POLICY ANALYSIS FOR HEALTH CARE AND PUBLIC HEALTH

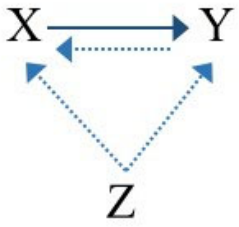
David H. Howard
Emory University

2024

POLICY ANALYSIS FOR HEALTH CARE AND PUBLIC HEALTH

HOW TO SUCCEED IN THIS CLASS

1. For key assumptions that address causal effects, answer the question: **How do we know** what the answer is without being able to conduct a randomized trial?



2. **Prune** your writing.

   Plaintiff John Doe is currently serving a custodial sentence in the New York State penal system."

   ↓

   John Doe is a prisoner at Sing Sing.[1]

3. Get started **early**.

[1] Freedman A. Why trial lawyers say it better. *Wall St. Journal* January 29, 2011.

DEPARTMENT: Health Policy and Management

COURSE NUMBER: 576 **SECTION NUMBER:** 1

CREDIT HOURS: 3 **SEMESTER:** Fall 2024

COURSE TITLE: Policy Analysis

LOCATION: R. Randall Rollins Bldg. R100

INSTRUCTOR NAME: David Howard

INSTRUCTOR CONTACT INFORMATION

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PHONE:	404-370-0913 (office), 404-433-1209 (cell)
SCHOOL ADDRESS OR MAILBOX LOCATION:	Grace Crum Rollins 664

COURSE DESCRIPTION

> The principal tools of the policy planner are logic, common sense, and experience with particular substantive areas. It helps to be practiced in data analysis, rational problem solving, and other specific skills. But more often than not we design our own approach or methodology to policy problems.
>
> --Patton and Sawicki, 1993.

> One of the great mistakes is to judge policies and programs by their intentions rather than their results. –Milton Friedman

This class will teach students how to apply the tools of policy analysis to make quantitative predictions about the impact of policy changes. For example, what will happen to tax revenue if a state increases cigarette taxes? Or, do the benefits of requiring hospitals to maintain minimum nurse staffing levels outweigh the costs? Students will learn how to use the tools of economics, statistics, and decision analysis to develop robust predictions. Topics covered include assessing causality in studies estimating the impact of policy changes, measurement of costs, monetarization of health benefits, and cost-benefit analysis. Students will conduct policy analyses using simple models and previously published estimates of causal effects. The course emphasizes presentation of results for non-technical audiences.

- Describe the formal and informal uses of policy analysis in policymaking.
- Evaluate the suitability of studies as the basis of behavioral and biological assumptions in policy analysis.

- Apply principles of good writing and sound communication to effectively communicate technical concepts to non-technical audiences.
- Develop and appropriately describe sensitivity analyses.
- Use publicly-available sources of information to develop assumptions regarding health care costs.
- Apply price indices and discount rates to adjust costs over time.
- Describe the concept of the value of a statistical life and the advantages and limitations of alternative approaches for estimating willingness-to-pay.
- Describe the basis of models to project the impact of health reform and COVID-related policies.

OFFICE HOURS

I do not hold formal office hours, but I am happy to meet you anytime. After class works pretty well. Feel free to drop by unannounced. If you'd like to make an appointment, you can use this app: https://calendly.com/dhhowar. The app will automatically generate a Zoom link. If you would rather meet in person, I will probably be in the office on Tuesdays and Thursdays. Use the https://calendly.com/dhhowar link for in-person meetings too.

COMMUNICATING WITH ME

There are a couple tips that will improve communication between you and I.

First, always put a descriptive heading in the subject line of emails.

Second, when you send attachments, include your name in the name of the attachment. For example, instead of PolicyAnalysis1.docx, name your document RanaJulia.PolicyAnalysis.docx. Even better, put the date: RanaJulia.PolicyAnalysis.2022.09.03.docx.

Third, if you want me to review something you have written, it is easier for me to review if you paste it into the body of an email instead of attaching it as a document.

EVALUATION

In-class quizzes	20%
Policy analysis (capstone project)	80%

Quizes: I will give unannounced quizzes on the readings

Original policy analysis: This is the main assignment for the class. You choose the topic.

Attendance: I expect that you will be in class. If you do miss class, you don't need to let me know. You are responsible for making up the material. I will post recordings of each class. After three absences, I take off two points off from the final course grade for each additional absence. To be counted as present, you must be in your seat at the

beginning of class.

Late assignments: I take two points off for each day an assignment is late.

Rubrics: I use a rubric to determine the grade for the policy analysis. I will provide the rubric with the assignment. I reserve the right to deviate from the rubric if a paper does not represent graduate-level work or if there is plagiarism.

Grading scale:

A+	>100	B+	87-90	C+	77-79
A	93-100	B	83-86	C	73-76
A-	90-92	B-	80-82	C-	70-72

COURSE CALENDAR

I maintain and update the course schedule using this Google spreadsheet: https://tinyurl.com/y9q39app

The full link is: https://docs.google.com/spreadsheets/d/1LJmS2oF_IBl6cNBzdZMiDGWzpclrfXl7UnqNZ_qZhH8/edit#gid=668867349

CLASS NOTES

Howard, David. Policy Analysis for Health Policy. Available at https://scholarblogs.emory.edu/davidhoward/. I will also hand out a copy in class.

READINGS AND TOPICS

Readings with a * are required.

We will cover chapters of “Hall, Trish. Writing to Persuade. W.W. Norton & Company. 2019.” throughout the semester.

The field of policy analysis

- What is the purpose of Congressional Budget Office analyses of proposed legislation?
- From what perspective does the Congressional Budget Office analyze policies?
- What is the purpose of regulatory impact analyses?
- Why do private sector entities perform conduct policy analysis?
- What factors should be considered when analyzing policies to prevent disease?

*Simon P, CJ Jarosz, T Kuo, JE Fielding. Menu Labeling as a Potential Strategy for Combatting the Obesity Epidemic. County of Los Angeles Public Health. May 2008. http://publichealth.lacounty.gov/docs/menu_labeling_report_2008.pdf

*Glied S, Lee TH. Is CBO Forecasting Good Enough for Government Work? New England Journal of Medicine 2019;380(23):2187-2189.

*Congressional Budget Office. How CBO Analyzes Approaches to Improve Health Through Disease Prevention. June 2020.

*Dudley, Susan, Richard Belzer, Glenn Blomquist, Timothy Brennan, Christopher Carrigan, Joseph Cordes, Louis A. Cox, Arthur Fraas, John Graham, George Gray, James Hammitt, Kerry Krutilla, Peter Linquiti, Randall Lutter, Brian Mannix, Stuart Shapiro, Anne Smith, W. Kip Viscusi, Richard Zerbe. Consumer's Guide to Regulatory Impact Analysis: Ten Tips for Being an Informed Policymaker. Journal of Benefit Cost Analysis 2017: 1-18.

*Office of the Assistant Secretary for Planning and Evaluation U.S. Department of Health and Human Services. Guidelines for Regulatory Impact Analysis. 2019.

Meyer R. It Takes Too Many Studies for the Government to Do the Right Think. New York Times July 8, 2024.

White J. Hypotheses and home: policy analysis and cost controls (or not) in the Affordable Care Act. Journal of Health Politics, Policy and Law 2018;43(3):455-482.

Making assumptions

- What is the difference between behavioral assumptions, biological/engineering assumptions, and counting assumptions?
- What is the difference between internal validity and external validity/generalizability?
- What is a "hidden" assumption?
- What is a difference-in-difference study design?
- What would threaten the internal validity of a difference-in-difference design?
- How do you interpret and use odds ratios, risk ratios, and marginal effects?

*Glied S. The Credibility Revolution in Economics and How It Has Changed Health Policy. JAMA Health Forum. 2021;2(11):e214335.

*Whitehurst, G. Does pre-k work? It depends how picky you are. Brookings. February 26, 2014.

*Staff of the Congressional Budget Office. How Economists Could Help Inform Economic and Budget Analysis Used by the US Congress. Journal of Economic Perspectives 2024;38(2):3-24.

*Turner N. Impact Over Orthodoxy. December 6, 2023. https://www.vera.org/news/impact-over-orthodoxy

*Ben-Menachem J. Malpractice or best practice? The fight over "rigor" in criminal justice reform.May 29, 2024. https://scatter.wordpress.com/2024/05/29/malpractice-or-best-practice-the-fight-over-rigor-in-criminal-justice-reform/

*Ben-Menachem J. "Research malpractice" or best practice? Debating "rigor" in criminal justice reform. May 29, 2024. https://jbenmenachem.substack.com/p/research-malpractice-or-best-practice

Oster E. Why I Look at Data Differently. https://parentdata.org/why-i-look-at-data-differently/ March 13, 2023.

Dowd B, R Town. Does X really cause Y? Changes in Health Care Finance and Organization monograph. September 2002. http://www.academyhealth.org/files/FileDownloads/DoesXCauseY.pdf

Oster E. Alcohol and Health. Cutting Through the Noise. January 26, 2023. https://parentdata.org/alcohol-and-health/

Joyce T, Bauer T, Minkoff H, Kaestner R. Welfare reform and perinatal health and health care use of latino women in California, New York City, and Texas. American Journal of Public Health 2001;91(11):1857-1864.

Auld C. A non-technical guide to the dueling Seattle minimum wage studies. ChrisAuld.com. July 3, 2017.

Soumerai SB, D Starr, SR Majumdar. How do you know which health care effectiveness research you can trust? A guide to study design for the perplexed. Preventing Chronic Disease. 2015;12(E101).

Grimes DA, Schulz KF. Making sense of odds and odds ratios. Obstetrics and Gynecology 2008;111(2 Pt 1):423-426.

Good intentions

*Spitalnic P. Certification of Medicare Diabetes Prevention Program. March 14, 2016.

Meyer H. Medicare Diabetes Prevention: Enrollment Short of Projections. Health Affairs 2021;40(11):1682-1687

American's Syringe Exchanges Kill Drug Users. The Economist. December 1, 2022.

St. Pierre RG, Layzer JI, Goodson BD, Bernstein LS. National Impact Evaluation of the Comprehensive Child Development Program. Abt Associates. June 1997.

Pradhan R. What Missouri Learned the Hard Way About Rapid Covid Testing in Schools. Kaiser Health News August 26, 2021.

Writing, tables, and graphs

- How can you help your reader understand your analysis?
- How can you communicate efficiently?
- How can you format tables and graphs to help your reader understand your results?

Nussbaumer, Cole. How to do it in Excel. November 10, 2011. http://www.storytellingwithdata.com/2011/11/how-to-do-it-in-excel.html

Schwabish, Jonathan A. An economist's guide to visualizing data. Journal of Economic Perspectives 2014;28(1):209-234.

Heavy B. Is Brevity the Soul of Success. Wall St. Journal. December 1, 2022.

Sensitivity analysis

- What is the purpose of a sensitivity analysis?
- What assumption(s) should be the focus of a sensitivity analysis?
- What are the different types of sensitivity analyses and when should you use them?
- How do you describe the results of a sensitivity analysis?

*Taylor M. What is sensitivity analysis? What is…? series. April 2009. http://www.whatisseries.co.uk/whatis/pdfs/What_is_sens_analy.pdf

Measuring costs

- How do insurers pay for hospital and physician care and drugs?
- What are some publicly available sources of data on health care costs?
- What is the "dead weight loss" associated with taxation?

*MEDPAC. Hospital Acute Inpatient Services Payment System. October 2020. http://medpac.gov/docs/default-source/payment-basics/medpac_payment_basics_20_hospital_final_sec.pdf?sfvrsn=0

*MEDPAC. Physicians and Other Health Professional Payment System. October 2020. http://medpac.gov/docs/default-source/payment-basics/medpac_payment_basics_20_physician_final_sec.pdf?sfvrsn=0

Barnett PG. An improved set of standards for finding cost for cost-effectiveness analysis. Medical Care 2008;47(7 S1):S82-S88.

Painter MW, Chernew ME. Counting Change. Robert Wood Johnson Foundation. http://www.rwjf.org/en/research-publications/find-rwjf-research/2012/03/counting-change.html

Riley GF. Administrative and claims records as sources of health care cost data. Medical Care 2009;47(7 S1): S51-S55.

Hay JW, Smeeding J, Carroll NV, Drummond M, Garrison LP, Mansley EC, Mullins CD, Mycka JM, Seal B, Shi L. Good research practices for measuring drug costs in cost effectiveness analyses: issues and recommendations: the ISPOR Drug Cost Task Force report--Part I. Value Health 2010;13(1):3-7.

Lund JL, Yabroff KR, Ibuka Y, Russell LB, Barnett PG, Lipscomb J, Lawrence WF, Brown ML. Inventory of data sources for estimating health care costs in the United States. Medical Care 2009;47(7 S1): S127-S142.

Regulatory Impact Analysis/Valuation/Cost benefit analysis

- What is the role of regulatory impact analysis in federal policy making?
- How do researchers estimate willingness-to-pay for reductions in mortality risk?
- What is the interpretation of the value of a statistical life?
- What are the advantages and disadvantages of assessing monetary values using contingent valuation?

*Sunstein, Cass R. The Economic Constitution of the United States. Journal of Economic Perspectives 2024;38(2):25-42.

*Viscusi WK. The value of life in legal contexts: survey and critique. American Law and Economics Review 2000;2:195-222.

*Economics Staff. Office of Economics and Analysis, Food and Drug Administration. Direct Final Rule to Revoke Use of Partially Hydrogenated Oils in Food. Federal Register (88 FR 53764), August 9, 2023. Docket No. FDA- FDA-2019-N-4750

*Department of Health and Human Services. Medicare and Medicaid Programs; Minimum Staffing Standards for Long-Term Care Facilities and Medicaid Institutional Payment Transparency Reporting. Federal Register 2023;88(171):61523-61429. (Focus on the Regulatory Impact Analysis that begins on page 61397.)

Viscusi WK, Gayer T. Safety at any price. Regulation Fall 2002.

Office of Management and Budget. Circular A-4. April 6, 2023.

Sandefur J. How Economists got Africa's AIDS Epidemic Wrong. May 31, 2023.

Cordes J, Dudley S, Kenkel DS, Nardinelli C, Robinson LA, Throton C, Viscusi WK. Promoting best practices for U.S. regulatory analysis. The Regulatory Review. October 12, 2023.

Cookson R. Distributional Cost-Effectiveness: Putting Money Where Your Mouth Is on Health Equity. Annals of Internal Medicine 2023;176(6):866-867.

Sunstein CR. Some Costs & Benefits of Cost Benefit Analysis. Daedalus. Summer 2021.

Dudley, SE. Regulatory oversight and benefit-cost analysis: a historical perspective. Journal of Cost Benefit Analysis 2020;11(1):62-70.

Vining A, Weimer DL. An assessment of important issues concerning the application of benefit-cost analysis to social policy. Journal of Benefit-Cost Analysis 2010;1(1):Article 6.

Robert C, Zeckhauser R. The methodology of normative policy analysis. Journal of Policy Analysis and Management 2011;30(3):613-643.

Bateman-House A. Bikes, helmets, and public health: decision-making when goods collide. American Journal of Public Health 2014;104(6):986-992.

Carson RT. Contingent valuation: a practical alternative when prices aren't available. Journal of Economic Perspectives 2012;26:27-42.

Hausman J. Contingent valuation: from dubious to hopeless Journal of Economic Perspectives 2012;26:43-56.

Kurth A, Weaver M, Lockhart D, Bielinski L. The benefit of health insurance coverage of contraceptives in a population-based sample. American Journal of Public Health 2004;94(8):1330-1332.

Ryan M, Farrar S. Using conjoint analysis to elicit preferences for health care. British Journal of Medicine 2000;320:1530-1533.

Zhang W, Bansback N, Anis AH. Measuring and valuing productivity loss due to poor health: A critical review. Social Science and Medicine 2011 Jan;72(2):185-92

Hanly P, Timmons A, Walsh PM, Sharp L. Breast and prostate cancer productivity costs: a comparison of the human capital approach and the friction cost approach. Value in Health 2012;15(3):429-36.

Food and Drug Administration. Regulatory Impact Analysis. Required Warnings for Cigarette Packages and Advertisements; Proposed Rule. Department of Health and Human Services. Federal Register. 2010;75(218): 69524-69564.

Basu S, O'Neill J, Sayer E, Petrie M, Bellin R, Berkowitz SA. Population Health Impact and Cost-Effectiveness of Community-Supported Agriculture Among Low-Income US Adults: A Microsimulation Analysis. American Journal of Public Health 2020;110(1):119-126.

Discounting and adjusting for inflation

- What is the purpose of discounting?
- What is purpose of adjusting for inflation?
- Why might official measures overstate inflation?

Greenstone M, JH Stock. The Right Discount Rate for Regulatory Costs and Benefits. Wall St. Journal. March 4, 2021.

Graboyes R. Medical care price indexes. Macroeconomic Data: A User's Guide, Roy Webb, ed.; Richmond: Federal Reserve Bank of Richmond: 1994. http://www.robertgraboyes.com/writings_files/MCPI.PDF

Webb RH, Willemse R. Macroeconomic price indexes. FRB Richmond Economic Review 1989; 75(4): 22-32. https://www.richmondfed.org/publications/research/special_reports/macroeconomic_data/pdf/macroecon_price_indexes.pdf

Council of Economic Advisors Issue Brief. Discounting for Public Policy: Theory and Recent Evidence on the Merits of Updating the Discount Rate. January 2017.

Hausfather Z, Peters GP. Emissions – the 'business as usual' story is midleading. Nature 2020; 557: 618-620.

Economics for policy analysis

- What is the relationship between market structure, prices, and production costs?
- What is the interpretation of elasticities?
- How can you use economic theory to predict the impact of policies?

Insurance simulation

- What is the difference between elasticity versus microsimulation-based models?
- How do models predict behavioral responses to changes in prices?
- How would you predict the impact of a new insurance option?

*Glied S, Tilipman N. Simulation modeling of health care policy. Annual Review of Public Health 2010;31:439-455.

*Galvani AP, Parpia AS, Foster EM, Singer BH, Fitzpatrick MC. Improving the prognosis of health care in the USA. Lancet 2020;395(10223):524-533.

Ringel JS, Eibner C, Girosi F, Cordova A, McGlynn EA. Modeling health care policy alternatives. Health Services Research 2010;45(5 Pt 2):1541-1558.

Sherry A. Glied, Anupama Arora, Claudia Solis-Roman. The CBO's Crystal Ball: How Well Did It Forecast the Effects of the Affordable Care Act? The Commonwealth Fund, December 2015.

COVID

- What is the basic structure of a SIR model?
- What are the key "hidden" assumptions of a SIR model?
- How is it possible to model the impact of lockdowns using SIR models?

*Tolles J, Luong T. Modeling Epidemics With Compartmental Models. Journal of the American Medical Association 2020;323(24):2515-2516.

Epelewicz J. The hard lessons of modeling the coronavirus pandemic. Quanta Magazine. January 28, 2021

BOILERPLATE

COMPETENCIES AND LEARNING OBJECTIVES

MPH/MSPH FOUNDATIONAL COMPETENCIES (CORE):

1. Apply epidemiological methods to the breadth of settings and situations in public health practice
2. Select quantitative data collection methods appropriate for a given public health context
3. Interpret results of data analysis for public health research, policy or practice
4. Discuss multiple dimensions of the policy-making process14, including the roles of ethics and evidence
5. Evaluate policies for their impact on public health and health equity
6. Apply "systems thinking" for resolving health policy problems.

HPM CONCENTRATION COMPETENCIES:

1. Apply principles of health economics in analyzing the behavior of healthcare market stakeholders.
2. Conduct economic evaluations of health services.
3. Utilize public finance theory to assess the impact of proposals to reform the financing and delivery of health services.
4. Prepare health policy briefings suitable for the range of policy stakeholders involved with the formulation and implementation of a health policy under consideration by decision makers.
5. Apply the tools of policy analysis to make quantitative predictions about the impact of policy changes.

RSPH POLICIES

Accessibility and Accommodations

Accessibility Services works with students who have disabilities to provide reasonable accommodations. In order to receive consideration for reasonable accommodations, you must contact the Office of Accessibility Services (OAS). It is the responsibility of the student to register with OAS. Please note that accommodations are not retroactive and that disability accommodations are not provided until an accommodation letter has been processed.

Students who registered with OAS and have a letter outlining their academic accommodations are strongly encouraged to coordinate a meeting time with me to discuss a protocol to implement the accommodations as needed throughout the semester. This meeting should occur as early in the semester as possible.

Contact Accessibility Services for more information at (404) 727-9877 or accessibility@emory.edu. Additional information is available at the OAS website at http://equityandinclusion.emory.edu/access/students/index.html

As the instructor of this course I endeavor to provide an inclusive learning environment. However, if you experience barriers to learning in this course, do not hesitate to discuss them with me and the Office for Equity and Inclusion, 404-727-9877.

	Policy critique	Policy analysis 1	Capstone
MPH/MSPH Foundational Competencies Assessed			
1. Apply epidemiological methods to the breadth of settings and situations in public health practice	✓	✓	✓
2. Select quantitative and qualitative data collection methods appropriate for a given public health context		✓	✓
3. Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software, as appropriate		✓	✓
4. Interpret results of data analysis for public health research, policy or practice	✓	✓	✓
5. Evaluate policies for their impact on public health and health equity		✓	✓
6. Select methods to evaluate public health programs		✓	✓
7. Apply "systems thinking" for resolving health policy problems.	✓	✓	✓
HPM Concentration Competencies Assessed			
1. Apply principles of health economics in analyzing the behavior of healthcare market stakeholders.	✓	✓	✓
2. Conduct economic evaluations of health services.		✓	✓
3. Utilize public finance theory to assess the impact of proposals to reform the financing and delivery of health services.	✓	✓	✓
4. Prepare health policy briefings suitable for the range of policy stakeholders involved with the formulation and implementation of a health policy under consideration by decision makers.		✓	✓
5. Apply the tools of policy analysis to make quantitative predictions about the impact of policy changes .	✓	✓	✓

Honor Code

You are bound by Emory University's Student Honor and Conduct Code. RSPH requires that all material submitted by a student fulfilling his or her academic course of study must be the original work of the student. Violations of academic honor include any action by a student indicating dishonesty or a lack of integrity in academic ethics. *Academic dishonesty refers to cheating, plagiarizing, assisting other students without authorization, lying, tampering, or stealing in performing any academic work, and will not be tolerated under any circumstances.*

The RSPH Honor Code states: "Plagiarism is the act of presenting as one's own work the expression, words, or ideas of another person whether published or unpublished (including the work of another student). A writer's work should be regarded as his/her own property." (http://www.sph.emory.edu/cms/current_students/enrollment_services/honor_code.html)

HPM 576 **July 24, 2024**

Final Project: A Policy Analysis on a Topic of Your Choice

Perform and describe an original analysis to predict the impact of a policy change.

The paper should present an original quantitative prediction. A paper consisting entirely of discussion and opinion will not receive credit. A paper reviewing another policy analysis will not receive credit. You may not use AI (for example, ChatGPT) to write the paper. If it helps, you may address your analysis to a specific audience.

Your paper should explain the policy change in some detail, the rationale behind it, arguments against it, and the mechanisms linking the policy change to the outcome. You should discuss implementation, if appropriate. Of course it should also present the analysis and justifications for key assumptions. You should include at least a one-way sensitivity analysis.

The paper should be no longer than 5 pages (aim for 3-5), single spaced. Use a 12 point font. The page limit includes graphs and tables but not references.

You are not required to take these intermediate steps, but if you do, you are more likely to produce a good final paper, have a more relaxed semester, and receive good, constructive feedback from me. If you do not turn in these products by the due dates below, I cannot promise that I will review them, especially drafts.

I will set up forms for you to turn in these products on Canvas.

Step 1. Pick a topic. September 24. You should be able to describe your topic in terms of a policy change and an outcome: I am going to predict the impact of [policy change] on [outcome].

1. Ideally, your topic should overlap with your career goals.
2. I encourage you, but do not require that, you choose a topic in the field of health policy.
3. Narrow down your topic as much as possible. "I am going to examine the impact of policies to reduce smoking" is not a topic. "I am going to predict the impact of taxing cigarettes on the share of teenagers who smoke." is a topic.
4. It is OK to take an existing policy analysis and modify it, as long as your modification counts as a substantial improvement. You should reference the original analysis.
5. You should try to get a sense of whether a topic is "doable" before selecting it. There are some topics that are interesting but there is little information on which to base assumptions.
6. An aspiration is not a policy.
7. It is fine to perform an analysis that addresses a policy change in another country or issues in global health.
8. You should not try to undertake an original study requiring a substantial amount of data analysis and manipulation. If your first thought is, "I will get data on…", then you are thinking about this assignment the wrong way.
9. If you are spending a lot of time thinking about which state or geographic unit to focus on, you are probably thinking about this assignment the wrong way. The analysis you do for one state will often have a very similar (or the same) structure to the analysis you do for another state.

Step 2. Identify the key behavioral assumption or assumptions. October 10. State the assumption and review the relevant evidence. For example, "They key assumption is how smokers will change cigarette consumption in response to a change in retail prices. The literature shows that…." Assumptions about how changes in policy change behavior are often the most difficult to get right. You should state the assumption and review the relevant evidence, which in some cases will be only one study, in 2-3 paragraphs.

1. You should identify the assumption and at least one study on which to base the assumption.
2. In some cases, you will be lucky to find one study that estimates the relevant effect. In other cases, there will be multiple studies, and you will need to come up with a way to sort through the evidence and either pick what you think is the best study or take something like an average across studies.
3. You should be able to describe the study design underlying the study on which you base the assumption and describe key limitations.

4. Many students lose points for failing to accurately describe the study design of the studies that are the sources of key behavioral assumptions.

Step 3. Tables. October 24. Turn in the tables describing your analysis. Good tables make your analysis much easier to follow.

1. Tables should be correctly formatted.
2. The number of tables will depend on your analysis.

Step 4. Draft for review. November 19. I will review a draft. It should be a complete, edited paper. My feedback will provide examples of the types of edits and corrections you should make on your own. I will not necessarily comment or highlight every problem.

1. Use yellow highlight to indicate every place that you mention the main result of your analysis.
2. Use green highlight to indicate where you discuss your key assumption re policy effects or behavior changes and the evidence behind it (see tips 1 and 2 below).

Step 5. Final paper. December 12. 5:00 pm.

Final paper rubric

	Levels	
High	Medium	Low
Brevity: The paper is short as it could be without sacrificing important content. Allow the content to shine through.		
Meets expectations.	There is room to reduce the word count by making minor adjustments to sentences and paragraphs.	There are many opportunities to make the paper shorter.
5.0	4.0	2.0
Clarity: The paper should be easy to read. There is no awkward phrasing. Sentences do not require re-reading to discern their meaning. The paper is well-organized. Jargon and acronyms are kept to a minimum. There are no non-sequiturs. It is easy to follow and understand the steps in the analysis. It is easy to understand the main result and how it was derived.		
Meets expectations	There are a few opportunities to improve clarity.	Sentences and paragraphs are difficult to understand. Key concepts and ideas are not well-explained.
10.0	8.0	4.0
Policy description: The policy is clearly defined. The paper provides some information, but not too much, about how the policy will be implemented and the party that is responsible for deciding whether to adopt it. The background and policy are described in a way so that it is easy for the reader to understand the relationship between the policy and the outcome. The mechanism underlying the impact of the policy change on the outcome is clear. The amount of explanation will vary from case to case. For example, an analysis of the impact of increasing cigarette taxes on smoking rates would require only a brief explanation of the policy. The policy is already established, and it is fairly intuitive why taxes and smoking are related. An analysis of how prohibiting pharmaceutical companies from funding charities that help offset patients' medication copayments would affect pharmaceutical spending would require more explanation. There is a match between the policy and the analysis.		
Meets expectations.	Some key details about the policy and mechanism are omitted.	The policy is not defined. The mechanism linking the policy to the outcome is not described.
10.0	8.0	6.0
Mastery of Concepts: The paper should display an understanding of concepts from economics, epidemiology, health policy and public health that ought to be familiar to a 2nd year health policy and management student.		
Meets expectations	Some concepts are not accurately described.	There are major mistakes in how concepts are described and characterized.
5.0	4.0	2.0
Design of the analysis. The structure of the analysis is logical. Key assumptions, especially those related to causal effects, are clearly stated and justified. Important limitations of the analysis are acknowledged. Nitpicky limitations are not mentioned. The analysis conforms to the instructions in the assignment.		
Meets expectations	Room for improvement.	Major flaws
20.0	16.0	8.0
Tables and figures are formatted according to the guidelines. They are easy to read. Each has a purpose.		
Meets expectations.	A little room for improvement.	Tables and figures are difficult to read and understand.
5.0	4.0	2.0

Assumptions

1. Policy analysis assumptions are numerical. For example, "I assume that an increase in the price of gas will reduce truck sales." is just stating a theory, not an assumption. An assumption would be something like, "I assume that a 10% increase in the price of gas will reduce truck sales by 3%." Describe, in non-technical terms, the study design behind studies used as the basis of assumptions about causal effects.
2. Pay particular attention to assumptions that describe how changes in policy change individual, firm, or government behavior. If the assumption was based on a randomized trial, say so. If not, describe, in non-technical terms, how this assumption was estimated and the direction of bias, if any.
3. Same goes for assumptions about the impact of exposures on health outcomes (for example, red wine consumption and heart disease incidence).
4. Suppose you are predicting the impact of a policy in a particular geographic area. Further suppose you base your assumptions on studies conducted in other areas. Before you list your use of an assumption based on a study conducted in one geographic area to predict the impact of a policy in another area as a limitation, stop and think. Are the areas really so different that the assumption is way off-the-mark? If so, describe why.
5. Same as above, but for time.

Tables (and other exhibits)

6. Remove unnecessary lines from tables and graphs. Maximize the content to ink ratio.
7. The font in tables and graphs should be as large as or almost as large as the text font.
8. Round to significant digits. For example, if you predict that a policy will decrease spending by $23,348,319.76, report it as $23,348,319 or, better yet, $23 million. (Same goes for references to numbers in the text.)
9. Numbers in tables should be right-aligned.
10. Create tables in Excel or using the table function in Word rather than using tabs in or spacing in text.
11. Try to write row labels on a single line (text on a single line is easier to read).
12. You can eliminate text like "Number of" or "Percent of". (It should be obvious—if there is a percent, put a "%" after the number of a "(%)" after the row label.)
13. Rows in tables should be single-spaced (makes it easier to follow the progression of calculations).
14. Eliminate unnecessary whitespace between rows labels and numbers. But make spart use of whitespace to group sections of tables.
15. Use row labels for descriptive text. Don't put text in the same cell as numbers. For example, write "People with diabetes (millions) 34,000,000" rather than "People with diabetes 34,000,000 million."
16. There is no set guideline on how many tables you should have. It depends on the analysis. Ask yourself, "How would I want to see the information displayed if I was reading the paper?" Long tables, especially those that spill over from one page to another, can be difficult to read. Break those up into smaller tables.

Organization

17. Is the policy clearly described? For example, merely citing the name of a piece of legislation is insufficient. Is the mechanism linking the policy to the outcome clearly described (in cases where it is not totally obvious)?
18. Make the goal of the analysis clear early on. If I've read a page and still don't know the objective, there is a problem.
19. Shorter paragraphs improve comprehension.
20. Use informative section headings.
21. If you include a sensitivity analysis, do not describe it until after you have fully presented the main analysis.
22. Make your main results easy to find and understand. It is OK to repeat your main result.

Word choice

23. Beware of "this." If you use "this" at the beginning of a sentence, make sure it is clear what "this" refers to.
24. Watch out for "result in." If you have a sentence like, "Enacting a tax will result in a reduction in…", change it to "Enacting a tax will reduce…"
25. The word "overestimation" should not appear in your paper. Same for the word "utilize".
26. Avoid jargon (for example, "relative risk"). If you must use it, explain it.
27. Avoid the phrase, "proposed policy." Just name the actual policy (for example, "tax increases" or "coverage").
28. Keep acronyms to a minimum or, better yet, avoid them completely.
29. It is fine to write in the first person and use active voice: "I assumed that…", "I predicted that…", "We conclude that…"
30. Know the difference between "cost-saving" and "cost-effective" and use these terms correctly.
31. Consider rewording sentences over 25 words or breaking them up into two shorter sentences.
32. Cut unnecessary sentences and words. Cut relentlessly. But cut words, not content.

CHAPTER 1: THE FIELD OF POLICY ANALYSIS

Whoever does that kind of thing?

Trump: It's a tremendous tax cut for people, and people are really learning. I don't have to explain it. They're just seeing a lot more money show up in their check that they didn't see a couple of years ago.

Hauser: And you said $5 billion in savings here in the state of Minnesota --

Trump: Yes.

Hauser: Is that according to -- who?

Trump: $5 billion according to whoever does that kind of thing.

Case 1: On October 11, 2017 President Trump said that if Mexico and Canada would not agree to renegotiate the North American Free Trade Agreement (NAFTA), "it'll be terminated and that will be fine." Five days later the *Wall Street Journal*[1] ran an editorial touting the result of a Boston Consulting Group analysis that "ending Nafta could mean the loss of 50,000 American jobs in the auto-parts industry as Mexico and Canada revert to pre-Nafta tariffs."

Case 2: The Affordable Care Act included a tax on high cost employer health plans, the so-called Cadillac tax. Economists have long argued that the tax deductibility of insurance leads employers to offer overly generous plans. The Cadillac tax attempted to restore balance to the tax treatment of wages versus health insurance benefits while raising funds to extend insurance coverage to people not covered by employer plans. The Congressional Budget Office (CBO) and Congressional Joint Committee on Taxation predicted that the Cadillac tax would increase federal revenue by $193 billion between 2019 and 2029.[2] Of that, employers would pay $96 billion. The remainder would be paid by employees. The CBO projected that employers would respond to the tax by shifting compensation from

[1] Editors. Trump's Nafta threat. *Wall Street Journal* October 16, 2017. Page A018.
[2] Congressional Budget Office. Federal Subsidies for Health Insurance Coverage for People Under Age 65: 2019 to 2029. May 2019.

insurance to wages (which would increase federal individual income tax receipts), though opponents of the tax were skeptical. Congress repealed the tax in 219.

What is policy analysis?

The goal of policy analysis is to project the future impact of policies. Our ancestors attempted to predict the future by observing seemingly random patterns in nature or manmade objects. Examples include alectromancy (observing a rooster pecking at a grain), ceromancy (dripping wax), and extispicy (animal intestines). Policy analysis tries to put prediction on a sounder, more scientific footing.

For purposes of this course, "policy analysis" is a term used to describe quantitative predictions of the impact of yet-to-be enacted policies. Elsewhere, the term is sometimes used to describe verbal descriptions of regulations and laws, memos that lay out options for addressing specific problems, summaries of feedback from stakeholders, subjective ratings of how policies satisfy various objectives, and analyses describing the challenges associated with implementing policies.

Caravaggio's Fortune Teller, 1595

Cost-benefit analysis, conducted from the societal perspective, is the foundational framework for policy analysis. But most policy analyses are not cost-benefit analyses and are not conducted from the societal perspective. They focus on outcomes that are more tangible, easier to digest, and relevant to policymakers and the public: jobs created, smoking rates, HIV prevalence, costs to patients, costs to firms, and, especially, costs to the government.

Often, policy analyses extend academic research by extrapolating results to salient outcomes (i.e., outcomes that normal people care about). Academic studies often measure the impact of policies or interventions on intermediate outcomes for practical reasons. For example, an academic study may measure the impact of an educational intervention on test scores or grade completion. But policymakers would rather know how it affects employment rates, earnings, incarceration rates, government spending, or other "downstream" outcomes. A policy analysis can make the connection between the intervention, results reported in an academic study, and outcomes that get the attention of policymakers and the media.

Many policy analyses assess the impact of policy changes on government spending. Partly, this is due to Senate rules that make it harder to pass legislation that increases the deficit, but many policymakers are concerned about the size of the deficit and federal debt. When a member of Congress considers a new policy, the first question they usually ask is, "How much will it cost?"

Analyses where the outcome is the cost are not simply accounting exercises. Instead, they need to take account of the complex effects of policy changes. For example, funding a program to treat uninsured HIV patients may reduce transmission, which could partially or completely offset the up-front costs of the program. To make this kind of prediction, an analyst would need to predict the impact of treatment availability on treatment rates, the

impact of treatment on HIV levels, and the impact of HIV levels on transmission opportunities and rates. The analyst would need to use methods and results from economics and epidemiology.

Some analyses are complex, but complexity for its own sake is not a virtue. The best analyses and models strip away extraneous assumptions and calculations and focus on the heart of the matter.

Simple can be harder than complex because you need to get your thinking straight first. -Steve Jobs

Policy analysis: a brief and incomplete history

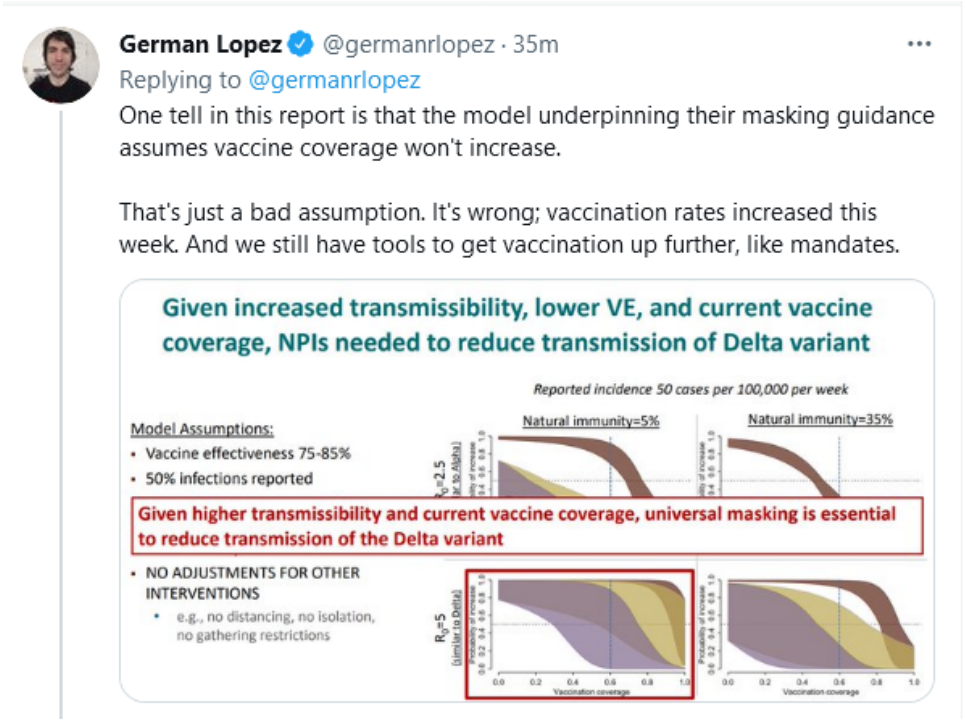
The Progressive Movement, a reaction to the machine politics of the late 1800s, emphasized "scientific" decisionmaking and the application of modern management techniques, pioneered by Frederick Winslow Taylor, to eliminate waste and improve efficiency. It elevated the status of experts and sought to reduce the influence of parochial political concerns on policymaking.

Jumping ahead, World War II and the Cold War presented many opportunities for experts to influence defense policy. The stakes were so large, the weapons so costly and destructive, that seat-of-the-pants decision making could lead to catastrophic failures. Here is an example of expertise applied to a pressing problem faced by military leaders.

> During World War II, [Abraham] Wald applied his statistical skills when considering how to minimize bomber losses to enemy fire. Researchers from the Center for Naval Analyses had conducted a study of the damage done to aircraft that had returned from missions, and had recommended that armor be added to the areas that showed the most damage. Wald noted that the study only considered the aircraft that had survived their missions—the bombers that had been shot down were not present for the damage assessment. The holes in the returning aircraft, then, represented areas where a bomber could take damage and still return home safely. Wald proposed that the Navy instead reinforce the areas where the returning aircraft were unscathed, since those were the areas that, if hit, would cause the plane to be lost.[8][9] This is still considered today seminal work in the then-fledgling discipline of operational research.
>
> -- https://en.wikipedia.org/wiki/Abraham_Wald

Ironically, Wald died in a plane crash. Nobel prize winner John Nash briefly worked at the RAND Corporation on game theory, which the Air Force used to develop strategies for deterring a nuclear attack by the Soviet Union.

