securing OUR economic FUTURE

Foreword by **HENRY M. PAULSON, JR.** and **ERSKINE BOWLES**

Edited by **MELISSA S. KEARNEY** and **AMY GANZ**

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Henry M. Paulson, Jr.
Co-Chair

Erskine Bowles
Co-Chair

Melissa S. Kearney
Director

Amy Ganz
Deputy Director

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Part III: The Global Climate Challenge and U.S. Policy Response

Foreword

By Erskine Bowles and Henry M. Paulson, Jr.

The American economy is in the midst of a wrenching crisis, one caused by the COVID-19 pandemic, intensified by the worst social unrest in a generation, and aggravated further by a series of climate-driven natural disasters.

The effects of the economic contraction are enormous. Over a ten-week period this spring, some 40 million Americans lost their jobs. Millions remain unemployed and tens of thousands of businesses remain closed. And while the economy has made some steps to recovery, the pandemic has laid bare that too many Americans are unable to meet many of their urgent and basic needs.

At the same time, it has become painfully clear that American society is not equipped to deal with the risks emerging from our changing climate. Hundreds of thousands have evacuated their homes in recent months due to raging wildfires on the West Coast and flooding in the South. And while these climate-driven shocks are a short-term certainty, we have not built the infrastructure needed to withstand them, nor have we adapted our policies to meaningfully reduce their likelihood in the future.

American policymakers need to tackle these crises head on, but they cannot afford to lose sight of the larger vulnerabilities that today's crises have exposed. The challenge facing the United States is not simply to recover. We must rebuild an economy that is more secure, equitable, and better insulated from the risks of the 21st century.

How can we restore a sense of economic security to American workers and families? What policies will expand opportunities across large geographic, social, economic, and racial disparities? How can we adjust our economic policies to guard against the worst effects of climate change? These are questions that many Americans are asking—to which policy makers will need answers.

This book is a contribution toward this end. It was largely written before the pandemic crises beset our country. But the analyses, diagnoses, and prescriptions contained within, all shed new light on the underlying fragilities that have since been exposed. The book is divided into three sections, covering the 'Economics of the American Middle Class'; the 'Geographic Disparities in Economic Opportunity and Place-Based Economic Development'; and the 'Geopolitics of the Climate and Energy Challenge and the US Policy Response.' Even after the pandemic recedes, the larger forces covered in this book will continue to shape our economy and lives.

As with previous publications, this volume is not intended to represent the consensus view of Economic Strategy Group members. It does, however, bring the best evidence to bear on some of the deep challenges facing the American economy, and does so in the same non-partisan spirit in which the Economic Strategy Group was conceived.

Introduction

By Melissa S. Kearney and Amy Ganz

The United States is currently gripped by deep uncertainty and economic anxiety. At the time of this writing, the United States is six months into the COVID-19 pandemic. More than 190,000 Americans have died from COVID (CDC 2020); more than 13 million Americans remain unemployed (Bureau of Labor Statistics 2020); and tens of thousands of businesses remain closed (Grossman 2020). Meanwhile, protests against racial injustice continue across the country, and in a number of tragic instances, they have been overtaken by violence. Wildfires rage through the northern Pacific states. In Oregon, 40,000 people have been evacuated and more than 1,500 square miles have burned. California has already experienced three of the top four largest wildfires in its history in this year alone. Perhaps more than any time in recent memory, the economic future of our country feels uncertain.

The overarching theme of this book "Securing our Economic Future" and the specific topics therein—the economics of the middle class, geographic divergence and place-based economic development, and the global climate challenge and U.S. policy response—were chosen in early 2020, before the COVID pandemic and associated recession had taken hold of the nation. But the acute challenges before us make the goal of securing our economic future even more imperative. Today's alarming and immediate crises expose deep, structural weaknesses that have been building. The pandemic-induced recession has exposed the economic fragility of so many American households. The wildfires of historic proportion reveal the effects of environmental pressures. Bitter partisan and social divides that characterize the country during this Presidential campaign season reflects—among other things—increased economic divergence that often falls along geographic lines. These divides fall along racial lines as well, but those critical challenges are beyond the scope of this single volume.

By the time this volume appears in print, the election will have been decided. We fervently hope that the public health crisis will be abating, the labor market will be recovering, the wildfires will be under control, and that social change will progress peacefully. But without a doubt, the elected administration will face critical economic policy challenges. This volume focuses on three of the most important ones.

Part I focuses on the economic wellbeing of the American middle class. The chapters in this section evaluate—and call into question—the prevailing narrative of its decline. Chapter 1 documents facts about middle-class jobs and income. Chapter 2 explores how the middle class fares under the government's tax and transfer system. Chapter 3 presents new insights about the economic (in)security of the middle class. Part II focuses on geographic disparities in economic opportunity across the United States. Chapter 4 presents evidence that there is no longer an urban wage premium for non-college-educated workers, which calls into question the conventional wisdom that moving to economically vibrant cities offers an economic path forward for most workers. Chapter 5 discusses the pitfalls and promise of place-based economic policies. Chapter 6 presents a proposal for a federal emergency rental assistance program that addresses a critical gap in the nation's suite of housing policies. Part III focuses on the global climate and energy challenge and the U.S. policy response. Chapter 7 makes the case for a federal carbon tax and discusses implementation challenges. Chapter 8 highlights the role of technology policy in reducing carbon emissions and atmospheric concentrations. And finally, Chapter 9 describes the need for policies that help communities ameliorate threats from and improve resilience to climate change.

Part I: The Economics of the American Middle Class

Even in the booming pre-crisis economy, numerous news articles, policy reports, and political leaders asserted that middle-class Americans are struggling economically, more so than in earlier decades. The middle class, according to these reports, was "squeezed," "shrinking," "disappearing," and "dead."[1] Reports emphasized long-term stagnant wage growth, fewer job opportunities, and declining intergenerational economic mobility, painting a dire picture of middle-class wellbeing. The American public took note: In 2018 nearly two-thirds (61 percent) of respondents in a Pew Research Center poll said the federal government does too little to help the middle class. Politicians from both parties have made middle-class economics a centerpiece of their platform.

However, a careful look at the data presents a much more nuanced picture. Data on middle-class jobs and income show that the rise in income inequality and the "hollowing out" of the middle has been associated with more middle-class households moving *up* in the income distribution, as opposed to down, and being more likely than previous generations to have higher markers of consumption. Evidence on

1 See for example: Rose, Stephen. 2020. "Squeezing the Middle Class." The Brookings Institution. https://www.brookings.edu/research/squeezing-the-middle-class/; Pew Research Center. 2016. "America's Shrinking Middle Class: A Close Look at Changes Within Metropolitan Areas." https://www.pewsocialtrends.org/2016/05/11/americas-shrinking-middle-class-a-close-look-at-changes-within-metropolitan-areas/ ; Morris, Alex. 2018. "American Middle Class: Why Is It Disappearing?" *Rolling Stone*, Novem ber 13, 2018. https://www.rollingstone.com/culture/culture-features/american-middle-class-disappearing-754735/ ; Matthews, Chris. 2016. "Here's Why the Middle Class Is Disappearing All Around the World." *Fortune*, July 13, 2016. https://fortune.com/2016/07/13/middle-class-death/.

household responses to income volatility shows that American households use a variety of low-cost approaches to respond to volatility, revealing a degree of financial resilience that is often overlooked in discussions about promoting savings among such households.

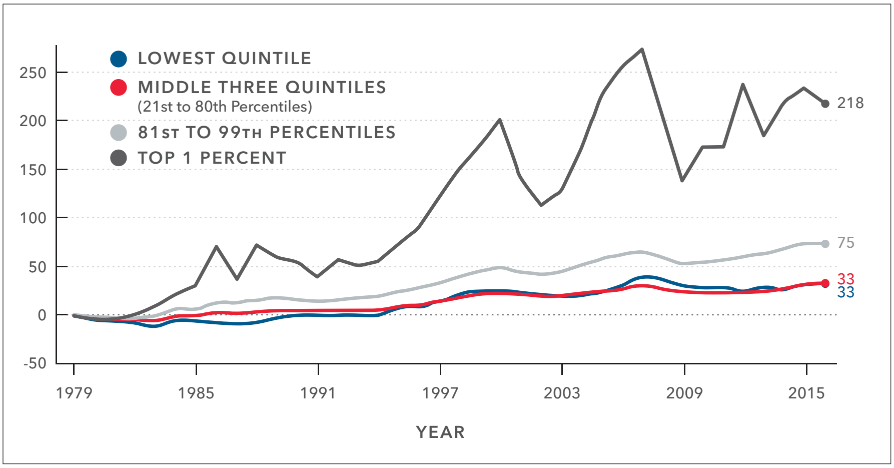
Should the federal government be spending more to bolster the income of middle-class households? Data on government tax receipts and transfer payments show that federal policy has become *more* generous toward the middle class in recent decades. The Congressional Budget Office (CBO) reports that American households in the middle three quintiles of the income distribution experienced cumulative market income growth of 33 percent between 1979 and 2016. After accounting for most federal taxes and transfers, cumulative income growth increases to 47 percent over the same period (as shown in Figure 1). In part, this is the result of tax policy changes that benefitted middle-income households. The average federal tax rate fell from 19 percent to 15 percent for households in the middle three quintiles between 1979 and 2016.

In Chapter 1, Professor Bruce Sacerdote of Dartmouth College documents that over the past 30 years, middle-class Americans have experienced slower pre-tax income growth relative to past decades and as compared to those in the top decile. However, Sacerdote argues that claims about a vanishing middle class are not well-founded. Because the income distribution has widened over time, the number of households falling within a given income range has also declined. However, these trends do not necessarily result in a "hollowed out" middle class, in which there are poor households, rich households, and no one in the middle. Sacerdote documents that middle-income households have become more likely to transition into the upper part of the income distribution over time than they are to move lower in the distribution. As a result, Sacerdote finds that key measures of consumption, such as the likelihood of owning a home, having two cars, or sending a child to college, have increased among households at all income levels including the middle class, which he defines as those in the middle 60 percent of the distribution. However, despite these positive indicators of middle-class economic well-being, rising inequality and slower economic growth have led to lower rates of intergenerational mobility, while advances in global trade and automation have disproportionately negatively affected many longstanding middle-class occupations.

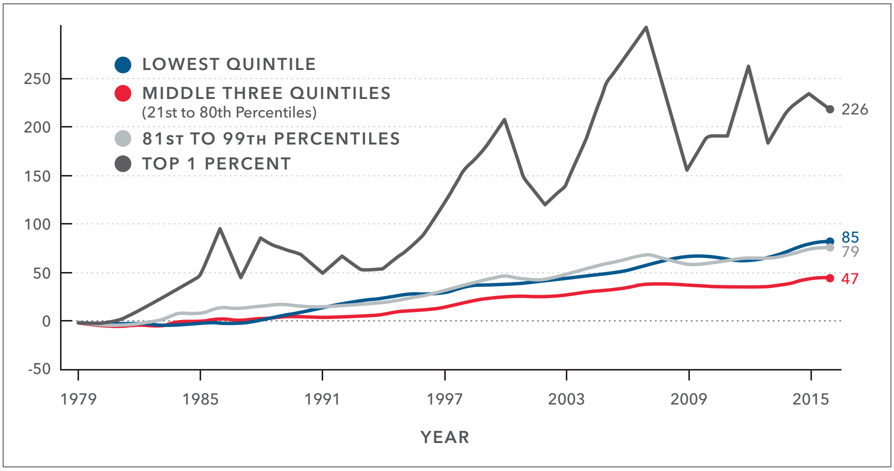
In Chapter 2, Adam Looney, Visiting Professor of Economics at the David Eccles School of Business at the University of Utah, David Splinter, Economist for the Joint Committee on Taxation, and Jeff Larrimore, Chief of Consumer and Community Development Research at the Federal Reserve Board of Governors, dig deep into measures of after tax and transfer incomes of the middle class. They refine CBO estimates of pre- and post-tax and transfer income growth (shown above

Figure 1. Cumulative Growth in Average Income, by Income Group, 1979–2016

(a) Before Tax and Transfers



(b) After Tax and Transfers



Source: Congressional Budget Office (2019) "The Distribution of Household Income."

in Figure 1) to incorporate additional measures of income and social insurance benefits that are excluded from the CBO statistics, including undistributed income earned in retirement accounts, imputed rent of owner-occupied housing, and the employee insurance contributions that are excluded from taxable wages. This more comprehensive measure of income implies higher cumulative growth in market income and post-tax/post-transfer income among middle-class households than do the CBO statistics. Among non-elderly individuals in the middle three quintiles, they find market income per person increased 39 percent between 1979 and 2016, and by 57 percent over the same period after accounting for taxes and transfers.

Additionally, the chapter by Looney, Splinter, and Larrimore reveals that this level of government income support to middle-class households is a relatively new phenomenon. The after-tax, after-transfer income and market income of the middle class trended together between 1979 and the 1990s but diverged after 2000. Since 2000, middle-class income after taxes and transfers grew three times faster than market income.

