Are the Rates Right? Benchmark Protection against Escalation SWAG

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INTRODUCTION

Shipyards, aerospace manufacturers, labor unions, contract negotiators, program offices, and defense cost analysts face the difficult task of estimating yearly escalation rates for labor, material, and high-dollar components of indirect costs such as medical, pensions, and workmen's compensation. In the indirect realm, the subject of this research paper, the challenge is especially stiff. As Dr. Ashton Carter, former Secretary of Defense, noted,

> *"… a thorough review of contractor overhead costs is a complex undertaking requiring insight into corporate structures, business assumptions, and subcontractor arrangements … requiring time and a trained … team."*[1]

The stakes are high despite the difficulty. Over the development and production phases of a weapon system acquisition program, a difference of two- or three-percentage points per annum in escalation rates for a major element of indirect cost such as healthcare can translate into billions of dollars. This impact, in turn, can jeopardize a program's affordability and perturb the composition of an otherwise optimized capability portfolio.

Different perspectives on this important issue of escalation complicate the decision calculus.[2] In collective bargaining, for example, a natural tension exists between the interests of union members for generous fringe benefits and a company's constraint of maintaining a competitive cost structure in a highly consolidated industry. One party argues for higher rates and the other for lower. Program Management Offices (PMOs), meanwhile, argue for both.[3] This schizophrenic behavior is driven by current defense policy – requiring full-funding over the FYDP based on what escalation rates *will be* versus what the rates *could be* in should-cost circumstances.[4] Cost analysts supporting the program offices and those generating Independent

[1] "Should Cost Management: Why? How?," Dr. Ashton Carter and Professor John Mueller," Defense AT&L: Better Buying Power, Sep-Oct 2011

[2] USD(AT&L) memo of 13 Aug 2014, "Acquisition Data Management, Availability, and Archiving," underscores the flexibility granted to program offices in using non OSD-prescribed inflation indices. For additional details on this subject see "Inflation and Escalation Best Practices for Cost Analysis: Analyst Handbook," 2017, OSD Cost Assessment and Program Evaluation

[3] PMOs argue for high rates for budget planning purposes then lower rates in negotiations

[4] For details, see Under Secretary of Defense (Acquisition Technology and Logistics) Memorandum "Implementation of Will-Cost and Should-Cost Management," 22 April 2011Implementation of Will-Cost and Should-Cost Management, USD(AT&L), 22 April 2011

Cost Estimates (ICEs) and Independent Cost Assessments (ICAs) likely have a similar perspective, weighing in on both *will* and *should* costs. Finally, Defense Contract Management Agency (DCMA) and Defense Contract Audit Agency (DCAA) focus primarily on the allowability, reasonableness, and allocability of indirect costs, and implicitly annual escalation, per Federal Acquisition Regulation (FAR) and Cost Accounting Standards (CAS).[5]

Escalation timelines differ, too. Collective bargaining agreements are typically three to six years long. Similarly, defense contractors usually prepare operating plans and pro forma income statements for each of their business segments for a three- to five-year period. The plans cover projected sales and profits based on anticipated outyear workload, both domestic and foreign, and cost structure. Actuaries and defense cost analysts, however, face much longer time spans. They're often in the unenviable position of projecting rates up to thirty years out, and sometimes beyond.

This research seeks to illuminate and meld into a holistic whole the two critical elements of the escalation conundrum, measurement and projection:

(1) Escalation Measurement by developing benchmark metrics from a 360-degree perspective, using healthcare as a test case or proxy for major elements of indirect cost. The benchmarks focus on who pays for healthcare: 1) the employee or consumer, 2) the employer or a defense company, 3) the government (i.e., Medicare, Medicaid), or 4) all three. The indices are therefore of interest to all agents in the defense enterprise with an interest in escalation: labor unions, defense firms, DCMA and DCAA, cost analysts, and decision-makers.

(2) Escalation Projections by taking advantage of market data which reflects expectations inferred from the prices and yields of financial instruments actively traded on Wall Street, such as Treasuries and, more recently, inflation derivatives. As economists note, focus sharpens and credibility rises when prices are set by market agents with "skin in the game," such as pension, insurance, and hedge-fund managers, who put their "money where their mouths are."

In both cases the research attempts to guard against "SWAG," defined per the usual acronym and, metaphorically, as the "stuff" (numbers, reports, recommendations, and suggestions) obtained from another party and used as a pass-through in a cost estimate, without supporting data, due diligence, or a sanity-check. A classic and all-to-common example is use in the cost community of a Forward Pricing Rate Proposal (FPRP) from a prime contractor as the best and only projection of their escalation rates.

[5] See Section 31.201 of the FAR for additional details at https://www.acquisition.gov/far/html/FARTOCP31.html

CAPABILITY GAP

The Office of the Under Secretary of Defense, Comptroller, (OUSD(C)), issues inflation guidance annually for use by Department of Defense Components in pricing the President's Budget.[6] The inflation rates, for the Department's investment accounts, are best estimates of future *economy-wide* inflation, as measured by the Gross Domestic Product price index (GDPPI), in its current chain-linked Fisher formulation. The forecasts themselves are received by Comptroller from the Office of Management and Budget (OMB), which, in turn, generates them in conjunction with the President's Council of Economic Advisers and the U.S. Treasury. The three-member council, or Troika,[7] updates their forecasts of inflation and other economic aggregates every fall. Comptroller promulgates the projections along with appropriation outlay profiles, culled from U.S. Treasury data, thus enabling calculations of then-year dollar total obligational authority.

While generally regarded as *most-likely* forecasts in recent years, without the application of Executive-branch wishful thinking, there's no *a priori* reason to believe that the GDP price index, which is heavily weighted by consumption expenditures,[8] is a good measure of defense inflation in the first place. Indeed, a generic market basket of goods and services, dominated by items such as hamburgers, cars, and haircuts, seems an ill-suited measure of changes in the prices of specialized labor, material, software, and tooling needed to design, develop, and build sophisticated weapon systems. Blind acceptance of indices prescribed by OUSD(C) seems a risky leap of faith.

The Department of Defense has allocated scant resources to the daunting task of developing concrete, repeatable, *sampling processes* and *index formulae* which summarize accurately and parsimoniously the changes in prices and quantities of tens if not hundreds of thousands of items bought and sold in the defense sector of the economy every year. Methodological problems abound. They include the need to distinguish changes in labor mix from changes in labor rates, to adjust for increases in productivity, and to account for the introduction of new weapon systems in the defense "market basket."

[6] "Inflation Guidance – Fiscal Year (FY) 2018 President's Budget," 13 March 2017, Office of the Under Secretary of Defense, Comptroller, page 1. At https://www.ncca.navy.mil/tools/FY18_PB_Inflation_Guidance.pdf

[7] The 2017 Economic Report of the President, page 142, Council of Economic Advisers, Washington, D.C., January, 2017. Interestingly, the 2012 Report includes the Department of Commerce, Bureau of Economic Analysis, as supporting the forecast. The latest Report omits them.

Despite these obstacles, several defense organizations nevertheless employ custom-built or unique inflation indices in their commodity areas of responsibility, such as ships, aircraft, and satellites. But the consistency of these indices with local labor-market conditions, their technical quality and accuracy, their statistical properties, and the degree to which self-fulfilling prophecies are at play remain open questions.[9] The magnitude of the *actually-incurred* versus *OSD-prescribed* inflation differential therefore remains somewhat conjectural.

Further, scant attention has been paid to development of unique escalation rates for components of *indirect* costs, or company overhead and G&A (general and administrative). Most of the attention in the cost community for decades has been on direct labor rates and, more recently, material escalation.

Recognizing the gap in capability, the Department of the Navy Escalation IPT and a Program Office in the Naval Sea Systems Command sponsored the research documented here, with the task of developing benchmark escalation rates for healthcare.[10]

The requirement to generate cost estimates over the life cycle in then-year dollars confounds matters greatly, no matter which inflation indices are employed, OUSD(C) or custom-built. The stakes are huge. For example, a sample of commonly-denominated Major Defense Acquisition Programs (MDAPs) currently in development reveals that inflation accounts for 15% of the total cost of the programs, on average.[11] For Joint Strike Fighter alone, $60B is required to fund inflation from the baseline through the end of production, or 17% of total acquisition cost.[12]

Further, deltas in annual inflation rates can generate a large dollar impact ten or twenty years hence, due to compounding. A multiplier for the delta is easily computed as

$$\text{Yearly Multiplier} = (1+x)^n \div (1+y)^n \quad \text{, where} \tag{1}$$

x and y are alternative yearly inflation rates and $n = n^{\text{th}}$ year.

For example, a 100 basis-point delta in rates, from the current OSD projection of 2.0% per annum to a custom-built rate of 3.0% per annum, yields a multiplier of roughly 20% at the end of 20 years. A 200 basis-point delta yields a multiplier of 50%.