In the 1960s and 70s the federal government expanded its reach into areas like health, education, and the environment where previously it had only minimal involvement in these areas. This shift created a growing demand for analysis and program evaluation. Around the same time, University of Chicago economist and eventual Nobel Prize winner Gary Becker started to examine issues like discrimination, marriage, and crime that went well beyond the traditional boundaries of the discipline. His work showed how the tools of economics could be applied to analyze many different types of policies, not just those directly related to macroeconomic issues like unemployment rates and inflation.



More recently, businesses have increasingly come to realize the value of formal, quantitative analysis. In his book *Moneyball*, Michael Lewis describes how the Oakland A's, rather than relying solely on the subjective judgements of baseball scouts, combined data on player characteristics with insights about the game to select players that were undervalued. (It is a great book and worth reading even if you don't like baseball.) Today many sports franchises employ statisticians and analysts, some of whom have even become general managers. The demand for analysis among decisionmakers in finance, sports, government, and other fields has never been greater.

I put policy analysis into a few different categories. There are analyses that are required by law or executive order. And then there are policy analyses performed by academics, consulting firms, think tanks, and trade associations to influence decisionmakers.

The Congressional Budget Office

The Congressional Budget Office, or CBO, is the most influential and important body conducting policy analysis in the United States. Under the rules the Senate sets for itself, the requirements for passing a bill that increases the budget deficit are more stringent. A bill that increases the deficit requires 60 votes.

The CBO is the official scorekeeper: it analyzes the impact of proposed laws on federal spending and revenue over a 10 year period. When writing bills, lawmakers try to anticipate the CBO analysis and structure provisions to yield a favorable CBO "score". Sometimes, the cart drives the horse, in the sense that Congressmen shape a law to achieve the best score given the CBO's modeling assumptions and scoring rules. This was the case with the Affordable Care Act: "As it made its way through Congress in 2009 and 2010, the

Affordable Care Act basically took shape through a long series of back-and-forth adjustments between the relevant committees and the Congressional Budget Office, intended to tweak the coverage and cost scores of the bill to accord with the idiosyncrasies of CBO's modeling."[3,4] The Affordable Care Act passed in 2010, but major provisions, including the Medicaid expansion, did not take effect until 2014. Critics charged that the drafters delayed implementation of these costly provisions until year 4 of the 10 year CBO budget window so that the CBO analysis would show that the Act was deficit neutral.

The CBO does not publish its methods or models. Senator Mike Lee has introduced a bill that would require the CBO to do so. It is called the Show Your Work Act of 2017.

Regulatory impact analysis

Federal regulatory agencies are required to perform a cost benefit analysis of major regulations and have a difficult time enacting regulations unless the benefits outweigh the costs. We will return to this topic in another chapter.

Merger analysis

The Department of Justice and the Federal Trade Commission have authority to block mergers between companies that will harm consumers. They typically commission analyses to project the impact of the mergers on prices and other outcomes of interest. The merging companies will commission their own analysis. These analyses are arcane and highly technical, so we won't talk about them too much. But it is a good business. People who can execute and testify about these analyses are well compensated.

State requirements

State governments have idiosyncratic requirements for policy analyses. In California, laws that add new health insurance benefit mandates or modify existing ones are analyzed by the California Health Benefits Review Program. The Program projects the impact on community health, use of the service, and health care costs. The New Jersey legislature is considering (as of this writing) a bill that would require the state's Office of Legislative Affairs to prepare "racial and ethnic impact statements" that project how changes to criminal justice laws would affect minorities.

Policy analysis in the private sector

Outside the federal government, there are a number of consulting firms that perform policy analysis. These include niche players, for whom policy analysis is a core part of their business, and larger firms like PwC (PricewaterhouseCoopers), that perform policy analysis in addition to their usual management consulting activities. Some of the smaller firms that are active in the health care sector are Lewin and Avalere Health.

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[3] Saldin, Robert P. When Bad Policy Makes Good Politics: Running the Numbers on Health Reform. Oxford University Press. New York, NY 2017.
[4] Levin, Yuval. The Congressional Budget Office Needs to Be Reformed. National Review Online. June 2, 2017.

Non-partisan think tanks and contract research organizations that perform policy analysis under contract include RAND, Research Triangle Institute, Mathematica Policy Research, and the Urban Institute. With the exception of Mathematica, all are non-profit. There are also a number of associations, like Pharma and the American Cancer Society, ideologically-oriented think tanks, like the American Enterprise Institute and Families USA, and non-partisan research groups, like the Employee Benefit Research Institute, that produce policy analysis.

Advocacy groups, think tanks, and lobbyists release policy analyses to influence the opinions of policymakers, the media, and, in some cases, the general public. Here is an instance where the *Wall Street Journal* editorial page referred to the findings of a policy analysis of the cost of deporting illegal immigrants.

> Donald Trump and Ted Cruz say they'd deport all of the 11.3 million or so undocumented immigrants living in the U.S. They don't say how they would pull off this forced human exodus. But new research shows that executing on this promise would require at least $400 billion in new federal spending and reduce U.S. GDP by about $1 trillion. A study released this month by the American Action Forum, a free-market think tank led by economist Doug Holtz-Eakin, walks through the process of evicting 11 million people over two years, a time frame Mr. Trump has floated. The report assumes that about 20% of those here illegally would leave voluntarily once the roundups begin. But that still leaves about nine million to find and deport.[5]

Here is another discussing a policy requiring groceries and food manufacturers to label products with genetically modified organisms.

> Consumers will pay through higher grocery bills, perhaps $500 a year for a family of four, according to a Cornell University study of a similar proposal in New York. A recent study by economic consult John Dunham & Associates found that if national companies react to Vermont's law by switching to non-GMO commodities— most of which cost about 10% more—a family would pay $1,050 more a year for food. (Opponents of the law financed the study).[6]

Most policy analysis produced in the private sector are narrowly targeted at elites: corporate executives, Congressional and Executive Branch staff, think tank employees, and reporters at media outlets that cater to the rich and powerful. For example, pharmacy benefit manager Express Scripts released an analysis in 2013 predicting savings to the state of California if the Food and Drug Administration allowed pharmaceutical firms to sell biosimilars (kind of like generic copies of genetically engineered drugs). Given the obscure topic, Express Scripts probably did not expect to receive a lot of media coverage. Rather, they hoped the analysis would make key opinion leaders in the state more sympathetic to their cause.

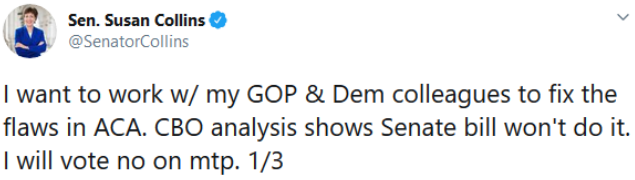
There are cases where the audience for a policy analysis is the general public. Trying to win approval for public funding for a new stadium, the Minnesota Vikings commissioned a policy analysis to show the economic benefits of the stadium for the local economy, the state

[5] Editors. The Costs of Mass Deportation. Wall St. Journal March 21, 2016.
[6] Editors. Vermont Invades Your Kitchen. Wall St. Journal March 10, 2016.

government, and the construction industry.[7] The analysis was widely reported in the local media.

Does policy analysis influence policy?

In 2016, President Trump and many Congressional Republicans ran on a platform of repealing the Affordable Care Act. Their position was unambiguous. In May of 2017, the House of Representatives voted 217 to 213 to repeal the Act. In June, the Congressional Budget Office came out with a revised projection of the impact of repeal. It showed that 22 million people would lose coverage. Confronted with the projection, Senator John McCain stated, "Well, obviously that's not good news." In July, the Senate took up the issue. Two Republican Senators, Susan Collins and Lisa Murkowski, came out against the bill. In a dramatic move, previously undecided Senator John McCain, who had been absent while he received treatment for a brain tumor, returned to the Senate to cast the deciding vote against repeal, which was defeated in a 49-51 vote. It is unclear if the CBO projection influenced Senators' votes or merely gave them cover for a position they would have taken anyway. But, to many observers, the CBO's projections of large increases in the uninsured population swayed public opinion and votes against repeal. Policy analysis made a difference.



The case of COVID and March 2020 lockdowns provides a particularly powerful illustration of the ability of policy analysis to influence policy. We will discuss COVID modeling in another chapter.

There are also many instances where decisions are made in spite of or in the absence of a policy analysis. Policy analyses have an important role to play in highlighting unintended consequences. Facing pressure from New York state governor Andrew Cuomo, Entergy, Inc. closed its Indian Point nuclear plant in Westchester County without performing an environmental impact review. (Opponents of the shutdown argued that a review was required under the state's Environmental Quality Review Act.) The plant was ostensibly closed for environmental reasons, but an analysis might have shown that replacing the energy from the nuclear plant with energy from gas-powered plants would increase carbon dioxide emissions.[8,9]

[7] U.S. Bank Stadium. Economic Impact. http://www.vikings.com/stadium/new-stadium/economic-impact.html
[8] Editors. Cuomo's Nuclear Short Circuit. Wall St. Journal. May 18, 2017
[9] Giambusso, David, Marie J. French. Cuomo to announce closure of Indian Point. Politico. January 6, 2017. http://www.politico.com/states/new-jersey/story/2017/01/sources-cuomo-to-announce-closure-of-indian-point-108520

An example

In 2008 the California state legislature considered a bill requiring restaurant chains to post calorie counts. Obesity rates have increased rapidly, paralleling the increase in the number of meals consumed at restaurants. Consumers and even nutritionists tend to underestimate the calories in restaurant food. Menu labeling could reduce obesity rates if, as a result of viewing calorie labels, restaurant patrons shift to lower calorie items and consume fewer calories in total.

A 2008 analysis by Los Angeles County's Department of Public Health predicted that posting calorie counts in restaurant chains with 15 or more locations would prevent 38.9% of the weight gain in the population that would have otherwise occurred during the course of a year. [10]

The analysis combines assumptions about restaurant revenue, the percent of revenue that accrues to chains subject to the law, and the price per meal to calculate the number of meals Los Angles consumers eat at restaurants each year. It then calculates how labeling would affect weight gain based on assumptions about the impact of labeling on consumption of low calorie meals, the difference in calories between regular and low calorie meals, the relationship between calories consumed and weight (3,500 additional calories equals one pound), and baseline trends in weight gain.

The key assumption in the analysis links labeling to consumer behavior. The authors assume that the share of patrons ordering reduced-calorie meals would increase by 10 percentage points if menus were labeled. This assumption is based on a study[11] that randomly-assigned menus with and without calorie counts to subjects in a mail survey and asked them to select an item. The share of subjects ordering the low calorie item (a sandwich "piled high with succulent turkey") was 10 percentage points higher among subjects receiving the menus with calorie counts.

Consumers' food choices in the real world may differ significantly from respondents' hypothetical responses to a mail survey. Respondents might be more willing to say that they would choose the low calorie turkey sandwich over the "deluxe hamburger with fries" (another one of the menu items) given that they did not actually have to eat it. The real-world effect of labeling might be less than 10 percentage points.

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[10] Simon P, CJ Jarosz, T Kuo, JE Fielding. *Menu Labeling as a Potential Strategy for Combatting the Obesity Epidemic.* County of Los Angeles Public Health. May 2008. http://publichealth.lacounty.gov/docs/menu_labeling_report_2008.pdf

[11] Burton S, Creyer EH, Kees J, Huggins K. Attacking the Obesity Epidemic: The Potential Health Benefits of Providing Nutrition Information in Restaurants. *American Journal of Public Health*. 2006;96(9):1669-1675. doi:10.2105/AJPH.2004.054973.

The survey asked respondents to make a one-time choice. If the effect of menu labeling wanes over time, the study will have overestimated the impact.

The response rate to the survey was only 50%. The study will have overestimated the impact of menu labeling if subjects who were more interested in health and nutrition were more likely to return the survey.

Ninety-seven percent of respondents had a high school degree compared to 88% of persons age 25 and older in the US.[12] It is unclear whether the real effect of labeling would be larger or smaller based on differences between the study sample and the U.S. population. Well-educated consumers may be able to better interpret calorie counts, but they may also be more informed about items' caloric content in the absence of menu labeling.

Another key assumption is that low calorie restaurant meals would have 100 fewer calories than regular meals. This assumption was based on a "personal communication", and so it is difficult to assess its validity.

According to the analysis, residents of Los Angeles gain 6.8 million pounds annually. The authors predict that labeling would prevent 2.6 million pounds of weight gain, or 38.9%, of the weight gain that would otherwise occur. The outcome is difficult to explain and put into context. It might have been more helpful to know how labeling would change the share of residents who are overweight or obese.

The analysis implicitly assumes that decreases in the amount of calories consumed at restaurants will not be offset by increases in the number of calories consumed at home. It is possible that patrons who consume low calorie meals at restaurants will compensate by consuming more calories at home, offsetting some of the benefits of labeling.

[12] Ryan CL, K Bauman. *Educational Attainment in the United States: 2015*. U.S. Census Bureau. March 2016.

Variable	Estimate	Data Source/ Method of Calculation
1. Total annual restaurant revenue, Los Angeles County	$14,600,000,000	Projected restaurant sales for 2007 in California as reported by National Restaurant Association, web site: Http://www.restaurant.org, accessed September
2. Large chain restaurant market share - 15 or more stores in California	51%	Extrapolated information from the NYPD Group, 2005; cited in the U.S. District Court Declaration of Thomas R. Frieden, Commissioner of the New York
3. Large chain restaurant revenue, Los Angeles County	$7,446,000,000	Calculated by multiplying the estimates in variables 1 and 2.
4. Average price per meal in large chain restaurants (includes fast food and sit-down restaurants)	$7.80	Based on national meal price estimates in 1992 (Jekanowski, 1999), adjusted for inflation using a factor of 2.866% per year compounded (based on the
5. Annual number of meals served in large chain restaurants, Los Angeles County	954,615,385	Calculated by dividing the estimate in variable 3 by the estimate in variable 4.
6. Annual number of meals served, ages 0-4 years	36,500,000	Estimate derived from the 2005 Los Angeles County Health Survey data.
7. Annual number of meals served, ages 5 and older	918,115,385	Calculated by subtracting the estimate in variable 6 from the estimate in variable 5.
8. Percentage of large chain restaurant patrons who select reduced-calorie meals as a result	10%	Extrapolated from data published by Burton et al., Am J Public Health 2006;96:1669-1675.
9. Annual number of reduced-calorie meals	91,811,538	Calculated by multiplying the estimates in variables 7 and 8.
10. Average amount of calorie reduction per meal	100	Unpublished survey data (person communication: Dr. Lynn Silver, New York City Department of Health and Mental Hygiene, December 3, 2007).
11. Total annual number of reduced calories attributable to menu labeling	9,181,156,846	Calculated by multiplying the estimates in variables 9 and 10.
12. Calories per pound of weight	3,500	Duyff RL. American Dietetic Association *Complete Food and Nutrition Guide*. Hoboken, New Jersey: John Wiley and Sons, 2002 (page 36).
13. Total annual pounds of weight loss attributable to menu labeling	2,623,187	Calculated by dividing the estimate in variable 11 by the estimate in variable 12.
14. Average annual population weight gain, ages 18 years and older (pounds)	5,500,000	Calculated using data from the 1997 and 2005 Los Angeles County Health Surveys.
15. Average annual population weight gain, ages 5 to 17 years (pounds)	1,250,000	Calculated using data from the 1999 and 2006 California Department of Education Physical Fitness Testing Program.
16. Average annual population weight gain, ages 5 years and older (pounds)	6,750,000	Calculated as the sum of the estimated in variables 14 and 15.
17. Percentage of population weight gain averted due to menu labeling	38.90%	Calculated by dividing the estimate in variable 13 by the estimate in variable 16.

Since 2008, over 30 studies have retrospectively evaluated the impact of state or local labeling laws on behavior.[13] These assess the "real world" impact of menu labeling on caloric consumption. The authors of a review article[13] conclude that, "there is an abundance of evidence that suggests calorie labeling, as it is currently being implemented, has no impact on overall food purchases or consumption for the population as a whole."

Academic research versus policy analysis

In some cases policy analyses are performed and published as academic studies, but in most cases they are not. Policy analysis and academic research exist in related but different spheres.

Academic research is historical, even when it is not being performed by historians. Academic researchers describe data that have been collected and experiments performed in the past. Policy analysis is future-oriented. The goal is to project what will happen in the future if a particular policy is changed. Of course it is helpful and usually necessary to look back in time to make projections into the future, but the goal is always to make predictions about events that have yet to occur.

Differences between academic research and policy analysis

Academic research	Policy analysis
Historical	Forward-looking
Descriptive	Predictive
Originality	Speed
Objective	Client-driven
Rigor	Back-of-the-envelope
Broad perspective	Narrow perspective
Scholarly	Accessible

Adopted from Table 2.1 in Weimer and Vining, *Policy Analysis: Concepts and Practice*, 1999.

While most academic researchers work hard, academic research often proceeds at a leisurely pace. The goal is to uncover the truth, however long that may take. By contrast, most policy analysis is conducted quickly. Policymakers may have an impending decision, and they need an analysis as soon as possible. The length of time between conception to completion for a policy analysis is typically weeks, not the months or years that an original academic study takes to complete. For this reason, policy analysis has to rely on previously published studies. In academic research, originality is prized. In policy analysis, speed and accuracy are more important. It is not feasible to perform an original analysis in most cases.

Ideally, academic research is objective, conducted by researchers who do not have a stake in the outcome. By contrast, many policy analyses are sponsored by interested parties. It is client-driven, with varying degrees of involvement from the client. It is important that a policy analysis have the veneer of objectivity, but it is unlikely that a client would pay money for an analysis that is not helpful to its cause.

Academic research is inherently conservative, not in the political sense, but rather in the sense that researchers have to be very careful about making assumptions and drawing inferences from data. Conclusions are usually cautiously stated. Rigor and formality are

[13] Kiszko KM, Martinez OD, Abrams C, Elbel B. The influence of calorie labeling on food orders and consumption: A review of the literature. *Journal of Community Health*. 2014;39(6):1248-1269.

prized. People who work in policy analysis do not have that luxury. They cannot hem and haw about the need to conduct more research. They need to come up with an answer, and they need to come up with it quickly based on whatever evidence is available. There is a greater tolerance for logical leaps and back-of-the envelope calculations. Support for assumptions can come from industry sources, government reports, and interviews in addition to peer-reviewed publications.

Academic research in the social sciences often adopts a societal perspective (even if that is not explicitly stated). If a study focuses on a narrow endpoint, the study manuscript will carefully acknowledge the broader effects of an intervention or policy change.

Academic research is scholarly. Researchers write for other researchers, and think nothing of using jargon like “cluster-adjusted standard errors” or “Pareto optimality”. Policy analysis tries to be more accessible. The audience includes policymakers, journalists, and even the general public. Technical concepts need to be explained in plain language, and there is relatively more emphasis placed on simplicity and transparency and less on rigor.

CHAPTER 2: THINKING LIKE A POLICY ANALYST

How do you perform a policy analysis?

In this section, I'll try to explain how to perform a policy analysis. But I have bad news: there is no formula. There is no cookbook approach. Each policy analysis is different. Patton and Sawicki[1] have a good quote about performing a policy analysis.

> The principal tools of the policy planner are logic, common sense, and experience with particular substantive areas. It helps to be practiced in data analysis, rational problem solving, and other specific skills. But more often than not we design our own approach or methodology to policy problems.

So how do you get started. First, you need to identify a well-defined policy, the more detail the better. For example: Increase taxes on cigarettes from $1.50 to $2.00 per pack. Eliminate cost-sharing for colon cancer screening. Reduce the payment for imaging services performed on contiguous body parts when performed on the same day. Allow physicians to take ownership stakes in hospitals.

Second, you need to identify an outcome. A good place to start is to think about which outcome is of greatest interest to the people who will decide whether or not to adopt the policy. Which outcome is the most *salient*?

Third, draw a model of the connection between the policy and the outcome. For example:

> Increase in cigarette taxes => increase in the retail price of cigarettes => decrease in smoking => decrease in the incidence of lung cancer => decrease in spending on lung cancer

Sometimes, you might not be able to draw the connection between the outcome you really care about and the policy, in which case you can settle for predicting the impact of the policy on an intermediate outcome. You should not report this model in your analysis, unless it is especially complicated.

Fourth, with the model in-hand, think about the types of assumptions you need to make the links, represented above by =>. For example, you need an assumption about how much of any cigarette tax will be passed on to consumers in the form of higher prices. You need an assumption about how smoking behavior changes in response to retail prices.

Fifth, you should identify numerical values for each assumption from published studies or other sources. We'll spend a lot of time on this part. But for now, know that you should not try to perform an original data analysis.

[1] Patton CV, DS Sawicki. Basic Methods of Policy Analysis and Planning. Prentice hall, Englewood Cliffs, New Jersey. 1993.

Sixth, combine the assumptions in a table (or tables) and calculate the result. An analysis combines assumptions with your own calculations. A table just listing random statistics you collected is not an analysis.

And you're done. Easy!

Electric charging stations

A colleague tweeted this out in 2018:

Is building charging stations a good use of the funds? Many people think that funds obtained from legal settlements ought to be spent on related programs.[2] For example, funds from the 1998 Tobacco Master Settlement Agreement should be devoted to tobacco control. In the case of Virginia's electric charging stations, the funds were obtained from a settlement with Volkswagen. The company admitted to installing "cheat" software in its cars. During Environmental Protection Agency emissions tests, the software would activate emissions control equipment. Otherwise, the equipment was de-activated, allowing Volkswagen cars to get better gas mileage.

Here is the description of potential benefits from the press release[3] announcing the construction of the new stations.

[2] The idea that settlement funds ought to be used for remediation and prevention is appealing, but it violates a principal of public finance: funds should be spent so that the incremental benefit of spending is equalized across programs. Suppose that the benefit of spending an additional dollar on preventing smoking is $X and the benefit of spending an additional dollar on repairing roads is $X+1. Then we should spend an extra dollar of revenue on repairing roads, regardless of the revenue source.

[3] Office of the Governor, Virginia, Ralph Northam. *Governor Northam Announces Selection of EVgo to Develop Statewide Public Electric Vehicle Charging Network* August 9, 2018.

> Virginia is taking a leading role to develop and deliver a statewide electric vehicle charging network that is driver-focused, user-friendly, and promotes electric vehicle usage," said Governor Ralph Northam. "Through this partnership with EVgo, Virginia will accelerate electric vehicle adoption, generate more private investment in electric vehicle technology, and help provide citizens in the Commonwealth with cleaner air.

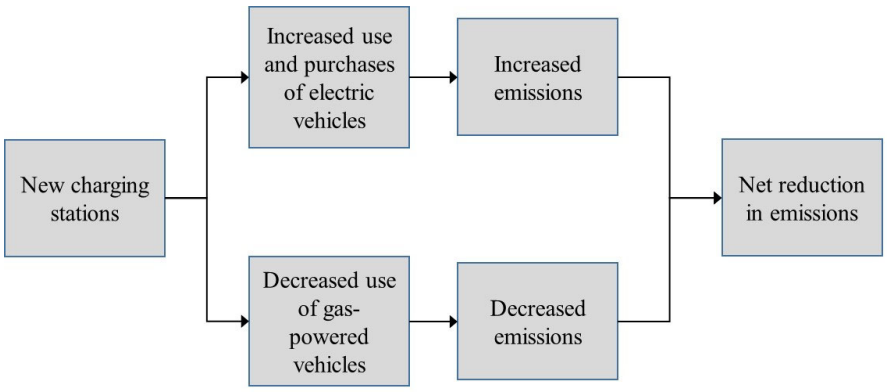
The goal is to increase the use of electric vehicles and ultimately decrease harmful emissions.

An outline of a policy analysis

Let's sketch out a policy analysis of the impact of funding more charging stations. All we know (or knew at the time) is that Virginia will spend $14 million on charging stations. There are a lot of potentially useful details missing: How many stations? Where will they be placed (according to the press release, "The network will prioritize some of the most heavily traveled corridors in the Commonwealth.")? Are they rapid-charging? Since the press release is silent on these issues, we can either try to fill in the details ourselves using common sense or by making some arbitrary assumptions. Or, we can try to construct our analysis in such a way that we do not need to make assumptions about these details.

Ultimately, policymakers probably care about the impact of charging stations on global warming or health. But creating a model to capture these downstream outcomes may be difficult, especially global warming. For now, let's focus on emissions.

Here is a model connecting the policy to the outcome.



New charging stations will offer a number of conveniences for electric car owners, which will make using an existing electric car or buying a new car more attractive. Electric cars generate pollution indirectly – the electricity has to come from somewhere – but reduce the use of polluting gas-powered cars. Using this framework, we can start to answer the question: How will Virginia's construction of new charging stations affect emissions?

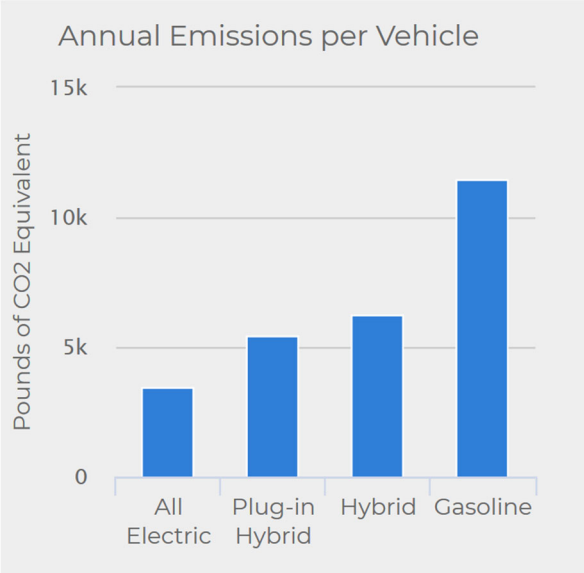
Impact of charging stations on electric vehicle adoption. There are many studies that examine the factors associated with the adoption of electric cars. Not all of these papers

contain estimates that are relevant or usable, but many do. Here is a summary[4] of one paper[5]:

> One additional installation of a public charging station per capita is associated with a 7.2 percent increase in battery electric car purchases and a 2.6 percent increase in hybrid cars (when they run on battery power), while it weakens with increasing ranges of battery electric vehicles. This suggests that hybrid owners tend to account for the availability of free charging stations when they calculate total cost of ownership. On the other hand, according to the researchers, owners of short-range battery vehicles tend to have more "range anxiety.

An estimate like this could serve as the basis for a policy analysis. And because it is a state-level analysis, we do not have to worry about making assumptions about where the charging stations are located, though obviously it would matter a great deal in practice.

But just because it is in print doesn't mean it's right. The authors of this analysis used state-level data to regress electric vehicle adoption on the availability of charging stations and other state characteristics. They interpret the results as showing that charging stations increase adoption, but the causality could run the other way. Companies and businesses find it more profitable to install charging stations if more people own electric vehicles. If I was doing this analysis for real, I would probably review other studies of the impact of station availability on electric vehicle use and adoption to find an estimate that I thought captured the causal relationship.



Impact of adoption on use of gas-powered cars. I might assume that every time a consumer buys a new electric car, one gas car is taken out of commission. There is a one-to-one tradeoff between miles driven in an electric car and miles driven in a gas car.

Impact of the switch from gas-powered to electric cars on emissions. Estimates of the annual carbon dioxide emissions from gas and electric vehicles are available from the Department of Energy.[6] These can be used in the policy analysis assuming that every purchase of an

[4] Shen, Xufei. With the Right Government Incentives, Electric Vehicle Adoption Could Rise. *Chicago Policy Review* February 15, 2019. http://chicagopolicyreview.org/2019/02/15/with-the-right-government-incentives-electric-vehicle-adoption-could-rise/

[5] Narassimhan, Easwaran, and Caley Johnson, "The Role of Demand-Side Incentives and Charging Infrastructure on Plug-in Electric Vehicle Adoption: Analysis of US States." *Environmental Research Letters* 13, no. 7 (2018): 074032.

[6] Department of Energy. *Emissions from Hybrid and Plug-In Electric Vehicles.* https://afdc.energy.gov/vehicles/electric_emissions.html

electric vehicle takes one gas-powered car off the road. Virginia generates more than 80% of its electricity from so-called clean sources, like natural gas and nuclear. The benefits of promoting adoption of electric vehicles in West Virginia are much lower, which generates over 90% of electricity using coal.

Possible limitations

Policy analyses cannot examine every possible effect of a policy change. Here are some of effects the analysis described above ignores.

Additional environmental benefits. Cars emit hydrocarbons, nitrogen oxide, and particulate matter in addition to carbon dioxide.

Increase in miles driven. The cost of driving a mile in an electric car is lower than the cost of driving a mile in a gas-powered car. According to a 2017 estimate, the average cost per mile driven is 3.7 cents for an electric car and 10 cents a mile for gas-powered cars, though there is a large range.[7] When driving becomes cheaper, people drive more. An analysis that ignores this effect would overstate the environmental benefits of electric vehicle adoption. You could incorporate this effect without too much additional work using estimates of the price elasticity of gasoline. Most estimates are around -0.3, meaning that a 10% decrease in the price of gas leads to a 3% increase in gasoline consumption.

Age of abandoned gas vehicles. The figures shown in the graph are for the average gas-powered car. Newer cars are more efficient than older cars. If drivers who switch to electric vehicles as a result of the policy get rid of older cars, an analysis based on the data in the graph will understate the environmental benefits.

Effects of new stations on electric vehicle adoption. Most studies of the impact of the availability of charging stations on electric vehicle adoption estimate the average effect of charging stations. But not all stations will have an equal effect. A station that is built in a densely-populated area that is not near another station will have a larger effect on consumers' decisions than a station that is built in a rural area or a station built near many others. Does the fact that Virginia will build stations where there are not already privately-operated stations tell us something about their impact?

All analyses have limitations. The point of this exercise is that we should avoid overly-simplistic judgements about policies, like "electric cars good-gas cars bad." We need to think carefully about the likely effects of proposed policies and try to predict their effects quantitatively.

A closing thought

If electric vehicle stations are so valuable, why aren't private companies rushing to open them? Why aren't vehicle owners willing to pay a price that will cover the costs of building

[7] Edmonds, Ellen. *AAA Reveals True Cost of Vehicle Ownership*. August 23, 2017. https://newsroom.aaa.com/tag/driving-cost-per-mile/

and operating them? Gas stations are built and run by private companies. Same for some electric vehicle charging stations. Is there a market failure?

CHAPTER 3: MAKING ASSUMPTIONS

Policy effects

It is helpful to classify the assumptions used in policy analysis into one of three categories:

1. policy or behavioral effect assumptions,
2. biological or engineering assumptions,
3. and counting assumptions.

Policy effect assumptions describe how behavior changes in response to a change in policy (for example, how does menu labeling change the share of consumers who order low calorie meals). Biological or engineering assumptions describe natural processes (for example, the relationship between calories consumed and weight). The other category encompasses everything else. I've named it "counting assumptions" for lack of a better term.

Before discussing policy effect assumptions, we'll briefly address the second and third categories.

Biological or engineering assumptions describe natural or mechanical processes. For example, what is the relationship between calories consumed and weight? How does smoking affect the likelihood of developing lung cancer? Or, what is the impact of wearing a helmet on the likelihood of suffering a severe head injury during a bicycle accident?

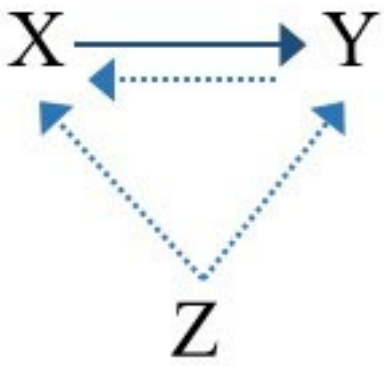
Counting assumptions are generally assumptions about rates, percentages, averages, and totals. How often do people eat out at restaurants? How many calories do they consume? What share of the population is obese? What is the average cost of treating diabetes? What share of bike riders use helmets? The research that underlies these assumptions relies on measurement, counting, and tabulation. Sometimes it is hard to find evidence on which to base counting assumptions, but that is just because someone hasn't performed the relevant count yet.

Policy effect assumptions are much more difficult to get right because they involve predicting changes in behavior. For example, if you require people to wear bike helmets, will they bike less?

In most applications individuals are the actors, but in some cases we are interested in the behavior of firms or even states. The Republican's American Health Care Act gives states the option of waiving various insurance regulations established by the Affordable Care Act. The Congressional Budget Office needed to consider how states would behave under the Act to model its effects.

Internal validity and external generalizability

An estimate of the impact of variable X on variable Y is confounded if there is an unobserved variable Z that is related to both X and Y. Estimates from randomized trials are inherently unconfounded. Randomization equalizes the distribution of the unobserved variable Z between the treatment and control groups.



Suppose we want to estimate the impact of graduating from college on health. A study that compares health between college graduates and non-graduates will be subject to several sources of bias.

- College graduates have other characteristics – such as growing up in more stable, well-off homes – that are related to health.
- Just as education influences health, health also influences educational attainment. People who expect to live longer get more education. They have a longer time over which to reap the benefits. In the case, the direction of causation is not clear.
- People with serious chronic diseases or mental illnesses may have trouble getting into and staying enrolled in college.

When estimating causal effects, statisticians speak of the "assignment process". What is the mechanism by which some humans end up with a college degree and others do not? If the assignment process depends on factors related to health, then estimates from cross sectional studies will be biased. Controlling for individual and family characteristics in a multivariable regression can reduce the degree of bias, but it does not eliminate it. There are always unobserved factors that cannot be measured.

Estimates of the impact of changes in policy on behavior are often based on observational, non-randomized studies. Studies have to be evaluated based on how they address confounding and reverse causation.

Studies that assess biological relationships can also be biased by confounding and reverse causation. Claims about the impact of drinking red wine on cardiovascular health are based on surveys where respondents are asked about prior wine consumption and health. People who drink wine tend to be better-educated and have higher incomes. We can control for some, but not all of these differences, leading studies to overstate the impact of drinking wine on health.

Hidden assumptions

When reading and conducting policy analyses, be aware of "hidden assumptions": assumptions that are implicit rather than explicit. Sometimes these implicit assumptions turn out to be more important than the assumptions that are stated explicitly.

For example, several analyses have projected the impact of Medicare-for-All on health care spending. A major source of savings to overall health spending (as opposed to spending by the federal government) is that Medicare reimbursement rates are much lower than private insurers' reimbursement rates. Shifting everyone who is currently privately insured into Medicare results in billions of dollars of savings as a result of the fee differential.

Policy analysts calculate savings using assumptions about the difference in reimbursement rates and total spending by category. For example, if hospital spending among individuals with private insurance is $200 billion, and Medicare payment rates are 90% of private insurers' payments, then Medicare-for-All will reduce hospital spending by $40 billion = ([1.0-0.9] × $400).

There is a hidden, implicit assumption behind this calculation: that the volume and intensity of treatment is unaffected by fee changes. Put another way, hospitals continue to treat patients the same way after the fee cut. But that isn't exactly true. There are a number of studies that show that reductions in reimbursement levels change treatment decisions. In most cases, reductions in fees cause treatment intensity to decline, but the opposite is possible. Is the hidden assumption a bad assumption? It depends on the magnitude of the responsiveness of treatment intensity to fee changes. If the response is sufficiently small, then analysts were correct in ignoring it. If not, they may have mis-estimated (probably underestimated) savings.

The point is this: train yourself to be on the lookup for hidden assumptions. Just because an assumption is hidden does not mean the authors of the analysis were trying to mislead you. They may have correctly believed that it was inconsequential. But maybe it wasn't.

A case in point: In 1978 California enacted building codes to reduce electricity and gas consumption. Engineers projected that the revised codes, which affected everything from insulation to air conditioners, would reduce energy use by 77% (see the Table).[1] The projections were inaccurate. A later study[1] found that newer homes, which were subject to the new energy-saving building requirements, actually used more electricity than older homes

[1] Levinson A. How much do building energy codes save? Evidence from California houses. *American Economic Review* 2016;106(10):2867-2894.

The engineers' projections were based on the mechanical relationships between the various energy-saving features and energy use. The real-world experience reflects these relationships as well as human behavior.

The study did not measure how behavior changed in response to the building codes, but we can speculate. Energy-efficient systems are cheaper to run, and so homeowners may have set their thermostats at cooler temperatures in the summer and warmer temperatures in the winter. They may have been more careless about leaving doors and windows open. Whatever the reason, the original analysis that failed to consider how policy changes would change behavior missed the mark by a wide margin. The implicit assumption in the engineers' analysis was homeowners would behave the same way regardless of whether they were in an old or new home. It turned out to be incorrect.

TABLE 1—PROJECTED COSTS AND SAVINGS FROM 1980 CALIFORNIA ENERGY CODES: SINGLE-FAMILY HOMES, SACRAMENTO

	Business as usual (1)	Regulation (2)	Difference (3)
Insulation	—	$2,831	$2,831
Window glazing	$879	2,108	1,229
Overhang	—	468	468
Shading	—	360	360
Caulking, sealing, etc.	—	551	551
Thermostat	82	138	56
Heating system	1,360	1,360	—
Cooling system	1,129	965	−164
Duct insulation	—	61	61
Total building envelope	$3,450	$8,842	$5,392
Water heater	284	2,736	2,452
Lighting	97	333	236
Total initial cost	$3,831	$11,911	$8,080
Total energy (1,000 BTU)	187,209	43,025	−144,184
Energy savings			−77%

Note: The median California home price in 1980 was $80,000.
Source: Horn et al. (1980)

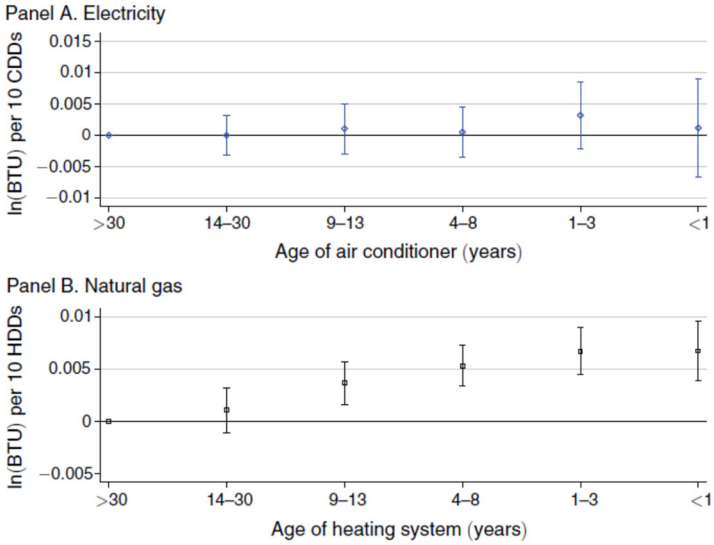


FIGURE 7. ENERGY USE AND AGE OF AIR CONDITIONER AND HEATER

China's "one child" policy provides another case.[2] In the mid 1970s, Chinese and Dutch mathematicians Song Jian and Geert Jan Olsder started developing models to forecast population growth. Their model showed that if left unchecked, China's population would increase to 4.5 billion by 2080. Their efforts attracted the attention of top Chinese policymakers, who, against a backdrop of Malthusian concerns about overpopulation and environmental catastrophe, adopted punitive measures to decrease the birth rate in 1980. If the policy worked, the state could always reverse course, as described in a letter from the Communist Party: "In 30 years, the current problem of especially dreadful population growth may be alleviated and then [we can] adopt different population policies." Fast forward to today: China's population is expected to decrease to 597 million in 2100, down from 1.4 billion today. China's government is trying to increase birth rates, but with little success. The original modeling

[2] See Qi, Liyan. China's Baby Bust is Hard to Reverse. Wall St. Journal. February 13, 2024 for the complete story.

efforts failed to consider how the one child policy would change tastes around childbearing and how these changes would propagate over generations. Having grown up in small families, today's parents believe small families are the norm and are unenthusiastic about having three or more children. Urbanization and economic growth have also contributed to declining birthrates.

Generalizability

Generalizability or external validity refers to the degree to which an estimate from a study is applicable to the larger world.

In the case of policy analysis, generalizability refers to the similarity between the population affected by the policy change and the population included in the study on which an assumption is based. If you were to redo the study on the population affected by the policy change, would you get the same result? "Population" here should be read broadly to incorporate characteristics of individuals as wells aspects of the time and place.