Increased generosity toward the middle class has also changed the composition of means-tested transfer recipients. The authors find that the share of means-tested transfers going to middle-class households increased from 27 percent to 49 percent between 1979 and 2016 and the share of federal taxes paid fell from 45 to 31 percent. This dramatic reversal of the middle class from net-contributors to net-beneficiaries was financed in part by reductions in defense spending and in part by deficit spending. This raises questions about the sustainability of current levels of redistribution and, in particular, whether it is possible to further finance redistribution to the middle class by raising new revenues from the top quintile. The authors review various scenarios in which taxes are increased on high-income households in order to reduce the tax burden on or finance new benefits for low- and middle-income households and demonstrate the limitations of this approach.

Chapter 3 takes up the issue of household economic insecurity with a focus on how middle-class households respond to income volatility. Dan Silverman, Professor and Rondthaler Chair of Economics at the W.P. Carey School of Business at Arizona State University, observes that many middle-class families are badly insecure, living paycheck to paycheck while maintaining insufficient savings to weather unexpected income or expense shocks. However, new administrative data reveal that households are surprisingly resilient in the face of such shocks, often rearranging obligations and dramatically reducing consumption in order to get by. Households respond in similar ways in the face of both predictable and unpredictable changes in income, suggesting that many prefer to rearrange future spending rather than reducing current consumption to accumulate a savings buffer. As a result, Silverman recommends that policy aim to insure households against income risk rather than promoting self-insurance through increased savings.

Part II. Geographic Disparities in Economic Opportunity

In recent decades, income convergence across U.S. regions has slowed or even reversed (Moretti 2011). According to Ganong and Shoag (2017), incomes across the U.S. converged at an average rate of 1.8 percent per year between 1880 and 1980. However, in the subsequent three decades, this trend weakened dramatically. They find the rate of income convergence between 1990 to 2010 was less than half the historical norm. At the same time, they document a decade-long decline in migration from low to high-income regions. These trends have led to renewed interest in place-based policies, among both economists and policy makers (for instance, see Austin, Glaeser, and Summers 2019). The Economic Strategy Group's February 2019 volume *Expanding Economic Opportunity For More Americans* took up these issues. The volume featured a chapter by economist James Ziliak (2019) highlighting the rural/urban divide in employment rates and economic prosperity. His chapter showed that less-educated, rural workers are further behind their urban counterparts today than they were fifty years ago, and put forward a set of proposals to address rural employment challenges, arguing for both people-based and place-based policy approaches. The volume also included a chapter by economist Joshua Gottlieb (2019) examining the indirect role that housing supply constraints may have on productivity and wage growth by restricting the flow of human capital. This volume builds on that work and revisits these topics with new insights.

Given the large variation across places in income and economic opportunities, it has been a standard view in economic and policy discussions that fostering migration from low to high productivity places would improve economic outcomes for individuals, and lead to economic convergence across places. If the decline in mobility over recent decades reflects barriers to migration — for example, limited information or the high cost of housing in productive areas — a reasonable policy response would be to address those barriers. But what if the reduction in migration actually reflects an erosion of "pull" factors, such as fewer good-paying job opportunities, as opposed to an increase in "push" factors, such as high housing costs? That is precisely what chapter 4 by David Autor, the Ford Professor of Economics at the Massachusetts Institute of Technology (MIT) and director of the MIT Work of the Future Initiative, addresses. Autor presents detailed data on wages and job opportunities in urban areas and shows that in a great reversal from earlier decades, there is no longer an urban wage premium for workers without a bachelor's degree. That means that moving to cities no longer confers an economic benefit for workers without a four-year college degree.

Autor's analyses show that urban workers without four-year college degrees are relegated to less specialized roles commanding lower wages, as compared to their counterparts in earlier decades. He further documents that this disappearance of middle-skill work among non-college workers—what he calls "occupational polarization"—has been more pronounced among non-white workers. Middle-skill employment among non-college Hispanic workers has receded the most, followed by Black workers, while the trend has been more moderate among whites. Alarmingly, Autor also finds that employment shares of black male college graduates in mid-paying occupations has fallen substantially and the share in low-paying occupations has risen, contrasting with the increase among college graduates in all other race/ethnicity and gender groups.

The revelation that even in highly productive cities, labor market outcomes are weak among workers without a bachelor's degree further enhances calls for dedicated investments in places in order to increase job opportunities for all workers and bolster widespread economic prosperity. It is becoming increasingly clear that policies to encourage migration away from distressed U.S. places to more prosperous ones is not a very promising approach to the challenges of economic malaise affecting certain groups of workers and certain parts of the country.

In chapter 5, Timothy Bartik, a Senior Economist at W.E. Upjohn Institute, explores the current landscape of state and local economic development policies in the United States and offers several proposals that would improve the cost-effectiveness of local economic development initiatives. Bartik argues for better targeting of local economic development policies on distressed areas, with an emphasis on achieving lasting job creation. He proposes that policies should be evaluated based on the cost per job created, and that by this metric, cash and tax incentives for businesses tend to be the least cost-effective, as they are often expensive and poorly targeted. But, of the roughly $50 billion spent by state and local governments on economic development each year, 95 percent of this total is in the form of tax or other cash incentives for firms. Bartik argues that such incentive packages should be discouraged, and that instead, state and local development programs should focus on providing businesses with customized public services, such as job training partnerships with community colleges and infrastructure development.

A thorough consideration of placed-based economics inevitably, and appropriately, must contend with the issue of housing costs. As noted above, high housing costs in economically productive areas was an issue we considered in our February 2019 volume. We turn to the issue of housing again in this volume, but this time we focus on the burden of housing costs for low-income renters. This is a distinct (albeit related) issue to the challenge of high housing costs more generally. The current COVID-19 pandemic and associated recession has served to highlight the extent of eviction and housing insecurity in America. Today, roughly half of all renter households are considered "rent burdened," defined as paying more than 30 percent of income in rent, while a quarter of all renter households are considered "extremely rent burdened," paying more than 50 percent of income in rent. The share of renters paying more than 30 and more than 50 percent of income in rent have both doubled since the 1960s (Ellen, Lubell, and Willis 2020).

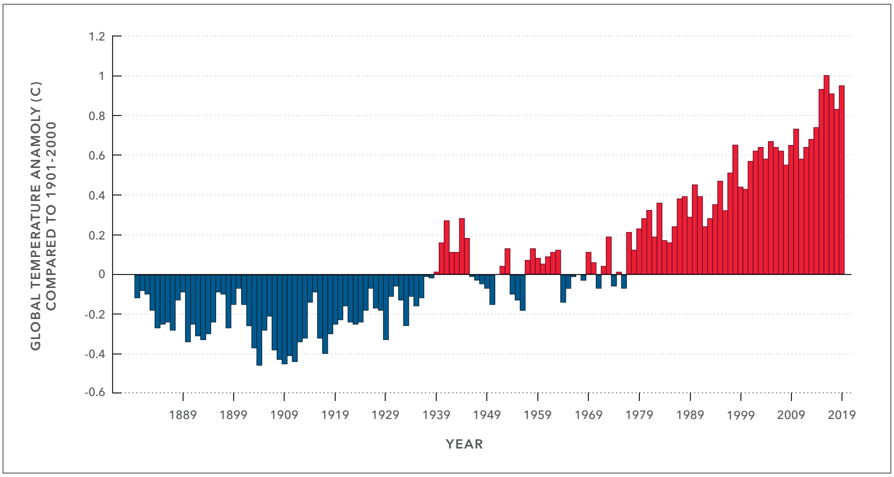
Renters, who are disproportionately concentrated in urban areas, are especially sensitive to rapidly rising rents, greater income volatility, and weak protections against eviction-caused homelessness. Chapter 6 of this volume, co-authored by Ingrid Gould Ellen, Paulette Goddard Professor of Urban Policy and Planning at the NYU Wagner School of Public Service and Faculty Director of the NYU Furman Center, Amy Ganz, Economic Strategy Group Deputy Director, and Katherine O'Regan, Professor of Public Policy and Planning at NYU Wagner and Faculty Director of the NYU Furman Center describe these challenges and offer a policy proposal to address them. The authors propose a federal program that provides one-time emergency financial assistance covering rent, utilities, and other qualifying costs in order to protect households against forced moves and evictions in the face of unexpected income shocks, both of which pose high costs to renters and to society more broadly. Their proposal complements current federal housing programs, which provide long-term rental assistance to a small share of eligible, low-income households, and are ill suited for addressing these one-time financial shocks. Emergency assistance is also far more cost effective at helping families maintain their housing, especially relative to long-term assistance programs.

Part III. The Geopolitics of the Climate and Energy Challenge and the U.S. Policy Response

In the United States and around the world, the cost of inaction on climate change continues to mount, with potentially catastrophic consequences. More frequent heat waves and wildfires, more extreme weather events, and global climate instability threaten to exacerbate economic inequality and reduce human health and prosperity. But the cost of addressing the challenge is daunting, and differences in risks, priorities, and cost-benefit tradeoffs across regions hinder coordinated action. Addressing the challenge is politically complicated by the fact that the costs of taking action will be borne long before the benefits of such investments are realized. But, a majority of Americans today report believing that the federal government needs to do more to address the effects of global climate change (Funk and Kennedy 2020). The final three chapters in this volume describe a multi-pronged approach the United States could pursue, including a market-based carbon tax, scientifically-backed risk control mechanisms, and investments in adaption and resilience strategies.

Part III includes three chapters about the U.S. policy response to climate change. In chapter 7, Trevor Houser of the Rhodium Group documents the many ways that rapid growth in carbon dioxide concentrations have already changed the Earth's climate by increasing average temperatures (shown in Figure 2) and the frequency and severity of extreme events. He also notes that the magnitude of future costs have become more clear, largely thanks to advances in econometric modeling of the economic impact of climate change. Houser reviews the state of this science and emphasizes the substantial variation in estimates of the negative impact of climate change across places, with poor individuals and countries experiencing greater economic and health losses. These inequities occur in both cause and effect: as wealthy countries contribute the most to global carbon emissions, they have the greatest ability and resources to adapt to climate-related risks and mitigate the worst harms.

Figure 2. History of Global Surface Temperature since 1880



Source: Lindsey and Dahlman (2020)

Regardless of what progress is made on reducing GHG emissions, Houser argues that U.S. policy should focus on improving resilience, both domestically and abroad. Within the United States he emphasizes several priorities, including making coastal communities more resilient to rising sea levels, making low-income households and individuals with co-morbidities less vulnerable to more frequent heat waves, supporting agricultural communities in the South and lower Midwest where climate change threatens traditional crops, and reducing wildfire risk in the western United States. Houser also argues the United States has a moral obligation to help ameliorate climate damages in the lower income countries that are most affected. As climate change increases forced human displacement around the world, he argues it is also within the United States' best interest to reduce causes of permanent human displacement, which increases refugee flows and, as a result, the likelihood of geopolitical conflict.

In chapter 8, Gilbert Metcalf, the John DiBiaggio Professor of Citizenship and Public Service and Professor of Economics at Tufts University, argues that a U.S. carbon tax should be the centerpiece of a federal climate policy agenda, but also acknowledges that a carbon tax alone is not sufficient to achieve a zero-carbon economy. He addresses two common concerns about carbon tax implementation: (1) the potential impact on trade competitiveness and (2) whether it would achieve desired emissions reductions. To the first, he proposes a border carbon tax adjustment. To the second, he describes how an Emissions Assurance Mechanism—through which established carbon prices could be dynamically adjusted over time to achieve desired emissions reductions—could be used to address environmental concerns. Finally, Metcalf discusses the macroeconomic impact of a federal carbon tax, which would lead to significant changes in the composition of jobs in the economy, but need not reduce total U.S. economic growth or job creation.

The final chapter of this volume moves beyond market-based approaches to climate policy and describes a role for climate risk control mechanisms. The chapter is co-authored by David Keith, the Gordon McKay Professor of Applied Physics at Harvard University and Professor of Public Policy at the Harvard Kennedy School, and John Deutch, emeritus Institute Professor in the Department of Chemistry at MIT and former U.S. Director of Central Intelligence as well as former U.S. Deputy Secretary of Defense, argue for four climate risk control mechanisms for the United States to address the climate challenge: (1) lowering the carbon intensity of energy; (2) increased investment in carbon dioxide removal (CDR) technologies; (3) policies and programs that protect communities, commerce, and the environment from adverse impacts; and (4) solar radiation modification (SRM) which deploys new technologies to reduce the intensity of solar radiation in the atmosphere. The authors model the deployment of these four policy proposals, compare potential welfare outcomes, and discuss central governance issues related to each mechanism. They also emphasize that developing new innovations at scale will require unprecedented mobilization and coordination of federal, state, local, and private sector organizations. Thus, the authors recommend the adoption of a multi-year program governed by a single federal agency. They further propose that the program be overseen by a single joint congressional climate action committee that could appropriate a multi-year climate budget.

References

Austin, Benjamin, Edward Glaeser, and Lawrence H. Summers. 2018. "Saving the Heartland: Place-Based Policies in 21st Century America," Brookings Papers on Economic Activity, March. https://www.brookings.edu/bpea-articles/saving-the-heartland-place-based-policies-in-21st-century-america/.