[8] 69% of GDP in 2016 was consumption expenditures; Ibid, with raw data on page 566.
[9] For additional details, see "Criteria for Evaluating the Quality and Application of Inflation Indices: Custom Built versus OSD Prescribed," Dr. Brian Flynn, 11 May 2012.
[10] The DON Escalation IPT is headed by Mr. Duncan Thomas, Technical Director, Naval Center for Cost Analysis (NCCA). Rudder guidance on the task was provided by Mr. Jake Mender, NCCA, and by Dr. Phil Koenig and Mr. Jim Rogal, Naval Sea Systems Command (NAVSEA), Cost Engineering and Industrial Analysis Division (SEA-05C).
[11] Selected Acquisition Report Summary Tables, 31 December 2015, OUSD(AT&L), Acquisition Resources Analysis.
[12] Ibid.

METHODOLOGY

Overview

Two interrelated problems were paramount in the research: measuring healthcare escalation accurately, especially from a firm's perspective, and then projecting or forecasting values up to thirty years out.

Escalation Measurement

In developing benchmark values, the study team conducted a thorough literature review to learn more about the sum and substance of healthcare escalation. The team reviewed relevant journal articles; reports from management consulting firms; reports, guidance, and news bulletins from federal-government statistical agencies; and actuarial reports.

Further, the study team sought additional intelligence by contacting subject matter experts in these agencies and organizations: Bureau of Labor Statistics (BLS), Bureau of Economic Analysis (BEA), Defense Contract Management Agency (DCMA), Defense Contract Audit Agency (DCAA), the Naval Sea Systems Command (NAVSEA), National Association of Healthcare Economists, and the Federal Reserve Board.

Based on this background investigation, the team selected indices from various sources that are relevant to the problem of measuring year-to-year escalation in healthcare costs. Each candidate index was analyzed in terms of its content or coverage, and, importantly, its perspective. That is, does the index focus on measuring changes in prices paid by consumers, by firms, by the government (e.g., Medicaid and Medicare), or by all three parties. Pros and cons were listed for each index. Strong emphasis was placed on indices that measure healthcare escalation from the perspective of a defense firm; that is, on what the firm pays to provide healthcare for its employees. This is the cost that companies incur. And it's the cost that becomes an indirect charge to the DoD on defense contracts.

The study team then computed a compound annual growth rate (CAGR) for each of the indices for various time spans: one year, three years, five years, and ten years. Exploratory data analysis provided useful insights on trends – current and secular.

Finally, a best-fit index was chosen for the task at hand – measuring escalation for defense firms.

Escalation Projections

For *whichever* indices are employed in life-cycle cost estimates, the forecasts of their outyear values has been problematic and a major issue in generating realistic S-curves in then-year dollars. First, there's the issue of *point projections* up to thirty years out – a distinct timeline for many acquisition programs. Second, there's the issue of *variance* – or just how stochastic the forecasts are. Simply employing a triangular distribution, with endpoints taken as plus and minus a percentage-point or two from a mean or median point estimate, seems wholly inadequate in capturing uncertainty.

This research takes advantage of the remarkable relationship between overall inflation in the economy and healthcare escalation, as depicted in Figure 1.[13] Trends in healthcare escalation and aggregate inflation both rise in the 1960s and 1970's, peak during the Carter years, and fall thereafter.[14] Interestingly, a pronounced gap of ~ 200 basis points persisted throughout the '80s and early '90s. It began to dissipate in the mid-1990s as "Many employers felt they had little choice but to convert to HMO insurance as the low-cost alternative in the face of rapidly escalating health insurance premiums."[15] HMO enrollment doubled from 40 million to 80 million from 1992 to 1998, and the gap closed. An exception to the linkage was the disconnect during the recent "Great Recession" when macro inflation momentarily turned negative.

Growth rates are currently muted for both indices, due perhaps to economic and policy-induced factors. On the first count, inflation is low in the macro economy. Indeed, healthcare may be helping to drive down overall inflation. Healthcare, after all, is a major component of consumer expenditures and national income, currently accounting for almost 18% of GDP, or roughly $3 trillion (current 2017 dollars) per annum. Secondly, these policy-induced factors may have played a role, too:

- The 2013 budget sequestration resulted in reductions to Medicare spending
- The Affordable Care Act (ACA), colloquially known as Obamacare[16], reduced annual inflation updates to Medicare providers
    - Economists see spillover effects to private insurers, holding down their costs
- One-off payment change to "disproportionate share hospitals"
- Coverage expansion that increased Medicaid enrollment, with lower payments than from private insurers.

[13] The simple correlation coefficient between the two variables is 0.85 over an 85-year period, and 0.89 using three-year moving averages. The Kendall and Spearman non-parametric tests reveal that the correlation is statistically significant

[14] Healthcare escalation in the graph in measured by the Personal Consumption Expenditure Index, which measures escalation for healthcare costs made *by* the consumer and *in behalf* of the consumer (by firms and the government). Macro inflation here is measured by the Consumer Price Index for Urban Wage Earners, or the CPI-U.

[15] RAND, Martin Markovich

[16] As of this writing, the American Health Care Act (AHCA), which would've replaced ACA as "the law of the land," recently failed to pass Congress

In any event, based on data for almost a century, it's almost inconceivable that healthcare escalation would remain low if macro inflation were to accelerate sharply in the decades ahead. Year-to-year perturbations will continue, but the indices will likely remain strongly linked.

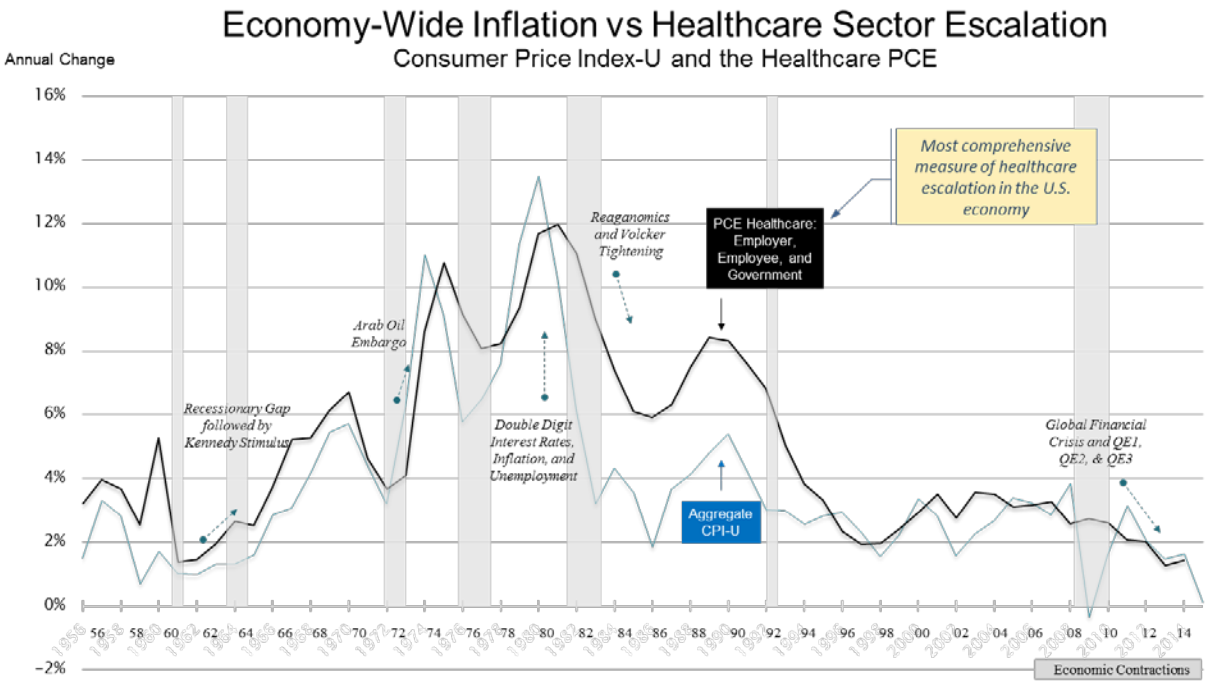


Figure 1

Forecasts of healthcare escalation rates and uncertainty leverage this linkage between core inflation and medical escalation. Forecasts are made using these five steps:

- Deflate historical medical indices using the CPI-U
- Compute deltas of medical escalation over macro inflation
- Use market-based forecasts of macro inflation from the Federal Reserve
  - Inflation swaps
  - Nominal Treasuries/TIPS (Treasury Inflation-Protected Securities) yield differentials
- Tack-on the medical escalation deltas
- Use market-based measures of inflation distributions to estimate probabilistic bounds for healthcare uncertainty.

Perhaps the biggest advantage of this methodology is that it takes defense companies, labor unions, cost analysts, and contract negotiators out of the business of forecasting core inflation.

Instead, the methodology relies on fully transparent, documented, and accessible forecasts based on market data, the same data used every month by the Fed's Board of Governors in their deliberations on monetary policy.[17]

HEALTHCARE COST ELEMENT STRUCTURE

As the Bureau of Labor Statistics (BLS) notes, "The 'best' measure of inflation for a given application depends on the *intended use* of the data."[18] The primary focus of this research is capturing escalation rates for indirect costs incurred by defense contractors for healthcare fringe. These costs, of course, are legitimate indirect expenses and are passed onto the government through contractor overhead rates. That said, healthcare indices that align with the perspectives of other agents in the marketplace such as employees and government are of interest, too.

