differs greatly depending on the setting in which services are provided and the type of service. Regarding some important sector-specific issues, we have additional information (anecdotal or otherwise) that is useful in projecting probable trends. For these payers, aggregation can be expected to obscure trends that apply to specific types of services. Prescription drugs, physician services, nursing home care, and dental services account for about three-fifths of OOP spending. Each of these sectors is influenced by a different mix of factors. As has been discussed throughout the paper, shifts in the composition of PHC

³⁴ The most widely recognized source of other private funds is philanthropy. Philanthropic support may be obtained directly from individuals, through philanthropic fund-raising organizations, or from foundations or corporations. Philanthropic revenues may be spent directly for patient care or may be held in an endowment fund to produce income to cover current expenses. For institutions such as hospitals and nursing homes, other private funds also include income from the operation of gift shops, cafeterias, parking lots, and educational programs, as well as investment income.

spending across sectors have important effects on aggregate trends.

Though private payers are modeled in a bottom-up fashion, they are adjusted for consistency between the sector-level and aggregate-level projections across two dimensions. First, the sum of spending for all private sources of funds by sector must equal total private spending for all sources of funding. Second, spending for PHI across all types of services must equal the aggregate spending for PHI. To make these consistency adjustments, we use iterative proportional fitting.³⁵

In addition to private sources of funds, we also project public sources of funds other than Medicare and Medicaid.³⁶ These other sources account for approximately 25 percent of total public spending. The largest of these payers are the Department of Veterans Affairs (VA) and the Department of Defense (DoD), and the methodology we use for these programs is discussed below. Residual Federal and other state and local spending for smaller government programs is projected based on econometric models similar to those used to project real per capita private spending.

vi. Spending projections for Department of Defense (DOD) and Department of Veterans Affairs (VA) health insurance programs

The NHE projection model includes the separate econometric type of service equations for both the VA and DOD health care systems. Projections based on these models are then adjusted using data from published Federal budget requests for the upcoming fiscal year and data projections of the veteran population from the current VA Office of the Actuary “VetPop” Model.

Expenditures for both the VA and DOD are driven mainly by fiscal policy, demographics, and economic conditions and, to a lesser extent, by overseas military operations. VA spending is expected to exhibit countercyclical elements, as eligibility is determined in part by income and the presence of other insurance coverage along with a myriad of other factors. Consistent with VA actuarial projections, it is expected that the number of veterans and active duty military personnel will decrease over the forecast period.³⁷

vii. Models for spending by sponsor of payment

Sponsor of payment categories define what group holds the ultimate responsibility for financing or supplying the funds needed to support health care spending by direct payers. Thus, our focus is on the

³⁵ According to Terry P. Speed, “Iterative proportional fitting, also known as iterative proportional scaling, is an algorithm for constructing tables of numbers satisfying certain constraints.” “Iterative Proportional Fitting.” In *Encyclopedia of Biostatistics* (2005). Available at <http://mrw.interscience.wiley.com/emrw/9780470011812/eob/article/b2a10027/current/abstract>.

³⁶ Specifically, we model the Department of Defense and Department of Veterans' Affairs portion of spending within spending classified as “Other Health Insurance Programs.” We also model spending trends for worksite health care, Indian Health Service, workers' compensation, general assistance, maternal and child health, vocational rehabilitation, other federal programs, Substance Abuse and Mental Health Services Administration, other state and local programs, and school health, all of which are included within “Other Third Party Payers.” For further details on specific programs included in “Other Health Insurance Programs” or “Other Third Party Payers,” please see the accounting identities for these categories in our NHEA methodology paper, available at <http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Downloads/dsm-15.pdf>.

³⁷ National Center for Veteran Statistics. *The Veteran Population Model 2014*. Available at http://www.va.gov/vetdata/veteran_population.asp

relative spending for governments, households, and businesses that support payment for insurance coverage. For example, NHE spending by payer for PHI contains premiums paid to insurance companies financed through multiple sources, including contributions from employers (both public and private) and households and from governments through premium subsidies. Similarly, financing for Medicare consists of dedicated tax revenue from employers and employees, premium and interest income, and intergovernmental transfers.³⁸

We project premiums for PHI plans, including its underlying components, employer-sponsored insurance (ESI) and other private health insurance for households and employers by types of insurance (group and individual) and sector of employment (public or private). Though PHI consists of ESI, Medicare supplemental insurance, and individually purchased plans, ESI premiums comprise the majority of PHI premiums (nearly 90 percent in 2015); consequently, the factors described previously that influence the PHI share of our aggregate projection of private PHC spending, combined with growth in the net cost of PHI, explain nearly all the variation in ESI premium growth.

Because premiums for Medicare supplemental insurance and other individually purchased plans grow differently than ESI premiums, we remove each type of spending from total PHI and project them separately. Our projections of per enrollee Medicare supplemental premium growth incorporate assumptions from the Medicare Trustees Report regarding beneficiary trends in benefits and cost-sharing. In addition to these assumptions of projected spending for Medicare beneficiaries, we also incorporate historical Medicare supplement insurance premium data from the National Association of Insurance Commissioners (NAIC) to develop projections of Medicare supplemental insurance spending.³⁹ For other individually purchased plans, we use their historical relationship with overall PHI to develop a projection of spending per enrollee. We then multiply projected enrollment in both Medicare supplemental plans and other individually purchased plans by their respective per enrollee premium projection to obtain an overall premium projection. (See further details on enrollment below.)