CDC. 2020. "CDC COVID Data Tracker." Centers for Disease Control and Prevention. March 28, 2020. https://www.cdc.gov/covid-data-tracker.

Congressional Budget Office. 2019. "The Distribution of Household Income, 2016." https://www.cbo.gov/publication/55413.

Ellen, Ingrid Gould, Jeffrey Lubell, and Mark Willis. 2020. "Through the Roof: The Rising Cost of Rental Housing in the United States and What Localities Can Do About It." Lincoln Institute of Land Policy.

Funk, Cary, and Brian Kennedy. 2020. "How Americans See Climate Change and the Environment in 7 Charts." Pew Research Center (blog). April 21, 2020. https://www.pewresearch.org/fact-tank/2020/04/21/how-americans-see-climate-change-and-the-environment-in-7-charts/.

Ganong, Peter, and Daniel W Shoag. 2017. "Why Has Regional Income Convergence in the U.S. Declined?" Working Paper No. 23609, National Bureau of Economic Research. https://doi.org/10.3386/w23609.

Gottlieb, Joshua D. 2019. "How Minimum Zoning Mandates Can Improve Housing Markets and Expand Opportunity." In *Expanding Economic Opportunity for More Americans,* edited by Melissa Kearney and Amy Ganz, 214–225. Aspen Institute Press. https://economicstrategygroup.org/wp-content/uploads/2019/12/Expanding-Economic-Opportunity-for-More-Americans.pdf.

Grossman, Matt. 2020. "140,000 Businesses Listed on Yelp Are Still Closed Because of Covid-19 Pandemic." Wall Street Journal, June 25, 2020. https://www.wsj.com/articles/140-000-businesses-listed-on-yelp-are-still-closed-because-of-covid-19-pandemic-11593057601.

Kearney, Melissa S, and Amy Ganz, eds. 2019. *Expanding Economic Opportunity for More Americans*. Aspen Institute Press. https://economicstrategygroup.org/wp-content/uploads/2019/12/Expanding-Economic-Opportunity-for-More-Americans.pdf.

Lindsey, Rebecca, and Dahlman LuAnn. 2020. "Climate Change: Global Temperature," August 14, 2020. https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature.

Matthews, Chris. 2016. "Here's Why the Middle Class Is Disappearing All Around the World." *Fortune*, July 13, 2016. https://fortune.com/2016/07/13/middle-class-death/.

Moretti, Enrico. 2011. "Local Labor Markets." Working Paper No. 15947, National Bureau of Economic Research. https://doi.org/10.3386/w15947.

Morris, Alex. 2018. "American Middle Class: Why Is It Disappearing?" *Rolling Stone,* November 13, 2018. https://www.rollingstone.com/culture/culture-features/american-middle-class-disappearing-754735/.

Pew Research Center. 2016. “America’s Shrinking Middle Class: A Close Look at Changes Within Metropolitan Areas.” https://www.pewsocialtrends.org/2016/05/11/americas-shrinking-middle-class-a-close-look-at-changes-within-metropolitan-areas/.

———. 2018. “Majorities Say Government Does Too Little for Older People, the Poor and the Middle Class.” https://www.pewresearch.org/politics/2018/01/30/majorities-say-government-does-too-little-for-older-people-the-poor-and-the-middle-class/.

Rose, Stephen. 2020. “Squeezing the Middle Class.” The Brookings Institution. https://www.brookings.edu/research/squeezing-the-middle-class/.

U.S. Bureau of Labor Statistics. 2020. “Employment Situation Summary.” https://www.bls.gov/news.release/empsit.nr0.htm.

Ziliak, James P. 2019. “Restoring Economic Opportunity for ‘The People Left Behind’" Employment Strategies for Rural America.” In *Expanding Economic Opportunity for More Americans*, 100–127. Aspen Institute Press. https://economicstrategygroup.org/wp-content/uploads/2019/12/Expanding-Economic-Opportunity-for-More-Americans.pdf.

PART I

MIDDLE CLASS ECONOMICS

Is the Decline of the Middle Class Greatly Exaggerated?

AUTHOR

Bruce Sacerdote*

ABSTRACT

Numerous articles and books are written describing the apparent shrinking, decline, or death of the American middle class.[1] In this chapter, I present several of the key facts and review the veracity of some of the more widely held conceptions. Income inequality in the United States has grown in the last 30 years; the middle deciles have made significantly less progress in pre-tax income than the top decile. However, the income distribution is not becoming bimodal; instead there is a noticeable movement of households from the middle of the distribution to the upper part of the distribution.[2] Households in the middle of the income distribution are experiencing positive growth in income and consumption, though at a slower pace than the growth at the top. In the last 30 years, the likelihood of owning a home, owning two cars, or sending a child to college has risen for households across the income distribution including those in the middle class. Disturbingly, lower GDP growth and increased inequality in the distribution of that growth have combined to reduce the probability that children out-earn their parents at similar ages (Chetty et al. 2017). And measures of life expectancy and subjective well-being fell for some groups (Case and Deaton 2017; Blanchflower and Oswald 2019), although life expectancies in aggregate are again rising.

1 See for example Nelson (2019) and OECD (2019).

2 This analysis requires holding the breakpoints for each decile fixed at the beginning period cutoffs and examining the shift in the distribution. All of these long-term facts are pre-Covid recession.

* Dartmouth College, National Bureau of Economic Research, and Abdul Latif Jameel Poverty Action Lab North America.

1. Introduction

Many popular press writers and social scientists associate increased inequality and declines in the number of manufacturing and middle-skill jobs with declines in middle-class living standards and even the disappearance of the middle class. Examples include the OECD's new volume *Under Pressure: The Squeezed Middle Class* (OECD 2019) and "The Shrinking American Middle Class" (Parlapiano, Gebeloff, and Carter 2019).

However, upheaval in the labor market and the loss of specific well-paying jobs is potentially a separate question from what is happening to the shape of the *income distribution* and to the consumption and well-being of Americans in the middle three quintiles of the income distribution. A hollowing out of the occupational skill distribution (Autor, Katz, and Kearney 2006) need not imply a hollowing out of the income distribution (Hunt and Nunn 2019).

In some survey data, 90 percent of Americans consider themselves to be middle class (Pew 2015). Thus it's not surprising for journalists to focus on the struggles of the middle class or for politicians to appeal to the middle class (i.e. nearly everyone) with tax cuts, higher education subsidies, and child-care subsidies.

My aim is to focus readers away from trying to count membership in the middle class and toward structural changes in the labor market and the slow growth in average income and consumption. In this chapter I review the facts on (a) growth in income inequality, (b) loss of manufacturing and middle-skill jobs, and (c) growth in income and consumption for households in different parts of the U.S. income distribution with a focus on the middle part of the distribution. I then examine changes in the shape of the income distribution as a whole.

The evidence leads me to conclude that the U.S. income distribution is not becoming bi-modal or hollowed out (Hunt and Nunn 2019). Nor are incomes and consumption for the middle of the distribution declining. Rather middle incomes are still growing, but less quickly than GDP growth due to increased inequality. In this same volume, Looney, Larrimore, and Splinter (2020) demonstrate that changes in federal taxation and spending have benefited the middle class so that *after*-tax and transfer income for the middle class has grown by 57 percent since 1979, versus 39 percent for pre-tax income.

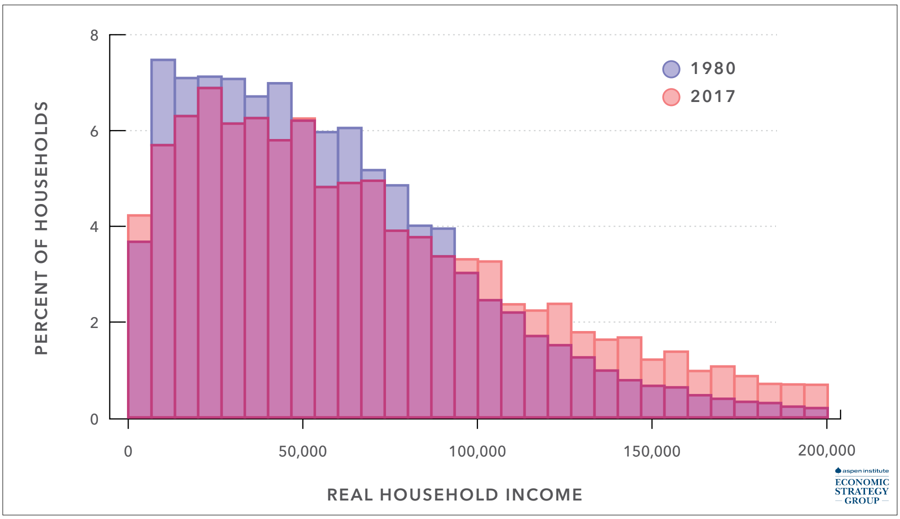
The notion that the middle class is shrinking depends upon the arbitrary goal posts one establishes to define which incomes count as middle class. If one defines middle class as having household income between 75 percent and 200 percent of the median household income, then the fraction of households who are "middle class" fell from 51 percent in 1980 to 43 percent in 2018 (see Table 1). However, this shift comes from more households moving *above* the 200 percent upper cutoff as opposed to falling *below* the lower 75 percent cutoff.

Table 1: Traditional Measures of the Middle Class

YEAR	PERCENT OF HOUSEHOLD INCOMES BELOW 75 PERCENT OF THE MEDIAN	PERCENT OF HOUSEHOLD INCOMES BETWEEN 75 AND 200 PERCENT OF THE MEDIAN	PERCENT OF HOUSEHOLD INCOMES ABOVE 200 PERCENT OF THE MEDIAN
1980	34.58	51.40	14.02
1990	35.28	48.45	16.28
2000	35.12	46.78	18.11
2010	36.48	43.94	19.58
2018	35.26	42.86	21.87

In a world with rising variation in income, it is expected that fewer households will fall between any two predetermined goal posts. If we instead examine changes in real household income from 1980 to 2017 (measured in 2019 dollars), we see that households are more likely to exit the lower part of the distribution and enter the upper part of the distribution as opposed to the reverse. In other words, significantly more households joined the upper tail of the distribution over this period. This is shown in Figure 1. In 1980, 48.5 percent of U.S. households had income of less than $50,000 (expressed in 2019 dollars). By 2017, this fraction had fallen to 40.7 percent. Trying to define the boundaries of the middle class and determine whether it is growing or shrinking is a somewhat futile exercise that distracts from the deeper social challenges that have been emphasized by many scholars.

Figure 1. Distribution of Real Incomes, 1970 and 2017



Note: American Community Survey/Census data on household income. Household income is expressed in 2019 dollars. Income is inflated using the Consumer Price Index (CPI).

The real challenges include the rapidly changing nature of work and the skills demanded in the labor market; the unequal distribution of income growth in the United States in which *median* income and consumption are growing less quickly than the economy as a whole; and the deterioration of happiness and mental health indicators (Case and Deaton 2015; Blanchflower and Oswald 2019).

The long-term trends discussed here took place before the COVID-19 induced recession, which has harmed the bottom quintile of wage earners much more than the middle- and upper-parts of the wage distribution (Berman 2020). The COVID-19 pandemic is likely to have long-term, negative impacts, which could reverse some of the long-term growth in consumption and well-being for the middle- and lowest-earning households documented here.

1. The Political Economy of Middle-Class Decline

The most cited author to predict the collapse of the middle class is Karl Marx (1844) who foresaw that as capitalism grew, the income distribution would become bifurcated into workers and capital owners. The next 175 years have been a disappointment for this prediction, but the topic has remained a popular one.

Lester Thurow (1984) is among the first to draw a connection between decreases in the number of manufacturing (or middle-skill) jobs and the decline of the middle class. Thurow makes several points. First, he notes that smokestack industries such as auto and steel provide jobs for high-wage and skilled blue-collar workers. Second, he asserts that high-tech industries such as microelectronics (which replaced smokestack industries) tend to have only high- and low-wage jobs with no middle-wage jobs; this second claim is not well supported.

Third, Thurow observes that within manufacturing, unions were successful in transforming low-wage jobs into middle-wage jobs. And finally, international trade was negatively impacting employment in the auto, steel, and machine tool industries and that this was removing millions of middle-class jobs. These last two points are supported by the data and foreshadowed the empirical work of Autor, Dorn, and Hanson (2013) and many others. It's likely that automation has also had large negative effects on manufacturing employment.[3]

Thurow defined middle-class households as those earning between 75 percent of the median household income and 125 percent. The number of families that fell in this range went from 28.2 percent in 1967 to 23.7 percent in 1982. Interestingly, half of the "exit" was from more families moving above the cutoff and the other half was from additional families falling below the lower cutoff. A natural interpretation of

3 See Acemoglu and Restrepo (2017), Abraham and Kearney (2018) and Griswold (2020).

these facts is that variance in household incomes rose, particularly with the rise of two-earner families. Changing household sizes alone could account for some of the increased variance.