An important first step in the analysis is to define a Cost Element Structure (CES) for healthcare, somewhat analogously to the development of a CES for weapon-system acquisition direct costs. A review of the literature reveals that comprehensive healthcare CES's are published by U.S. Department of Labor's Bureau of Labor Statistics and by the U.S. Department of Commerce's Bureau of Economic Analysis (BEA). The former publishes the Consumer Price Index and the latter the Personal Consumption Expenditures Index (PCE). As discussed in the next section, the healthcare components of the two indices differ significantly in perspective, formulaic construction, coverage, and content. The CPI captures costs incurred strictly by consumers while the PCE captures costs incurred by and *on behalf of* consumers, namely by government and industry. In any event, the two CES's themselves are closely matched, as Figure 2 shows, with two broad categories used in each: medical commodities and medical services.

The CES's are particularly useful in supporting an in-depth review of a company's overhead costs for healthcare. A comprehensive data dictionary is available from BLS for each cost element in their structure.[19] Firms differ, sometimes markedly, in the scope and coverage of their healthcare packages. The CES's provide a useful starting place for comparisons.

[17] Conversation between Dr. Brian Flynn and Dr. Stephanie D'Angelo, member of the research staff of the Federal Reserve Board, Constitution Avenue, Washington, DC.
[18] https://www.bls.gov/bls/inflation.htm
[19] The dictionary is also available from the authors

Perspective:
Employers, Employees, Government
(Personal Consumption Expenditures – Medical)

Medical Care Commodities

- Medical products, appliances, & equipment
  - Pharmaceutical products (e.g., prescription drugs)
  - Other medical products
    - Equipment
    - Appliances

Medical Care Services

- Outpatient services
  - Physician services
  - Dental services
  - Paramedical services
    - Home health care
    - Medical laboratories
    - Other professional medical services
- Hospital and nursing home services
  - Hospital
  - Nursing Home & Hospice Care

Perspective:
Consumers
(Consumer Price Index – Medical)

Medical Care Commodities

- Drugs
  - Medicinal
  - Prescription drugs
  - Non-prescription drugs
- Medical equipment and supplies

Medical Care Services

- Professional services
  - Physicians' services
  - Dental services
  - Eyeglasses and eye care
  - Other services
    - E.g., psychologists, chiropractors, physical therapists
- Hospital and related services
  - Hospital services
    - Inpatient
    - Outpatient
  - Nursing home and adult day care services
  - Car for invalids, elderly, and convalescents in the home
- Health Insurance

Figure 2

COMPONENTS OF HEALTHCARE ESCALATION

The terms *inflation rates* and *escalation rates* are sometimes used interchangeable. But, in a defense cost-analysis context, it's useful to distinguish between the two. The former captures changes in a market basket of goods and services for the macro economy. Examples of macro inflation indices are the CPI and the PCE. The CPI, arguably the best known inflation index in the U.S., measures changes in prices paid by consumers in their day-to-day living expenses. The PCE is the Federal Reserve's favored index for inflation primarily because of its broad coverage of medical costs.

Escalation indices, on the other hand, are best thought of as micro- rather than macro-level in perspective. They capture changes in prices at the firm and industry levels. It's appropriate in the cost-analysis vernacular, then, to use terms such as escalation rates for labor, material, and components of overhead. This holds for individual firms as well as for entire defense industries such as shipbuilding, aerospace, ground vehicles, missiles and electronics.

Healthcare escalation, in turn, is comprised of the following elements, each one of which can and does influence the overall value of the index:

- Pure Price Inflation
  - Change in the prices of *identical* medical goods and services over time. This is the classical definition of inflation and is measured by a market basket of items and their *price relatives*, or prices in one time versus another, suitably weighted by expenditures in either the current time period (Paasche Index) or the base period (Laspeyres Index)

- Utilization of Services
  - Changes in per capita demand for medical goods and services in response to factors such as: plan design; relative prices in the market place and their price elasticities; participant demographics and marital and dependent status; and participant health

- Deductible Leveraging
  - Increases in prices of claims year-to-year, with deductibles constant, yielding an increase in actual payouts

- Technological Advances
  - Change in medical costs due to the introduction of new procedures, equipment, and drugs. Recent examples are block-buster hepatitis and cancer drugs. Statistical agencies such as BLS and BEA periodically

adjust their market baskets as new goods and services become available and as old technologies disappear

- Cost Shifting
  - Shift from discount payers such as Medicare to "reasonable and customary" players in the private sector.

Some healthcare indices, such as the Employment Cost Index (ECI) discussed in the next section, fortuitously capture "cost at the end," or total expenditures made by a company for employee compensation. *All* of the above factors in this case are captured in the value of the index.

ANALYSIS OF HEALTHCARE ESCALATION INDICES

Based on a review of the literature and on-site discussions with subject matter experts at the BLS and BEA, five prospective healthcare escalation indices were identified:

- Consumer Price Index for All Urban Consumers (CPI-U) - Medical
- Personal Consumption Expenditures (PCE) – Medical
- Employment Cost Index (ECI) – Medical
- Employer Cost of Employee Compensation (ECEC) – Medical
- National Compensation Survey – Employer Premium Costs

Each index has its unique perspective, composition, and applicability to coverage in a defense industry environment, as discussed below.

- CPI-U Medical Consumer Price Index for All Urban Consumers
  - The CPI is arguably the best known inflation index in the U.S.
  - Published monthly by BLS
  - Measures changes in prices *paid by consumers* (e.g., a firm's employees) in their day-to-day living expenses
  - Covers 87% of population
  - Market basket is comprised of the prices of 85,000 items and services measured monthly; 8,800 for healthcare
  - Medical represents 8% of the total CPI-U, and includes prescription drugs and medical supplies, physicians' services, eyeglasses and eye care, hospital services
  - CPI-U Medical captures only:
    - Out-of-pocket medical expenditures made by consumers
    - Imputed healthcare premium costs, incurred by consumers
  - The CPI-U Medical does *not* capture costs incurred by employers (e.g., defense firms) on behalf of employees

- PCE Medical Personal Consumption Expenditures
  - The Federal Reserve's favored index for inflation primarily because of its broad coverage of medical costs
  - Captures medical spending "by and on the behalf of the consumer"
    - Employee, employer, and government costs
  - Published by BEA

- ECI Medical Employment Cost Index
  - Measures changes in "end cost" to companies of providing medical coverage to their workers
  - Published quarterly by BLS

- ECEC Healthcare for Union Firms Employer Cost of Employee Compensation
  - Measures employer cost per employee hour worked for employee healthcare compensation
  - Published quarterly by BLS
  - Uses a Chain Fisher Index
  - Unlike the ECI, industry and occupational weights vary
  - Uses the same categories of healthcare as the ECI
  - Raw data in nominal dollars; escalation computed from yearly deltas
  - No statistically discernible difference in escalation rates between large and union firms
  - Healthcare component of total worker compensation for union firms
    - 10.3% in 2006
    - 12.6% in 2016

- National Compensation Survey – Employer Medical Premium Costs
  - Measures employer's medical insurance premium costs for union firms
  - Published quarterly by BLS
  - However, detailed data on medical premiums published only yearly
  - Raw data in nominal dollars
  - Average flat monthly dollar contribution per covered employee
    - Single and family coverage
    - Escalation computed from yearly deltas

Of the five indices, the CPI-U's focus is too narrow – the consumer only. The PCE medical, on the other hand, is perhaps too broad. It captures all medical costs from *whatever* perspective. Both of these indices, however, perhaps provide useful contextual information to firms and labor unions.

The ECI addresses the study issue head-on by capturing costs incurred by defense firms in providing medical care to their employees. The ECI is comprehensive. It covers nearly all employees in the civilian (non-Federal) economy. Further, it measures the "pure" change in labor costs; that is, it is not affected by changes in relative employment of industries and occupations with different wage and compensation levels. The ECI is calculated using inputs from almost all occupations providing a robust macro perspective of the trends seen for a company's rise in the costs of doing business. Because of its broad nature, former Federal Reserve Board Chairman Ben Bernanke has called the ECI

> *"… indispensable to understanding America's economy. It ensures the accuracy of the statistics on employers' compensation costs that we rely on for economic policy making and successful business planning."*

Since the ECI's utility is so striking, its construction is worth briefly noting. The ECI is a Laspeyres index. It uses the wage bill in a cell as the base-period weights. Employment counts are updated every 10 years to prevent employment shifts among occupations and industries from influencing the measurement. The last update was made in 2013. A cell, in turn, is composed of raw wage data for a set of workers, sorted by ownership sector, industry, and occupational group. Raw, annual, historical ECI data is available along these dimensions:

- Medical premiums
  - Individual and family
  - Employer and employee
- Union versus non-union
- By salary quartile and size of company
- By geographical region at the total benefit level
- By access and participation rates.