Suppose you wanted to project the impact of a policy that would provide college scholarships to low-income students on future earnings. When looking for estimates of the impact of entry to college on future earnings, you would have to consider whether estimates are applicable to the students who will be eligible for the program and for whom the scholarship program will affect their decision to attend college.

Sometimes people ask me, "How old is too old for a study that serves as the basis for an assumption?" The answer is always, "It depends." You have to assess whether conditions have changed significantly between when the study was performed and now such that the information from the study is no longer relevant. Estimates of the relationship between smoking and lung cancer are decades old. I can think of some reasons why the relationship might have changed (for example, maybe declines in air pollution have improved overall lung health, making smokers less susceptible to the damaging effects of cigarette smoke), but these are probably minor and can be ignored. On the other hand, estimates of kids' exposure to "screen time" that are more than 10 years' old are probably out-of-date.

Sources for estimates of policy effects

Medline, which indexes articles in medical and public health journals, and Econlit, which indexes articles in economics journals, are your best bets for finding good estimates of policy effects. (In Emory's library system you access Medline via the Ovid platform. Outside of Emory, you can use Pubmed.) There is some overlap between them.

Be careful about using Google. The first hits are not necessarily the best. The *Journal of the American Association* published a study showing that hospitals with high nurse staffing levels have lower patient mortality rates.[3] The study received a lot of attention. As often happens when a study makes a splash, other researchers reexamined the question using

[3] Aiken LH, Clarke SP, Sloane DM, Sochalski J, Silber JH. Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *Journal of the American Medical Association* 2002 Oct 23-30;288(16):1987-93.

different datasets and study designs. Some of these reached a different conclusion. If you Google "nurse staffing patient mortality" the *Journal of the American Association* paper is the first hit. There are good studies that do not appear in the first 50 hits. You will find these using Medline and Econlit, but not Google.

Another reason to be wary of Google: Some poor quality studies receive a lot of media attention, which boosts the study in Google's rankings. Studies that show that coffee/dark chocolate/wine/green tea are associated with better health outcomes get covered in the press. Studies that show that coffee/dark chocolate /wine/green tea are unrelated to health outcomes do not.

Don't try this at home

It is almost always preferable to base assumptions about the impact of policies on previously-conducted studies rather than trying to conduct an original study. Performing a good original study takes time and an in-depth understanding of the policy and data sources.

Casual analyses – analyses done quickly with limited knowledge of policy, data, and study design – are likely to lead you astray, though you see them all the time in the press. The Law Center to Prevent Gun Violence assigns a grade to each state based on its gun control measures. In 2016, Illinois earned a B+, indicating that the state has laws that restrict access to firearms, and Florida earned an F for its less restrictive laws.[4] The 2015 murder rate was 6.9 per 100,000 in Illinois and 6.3 per 100,000 in Florida. So, obviously allowing easy access to firearms reduces the murder rate, right? Perhaps, but you don't really learn much from this casual analysis.

A number of studies have examined the impact of gun laws on deaths. How do they differ from a simple comparison of two states?

- They do not ignore data. They include all 50 states.
- They adjust for other factors (for example, percent of residents in poverty) that may affect murder rates.
- They carefully consider measurement issues. Should the outcome be murder rates or gun deaths (which include suicides)? What about people who were shot and survived?
- They compare changes in deaths in states that changed gun laws to changes in states that did not, thereby controlling for unobserved factors that differ between states.

Here are two cases of casual analysis gone wrong.

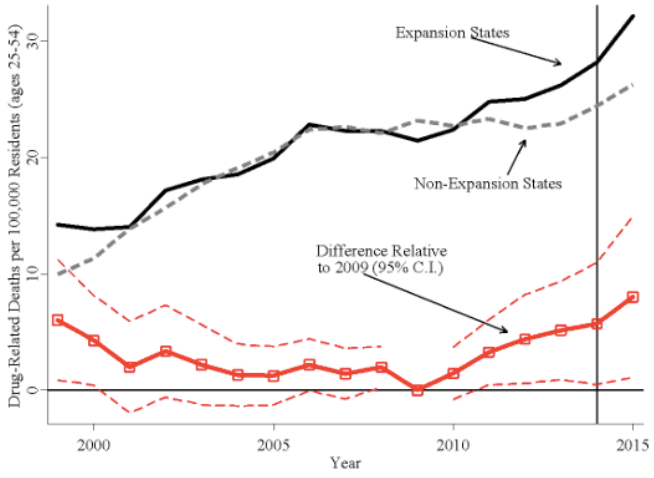
Case 1. Some prescription opioids are expensive. Senator Ron Johnson (R-WI) argued that Medicaid expansion under the Affordable Care Act helped fuel the opioid epidemic by making it easier for patients to obtain low-cost drugs. Here is a quote from an August 15, 2017 editorial in the *Wall Street Journal*.[5]

[4] Law Center to Prevent Gun Violence 2016 Gun Law State Scorecard. http://gunlawscorecard.org/
[5] Medicaid's Opioid Fix. *Wall St. Journal* August 15, 2017.

Wisconsin Sen. Ron Johnson presents intriguing evidence that the Medicaid expansion under ObamaCare may be contributing to the rise in opioid abuse. According to a federal Health and Human Services analysis requested by the Senator, overdose deaths per million residents rose twice as fast in the 29 Medicaid expansion states—those that increased eligibility to 138% from 100% of the poverty line—than in the 21 non-expansion states between 2013 and 2015.

There were also marked disparities between neighboring states based on whether they opted into ObamaCare's Medicaid expansion. Deaths increased twice as much in New Hampshire (108%) and Maryland (44%)—expansion states—than in Maine (55%) and Virginia (22%). Drug fatalities shot up by 41% in Ohio while climbing 3% in non-expansion Wisconsin.

Figure 1. Age-Adjusted Drug-Poisoning Mortality Rate for Ages 25-54 by Medicaid Expansion Status, 1999-2015



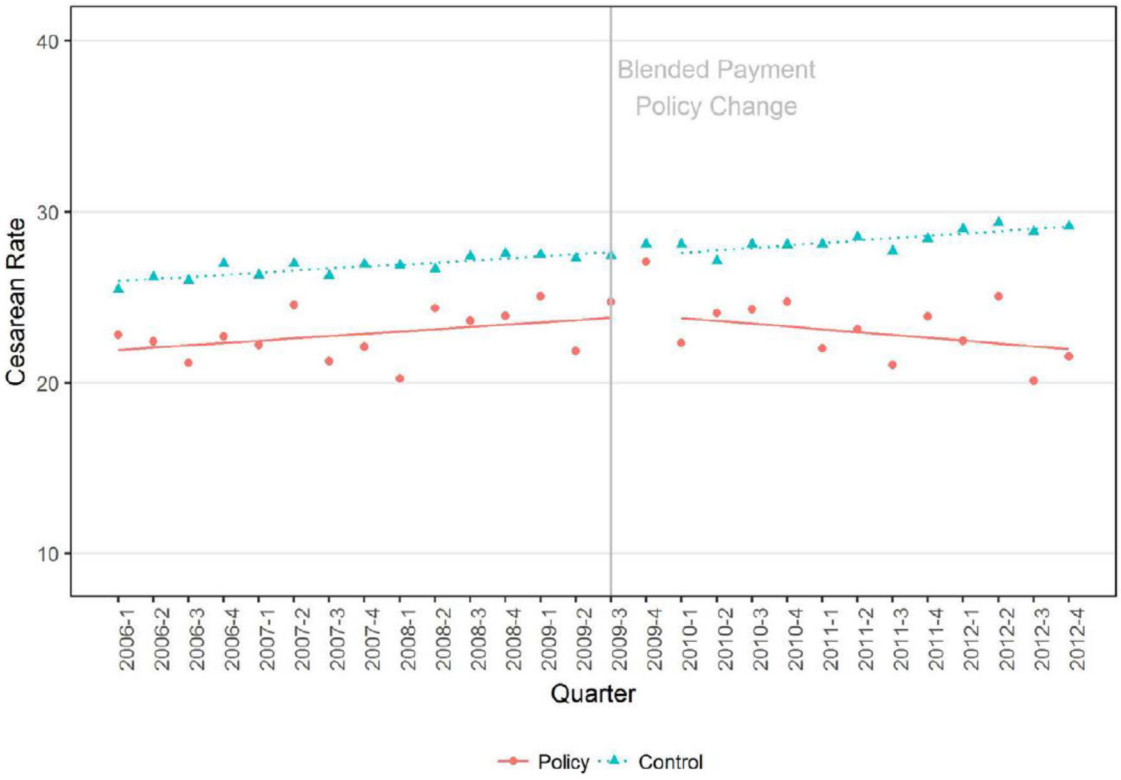
Different versions of this claim have been made in many venues. Two researchers[6] took a closer look. They found that drug-related deaths increased more rapidly in states that expanded Medicaid under the Affordable Care Act. However, drug-related death rates were growing more rapidly in expansions states *before* the Medicaid expansion occurred in 2014. In fact increases in drug deaths may have served as the impetus for some states to expand Medicaid. These data are uninformative about the impact of Medicaid expansion on opioid abuse.

Case 2. Before October 2009, Medicaid in Minnesota paid hospitals $5,266 for a Cesarean birth and $3,144 for a vaginal birth. Medicaid paid physicians $1,147 for a Cesarean birth and $776 for a vaginal birth. Concerned that the higher payment rates for C-sections were leading to its overuse, the state adopted a blended payment rate in October 2009. Medicaid would pay the same amount regardless of delivery mode.

In 2015 Medicaid reversed the policy and went back to the old approach. One of the factors that influenced the decision was internal data showing that Cesarean section rates did not decline.

[6] Goodman-Bacon A, Sandoe E. Did Medicaid Expansion Cause The Opioid Epidemic? There's Little Evidence That It Did. *Health Affairs Blog* August 23, 2017.

The figure below shows results from an independent study of the impact of the policy.[7] An analysis focusing only on the Cesarean section rate in Minnesota (the red line) would show that the Cesarean section rate was around 22% before the policy and 22% after the policy. It did not change. But….rates in a group of control states (the blue line) were going up before the policy change and continued to increase after it. Viewed against this backdrop, it appears the policy reduced the use of Cesarean section, as intended.



[7] Kozhimannil KB, Graves AJ, Ecklund Am, Shah N, Aggarwal R, Snowden. Cesarean delivery rates and costs of childbirth in a state Medicaid program after implementation of a blended payment policy. *Medical Care* In press.

CHAPTER 4: CAUSAL INFERENCE FOR POLICY ANALYSIS

Study design and policy effects

There are a number of approaches for estimating the impact of policy changes on behavior.

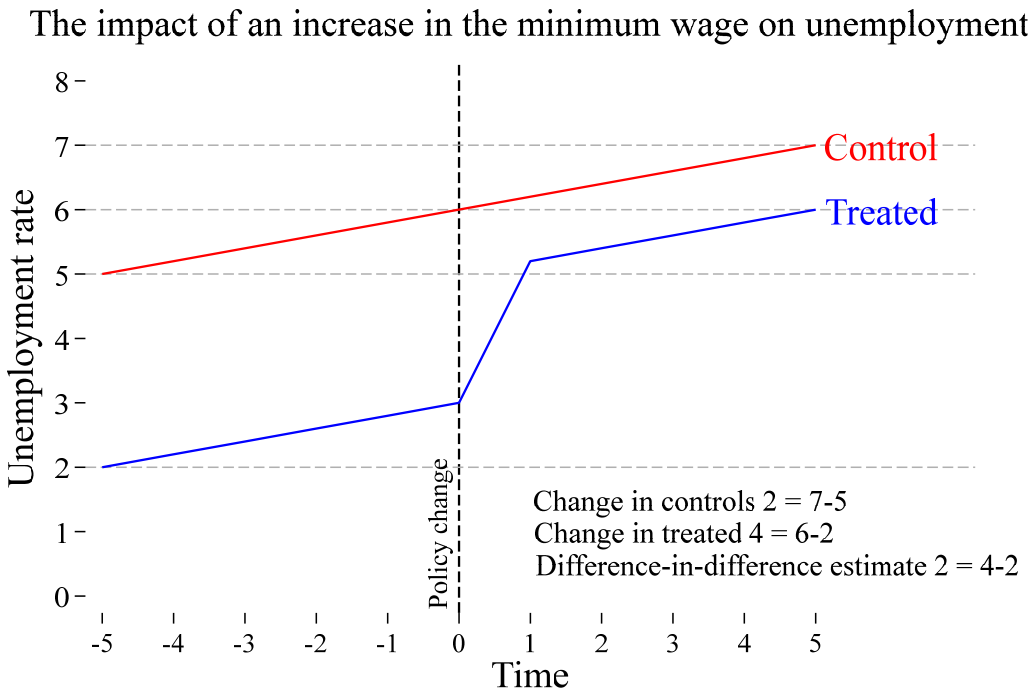
- Randomized trials in the real-world.
- Randomized trials in laboratory settings.
- Surveys (Ask people how their behavior would change).
- Cross-sectional studies.
- Pre-post comparisons.
- Pre-post with concurrent controls or "difference-in-difference" studies.
- Regression discontinuity designs.
- Natural experiments or instrumental variables studies.

Many studies that estimate the impact of policies use a difference-in-difference design. Suppose some states implemented a policy (for example, an increase in the minimum wage) and others did not. Individuals in states that raised the minimum wage are the treatment group and individuals in other states are the control group. The outcome is the likelihood of being employed. Suppose y is the outcome variable, like the unemployment rate. The difference-in-difference estimator is

$$(y^{T,POST} - y^{T,PRE}) - (y^{C,POST} - y^{C,PRE})$$

where T = treated and C = control. PRE = outcome before the policy change, POST = outcome after the policy change.

By comparing changes in outcomes rather outcomes at a point in time, the design removes bias due to time-invariant (i.e. unchanging) differences between the states. A picture is useful for illustrating this concept.



States in the treatment group may have raised the minimum age at different points in time. We can transform time so that time = 0 corresponds to the date when the wage increase went into effect. Time 0 will correspond to different calendar years in different states.

The *cross-sectional*, post-period difference between treatment and control states is -1 = (6 – 7). It implies that unemployment is *lower* in states that increased the minimum wage.

The cross-sectional comparison is biased by the fact that the states start out with different unemployment levels. The pattern makes sense: states that have a higher unemployment rate to begin with may be less willing to take the risk of increasing the minimum wage.

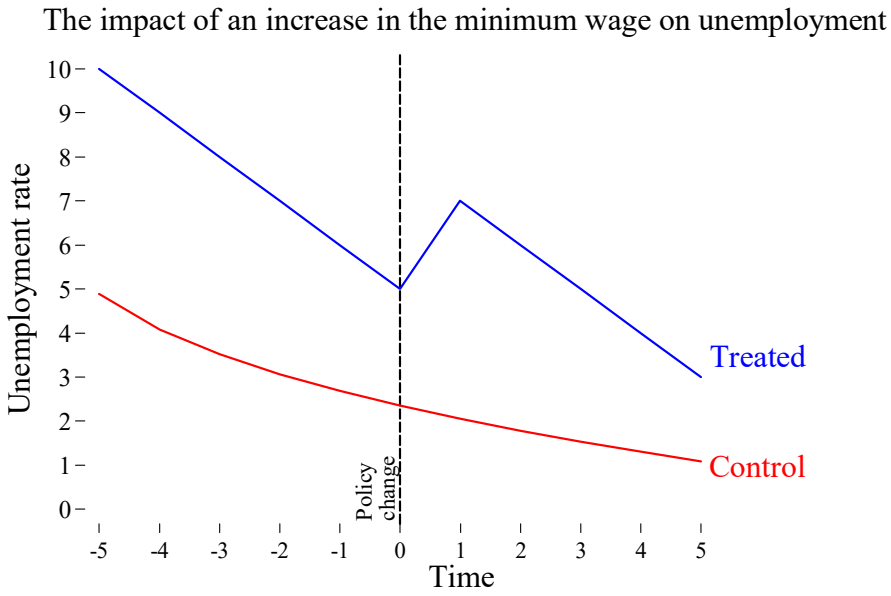
The *pre-post* difference in the treated group is 4 = (6 – 2). (Unemployment increased.)

The pre-post difference is biased by the fact that unemployment rates were trending up before the increase in the minimum wage. There was a "secular" trend.

The difference-in-difference estimate is 2 = (6 – 2) – (7 – 5). (Unemployment increased.)

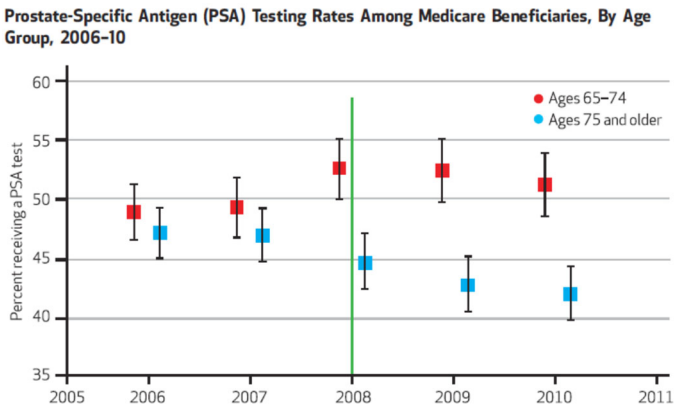
The difference-in-difference estimate adjusts for underlying differences in the unemployment rate between treatment and control states. It also adjusts for secular trends that are common to the treatment and control groups.

Here is a case where a difference-in-difference study probably would not yield the right outcome.



The pre-trends look similar, but the post-trends do not. The policy change may have had an impact, but unemployment in control states is close to 0. It is unusual for employment rates to be below 2%. This boundary effect may be why the rate of decline in unemployment rates in control states was lower.

Here is an example from a real study. [1] In 2008 the United States Preventive Services Task Force recommended against routine prostate cancer screening for men 75 years and older. In this study, men ages 65 to 74 are the control group. It appears that the recommendation had an impact. Screening rates decreased among men 75 years and older and were

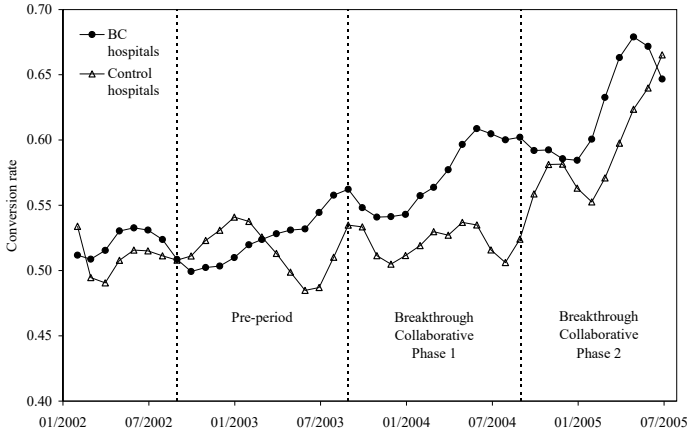


[1] Howard DH, Tangka F, Ekwueme D, Guy G, Lipscomb J. Prostate cancer screening in men ages 75 and older fell by 8 percentage points after Task Force recommendation. *Health Affairs* 2013;32(3):596-602.

basically unchanged among men ages 65 to 74.

Here is another example.[2] In 2003 the Department of Health and Human Services began a campaign (the "Breakthrough Collaborative on Organ Donation") to increase organ donation rates in selected hospitals. In 2003 the Department expanded to program to all hospitals. It looks like the Collaborative had an effect on donation rates, but rates were trending upward prior to the Collaborative.

Figure 1: Smoothed trend in the coversion rate among hospitals participating in the first phase of the Breakthrough Collaborative and control hospitals



BC: Breakthrough Collaborative. NOTE: The conversion rate is smoothed using the ksm command in Stata Verson 7.0 (Stata Corporation, College Station, TX) with a bandwidth of 0.15 and the "lowess" option.

Yet another example: Between 1997 and 2002 15 children were diagnosed with leukemia in Clark County Nevada, making Clark County one of a number of "cancer clusters" around the country. Davis (2004) studied the impact of the discovery of the cluster on home prices. He used Lyon County, which borders Clark County and has similar income and housing price levels, as a control. Although the first case was diagnosed in 1997, it was not until 2000 that there was a steep uptick in cases and newspapers began running stories on the cluster. The graph shows that trends in Churchill and Lyon Counties were similar before 2000. After 2000, they diverged. Estimates in the table to the left show that relative to prices in Lyon County, home prices in Churchill County declined by about 7.7 percent.

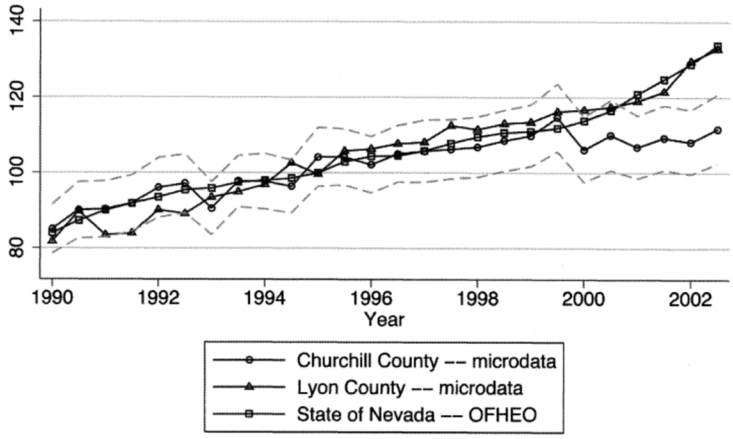


FIGURE 2. ASSESSING THE VALIDITY OF THE COUNTERFACTUAL: HOUSE-PRICE INDICES FOR SINGLE-FAMILY RESIDENCES, 1990–2002

[2] Howard DH, L Siminoff, V McBride, M Lin. Does quality improvement work? Evaluation of the Organ Donation Breakthrough Collaborative. *Health Services Research* 2007;42(6):2160-2173.

Regression analysis versus study design

A regression model is not a study design. A study design refers to how the effect is estimated. A regression model is an approach for implementing a study design. Consider the following model where the coefficient (β^1) on an indicator variable for treatment, $Treat^i$, is of interest.

$$y_{it} = \beta^0 + \beta^1 Treat_i + \beta^2 Age_i + \beta^3 Male_i + \varepsilon_{it}$$

You could use this model for a non-randomized cross-sectional analysis or a randomized trial. The model itself tells you nothing about whether treatment was randomly assigned or not.

A regression model for a difference-in-difference study is:

$$y_{it} = \beta^0 + \beta^1 Treat_i + \beta^2 Post_t + \beta^3 Treat_i \times Post_t + \beta^4 Age_i + \beta^5 Male_i + \varepsilon_{it}.$$

The coefficient on the interaction of the treatment indicator and post-period indicator, β^3, is of interest.

Different regression models (for example, logistic, generalized linear model) are designed to handle different types of data. You would use a logistic model to estimate effects when the outcome is dichotomous (0/1), regardless of whether the underlying study design was a randomized trial, pre-post analysis, cross-sectional, or a difference-in-difference study.

Interpreting effects from randomized trials with non-compliance

Randomized trials are usually considered the gold standard for estimating the effects of policies and medical treatments because they produce unbiased estimates. However, results may not be externally generalizable, especially when there are high rates of non-compliance.

Prostate specific antigen (PSA) testing is widely used in the US to screen men for prostate cancer. However, use of PSA screening is controversial. Many men are treated for prostate cancers detected via PSA screening that would never have become clinically apparent in the absence of screening.

The CAP Randomized Trial randomly assigned primary care practices in Britain to an intervention to increase PSA screening (patients received an invitation to a PSA testing clinic) or usual care.[3] Of the 189,386 men in the intervention group, only 36% actually had

[3] Martin RM, Donovan JL, Turner EL, Metcalfe C, Young GJ, Walsh EI, Lane JA, Noble S, Oliver SE, Evans S, Sterne JAC, Holding P, Ben-Shlomo Y, Brindle P, Williams NJ, Hill EM, Ng SY, Toole J, Tazewell MK, Hughes LJ, Davies CF, Thorn JC, Down E, Davey Smith G, Neal DE, Hamdy FC, . Effect of a Low-Intensity PSA-Based Screening Intervention on Prostate Cancer Mortality. The CAP Randomized Clinical Trial. *Journal of the American Medical Association* 2018;319(9):883-895.

blood drawn for a PSA test. The authors estimate that about 15% to 20% of the men in the control group had a PSA test.

The investigators compared men randomized to the treatment arm to men randomized to the control arm, regardless of whether they had a PSA test or not. This approach produces an "intent to treat" estimate. It will systematically underestimate the effect of the treatment. It estimates the effect of being *randomized* to the treatment arm, not the impact of the treatment itself. The CAP trial concluded that PSA screening did not reduce death from prostate cancer with a 10 year follow-up.

An alternative to the intent-to-treat estimate is the "per protocol" estimate. In the case of the CAP trial, a per protocol estimate would compare 1) men in the treatment arm who were screened to 2) men in the control arm who were not screened. (In the case of perfect compliance, the intent-to-treat and per protocol estimates would be the same.) The per protocol estimates the impact of being screened, as opposed to being randomized to the screening arm, but the estimate is biased. Men in the treatment arm who were screened probably differed from those who were not. Perhaps they were more likely to have a family history of cancer. Ditto for screened and unscreened men in the control arm. Focusing on only a non-randomly selected subset of participants in the treatment and control arm eliminates the benefits of randomization.

There is a statistical technique for trying to estimate the impact of an intervention in the face of non-compliance to treatment assignment (for example, some people in the control arm receive the treatment), but not all randomized trials report these adjusted estimates.

Interpreting and applying policy effect estimates

Studies describe effect estimates using many different measures: elasticities, risk ratios, odds ratios, etc. It is important to know how to interpret and apply these quantities.

If you cannot explain something in simple terms, you don't understand it.
–Richard Feynman

Estimates of the impact of a variable on a continuous outcome, like dollars, are usually stated in terms of the original scale or percent changes. Sometimes they are stated in terms of elasticities. If the price elasticity of smoking is -0.4, a 10% increase in price leads to a 4% decline in smoking.

Things get trickier when the outcome is binary. Consider an intervention that reduces the proportion of people who smoke from 20% to 15%.

The intervention reduces the smoking rate by 5 *percentage points*. When describing an effect in terms of percentage points, you should always use the verbiage "percentage points" and not "%".

Equivalently, you might say that the intervention led to a 25 *percent* (or %) decline in smoking rates (= 5 ÷ 20%).

It would be incorrect to say that the intervention caused smoking rates to decline by 5% (which would imply that smoking rates declined from 20% to 19%). It would be correct to say that the intervention caused rates to fall by 5 percentage points, or 25%.

The *relative risk* of smoking in the intervention group compared to the non-intervention group is 0.75 (= 15% ÷ 20%). Without knowing the baseline probability (20% in this case), you cannot convert a relative risk into a percentage point change.

The *odds ratio* would be

$$\frac{\frac{0.15}{1-0.15}}{\frac{0.2}{1-0.2}} = 0.71$$

It's close to the risk ratio, but not the same. A formula for converting odds ratios to risk ratios is

$$\frac{OR}{(1-P_o)+P_o \times OR} = RR$$

$$\frac{.71}{(1-.2)+.2\times.71} = 0.75$$

To apply this formula, you need to make an assumption about the baseline level of risk P_o. If the baseline risk is less than 30%, then the odds ratio will be close to the risk ratio.

Applying absolute or relative effects

Policy effect assumptions can be applied as absolute or relative effects. The absolute decline in smoking rates associated with the hypothetical intervention mentioned earlier is 5 percentage points. The relative decline is 25% (= 5 ÷ 20%).

Absolute versus relative effects

	Absolute decline (5 percentage points)		Relative decline (25%)		
Baseline	Change (percentage points)	New level	Change (percentage points)	New level	Difference
10%	5	5%	3	8%	3%
20%	5	15%	5	15%	0%
30%	5	25%	8	23%	-3%
40%	5	35%	10	30%	-5%
50%	5	45%	13	38%	-8%

Suppose you want to use these results to estimate the impact of expanding the intervention to a different population. Unless the baseline rate of smoking happens to be 20%, the same as in the original study, your prediction will depend on whether you apply a relative or absolute effect (see table).

Suppose the baseline smoking rate is 10%. Using the effect stated as an absolute decline, you would predict that smoking rates fall to 5%. Using the effect stated as a relative decline, you would predict that that rates fall to 8%. Which is correct? Maybe the smokers in this population are more committed, more addicted smokers than in the population included in the study (where the baseline rate was 20%). Maybe they are more resistant to efforts to get them to quit. In that case, you might want to use the relative effect, which yields a more conservative prediction. But it is a judgement call.

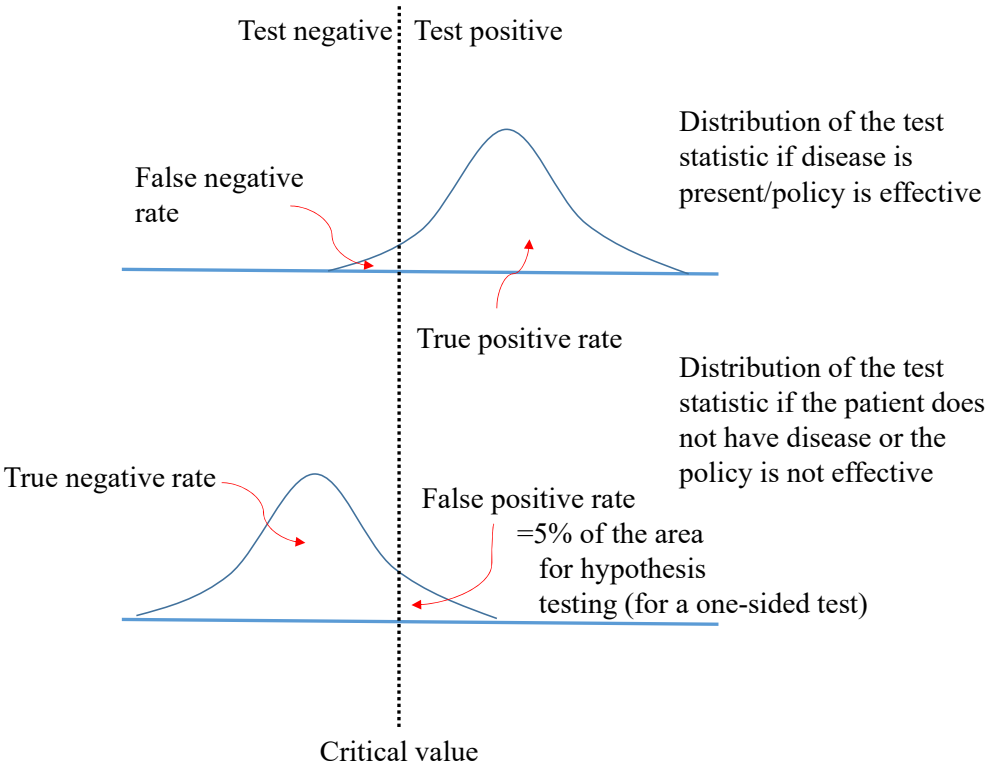
Statistical significance

In the academic literature, measures of policy effects are almost always reported alongside confidence intervals, t-statistics, p-values, etc. How should significance levels affect our interpretation of policy effects? It helps to think about the analogy between hypothesis testing in statistics and diagnostic testing in medicine.

In medicine, the true positive rate is the probability that a test is positive for a patient who is diseased. The true negative rate is the probability that a test is negative for a patient who does not have a disease. The people who design diagnostic tests (or the physician who interprets them) can control the true positive rate and true negative rate by adjusting the threshold of the test to balance the harms of failing to detect disease in a patient who has it (a false negative) and treating disease in a patient who does not (a false positive). There is a tradeoff: moving the threshold to increase the true positive rate will reduce the true negative rate.

In statistical hypothesis testing the convention is to set the threshold for a positive test such that the true negative rate is 95% and the false positive rate is 5%.

Suppose we want to analyze whether a policy works by performing a t-test comparing an outcome between subjects exposed to the policy and control subjects. Due to sampling variability, the observed value of the test statistic will be different every time we perform the analysis. The top panel of the Figure depicts the distribution of the test statistic if the policy works. The bottom panel depicts the distribution of the test statistic if the policy does not work (i.e. the null hypothesis). The distributions overlap. Unless the statistic is far to the right or left, we cannot tell which state of the world we are in based on the test statistic. We have to make an educated guess. If the test statistic is above the critical value, we conclude that we are probably in the state of the world where the policy is effective. Of course in hypothesis testing, there is a 5% chance that even if the policy doesn't work, the test statistic will be above the critical value (a false positive result).



The p-value of a test refers to the area to the right of the test statistic under the distribution of the test statistic in the state of the world where the policy does not work. In hypothesis testing, we set the critical value such that the false positive rate is 5%.

Diagnosis based on a lab test in medicine works much the same way, but clinicians set the critical value to balance the harms and benefits of detection, not based on convention. The false positive rate may be higher or lower than 5%. For example, if treatment is inexpensive and does not have side effects, then a false positive is not a bad outcome. A test maker might set the cutoff so that the false positive rate is higher than 5%.

Academic researchers adhere to the 5% convention (there is a little wiggle room). Policy analysts are not. In some cases the 5% convention maybe overly conservative, leading policymakers to reject a policy that, even taking the uncertainty into account, would pass a cost-benefit test. That said, it would be unusual to see a policy analysis of a policy that failed to produce a statistically significant improvement in its primary outcome. You might see analysts incorporate secondary endpoints where the effect is not statistically significant. For example, a policy that increases high school graduation rates might also reduce crime. A policy analyst may consider both effects, even if the impact on crime is not significant by conventional measures.

CHAPTER 5: WRITING A POLICY ANALYSIS

The outline of a policy analysis

Here is a suggestion for the sections of a policy analysis and what to include in them.

Introduction

> *The most important lesson in the writing trade is that any manuscript is improved if you cut away the fat.*
>
> -Robert Heinlein

The amount of space you devote to the introduction will vary a great deal from analysis to analysis. You will not need a long introduction for an analysis that evaluates the impact of increasing cigarette taxes. The issue, smoking and its impact on health, will be familiar to most readers, and the policy proposal entails modifying an existing policy rather than implementing a completely new one. A policy analysis that addresses an unfamiliar topic or policy will require a longer introduction.

Describe the circumstances behind the proposed change in policy. What is the **problem** the policy is trying to address? Why now?

Describe the policy. What, exactly, will the policy do? Emphasize the **contrast** between the proposed policy and the status quo. Avoid bland, generic descriptions of policy changes. Be specific.

Describe the **rationale** for the policy. How will the policy address the problem? What is the theoretical justification? Is there a market failure? Of course, describe the rationale in clear, jargon-free language.

Describe the **mechanism** by which the policy change may affect the outcome. In some cases, the mechanism will be obvious. You should not devote much space to it. In other cases, the mechanism will not be obvious. You should explain it.

Provide a **summary** of your main finding or result. This is very important. It highlights the most important piece of information in the paper and provides a context for understanding everything that follows.

Methods and Results

Note that Methods and Results go in a single section, in contrast to the way that scientific papers are typically organized. I find that presenting results alongside methods often helps the reader understand what you did. The alternative is presenting methods and results separately, with other text in-between. When reading the results, the reader has to remember what he or she read in the methods. Better to put them together (in most cases). Consider this sentence, which combines methods and results:

> I calculated the decrease in the share of diabetic patients who would have an unhealed ulcer (-2 percentage points), by multiplying the percent reduction in ulcers associated with the intervention (-10%) by the baseline prevalence (20%).

I find that the text and numbers complement one another. It is easier to understand the methods if you see the actual numbers.

Begin this section with a conceptual overview of your methods. It is like a map that helps the reader navigate through the details. Like this: "Using an estimate of how cigarette consumption declines with increases in prices and an estimate of the share of cigarette tax increases that are passed on to consumers in the form of higher prices, I predict how increasing the cigarette tax in Georgia will affect tax revenue." A conceptual overview is not a piece of theoretical jargon. It is more than a list of assumptions. A good general format is "Using assumptions about [describe one or two key assumptions], I predict [describe key steps in the analysis and the outcome]."

Describe your assumptions and how they fit together. Including details here helps to establish your credibility. Pay particular attention to "policy effect" assumptions that describe how behavior responds to changes in policy. Give the reader a sense of how causal effects were estimated (but avoid jargon). **How do we know what the effect is without being able to conduct a randomized trial?**

Don't just say, "Our assumption about the impact of the policy is based on a study using data from California." That tells the reader very little. Instead, tell the reader about how the causal relationship between the policy and the outcome was estimated. Since assumptions regarding causal effects are so critical and important, it is OK to refer to them multiple times. For example, you could write a sentence in the Introduction or Conclusion like "Based on the results of a study that examined how health care costs changed when XYZ Corporation added coverage for contraceptives, we predict that…."

> *Clutter is the disease of American writing. We are a society strangling in unnecessary words, circular constructions, pompous frills and meaningless jargon…Our national tendency is to inflate and thereby sound important. The airline pilot who announces that he is presently anticipating experiencing considerable precipitation wouldn't think of saying it may rain. The sentence is too simple—there must be something wrong with it.*
>
> *But the secret of good writing is to strip every sentence to its cleanest components. Every word that serves no function, every long word that could be a short word, every adverb that carries the same meaning that's already in the verb, every passive construction that leaves the reader unsure who is doing what—these are the thousand and one adulterants that weaken the strength of a sentence. And they usually occur in proportion to education and rank.*
>
> -William Zinser

Describe the sources and direction of any biases. A statement like, "This study may not be generalizable because it was based on data from 2007," is inadequate. You need to explain why a study from 2007 may not be generalizable. What is different about today and 2007? Is the estimate too large or too small?

Clearly differentiate between assumptions you pulled from external sources and numbers you calculated yourself. Suppose you are projecting the impact of requiring employers to cover contraceptives on costs. You find a study that reports that when an employer added coverage for contraceptives, health care costs declined by 10%. You use this figure to project the impact of contraceptive coverage. It would be incorrect to say, "We estimated that contraceptive coverage will reduce costs by 10%." You didn't estimate this figure. You assumed it.

Describe the limitations of your analysis. This does not mean you should list every limitation, only those that you think are most important. You should also describe the direction of the bias and the rationale behind it. For example, "Omitting changes in longevity leads us to overstate the impact on revenues because….." You do not need to have a separate section or paragraph that describes limitations. Instead, limitations should be woven into the rest of the analysis. Do not include this sentence in your analysis. "This analysis has a number of limitations." You could put that into any policy analysis, and so it is not informative.

Conclusion

Summarize your main results. You can also address the implications for policy, but be cautious. You want to appear like an analyst, not an advocate. If you seem overly opinionated, the analysis may seem less credible.

Jargon

Avoid jargon. Just because we use a term in class does not mean it is OK to use it in a policy analysis. I am not your audience. Jay Sulzmann (and people like him) are your audience.

Informative section headers

Just because I have used the section headings "Introduction", "Methods and Results", and "Conclusions" when describing the content of a policy analysis does not mean you have to use them. It is fine to use more descriptive headings (for example, "The impact of tax levels on cigarette consumption.") and by all means, break your paper up into smaller sections.

Citing sources in the text

The normal rules of citation apply. Generally, you do not need to cite common knowledge.

Think carefully about how you phrase citations. Consider the following study by Harvard Medical School professor Lisa Rotenstein.

> Rotenstein LS, Ramos MA, Torre M, Segal JB, Peluso MJ, Guille C, Sen S, Mata DA. Prevalence of Depression, Depressive Symptoms, and Suicidal Ideation Among Medical Students: A Systematic Review and Meta-Analysis. *Journal of the American Medical Association* 2016;3016(21):2214-2236.

Here are five alternative approaches to citing it in the text.

1. According to the American Medical Association, 27% of medical students are depressed (Rotenstein et al. 2016).
2. According to Rotenstein et al. (2016), 27% of medical students are depressed.
3. According to Harvard University researchers, 27% of medical students are depressed (Rotenstein et al. 2016).
4. Twenty seven percent of medical students are depressed (Rotenstein et al. 2016).
5. Twenty seven percent of medical students are depressed.[1]

The first approach is wrong. Although the American Medical Association owns the *Journal of the American Medical Association*, it did not perform the study.