Recently the OECD issued its report titled "Under Pressure: The Squeezed Middle Class," which defines middle class as having a household income between 75 percent and 200 percent of the median household income. Across all OECD countries the fraction that fell within this range went from 64 percent in 1985 to 61 percent in 2015. The OECD concludes that the income distribution is being hollowed out. But again, it's quite possible that the variance of household income is simply rising and that using an arbitrary set of goal posts to label the middle class is not the best approach.

In Table 1, I use U.S. Census and American Community Survey Data from 1980 to 2018 to show that the OECD is correct; fewer households are within a specific band of 75 percent to 200 percent of median income. As mentioned, defining the middle class in this way, the fraction of middle-class households fell from 51.4 percent in 1980 to 42.9 percent in 2018. However, this is not due to bifurcation but rather to the fact that many households have moved above the upper cutoff of two times the median income (measured in 2018 dollars). As Figure 1 shows, the fraction of households above the upper cutoff has risen from 14 percent in 1980 to 21 percent in 2018. The income distribution has shifted to the right in real terms with fewer households in the lower levels of real income.

The OECD report notes that, "the middle class dream is increasingly only a dream for many." It's not clear how to accept or reject this statement. A more straightforward approach might be to ask whether homeownership or college attendance for children in the family has risen or fallen for people in the middle quintiles of the income distribution. I find that since the 1980s, homeownership, square footage of housing consumed, number of automobiles owned, and college attendance have all been rising. The one exception is the modest dip in homeownership that occurred immediately after the financial crisis of 2008.

Politicians frequently target the middle class for additional policies, subsidies, and tax cuts.[4] This is a sensible political strategy since most Americans consider themselves to be middle class. At the extreme end, a 2015 Pew survey found that 90 percent of Americans self-identified as middle class. In responding to questions about cost burdens under Medicare for All, Warren appears to suggest that everyone

4 See, for example, Senator Elizabeth Warren's (D-Massachusetts) plan to rebuild the middle class. https://elizabethwarren.com/plans#rebuild-the-middle-class or President Trump's proposed middle class tax cut https://www.politico.com/news/2020/02/14/trump-middle-class-tax-cut-115262.

excepting billionaires is in the middle class (Lybrand 2019). Other surveys find self-identified middle-class status of around 70 percent (Martin 2018).

Perhaps more importantly, Americans view being a homeowner and being hardworking as key determinants of being in the middle class. Unfortunately, half of Americans also view the middle class as shrinking in size. This belief in a declining middle class could be explained in one of several ways. Survey respondents might prefer the OECD/Thurow method of fixing certain income goal posts to define the middle class, and then observing the population to move outside of those goal posts. Or respondents might take newspaper reports of middle-class decline on faith. Or, like some of the articles cited above, survey respondents may equate rising income inequality and the disappearance of specific high-paying, non-college jobs for men with a shrinking middle class and declining incomes. This final explanation for the survey results strikes me as the most likely, and I now discuss some of the social challenges that are perhaps causing Americans to believe that consumption is declining and that the middle class is shrinking.

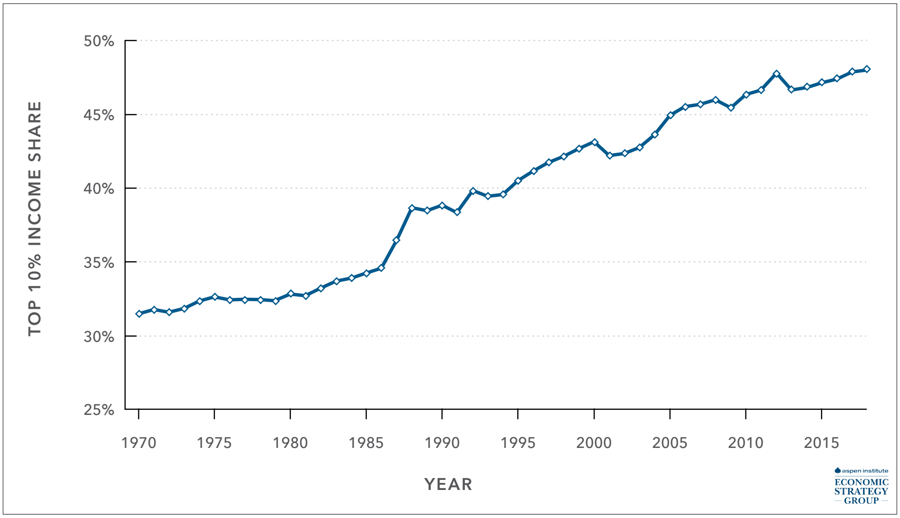
2. The Rise of Inequality

Pikkety and Saez (2003) and Saez (2018) document a stunning rise in pre-tax income inequality over the last 30 or 40 years. There are many different ways to make this point, but one simple way to see the magnitude of the increase is to consider the income share of the top decile of income (Saez 2018), which I reproduce in Figure 2. In 1967, the top decile accounted for about 35 percent of all income in the United States. By 2012, this was 51 percent.

The most cited papers on inequality by economists are concerned with income growth at the very top, meaning the top 0.1 percent, top 1 percent, or top 10 percent. Piketty and Saez tell us that the rich are getting much richer. But the astounding growth at the top of the distribution need not be making the middle class worse off in absolute terms.

Significant work has been done re-examining Pikkety and Saez's conclusions and pointing out some caveats. Slemrod (1995) and others have noted that accounting for tax reform that moved incomes from corporate to personal returns explains some of the rise. Adjusting for changes in household size, filing status, and taxes and transfers also makes an important difference (Burkhauser et al. 2012). Auten and Splinter (2018) account for tax unit size, the allocation of underreported income, and retirement income. They find that the top one percent's share of pre-tax income only rose by 4.1 percentage points from 1979 to 2014, versus the 7.6 percentage point rise

Figure 2. Top Decile Share of Income



Note: Author's calculation of data provided by Saez (2019) and Piketty and Saez (2003). This figure is a subset of Saez 2019 Figure 1. We show the share of income earned by the top 10 percent of earners, excluding capital gains, which are highly volatile and accrue disproportionately to the top 10 percent.

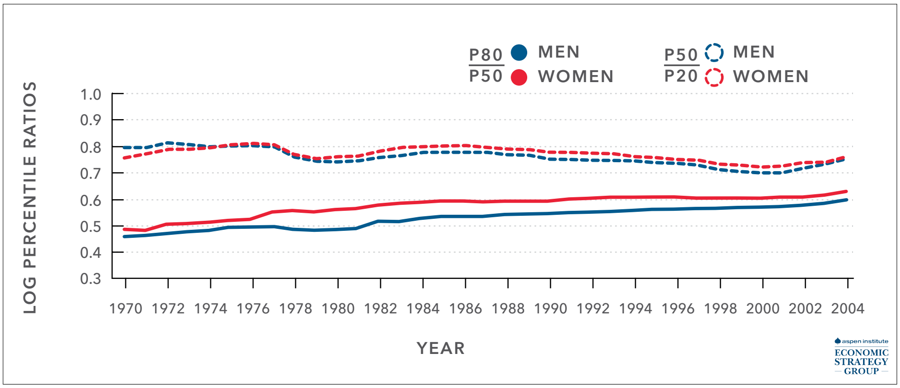
found by Pikkety, Saez, and Zucman (2018). Auten and Splinter (2018) also find that increased effective tax rates on top earners make the rise in the top one percent's share of *after-tax income only 0.7 percentage points* over the same time period.

There are two important points that are not captured by the basic analysis of top income shares. Consistent with Auten and Splinter's (2018) point about after-tax income, inequality of consumption has grown less rapidly than inequality of income. Krueger and Perri (2006) examine the period from 1980 to 2003. During this time the ratio of pre-tax incomes at the 90th percentile to incomes at the 10th percentile rose from 4.2 to 6, meaning the households at the 90th percentile had earnings six times that of households at the 10th percentile by 2003. But the same ratios for *consumption* only rose from 2.9 to 3.4.[5] This suggests that actual inequality of consumption moved by a lot less than inequality of income. How can this be? Krueger and Perri suggest that increased year-to-year volatility of income could be driving some of the rise in income inequality. Or taxes and transfers might enable poor or middle-income households to grow consumption even if their pre-tax income has grown slowly, as described by Looney, Larrimore, and Splinter in this volume.

5 Aguiar and Bils (2015) suggest that Krueger and Perri are too optimistic; when Aguiar and Bils account for measurement error in the consumption data, they find that consumption is also seeing growing inequality.

A more interesting question may concern income growth for households at the 50th percentile of income relative to households at the 80th percentile. Figure 3, reproduced from Kopczuk, Saez, and Song (2010), shows that in 1965, workers at the 80th percentile of income earned 48 percent more than workers at the 50th percentile. By 2004, workers at the 80th earned 62 percent more. While this represents an increase in income inequality, it's substantially less than the dramatic gains at the top of the distribution. During 1965–2004, the gap between the 50th percentile and the 20th percentile actually *decreased* a bit, meaning that workers at the bottom gained relative to workers at the median. In other words, growth in inequality in the upper-middle of the distribution (the 80-50 ratio) and in the lower-middle of the distribution (the 50-20 ratio) is not as severe as the pre-tax income inequality of everyone relative to the very top.

Figure 3. Ratios of 80th to 50th Percentile of Income and 50th to 20th



Note: Produced using the data provided by Kopczuk, Saez, and Song (2010). This graph is a subset of KSS Figure 2.

3. Job Polarization

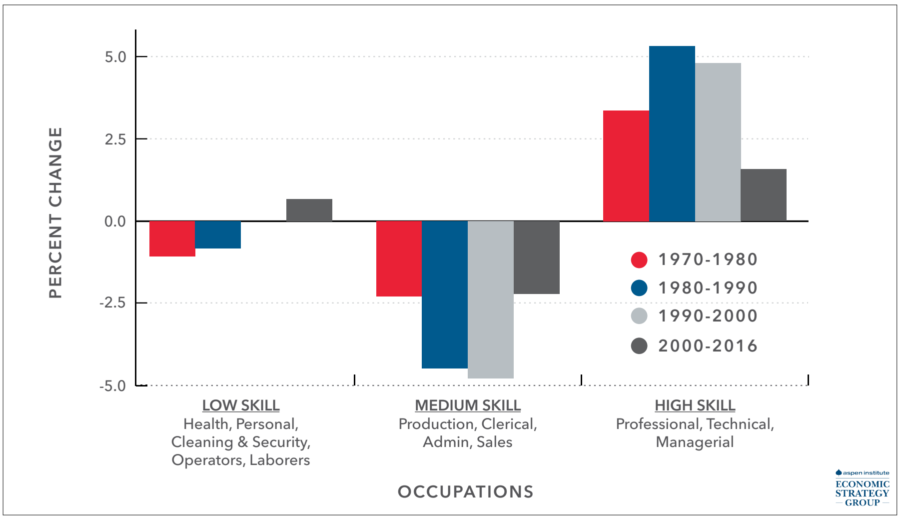
Perhaps more concerning to Americans than inequality statistics are visible losses of the jobs that have traditionally been stable, well-paying sources of employment for non-college-educated workers. Autor, Katz, and Kearney (2006) study *job polarization*. Suppose that technology makes it possible to replace workers at routine cognitive tasks (e.g., a bank clerk or a bookkeeper) and workers at routine manual tasks (production line work). Technology may also be complimentary to the skills of non-routine, high-cognitive jobs, such as managers and computer programmers, and may not substitute for lower-skill, service-sector jobs, such as retail and food service. The result is a loss of middle-skill jobs and growth of high- and low-skill jobs.

Autor, Katz, and Kearney (2006) and many subsequent papers, including Autor (2010), find evidence of job polarization. Autor, Katz, and Kearney (2006) also show large gains in the number of high-skill jobs, losses in middle-skill jobs, and small gains in the share of the lowest-skill jobs.

Autor (2019) groups occupational categories into three skill levels (Figure 4) and shows the change in the employment share of each skill group for each decade from the 1970s through the 2010s. Middle-skill occupations such as production, clerical, admin, and sales workers declined as a share of all employment by about 2.5 to 5 percentage points each decade[6]. Meanwhile, high-skill jobs, such as technicians, professionals, and managers were gaining share at a slightly faster rate, perhaps by 3 to 5.3 percentage points each decade. But interestingly in this latest analysis by Autor, low-skill jobs were *decreasing* as a share of all jobs each decade during the 1970s and 1980s, and only saw modest (1 percentage point) increases in the 2010s.

Thus, when we look at the labor market as a whole (including college and non-college-educated workers), job polarization is not extreme. As Autor notes, Figure 4 is not worrying since we see movement toward high-skill jobs and away from low- and middle-skill jobs. However, when Autor splits the data by non-college- versus

Figure 4. Job Polarization



Note: This figure is reproduced from Autor (2019), Figure 4.