As BLS notes, the ECI's power lies in that

> *"An established company can compare the premiums it currently pays for health benefits with nationwide averages. The comparison helps the established company assess its health benefits or negotiate contracts with health benefit companies."*[20]

Along the same lines, the ECEC also addresses a firm's cost of providing healthcare benefits to its employees. Indeed, with data available for union firms, it's arguably the best-fitting index for this study's purpose. It provides sharpened focus over the ECI Medical.

Finally, as a corollary, the National Compensation Survey yields data on premium costs incurred by firms. This index is best regarded as a subset of the broader ECEC Healthcare index.

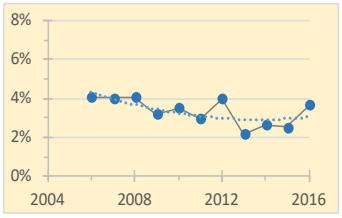
In summary, the ECEC for Union Firms appears to be the best-fit index for capturing a typical defense firm's cost for medical. The pros and cons of each of the indices are summarized in the table below.

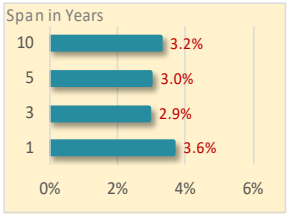
[20] Source: National Compensation Measures, Chapter 8, pages 17 and 18; BLS

Description	Escalation Rates	Average Annual Growth	Assessment

Consumer Price Index Healthcare

Market basket of *out-of-pocket medical expenditures* made by *consumers* for physicians' services, dental services, eyeglasses and eye care, hospital services, nursing home and adult day-care services, medical drugs, and medical equipment and supplies
- At the price level
- Taxes included

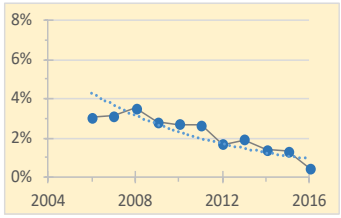


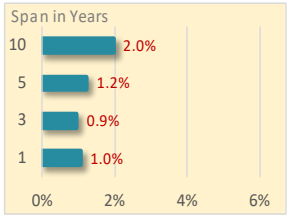


Captures an *employee's* perspective, or that of a consumer of healthcare
- Pros:
  - Nationally recognized benchmark metric
  - Useful backdrop information to company, workers, and DoD
- Cons:
  - Doesn't capture costs incurred by firms

Personal Consumption Expenditures Healthcare

Market basket of *medical expenditures* made *by* and *on behalf* of *consumers*. Includes:
- Out-of-pocket expenditures by *consumers*
- Health care services *paid for* by *employers* through employer-provided insurance
- Health care *paid for* by the *government* through programs such as Medicare Part A and Medicaid

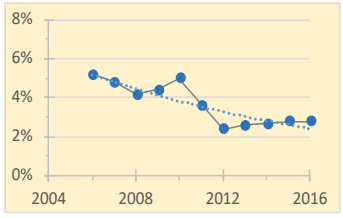


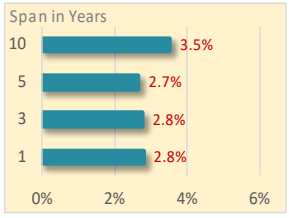


Captures a *firm, employee, and federal government* perspective
- Pros:
  - Broadest measure of healthcare inflation in the economy
  - Useful backdrop information
- Cons:
  - Government costs likely viewed as *exogenous* to collective bargaining

Employment Cost Index Healthcare

Market basket of *healthcare commodities and services* paid for *by companies on behalf* of their *employees*, through employer-provided insurance
- Typically includes medical care, vision, and dental
- A Principal Federal Economic Indicator
- Military pay raises statutorily linked to the ECI aggregate

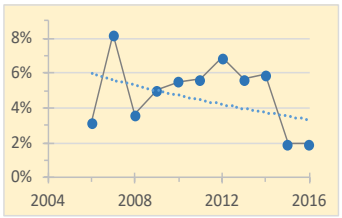


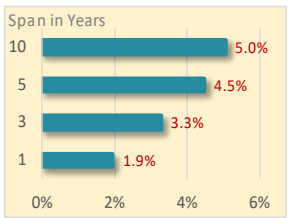


Captures the perspective of a firm providing healthcare benefits to its employees
- Pros:
  - Directly applicable to medical indirect costs for *any defense contractor*
- Cons:
  - National benchmark which may not exactly match defense industry

Employer Cost of Employee Compensation Healthcare

Measures *employer cost* per *employee hour* worked for *employee healthcare compensation*
- Raw data in nominal dollars per hour
  - Escalation computed from yearly deltas
- Same categories of healthcare as the ECI
- Healthcare now *12.6%* of total worker compensation for *union firms* vice *10.3%* in 2006

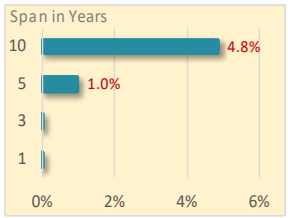




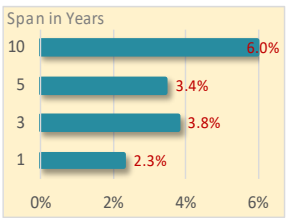
Captures the perspective of a firm providing healthcare benefits to its employees
- Pros:
  - Perhaps the *best analogy* for *defense*
  - Provides a strong basis for should-cost analysis
- Cons:
  - Uncertain applicability to any one company

National Compensation Survey

Measures *employer's medical insurance premium costs* for union firms
- Raw data in nominal dollars
- Average flat monthly dollar contribution per covered employee
  - Firms requiring an employee contribution
- Escalation computed from yearly deltas



Union Workers: Single Coverage



Union Workers: Family Coverage

Captures the perspective of a firm providing healthcare benefits to its employees
- Pros:
  - Focuses on *union* firms and provides *details* on one component of healthcare costs - *premiums*
- Cons:
  - Limited scope compared to the ECEC

FORECASTS OF MACRO INFLATION

Overview

To recap, the aim of this research is two-fold: to develop benchmark escalation indices for capturing the costs of healthcare for defense firms, and, secondly, to forecast their values throughout the life of a weapon-system acquisition program. With a best-fit escalation index now chosen, the Employer Cost of Employee Compensation (ECEC) for Healthcare for Union Firms, the next step is to develop forecasts of macro inflation. The macro inflation forecast, in turn, will serve as a *baseline* upon which to later tack on a *healthcare differential*, or the numerical delta (number of basis points[21]) above and beyond the underlying rate of change in the prices of a market basket of goods and services in the general economy.

Further, due to the recent achievement of critical mass in a nascent financial market in the U.S. for inflation options, the macro inflation forecasts will be stochastic in nature, with PDFs derivable from market *put* and *call* prices. The estimated macro inflation PDFs, in turn, will impart uncertainty into the forecasts of healthcare escalation rates.

But, first things first – namely, the establishment and description of methodology for forecasting point and stochastic estimates of *macro inflation*.

Point Estimates

Treasury "breakevens" and zero-coupon vanilla swaps yield point estimates of inflation, with their underpinnings described below.

- Treasury "Breakevens"

The U.S. Treasury issues bills, notes, and bonds to finance the nation's annual deficits and cumulative debt. Bills mature in a year or less, and, like zero-coupon bonds, do not pay interest prior to maturity. They're quoted for purchase and sale on an annualized discount basis. Notes mature in two to ten years, and pay interest every six months. Bonds are issued in 20- and 30-year maturities, with coupon payments also made every six months.

In 1997, Treasury Inflation Protected Securities (TIPS) were added to mix of financial instruments used for debt financing. They're sold today in maturities of 5, 7, 10, 20, and 30 years. Unlike nominal bills, notes, and bonds, the principal dollar value of a TIPS is automatically adjusted to the Consumer Price Index, providing a hedge against inflation so long

[21] A basis point is 1 one hundredth of one percentage point. Hence, 100 bps (basis points) = 1% and 200 bps = 2%.

as the security is held to maturity.[22] Further, while the coupon rate of the TIPS is constant, it generates a different amount of interest when multiplied by the inflation-adjusted principal.

The difference between yields on nominal and TIPS securities, of identical maturities, produces the so-called *breakeven* inflation rate. This is the degree of future inflation at which investments in both kinds of securities would be equally profitable. Investors will *breakeven* on purchases of either if *realized* inflation turns out to exactly match the breakeven value. If inflation runs higher, investors would have been better off with the inflation-indexed TIPS. Figure 3 shows the breakeven rates observable in the marketplace on a single day for 5- to 30-year maturities. The breakeven inflation rate over the 25-year span of TIPS' maturities increases monotonically from 1.90% five years out (2.11% minus 0.21%) to 2.10% 30 years out (3.16% minus 1.06%). Two percent (200 basis points) is a reasonable, rough average, which coincides with the Feds long-term target for inflation.