The second approach is the type of citation you would typically see in an academic journal. Academics working in this area might see the name "Rotenstein" and think, "Okay, I know Lisa, she does good work, I can trust this estimate." But you are not writing for an academic audience. If you do not think your audience knows or has heard of Lisa Rotenstein, the phrase "According to Rotenstein et al. (2016)" adds verbiage without adding information.

The third approach conveys information that may or may not be useful depending on the context. If the result is unexceptional and believable, then you do not really need the opening phrase. However, if the result is unexpected, then the opening phrase helps establish credibility. Consider the following statements.

> Regular participation in yoga can increase your life expectancy by 5 years.
>
> According to Emory University researchers, regular participation in yoga can increase your life expectancy by 5 years.

My reaction to the first statement is "No way!" My reaction to the second, "That is hard to believe, but, given the source, I'm open to the idea." The opening phrase provides useful information in this context.

When in doubt, use approach 4 or 5 above.

Formatting references

A citation should, at a minimum, provide the name of the first author, the title of the document, and the title of the place of publication (if a journal, newspaper, book, magazine, online site [like Slate or Vox]). The exact form of the citation does not matter. A web link is not sufficient.

Avoid quotes

In rare cases it is permissible to use a direct quotation. For example, if a well-known individual has a quote about the impact of a policy that conflicts with your results, then you could use the quote to help motivate your analysis.

Do not use quotations as a substitute for rephrasing ideas and concepts in your own words.

Why does writing matter?

When we ask prospective employers about the skills they find lacking in our graduates, "writing" is always at the top of the list. Many employers screen job applicants for writing ability. Once you get a job, you will be more likely to be noticed by people who are in a position to advance your career.

> *As an investor, you need to perform calculations and have a logical investment thesis. This is your left brain working. But you also need to be able to do things such as judging a management team from subtle cues they give off. You need to be able to step back and take a big picture view of certain situations rather than analyzing them to death. You need to have a sense of humor and humility and common sense. And most important, I believe you need to be a good writer. Look at Buffett; he's one of the best writers ever in the business world. It's not a coincidence that he's also one of the best investors of all time. If you can't write clearly, it is my opinion that you don't think very clearly.*
>
> - Mark Sellers, Hedge Fund Manager in a talk to Harvard Business School Students

> *Toronto Blue Jays president Mark Shapiro, Cleveland's longtime GM, pointed out that almost every applicant to a team is "smart, hardworking and passionate about baseball." The Indians, he said, "were looking for a point of differentiation," like writing.*
>
> -Wall St. Journal article: The Cleveland Indians' Brain Trust: Baseball Writers. Why the reigning American League champions have stocked their front office with former journalists

Good writing in the context of policy analysis (and in pretty much every other field) is clear and concise. Good writing does not have to be poetic or literary. Good writing is workmanlike. It has a job to do – communication – and it gets the job done efficiently.

If you are now thinking, "This is a policy analysis course. He should grade based on the content, not the writing," you are missing the point.

Writing = content.

If you do a great analysis but can't communicate it clearly, you might as well not have done it.

Consider the quote below from a statistician with the San Francisco 49ers.

> *At the end of the day, it boils down to this. The information is only as good as it is to the person receiving it. I'll take a C+ piece of analysis communicated perfectly over an A+ piece of analysis that's not communicated well. Only a small portion of the work is the analytics itself. The rest is putting it in a practical format so the salary-cap person and the coach can appreciate it and use it. Instead of trying to go overboard with analytics, focus on the practical: Focus on the things that have the highest impact on your organization.*
>
> -Paraag Marathe, Chief Strategy Office, San Francisco 49ers in interview with C. Bialik of FiveThirtyEight Decemer 23, 2014

When it comes to analysis, no amount of rigor, precision, or creativity can make up for poor communication. In the context of this class, good writing means that your paper clearly explains your analysis. It makes it easy for the reader to understand key assumptions, the structure of the model, and the results.

A well-written paper is one where the writer put in a lot of effort so the reader doesn't have to.

How to write well

A common thread running throughout all writing advice is that authors should strive for brevity. You should include all important information, but convey it as concisely as possible. In mathematical terms, good writing maximizes the ratio of words to content. Good writers scour their work for opportunities to cut out words, sentences, and even entire paragraphs.

> *Vigorous writing is concise. A sentence should contain no unnecessary words, a paragraph no unnecessary sentences, for the same reason that a drawing should have no unnecessary lines and a machine no unnecessary parts.*
> - William Strunk and E. B. White, The Elements of Style

It is probably easiest to illustrate good writing with examples.

> BAD: Plaintiff John Doe is currently serving a custodial sentence in the New York State penal system."
>
> IMPROVED: John Doe is a prisoner at Sing Sing.[1]
>
> BAD: Beginning in 01/00, a numberholder (BIC A only) who has attained full retirement age (FRA), but is not yet age 70, may elect to suspend his/her retirement benefit in order to earn delayed retirement credits (DRCs). This change is part of the Senior Citizens' Freedom to Work Act of 2000. This legislation eliminated the annual earnings test (AET) and the foreign work test (FWT) for those who have attained FRA. It allows beneficiaries to receive full retirement benefits regardless of earnings. Prior to 01/00 those benefits would have been subject to the AET or FWT and DRCs would have been earned for months subject to a full work deduction. Because those beneficiaries will no longer be subject to the AET or FWT, they are being given the opportunity to elect voluntary suspension of retirement benefits to earn DRCs.

[1] Freedman A. Why trial lawyers say it better. *Wall St. Journal* January 29, 2011.

> IMPROVED: A Social Security recipient who previously filed for Social Security benefits can suspend benefits at Full Retirement Age (66 for most people) and earn delayed retirement credits [an extra 8% per year added to their Social Security] until age 70. At full retirement age (66 for most), they may also continue to work and earn unlimited earnings without having any of their Social Security benefits withheld due to the Annul Earnings Test.[2]

The improved versions are much shorter than the originals, and they are easier to understand. They do not omit relevant information.

Good writing should also be clear, which means avoiding jargon, acronyms, and other constructions that make it difficult for your reader. It means having compassion for your reader. It means using simple words. For example, use "use" in place of "utilize".

One of the worst things you can do is try and sound "smart" by using complicated words and sentences. Writers who use big words sound dumb.[3]

While I've been writing this document, I've been trying to pay more attention to my own writing. Here are some examples of edits I made to improve clarity and excise unnecessary words.

> ORIGINAL: The survey was initiated by 956 unique individuals with 674 respondents completing the entire survey (70.5% completer rate).
>
> REVISED: Nine hundred and fifty six individuals started the survey and 674 (70.5%) completed it.

The revised version is four words shorter

Good prose is like a window pane: you see straight through it to what the author is trying to say. –George Orwell

> ORIGINAL: Hospitals' average acquisition cost for a unit of red blood cells was $225 in 2011 (DHHS 2011). Hospitals incur additional costs to store and process blood units and perform blood typing and cross-matching prior to transfusion.
>
> REVISED: Hospitals pay about $225 for each unit of blood (DHHS 2011) and incur additional costs for storage, processing, blood typing, and cross-matching.

The revised version is much shorter.

> ORIGINAL: Based on the comments, we took the opportunity to make substantial revisions to the approach

[2] Evans H. *Do I Make Myself Clear?* New York: Little, Brown, and Company; 2017.
[3] Oppenheimer, D. M. (2005). Consequences of erudite vernacular utilized irrespective of necessity: Problems with using long words needlessly. *Applied Cognitive Psychology* 20(2), 139-156.

> REVISED: Based on the comments, we made substantial revisions to the approach

"Took the opportunity" doesn't add anything.

> ORIGINAL: Our study will help to advance our understanding of the generalizability and sustainability of interventions
>
> REVISED: Our study will advance our understanding of the generalizability and sustainability of interventions

You don't need "help to". The second version sounds stronger and more confident.

> ORIGINAL: The *Journal of the American Association* published a study in 2002 on the impact of nurse staffing levels in hospitals on patient mortality.
>
> REVISED: The *Journal of the American Association* published a study in 2002 showing that hospitals with high nurse staffing levels had lower patient mortality rates.

The revised version is slightly longer (by one word, if you are counting), but it provides a lot more information. It tells us about the direction of the association.

> ORIGINAL: Organizations commission and perform policy analyses for a variety of reasons.
>
> REVISED: Organizations commission and perform policy analyses because of legal and regulatory requirements and to influence policymakers, the media, and the general public.

The revised version is quite a bit longer, but it provides a lot more information. The original phrase "a variety of reasons" is vague.

> ORIGINAL: However, if lawsuits put providers on notice that their behavior is being monitored, then they have the potential to have a significant impact on treatment patterns.
>
> REVISED: However, if lawsuits put providers on notice that their behavior is being monitored, then they may have a significant impact on treatment patterns.
>
> REVISED AGAIN: However, if lawsuits put providers on notice that their behavior is being monitored, they may affect how doctors treat patients.

The revised version is shorter.

Editing

A truism of writing is that it never comes out good the first time. You have to edit and then edit some more. And some more. It is not uncommon for authors to go through 10, 20, or 50 drafts of their work.

The letter I have written today is longer than usual because I lacked the time to make it shorter.

- Blaise Pascal

You need perspective to edit your work. You need to see your work through the eyes of your reader. It is hard to get perspective, which is why "editor" is a job category.

You do not have access to an editor. You can and should have friends and classmates read your work. If you are lucky, you will find a classmate who is a good writer and is conscientious and confident enough to make good suggestions to improve your work

The only kind of writing is rewriting.

- Ernst Hemingway

Time is the best editor.

Constantly step back from your canvas.

You gain perspective with time. Which is why it is important to leave enough time to put your paper down for a day or two and then come back to it with a fresh set of eyes. Time and time again I put a paper aside, thinking it is good, only to pick it up again and find that it needs a lot of work.

The moral of the story: good writing takes time, and cherish people who give constructive feedback.

An illuminating twitter thread

Bill Gardner is thinking of a grad student writing a grant, but you could sub in “professor” or “boss” for “grant reviewer” and “memo” for “grant” and it would still apply.

I will never grade your paper after two drinks, but you can assume I will be reading your paper 1) alongside many other papers, 2) at night, 3) when I am busy/harried/distracted. Write accordingly.

"Rules" you should break

It is perfectly OK to use "I" or "we". If you are the only author, it should be "I".

A paragraph need not have three sentences. One sentence paragraphs are fine.

You can start a sentence with "And" or "But".

A bad piece of writing

I was reading a paper the other day in a top economic journal and came across a piece of writing that just struck me pretty bad. The paper addresses the question: Did the Affordable Care Act's Medicaid expansion cause doctors to cut back on care provided to Medicare beneficiaries? The authors find that they do. This is from the paper:

> The leading explanation for our results is that they stem from physician responses to changes in fixed practice components brought on by changes in the heterogeneous payment environment. That is, when physicians who treat both Medicare and Medicaid patients experience increases in the share of Medicaid patients (whose coverage is more restrictive), these physicians reduce treatment intensity for all patients.

Where to begin. The opening clause ("The leading explanation for our results is that they stem…") is redundant. You expect an explanation to follow "The leading explanation for our results is that…". But "they stem" is not an explanation. It would be better to write the first sentence in such a way as to eliminate the "they stem" or keep the "they stem" but omit the "leading explanation for our results". But that hardly solves the problem.

The rest of the sentence is a mess. "fixed practice components"? "heterogeneous payment environment"? What the hell do those mean? I work in this field. I don't know.

Sometimes "That is" or "In other words" precedes a sentence that helps to clarify or expand the point of the sentence before it. Here it is code for "I know you didn't understand the first sentence, so now we are going to explain it to you in language you can understand."

A rewrite: Our results suggest that when physicians who treat both Medicare and Medicaid patients experience increases in the share of Medicaid patients (whose coverage is more restrictive), these physicians reduce treatment intensity for all patients.

Another one

This is from a draft paper on which I am a coauthor.

> ORIGINAL: African-American (AA) vs. white disparities exist in referral by dialysis facility providers for evaluation at a transplant center, completion of the medical evaluation, placement on the national transplant waiting list, and receipt of a living or deceased donor transplant. In addition, ethnic disparities

> exist in transplant access, in that Hispanics have lower transplant rates after waitlisting, but not before.

This has 59 words.

> REVISED: Compared to whites, African-Americans (AA) are less likely to be referred by dialysis centers for transplant, complete the evaluation, be placed on the waiting list, and receive a living or deceased donor transplant. In addition, Hispanics are equally likely to be listed but are less likely to receive a transplant after waitlisting.

The revised version is shorter (52 words) and more direct. I think it is also more forceful. It describes the impact of disparities rather than simply saying that they exist.

It also avoids the awkward construction, "In addition, ethnic disparities exist in transplant access, in that…" Just get to the point already.

Stilted academic writing

> I Walk My Dog Because It Makes Me Happy: A Qualitative Study to Understand Why Dogs Motivate Walking and Improved Health[4]
>
> Abstract: The strength of the dog-owner relationship is known to be correlated with dog walking, and this qualitative study investigates why. Twenty-six interviews were combined with autoethnography of dog walking experiences. Dog walking was constructed as "for the dog," however, owners represented their dog's needs in a way which aligned with their own. . . . Owners reported deriving positive outcomes from dog walking, most notably, feelings of "happiness," but these were "contingent" on the perception that their dogs were enjoying the experience. . . . Perceptions and beliefs of owners about dog walking were continually negotiated, depending on how the needs of the owner and dog were constructed at that time. Complex social interactions with the "significant other" of a pet can strongly motivate human health behaviour. Potential interventions to promote dog walking need to account for this complexity and the effect of the dog-owner relationship on owner mental wellbeing.

[4] Westgarth C, Christley RM, Marvin G, Perkins E. I Walk My Dog Because It Makes Me Happy: A Qualitative Study to Understand Why Dogs Motivate Walking and Improved Health. *International Journal of Environmental Research and Public Health* 2017;14(8): E936.

Some tips

A number of years ago Emory brought in a writing expert, Paul Cassella, to give a presentation on writing grants. I thought he had some good insights that I'd like to share with you.

1. Writing advice is empirical. It is based on common mistakes.
2. Writing is re-rewriting. Writing rarely comes out good the first time.
3. Put emphasis on the second part of the paragraph.
4. Display confidence
5. Ok to use I/we
6. Feature-Benefit model
7. Writing is a tool for thinking
8. The easier it is to understand the writing, the more the reader can focus on content
9. Use spoken language to inform writing and vice versa.
10. Vary passive voice.
11. Repetition of terms, especially technical ones, is ok.
12. Memo written to grandmother will be clearer than one written to a Nobel prize winning scientist.

Some more tips/instructions

1. Know the difference between a cost analysis, cost benefit analysis, and cost effectiveness analysis. Also, be aware that these are jargonny terms. Avoid them. Instead of saying, "I performed a cost analysis.", write, "I predicted the impact on costs to the state."
2. Do not have a separate limitations section. Weave limitations throughout the rest of the paper.
3. Never call for future study. Your reader wants to know the answer now.
4. Do not phrase topic as "I am going to look at". Instead: "I will predict…".
5. Do not write, "I propose [policy]." You are analyzing a policy, not proposing it.
6. Overestimation is not a word. (As in, "This may be an overestimation...").
7. Be clear about the perspective. To whom do savings accrue? Who pays the costs?
8. State clearly what you plan to do. Make sure your description matches what you do.
9. Avoid acronyms and quotations.
10. Do not make overly broad assumptions, like, "I assume that X policy will improve Y". Assumptions are quantitative relationships.
11. Breaking your paper up into smaller sections will make it more readable.

Here is a good website

https://insidegovuk.blog.gov.uk/2014/08/04/sentence-length-why-25-words-is-our-limit/

CHAPTER 6: TABLES AND GRAPHS

Tables

Tables are an effective way to communicate the structure of a model and the results. You can replace a lot of words with a well-constructed table. A poorly-laid out table can just make an analysis more confusing.

Give a lot of thought to how you create, construct, and label tables.

Look at this: Clear Off the Table, http://www.darkhorseanalytics.com/blog/clear-off-the-table.

And this: https://medium.com/mission-log/design-better-data-tables-430a30a00d8c

Art created by T.Horiuchi in Excel. See https://pasokonga.com/ for more.

Good tables make it easy for the reader to understand the results, emphasize the main results, avoid unnecessary shading or lines, use whitespace, and avoid unnecessary digits or numbers.

Rules for tables

1. Round to significant digits. Use "$1.4 billion" instead of "$1,364,908,433.62." The same principle applies to decimal places. Write, "The smoking rate is 11%." rather than, "The smoking rate is 11.25%." The extra digits do not provide useful information.

2. If your table is displaying billions of dollars (or millions or thousands), but "Billions of dollars" or something like that in the row or column labels. Don't write "billions" under each entry in the table.

3. Do not put a border around every number or cell. Take out unnecessary lines.

4. Numbers should be right-justified.

5. Text should be left-justified. (Except that headings of columns with numbers should probably be right-justified like the numbers.)

6. Use shading sparingly, if at all.

7. Rows in tables should be single-spaced. Reduce the white space between row labels and the numbers.

8. I suggest that you make tables in Excel. I think it is easier to adjust row and column spacing in Excel, and you can do the analysis in Excel so that you do not have to copy it into Word tables.

9. Tables should have a consistent look.

10. Try to avoid the words “Number of” and “Total” in row or column labels, as they are often self-explanatory.

11. If some headers have long text descriptions, it is better to set up the table so that they are in rows rather than columns.

12. If you have a table that displays all the steps in an analysis, orient the table so that the steps are in rows rather than columns.

13. The font size should be readable.

14. The font should be something other than the default, Calibri.

15. Emphasize the main result.

16. Tables should be laid out logically in a way that facilitates reader interpretation

17. Use whitespace or overlapping headings to group related items. But rows should not be double-spaced.

18. Take out all superfluous lines/numbers in your table. Here’s a quick check: If you change a number in your table and your final result doesn’t change, take out that number.

Bad

	Best-case	Worst-case
Birth costs		
Birth rate per 1,000 women 15-44[a]	65.6	65.6
Percent reduction in births[b]	8.9	0.004
Reduction in the birth rate per 1,000 women 15-44	5.8	0.0
Cost per birth 1996[c]	$12,700	$12,700
PPI-Hospital 2006/1996[d]	1.35	1.35
Cost per birth 2006	$17,000	$17,000
Avoided birth costs	$99,000	$40

Better

	Best-case	Worst-case
Birth costs		
Birth rate per 1,000 women 15-44[a]	65.6	65.6
Percent reduction in births[b]	8.9	0.004
Reduction in the birth rate per 1,000 women 15-44	5.8	0.0
Cost per birth 1996[c]	$12,700	$12,700
PPI-Hospital 2006/1996[d]	1.35	1.35
Cost per birth 2006	$17,000	$17,000
Avoided birth costs	$99,000	$40
Abortion costs		
Abortion rate per 1,000[a]	22.9	22.9
Percent reduction in abortions[b]	33.3	0.004
Reduction in abortions	7.6	0.0

Best

	Best-case	Worst-case
Birth costs		
Birth rate per 1,000 women 15-44[a]	65.6	65.6
Percent reduction in births[b]	8.9	0.004
Reduction in the birth rate per 1,000 women 15-44	5.8	0.0
Cost per birth 1996[c]	$12,700	$12,700
PPI-Hospital 2006/1996[d]	1.35	1.35
Cost per birth 2006	$17,000	$17,000
Avoided birth costs	$99,000	$40
Abortion costs		
Abortion rate per 1,000[a]	22.9	22.9
Percent reduction in abortions[b]	33.3	0.004

19. Tables made in Excel will look better than tables made in Word.

20. Minimize space between the row labels and numbers.

Bad

	Best-case	Worst-case	Source
Birth costs			
Birth rate per 1,000 women	65.6	65.6	CDC (2018)
Percent reduction in births[b]	8.9	0.004	Redd et al. (2014)

Better

	Best-case	Worst-case	Source
Birth costs			
Birth rate per 1,000 women	65.6	65.6	CDC (2018)
Percent reduction in births[b]	8.9	0.004	Redd et al. (2014)

21. Try to format tables so that row labels aren't wrapped.

Bad

	Best-case	Worst-case	Source
Birth costs			
Birth rate per 1,000	65.6	65.6	https://www.cdc.gov/nchs/nvss/births.htm
Percent reduction in births[b]	8.9	0.004	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6482903/
Reduction in the birth rate per 1,000 women 15-44	5.8	0.0	

Better

	Best-case	Worst-case	Source
Birth costs			
Birth rate per 1,000 women	65.6	65.6	CDC (2018)
Percent reduction in births[b]	8.9	0.004	Redd et al. (2014)

22. To paste an Excel table into Word, select "Paste Special" from the Edit menu and then double click on "Picture".

23. Tables should fit on a single page. Adjust spacing or location if your table bleeds onto a second page.

Some examples

Good

	Assumption	Notes
Step 1	45	
Step 2	25%	
Step 3	11.3	
Step 4	38%	
Step 5	43%	
Step 6	425	

Bad

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
45	25%	11.25	38%	43%	425

Good

	Before	After	Difference	Notes
Step 1	45	45		
Step 2	0.25	0.25		
Step 3	11.3	9	2.3	
Step 4	38%	30%	8	
Step 5	43%	35%	8	
Step 6	427	350	77	

Section headings can help

	Before	After	Difference	Notes
Enrollment				
Step 1	45	45		
Step 2	0.25	0.25		
Step 3	11.3	9	2.3	
Completion				
Step 4	38%	30%	8	
Step 5	43%	35%	8	
Step 6	427	350	77	

Ok but could be better

Annual Medicare Spending	$536,000,000,000	Kaiser Family Foundation (2012) (2)
Total Medicare Beneficiaries	48,722,929	Kaiser Family Foundation (2012) (3)
Eligible Beneficiaries	29,720,987	Centers for Medicare and Medicaid Services (4)
Enrolled Beneficiaries	19,814,982	Ackermann (2008) (5)
Beneficiaries That Complete Program	8,916,742	Ackermann (2008)
Percent of Total Beneficiaries That Complete Program	18%	(Beneficiaries who complete the program/Total Medicare Beneficiaries) x 1
Percent of Eligible Beneficiaries That Complete Program	30%	(Beneficiaries who complete the program/Eligible beneficiaries) x 100
Percent of Enrolled Beneficiaries That Complete Program	45%	(Beneficiaries that complete the program/Enrolled Beneficiaries) x 100
Annual Program Cost Per Beneficiary	$660.00	Average US gym membership ($55.00 per month) x 12 months (6)

Bad, bad, bad

	Total cost of Medicare *Before* intervention	**Total cost of the program**	**Total cost of Medicare *after* intervention**	**Net saving from program intervention/ year**	**Reduction percent**
2 to 3 chronic disease	56 million	4 million	24 million	32 million	
4 to 5	87 million	2 million	40 million	85 million	
6+	142 million	780 thousand	70 million	141 million	
Total	285 million	7 million	136 million	260 million	48%

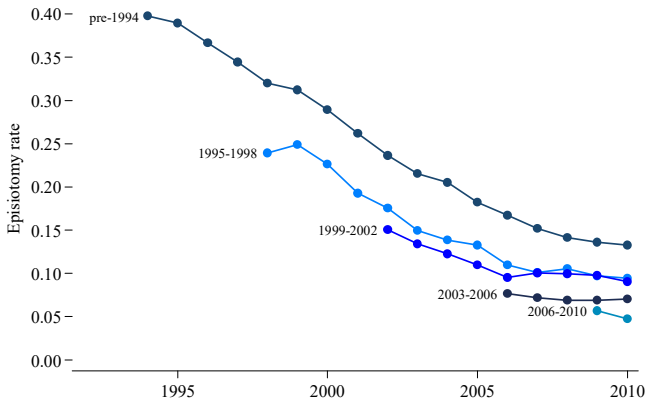
Variable	Estimate	Data Source/ Method of Calculation
Number of meals consumed at restaurants subject to calorie labeling rules		
1. Total annual restaurant revenue, Los Angeles County	$14,600,000,000	Projected restaurant sales for 2007 in California as reported by National Restaurant Association, web site: Http://www.restaurant.org, accessed September
2. Large chain restaurant market share - 15 or more stores in California	51%	Extrapolated information from the NYPD Group, 2005; cited in the U.S. District Court Declaration of Thomas R. Frieden, Commissioner of the New York
3. Large chain restaurant revenue, Los Angeles County	$7,446,000,000	Calculated by multiplying the estimates in variables 1 and 2.
4. Average price per meal in large chain restaurants (includes fast food and sit-down restaurants)	$7.80	Based on national meal price estimates in 1992 (Jekanowski, 1999), adjusted for inflation using a factor of 2.866% per year compounded (based on the
5. Annual number of meals served in large chain restaurants, Los Angeles County	954,615,385	Calculated by dividing the estimate in variable 3 by the estimate in variable 4.
6. Annual number of meals served, ages 0-4 years	36,500,000	Estimate derived from the 2005 Los Angeles County Health Survey data.
7. Annual number of meals served, ages 5 and older	918,115,385	Calculated by subtracting the estimate in variable 6 from the estimate in variable 5.
Reduction in caloric consumption due to calorie labeling rules		
8. Percentage of large chain restaurant patrons who select reduced-calorie meals as a result	10%	Extrapolated from data published by Burton et al., Am J Public Health 2006;96:1669-1675.
9. Annual number of reduced-calorie meals	91,811,538	Calculated by multiplying the estimates in variables 7 and 8.
10. Average amount of calorie reduction per meal	100	Unpublished survey data (person communication: Dr. Lynn Silver, New York City Department of Health and Mental Hygiene, December 3, 2007).
11. Total annual number of reduced calories attributable to menu labeling	9,181,156,846	Calculated by multiplying the estimates in variables 9 and 10.
Impact on population weight gain		
12. Calories per pound of weight	3,500	Duyff RL. American Dietetic Association *Complete Food and Nutrition Guide*. Hoboken, New Jersey: John Wiley and Sons, 2002 (page 36).
13. Total annual pounds of weight loss attributable to menu labeling	2,623,187	Calculated by dividing the estimate in variable 11 by the estimate in variable 12.
14. Average annual population weight gain, ages 18 years and older (pounds)	5,500,000	Calculated using data from the 1997 and 2005 Los Angeles County Health Surveys.
15. Average annual population weight gain, ages 5 to 17 years (pounds)	1,250,000	Calculated using data from the 1999 and 2006 California Department of Education Physical Fitness Testing Program.
16. Average annual population weight gain, ages 5 years and older (pounds)	6,750,000	Calculated as the sum of the estimated in variables 14 and 15.
17. Percentage of population weight gain averted due to menu labeling	38.90%	Calculated by dividing the estimate in variable 13 by the estimate in variable 16.

Graphs

For every paper I write, I ask myself one question, "If I could only show someone one picture that would illustrate my result, what would it be?" I then set out to create that picture, before I do any regression analyses.

I know if I have one good picture, then a harried reader can look at the paper and quickly get an idea of what it is about. I know that someone who does not have any background in statistics, like most journalists or policymakers, can look at the picture and understand the study. I know that someone who wants to share the result can copy and paste the picture into an email or Powerpoint presentation. Here is an example:

Figure 4: Episiotomy rates by obstetricians' year of entry



Now of course it helps to have some explanation, but many of you can probably understand what is going on without any additional text. Just in case: The use of episiotomy has declined, but at any point in time, women treated by older doctors are more likely to have an episiotomy.

Graphs can also lend credibility to claims. They make them seem more rigorous. Respondents to a survey were more likely to believe that a drug is effective if materials about the drug were accompanied by a graph, even if the graph did not provide new or useful information.[1]

[1] Tal A, Wansink B. Blinded with science: Trivial graphs and formulas increase ad persuasiveness and belief in product efficacy. *Public Understanding of Science* October 15, 2014.

A quick guide to good graphs

1. Use a figure only if you have two or more data points.

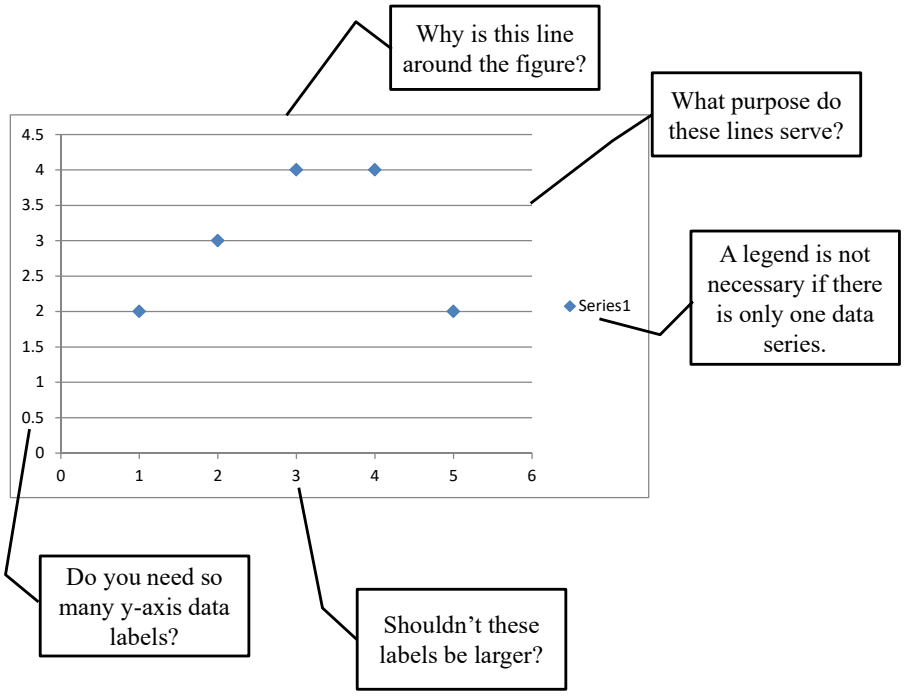
2. Label axes clearly.

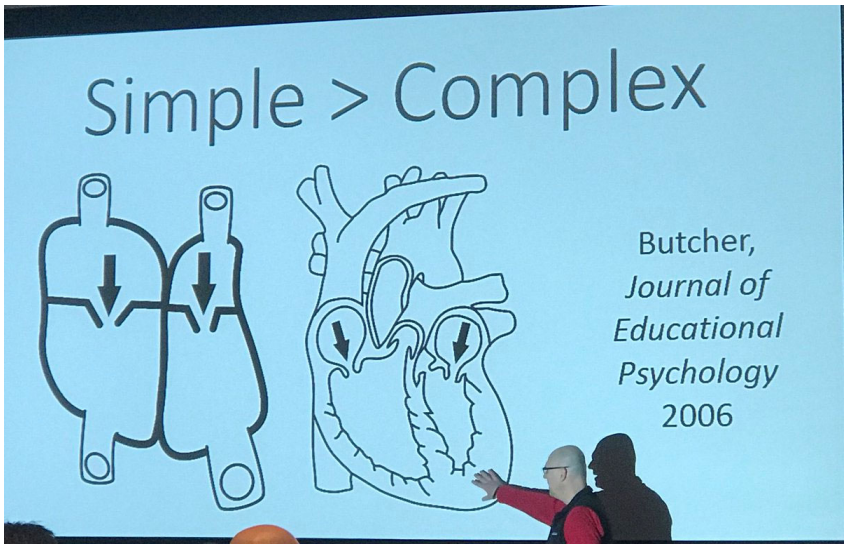
3. The units on axes should be appropriate for the data. For example, if you are trying to display trends in total Medicare spending, you do not need a tick mark for every $100 increment. Round to significant digits. If you are graphing total Medicare spending, don't put "$300,000,000,000" on the y-axis. Instead, put "$300" and then use "Total Medicare spending ($ billions)" as the y-axis label.

4. Label lines and bars clearly.

5. The font size should be readable.

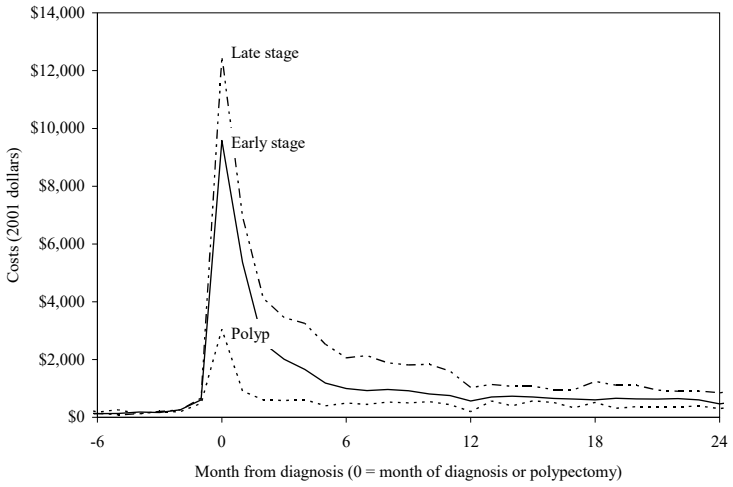
6. Avoid unnecessary lines, outlines, and shading.





7. Label lines or bars in graphs directly rather than using a key:

Figure 1: Average monthly costs by stage at diagnosis for men 65-74 without comorbidities



NOTE: Comorbidities are heart disease, pulmonary conditions, and diabetes. Costs from diagnosis onward include only costs for men who have survived to that point. Decedents are excluded from the month of death onward.

8. Don't leave the default border around graphs. To get rid of the border, always select the "on a new sheet option" in the chart wizard. Then, click on the sheet and copy.

9. To paste a Excel graph into Word, select "Paste Special" from the Edit menu and then double click on "Picture".

10. Use constant design-examples are open-high-low-close stock charts and chess diagrams.

Bad graphs made better

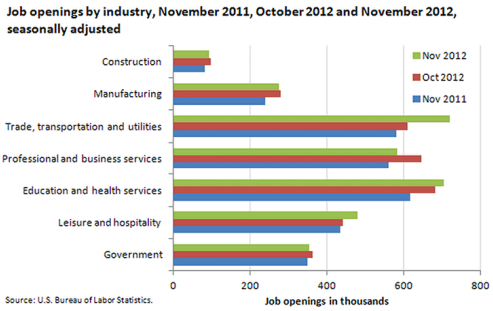
Please look at this: Data Looks Better Naked:
http://www.darkhorseanalytics.com/blog/data-looks-better-naked

Job openings in November 2012

JANUARY 11, 2013

There were 3.7 million job openings on the last business day of November 2012, unchanged from October 2012. In November 2011 there were 3.3 million job openings.

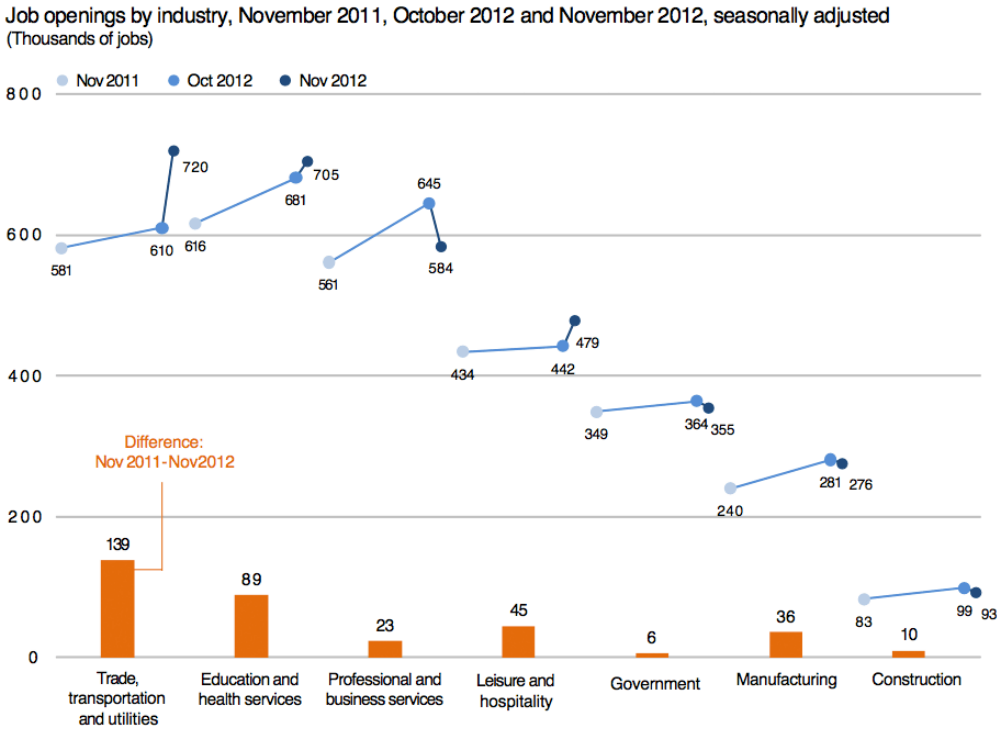
CHART IMAGE | CHART DATA



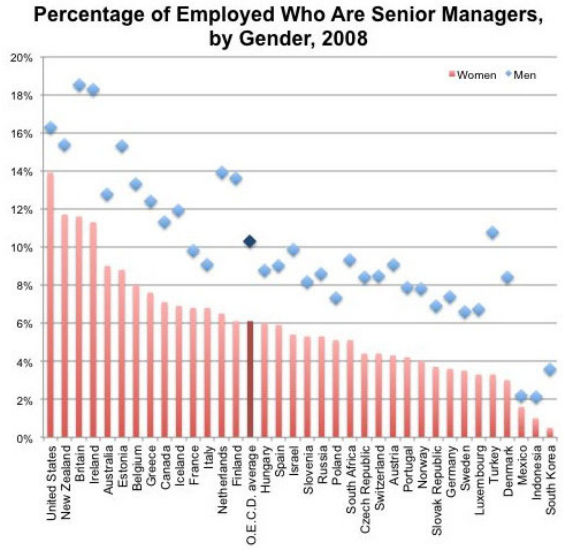
From November 2011 to November 2012, job openings increased most in retail trade (144,000, within the trade, transportation and utilities industry) and health care and social assistance (91,000, within the education and health services industry).

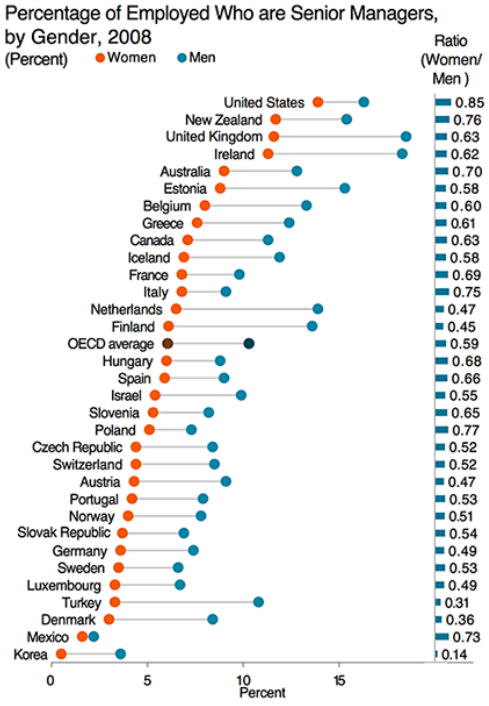
Government job openings increased the least, by 6,000.

These data are from the Job Openings and Labor Turnover Survey. Data for the most recent month are preliminary and subject to revision. For additional information, see Job Openings and Labor Turnover — November 2012" (HTML) (PDF), news release USDL-13-0015. More charts featuring data on job openings, hires, and employment separations can be found in Job Openings and Labor Turnover Survey Highlights: November 2012 (PDF).