6 The numbers in Figure 4 are the change in share of total hours worked that falls into each of three skill categories (low, middle, and high). Skill is determined by median wages in the occupation in 1980.

college-educated workers, we see worrying polarization among non-college workers. As Autor describes in this volume, these workers are transitioning from middle-skill to lower-skill occupations. Autor demonstrates that non-college-educated workers saw increases in the share of low-skill jobs by 3.0–3.5 percentage points *each* decade in the 1980s, 1990s, and 2000s.

4. Robots, Trade, the China Shock, and the Decline of Manufacturing Jobs

The job polarization literature is closely tied to recent work on trade shocks, automation, and industrial robots. As Abraham and Kearney (2018) demonstrate, it is likely that international trade and automation are chief causes for the elimination of jobs. They find that of the 4.5 percentage point decline in employment to population during 1999 to 2016, a full 1.04 percentage points is attributable to import competition from China while 0.37 percentage points is attributable to industrial robots.

Imports from China lead to a major shock to the number of manufacturing workers in the United States. During the period 2000 to 2007, the share of all U.S. spending on Chinese imports jumped from 2 percent to almost 5 percent. By 2018, the United States was importing $558 billion worth of goods and services each year (USTR, n.d.). In a study of commuting zones containing industries that are differentially exposed to trade competition with China, Autor, Dorn, and Hanson (2013), conclude that between 2000 and 2007, the more exposed commuting zones (at the 75th percentile of exposure) experienced lower employment growth by 0.8 percentage points and lower wage growth by 0.8 percentage points relative to commuting zones in the 25th percentile of trade competition exposure. Chinese import penetration has increased significantly in the 12 years from 2007 to 2019. Residents of the more affected commuting zones are also 2 to 3.5 percentage points more likely to receive federal assistance in the form of unemployment insurance (UI), Social Security Disability Insurance (SSDI), Supplemental Security Income (SSI), Temporary Assistance to Needy Families (TANF), or Supplemental Nutritional Assistance (SNAP).

Acemoglu and Restrepo (2017) use data on the presence of industrial robots across commuting zones to estimate the impact of robot penetration on employment and earnings. They document that from 1993 to 2007, robots in the United States rose from 0.4 robots per thousand workers to 1.4 per thousand. Importantly 39 percent of these robots were in auto manufacturing and 19 percent in electronics. Acemoglu and Restrepo use the cross-commuting zone variation in robot introduction to estimate that the introduction of robots reduced the employment-to-population ratio in the average commuting zone by 0.34 percentage points, and reduced wages by 0.5 percentage points during 1993 to 2007. These are substantial impacts and could suggest that larger impacts are on the way as automation further ramps up.

5. Slow or Negative Growth in Wages

Greenstone and Looney (2011) is one of several papers showing that real wages for non-supervisory and production workers declined in the 1980s and only recently surpassed the 1979 level. In Figure 5, I show the graph of real wages for production and non-supervisory workers expressed in 2020 dollars. Here I use the standard Consumer Price Index (CPI) inflator to convert wages to 2020 dollars. Indeed, it is not a pretty picture. Wages fall in real terms through 1995 and then begin to grow, only recently regaining the 1979 peak.

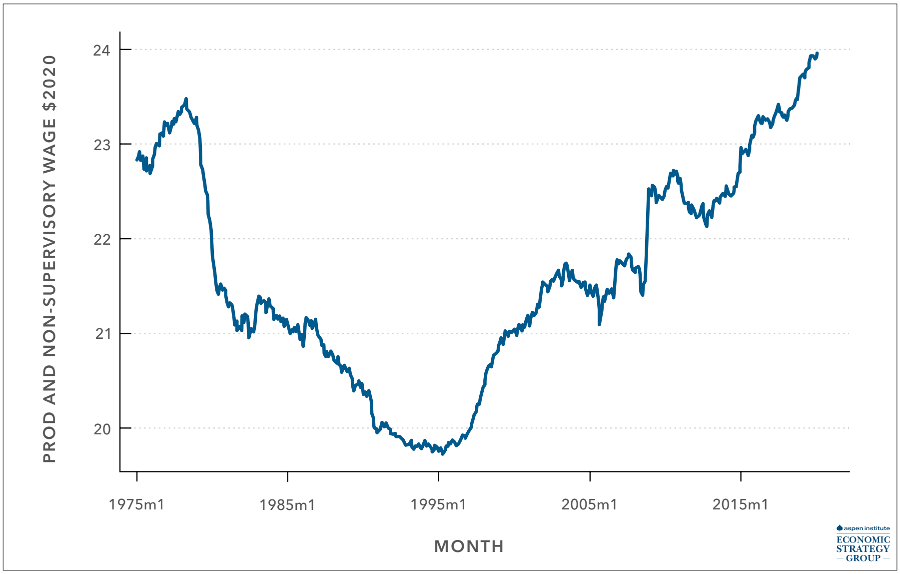
This picture is likely driven in part by the loss of middle-skill jobs and union jobs to automation and trade, as discussed above. The picture looks significantly less bad when we consider that the price adjustment used to convert to 2020 dollars may be overstated. In fact, if one were to graph the series of nominal wages, one would simply see a smooth, upward-sloping line. Much of the time series variation in median real wages is driven (in a mechanical sense) by the inflation series.

Many authors (Meyer and Sullivan 2009; Broda and Weinstein 2010 and the Bureau of Labor Statistics have quantified sources and magnitudes of bias to the CPI. The Boskin Commission noted at least four sources of bias: (1) bias from failing to include new goods; (2) bias from being unable to fully adjust for the quality of goods; (3) outlet bias stemming from the availability of new and cheaper ways to procure goods (e.g., Amazon); and (4) substitution bias, which stems from holding a basket of goods and services fixed, rather than recognizing that consumers adjust their consumption bundles toward less expensive goods.

Broda and Weinstein (2010) use scanner (bar code) level consumption data to examine how consumers respond to changes in price and availability of goods. They estimate that new goods bias and quality bias together caused CPI inflation to be overstated by 0.18 percentage points per year during 1994 to 2003. Failure to account for substitution of goods adds another 0.4 percentage points of upward bias (Broda and Weinstein 2008)[7]. Costa (2001) and Hamilton (2001) each suggest that CPI is biased upward by about 1.6 percent per year from 1972 to 1994. Bils and Klenow (2001) estimate an upward bias of 2.2 percent per year.

7 These authors estimate the total CPI bias to be 1 percentage point per year. This includes 0.31 percentage points of substitution and quality bias in the non-housing service sector.

Figure 5. Real Wages of Production and Non-Supervisory Workers



Note: Data are BLS wage data for production and non-supervisory workers adjusted using the CPI for Urban consumers. Data are accessed via the St. Louis's Federal Reserve Banks FRED data retrieval tool.

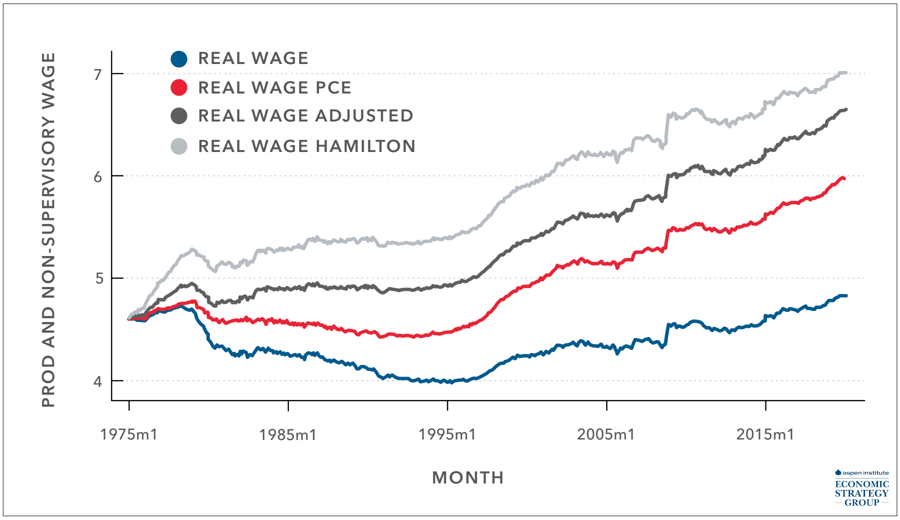
In Sacerdote (2017) I estimated real wages over time using several different methods to adjust the CPI. The results are updated through January 2020 and shown in Figure 6. The base case is the blue line, which uses the standard CPI adjustment. The red line switches the inflation adjustment from CPI to the Bureau of Labor Statistics Personal Consumption Expenditures (PCE) deflator. This is a price index that uses the change in prices for goods weighted by actual consumption in the United States, as opposed to fixing the contents of the basket. Here real wages grow by 29.5 percent from 1975 to 2020. The dark gray line assumes that CPI inflation is always overstated by 20 percent.[8] In that scenario, real wages grow by 44 percent from 1975 to 2020. Finally the light gray line uses the Hamilton/Costa method of adjustment, which relies on changes in food's share of the household budget to back out true changes in real income and hence CPI bias.[9] Using the method employed by Hamilton and Costa, real wages grew by 52 percent from 1975 to 2020.[10]

8 By this I mean I multiply the actual change in the CPI by 0.80.

9 Hamilton (2001) and Costa (2001) use the fact that changes in the non-food share of households budgets can be explained by (a) changes in the price of food and non-food, and (b) real income changes. CPI bias is estimated as the adjustment in CPI to make real income growth align with the rise (fall) in the non-food share of the household budget. If prices remained constant and the non-food share rose by 10 percent, then real incomes must have risen by 0.10/(elasticity of non-food share to income). The CPI adjustment (bias) is the change to CPI needed to make this identity hold.

10 Meyer and Sullivan (2009) find that accounting for CPI bias (and also for federal tax policy) leads to substantial declines in the poverty rate from 1960 to 2005.

Figure 6. Real Wage as Published and Adjusted



Note: The blue line shows the real wage deflating by the published CPI. The red line deflates using Bureau of Labor Statistics chain weighted PCE index, which allows the consumption bundle to change based on total consumption in the economy. The dark gray line assumes that CPI inflation is consistently overstated by 20 percent. The light gray line uses the Hamilton/Costa method to calculate (and remove) bias in the CPI.

Using this last (and largest) adjustment, I conclude that real wages grew by about 1.5 percent per year during 1996–2005, and 0.8 percent per year during 2006–2020. During the previous decade (1996–2005), real wage growth is substantially less than the growth in real GDP per capita of 2.3 percent.[11] For the most recent decade ending in July 2019, real wage growth has also been below the real annual GDP growth of 1.5 percent. Meyer and Sullivan (2009) conclude that the measured poverty rate in the United States is also substantially lower after accounting for CPI bias.

6. Growth in Consumption

If median wages are growing, what about the consumption of middle-income households? I provide some answers using data from the Bureau of Labor Statistics' Consumer Expenditure Survey. Results are shown in Table 2. I use two-person households as a simple way to eliminate variance from changes in household size. I divide the sample into households in the bottom income quintile, quintiles two through four (the middle class), and the top quintile. The top panel of Table 2 shows

11 Author's calculations from Bureau of Economic Analysis data.

consumption in 2018 dollars for quintiles two through four. I also report the implied annual growth rates between 1960 to 1986 and 1986 to 2018. In the lower panel I report the annual growth rates for only the bottom and top quintiles.

In column 1, I use the CPI to convert to 2018 dollars and report for various years (a) total expenditures; (b) spending on the necessities of food apparel health and utilities; (c) housing alone; and (d) food. Using the CPI, total real expenditures for the middle class have grown 0.80 percent per year in the earlier period and 0.55 percent per year in the more recent period. Consumption rose from $35,000 per year in 1960 to $51,800 per year in 2018. The picture looks rosier in column 2, when I inflate spending using the Hamilton/Costa method to adjust CPI.[12] Here consumption for middle-income Americans grows by 3 percent per year during 1960 to 1986 and 2 percent per year from 1987 to 2018.

Turning to individual components of consumption, housing expenditures (column 4) grew by 3 percent per year in the earlier period and 0.11 percent per year in the later period. Food expenditures (column 5) grew significantly less rapidly than total expenditures. The reduced budget share of food is consistent with the idea that American incomes are growing and that the real costs of housing and healthcare have risen.

In the remaining rows of Table 2, I report growth rates in real consumption for the bottom quintile and for the top quintile. The results are somewhat surprising but consistent with Kopczuk, Saez, and Song's 2010 analysis of income growth. Consumption for the lowest quintile has grown faster than for the middle class. Consumption growth for the highest quintile during the most recent 32 years has been 1.33 percent per year (using CPI inflation), which is 2.4 times the analogous rate of growth for the middle class. In 1986, consumption for the top quintile was 1.6 times that of the middle class. By 2018, this ratio expanded to 2.0, according to my calculations.

One concern discussed in this volume by Daniel Silverman is that the consumption of middle-class households may be highly variable since individual income is so volatile and households maintain very small liquidity buffers. He finds that while consumption of middle-class households does respond strongly to temporary shocks, these households also have a wide variety of mechanisms to partially smooth out such shocks, including delaying payment of bills and increasing reliance on government transfers.