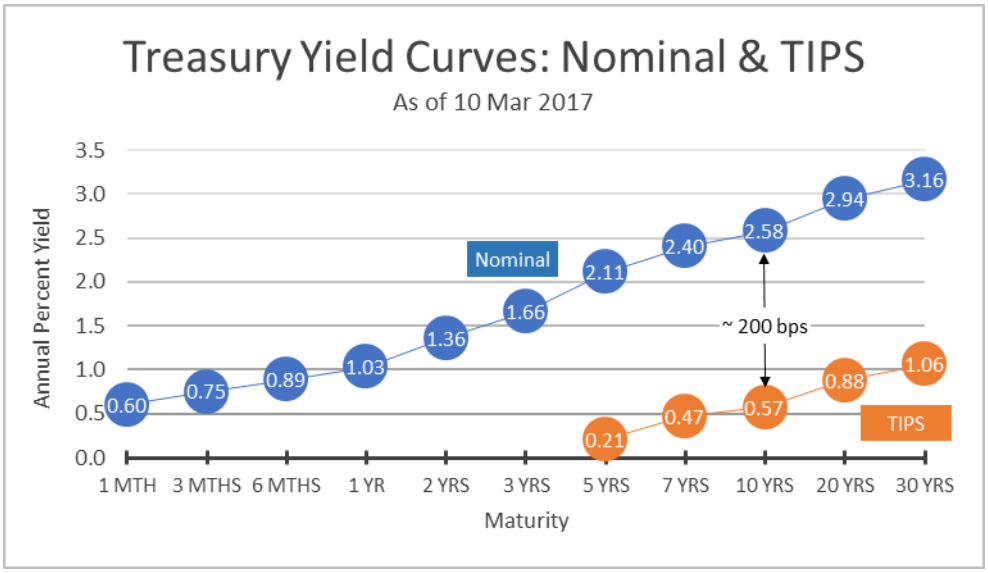


Figure 3

As Federal Reserve warns, the use of breakeven inflation rates as a true measure of inflation expectations is confounded by the presence of *risk premia* in the market place:[23]

- Nominal Treasuries include a premium that inflation will overshoot its expected path, and
- TIPS include a premium for holding an asset less liquid than a nominal security.

[22] TIPS are indexed to the non-seasonally adjusted U.S. City Average All Items Consumer Price Index for all Urban Consumers (CPI-U), published by the Bureau of Labor Statistics (BLS). See www.BLS.Gov for more information.
[23] "Tips from TIPS: The Informational Content of Treasury Inflation-Protected Security Prices," Stefania D'Amico, Don Kim, and Min Wei, 2010, Divisions of Research and Statistics and Monetary Affairs, Federal Reserve Board, Washington, D.C., page 1.

The risk premium on nominal Treasuries raises the nominal curve and *widens* the measure of breakeven inflation. The liquidity premium on TIPS, on the other hand, raises the real curve and *narrows* the breakeven rate. As the Fed indicates, "The yield premiums associated with both factors vary over time and often in offsetting ways, making it difficult to capture the residual expectations component of the breakeven inflation rate."[24]

In today's economic environment, and with the TIPS market growing over time, the total risk premium is estimated at slightly above 0 basis points to as much as 50.[25] Use of the midpoint as an expected value seems reasonable given the competing methodologies at play and lack of consensus within the Federal Reserve for either end of the range.

A procedure observed in the defense cost-analysis community not only erroneously uses breakeven rates as a *pure* measure of outyear inflation but egregiously adds to the mischief by using the variation in values over time to compute a coefficient of variation.

- Zero-Coupon Swaps[26]

Almost non-existent in the U.S. a couple of decades ago, inflation swaps have grown along with the TIPS market.[27] As a measure of inflation expectations, they offer some distinct advantages over the bond-market "breakevens." First, derivatives are traded over a wider range of maturities, often from one to 30 years out, thus providing insights on inflation near term and in the long run. Trading in a primary or dealers' market, they avoid some of the liquidity issues faced by TIPS.

In their simplest form, as zero-coupon vanilla swaps,[28] an inflation derivative is a bilateral contract between a *buyer* and *seller* of inflation protection, as shown in Figure 4.

[24] "TIPS Liquidity, Breakeven Inflation, and Inflation Expectations," Federal Reserve Bank of San Francisco, Economic Letter 2011-19, Jens Christensen and James Gillan, 20 June 2011.
[25] Christensen and Gillan.
[26] A swap is "an exchange of cash flows between two … [parties] … for a predetermined period or prescribed dates;" *Global Derivatives; Products, Theory and Practice*, Eric Benhamou, page 105.
[27] "Derivatives are financial instruments whose value is derived from the value of an underlying asset (such as gold, wheat or other commodities) or other financial instruments including bonds, or market benchmarks such as interest rates [and breakeven inflation rates]"; Financial Times.
[28] A swap is "an exchange of cash flows between two … [parties] … for a predetermined period or prescribed dates;" *Global Derivatives; Products, Theory and Practice*, Eric Benhamou, page 105.

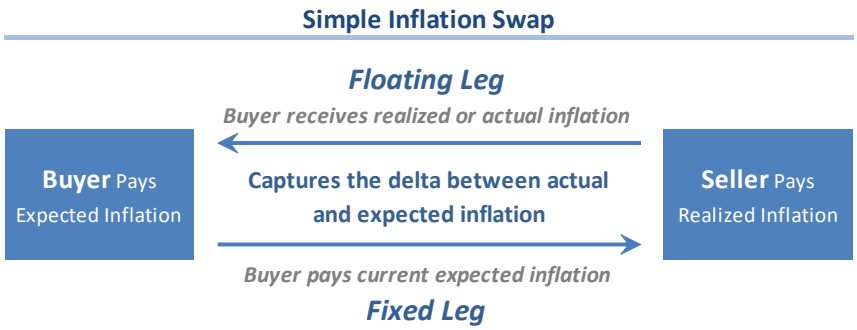


Figure 4

In this arrangement, the buyer agrees to pay a compounded, fixed rate of interest, or an inflation expectation, b, on a nominal dollar value over the tenor of the swap

$$Expected\ Inflation = \$Notional * ((1 + b)^{tenor} - 1) \quad (7)$$

The seller of protection, on the other hand, agrees to pay the cumulative percentage increase in the value of a pre-established price index over the identical tenor of the swap

$$Realized\ Inflation = \$Notional * \left(\frac{CPI_{t+tenor}}{CPI_t} - 1\right) \quad (8)$$

Expected and realized inflation are typically measured in terms of the non-seasonally-adjusted Consumer Price Index for All Urban Workers, the same index used for TIPS breakeven inflation. There's no exchange of money until maturity. The breakeven swap rate, b, quoted daily in the marketplace for various maturities, is set at such a level that the market considers the value of the fixed leg equal to the value of the floating leg upon issuance, or

$$Value_{swap} = Value_{fixed\ leg} - Value_{floating\ leg} = 0 \quad (9)$$

As with Treasury breakevens, the inflation swap rate should not be interpreted as a pure measure of inflation expectations. Both buyers and sellers of inflation protection incur risks

$$Buyer\ Side:\ Realized\ inflation < fixed\ payment \quad (10)$$

$$Seller\ Side: Realized\ inflation > fixed\ payment \quad (11)$$

Seller-side risk is typically higher than buyer-side risk. In theory, inflation rates can rise unbounded above a mean expected value while, normally, the downside is limited to a small positive value. The swap rate, then, usually includes a net premium demanded by the seller as compensation for bearing asymmetric risk. The Federal Reserve Bank of Cleveland estimates this net risk premium at roughly 100 basis points today on a 30-year swap rate. This, in turn,

yields an expected inflation rate of roughly two percent per annum, in line with TIPS' breakeven numbers.

Together, the Treasury TIPS/nominal *breakevens* and the inflation swaps yield point forecasts of the inflation rate for various timelines up to three decades ahead, after properly accounting for risk premiums. The Federal Reserve Bank of Cleveland provides estimates of these adjustments and generates official inflation forecasts using methodology presented here.[29] The forecasts are fully transparent, publically available, tracked historically, and updated monthly, with a recent issuance shown in Figure 5.

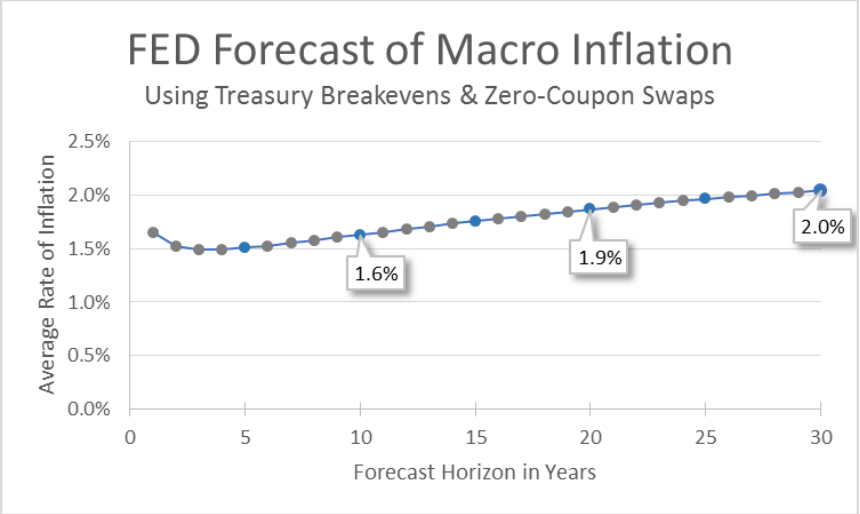


Figure 5

This invaluable product of the FED adds to the utility of the escalation methodology as it saves others the time and trouble of collecting and analyzing ever-changing Treasury yield and inflation swap data.