And this: http://thewhyaxis.info/gap-remake/

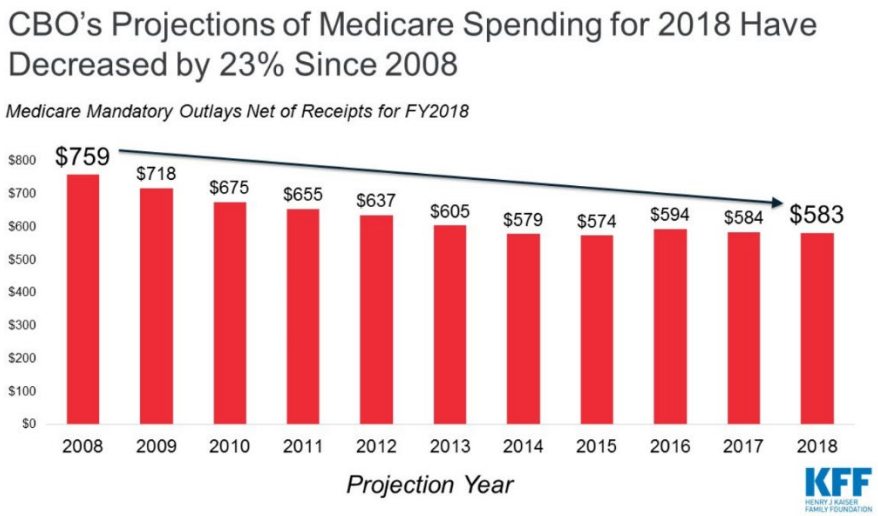

Percentage of Employed Who Are Senior Managers, by Gender, 2008
Women
Men
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
United States
New Zealand
Britain
Ireland
Australia
Estonia
Belgium
Greece
Canada
Iceland
France
Italy
Netherlands
Finland
O.E.C.D. average
Hungary
Spain
Israel
Slovenia
Russia
Poland
South Africa
Czech Republic
Switzerland
Austria
Portugal
Norway
Slovak Republic
Germany
Sweden
Luxembourg
Turkey
Denmark
Mexico
Indonesia
South Korea


Percentage of Employed Who are Senior Managers, by Gender, 2008
(Percent)
Women
Men
Ratio (Women/ Men)
United States 0.85
New Zealand 0.76
United Kingdom 0.63
Ireland 0.62
Australia 0.70
Estonia 0.58
Belgium 0.60
Greece 0.61
Canada 0.63
Iceland 0.58
France 0.69
Italy 0.75
Netherlands 0.47
Finland 0.45
OECD average 0.59
Hungary 0.68
Spain 0.66
Israel 0.55
Slovenia 0.65
Poland 0.77
Czech Republic 0.52
Switzerland 0.52
Austria 0.47
Portugal 0.53
Norway 0.51
Slovak Republic 0.54
Germany 0.49
Sweden 0.53
Luxembourg 0.49
Turkey 0.31
Denmark 0.36
Mexico 0.73
Korea 0.14
0
5
10
15
Percent

CHAPTER 7: SENSITIVITY ANALYSIS

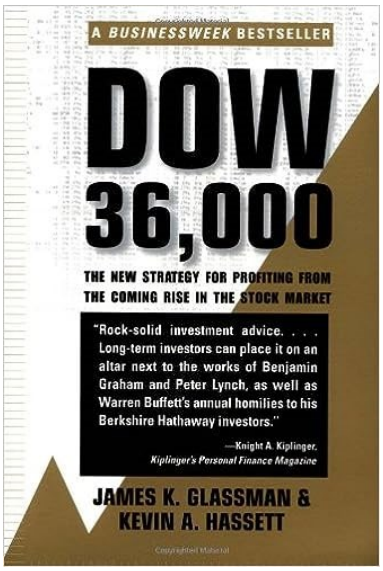
Overview

It is hard to make accurate predictions, especially in rapidly-changing fields such as health care. The graph below shows the Congressional Budget Office's predictions of health care spending in 2018 by the year when the prediction was made. As you can see, predictions before 2013 were off by a wide mark. Given the difficulty of making accurate predictions, it is important to convey uncertainty to policymakers who consider predictions when making decisions.



Confidence

Forecasters should describe how confident they are in their predictions. Economist Charles Manski writes[1]:



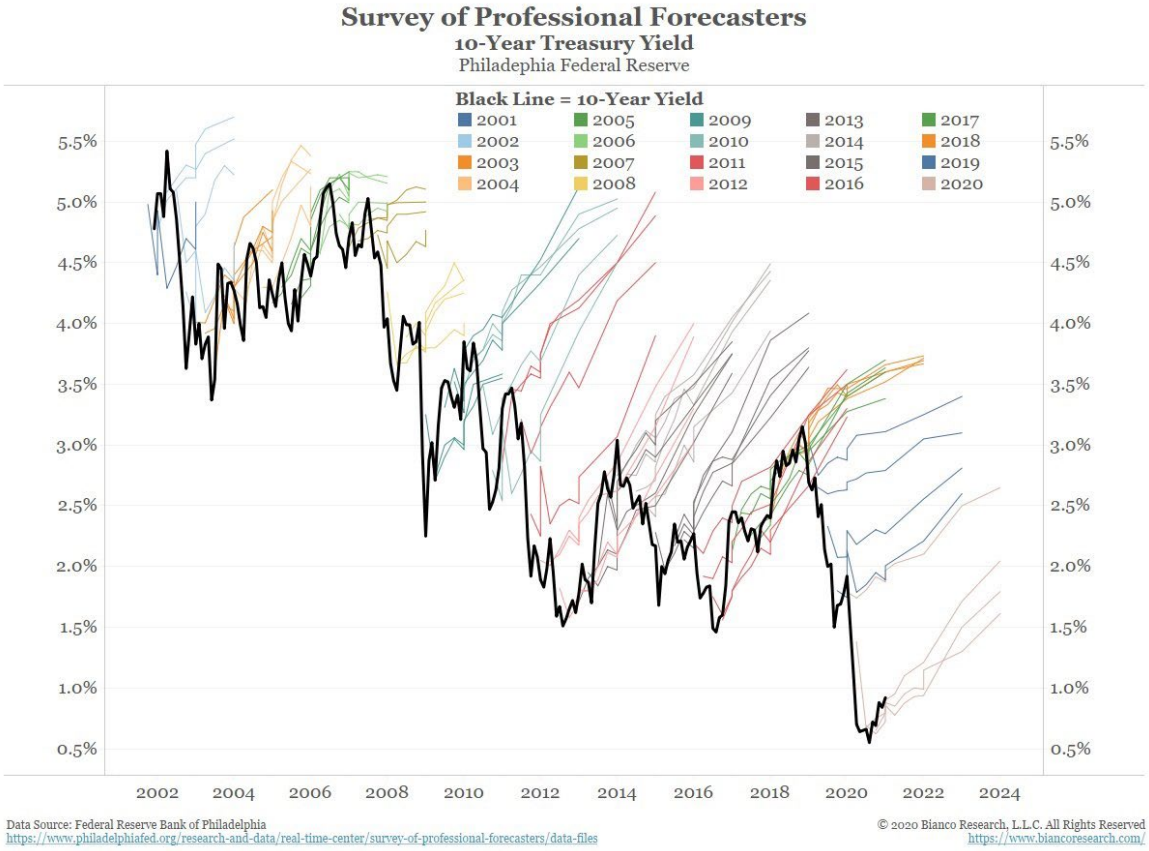
> Analysts produce estimates without qualification based on the belief that policymakers demand certainty and are unable to cope with ambiguity. But forecasts that do not express uncertainty ultimately will risk their credibility and policymakers see time and time again that the forecast is not accurate.

Unfortunately, analysts who make bold, confident predictions tend to receive more attention than those who hedge their bets. Confidence sells. Journalist James Glassman and economist Kevin Hassert, who recently stepped down as the head of Trump's Council of Economic Advisors, wrote a book in 1999 called Dow 36,000, predicting that the Dow Jones Industrial Average would soon reach 36,000 (at the time it was around 11,000). The stock market crashed soon after the book was published.

[1] Manski CF, Policy analysis with incredible certitude. *The Economic Journal* 2011.

The index's value as of this writing is 22,773. The authors received a lot of publicity for their prediction. They received some criticism, but their careers have flourished.

The moral of the story: if you are interested in fame or fortune, it is better to write a book called *Dow 36,000* than one titled *The Dow May Reach 36,000, But There Is Also A Good Chance It Will Hover Between 10,000 and 20,000 For Awhile.* But, if you are policy analyst, you should be more circumspect. Predictions and recommendations should be commensurate with the quality of the evidence.

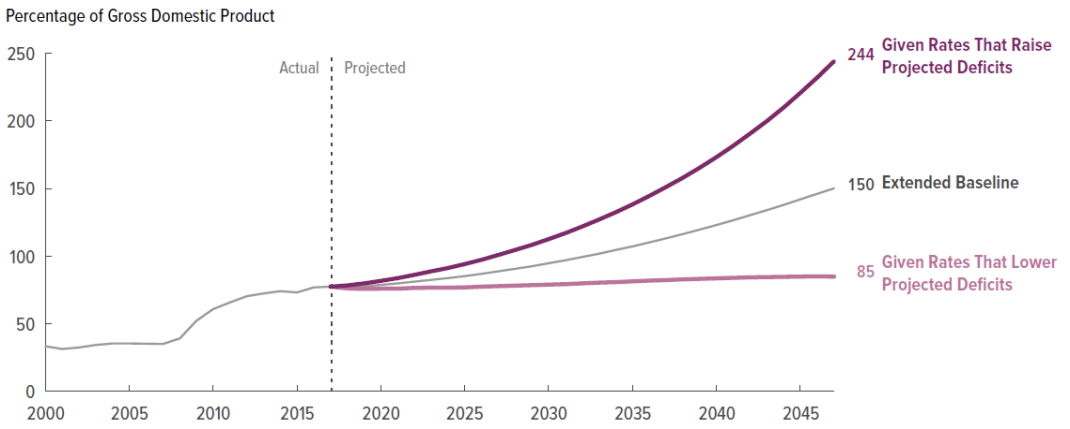


Agencies and analysts differ in how they convey uncertainty. It its Long Term Budget Outlook[2], the Congressional Budget Office estimates federal debt under difference scenarios.

[2] Congressional Budget Office. The 2017 Long-Term Budget Outlook. March 2017.

Figure 10.

Federal Debt Given Different Labor Force Participation Rates, Productivity Growth Rates, Federal Borrowing Rates, and Rates of Excess Cost Growth for Federal Spending on Medicare and Medicaid



The Bank of England uses Monte Carlo simulation to develop ranges of predictions for the inflation rate.[3]

Chart 5.1 CPI inflation projection based on market interest rate expectations, other policy measures as announced

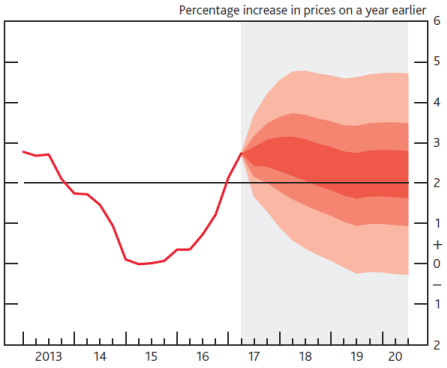
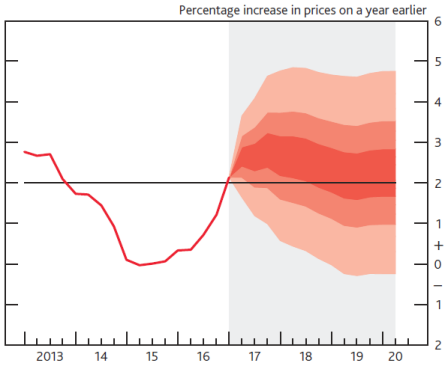


Chart 5.2 CPI inflation projection in May based on market interest rate expectations, other policy measures as announced



Charts 5.1 and 5.2 depict the probability of various outcomes for CPI inflation in the future. They have been conditioned on the assumptions in Table 5.B footnote (b). If economic circumstances identical to today's were to prevail on 100 occasions, the MPC's best collective judgement is that inflation in any particular quarter would lie within the darkest central band on only 30 of those occasions. The fan charts are constructed so that outturns of inflation are also expected to lie within each pair of the lighter red areas on 30 occasions. In any particular quarter of the forecast period, inflation is therefore expected to lie somewhere within the fans on 90 out of 100 occasions. And on the remaining 10 out of 100 occasions inflation can fall anywhere outside the red area of the fan chart. Over the forecast period, this has been depicted by the light grey background. See the box on pages 48–49 of the May 2002 *Inflation Report* for a fuller description of the fan chart and what it represents.

[3] Bank of England. *Inflation Report*. August 2017.

Two Types of Uncertainty

The policy analysis Menu Labeling as a Potential Strategy for Combatting the Obesity Epidemic[4] predicts that menu labeling would prevent 39% of the weight gain that would otherwise occur in the population, assuming that labeling causes 10% of patrons to switch to a low calorie meal. The estimate comes from a 2006 paper in the *American Journal of Public Health*.[5] The paper describes the effect thusly:

> When calorie-plus-nutrient information was presented, the percentage of consumers choosing the turkey sandwich (which generally met or exceeded nutrition expectations) increased from 11% to 21%, and it decreased selection of items with higher levels of calories and fat than expected.

(As we discussed previously, this effect should be interpreted as a percentage point change, not a percent change.) There are several sources of uncertainty

- First, it is unclear whether the effect, which reflects respondents' answers to a mail survey, reflects the behavior change we might observe in the real world. Restaurant patrons make decisions on a repeated basis and must eat the food they choose. We might expect the real-world effect to be smaller than 10%. There is uncertainty due to the study design and the generalizability of the effect.

- A second source of uncertainty is statistical uncertainty. Even if the estimate is unbiased, it may differ from the true value because of sampling variation. The sample on which the estimate was based is finite. Standard errors and confidence intervals capture statistical uncertainty.

A sensitivity analysis can address one or both types of uncertainty.

The authors of the analysis present a two-way sensitivity analysis.

[4] Simon P, CJ Jarosz, T Kuo, JE Fielding. *Menu Labeling as a Potential Strategy for Combatting the Obesity Epidemic.* County of Los Angeles Public Health. May 2008. http://publichealth.lacounty.gov/docs/menu_labeling_report_2008.pdf

[5] Burton S, Creyer EH, Kees J, Huggins. Attacking the obesity epidemic: the potential health benefits of providing nutrition information in restaurants. *American Journal of Public Health* 2006;96:1669-1675.

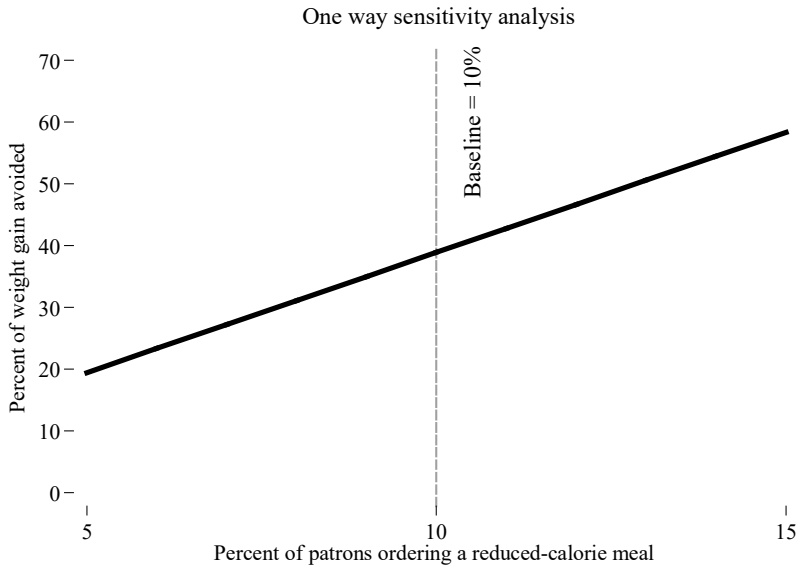
Table 2
Impact of consumer response to menu labeling on the percentage of population weight gain averted: simulation of multiple scenarios of calorie reduction.[§]

Average Amount of Calorie Reduction per Meal	Percentage of Large Chain Restaurant Patrons Who Purchase a Lower-Calorie Meal as a Result of Menu Labeling				
	10%	20%	30%	40%	50%
25	9.7%	19.4%	29.1%	38.9%	48.6%
50	19.4%	38.9%	58.3%	77.7%	97.2%
75	29.1%	58.3%	87.4%	116.6%	145.7%
100	**38.9%**	77.7%	116.6%	155.4%	194.3%
125	48.6%	97.2%	145.7%	194.3%	242.9%
150	58.3%	116.6%	174.9%	233.2%	291.5%
175	68.0%	136.0%	204.0%	272.0%	340.0%
200	77.7%	155.4%	233.2%	310.9%	388.6%

[§] Percentages presented in the table refer to the percentage of population weight gain averted.

They chose to examine only values of the share of patrons choosing a low calorie meal greater than 10%. But, given the likelihood that the 10% estimate is too high, it would have been better to at least include some values below 10%.

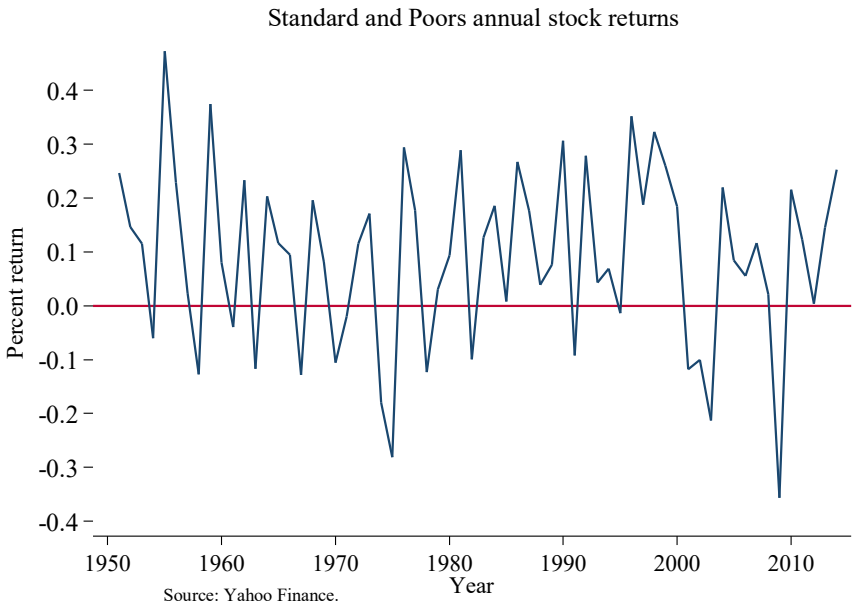
The graph below displays a deterministic, one way sensitivity analysis. I selected the upper and lower bounds, 5 and 15, arbitrarily.



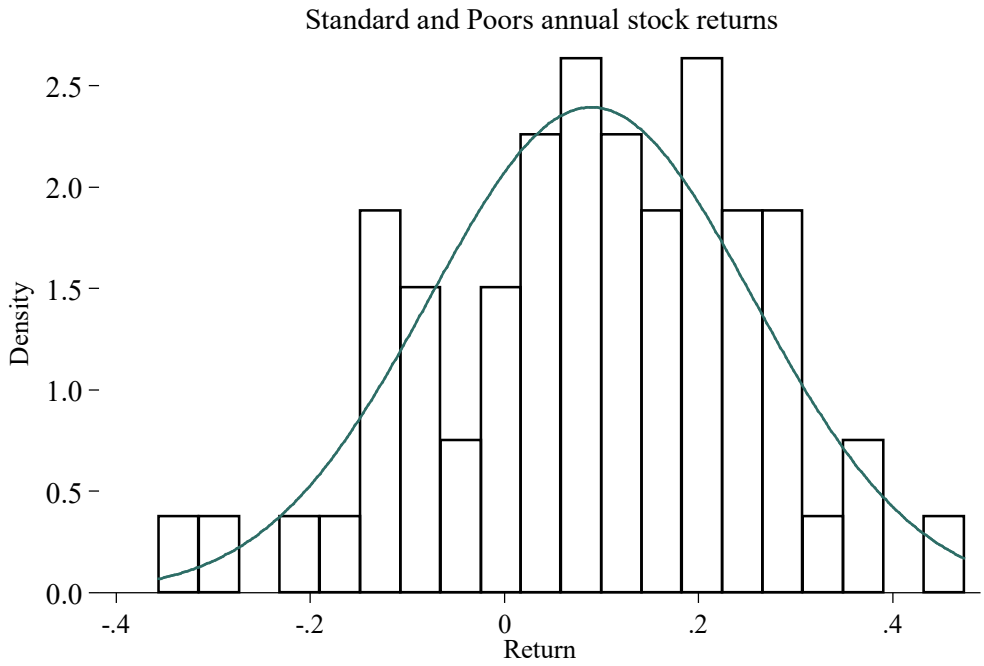
Monte Carlo Simulation

Monte Carlo simulation is a tool for conducting sensitivity analysis that takes advantage of prior information about the distribution of an uncertain outcome or variable. We may not know the eventual value of the outcome, but we do know which outcomes are more or less likely. What will happen to $10,000 if you invest it in the stock market for 10 years? What is the probability that you lose money? You can use Monte Carlo simulation to answer the question.

Here is the annual return on a portfolio invested in the Standard and Poor's 500 index.



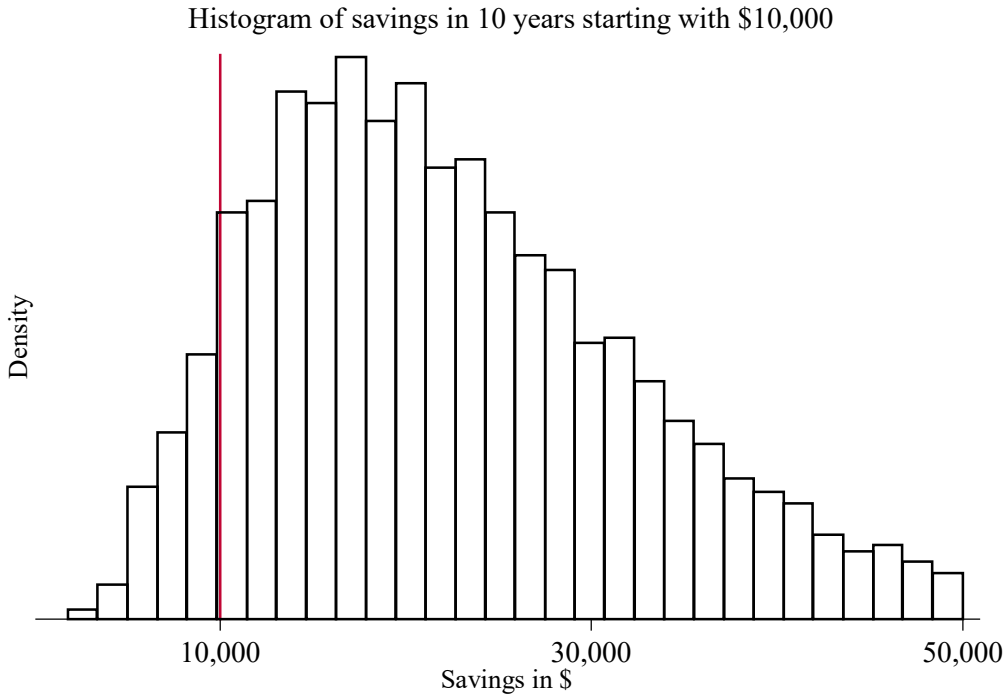
Here is a histogram of the returns.



Source: Yahoo Finance.

The mean return was 9%. The return was negative in 17 of 65 years. The market yields a positive return in most years, but on occasion the value of a portfolio will decline by 20% or more.

To calculate the distribution of portfolio values after 10 years, I assume that the distribution of returns in the future will mirror the distribution of returns in the past. I randomly drew a return from the historical distribution, multiply it by the portfolio value, and repeat this process 9 more times (for a total of 10 times, representing 10 years). At the end, I have the predicted value of a simulated portfolio. Then, I repeated the entire process 10,000 times. Each time, I record the value of the portfolio at the end of 10 years. Here is a histogram of the results.



The average portfolio value was $23,000. The portfolio was less than $10,000 in 8% of the simulations.

You could have put the money into a safer investment. If the safer investment returned a steady 2% per year, you would have had about $12,000 at the end of 10 years. The stock portfolio was less than $12,000 in 14% of the simulations.

Deterministic versus probabilistic sensitivity analysis

In a "deterministic" sensitivity analysis, the analyst just examines the sensitivity of results to a range of possible values for an assumption (or assumptions) without worrying about whether some values in the range are more or less likely.

In a "probabilistic" sensitivity analysis, the analyst assumes a distribution for the assumption and randomly samples, via Monte Carlo simulation, from the distribution. The analyst could pick a distribution based on prior knowledge or, if the goal is to capture uncertainty due to sampling variation, a confidence interval.

If you have a good basis for selecting a distribution, then probabilistic sensitivity analysis is preferable, though it is difficult to explain to non-technical audiences. Otherwise, deterministic sensitivity analysis is the default option.

Probabilistic sensitivity analysis for the menu labeling paper

The *American Journal of Public Health* menu labeling paper does not report the confidence interval for the 10% estimate. I calculated it assuming the sample of 240 respondents was

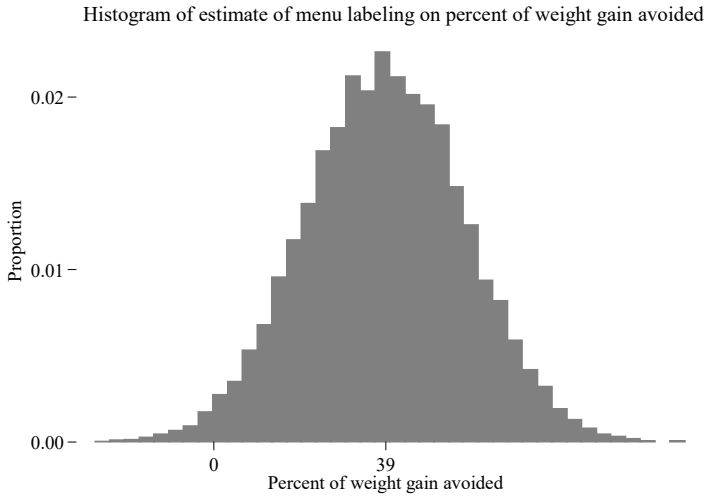
evenly split between the treatment and control groups and applying the formula for calculating the standard error for a difference in proportions: = sqrt [p1(1-p1)/n1 + p2(1-p2)/n2]. The upper and lower bounds of the 95% confidence interval are 0.8% and 19%. The standard deviation is 5% (with some rounding).

Suppose we want to conduct a sensitivity analysis to reflect uncertainty in the assumption about the share of consumers who will switch to a low calorie meal due to sampling variability. We could perform a deterministic sensitivity analysis where we vary the assumption between its 95% confidence interval bounds. But not all values between 0.8% and 19% are not equally likely. Instead, the distribution of the estimate is normal, centered on 10% with a standard deviation of 5%. A probabilistic sensitivity analysis, using Monte Carlo simulation, can account for the distribution of the estimate. To conduct the analysis, I

1) took a random draw from a normal distribution with mean 10 and standard deviation 5,
2) recalculated the outcome of the menu labeling model, and
3) repeated this process 1,000 times.

I performed the analysis in Stata, but it is easy to do in Excel. If you were doing this analysis in Excel, you would type "=NORMINV(RAND(),10,5)" in a cell to take a random draw.

Here is a histogram of the percent of weight gain prevented. The distribution of the outcome (percent of weight gain prevented) reflects the distribution of the estimate of the impact of calorie labels on the share of consumers who will select a low calorie meal.



Since the normal distribution is unbounded (values between $-\infty$ and $+\infty$ are possible), you do end up taking some random draws where the value is negative (which would correspond to the situation where menu labeling *decrease*s the share of consumers ordering reduced calorie meals). It would be reasonable to discard these values as part of a sensitivity analysis.

Performing a sensitivity analysis

To perform a one way sensitivity analysis, identify a key assumption that you think has a big influence on the outcome and where you are unsure of the true value. The policy effect assumption is usually a good choice.

Consider the rationale. Is uncertainty due to random, sampling error? In that case, consider a Monte Carlo sensitivity analysis if you know the standard error or confidence interval associated with the assumption or a deterministic sensitivity analysis where you examine the sensitivity of results to a symmetric range centered on the baseline assumption.

Is uncertainty due to a flawed study design? Perhaps you have an assumption about the impact of a policy on an outcome but you believe the study on which it is based may have systematically overstated the effect. In that case perform a deterministic sensitivity analysis. The interval over which you examine the sensitivity of results does not necessarily need to be symmetric or centered on the baseline assumption. If the baseline assumption is Z, then you might perform a sensitivity analysis over the interval 0 to Z (if you think Z overstates the true effect).

You will sometimes see policy analyses present estimates under different scenarios (for example, a “best case” scenario and a “worse case” scenario). This is another approach to sensitivity analysis. It should not be the default approach. In general it is better to first present a single baseline projection.

Put the sensitivity analysis in a separate section. Describe the baseline analysis first. If you try to describe the baseline and sensitivity analyses at the same time, you may confuse your reader.

A sensitivity analysis does not cure or address problems with internal validity or generalizability. It simply shows how results changes as you vary assumptions. That’s it.

CHAPTER 8: MEASURING COSTS

Conceptual framework

Policy analyses should count the opportunity costs of resources used (or saved) by a program. These represent "the long-run marginal value forgone due to the use of these resources."[1] Another way to think about it: we want to count resources that are lost or destroyed during the production of a program.

When conducting an analysis from the societal perspective, you should not count transfer payments. Transfer payments are one-way transfers of a resource, usually money, for which no money, good, or service is received in exchange.

From Barnett (2008):

> Resources are to be valued at their opportunity cost, sometimes called the economic cost. The opportunity cost is the value of the resources applied to their next best use (ie, the potential benefit from taking the opportunity to use the resource in another way). Opportunity cost may differ from price or reimbursement; health care markets function imperfectly, and these may not reflect the opportunity cost. CEA guidelines also state that cost should be estimated from the societal perspective.

For example, forgone earnings should be included in the cost of a college education.

Approaches to measuring costs

Microcosting: Researchers directly measure and price all the resources used in producing a program or intervention. Many costs are difficult to assign to a particular activity. Note that labor costs should be adjusted for fringe benefits. Some researchers increase salary costs by 25%, but higher figures can be justified.

Activity-based cost allocation system: Use producers' internal accounting systems to estimate costs.

Cost-to-charge ratios: Multiply charges by a cost-to-charge ratio. Hospitals' cost-to-charge are available from the Center for Medicare & Medicaid Services.

Gross costing: Multiply units by a general measure of prices. This is the most common approach in policy analysis.

[1] Sanders GD, Neumann PJ, Basu A, Brock DW, Feeny D, Krahn M, Kuntz KM, Meltzer DO, Owens DK, Prosser LA, Salomon JA, Sculpher MJ, Trikalinos TA, Russell LB, Siegel JE, Ganiats TG. Recommendations for Conduct, Methodological Practices, and Reporting of Cost-effectiveness AnalysesSecond Panel on Cost-Effectiveness in Health and Medicine. *Journal of the American Medical Association* 2016;316(10):1093–1103.

Reimbursements

We have a special word for the prices that insurers pay health care providers: reimbursements. Private insurers set payment rates through negotiation. Medicare payment levels often serve as the starting point for negotiations. Private insurers' payment rates usually exceed Medicare payment rates. Providers with greater bargaining power are able to negotiate higher rates. Quality is one of the factors that influences providers' bargaining power. For example, hospitals with higher survival rates for cardiac bypass surgery negotiate higher reimbursement rates with private insurers.

Medicare and Medicaid reimbursements are set administratively rather than in the market. Medicare uses formulae to set payment rates equal to providers' average costs, though there are situations where Medicare payments and costs differ by a large amount. Traditionally, the visit or admission has been the unit of pricing. That remains the case today, though Medicare is adopting alternative reimbursement schemes that tie payment to performance measures, like readmission rates.

Sources of data on reimbursement rates

Reimbursement rates are a good place to start when establishing the cost of health care services. There are several caveats to keep in mind. First, they are not useful for measuring the costs of services that are not separately billable. Second, providers may earn profits, in which case reimbursement rates will exceed providers' costs. Profit margins vary by service and payer. Margins are typically higher for private payers.

Medicare fee schedules are publicly available, though it may take some detailed knowledge of the underlying formulae to apply them. For some fee schedules, like the physician fee schedule[2], CMS has created online tools that make reimbursement rates easy to find. For others, like the inpatient prospective payment system, you have to apply the formula using inputs provided in tables on the CMS website or install special software. Medicare claims data are also publicly available for a fee. They take a lot of expertise to manipulate.

It is more difficult to find data on private insurers' payment rates. In many cases they are a closely guarded trade-secret. Some firms make private claims data, with actual payment rates, available. These are costly and difficult to work with. Here are some alternative, free sources.

- Fair Health[3] collects claims data and reports summary statistics about providers' charges. Historically insurance companies have based payments to out-of-network providers on discounted charges.

[2] CMS. Physician Fee Schedule Look-Up Tool. https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/PFSlookup/index.html
[3] See http://www.fairhealthconsumer.org/

- Some states collect and report data about payment levels in the name of "price transparency".[4]

- Sometimes payment rates or costs for specific services and procedures are available in the published literature.

The Trump administration has floated a proposal to require private insurers to disclose the reimbursement rates they have negotiated with providers, but it is unclear if it will be enacted.

Drug prices

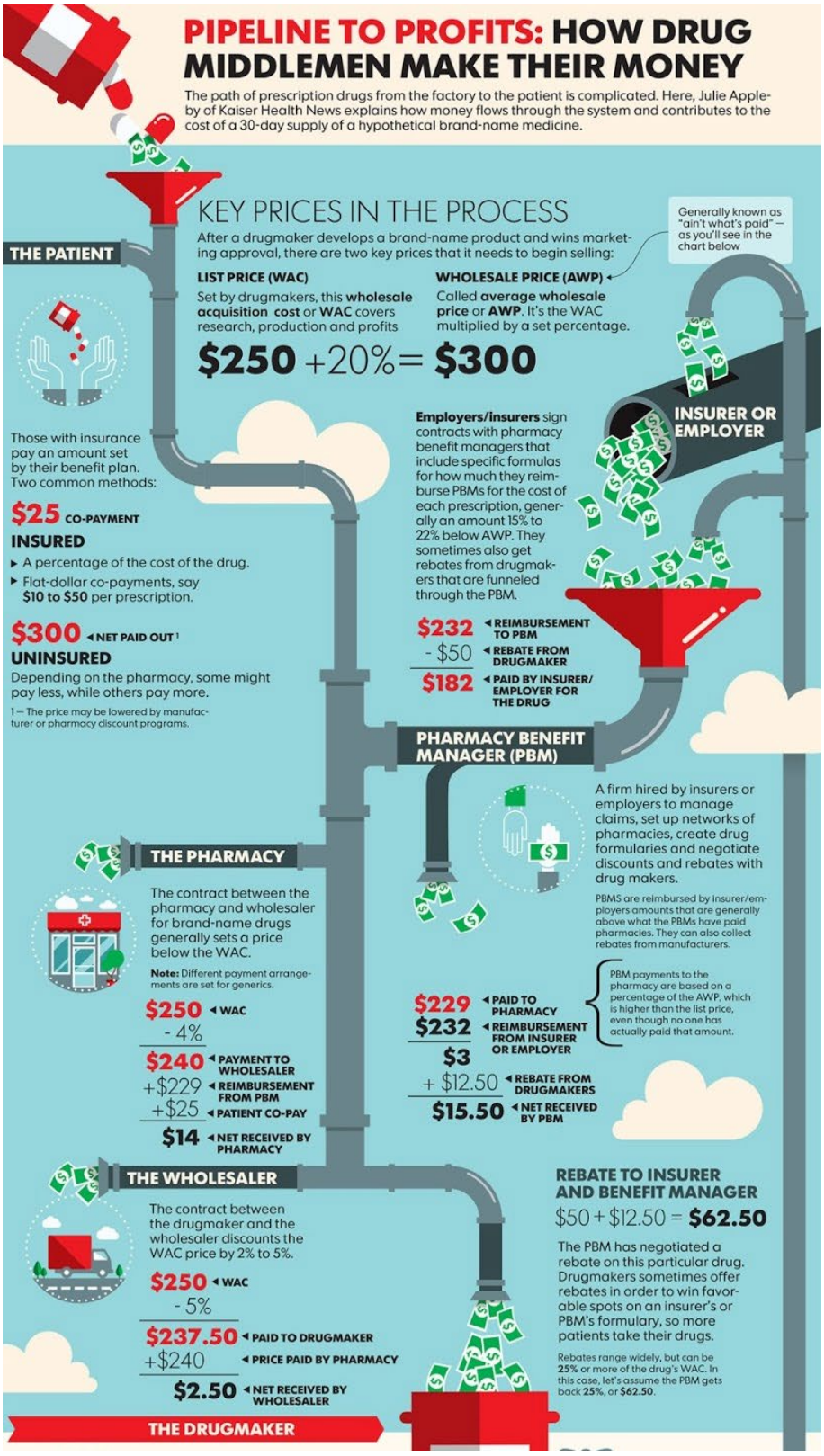
The Average Wholesale Price of a drug is the price at which wholesalers sell the drug to pharmacies and providers. Drugs' Average Wholesale Price is available from private sources like Red Book (it used to be an actual book with a red cover). Average Wholesale Prices do not take discounts or rebates into account (the joke: AWP = Ain't What's Paid). The figure on the next page provides a more detailed description of drug pricing.[5]

Medicare separately reimburses physicians and hospitals for physician-administered drugs. Medicare does not separately pay for drugs provided to hospital patients. The DRG payment includes hospitals' drug costs. Medicare bases reimbursement for outpatient physician administered drugs on Average Sales Prices, which it computes by dividing drug firms' total revenue by the number of units sold. Drug firms are required to report this information. Average Sales Price data are available on the CMS website. These data cover only physician-administered drugs, like injectable chemotherapeutics. A physician cannot bill Medicare for giving a pill to a patient. You can use CMS's Average Sales Price data to determine what Medicare pays for physician-administered drugs (generally Average Sales Price plus 4.3% to 6%). Average sales prices account for privately-negotiated discounts. They do not account for government-mandated discounts under the 340B program.

Price data for self-administered drugs (i.e., drugs the patient picks up at a pharmacy) are available from the Medicare Plan Finder for Health, Prescription Drug and Medigap plans. The Prescription Drug Plan Finder is designed to help beneficiaries select Part D plans. It allows users to enter in the name of a drug and reports the total cost of the drug. Drug prices are also available from online pharmacies. These prices do not include manufacturer discounts and rebates, which can be substantial.