12 Recall that the smaller (debiased) inflation estimates imply that historical real consumption was lower measured in 2018 dollars and hence more of the growth in reported consumption is real growth as opposed to price index growth.

Table 2: Consumer Expenditure Survey Expenditures Over Time: Two-Person Households In Middle Two Quintiles of Income

YEAR	TOTAL EXPENDITURES (CPI INFLATION)	TOTAL EXPENDITURES (HAMILTON INFLATION)	FOOD, CLOTHING, HOUSING,HEALTH, & UTILITIES (CPI INFLATED)	HOUSING (CPI INFLATED)	FOOD (CPI INFLATED)
1960	35,328	22,860	18,948	7,062	8,623
1972	40,335	27,350	19,614	8,696	8,709
1986	43,437	38,057	26,316	16,253	6,695
1996	45,028	42,467	26,776	16,009	7,246
2006	50,132	50,138	27,562	17,100	7,021
2018	51,803	51,810	27,743	16,834	7,689
Annualized Growth 1960–1986	0.80%	1.98%	1.27%	3.26%	-0.97%
Annualized Growth 1986–2018	0.55%	0.97%	0.17%	0.11%	0.43%
GROWTH FIGURES FOR BOTTOM 20%					
Annualized Growth 1960–1986	1.85%	3.05%	2.38%	4.92%	-0.08%
Annualized Growth 1986–2018	1.75%	2.17%	1.02%	0.85%	1.47%
GROWTH FIGURES FOR TOP 20%					
Annualized Growth 1960–1986	0.20%	1.38%	1.13%	3.11%	-1.36%
Annualized Growth 1986–2018	1.33%	1.75%	0.44%	0.38%	0.79%

Note: This table shows annual CEX expenditures for two-person households within the middle two quintiles of income. All figures are in 2018 dollars. Column 1 uses CPI inflation. Column 2 uses CPI but adds bias adjustments of Hamilton and Costa. Columns 2-5 use CPI inflation for each relevant category of expenditure. The lower two panels show the growth in consumption for the bottom and top quintiles of income.

A different way to examine consumption for households at various parts of the income distribution is to look at the growth in the number of cars owned by households, or at homeownership, or at the number of bedrooms in one's home. Figure 7 uses Census data to show cars per household for the bottom quintile of household income, the middle class, and the top quintile of household income. All three lines grow slowly and roughly in parallel over time.

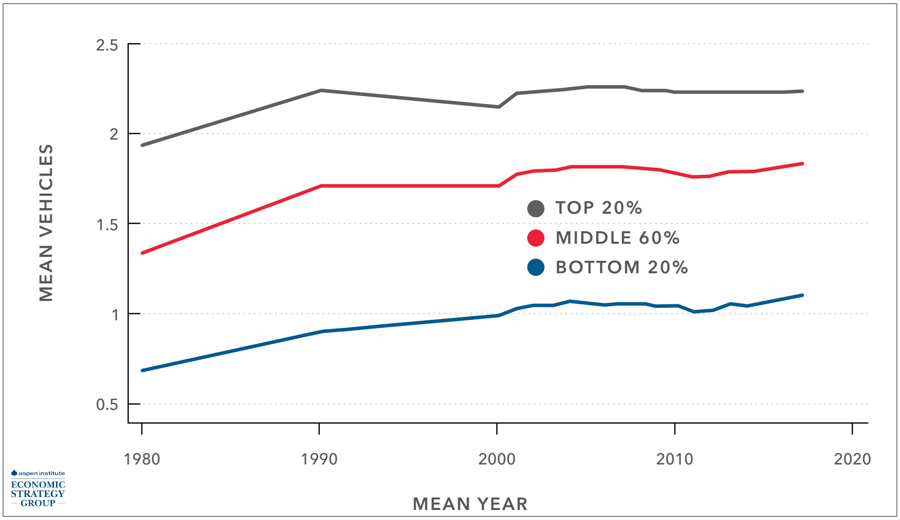
In 1980, middle-class households averaged fewer than 1.5 cars per household. This rose to 1.8 cars per household in 2017. These figures do not adjust for the decline in average household size, though the average household size has been roughly two since 1989. Cars per household show similar patterns for the highest and lowest income quintiles. The highest quintile showed modestly slower growth than the other two categories.

The number of bedrooms per household (Figure 8) also shows slow growth. For middle-class households, the number of bedrooms grew from 2.5 in 1980 to 2.8 in 2017. These data include both renters and owners.

One well-defined measure of consumption is whether or not households own their own home. Homeownership for the middle class has only seen modest changes during 1980 to 2018. In 1980, 64 percent of middle-class households owned a home. This percentage rose during the housing bubble, as shown in Figure 9, peaking at around 75 percent during 2007 to 2009. Homeownership then declined modestly to end at 71 percent in 2017.

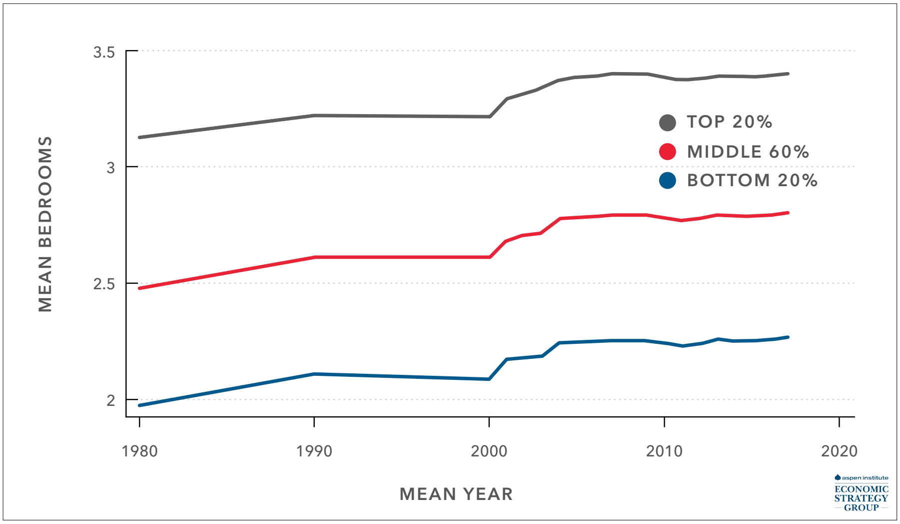
This graph does not support the contention that the dream of homeownership has become newly out of reach. At the same time, there is no evidence of growth in homeownership. Given the transactions costs (and reduced mobility) that come with owning, there are many households for which renting delivers higher utility than owning. It's possible that the United States has reached some long-run "natural rate" of homeownership.

Figure 7. Mean Vehicles by Household Income



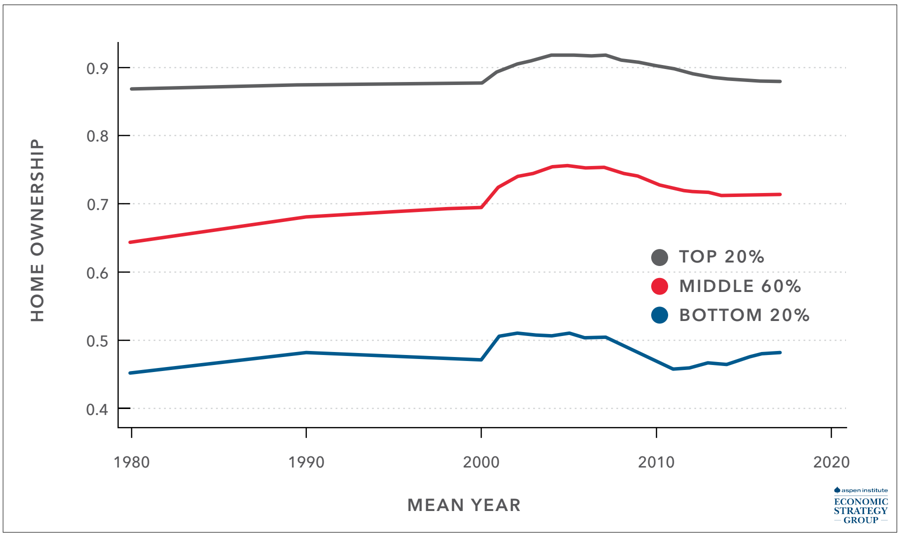
Note: Vehicles per household over time, based on Census and ACS data. Top 20 percent of households, ranked by household income, middle 60 percent, bottom 20 percent.

Figure 8. Mean Bedrooms by Household Income



Note: Bedrooms Per Household: Census and ACS data. Top 20 percent of households ranked by household income, middle 60 percent, bottom 20 percent.

Figure 9. Mean Home Ownership by Household Income



Note: Home ownership measured in Census and American Community Survey data. Top 20 percent of households ranked by household income, middle 60 percent, bottom 20 percent.

Finally, I ask whether middle-income families are more likely to have their young adult children enrolled in college. Results are shown in Figures 10 and 11. Figure 10 uses the CPS October data and shows the fraction of household members aged 16–24 who completed high school within the same calendar year *and* are currently enrolled in two-year colleges or four-year colleges and universities. I show separate lines for low, middle, and high-income families. Figure 10 makes clear that children from all levels of family income have seen steady growth in the likelihood of college enrollment from 1975¬ to 2017. All three lines grow roughly in parallel, though there is some evidence that low- and middle-income rates of college enrollment are converging slightly toward rates of enrollment for high-income families. Mean enrollment rates for high school completers in middle-income families were 65 percent by 2016. This comes with the important caveat that this analysis only measures college enrollment rates among families in which the child is counted as living at home.

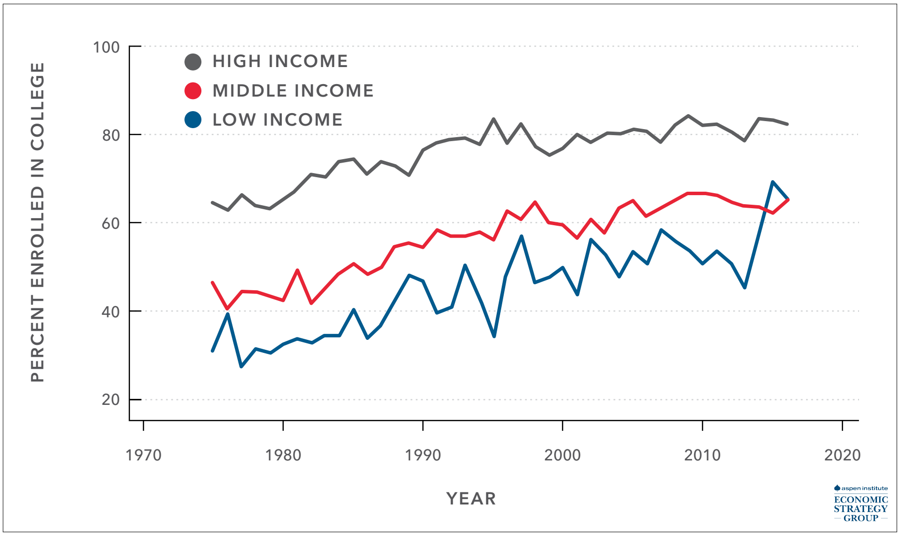
Figure 11 uses the ACS/Census data and conducts a similar analysis. In Figure 11, I limit the sample to families with young adults aged 19 to 22 living with their parents. I then sum up across households within each income category to measure the fraction of the young adults (19–22) who are enrolled in college. As in the CPS data, rates of college enrollment grew sharply for these young adults. And college enrollment rose more quickly among the lowest and middle quintiles than among young adults in the upper quintile of family income. One difference between Figure 10 and 11, is that in the latter, I do not limit the sample to newly minted high school graduates. This explains the lower average enrollment rate in Figure 11.

7. Costs of Higher Education

A widespread concern for middle-class families is the rising real cost of undergraduate education. Indeed, costs of attendance have gone up significantly, though not by as much as the public perceives. There is significant confusion between sticker price and average net cost of attendance (Levine, Ma, and Russell 2020). The College Board's *Trends in College Pricing* is a comprehensive source for time series data on sticker and net prices for tuition, fees, and room and board for public and private institutions. Consider the real increase in net tuition and fees at *four-year public institutions*. During the 1999–2000 school year, net tuition and fees averaged only $1,800 in 2019 dollars. This more than doubled to $3800 by 2018–2019 but from a low base price. Net tuition, fees, and room and board (together) rose from $9000 in 1999–2000 to $15,000 in 2018–2019, a 67 percent increase.