To maintain consistency within total expenditures across sponsor and payer estimates, we again utilize iterative proportional fitting to adjust the matrix of spending for each cell relative to totals. For example, projections of components of PHI premiums, described above, for households and employers by types of insurance (group and individual) and sector of employment (public or private) must be adjusted to sum to total PHI spending. Additionally, we project payments by employers to state and local governments for workers' compensation and temporary disability insurance econometrically using macroeconomic trends. Conversely, a number of categories of spending are exogenous projections, based on the financing assumptions for both Medicare and Medicaid contained in the 2016 Medicare Trustees Report. These categories include the following:

³⁸ Classification of spending by sponsor in the NHE projections is consistent with overall NHEA classification. A detailed description of how spending by source of funding maps to sponsor categories and associated sponsor accounting identities can be found in our NHEA methodology paper, available at <http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Downloads/dsm-15.pdf>.

³⁹ National Association of Insurance Commissioners (NAIC). Medicare Supplemental Insurance Experience Exhibit. 2015

- Worker contributions to Hospital Insurance trust fund and taxation of benefits
- Employer contributions to Hospital Insurance trust fund
- Supplemental Medical Insurance Part B and Part D premium revenues
- Medicaid buy-ins for Medicare premiums
- State Medicaid phase-down payments

d. Private health insurance enrollment and uninsured population models

In projections of private health insurance (PHI) enrollment, we take trends in Medicaid, Medicare, and CHIP enrollment as exogenous inputs. Current projections of enrollment for these programs are based on the 2016 Medicare Trustees Report and the 2016 Medicaid Actuarial Report. PHI enrollment consists of three components, which are (1) Employer-sponsored insurance, (2) Individually purchased insurance (non-Medigap), and (3) Individually purchased insurance (Medigap).

i. Employer-sponsored insurance

Employer-sponsored insurance (ESI) enrollment is obtained through the employment relationship and is therefore modeled as a ratio of ESI coverage to total employment. Growth in ESI enrollment may differ from growth in employment for several reasons. One reason is that not all employees have access to coverage through their employers. The offer rate for coverage and the terms under which it is offered (share of premium paid by employee) change over time. Another reason is that not all employees accept coverage when offered, which can also vary year-to-year. Finally, a number of those enrolled in ESI are not employees, as retirees and dependents of employees may also have coverage. For these groups, rates of coverage are determined by access to family or retiree coverage and the terms on which it is available.

The model of ESI enrollment includes the following independent variables:

- *Moving two-year average of real Gross Domestic Product (GDP) per capita, lagged 1 years (rGDP).* When economic growth as measured by rGDP is stronger, relative growth in employment tends to increase with concurrent increases in ESI enrollment growth.
- *Growth in the ratio of the sum of Medicare supplemental coverage and Medicare Advantage enrollees to overall Medicare coverage.* Growth in the number of Medicare enrollees with supplemental coverage or enrollees covered through Medicare Advantage is partially driven by growth in the number of retirees with supplemental coverage through employer plans. This effect has a negative coefficient, as retirees without access to employer-sponsored supplementary coverage tend to purchase supplemental coverage or enroll in Medicare Advantage.

The inclusion in the model of growth in GDP captures some of the variation in offer and take-up rates, which tend to strengthen in periods of more robust economic growth. The remaining trend in the ratio of ESI enrollment to employment is captured in the negative constant term, which reflects the declining trend in coverage caused by decreasing offer and take-up rates for individual and family coverage. We dampen this decline in coverage over the projection to reflect the estimated effects of employer and individual coverage mandates in the ACA.

ii. Individually purchased insurance (excluding Medicare supplement insurance)

Individually purchased insurance for non-Medicare enrollees comprises coverage purchased both within and outside of the ACA Health Insurance Marketplaces. We model such insurance as a share of total employment (consistent with the method for employer-sponsored insurance), because it acts as a substitute for ESI coverage. It therefore tends to vary counter to the macroeconomic business cycle, fluctuating largely as a function of labor market conditions. Variables in the econometric model for individually purchased insurance (non-Medicare) are as follows:

- ESI share of employment
- Unemployment rate
- Dummy variable to exclude outlier in 2004

Changes to ESI coverage that are attributable to the ACA influence individual coverage through the ESI variable in the model. In addition, we also adjust the projection generated by the model to account for additional effects of the ACA (from factors such as the individual mandate) on individual enrollment.

iii. Individually purchased insurance (Medicare supplemental insurance)

We model Medicare supplemental insurance—that is, private secondary Medigap coverage for Medicare enrollees—as a share of overall Medicare enrollment. Variables in this model consist of the previous period's growth (lagged dependent variable) and an exogenous projection of Medicare Advantage enrollment (consistent with the 2016 Medicare Trustees Report). Medicare Advantage plans act as a substitute for privately purchased Medigap plans.

iv. Uninsured population

Historical data for the uninsured population are based on survey data. We expect growth in this population to be consistent with the growth in the sum of enrollment in insurance across all sources of coverage. In practice, although these growth trends historically are somewhat consistent, due to data limitations they tend to differ modestly from each other. According to recent data, increases in the sum of enrollment across all sources of coverage correspond to a smaller decrease in the uninsured population. This relationship reflects a trend toward a rising share of insured persons with overlapping coverage from more than one source.

We project the uninsured population using the projected growth in the sum of enrollment across all public and private insurance categories together with a projection of the overall population of the U.S. The overlap across enrollment categories is assumed to continue rising gradually at a rate consistent with recent historical data; an increase in enrollment from any insurance source translates to a slightly smaller reduction in the uninsured population.

4) CONCLUDING NOTE

Our projection process is based on accepted econometric and actuarial projection techniques. However, we are constantly reviewing the accuracy of our work and striving to make improvements in the methodology.⁴⁰ Please e-mail DNHS@cms.hhs.gov with any comments, feedback, or suggestions on our NHE projection model.

⁴⁰ Centers for Medicare & Medicaid Services. National Health Expenditure Data: Projected. Available at <https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Downloads/ProjectionAccuracy.pdf>