[4] For example, Texas Department of Insurance, Health Insurance Reimbursement Rates Consumer Information Guide

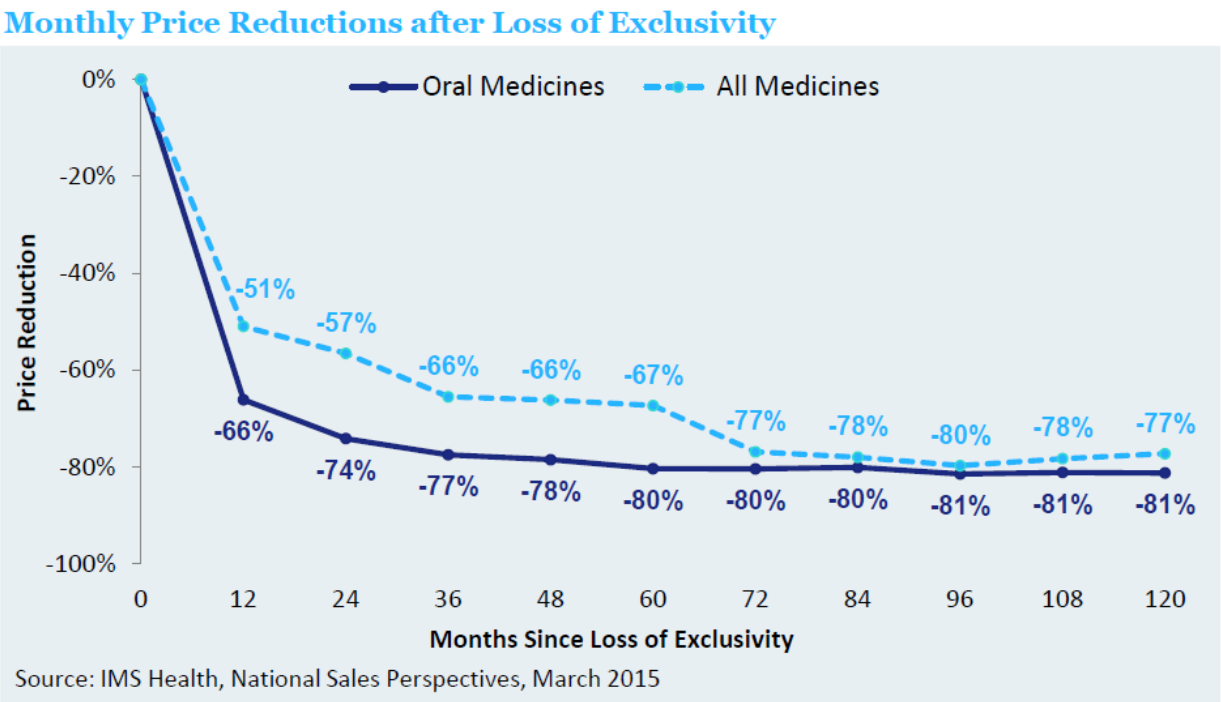
[5] Ramsey L, Gould S. Everyone wants a piece of the drug industry and it's one reason prices are rising so fast. *Business Insider* Novmber 6, 2016


PIPELINE TO PROFITS: HOW DRUG MIDDLEMEN MAKE THEIR MONEY
The path of prescription drugs from the factory to the patient is complicated. Here, Julie Appleby of Kaiser Health News explains how money flows through the system and contributes to the cost of a 30-day supply of a hypothetical brand-name medicine.
KEY PRICES IN THE PROCESS
After a drugmaker develops a brand-name product and wins marketing approval, there are two key prices that it needs to begin selling:
LIST PRICE (WAC)
Set by drugmakers, this wholesale acquisition cost or WAC covers research, production and profits
WHOLESALE PRICE (AWP)
Called average wholesale price or AWP. It's the WAC multiplied by a set percentage.
$250 +20%= $300
Generally known as "ain't what's paid" — as you'll see in the chart below
THE PATIENT
Those with insurance pay an amount set by their benefit plan. Two common methods:
$25 CO-PAYMENT
INSURED
A percentage of the cost of the drug.
Flat-dollar co-payments, say $10 to $50 per prescription.
$300 NET PAID OUT 1
UNINSURED
Depending on the pharmacy, some might pay less, while others pay more.
1 — The price may be lowered by manufacturer or pharmacy discount programs.
INSURER OR EMPLOYER
Employers/insurers sign contracts with pharmacy benefit managers that include specific formulas for how much they reimburse PBMs for the cost of each prescription, generally an amount 15% to 22% below AWP. They sometimes also get rebates from drugmakers that are funneled through the PBM.
$232 REIMBURSEMENT TO PBM
- $50 REBATE FROM DRUGMAKER
$182 PAID BY INSURER/EMPLOYER FOR THE DRUG
PHARMACY BENEFIT MANAGER (PBM)
A firm hired by insurers or employers to manage claims, set up networks of pharmacies, create drug formularies and negotiate discounts and rebates with drug makers.
PBMS are reimbursed by insurer/employers amounts that are generally above what the PBMs have paid pharmacies. They can also collect rebates from manufacturers.
THE PHARMACY
The contract between the pharmacy and wholesaler for brand-name drugs generally sets a price below the WAC.
Note: Different payment arrangements are set for generics.
$250 WAC
- 4%
$240 PAYMENT TO WHOLESALER
+$229 REIMBURSEMENT FROM PBM
+$25 PATIENT CO-PAY
$14 NET RECEIVED BY PHARMACY
$229 PAID TO PHARMACY
$232 REIMBURSEMENT FROM INSURER OR EMPLOYER
$3
+ $12.50 REBATE FROM DRUGMAKERS
$15.50 NET RECEIVED BY PBM
PBM payments to the pharmacy are based on a percentage of the AWP, which is higher than the list price, even though no one has actually paid that amount.
THE WHOLESALER
The contract between the drugmaker and the wholesaler discounts the WAC price by 2% to 5%.
$250 WAC
- 5%
$237.50 PAID TO DRUGMAKER
+$240 PRICE PAID BY PHARMACY
$2.50 NET RECEIVED BY WHOLESALER
REBATE TO INSURER AND BENEFIT MANAGER
$50 + $12.50 = $62.50
The PBM has negotiated a rebate on this particular drug. Drugmakers sometimes offer rebates in order to win favorable spots on an insurer's or PBM's formulary, so more patients take their drugs.
Rebates range widely, but can be 25% or more of the drug's WAC. In this case, let's assume the PBM gets back 25%, or $62.50.
THE DRUGMAKER

Treatment of drug profits

It is customary in policy analyses and cost-effectiveness analyses to use drugs' actual prices. However, in the case of brand name drugs, prices are often well above manufacturers' costs. Prices in excess of manufacturers' costs should not count as a cost from the societal perspective. Profits are a transfer payment from buyers to manufacturers.

Question: How would you estimate a drug's true cost if the manufacturer does not report profit margins (see Figure[6])?

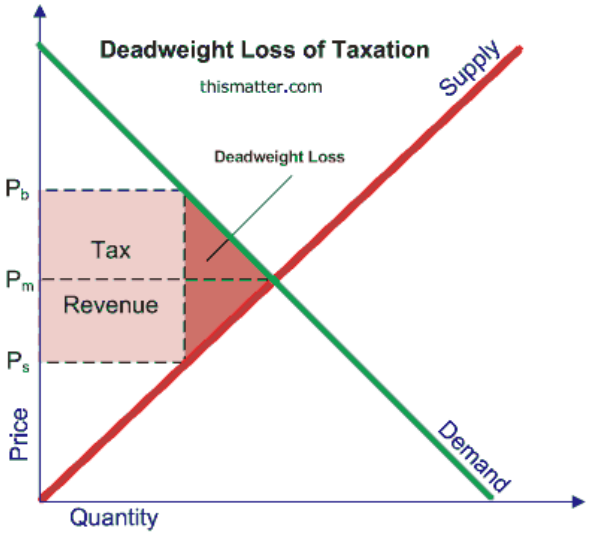


Salaries

You can assign costs to interventions that involve hiring (or firing) people using salaries plus fringe benefits. Occupation-specific salary data are available from the Bureau of Labor Statistics. It is customary to multiply salaries by 1.25 to account for the cost of fringe benefits, like health insurance.

[6] IMS. *Price Declines after Branded Medicines Lose Exclusivity in the US*. January 2016.

Excess tax burden



From the Tax Foundation[7]:

> Economists have long focused on the role taxes play in the everyday decisions of people and businesses. Resources transferred from the private economy to the government through taxes reduce disposable income, and the manner in which revenues are raised can have important consequences for the economy. The more households and businesses base decisions on tax considerations, the more economic resources are wasted. High tax rates in particular can be especially harmful. They can affect the amount of labor workers supply, especially for secondary workers among married couples, by decreasing the financial reward for additional work. High tax rates can also discourage saving, affect allocations of investments, and affect how households spend their money. In addition, high rates can reduce taxpayer compliance because the gain from not reporting income is greater.

How does the income tax change behavior? A few examples:

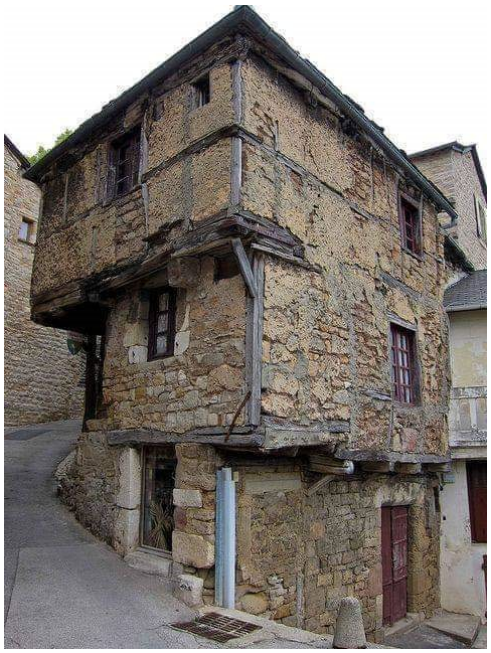
- It changes decisions about hours worked and labor force participation.
- It affects the form of compensation.
- It affects whether we rent or buy homes.

The Tax Foundation reports that the average marginal burden of the current (as of 2009) income tax is $105 billion, or 11.5% of total revenue ($921 billion). For increases in the tax rate, the excess burden may be 30% or higher.

[7] Carrol R. *The Excess Burden of Taxes and the Economic Cost of High Tax Rates*. August 2009. http://taxfoundation.org/sites/taxfoundation.org/files/docs/sr170.pdf

The Office of Management and Budget recommends increasing the cost of policies that entail tax increases by 25% to reflect the excess burden:[8]

> a. Analysis of Excess Burdens. The presentation of results for public investments that are not justified on cost-saving grounds should include a supplementary analysis with a 25 percent excess burden. Thus, in such analyses, costs in the form of public expenditures should be multiplied by a factor of 1.25 and net present value recomputed.
>
> b. Exceptions. Where specific information clearly suggests that the excess burden is lower (or higher) than 25 percent, analyses may use a different figure. When a different figure is used, an explanation should be provided for it. An example of such an exception is an investment funded by user charges that function like market prices; in this case, the excess burden would be zero. Another example would be a project that provides both cost savings to the Federal Government and external social benefits. If it is possible to make a quantitative determination of the portion of this project's costs that give rise to Federal savings, that portion of the costs may be exempted from multiplication by the factor of 1.25.



The oldest house in France (13th century). At the time, taxes were based on the area of the ground floor.

[8] Office of Management and Budget. *Circular A=94. Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs.* https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/circulars/A94/a094.pdf

CHAPTER 9: DISCOUNTING

Overview

Discounting can be a pretty dry subject, but scratch the surface and there are a lot of deep questions that underlie discussions about the appropriate discount rate in policy analysis. The theory of discounting draws on:

- Economics: How do we maximize social welfare over time?
- Accounting: How do we assess the profitability of a project?
- Philosophy: What, if anything, does the current generation owe future generations? Should government impose patience?

Businesses discount future revenue streams to take account of the opportunity cost of investment funds. For example, a bank can invest $500,000 in opening up a new branch, or invest the money in the stock market with an 8% expected return. If the bank opens up a new branch, it can expect profits of $10,000 for the first three years, and $20,000 every year thereafter. So is opening the branch profitable, assuming the risk is the same as in the stock market? Businesses use discounting to answer the question: Are we investing funds in a way that maximizes profits?

There are several justifications for discounting in policy analyses.

Rationale 1: If we want government decisions to **maximize social welfare**, then decisions should take account of public preferences. Government should act on our behalf. We believe there is a societal preference for current consumption over future consumption. You can think of the discount rate as a price for shifting consumption across time.

Rationale 2: If public **spending displaces $1 of consumption, the** cost is $1. If public spending displaces private investment, the cost is $1 plus whatever return the investment would earn. If the government finances spending via borrowing, it will increase the demand for loans, which will increase the interest rate (the price of borrowing). Many large local and state projects are financed via bonds, which reduces the pool of funds available for private investment.

Rationale 3: If we don't discount, we might get **weird, counterintuitive results**. How do you value an infinite stream of returns? For example, suppose government could spend $10 billion today for a project that would yield $1 every year thereafter. Is the project worthwhile? Not if the discount rate is positive.

Mechanics of discounting

The present value of X dollars received at time t is

$$PV(X_t) = \frac{X}{(1+d)^t}$$

In most cases it won't matter whether you assume that interest is compounded at the beginning or end of the period as long as you are consistent about it.

In some cases we want to know the present value of an infinite sum (for example, the present value of $20,000 received every year from now until eternity). There is a neat little trick:

$$\frac{X}{(1+d)^1} + \frac{X}{(1+d)^2} + \frac{X}{(1+d)^3} + \ldots + \frac{X}{(1+d)^\infty} = \frac{X}{d}.$$

Sometimes authors refer to the discount rate. The discount rate is d, a number between 0 and 1. You may come across a reference to a "discount factor." The discount factor is

$$\frac{1}{(1+d)}.$$

Choosing a discount rate

Businesses should select a discount rate that reflects the return on an investment with a similar level of risk. (For example, returns on the stocks of firms in the same industry).

The choice is less clear for government. One approach is to set the discount rate to the social rate of time preference. Another is to peg the discount rate to the rate of return on displaced funds (i.e., investments that would have occurred if taxes were lower).

Since the social rate of time preference is not directly observable, there is a robust discussion about how to measure it.

Some researchers use surveys of the form, "Would you rather have 100 today or $X tomorrow?" Of course surveys are artificial. Respondents don't have to face the consequences of their responses.

The preferred approach is to use market interest rates. Market interest rates are based on real world behavior. There are many different interest rates in the market at one time (e.g., the rate on savings, 30 year mortgages, business loans). The preferred approach is to use the interest rate on short-term treasury bonds because they are riskless. Some experts advocate reducing this rate by the tax rate on savers (about 30%) and also by inflation expectations.

Market interest rates reflect the preferences of those who save. Many people have no savings. The low savings rate and the widespread use of high-interest debt (e.g., payday loans) suggests the social discount rate is much higher than the conventional estimate of 3%. Should government respect these preferences? Or should government act paternalistically and use a discount rate that is lower than the average discount rate in the population? Put another way, should government try to correct our tendency to put too much emphasis on the present at the expense of the future?

Recommendations for discount rates

The US Panel on Cost-Effectiveness in Health and Medicine[1] recommends using a base case discount rate of 3% and conducting a sensitivity analysis with rates in the range of 0% to 7%.

The US Office of Management and Budget[2] recommends costs be discounted by 3%, reflecting the social rate of time preference, and 7%, reflecting the opportunity cost of capital (i.e., the rate of return on displaced funds).

Distributional issues

In most applications the discount rate for benefits and costs is the same. However, they need not be. If the group that is taxed differs from the group that receives the benefits from the project, it is permissible to use different discount rates. In practice, analysts almost always use the same rate to discount costs and benefits.

How should we value the welfare of future generations? Even with a relatively low discount rate, like 3%, what happens in 200 years doesn't really matter in present value terms.

$$\frac{1}{(1.03)^{200}} < 0.01$$

The choice of a discount rate has a strong influence on the outcomes of environmental policy analyses because the benefits often occur many years into the future.

Discounting health

Evaluations of programs that improve health require us to discount benefits, which are sometimes stated in terms of health, and costs. Should costs and benefits be discounted at the same rate? There are several justifications. First, for an individual, health is not tradable. You can't save health. (But society at large can trade off health today for health tomorrow.)

Second, behavior (e.g. smoking) implies that many people have very high discount rates for health. Third, the value of good health is improving. Using a low discount rate is a way to capture the fact that the value of a given unit of health changes over time. Suppose the value of health is increasing at 2% a year, so 1 QALY today is worth 1.02 QALYs in one year. Also suppose the social discount rate is 3%. Then one method of discounting health while capturing the fact that the benefit of good health is increasing is to discount at 1% (= 3% - 2%).

Britain's National Institute for Clinical Effectiveness used to recommend discounting costs at 6% and benefits at 1.5%. The current recommendation is to discount both at 3.5%.

[1] Weinstein et al. Recommendations of the Panel on Cost-Effectiveness in Health and Medicine. *Journal of the American Medical Association* 1996;276(15);1253-1258.
[2] Office of Management and Budget. Circular A-4. September 17, 2003.

Here is what the US Panel on Cost-Effectiveness in Health and Medicine had to say on the subject.

> [Discount] rates reflect people's preference for having money and material goods sooner rather than later. Similarly, people value health outcomes that occur in different time periods differently. In CEA, time preference for resources is reflected by discounting future costs to present value. Discounting the value of future expenditures requires that health effects experienced in the future also be discounted at the same rate. This conclusion is based on the observation that people have opportunities to exchange money for health, and vice versa, throughout their lives. Failure to discount health effects will lead to inconsistent choices over time; for example, it will appear that delaying investments will always result in a program's becoming more cost-effective. For this reason and based on other evidence and considerations outlined in its full report, [3] the panel recommends that costs and health outcomes occurring during different time periods should be discounted to their present value and that they should be discounted at the same rate.

Discounting at different rates can lead to odd conclusions

Suppose a program costs $100,000 and delivers benefits of 2 QALYs. Is it better to perform the project now or in 100 years?

The cost effectiveness ratio if the project is undertaken today is:

$$\frac{\$100{,}000}{2} = \$50{,}000$$

The cost effectiveness ratio if the project is undertaken in 100 years and costs and benefits are discounted at 3% is:

$$\frac{\frac{\$100{,}000}{(1.03)^{100}}}{\frac{2}{(1.03)^{100}}} = \frac{\$100{,}000}{2} = \$50{,}000\,.$$

The cost effectiveness ratio if the project is undertaken in 100 years and costs are discounted at 3% and benefits at 1% is:

$$\frac{\frac{\$100{,}000}{(1.03)^{100}}}{\frac{2}{(1.01)^{100}}} = \$7{,}036.$$

Postponing the project until 500 years is associated with a cost-effectiveness ratio of $2.70 with unequal discount rates. This just doesn't make sense.

Amortization

If you want to describe the yearly cost of a multi-year program, but some of the costs are incurred only once, you might use amortization to "annualize" the cost. For example, what is the annual cost to a health care facility of building a new outpatient clinic that costs $25,000 up-front but will last 20 years? You might ask the question: Suppose we took out a 20 year loan for $25,000. How much would we have to repay annually?

$$\$25{,}000 = \frac{X}{(1+d)^1} + \frac{X}{(1+d)^2} + \frac{X}{(1+d)^3} + \ldots + \frac{X}{(1+d)^{20}}$$

If d = 0.03, X is $1,680. I calculated this using the formula "=PMT(0.03,20,25000)" in Excel. This figure is quite a bit higher than what you'd get if you simply divided $25,000 by 20: $1,250.

The calculation described above is sometimes referred to as "amortizing" the cost. Another way to think about this calculation is that $1,680 is the rental price of a good.

An example: Suppose there is a program with an up-front cost of $1,000 and an annual cost of $500 that will run for 10 years. What is the annualized cost (the cost spread out over 10 years) if the discount rate is 3%?

Calculating the annualized cost of a program with upfront costs of $1,000, yearly cost of $500, and an interest rate of 3%

	Year											Annual basis	
	1	2	3	4	5	6	7	8	9	10	Total	Value	Formula
Program costs ($)													
Without discounting	1,500	500	500	500	500	500	500	500	500	500	6,000	600	=$6,000/10
With discounting	1,456	471	458	444	431	419	407	395	383	372	5,236	614	=PMT(0.03,10,5236)

The annualized value is $614.

Discounting ≠ Adjusting for inflation.

Both adjusting for inflation and discounting involve adjusting sums of money over time. They are easy to confuse. But conceptually, they are very different.

Inflation adjustment is "backward-looking." We are restating historical cost/price figures in today's dollars. The key input is the inflation rate or a price index.

Discounting is "forward-looking." We discount future sums to account for the preference for current over future consumption. The key input is the discount rate.

Market interest rates account for 1) rate of time preference, 2) inflation expectations, 3) the riskiness of a project. Forget #3 for a minute. The market interest rate is:

$$r = (1 + d)(1 + i)$$

Where r is the interest rate, d is the discount rate, and i is the inflation rate. We want to use d when discounting, not r.

Sample problem

Both adjusting for inflation and discounting involve adjusting sums of money over time. They are easy to confuse. But conceptually, they are very different.

CHAPTER 10: ADJUSTING COSTS FOR INFLATION

What is inflation?

Money is a way of keeping track of the real resources consumed by a program or policy. But, because of inflation, money is an imperfect means for comparing resource use over time.

Remember this:

> Total spending = price × quantity.

Inflation refers to changes in price only.

Sometimes you hear people refer to "inflation in health care costs" in the popular press. They are probably using "inflation" as a stand-in for "increases" rather than a technical term to describe increases in price levels.

The mechanics of adjusting for inflation

We are used to thinking about inflation in terms of an "inflation rate", a number between 0 and 1, as in "The inflation rate is 3%." However, for purposes of adjusting dollar amounts over time, it is more helpful to use the price index. The price index is constructed around an arbitrary base year where the index = 100.

If we want to transform $1,000 in 1986 dollars to 2001 dollars, we perform the following calculation:

$$\frac{I_{2001}}{I_{1986}}\$1{,}000$$

Where I_y is the value of the price index in year y.

More generally, the formula to transform $X dollars in year k to $X dollars in year j is:

$$\$X_j = \frac{I_j}{I_k}\$X_k$$

Note that we can go backwards and forwards with this formula; you can transform 2001 dollars into 1986 dollars and vice versa.

Price indices

The Consumer Price Index (CPI) is the main measure of inflation in the United States. The Bureau of Labor Statistics in the Department of Labor is responsible for measuring and reporting the CPI.

The CPI is designed to answer the question: How much would consumers need to spend today to be just as well off as they were yesterday? There are two sources of data:

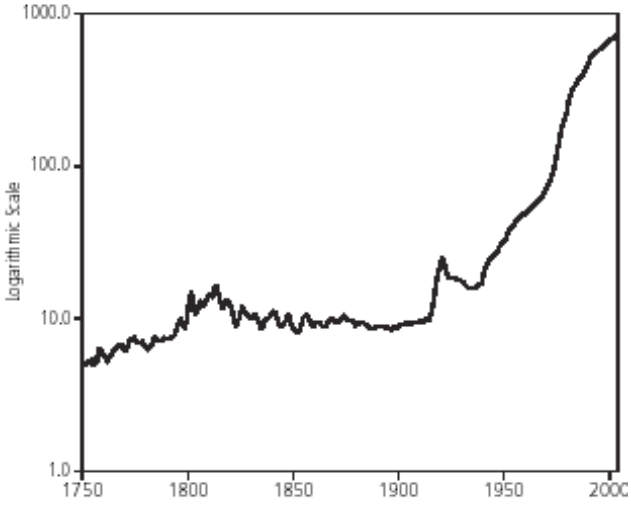
1) Consumer purchases: Bureau of Labor Statistics staff measure the goods and services consumers buy using the Consumer Expenditure Survey.

2) Prices: Each month, Bureau of Labor Statistics employees collect prices for approximately 71,000 goods and services from 22,000 outlets. For example, an employee might be charged with recording the price for Brand "X" fever thermometers for babies, model 41303, 4 3/10 inches long with plastic case, sold by "Y" Foods, Inc. in West Terre Haute Indiana. Approximately 20 percent of the product sample is rotated every year such that full rotation takes 5 years. Separately, Bureau of Labor Statistics employees collect pricing data from about 5,000 renters and 1,000 homeowners for the housing components of the CPI.

CPI items priced monthly everywhere[1]

All food at home items
Housing at school, excluding board
Other lodging away from home, including hotels and motels
Tenants' and household insurance
Fuel oil
Propane, kerosene, and firewood
Electricity
Utility (piped) gas service
Used cars and trucks (secondary source)
Gasoline (all types)
Other motor fuels
Tires
Vehicle accessories other than tires
State and local registration, license, and motor vehicle
property tax
Parking and tolls
Newspapers and magazines
Recreational books
Postage
Delivery services

Figure 3
Composite Price Index 1750 to 2003, January 1974 = 100 (logarithmic scale)



[1] See http://www.bls.gov/opub/hom/pdf/homch17.pdf

Landline telephone services, local charges
Landline telephone services, long-distance charges
Wireless telephone services
Cigarettes
Tobacco products other than cigarettes

Medical care in the CPI

Medical care accounts for 7.4% of the CPI, but over 15% of GDP. Why? The CPI reflects consumer spending. Most health care costs are paid by government and employers.

Other indices

The producer price index ("the PPI") measures changes in the prices that producers receive for the goods and services they sell.

The Gross Domestic Product (GDP) deflator is a broad index of price levels. The GDP deflator is not the same as the GDP. The GDP deflator is a measure of prices; the GDP is a measure of output (= price × quantity). The Consumer Price Index holds the types of goods purchased fixed. The GDP deflator does not.

The Medicare Economic Index and the Inpatient Prospective Payment System Hospital Market Basket measure the change in input prices (e.g., nurse wages) for physicians and hospitals.

Problems with the CPI (and other price indices)

Substitution bias: CPI is based on a fixed market basket of goods. The market basket is updated every decade, but in the intervening time period consumers may change their buying patterns.

TABLE 1: HYPOTHETICAL EXAMPLE OF SUBSTITUTION BIAS

					Price Relatives		Relative Weights	
	Price in Period 1	Quantity in Period 1	Price in Period 2	Quantity in Period 2	P2/P1	P1/P2	1	2
Beef	1	1	1.6	0.8	1.6	0.63	0.5	0.43
Chicken	1	1	0.8	2	0.8	1.25	0.5	0.57

When comparing price levels over time for two or more goods, should we use consumers' consumption at the beginning or the end of the period (see Table 1[2])? They give different

[2] Toward A More Accurate Measure Of The Cost Of Living. Final Report to the Senate Finance Committee from the Advisory Commission To Study The Consumer Price Index December 4, 1996. See: http://www.ssa.gov/history/reports/boskinrpt.html.

answers. Consumers shift consumption in response to price increases, and we will calculate smaller changes in the level of a price index if we use consumption at the end of the period.

Substitution bias

	Old quantities			New quantities		
	Quantity	Price	Total	Quantity	Price	Total
Period 1						
Beef	1.0	1.0	1.0	0.8	1.0	0.8
Chicken	1.0	1.0	1.0	2.0	1.0	2.0
Total			2.0			2.8
Period 2						
Beef	1.0	1.6	1.6	0.8	1.6	1.3
Chicken	1.0	0.8	0.8	2.0	0.8	1.6
Total			2.4			2.9
Price index[a]			120			103

[a] $120 = 100 \times (2.4 \div 2.0)$

Outlet substitution bias (i.e. the Costo bias): The Bureau of Labor Statistics samples a fixed set of establishments to record prices, but over time consumers shift to retailers with lower prices. This is probably a bigger problem than it used to be because of the proliferation of discount retailers like Costo and the Internet.

Quality change bias: The quality of many products has improved dramatically over time, making it difficult to compare prices between years in certain product categories (e.g., televisions).

New product bias: New products may be associated with large gains in consumer welfare, but are not included in the Consumer Price Index or included only they have been around for a long time.

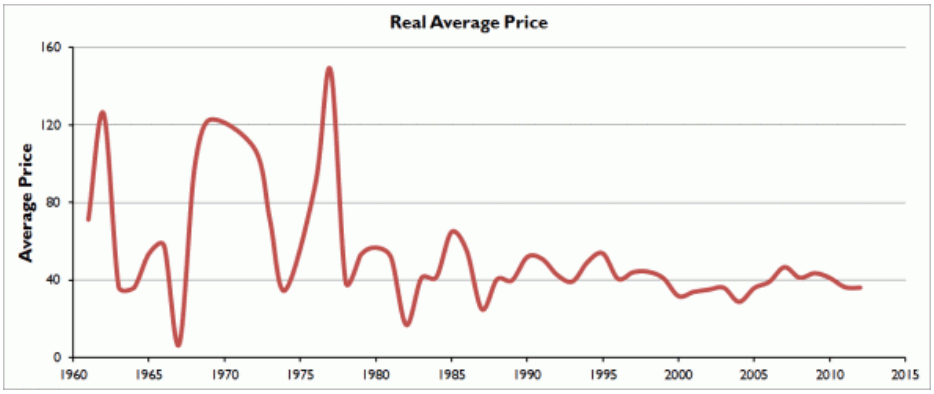
Some recommendations for adjusting for inflation

USING APPROPRIATE PRICE INDICES FOR ANALYSES OF HEALTH CARE EXPENDITURES OR INCOME ACROSS MULTIPLE YEARS
https://meps.ahrq.gov/about_meps/Price_Index.shtml

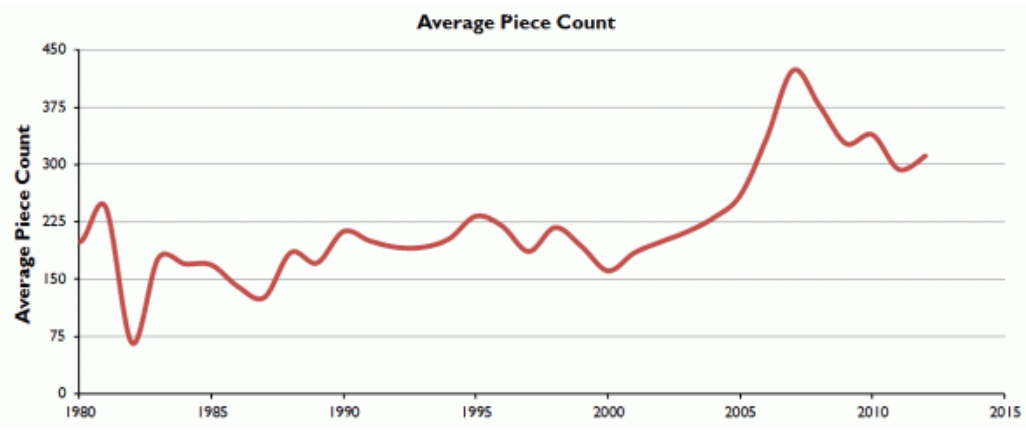
TABLE 3: Estimates Of Biases In The CPI-Based Measure Of The Cost Of Living (Percentage Points Per Annum)	
Sources of Bias	***Estimate***
Upper Level Substitution	0.15
Lower Level Substitution	0.25
New Products/Quality Change	0.6
New Outlets	0.1
Total	**1.10**
Plausible range	(0.80-1.60)

Application to Lego

Price per set



Number of pieces in a set



Price per Lego piece

See http://www.realityprose.com/what-happened-with-lego/?utm_source=share&utm_medium=ios_app&utm_name=iossmf

CHAPTER 11: MAKING PREDICTIONS USING ECONOMIC THEORY

The role of economic theory in policy analysis

Economic theory is a useful tool for conducting policy analysis. In some cases, we can make predictions using theory and a little knowledge about the real world. In other cases, economic theory is a useful framework around which to build a policy analysis. This chapter presents three cases illustrating the use of theory.

Case 1: Banning direct-to-consumer advertising

Sometimes economic theory is helpful for making predictions. Economic theory might not give a precise prediction, but it can help rule out illogical predictions. Consider the following statements about direct-to-consumer pharmaceutical advertising.

> Almost every country in the industrialized world bans or severely restricts direct-to-consumer advertising because it increases prescription drug costs…1

> In fact, it would seem that the spending drug companies need to recoup with higher prices is at least partly due to how much is spent on direct-to-consumer advertising.2

The claim is that prohibiting direct-to-consumer pharmaceutical advertising would cause drug prices to fall. We can assess the claim using the economic model for monopoly pricing.

If you write down a function describing monopoly profits, take the derivative with respect to price, and do a bit of re-arranging, you get something called the Lerner Index

$$\frac{p-c}{p} = -\frac{1}{\varepsilon},$$

The left-hand side is the profit margin (price minus cost divided by price). The right hand side is one divided by the price elasticity. The profit maximizing price satisfies this expression. It shows that the profit margin is higher in markets where the price elasticity is lower.

You can re-arrange the expression to get:

$$p = \frac{1}{1+\frac{1}{\varepsilon}}c\,.$$

[1] Hillary's Plan to Respond to Unjustified Price Hikes for Long-Available Drugs. September 2, 2016. https://www.hillaryclinton.com (Accessed June 16, 2017).
[2] Consumer Reports. Is There a Cure for High Drug Prices? July 29, 2016 http://www.consumerreports.org/drugs/cure-for-high-drug-prices/ (Accessed June 16, 2017).

The price elasticity of demand for specialty drugs is 0.01-0.21.[3,4] Let's plug in 0.1.

$$p = \frac{1}{\left(1+\frac{1}{0.1}\right)} MC$$
$$= 0.09MC$$

This implies that if costs fall by $1.00, prices will fall by only $0.09. The theory is not consistent with the claim that that prohibiting direct-to-consumer advertising will have a substantial impact on consumer prices.

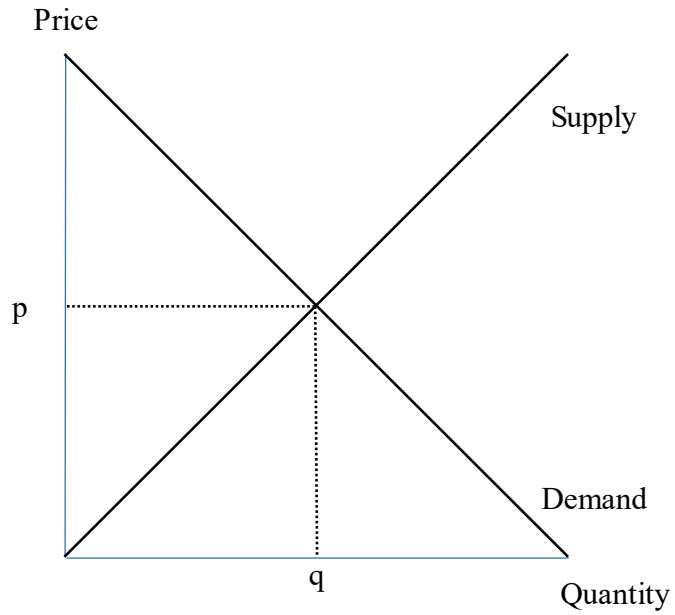
Using this framework, you can investigate more complex models: What if advertising is a fixed cost (instead of a marginal cost)? What if advertising makes demand less elastic? What if it expands the size of the market? A simple analysis like this will not provide a definitive answer, but it can help you think about what matters and reject, out-of-hand, the simple notion that there is a dollar-for-dollar tradeoff between prices and advertising expenditures.

Case 2: A cigarette tax

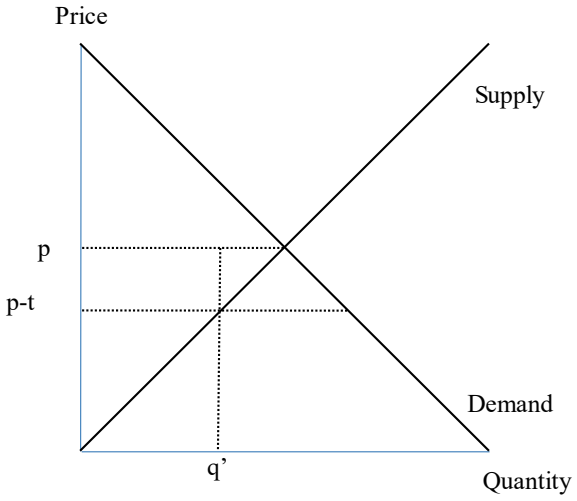
Suppose a state is considering increasing the tax on cigarettes. Stores are responsible for paying the tax. We can use economic theory to assess the claim: "Increasing the tax will have no impact on smoking rates because stores, not consumers, are responsible for paying it." Initially, we have a market in equilibrium.

[3] Goldman DP, Joyce GF, Lawless G, Crown WH, Willey V. Benefit design and specialty drug use. Health Affairs 2006;25(5):1319-31.

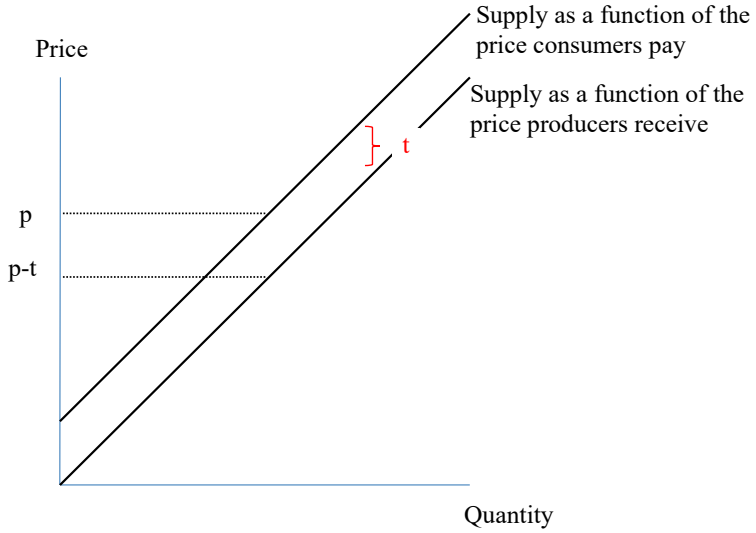
[4] One caveat: Monopolists should always price in the elastic part of the demand curve. That the price elasticity is so low suggests that drug firms are not fully exploiting their power to raise prices, at least in the market for specialty drugs.



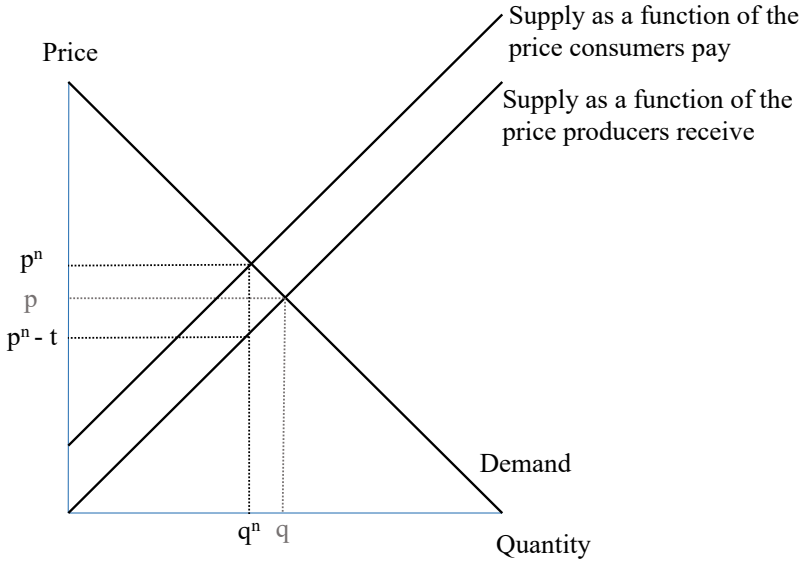
If the government imposes a tax on producers of t for every unit sold, then producers will receive p – t. Suppose for a minute that producers pay the entire tax. They would be willing to supply q' units at that price, but consumers would still demand q units at the old price. There would be a shortage. That would lead producers to raise the price.



To determine the equilibrium price, it helps to draw a new supply curve that depicts the relationship between the price consumers pay and the amount producers are willing to supply. It is the old supply curve shifted up vertically by the amount of the tax.



We can now determine the new equilibrium price and quantity. The amount consumers pay increases from p to p^n and the quantity decreases to q^n. At that price and quantity combination consumers do not want to buy any more (or less), and producers do not want to supply any more (or less).



The price consumers pay increases from p to p^n. The price producers receive decreases from p to p^n-t.

Mandated benefits

Economic theory suggests that there is a one-to-one tradeoff between wages and fringe benefits. The market price of labor reflects total compensation, inclusive of wages and fringe benefits. A change to wages that does not alter the market price must necessarily cause an adjustment in fringe benefits (and vice versa) to keep the labor market in equilibrium. A new mandated benefit will be accompanied by a reduction in wages, which is important to account for in policy analyses that assess the impact of benefits on individual welfare and employers' costs.

Prior to the mid 1970s, most insurance plans did not cover maternity benefits (pregnancy care and delivery). In the second half of the 1970s a number of states required plans to cover maternity benefits. (The 1978 Pregnancy Discrimination Act mandated coverage of maternity benefits nationwide.)

Gruber (1994) studied the impact of the mandates on women's wages and employment. The table below reports data from Table 3 in Gruber's paper, minus the standard errors. The outcome is the log of wages. The difference in log wages is the percent change in wages.

Table 3 from Gruber (1994). The incidence of mandated maternity benefits

	Pre	Post	Difference
	ln(wages)		
Married women, 20-40 years old			
Treated states	1.547	1.513	-0.034
Control states	1.369	1.397	0.028
Difference-in-difference			-0.062
Women over 40, single males 20-40			
Treated states	1.759	1.748	-0.011
Control states	1.630	1.627	-0.003
Difference-in-difference			-0.008
Difference-in-difference-in-difference			-0.054

Wages declined by 3.4% among women of childbearing age in states that required insurers to cover maternity benefits. Wages increased by 2.8% in control states. The difference-in-difference estimate is -6.2%, which indicates that requiring insurers to cover maternity benefits caused the wages of women ages 20-40 to decline by 6.2%.

But wait! There is another control group: women over 40 and single males ages 20-40 in treatment states. So we have a difference-in-difference-in-difference analysis. In the treated states, wages in this group declined, but by only 1.1% compared to 3.4% among women ages 20-40. The difference-in-difference-in-difference estimate (call it the "triple diff" if you want to sound in-the-know) is -5.4% [= -6.2 – (-5.4)].

Gruber finds that there was no change in employment or hours worked. The implication is that women valued the new benefit, and were willing to accept a dollar-for-dollar reduction in wages.

If they valued the benefit at less than the full cost, then it is more like a tax, and we would expect there to be reductions in labor supply.