Stochastic Estimates

The methodology prescribed above provides *zero information* regarding the market's collective view of the *stochastic nature* of the projections. Within the last decade, however, a new and growing market has emerged for inflation derivatives, "caps and floors," which are option-like securities whose payoff is linked to realized changes in a pre-established index, such

[29] See https:/www.ClevelandFed.org for details.

as the headline CPI.[30,31] They can be used to estimate probability density functions (PDFs) for outyear inflation expectations.[32] That is, they provide information on both mean *and* variance. PDFs constructed from derivatives' pricing in the open marketplace have the added credibility of reflecting the views of players "with skin in the game."

- Market Mechanics

In the cap and floor market, the seller of the cap promises to pay, upon contract expiration, an unlimited amount of inflation on a notional principal, $\$N$, above a certain threshold inflation rate, k, over the life of the contract, T, or

$$\$N \cdot max\left[\left(\left(\frac{CPI_T}{CPI_o}\right)^{\left(\frac{1}{T}\right)} - 1\right) - k, 0\right], where \quad (12)$$

k is also referred to as the strike of the cap, such as 2% inflation per annum. The buyer of the cap, then, such as a pension fund that's required to earn a minimum *real* rate of return on client money, is protected against any rise in inflation above k percent per year. Their risk exposure to inflation, from a portfolio perspective, is *capped* at this value. In return for the protection, the borrower makes an up-front payment $P_o(k,T)$. As Kitsul and Wright note, "the contract is effectively a call option on inflation."[33] If the actual annualized rate of inflation ends up higher than k, the buyer is in-the-money. Otherwise, the option expires out-of-the-money, and worthless.

In the case of a floor, the payment is

$$\$N \cdot max\left[k - \left(\left(\frac{CPI_T}{CPI_o}\right)^{\left(\frac{1}{T}\right)} - 1\right), 0\right] \quad (13)$$

The theoretical underpinnings required to derive implied PDFs from option prices on the caps and floors flow from the expression for the market price P_o of the call option at time t_o, which equals the discounted value of its expected payoff:

[30] Options are contracts giving the right to buy or sell an asset at a point in the future at a price set now, called the strike price. An option gives the *right* to make the transaction but is not an *obligation* to do so.
[31] The cap and floor market in the U.S. seems to have reached critical mass beginning in March 2009, based on statistics provided in "Inflation, Hedging It and Trading It," Deutche Bank, 2011, section 6.1.
[32] "The Economics of Options-Implied Inflation Probability Density Functions," Yuriy Kitsul and Jonathan Wright, Division of Monetary Affairs, Federal Reserve Board, Washington, D.C., and, Department of Economics, Johns Hopkins University, Baltimore, MD, 6 June 2012.
[33] Kitsul and Wright, page 3.

$$P_o(k,T) = e^{-rT}E[\max(S_T - k, 0], where \quad (14)$$

S_T is the *spot* or market price of the asset at the delivery date, a clearly stochastic variable with a probability distribution, and where r is the interest rate.[34] Equivalently,

$$P_o(k,T) = e^{-rT}\int_k^{\infty}(S_T - k)f(S_T)dS_T\,, where \quad (15)$$

$f(S_T)$ is the PDF of the value of the option at maturity. The first derivative of P_o with respect to the strike price is a function of the cumulative distribution

$$\frac{\partial P}{\partial k} = e^{-rT}\big(1 - F(S_T)\big), \quad (16)$$

with the second derivative, as is well known in the literature,[35] yielding the PDF for inflation, $f(S_T)$

$$\frac{\partial^2 P}{\partial k^2} = e^{-rT}f(S_T) \quad (17)$$

- Estimation of the PDF

Inflation call options, for a given maturity date in the future, are traded at different strike prices. The *call-price function*, with an actual example shown in Figure 6, relates the prices of call options of the same maturity to their strike price. The curve slopes downward because the higher the cap, or the minimum inflation per annum covered the next twenty five years, the greater will be the exposure to inflation. In simple words, it costs more to protect against inflation at 1% per annum than it does at 6% per annum because the latter figure is far less likely than the former.

[34] 'Option-Implied Probability Distributions and Currency Excess Returns," Allan M. Malz, Federal Reserve Bank of New York Staff Reports, Number 32, November 1997.

[35] "Prices of State-Contingent Claims Implicit in Option Prices," Douglas T. Breeden and Robert H. Litzenberger," *The Journal of Business*, Vol. 51, No. 4 (Oct., 1978), pages 621-651.

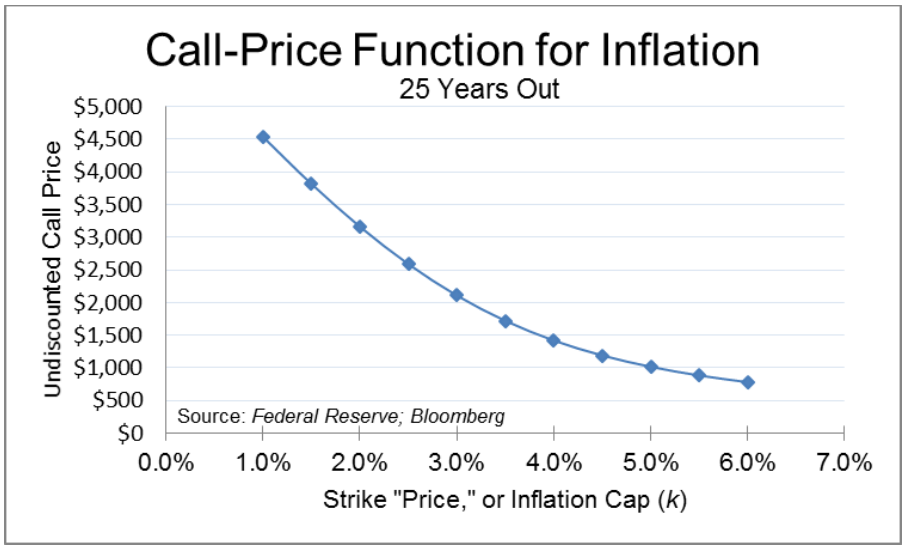


Figure 6: Call-Price Function for Inflation

This relationship enables estimation of the probability density function for the asset; in this case, the future rate of inflation. Intuitively, as the Bank of England notes,

> *"A call option with a lower strike price will always be worth more than a higher strike option. This is because the option with the lower strike price will have a higher pay-off if exercised and has a higher probability of delivering a positive pay-off. This additional probability reflects the chances that the underlying asset price will lie between these strikes. If we have option prices for a range of strikes, it is possible to infer what the probabilities are of the underlying asset price at maturity lying between each of them, by examining the relative prices of options with adjacent strikes."*[36]

Employing a numerical technique suggested by a member of Dr. Janet Yellen's research staff, Figure 7 plots a PDF for inflation 25-years ahead, based on prices in the market place for a point in time.[37] The estimated mean is 2.0% per annum inflation and the estimated CV 60%.

[36] "Recent developments in extracting information from options markets," *Bank of England Quarterly Bulletin*, February 2000, Clews, R., N. Panigirtzoglou and J. Proudman, 2000, page 51.

[37] Technique suggested by Dr. Yuriy Kitsul in a visit by the authors to the Federal Reserve Board. Using the call-price function illustrated in Figure 11, the first derivative, $\partial C/\partial k$, is approximated by $(c2 - c1)/(k2 - k1)$, where the c's and k's are call and strike prices respectively. Symmetric numerical derivative was applied at x-values from 1.5% to 5.5%, inclusive. The second derivative, $\partial^2 C/\partial k^2$, is then approximated similarly. In using this procedure, inflation floors should, ideally, be converted to inflation caps using the call-put parity equation. This gives direct observations on zero and negative values of inflation.