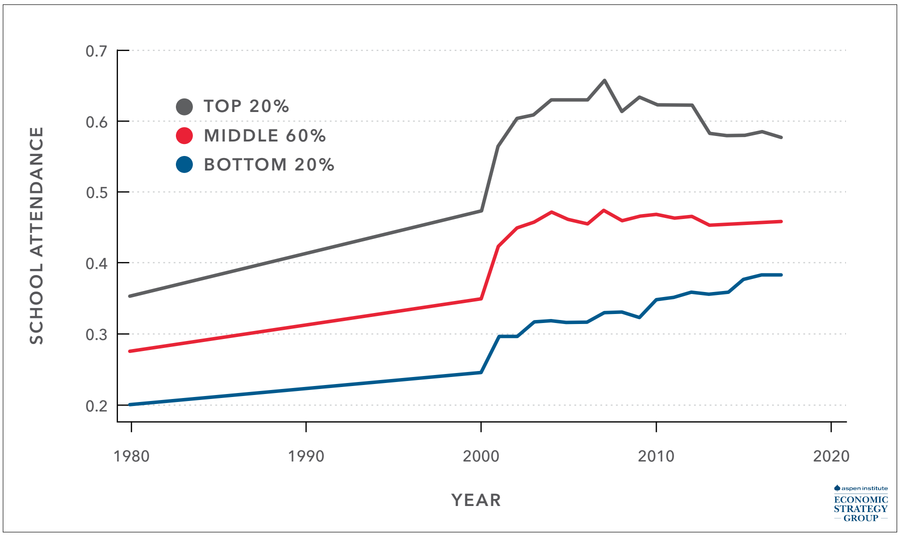
Two-year public institutions remain quite affordable once Federal Aid, including the Pell Grant, is taken into account. In 1999–2000, the average student at a two-year

Figure 10. Annual College Enrollment of Recent High School Graduates



Note: October Current Population Survey data are used to measure enrollment rate in two- and four-year post-secondary institutions. Sample includes young people ages 16–24 who completed high school within the current calendar year. These means are reported by the National Center for Education Statistics in the 2017 Digest of Educational Statistics.

Figure 11. Fraction of Young Adults Enrolled in College



Source: Census and ACS data.

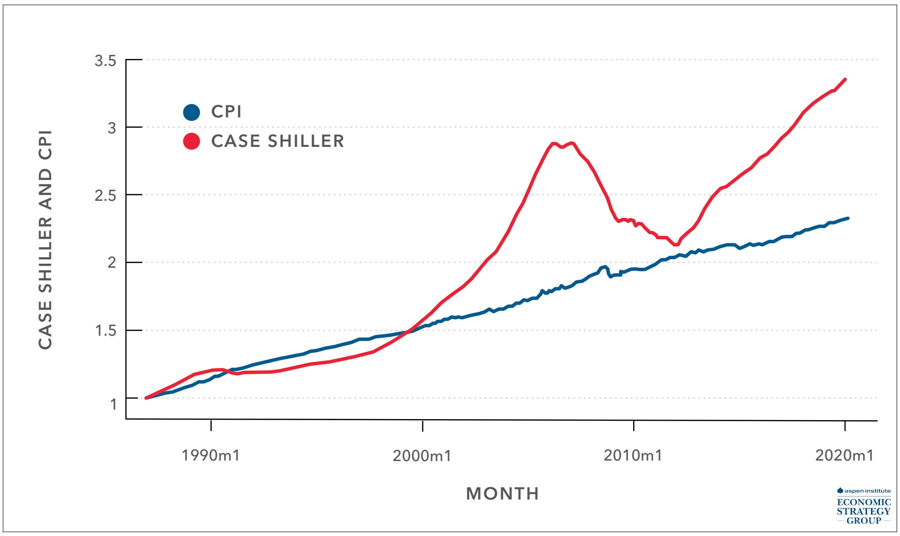
Note: We take the sample of households containing parents and their young adult children ages 19–22. We report the fraction of young adults 19–22 who are enrolled in college.

public institution paid net tuition and fees of $0. By 2018–2019, this *fell* to -$460, meaning that, on average, students were receiving refund checks to offset some living expenses.

8. Costs of Housing

There is no question that the real cost of housing has risen significantly. In Figure 14, I show the trend lines for the nominal Case Shiller Home Price Index. In short, housing is up by a factor of 4.4, whereas prices are only up by a factor of 2.2. Note that this rapid house price growth occurred after 2000. It occurred largely on the coasts, meaning that the 46 percent of the U.S. population that does not live in the East or West Coast states is much less affected by rising home prices. Of course, that means that for the people who do live on the coasts, the price run up effect is likely twice as severe as the national average. It is worth noting that home price increases are also a newfound source of wealth for middle-class families that do own a home.

Figure 12. Growth in the Case Shiller Home Price Index and Growth in the CPI, 1987-2020



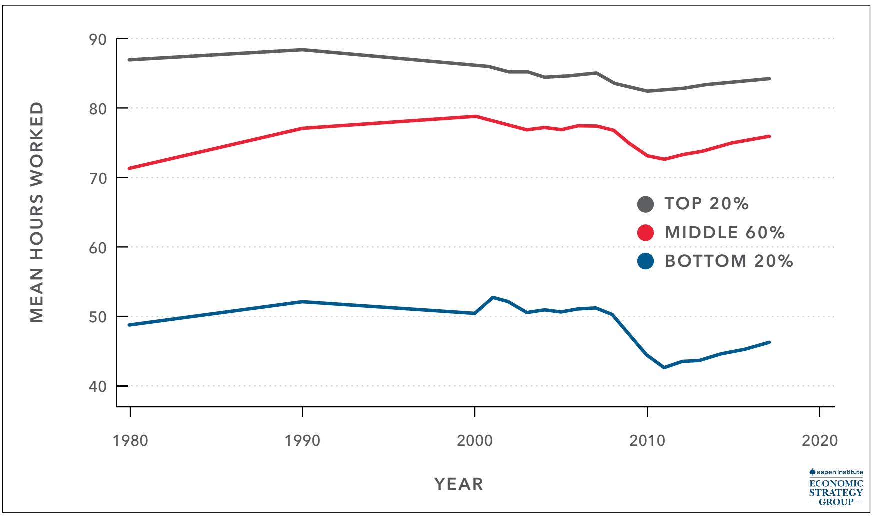
Source: S&P Dow Jones Indices LLC

9. Growth and Widening in the Income Distribution

As described in Figure 1, I compare the household distributions of income in 1980 and 2017. Both series are inflated to 2019 dollars using the CPI. To make the histograms readable, I limit the displayed portion of the graph to households with incomes between $0 and $200,000. The 1980 distribution is in blue and the 2017 distribution is in red. Areas where the distributions overlap appear as purple. From 1980 to 2017, there has been significant movement of households from incomes of $6,000 to $78,000 toward incomes above $78,000, all expressed in 2019 dollars. As Thurow and the OECD note, the shape of the income distribution is changing with less concentration around the median income. But as Hunt and Nunn show, this shift is due to the presence of more higher-income households, not a bifurcation into high- and low-income groups.

An important question is whether the rise in household income is driven by people in each household working more hours in formal employment. A common concern about the rise in earnings is that it may derive from more households having two full-time earners and from people having to hold multiple jobs to make ends meet. Figures 12 and 13 suggest that at least on average this is not the case. I limit the sample to households that have two working age adults (25–64 years old). These households may contain any number of children or older household members. In

Figure 13. Mean Hours Worked per Week for Two-Person Households



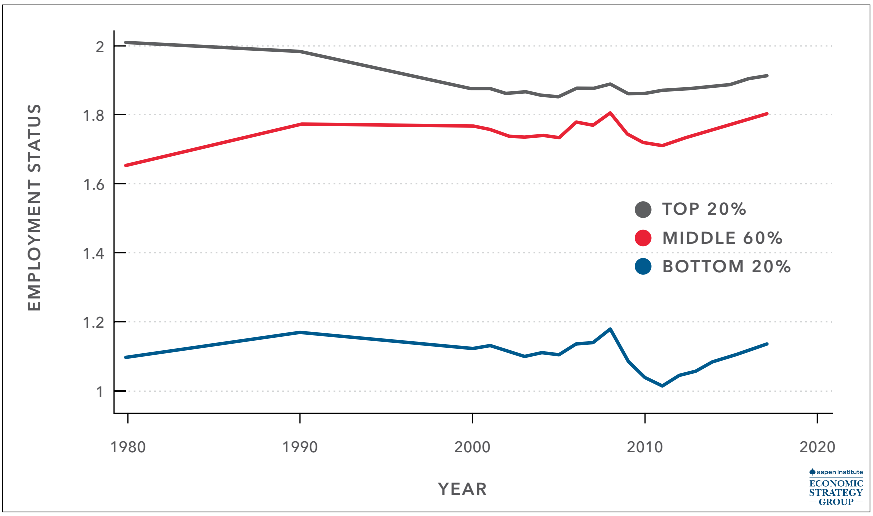
Source: Author's calculations from American Community Survey and Census microdata.

Figure 12, I plot the average (across households) of mean weekly hours worked by the household, where I sum across both members of the household. Total hours worked by the average household has fallen slightly since 2000. This is consistent with Alesina, Glaeser, and Sacerdote (2005), who document the long-run time trends in hours worked in the United States and Europe.

Jones and Klenow (2016) show that the United States and France have very different levels of average market income, but likely quite similar levels of utility. The French are working 535 hours per person per year (including all people), versus 877 per person in the United States. And life expectancy at birth in France is three years higher.

If I instead look at the average number of people working (among the two working age adults in my sample), the number working has followed a modestly different pattern than total hours averaged across households. This is shown in Figure 13. The statistic being graphed is the number of people (of a possible 2.0) who are employed. This is then averaged across households. The red line represents the middle three income quintiles. From 1980 to 2000, this number shows a steady rise from 1.65 to 1.77 workers per household. The number dips with the Great Recession and then rises further in the 2019 "hot" (pre-COVID) labor market.

Figure 14. Mean Employment Status within Two-Person Households



Source: Author's calculations from American Community Survey and Census microdata.

10. Declines in Happiness and Life Expectancy

Blanchflower and Oswald (2004) point out that even when incomes are rising, happiness can be flat or even falling. That could be the case with the U.S. middle class. Blanchflower and Oswald (2019) show that measured levels of happiness in the United States have been declining modestly since 1989. Their self-reported happiness index takes on the levels of very happy (3), pretty happy (2), or not very happy (1). For Americans with exactly a high school diploma, the index fell from about 2.2 in 1989 to 2.1 in 2016. To make this decline easier to interpret, they also report the fraction of high school grads responding with the lowest category (not very happy). This fraction increased from about 12 percentage points in the 1980s to 15 percentage points in 2016. There was also a very slight negative trend for Americans with some college or more. The trend in happiness for high school dropouts is particularly negative, but the authors point out that the composition of the high school dropout category has been changing very rapidly from the 1980s to present time.

Related to this decline in happiness is the rise in mortality among non-Hispanic whites aged 45–54, discussed by Case and Deaton (2017). After many decades of increasing life expectancy, American non-Hispanic whites saw increases in mortality from (very roughly) 380 per 100,000 in 1999 to 410 per 100,000 in 2013. This is equivalent to an additional 7,000 deaths per year relative to if mortality had remained constant at its 1999 level. For an individual person aged 45–54, this is a relatively modest absolute increase in the risk of dying, i.e. a 0.0004 (.04%) risk became a 0.00044 risk. However, it is a large increase in percentage terms, and a reversal of a longstanding positive trend. The typical middle aged, middle-class person still has a very low risk of death, but death is obviously an extreme outcome, and this is a warning sign of falling happiness and utility more broadly. The bad news is concentrated among individuals whose highest level of educational attainment is high school or less.

However, this trend toward lower life expectancy has recently reversed. The latest briefings from the National Center for Health Statistics (which contain data through 2018) show declines in drug-related deaths and increases in life expectancy at birth averaged across all Americans (Xu et al. 2020).

Conclusion

The middle class continues to outlive the epitaphs that are written for it. Many authors reflect on the shrinking or growing of the number of households in the middle class. However, this exercise may not be that meaningful if it amounts to fixing an income range and then simply asking whether more or fewer people fall within that range in a subsequent year. In this chapter I show that income in the United States is not becoming bifurcated into the rich and the poor. Instead the important phenomena are those that have been discussed by Piketty and Saez, Auten and Splinter (2018), Kopczuk, Saez, and Song (2010), Chetty et al. (2017) and Chetty et al. (2014). Specifically, there has been significant pre-tax income growth at the top of the distribution. This growth at the high end means that the middle of the distribution has experienced lower pre-tax income growth than mean growth or GDP per capita growth. Looney, Larrimore, and Splinter (2020) show that fiscal policies have partially offset this differential pre-tax growth. Importantly the gap between the 80th and 50th percentiles has only widened modestly since 1980, and the 20th percentile of earnings has actually gained ground relative to the median.

While wage growth and median household income have underperformed the economy from 1980 to 2019, the growth in these two metrics has still been positive. Changes in consumption are potentially more interesting than changes in income; measuring actual units of housing, cars, and higher education consumed eliminates some of the price index problems and tax and transfer measurement questions that plague real income measurement. As noted above, homeownership among households in the middle of the distribution has remained flat. The number of bedrooms in the dwellings of middle-income households has risen by about 10 percent, while the number of cars owned by those households has risen from an average of 1.5 cars to 2.0 cars. And college enrollment has increased significantly for the middle class (and all families) since 1980.

More concerning are the facts that the positive time trend in happiness has leveled off and maybe declining. And longevity did have a recent decline in specific age and race categories, namely non-college-educated whites aged 45–54.