CHAPTER 12: COST-BENEFIT ANALYSIS

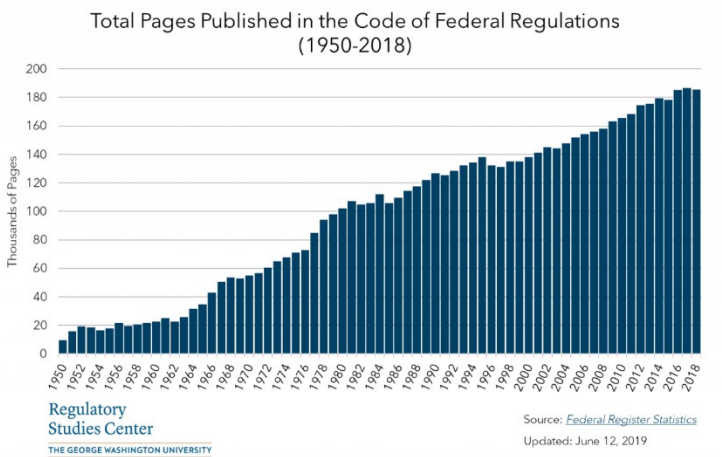
Overview

Many decisions about public health, safety, and environmental policies involve trading off money for health. For example, should car makers be required to install collision avoidance equipment that will increase the price of cars but reduce the number of accident fatalities? Cost-benefit analysis is a tool to help policy makers make these decisions. In cost-benefit analysis monetary values are assigned to benefits. This chapter describes the theory and methods that underlie the dollar values the government uses to value reductions in mortality risk and other benefits.

Regulatory impact analysis

When Congress passes a law, it is up to the executive branch departments and agencies to implement it. Laws are often vague, and so these departments and agencies have to make decisions about how they will put laws into action. The documents that describe how laws will be implemented are called regulations. There are a number of agencies that operate almost exclusively through regulations that apply to private business and individuals. These include the National Highway Traffic Safety Administration (created 1966), the Occupational Safety and Health Administration (1970), the Environmental Protection Agency (1970), the Consumer Product Safety Commission (1972), and the Nuclear Regulatory Commission (1974).

The Code of Federal Regulations has about 180,000 pages[1], covering everything to the formulae used to determine Medicare's payment to physicians to the food that farmers are allowed to feed to pigs.



[1] Regulatory Studies Center. Columbian College of Arts & Sciences. George Washington University. https://regulatorystudies.columbian.gwu.edu/reg-stats

Business groups, some academic economics, and conservatives have been concerned about the proliferation of costly regulations. They worry that government regulators face incentives to overweight the benefits and underweight the costs (to private business and individuals) of new regulations. They have pushed for agencies to conduct cost-benefit analyses before proposing regulations.

Executive Order 12044, issued by President Jimmy Carter in 1978, requires federal regulatory agencies to perform a regulatory impact analysis for any proposed regulation with an economic impact of $100 million or more (so-called "economically significant" regulations).

Building on Executive Order 12044, President Ronald Regain issued Executive Order 12291 in 1981 giving the Office of Information and Regulatory Affairs within the Office of Management and Budget the ability to reject regulations where the costs exceeded the benefits.[2] Ever since, the director of the Office of Information and Regulatory Affairs is often described as "the most powerful position in DC that no one has heard about." Since Reagan's Executive Order 12291, presidents in both parties have issued additional executive orders that re-affirm the role of cost-benefit analysis in federal regulatory policy.

President Obama appointed a strong proponent of cost-benefit analysis, University of Chicago law professor Cass Sunstein, as Office of Information and Regulatory Affairs. He also broadened the focus of the Office: in addition to considering efficiency, the Office should also consider the impact of regulations on, "equity, human dignity, fairness and distributive impacts." (Executive Order 13563; 2011).

The Supreme Court has also weighed in. The Clean Air Act says the Environmental Protection Agency may regulate mercury and other hazardous power-plant pollutants if the agency concludes action is "appropriate and necessary." In Michigan v. EPA (2015), the Court ruled, "The agency must consider cost -- including, most importantly, cost of compliance -- before deciding whether regulation is appropriate and necessary." Of course this decision was very context specific and was not a blanket endorsement of cost-benefit analysis.[3]

President Trump placed a cap on new regulations: agencies that wanted to promulgate a new regulation had to eliminate two existing ones. He also placed a cap on annual increases in regulatory costs.

One of President Biden's first actions was to release an Executive Order modifying the regulatory review process. The order, Modernizing Regulatory Review, directs the Office of

[2] For information on trends in the number of regulations requiring Office of Management and Budget review, see Carey MP. Counting Regulations: An Overview of Rulemaking, Types of Federal Regulations, and Pages in the Federal Register. *Congressional Research Service* October 4, 2016.
[3] Sinden A. Supreme Court Remains Skeptical of the "Cost-Benefit State". *The Regulatory Review* September 26, 2016.

Information and Regulatory Affairs to develop recommendations to broaden the goals of review.

> These recommendations should provide concrete suggestions on how the regulatory review process can promote public health and safety, economic growth, social welfare, racial justice, environmental stewardship, human dignity, equity, and the interests of future generations. The recommendations should also include proposals that would ensure that regulatory review serves as a tool to affirmatively promote regulations that advance these values.

The Order also seems to take the Trump administration's anti-regulatory policy in the opposite direction:

> …ensure that the review process promotes policies that reflect new developments in scientific and economic understanding, fully accounts for regulatory benefits that are difficult or impossible to quantify, and *does not have harmful anti-regulatory or deregulatory effects* [emphasis mine]

The Order gives vague guidance about quantifying distributional effects.

> …propose procedures that take into account the distributional consequences of regulations, including as part of any quantitative or qualitative analysis of the costs and benefits of regulations, to ensure that regulatory initiatives appropriately benefit and do not inappropriately burden disadvantaged, vulnerable, or marginalized communities

It is too early to tell how the Office of Information and Regulatory Affairs will change the review process and cost-benefit analysis to comply with the Order.

Pricing the priceless

Regulatory impact analysis and cost-benefit analysis more generally entail assigning dollar values to benefits. Benefits may be in the form of lives saved, injuries avoided, or, in the case of some environmental regulations, animals saved, pristine forests preserved, etc. The rest of this chapter describes methods for coming up with these dollar values. Most of the discussion is devoted to valuing deaths prevented. In regulatory impact analysis of regulations that reduce mortality risks, monetary benefits are calculated by multiplying deaths prevented by the value of a statistical life. Estimates of the value of a statistical life are usually in the $5 to $15 million dollar range.

NEWS

Kidnappers Realize They Have No Idea What Child Is Worth

4/26/06 12:13pm • SEE MORE: LOCAL

SAN YSIDRO, CA—The weekend kidnapping of 5-year-old Brendan Adler stalled Tuesday when the two men responsible for his abduction announced that they have no way to gauge the current market value of the boy.

Adler last month.

"We've run through a lot of figures, but the truth is we have no idea," said Troy Alan Curtis, the crime's primary planner. "We've been talking about anything from $1,000,000 to $10,000. It's all over the map."

The inability of Curtis and partner Steve Rodriguez to arrive at a realistic ransom figure has stymied the otherwise smooth kidnapping, which began Saturday morning when the pair snatched Adler from a local park and drove him to their abandoned-warehouse hideout. Yet four days later, the kidnappers say they are no closer to an accurate estimate of how much a boy in Adler's age and condition can fetch in the often confusing, constantly changing abductee marketplace.

Ex ante and ex post

Ex ante is a Latin phrase that roughly translates as “before the fact”. It is used to indicate a period or state of mind before uncertainty is resolved. Ex post translates as “after the fact”. It is used to indicate a period or state of mind after uncertainty is resolved.

When valuing policies that reduce mortality risk, we want to take an “ex ante” perspective. That means that we want to value the benefit that everyone derives from knowing that they face a lower mortality risk. Ex post, we will know who actually died. We are not asking the question, “How much were these individuals’ lives worth?” Another way to think about the distinction is in terms of small versus large risks. Read on.

Small versus large risks

For most public decisions, we want to focus on small risks to life. These are more relevant to public policy, where interventions have small effects on mortality risks from the standpoint of any particular individual. We are interested in “ex ante” (i.e. before the fact) valuations. A general principle of valuation is that the value of something equals the individuals’ “willingness-to-pay”. There are some circumstances where value and willingness-to-pay may diverge, but these are special cases.

The key question is: How much are you willing to pay to reduce your mortality risk by ε (where ε is some small amount)? Not: How much are you willing to pay to avoid certain death?

Most people would pay all of their wealth (including the present value of future earnings) to avoid certain death. Willingness-to-pay can never be greater than wealth. But wealth is not necessarily a good guide to individuals' willingness to pay to avoid small risks.

Suppose an individual is willing to pay $200,000 today to avoid certain death. How much should they be willing to pay for a 0.01% reduction in the risk of death? Is the answer $200,000*0.0001 = $20? Maybe, but there is no theoretical reason why this must be the case. It is not unreasonable or theoretically unsound to think that individuals might be willing to spend more than $20.

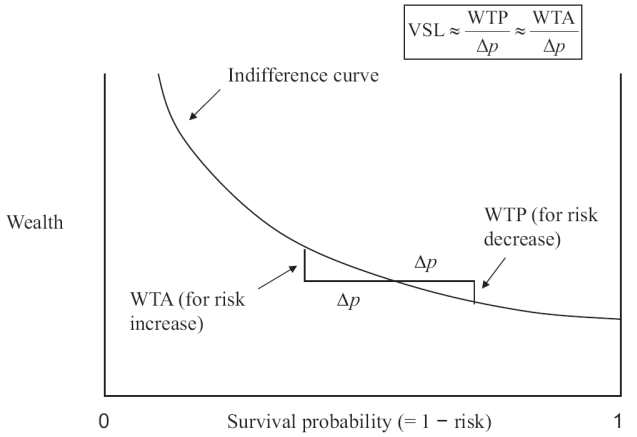


Figure 1
The trade-off between wealth and survival probability.

The figure to the right displays an indifference curve between wealth and survival risk. It is downward sloping: individuals are indifferent between a lot of wealth and a low survival probability and low wealth and a high survival probability.
From a given point, the amount of money you would be willing to pay for a small increase in your survival probability is your willingness to pay. The amount you would be willing to accept for a small decrease in your survival probability is your willingness to accept.

The Statistical Value of Life

If, on average, people are willing to spend $X to reduce the risk of death by 0.01% (or 1/10,000 or 0.0001), then the value of a statistical life is $X/0.01%. Suppose $X = $500. Then the value of a statistical life is $500/0.0001 = $5,000,000. Think about this value as representing the sum across individuals of willingness to pay to reduce risk by a small amount. Do not think about this figure as the value of a specific individual.

Estimating the value of a statistical life: market-based estimates

We observe individuals making tradeoffs between money and mortality risk in a number of different situations: what job we take, what care we buy, where we live.
Researchers study the relationship between prices and mortality risk to estimate willingness-to-pay for reducing mortality risk. For example, they may run regressions of the following form:

$$\text{Wages} = \beta^0 + \beta^1 \times \text{mortality risk} + \beta^2 \times \text{days off} + \beta^3 \times \text{time outdoors} + \ldots.$$

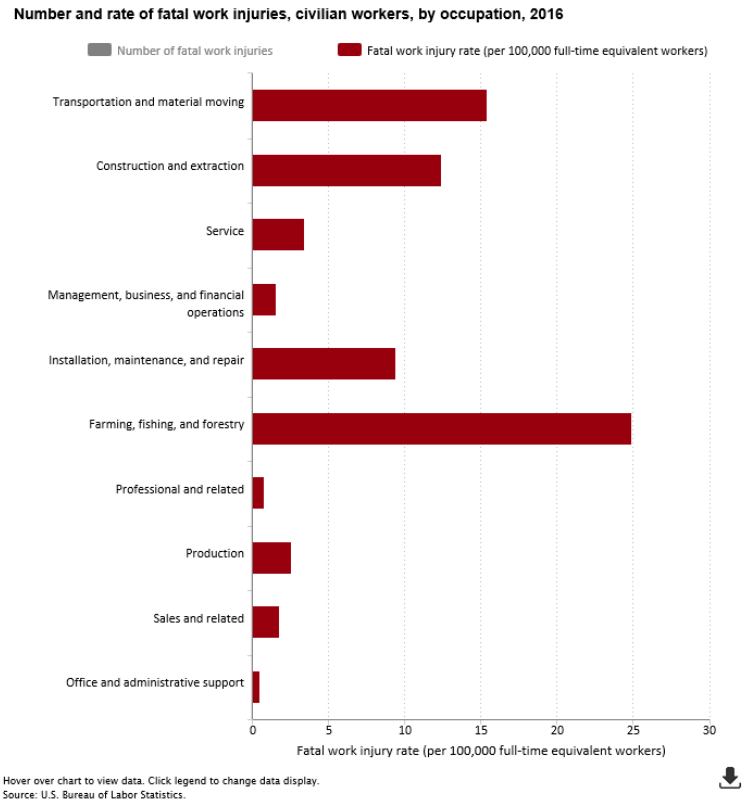
The coefficient on mortality risk is of interest and shows how much more in wages workers demand in return for accepting a higher risk of on-the-job mortality. Inclusion of other variables measuring job/industry characteristics controls for other features of jobs that may influence wages.

Approaches based on occupational choice reflect real-world behavior. People are faced with the consequences of their actions. Also, they are making choices in a familiar "decision frame".

There are also some drawbacks.

In some industries wages may not be set competitively because of labor unions or because employers are monopsonies (like a monopoly, but on the buying instead of the selling side of the market).

Estimates are valid for workers who are deciding between different types of occupations and industries, like retail versus fishing. They represent the preferences of persons "on the margin". These individuals tend to be less risk averse and have lower educational levels.



Work-related risks are not necessarily fixed, immutable characteristics of jobs. They depend on who fill the jobs. The empirical approach assumes that workers have good information about mortality risks and that researchers can accurately measure risks.

This technique measures willingness-to-pay for a specific type of risk. Willingness-to-pay may depend on the type of risk (e.g., voluntary versus not voluntary).

The validity of estimates depends on the ability to adequately control for other features of jobs.

A study that estimates the value of a statistical life using home prices

Most studies that estimate willingness-to-pay to reduce mortality risk study occupational choice, but there are studies that estimate willingness-to-pay in different contexts. For example, Lucas (2004) studied what happened to home prices in Churchill County Ohio after it became known that the county was home to a "cancer cluster".[4] He used home prices in Lyon County as a control. He found that home prices in Churchill County declined by 7.7 percent relative to prices in Lyon County. Based on the change in prices and an estimate of the increase in perceived cancer risk, he estimates that the value of a statistical life is $5.6 million.

TABLE 2—DIFFERENCE-IN-DIFFERENCE ESTIMATOR: MEAN LOG SALES PRICE BEFORE AND DURING LEUKEMIA INCREASE

	1990–1999	2000–2002	Difference
Churchill County	11.587 (0.408) $n = 2800$	11.550 (0.407) $n = 796$	−0.037
Lyon County	11.627 (0.403) $n = 4323$	11.667 (0.342) $n = 2285$	0.040
Relative difference			−0.077 (0.019)

The human capital approach

Another approach to valuing changes in mortality risk is to value changes based on earnings. This method is known as the "human capital" approach. Under this approach, the value of statistical life is set equal to the present value of earnings or the present value of earnings minus the present value of personal consumption plus the present value of taxes. The human capital approach was widely used before the development of market-based estimates (see the preceding section) and it is almost certainly wrong. It is wrong because it equates willingness-to-pay with wealth. Though wealthier individuals may be willing to pay more than poor ones for a small reduction in mortality risk, willingness-to-pay for *small* changes in mortality risks is not necessarily some fixed percentage of wealth. Your willingness to pay to reduce mortality risk by 0.001 percent is probably more than 0.001 percent of your wealth. (You might be thinking, equating willingness-to-pay with earnings or wealth is also inequitable. More on that later.)

Age and the value of a statistical life

If a proposed regulation will prevent 100 deaths, should we value the benefit differently if the population affected is young or old? You might think willingness to pay to reduce mortality risk would be higher among young individuals, who have longer to live, but studies do not report a consistent relationship between age and willingness-to-pay. Estimates may be confounded by wealth (older individuals have higher savings and income and are thus willing to pay more). The convention is to use a single value of a statistical life estimate for all regulations, regardless of the age distribution of the affected population.

The value of a (statistical) life versus the value of a year of life

Regulatory impact analysis values mortality reductions based on the value of a statistical life (a figure usually around $10 million). In the cost-effectiveness literature you may

[4] Davis LW. The Effect of Health Risk on Housing Values: Evidence from a Cancer Cluster. *American Economic Review* 2004;94(5):1693-1704.

sometimes see references to the value of a life year or value of a quality-adjusted life year, a figure usually around $100,000. This difference in approaches is partly due to convention and partly due to differences in the context in which these figures are employed. Regulatory impact analysis often deals with policies, like regulations limiting air pollution, that affect broad swaths of the population. Medical interventions on the other hand are usually targeted at a narrow segment of the population, often with limited life expectancy.

Equity and the willingness to pay principle

Market and survey data indicate that willingness to pay to avoid mortality risk varies positively with income. Should the government using a different willingness to pay standard based on the income of the affected population? Should we place a higher value on interventions to prevent airplane fatalities as opposed to motor vehicle fatalities? In practice, it does not. Federal agencies use a single figure, regardless of the characteristics of the affected population.

A related issue is whether trade agreements between the US and less developed countries should impose US health, safety, and environmental standards on firms in other countries. In effect, should we impose our willingness to pay for life on other countries where the actual willingness to pay may be lower? A related issue is the use of a constant value of a statistical life estimate in cost-benefit analyses of policies to decrease pollution in low income communities. If removing pollution causes rents to rise because the community becomes more desirable, it is possible that removing pollution could pass a cost-benefit test (using a nationwide standard) but still harm low income residents if they have a below-average willingness-to-pay.[5]

Another related issue: Should we use a higher willingness to pay for interventions that will affect future generations if we think these generations will place a higher value on safety and environment?

Value of life in the courts

Tort awards have two purposes: 1) to compensate victims 2) to deter negligent behavior. How should courts and juries determine monetary penalties?

The primary objective of awarding damages in the courts is compensation based on the principle of justice. This is an ex post perspective, and so the human capital approach, where damage are assessed based on lost earnings, is appropriate.

A secondary goal is to deter individuals and companies from presenting workers, customers, others with excessive risks in the first place from an ex ante perspective. If deterrence is the goal, courts assess penalties based on the value of a statistical life.

[5] Banzhaf, Spencer, Lala Ma, and Christopher Timmins. Environmental Justice: The Economics of Race, Place, and Pollution. *Journal of Economic Perspectives* 2019;33(1):185–208.

Courts mostly use human capital approach in practice, but value of life estimates can be useful in establishing liability (Did the defendant spend sufficient sums to avoid the accident?).

Contingent valuation

Rather than trying to back-out willingness-to-pay estimates based on market behavior, contingent valuation methods adopt a more straightforward approach: If you want to know an individual's willingness-to-pay, ask him or her. In reality, the approach is a bit more sophisticated than that, but it relies on responses to surveys rather than market behavior. Researchers who work on contingent valuation methods spend a lot of time developing question formats that they hope will elicit respondents' true willingness to pay. Willingness to pay for reductions in mortality risk could be assessed using questions of the following form.

- What is the most you would be willing to pay to avoid a 1 in 10,000 risk of death?
- "Would you accept $1,000 to move from a 1 in 10,000 chance of death to a 3 in 10,000 chance of death?"
- "Would you pay $1,000 to move from a 2 in 10,000 chance of death to a 1 in 10,000 chance of death?"
- Which of the following cars would you buy?
  Car A: Price $31,000, risk of death in a crash is 1 in 10,000
  Car B: Price is $30,000, risk of death in a crash is 2 in 10,000

Each has advantages and disadvantages.

Unlike approaches that rely on observing market behavior, contingent valuation approaches can obtain willingness to pay estimates from a much more representative sample of the population (i.e., not just workers deciding between becoming loggers or store clerks). Researchers can use contingent valuation to elicit willingness-to-pay values for non-traded goods (i.e., goods that are not priced in the market), such as endangered species.

There are, however, some important limitations to contingent valuation.

Respondents do not have to face the real-world consequences of their decisions. They are spending free money, and so they may give inflated responses, especially in situations where social desirability is a factor. Willingness-to-pay values estimated using continent valuation are not systematically higher than those estimated using market-based approaches (in the few situations where it is possible to compare them), but the concern remains. A National Oceanic and Atmospheric Administration (NOAA) expert panel on contingent valuation methods recommends dividing willingness-to-pay estimates by 2 to account for respondents' overstatement of willingness to pay.[6]

[6] Arrow, Kenneth ; Robert Solow; Paul R. Portney; Edward E. Leamer; Roy Radner; Howard Shuman. Report of the NOAA Panel on Contingent Valuation. *Federal Register* 1993;58: 4601-4614.

Respondents are not used to responding to questions that ask them to trade off money and health or other benefits. They may not give reasoned, well-informed answers as a result.

Many people have difficulty interpreting small probabilities.

Respondents may confuse willingness-to-pay with the liability for payment. Why should I pay for someone else's negligence?

Responses from contingent valuation studies display inconsistencies. For example: WTP(X) + WTP(Y) may not always equal WTP(X+Y). In Australia at one time cable companies provided customers with broadcast channels without paying anything to them. A lawsuit resulted, and a contingent valuation study was performed to determine how much the cable companies owed to the broadcast channels. The goal was to assess consumers' value for the channel. Respondents were given the choice of:
1. Paying $X per month over and above their standard cable bill to continue receiving the channels or
2. Paying nothing over and above the standard cable bill and losing the channels.

Respondents were presented with varying values of $X (Note: the choice of $X can influence the final results via the "anchoring" effect) and different bundles of channels (A: Channel 9 and SBS, B: Channel 7 and Channel 10). The results were as follows.

WTP(Bundle A) = $2.96
WTP(Bundle B) = $1.64
WTP(Bundle A and Bundle B) = $2.81

There responses were inconsistent:

WTP(Bundle A) + WTP(Bundle B) > WTP(Bundle A and Bundle B)
$4.60 > $2.81

Contingent valuation studies often include validity checks to help assess the robustness of results. For example, if you double the size of the benefit, does willingness-to-pay double

National Oceanic and Atmospheric Administration (NOAA) panel

Formed after Congress directed the Department of Commerce to write regulations governing recovery of damages following oil spills. The Department's National Oceanic and Atmospheric Administration commissioned a group of prominent economists and researchers to assess the use of contingent valuation as a method for assessing damages. The report's main conclusion was as follows.

> …The Panel concludes that CV studies [applications of the contingent valuation method] can produce estimates reliable enough to be the starting point of a judicial process of damage assessment, including lost passive-use values.

The report also included recommendations about how to administer contingent valuation studies to elicit accurate reports. These are (direct quotations follow).

- Studies should rely on personal interviews or telephone surveys rather than mail surveys.
- Applications should focus on willingness to pay to avoid a future accident, not an event that has already occurred.
- Questions should follow the "referendum" format of referring to payment in the form of higher taxes. This format most closely reflects real world decisions.
- Questions must remind respondents that by spending money on the program in question, they will have less money to spend on other things.
- Questions must reference alternative programs to accomplish the same goal.
- Surveys should include follow-up questions to test validity of answers. For example, double the benefit and see if willingness to pay nearly doubles.

Questions for thought

Suppose a proposed regulation will mainly affect mortality risks faced by low income consumers or workers. When assessing whether benefits exceed costs, should the government use an estimate of the willingness to pay to reduce mortality risks that is specific to low income consumers or workers, or use a population-wide average?

Suppose a proposed regulation will mainly affect mortality risks faced by high income consumers or workers. When assessing whether benefits exceed costs, should the government use an estimate of the willingness to pay to reduce mortality risks that is specific to high income consumers or workers, or use a population-wide average?

Supposed a proposed regulation will mainly reduce risks faced by old people. When assessing whether benefits exceed costs, should the government use a lower estimate of the willingness to pay to reduce mortality risks?

Should low income and high income countries use the same willingness to pay value to assess the benefits of regulation?

Which option should the government pursue:

Option A	Option B
Costs $250 million Benefits: $350	Costs $1 Benefits $250

Women report a higher willingness to pay than men. Should regulations that mainly affect mortality risk for men or women use different estimates of the willingness-to-pay?

CHAPTER 13 PRODUCTIVITY COSTS

Policy effects

According to the Centers for Disease Control and Prevention, the economic burden of diabetes in Georgia is $12.8 billion. Direct medical costs account for less than half of this total. The remainder fall into an "indirect cost" category, otherwise known as "productivity costs". These costs are broken down into the following components.

Absenteeism: The worker has to miss work due to illness but is still employed.

Presenteeism: The worker is at work but is not as productive due to illness.

Household productivity loss: Individuals who are not employed engage in "household production" like yardwork, laundry, and cleaning. In effect, they are working for themselves. When they get sick, their household production output falls.

Inability to work: This category refers to individuals who are out of the labor force as a result of their illness.

Mortality: Workers who die as a result of the disease. Costs are calculated under the assumption that workers would have worked until age 65 had they lived.

Annual Total Indirect Costs Attributable to Diabetes, Georgia, 2013 Dollars

Category	Total Cost ($ in Millions)
Medical costs	5,295
Indirect costs	7,607
Morbidity	4,222
Work Absenteeism	221
Presenteeism	1,263
Household Productivity Loss	212
Inability to Work	2,525
Mortality	3,385

Source: Centers for Disease Control and Prevention, Diabetes State Burden Toolkit, https://nccd.cdc.gov/Toolkit/DiabetesBurden/.

Productivity-related costs are typically calculated using the human capital approach. The cost of reductions in time at work and labor participation due to a disease equals the number of missed hours multiplied by the wage rate. Most of the time, analysts use national average wage rates, not the wage rate for a specific occupation or individual. Wages are also used to value lost household production.

The friction cost approach is an alternative to the human capital approach. It is based on the assumption that if a worker misses or has to quit work, the work isn't lost. Instead, coworkers and replacement workers make up the work. The friction cost captures disruptions due to illness-related absences and retirement. Friction costs depend on how easy it is to substitute one worker for another.

An example

Hanly et al. (2012)[1] calculated productivity costs associated with breast and prostate cancer using the human capital and friction cost approaches. They sent surveys to 1,373 Irish breast and prostate cancer survivors and received responses from 740. The survey asked respondents about their work history and current employment status. The authors calculated disability and absenteeism based on responses to the survey, assuming implicitly and a bit unrealistically that all absenteeism and workforce exits were due to cancer rather than some other cause. They calculated the number of lost work years assuming that had patients not been diagnosed with cancer, they would have died at rates similar to the overall population (i.e., not everyone would have lived to retirement at age 65).

Under the human capital approach, they valued productivity based on age- and gender-specific earnings. They assume that one day of missed work due to absenteeism results in one day of lost output.

Under the friction cost approach, they assumed that it takes 11.3 weeks to replace a worker (including training time). As in the human capital approach, they valued lost productivity under the friction cost approach by multiplying the friction period (11.3 weeks) by age- and gender-specific earnings.

Their results show that the human capital and friction cost approaches give very different answers (193,000 Euros versus 8,000 Euros). Not surprisingly, researchers and advocates who want to claim that "their" disease is associated with a greater burden use the human capital approach.

[1] Hanly P, Timmons A, Walsh PM, Sharp L. Breast and prostate cancer productivity costs: a comparison of the human capital approach and the friction cost approach. *Value in Health* 2012;15(3):429-36.

Average per person productivity costs for breast cancer patients, in 1,000s of Euros

	Approach	
	Human capital	Friction
	1,000s €	
Disability costs		
Temporary disabilty costs	26	6
Permanent disability		
Workforce departure	33	1
Reduced hours	50	<1
Total disability costs	109	7
Premature mortality costs	84	1
Total productivity costs	193	8

Source: Hanly et al. Value in Health 2012.

Team production

In teams, the absence of a worker affects the productivity of teammates. There are negative spillovers. According to one study[2], the average cost of a missed hour of work is 1.28 times the wage rate, reflecting the negative effect of an absence on the productivity of coworkers.

Wages

Productivity losses are typically valued using wage rates. Industry- and job-specific wage rates are available from the Bureau of Labor Statistics.

Measurement

There are several different approaches to measuring the impact of disease on labor force participation and hours worked. Some surveys ask whether individuals have stopped working or took time off work as a result of a health condition. This approach assumes the decision to exit the labor force or take a day off work can be attributed to a single cause and, in the case of absenteeism, that individuals can correctly recall how many days they took of work and the reasons why.

[2] Nicholson S, Pauly MV, Polsky D, Sharda C, Szrek H, Berger ML. Measuring the effects of work loss on productivity with team production. *Health Economics* 2006;15(2):111-23.

Another approach is to compare labor force participation and days worked between individuals with and without a disease after adjusting for age, sex, and other individual characeristics. This approach assumes that comparisons are not biased by unobserved individual characteristics. Maybe individuals who are sick would be less likely to work even if they were not sick.

Presenteeism (individuals are at work but not working as hard due to illness) is particularly difficult to measure. There are survey instruments designed to measure it, but there is probably a lot of measurement error.

Labor versus leisure. Or: Does the human capital approach yield a useful number?

If you do not work, the time you would have spent working does not disappear. You gain leisure. The wage rate is a good measure of the value of leisure under the assumption that workers work up until the point where the wage equals the marginal value of an additional hour of leisure.

Suppose a worker earning $20 per hour misses an 8 hour day of work due to the flu. Is the productivity cost $160 (=$20 × 8 hours of work missed)? It is using the human capital approach. But the worker gains 8 hours of leisure.

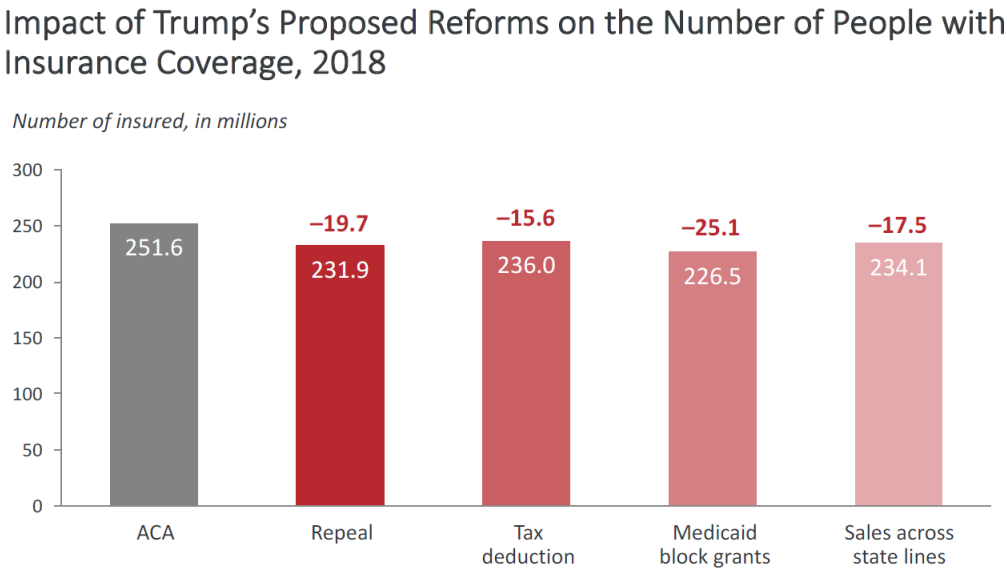
If we value the leisure using the wage rate, then the benefit to the worker is $160 (=$20 × 8 hours of leisure gained). So the net cost is $0 ($160 productivity cost - $160 gain in leisure). But that does not seem quite right. One of the defining features of illness is the inability to fully enjoy leisure. So maybe we should adjust the value of leisure downward to account for the impact of illness on quality of life. Suddenly, this analysis is starting to sound a lot like measuring quality-adjusted life years.

What to do? The human capital approach is the most widely used, but it is not necessarily the right approach. It does not capture the value of leisure gained, even if the recipient cannot fully enjoy the leisure due to illness. And businesses can adapt when a worker misses work. They can bring in another worker. They can shift workers to more urgent tasks. They can hire additional workers. The output is not necessarily lost forever. Which is not to say that absenteeism isn't costly, but valuing absenteeism based on the hours missed multiplied by the wage may overstate costs by quite a bit.

CHAPTER 14: POLICY ANALYSIS OF INSURANCE REFORMS

Overview

Many of the highest profile policy analyses examine the impact of health reform and coverage expansion policies (for example, the Affordable Care Act, single payer). Given their prominence, it is worth understanding how modelers approach policies that will have ripple effects throughout the system.



From: Saltzman E and C Eibner. Donald Trump's Health Care Reform Proposals: Anticipated Effects on Insurance Coverage, Out-of-Pocket Costs, and the Federal Deficit. The Commonwealth Fund. September 2016.

Most of the models used to predict the impact of health reform policies are large, complex, proprietary, and have been developed over many years. In some cases, they are a product that firms (like the Lewin Group) or individuals (for example, Professor Stephen Parente at the University of Minnesota) market and sell. So we will not try to replicate them. Instead, the goal is to try to understand how they work. How do they predict how a policy, like subsidizing individuals to buy private insurance, will affect coverage rates, employer behavior, federal spending, etc.?

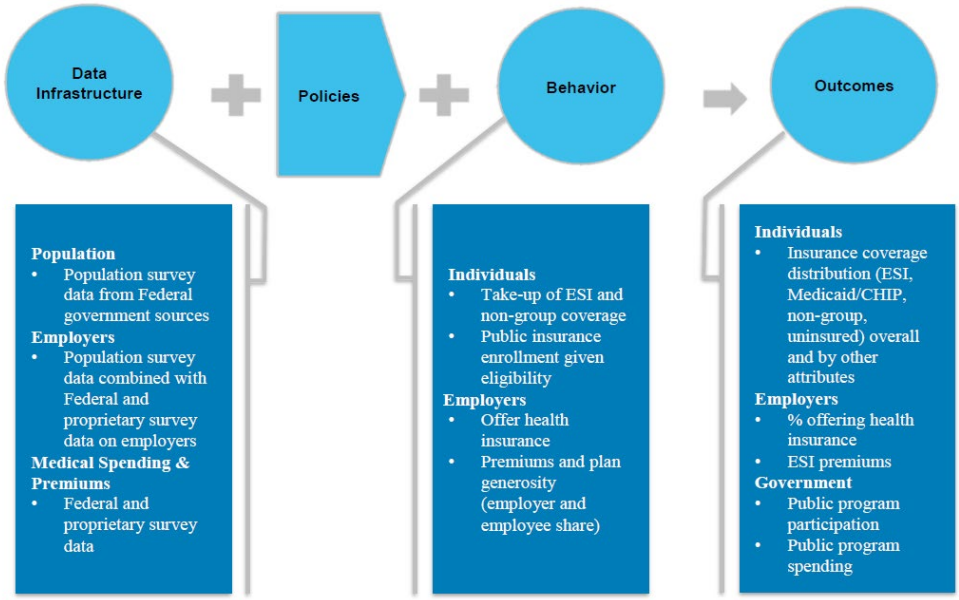
We are going to draw heavily on a paper by Sherry Glied and Nicholas Tilipman (Simulation Modeling of Health Care Policy *Annual Review of Public Health* 2010;31:439-455). Dr. Glied worked in the Obama administration during the passage of the Affordable Care Act and has conducted research on which some key assumptions behind these models are based.

Health reform models have played an important role in assessing, designing, and gaining support for coverage expansions. But that wasn't always the case. Glied and Tilipman write:

> ministrations. Over this period, without the constraint of a balanced budget in place, the importance of budget estimators diminished (115). When President Lyndon Johnson developed the Medicare program, for example, he waved away objections about the cost of the program saying, "I'll go a hundred million or a billion on health or education. I don't argue about that any more than I argue about Lady Bird [Mrs. Johnson] buying flour. You got to have flour and coffee in your house and education and health" (88).

Key assumptions

The models rely on a number of assumptions.



From: Abraham JM. Predicting the effects of the Affordable Care Act: A comparative analysis of health policy microsimulation models. State Health Reform Assistance Network. Robert Wood Johnson Foundation. Policy Brief. March 2012.

Parameters	Issues
Baseline	
Uninsured counts	• No administrative count of uninsured
	• Discrepancy between surveys (CPS, MEPS, SIPP) in uninsured counts
	• Selection of appropriate uninsured definition (full year, part year, etc.)
Price of health insurance	• Poor data on nongroup prices
	• Information on loading is dated
Provider supply	• Difficult to obtain data on physician and hospital availability at the local level
Expenditures	• MEPS data omits services including in the National Health Accounts
	• National Health Accounts report only aggregate data and cannot stratify by subpopulation
Behavioral	
Coverage participation	• Significant variation in estimates of take-up rates for public programs, price elasticity of demand, and crowd-out
	• Family decisions surrounding public program enrollment can affect take-up
Employer behavior	• Treating each worker as representative of his or her firm excludes characteristics of other workers at the firm
	• Few studies on the nature of actual firm decision rules
	• Estimates on the firm's decision to offer health coverage based on the price of firm offer vary
Nonprice factors	• Difficult to incorporate nonprice barriers to enrollment (administrative barriers, rules limiting coverage, perceived benefits, stigma, etc.)
Provider behavior	• Estimates of the relationship between public program fees and provider willingness to participate vary
	• Provider behavior is affected by level and nature of payment

There are "counting" assumptions. For example, how many people are uninsured? The Congressional Budget Office's model bases assumptions on the Survey of Income and Program Participation, the Medical Expenditure Panel Survey, the National Health Expenditure Accounts, and the National Compensation Survey.

There are a number of behavioral assumptions. For example, how will an increase in the share of a firm's workers who are eligible for subsidized individual coverage affect the firm's decision to offer coverage? Will a firm drop coverage if a large share of its workers are eligible for Medicaid or other free public programs? Will individuals limit their income to stay under the threshold to qualify for Medicaid?

Just because a person is eligible for free or heavily subsidized coverage does not mean they will take advantage of it. (There is an important lesson here generally: just because you make a product or service free does not mean everyone will use it.) Models incorporate assumptions to reflect actual, rather than optimal, use and enrollment of public programs.

Non-price factors. Most insurance reform models base participation in coverage primarily on the cost of coverage. Many other factors, however, affect participation, including administrative hurdles (complex application forms, recertification processes, etc.), rules limiting coverage to those without alternative coverage available, the nature of coverage offered, the extent of beneficiary educational efforts, and stigma associated with public programs (43, 100, 109). Many policy proposals would alter

The earliest health reform models expressed behavioral responses to policy changes in terms of elasticities. For example, a modeler might assume there are 10,000 small firms,

each with 10 workers, and that a 10% decrease in the price of insurance will increase the share of small firms that offer coverage to employees by 9%. A model might include assumptions about the elasticity for individual coverage, employers' decision to offer coverage, and workers' decision to buy insurance through their employer.

Source	Reported elasticity	Universe
Feldman et al. (1997) (47)	Single cov: −3.91; family cov: −5.82	2000 small firms in Minnesota (1993)
Finkelstein (2002) (48)	Range −0.42 to −0.54	Canadian General Social Surveys (1991–1994), Quebec
Gentry & Peress (1994) (52)	−1.8	U.S. workers (1988–1992)
Gruber & Lettau (2000) (62)	Range −0.31 to −0.41	Workers (1983–1995)
Hadley & Reschovsky (2002) (66)	−0.54	Small-firms in 1996
Helms et al. (1992) (68)	Range by state: −0.1 to −1.1	Small-firms in 8 states (1991)
Leibowitz & Chernew (1992) (83)	To premiums: −0.8 to subsidies: −2.9	U.S. workers (1989)
Marquis & Long (2001) (90)	−0.14	Workers in 10 states (1993)
Morrisey et al. (1994) (96)	−0.92	Small-firms (<50) in 1993
Royalty (1999) (114)	−0.63	Full-time, nonelderly U.S. workers (1988 and 1993)
Thorpe et al. (1992) (121)	Range −0.07 to −0.33	Small-firms (<20) in Albany, Poughkeepsie, and Brooklyn (1988)

Another approach to modeling behavior, which is used in some of the newer models, is to specify individual and firm utility and base predictions on utility maximizing behavior. For example, the utility of an individual may depend on whether or not they have insurance and money (a stand-in for all other goods). Individuals choose whether or not to buy coverage:

Utility(insured) = U(Covered, Income - premium)

Utility(not covered) = U(Not covered, Income)

Individuals will buy coverage if the utility of being insured, which requires that they pay a premium, is greater than the utility of not being covered.