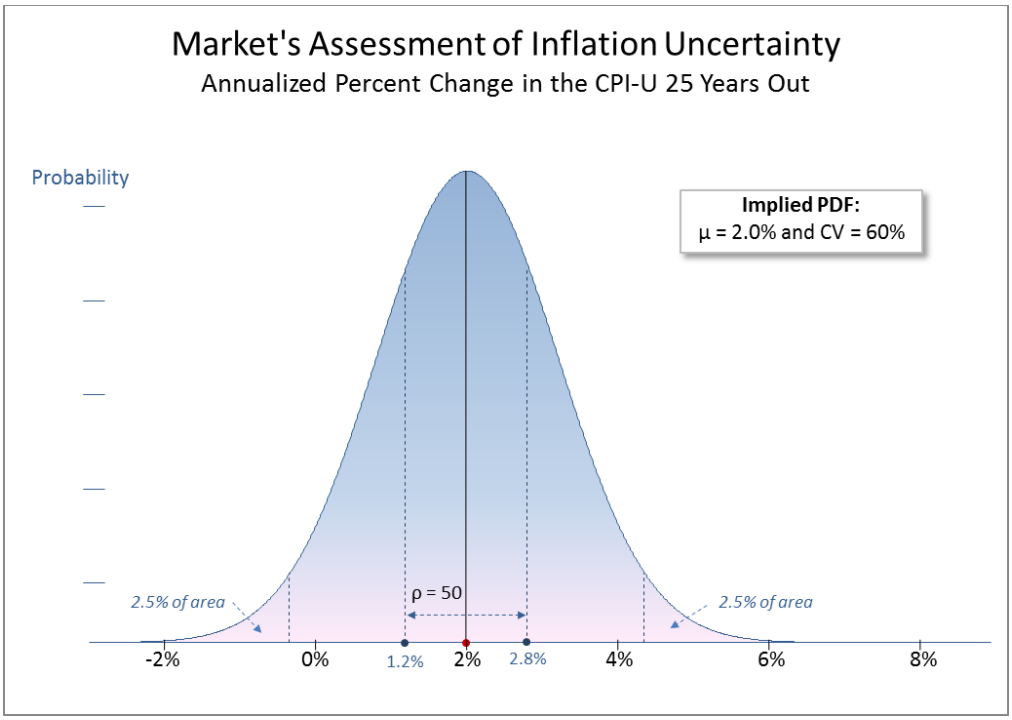


Figure 7

It's important to emphasize that Figure 7 represents the view of an open, active, and vigorous market in inflation protection. Agents in the market include pension funds, insurance companies, utilities, speculators, and hedge-fund managers, with large sums of client or individual monies at stake.

Equipped now with a mean and variance for outyear forecasts of macro inflation, the next section will estimate the healthcare differential.

FORECASTS OF HEALTHCARE ESCALATION

Healthcare Differential

Nominal- and constant-dollar based rates for the ECEC (Employer Cost of Employee Care) Healthcare index for union firms show a general decline since the Great Recession. The gap has closed between nominal medical rates and macro inflation from ~ 200 bps in 2010 to ~ 100 bps delta today, as Figure 8 shows.

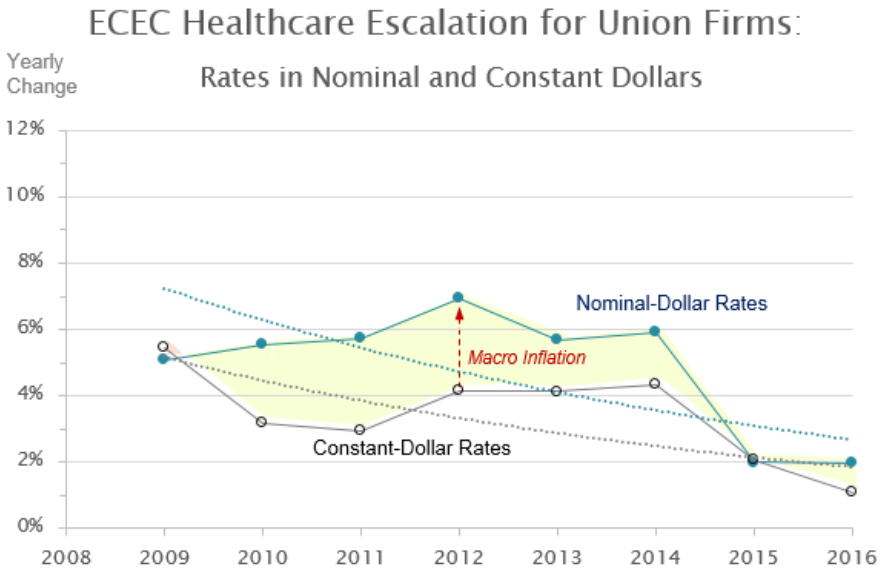


Figure 8

Point Projections

Average, compounded deltas (nominal versus real escalation for the ECEC) over various time periods are computed. To support long-range forecasts, the five- and ten-year averages seem most appropriate, as shown in Table 1.

Historically-Based Δ's: ECEC above Core Inflation

# of Years	Rate
1	1.1%
3	2.5%
5	3.1%
10	3.2%

Table 1

A more aggressive position would be to use perhaps a 2 or 2 ½ percentage-point delta above core inflation.

With the healthcare differential established, the next step in the forecasting process is to estimate outyear core inflation and its variance. For point estimates of core inflation, Treasury "breakevens" and zero-coupon vanilla swaps are employed, as discussed at length in the section on macro inflation.[38] Combining the core inflation forecast thirty years ahead with a range of plausible values for the healthcare escalation differential yields the shaded interval of Figure 9.

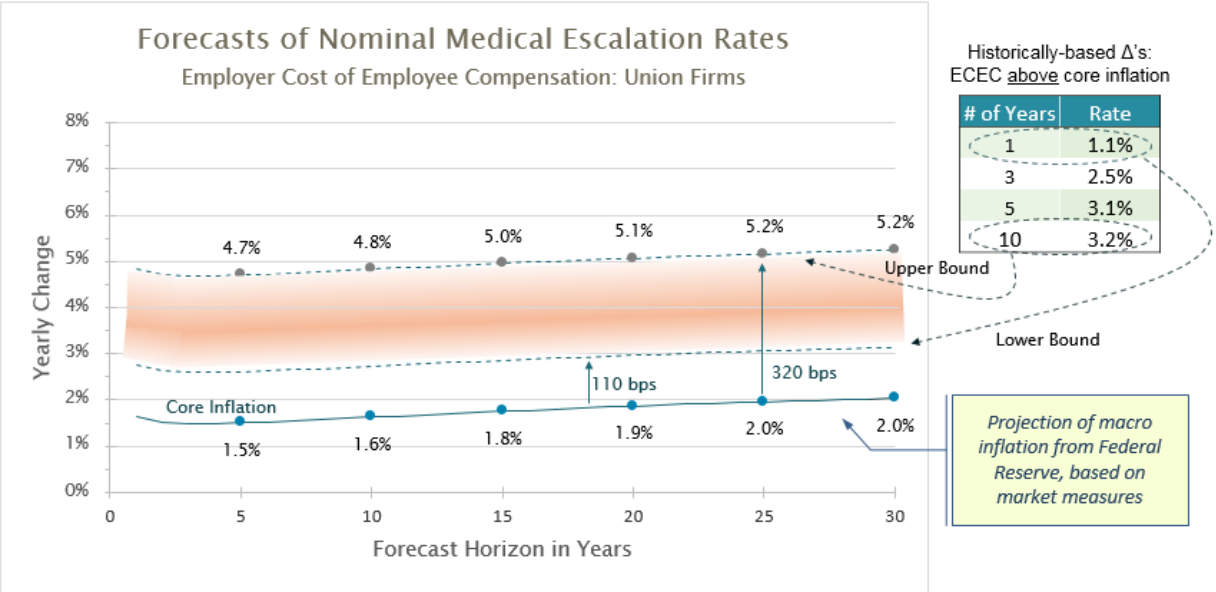


Figure 9

The upper bound, based on the average differential over the past ten years, yields a nominal point forecast healthcare escalation of roughly 5% per annum. This accords with the Federal Reserve's long-term target of macro inflation of roughly 2% per annum.[39]

[38] The Federal Reserve Bank of Cleveland uses the same methodology, and updates their numbers monthly. These are shown in the graph.

[39] The requirement is statutory, along with the objective of promoting full employment.

Probabilistic Projections

Next, combining the upper-bound nominal healthcare escalation rates with outyear inflation uncertainty, as estimated using cap and floor inflation derivatives, yields the probabilistic fan chart of Figure 10.[40] The further out the forecasts, the more uncertain they are. Baseline or point estimates are defined by the line bisecting the fan horizontally.

The cross-cut view of the fan is shown in the lower portion of the figure for one year – 2028, a point of central tendency for a least one current Major Acquisition Program (MDAP) in the Department.

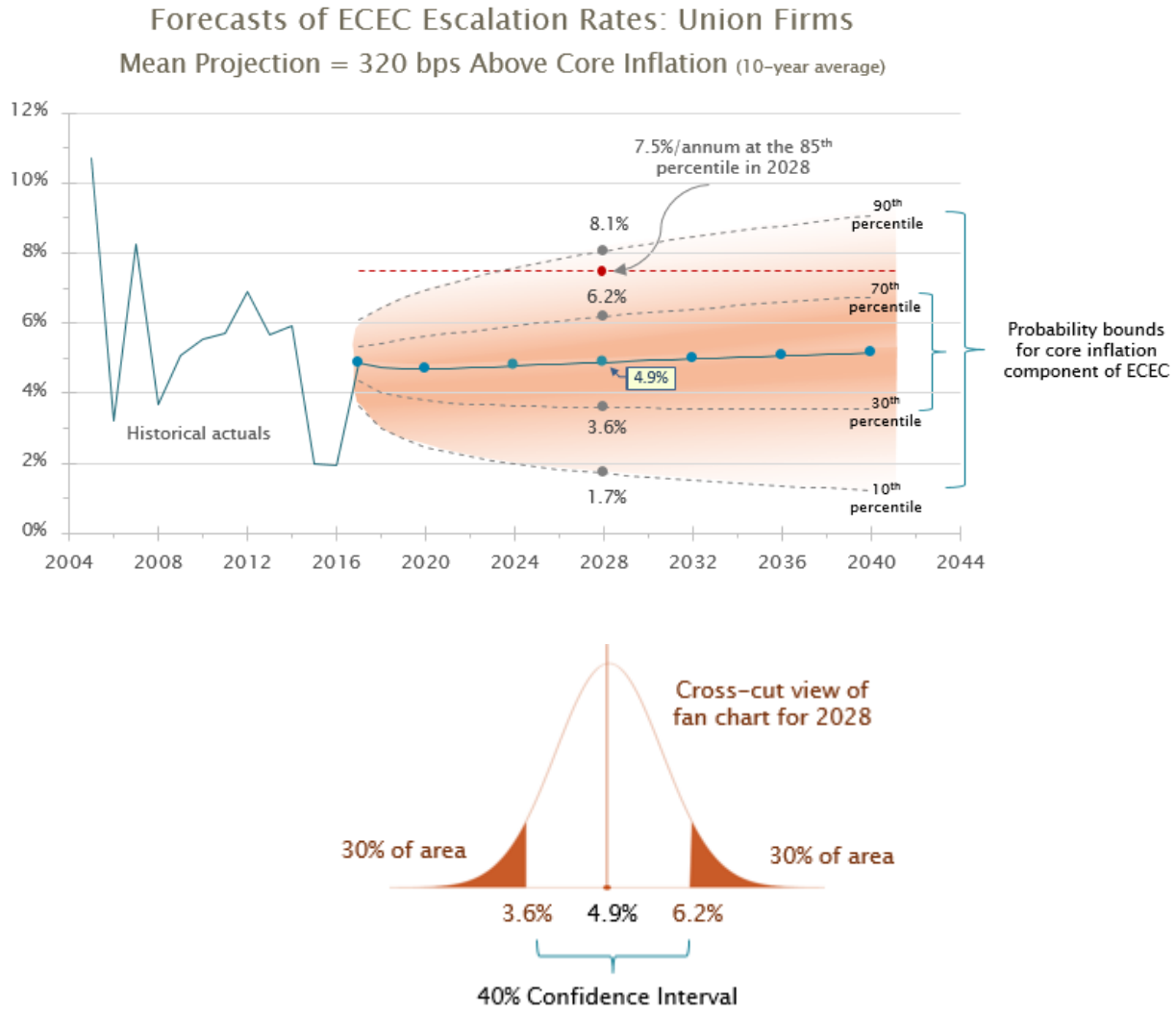


Figure 10

[40] Fan charts were invented by the Bank of England in 1975, and are used by the Bank and by HM Treasury today.

Cross Check

A publically-available actuarial model, based on macroeconomic factors, provides a useful cross-check for point estimates of medical escalation. The model was first prepared by T.E. Getzen for the Society of Actuaries a decade ago. It provides long-term forecasts of medical cost growth based, in turn, on projected growth rates inflation, per capita GDP, a factor called "Excess Medical Cost Growth," and, additionally, a set of constraints.[41]

The constraints directly address the percentage of national income, or GDP, spent on medical by all parties, consumers, companies, and all levels of government. This percentage is projected to reach close to 20% in the U.S. within the next half dozen years, meaning that one out of every five dollars spent in the economy will be for healthcare. There's a limit, of course, to how much the economy that absorb. Many healthcare economists set this value at 25%.

Entering a realistic set of assumptions into the model yields a long-term medical escalation rate of 4.7% per annum, a value closely aligned with this study's point projection of 5%.

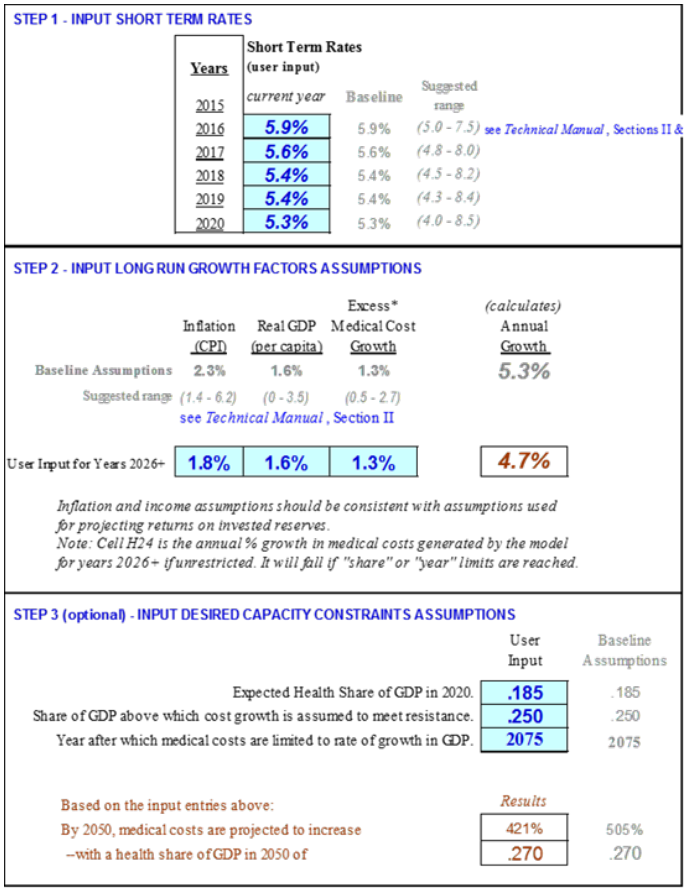


Figure 11

[41] For details and an Excel-based version of the model, visit https://www.soa.org/research-reports/2016/research-hlthcare-trends/

CONCLUSION

As noted by former Under Secretary of Defense for Acquisition, Technology, and Logistics, Mr. Frank Kendall, "All acquisition managers should routinely analyze *all cost elements* and consider reasonable measures to reduce them, with prudent … considerations of associated risks."[42] Included in the domain of *all elements* are not only direct costs but indirect costs as well. All too often indirect costs have received short shrift in the defense cost analysis community, with pass-through values accepted without due diligence.

This research has sought to illuminate and meld into a holistic whole the two critical elements of the escalation conundrum for indirect costs, measurement and projection. For the measurement challenge, benchmark metrics were identified and assessed from a 360-degree perspective, using healthcare as a test case or proxy for all major elements or components of a company's overhead. The benchmarks focused on who pays for healthcare: the employee or consumer, a defense company, the government (Medicare, Medicaid), or all three. A best-fit index was identified for defense firms – the Employer Cost of Employee Compensation (ECEC) – Union Firms.

On the second issue, this research takes advantage of market data which reflects expectations inferred from the prices and yields of financial instruments actively traded on Wall Street, such as Treasuries and, more recently, inflation derivatives. Macro inflation is projected three decades ahead using the market data, with a medical delta or differential then tacked on. Uncertainty bounds for the forecasts are established using PDFs inferred from call/put prices for inflation.

Together, the benchmarks and the projections enable the independent estimation of outyear escalation rates, information useful to all parties – labor unions, firms, contract negotiators, program offices, and government cost analysts.

[42] USD(AT&L) Memo, "Should Cost Management in Defense Acquisition," 6 Aug 2013

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Federal Reserve Bank of San Francisco, Jeffrey Clemens, Joshua Gottlieb, and Adam Shapiro

"Medicare Payment Cuts Continue to Restrain Inflation," Federal Reserve Bank of San Francisco, Economic Letter, Jeffrey Clemens, Joshua D. Gottlieb, and Adam Hale Shapiro

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"Medical Cost Trend: Behind the Numbers 2016," PwC, Jun 2015

"Healthcare Inflation and the Core Inflation Gap," Federal Reserve Bank of Cleveland, Randal Verbrugge and Christian Garcig, Sep 2015

"GOLDMAN: Here's a Huge Reason Why the Fed's Favorite Measure of Inflation Is So Much Lower Than the Others," Goldman Sachs and Business Insider

"Understanding Self-Funded Vs. Fully Insured Health Plans," National Insurance Services, Inc.

ADDENDUM – ON-LINE RESOURCES

- National Compensation Measures Handbook of Methods
  http://www.bls.gov/opub/hom/pdf/homch8.pdf
  - This Handbook describes methodology behind the National Compensation Survey (NCS) which collects information used in the Employment Cost Index (ECI), Employer Costs for Employee Compensation (ECEC), and employee benefits
- National Compensation Survey (NCS) main page
  www.bls.gov/ncs
- ECI links
  - ECI archives including latest release
    http://www.bls.gov/schedule/archives/eci_nr.htm
  - Health series
    http://www.bls.gov/web/eci/echealth.pdf
- ECEC links
  - ECEC archives including latest release
    http://www.bls.gov/schedule/archives/ecec_nr.htm
- Employee benefits in the United States
  http://www.bls.gov/ebs/
  - This has incidence and provisions of selected employee benefits, including details on health and retirement
- BLS Database query tools
  http://www.bls.gov/ncs/#data