Buy coverage if: Utility(insured) > Utility(not covered)

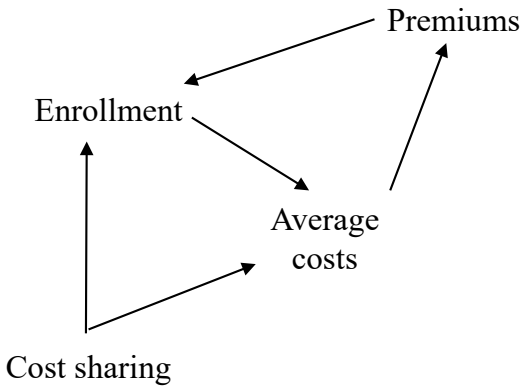
Government policy takes the form of a subsidy:

Utility(insured) = U(Covered, Income - premium + subsidy)

The size of the subsidy affects the purchase decision. We cannot actually observe individuals' utility functions. We can infer information about the functions based on actual behavior (the same way we can estimate price elasticities).

The actual utility functions used in models include more arguments describing the characteristics of insurance. For example, utility may depend on premiums, copayments, deductibles, and whether the coverage is private or public (if you think public coverage has a stigma or requires complex application forms). Individuals may select from amongst multiple different types of coverage. Utility functions may include parameters that vary the utility that individuals obtain from coverage based on their age, health status, marital status, etc.

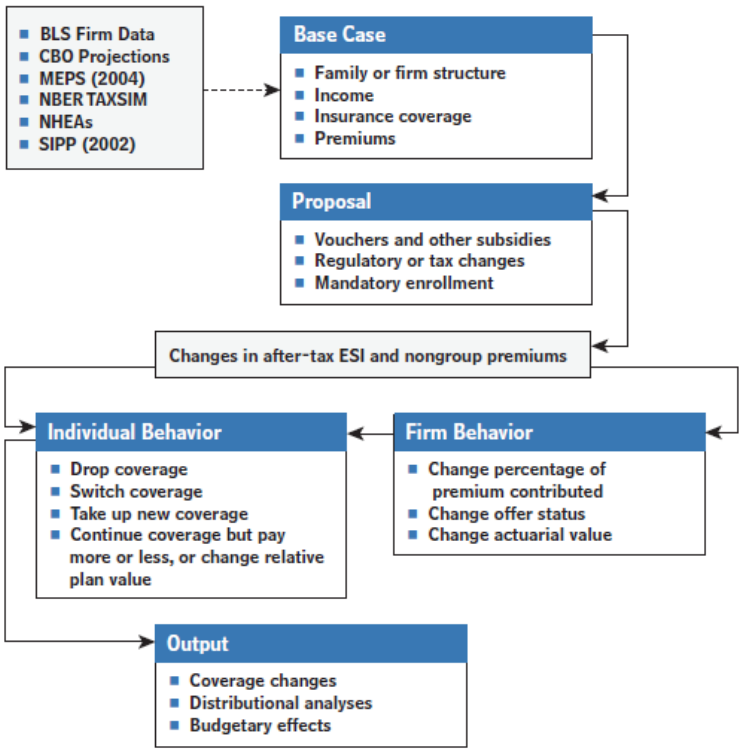
Models will incorporate feedback loops. For example, under community rating, premiums reflect the average costs of the pool of people who buy coverage. Who buys coverage will depend on premiums.



Modelers create "synthetic firms" made up of workers, and each worker has his or her own utility function. Firms consider the utility of their workers when deciding whether to offer coverage and the generosity of coverage.

Figure 1.

CBO's Health Insurance Simulation Model



Source: Congressional Budget Office.

Notes: This diagram represents the basic flow and key components of the model. Although some elements or pathways are shown for illustration, the diagram is not meant to present every interaction or behavioral response in the model.

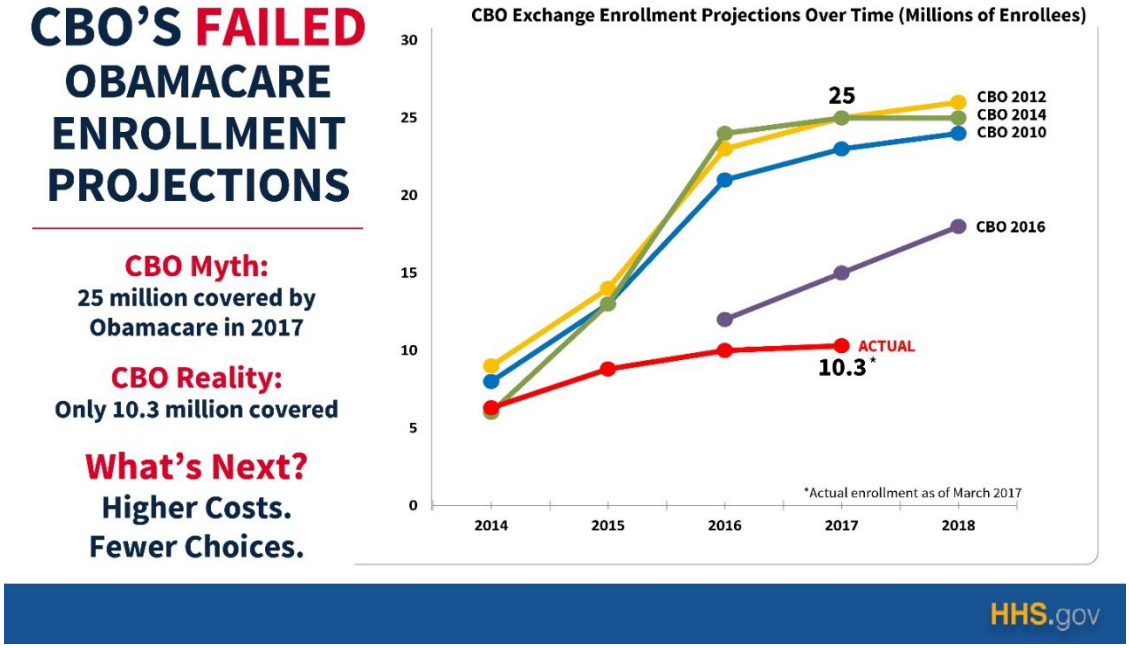
BLS = Bureau of Labor Statistics; MEPS = Medical Expenditure Panel Survey; NBER TAXSIM = National Bureau of Economic Research Tax Simulator; NHEAs = national health expenditure accounts; SIPP = Survey of Income and Program Participation; ESI = employer-sponsored insurance.

Model performance

Glied and Tilipman present a table comparing model's predictions with actual spending, indicating that the models perform pretty well.

Proposal	Year of prediction[a]	Estimated coverage impact (thousands)	Estimated cost impact[b] (millions)	Actual coverage impact (thousands)	Actual cost impact[b] (millions)
Medicare	1967	19,000 (27)	$22,400 (27)	19,500 (10)	$30,600 (11)
Medicaid Expansions[c]	1988–1992	3,050 (17)	$3,863 (26)	3,400 (71)	$4,655 (71)
MA Health Reform[d]	2007–2008	136 (38, 122)	$610 (91)	176 (92)	$733 (91)
Medicare Drug Coverage	2007	38,000 (18)	$60,900 (18, 19)	40,000 (76)	$49,500 (46)

However, the Congressional Budget Office's model overestimated enrollment in the exchanges (as shown in this slide from the Trump-era Department of Health and Human Services).



Provider behavior

Up until now, we have focused on health reform and insurance markets. But some models have many moving pieces that address other segments of the health care system. For example, some health reform proposals, such as the Affordable Care Act, fund a portion of the cost of insurance expansions by cutting Medicare payments to physicians and other providers. They may react. The Congressional Budget Office assumes a 10% reduction in physician fees will lead to a 2.8% increase in the use of services.

CHAPTER 15: PREDICTING COVID

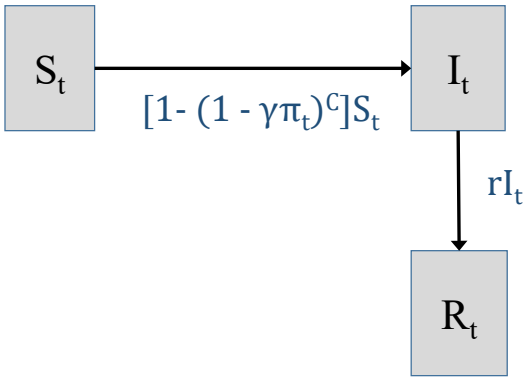
Lockdown 2020

As of March 21, 2020, only about 500 people had died from COVID[1] (Admittedly, attributing deaths to COVID is a tricky business) in the US. Over 58,000 people had died from other causes since January 1, 2020. Yet, around that time, many governors took the drastic step of ordering "lockdowns", closing non-essential businesses and placing restrictions on essential ones. Predictions from models of infectious disease transmission played a key role in the response. The situation wasn't bad in mid-March, but models showed that in the absence of a lockdown, hospitals would be overwhelmed and millions would die. Since then, models have been used to address a variety of questions about re-opening, whether to allow in-person school and college, masks, and testing.

Example of an SIR model

The Susceptible-Infectious-Recovered model is a workhorse of infectious disease epidemiology. The model follows the population over time. Time periods can represent days, weeks, or months, depending on the disease in question. In the model, the population can be divided into three groups: people who are at risk of getting infected (susceptible), people who are infected, and people who have recovered from infection and are immune. S_t, I_t, and R_t represent the number of people in each state at time t.

Susceptible-Infected-Recovered model



[1] Centers for Disease Control and Prevention. Daily Updates of Totals by Week and State. Provisional Death Counts for Coronavirus Disease 2019 (COVID-19) https://www.cdc.gov/nchs/nvss/vsrr/covid19/index.htm

Note that this one of many possible forms of the model.

The total population size is

$$S_t + I_t + R_t \quad [1]$$

The prevalence of infection at time t is

$$\pi_t = \frac{I_t}{S_t + I_t + R_t} \quad [2]$$

The probability that an uninfected person becomes infected at time t is given by this gnarly equation:

$$\theta_t = 1 - (1 - \gamma\pi_t)^C, \quad [3]$$

where γ is the probability that you get sick if you come in contact with an infected person (the transmission rate) and C is the number of people you come in contact with.

The movement of people between states over time is described by a series of equations. Usually, these are written as differential equations, but we will write them in a simpler form.

$$S_{t+1} = S_t - \theta_t S_t \quad [4.1]$$

$$I_{t+1} = I_t + \theta_t S_t - rI_t \quad [4.2]$$

$$R_{t+1} = R_t + rI_t \quad [4.3]$$

The last term in 4.2 and 4.3 represents recovery, where r is the recovery rate, i.e. the share of infected people who recover every period.

Let's unpack equation 3. Suppose you come in contact with a random person. What is the probability you get infected? It is the probability your contact is infected multiplied by the probability that you catch the disease from an infected person: $\gamma\pi_t$.

Now suppose you come in contact with C people? What is the probability that you get infected? I learned to think about probabilities of this sort using the example of torpedoes. Suppose there are three torpedoes heading for the boat you are on. The boat will sink if any one of the torpedoes hits it. The probability that any one of the torpedoes hits the boat is 0.25 (or 25%). What is the probability that the boat sinks? It is the probability that any one of the torpedoes hits. There are multiple combinations (e.g., the first torpedo hits the boat but not the other two, the first two hit but not the third, the probability that the first and third miss but the second hits). To calculate the probability that at least one hits, you could calculate the probabilities of all these combinations and add them together. Or, you could just calculate one minus the probability that none hit.

Here's how to do it. The probability that one torpedo doesn't hit is 1 – 0.25. The probability that three independent events occur (i.e., three torpedoes not hitting) is the probabilities multiplied together. So the probability that none of the torpedoes hit is

$$(1 - 0.25) \times (1 - 0.25) \times (1 - 0.25) = (1 - 0.25)^3 = 0.422.$$

The probability that at least one of the torpedoes hits is one minus the probability that none of them hit:

$$0.578 = 1 - (1 - 0.25)^3,$$

Better jump off that boat.

In the case of COVID, each contact is like a torpedo. You have to calculate the probability that an uninfected person becomes infected from any of his C contacts.

I simulated the model using the following assumptions:

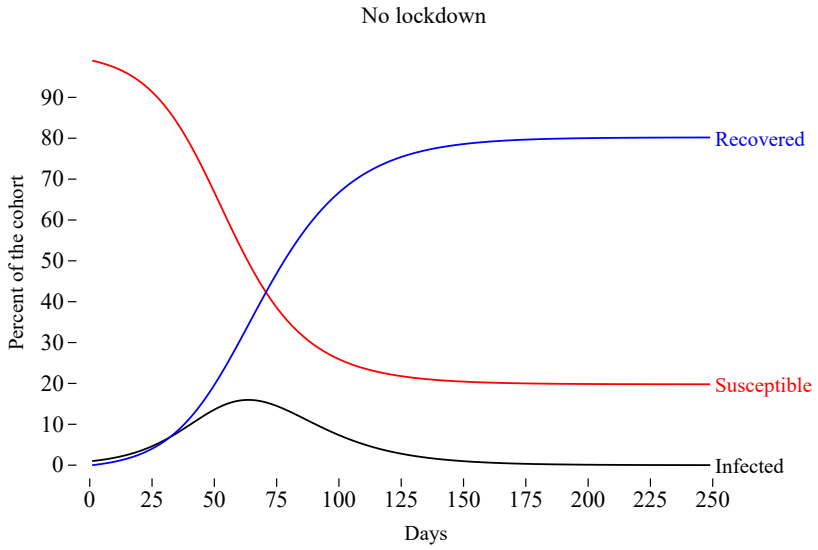
r = 1/14 (i.e., the average duration of infection is 14 days)
C = 2.14 (contacts per day)
γ = 0.0666 (transmission rate)

I selected C and γ so that an infected person infects two other people:

2.14 × 0.0666 × 14 (days) = 2.

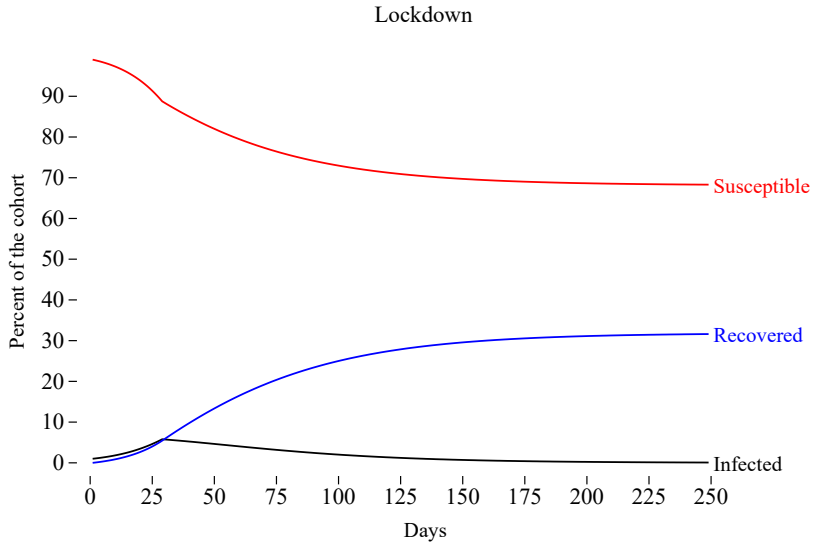
Two was a reasonable assumption of the R_0 value for COVID (although some recent estimates place the value higher).

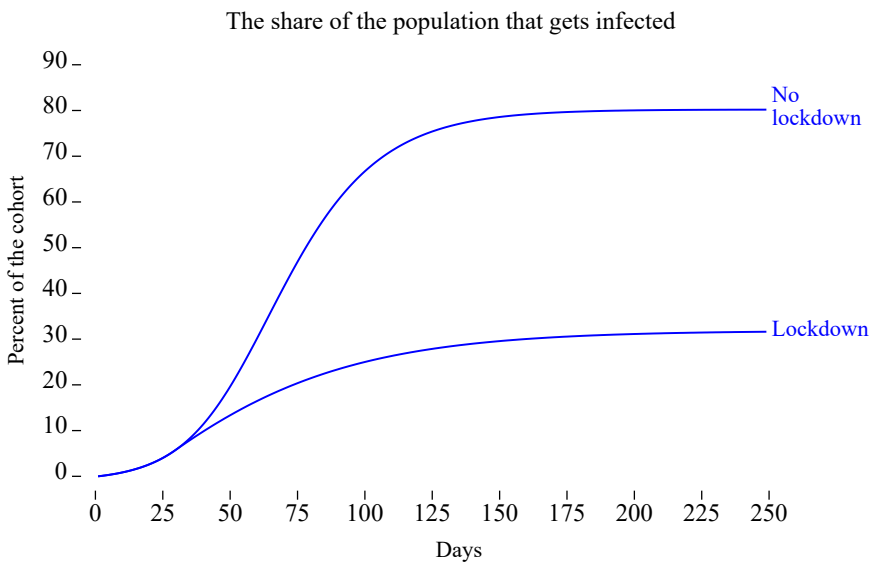
The graph below shows the share of the population in each of the three states over time.



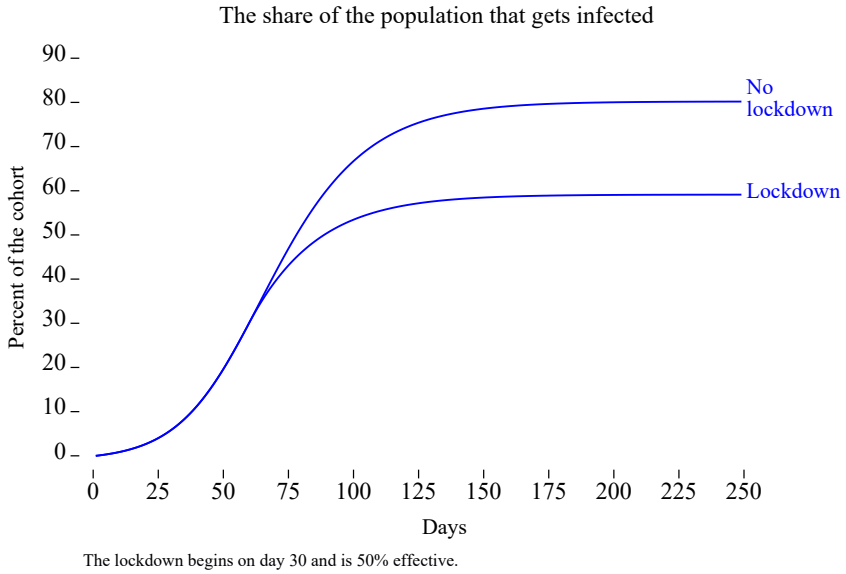
In this case, herd immunity is reached once 80% of the population has become infected. Herd immunity occurs when enough people are immune that the infection no longer propagates itself through the community.

How would a "lockdown" affect outcomes? We can model a lockdown by reducing the number of contacts, C. Lockdowns aren't perfectly effective. Essential workers still have contacts with co-workers and customers, people have contacts with others in their households, and some people are non-compliant. Let's assume a lockdown is 50% effective, meaning that under a lockdown, the number of contacts is cut in half. In this case, a lockdown imposed on day 30 means that only 32% of the population gets infected.

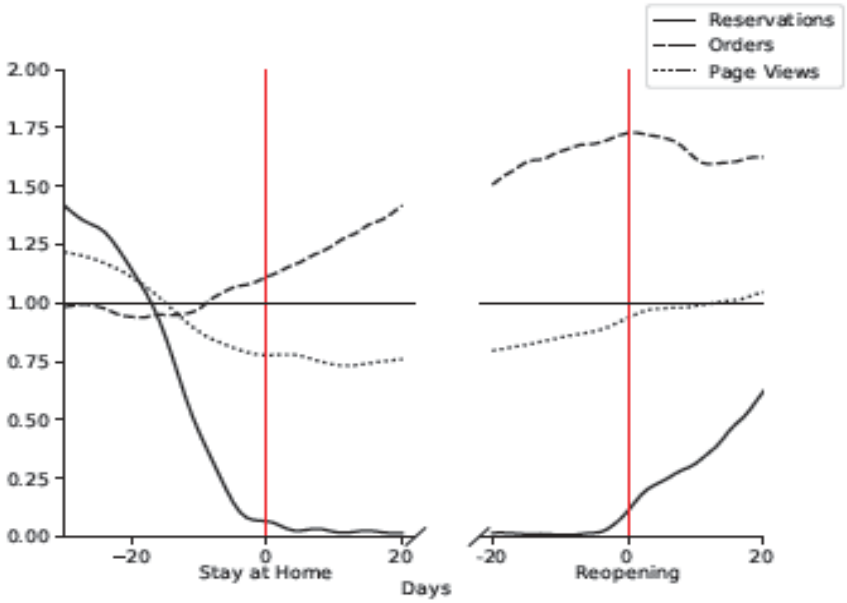




The timing of the lockdown is important. Here is what happens if the lockdown begins on day 60 instead of 30.



Lockdowns are, fortunately, rare. But that makes it difficult to evaluate their impact. Data from Yelp[2] shows that the number of restaurant reservations plummeted before state lockdowns went into effect. This result suggests that lockdowns don't have much of an effect over and above the precautions that people take on their own. But trends around the removal of lockdowns suggest that they affect behavior. Additional lockdowns may be less effective than the initial lockdown as the shock of the pandemic wares off.



Yelp Outcomes

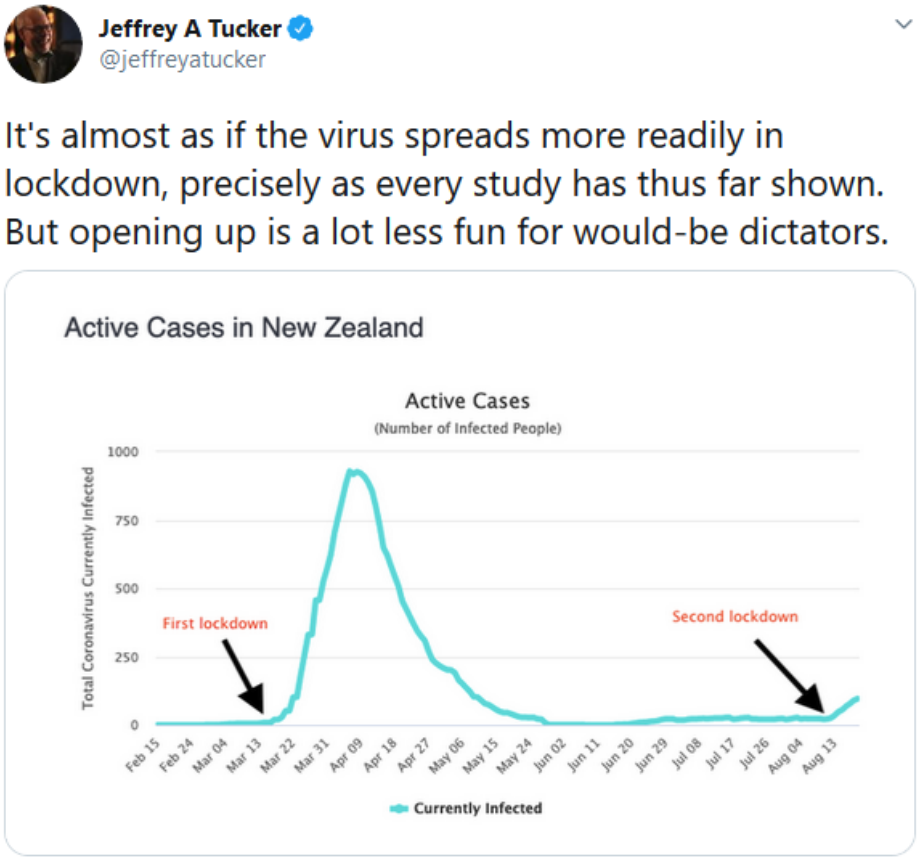
[2] Glaeser EL, G Zhe Jin, BT Leyden, M Luca. Learning from deregulation: the asymmetric impact of lockdown and reopening on risky behavior during COVID-19. National Bureau of Economic Research working paper 27650.

An alternative to SIR models

One approach (SIR models) is to develop a mathematical model to represent transmission of an infectious agent based on the number of contacts between people and the probability that the pathogen is transmitted during a contact between two people. The growth (or decline) of an epidemic depends on the underlying assumptions about contacts, transmissibility, and the duration of time during which people are infectious (i.e., able to transmit the pathogen).

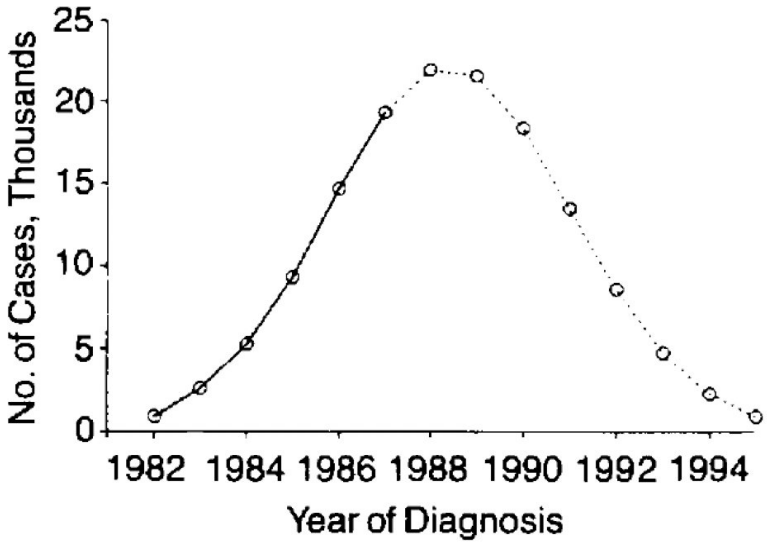
A second approach is to project the growth or decline based on historic data about the path of the epidemic in other regions. For example, we know that epidemics usually follow a bell-shaped pattern. So if we know the peak of the bell shape in another region, and have some data about the left side of the bell shape in our own region, we can project the trajectory going forward. It doesn't require us to make any assumptions about transmission rates, contacts, etc.

Can you guess the problem with the analysis below???



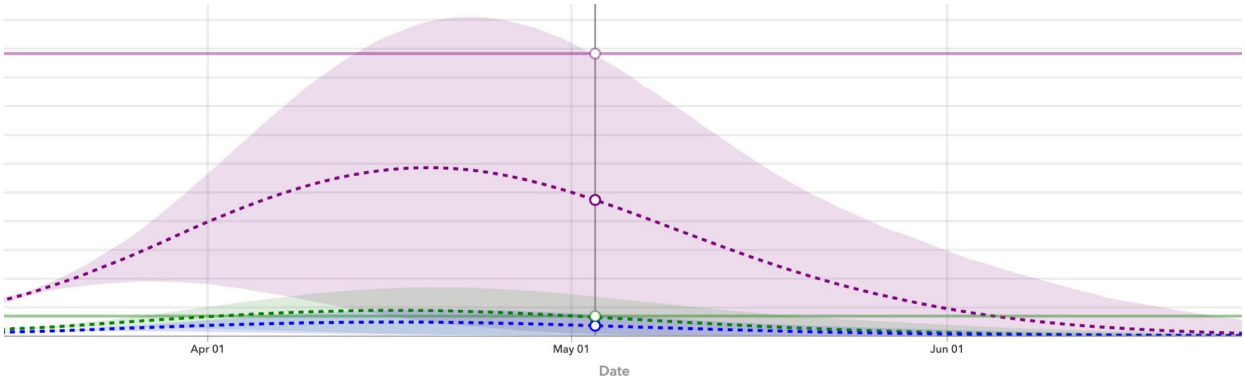
The University of Washington's Institute for Health Metrics and Evaluation developed a model for predicting COVID outcomes that took a different approach from the S-I-R models that dominate much of infectious disease modeling. (Reportedly the model now incorporates some elements of the S-I-R model.)

The model is based on the observation, known as Farr's law, that the share of the population infected with a novel pathogen at a point in time looks like a bell curve or normal distribution. Here is a graph from a study that projected the incidence of AIDS.[3]



[3] Bregman DJ, Langmuir AD. Farr's Law Applied to AIDS Projections. *Journal of the American Medical Association* 1990;263(11):1522–1525.

The early versions of the IHME model fit a normal curve based on early infection data and assumptions about the trajectory of the disease based on data from China and Italy.



IHME model projections[4]
Pink line: All beds. Green line: ICU beds. Blue line: ventilators.

Despite being panned by many infectious disease experts, the IHME model was widely quoted in the media and Trump administration officials in the pandemic's early days. Here is how an article in *Vox*[5] explained the IHME model's influence.

> Some of the factors that make the IHME model unreliable at predicting the virus may have gotten people to pay attention to it. For one thing, it's more simplistic compared to other models. That means it can be applied in ways more complicated models could not, such as providing state-level projections (something state officials really wanted), which other modelers acknowledged that they didn't have enough data to offer.
>
> Meanwhile, its narrow confidence intervals for state-by-state estimates meant it had quotable (and optimistic) topline numbers. A confidence interval represents a range of numbers wherein the model is very confident the true value will lie. A narrow range that gives "an appearance of certainty is seductive when the world is desperate to know what lies ahead," a criticism of the IHME model published in the Annals of Internal Medicine argued. But the numbers and precise curves the IHME is publishing "suggests greater precision than the model is able to offer."

An article in the *Annals of Internal Medicine*[6] described the IHME model as a "statistical model with no epidemiologic basis." It helped that the IHME model gave optimistic forecasts compared to other models (for example, at one point the model projected that there would

[4] Hospital resource use. https://pbs.twimg.com/media/EULx0s0UwAAGoqX?format=jpg&name=4096x4096
[5] Piper K. This coronavirus model keeps being wrong. Why are we still listening to it? *Vox*. May 2, 2020.

[6] Jewell NP, Lewnard JA, Jewell BL. Caution Warranted: Using the Institute for Health Metrics and Evaluation Model for Predicting the Course of the COVID-19 Pandemic. *Annals of Internal Medicine* 2020;173(3):226-227.

be only 60,000 deaths), which allowed the Trump administration to claim that Democrats were overreacting to COVID.

The IHME's director argued that most other models do not report results that are useful to policymakers[7]: "We're willing to make a forecast. Most academics want to hedge their bets and not be found to ever be wrong…That's not useful for a planner — you can't go to a hospital and say you might need 1,000 ventilators, or you might need 5,000."

To be fair, IHME was not the only modeling outfit making incorrect projections. At the other end of the spectrum, Michael Osterholm, director of the University of Minnesota's Center for Infectious Disease Research and Policy projected on the Joe Rogan podcast[8] that "conservatively", COVID will result in 480,000 deaths and 48,000,000 hospitalizations (the actual number, as of September 4, 2020, was less than 2 million.).

[7] Cancryn A. How overly optimistic modeling distorted Trump team's coronavirus response. *Politico* April 24, 2020.
[8] DeRensis, Hunter. Scientist: 480,000 People Could Die Due to Coronavirus, 48 Million Hospitalizations. *The National Interest* March 12, 2020.


Megan McArdle and 5 others liked
Carl T. Bergstrom @CT_Bergstrom · 14h
410,451 deaths by Jan 1.
Not 410,000, or 411,000.
If I'd missed by an order of magnitude in April, I wouldn't be predicting to six significant digits in September.
Ali H. Mokdad @AliHMokdad · 19h
.@IHME_UW now projects 410,451 #COVID19 deaths by Jan 1st, this is about 224,000 deaths from now until the end of the year. These are not numbers or statistics but family member, friends, and loved ones. 1/14 covid19.healthdata.org/united-states-...
Show this thread
46
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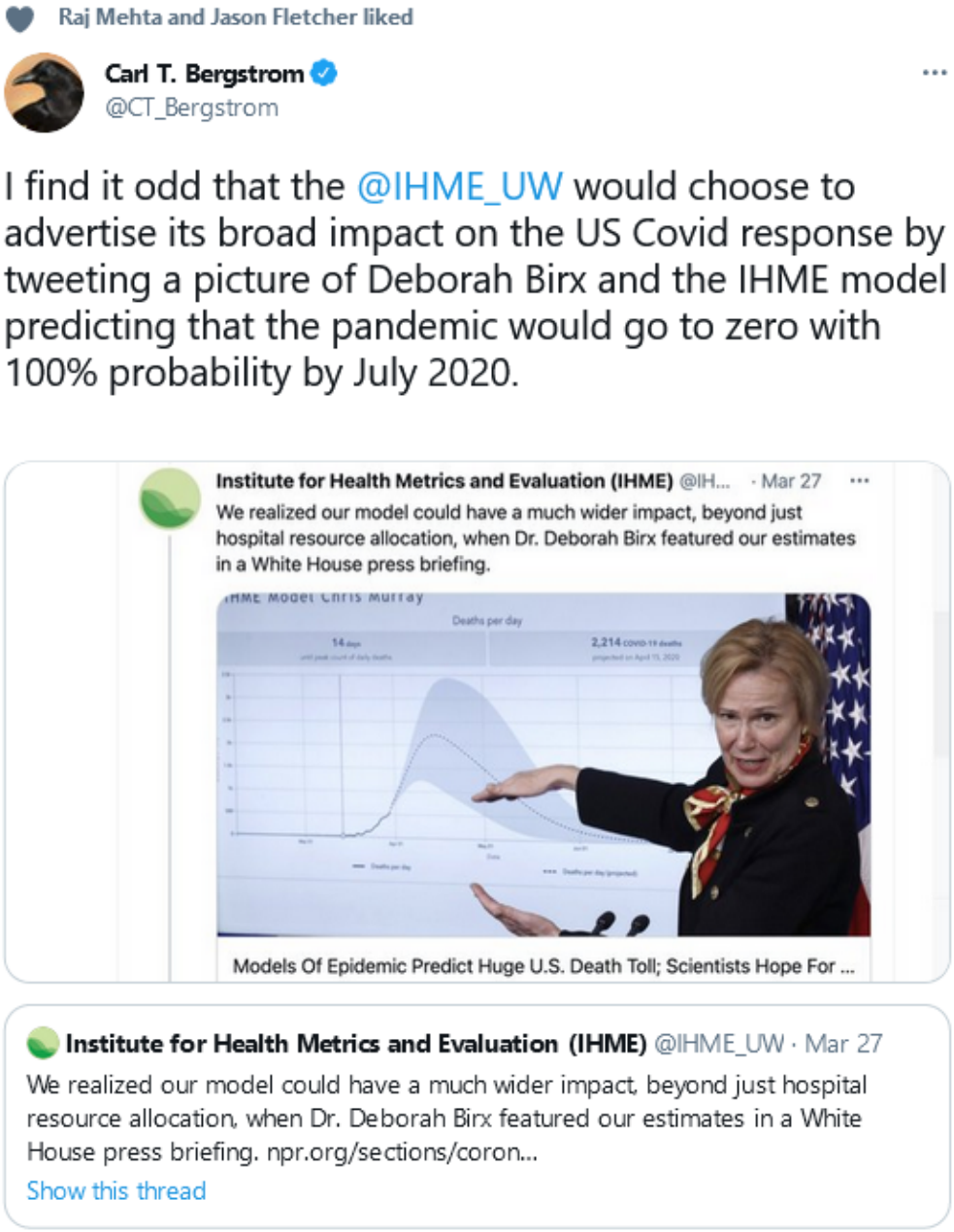


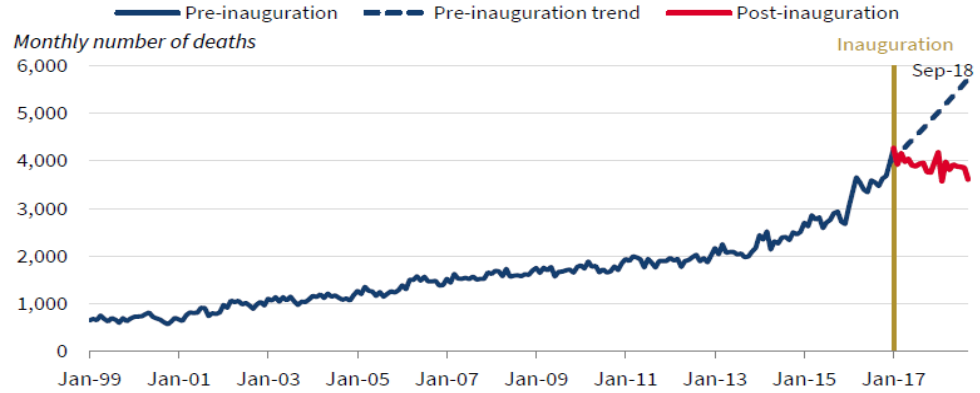
Here is another example of a projection based off of past trends.[9] Do you think this is a good analysis? Why or why not?

[9] The Role of Opioid Prices in the Evolving Opioid Crisis. The Council of Economic Advisors. April 2019.

Box 1. The Slowing of the Opioid Epidemic under the Trump Administration

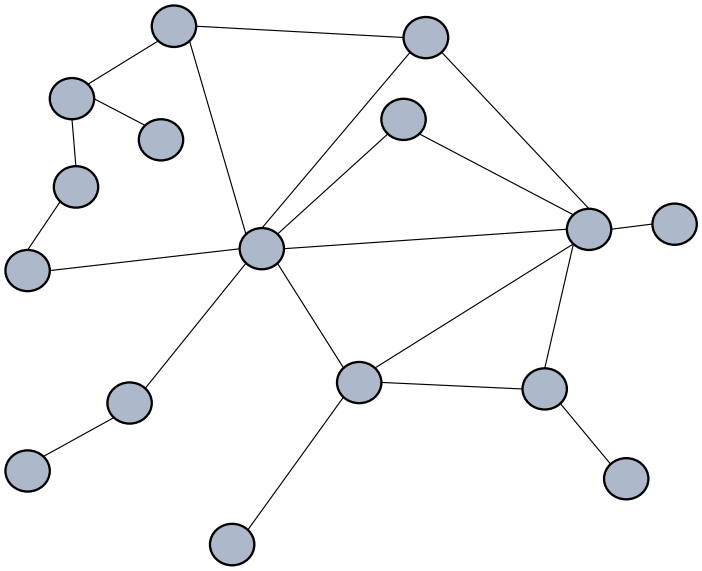
When President Trump took office in January 2017, monthly overdose deaths involving opioids had reached an all-time recorded high, a 21 percent increase from the average number of monthly deaths in 2016. The total number of opioid deaths grew again in 2017 (47,600) compared to the previous year (42,249 in 2016). Fortunately, the growth in opioid deaths may have finally begun to reverse. The rising overdose death toll through September 2018, the latest month for which provisional data is available, has flattened compared to previous trends (see figure i). The opioid epidemic remains at crisis levels, but the dramatic growth of the epidemic seems to be slowing down.

Figure i. Monthly Opioid-Involved Overdose Deaths, 1999–2018



Sources: Centers for Disease Control and Prevention; Ahmad et al. (2019); CEA calculations.
Note: Data from before January 2018 are compiled from the CDC WONDER database, and monthly data beginning in January 2018 are calculated using the provisional reported number of deaths from the CDC which is available through September 2018 as of April 25th, 2019. Pre-inauguration trend is calculated for the compound annual growth rate on a sample period from January 1999 through January 2017, with forecasted levels reconstructed from projected rates.

Network models



Additional resources

Tufekci, Zeynep. Don't Believe the COVID-19 Models. The Atlantic April 2, 2020.

SEIRS+ Model Framework with nice diagrams: https://github.com/ryansmcgee/seirsplus

A visual simulation of network models

https://www.washingtonpost.com/graphics/2020/health/coronavirus-herd-immunity-simulation-vaccine/?hpid=hp_hp-banner-main_herdimmunity-1155am%3Ahomepage%2Fstory-ans&itid=hp_hp-banner-main_herdimmunity-1155am%3Ahomepage%2Fstory-ans

And Why outbreaks like coronavirus spread exponentially, and how to "flatten the curve" - Washington Post

A compilation of predictions from various COVID models
https://projects.fivethirtyeight.com/covid-forecasts/

Podcasts on COVID models:

Ellie Murray and Lucy D'Agostino McGowan Coronavirus Conversations 2 | Episode 10
https://casualinfer.libsyn.com/coronavirus-conversations-2

Sensationalist Science: https://twitter.com/SenSciPod/status/1286779649813385216