The elimination of many middle-skill jobs during the last 40 years is an important phenomenon that has had a profound impact on individual families and communities. Occupational polarization does not appear to be causing income polarization (Hunt and Nunn 2019) but rather is a force for slower income growth in the lower half of the income distribution. Since 1980, households in the middle of the income distribution have undergone significant change and upheaval in the labor markets. On average, these households have been able to maintain and grow consumption, though possibly their mental health and happiness has declined. The question for the coming decades is whether the trend towards higher income inequality will abate and whether middle-income households will be successful in responding to labor market shifts by changing occupations, moving geographically, and investing even more deeply in human capital.

The COVID-19 recession presents an entirely new and severe challenge that is worse for low- and moderate-income families; ideally the epidemic and accompanying recession will be a short run phenomenon that does not reverse the positive trends discussed in this chapter.

Chetty et al. (2017) finds that a combination of rising inequality and slower growth has significantly reduced the probability that children are better off than their parents. Hopefully with sufficient investment in communities and in human capital, this lack of absolute upward mobility will reverse itself.

References

Abraham, K.G., and Melissa S. Kearney. 2018. "Explaining the Decline in the U.S. Employment to Population Ratio: A Review of the Evidence." NBER Working Paper No. 24333, National Bureau of Economic Research.

Acemoglu, Daron. 2000. "Technical Change, Inequality, and the Labor Market." Working Paper No. 7800, National Bureau of Economic Research. http://www.nber.org/papers/w7800.

Acemoglu, Daron, and Pascual Restrepo. 2017. "Robots and Jobs: Evidence from US Labor Markets." Working Paper No. 23285, National Bureau of Economic Research. http://www.nber.org/papers/w23285.

Aguiar, Mark, and Mark Bils. 2015. "Has Consumption Inequality Mirrored Income Inequality?" *American Economic Review* 105(9): 2725–56. https://doi.org/10.1257/aer.20120599.

Alderson, Arthur S., Jason Beckfield, and François Nielsen. 2005. "Exactly How Has Income Inequality Changed?: Patterns of Distributional Change in Core Societies." *International Journal of Comparative Sociology*, 46, no. 5–6(Dec): 405–23. https://doi.org/10.1177/0020715205059208.

Alesina, Alberto, Edward L. Glaeser, and Bruce Sacerdote. 2005. "Work and Leisure in the U.S. and Europe: Why So Different?" Working Paper No. 11278, National Bureau of Economic Research. http://www.nber.org/papers/w11278.

Appelbaum, Binyamin. 2012. "Family Net Worth Drops to Level of Early '90s, Fed Says." *The New York Times,* June 11, 2012. NYTimes.com, https://www.nytimes.com/2012/06/12/business/economy/family-net-worth-drops-to-level-of-early-90s-fed-says.html.

Atkinson, Anthony B., and Andrea Brandolini. 2013. "On the Identification of the Middle Class." *Society for the Study of Economic Inequality*, 77–100.

Atkinson, Anthony, Thomas Piketty, and Emmanual Saez. 2011. "Top Incomes in the Long Run of History." *Journal of Economic Literature* 49(1): 3–71.

Attanasio, Orazio, Erich Battistin, and Hidehiko Ichimura. 2004. "What Really Happened to Consumption Inequality in the US?" Working Paper No. 10338, National Bureau of Economic Research. http://www.nber.org/papers/w10338.

Austin, Benjamin A., Edward L. Glaeser, Lawrence H. Summers. 2018. "Jobs for the Heartland: Place-Based Policies in 21st Century America." Working Paper No. 24548, National Bureau of Economic Research.

Auten, Gerald, and David Splinter. 2017. "Income Inequality in the United States: Using Tax Data to Measure Long-Term Trends." Unpublished manuscript. http://davidsplinter.com/AutenSplinter-Tax_Data_and_Inequality_2017.pdf.

---. 2019. "Top 1 Percent Income Shares: Comparing Estimates Using Tax Data." AEA Papers and Proceedings, American Economic Association, 109: 307–11.

Autor, David H. 2008. "Trends in U.S. Wage Inequality: Revising the Revisionists." *The Review of Economics and Statistics* 90(Feb): 300–23. https://doi.org/10.1162/rest.90.2.300.

---. 2010. "The Polarization of Job Opportunities in the US Labor Market: Implications for Employment and Earnings." *Community Investments* 23(Jan): 11–16.

---. 2014. "Skills, Education, and the Rise of Earnings Inequality among the 'Other 99 Percent.'" *Science* 344, no. 6186(May): 843. https://doi.org/10.1126/science.1251868.

---. 2015. "Why Are There Still So Many Jobs? The History and Future of Workplace Automation." *Journal of Economic Perspectives* 29(3): 3–30. https://doi.org/10.1257/jep.29.3.3.

---. 2019. "Work of the Past, Work of the Future." Working Paper No. 25588, National Bureau of Economic Research. http://www.nber.org/papers/w25588.

---. 2020. "The Faltering Escalator of Urban Opportunity" In *Securing Our Economic Future*, edited by Amy Ganz and Melissa Kearney, Aspen Institute Press.

Autor, David H., and David Dorn. 2009. "The Growth of Low Skill Service Jobs and the Polarization of the U.S. Labor Market." Working Paper No. 15150, National Bureau of Economic Research. http://www.nber.org/papers/w15150.

Autor, David H., David Dorn, and Gordon H. Hanson. 2013. "The China Syndrome: Local Labor Market Effects of Import Competition in the United States." *American Economic Review* 103(6): 2121–68. https://doi.org/10.1257/aer.103.6.2121.

---. 2016. "The China Shock: Learning from Labor-Market Adjustment to Large Changes in Trade." *Annual Review of Economics* 8(1): 205–40. https:// doi.org/10.1146/annurev-economics-080315-015041.

Autor, David H., and Michael J. Handel. 2013. "Putting Tasks to the Test: Human Capital, Job Tasks, and Wages." *Journal of Labor Economics* 31(2): S59–96. https://doi.org/10.1086/669332.

Autor, David H., Lawrence F. Katz, and Melissa S. Kearney. 2006. "The Polarization of the U.S. Labor Market." *American Economic Review* 96(2): 189–94. https://doi.org/10.1257/000282806777212620.

Autor, David H., Frank Levy, and Richard J. Murnane. 2003. "The Skill Content of Recent Technological Change: An Empirical Exploration." *The Quarterly Journal of Economics* 118(4): 1279–333.

Bakija, Jon, Adam Cole, and Bradley T. Heim. 2012. "Jobs and Income Growth of Top Earners and the Causes of Changing Income Inequality: Evidence from US Tax Return Data."

Battistin, Erich. 2003. *Errors in Survey Reports of Consumption Expenditures.* IFS Working Papers, Institute for Fiscal Studies (IFS).

Berman, Yonatan. 2020. *The Distributional Short-Term Impact of the COVID-19 Crisis on Wages in the United States.* MPRA Working Paper No. 100466, University Library of Munich, Germany. https://ideas.repec.org/p/pra/mprapa/100466.html.

Bils, Mark, and Peter J. Klenow. "Quantifying quality growth." *American Economic Review* 91, no. 4 (2001): 1006-1030.

Bischoff, Kendra, and Sean F. Reardon. 2014. “Residential Segregation by Income, 1970–2009.” In *Diversity and Disparities: America Enters a New Century,* edited by John Logan. New York: The Russell Sage Foundation.

Blanchflower, David G. 2020. “Is Happiness U-Shaped Everywhere? Age and Subjective Well-Being in 132 Countries.” Working Paper No. 26641, National Bureau of Economic Research.

Blanchflower, David G., and Andrew J. Oswald. "Well-being over time in Britain and the USA." *Journal of public economics* 88, no. 7-8 (2004): 1359–1386.

Blanchflower, David G., and Andrew J. Oswald. 2008. “Is Well-Being U-Shaped over the Life Cycle?” *Social Science & Medicine*, 66, no. 8(Apr): 1733–49. https://doi.org/10.1016/j.socscimed.2008.01.030.

Blanchflower, David G, and Andrew J. Oswald. 2019. “Unhappiness and Pain in Modern America: A Review Essay, and Further Evidence, on Carol Graham’s Happiness for All?” *Journal of Economic Literature* 57(2): 385–402.

Boskin, Michael J., Ellen L. Dulberger, Robert J. Gordon, Zvi Griliches, and Dale W. Jorgenson. 1998. “Consumer Prices, the Consumer Price Index, and the Cost of Living.” *Journal of Economic Perspectives* 12(1): 3–26. https://doi.org/10.1257/jep.12.1.3.

Broda, Christian, and David E. Weinstein. 2010. “Product Creation and Destruction: Evidence and Price Implications.” *American Economic Review* 100(3): 691–723. https://doi.org/10.1257/aer.100.3.691.

Buchinsky, Moshe. 1994. “Changes in the US Wage Structure 1963-1987: Application of Quantile Regression.” *Econometrica* 62, no. 2(Mar): 405–405.

Burkhauser, Richard V., Shuaizhang Feng, Stephen P. Jenkins, and Jeff Larrimore. 2012. “Recent Trends in Top Income Shares in the United States: Reconciling Estimates from March CPS and IRS Tax Return Data.” *The Review of Economics and Statistics* 94, no. 2(May): 371–88. https://doi.org/10.1162/REST_a_00200.

Card, David, and John E. DiNardo. 2002. “Skill-Biased Technological Change and Rising Wage Inequality: Some Problems and Puzzles.” *Journal of Labor Economics* 20(4): 733–83.

Case, Anne, and Angus Deaton. 2015. “Rising Morbidity and Mortality in Midlife among White Non-Hispanic Americans in the 21st Century.” *Proceedings of the National Academy of Sciences* 112 (49): 15078–83. https://doi.org/10.1073/pnas.1518393112.

Champlin, Dell P., and Janet T. Knoedler. 2008. “American Prosperity and the ‘Race to the Bottom:’ Why Won’t the Media Ask the Right Questions?” *Journal of Economic Issues* 42(1): 133–51.

Chetty, Raj, John N. Friedman, Nathaniel Hilger, Emmanuel Saez, Diane Whitemore Schanzenbach, and Danny Yagan. 2011. “How Does Your Kindergarten Classroom Affect Your Earnings? Evidence from Project STAR.” *The Quarterly Journal of Economics* 126(4): 1593–660.

Chetty, Raj, David Grusky, Maximilian Hell, Nathaniel Hendren, Robert Manduca, and Jimmy Narang. 2017. “The Fading American Dream: Trends in Absolute Income Mobility since 1940.” *Science* 356 (6336): 398–406. https://doi.org/10.1126/science.aal4617.

Chetty, Raj, Nathaniel Hendren, Patrick Kline, and Emmanuel Saez. 2014. “Where Is the Land of Opportunity? The Geography of Intergenerational Mobility in the United States.” *The Quarterly Journal of Economics* 129(4): 1553–623. https://doi.org/10.1093/qje/qju022.

Cohen, Patricia. 2015. “Middle Class, but Feeling Economically Insecure.” *New York Times,* April 10, 2015. NYTimes.com, https://www.nytimes.com/2015/04/11/business/economy/middle-class-but-feeling-economically-insecure.html.

Committee, National Bureau of Economic Research Price Statistics Review, and United States Bureau of the Budget Office of Statistical Standards. 1961. *The Price Statistics of the Federal Government: Review, Appraisal, and Recommendations; a Report to the Office of Statistical Standards, Bureau of the Budget, Together with Twelve Staff Papers*. https://books.google.ca/books?id=FykeAAAAIAAJ.

Cortes, Guido Matias, et al. “Disappearing Routine Jobs: Who, How, and Why?” *The Swiss National Bank/Study Center Gerzensee Special Issue: “Modern Macroeconomics: Study Center Gerzensee Conference in Honor of Robert G. King," Journal of Monetary Economics* 91(Nov): 69–87. https://doi.org/10.1016/j.jmoneco.2017.09.006.

Costa, Dora L. 1999. “American Living Standards: Evidence from Recreational Expenditures.” Working Paper No. w7478, National Bureau of Economic Research.

---. 2000. “American Living Standards, 1888-1994: Evidence From Consumer Expenditures.” Working Paper No. w7650, National Bureau of Economic Research. http://www.nber.org/papers/w7650.

---. 2001. “Estimating Real Income in the United States from 1888 to 1994: Correcting CPI Bias Using Engel Curves.” *Journal of Political Economy* 109(6):1288–310.

Davis, Joe C., and John H. Huston. 1992. “The Shrinking Middle-Income Class: A Multivariate Analysis.” *Eastern Economic Journal* 18(3): 277–85. JSTOR.

DiNardo, John, Nicole M. Fortin, and Thomas Lemieux. 1995. “Labor Market Institutions and the Distribution of Wages, 1973-1992: A Semiparametric Approach.” Working Paper No. 5093, National Bureau of Economic Research. http://www.nber.org/papers/w5093.

Duhigg, Charles, and Keith Bradsher. 2012. “How the US Lost out on IPhone Work.” *New York Times,* January 21, 2012.

“Economists Are Rethinking the Numbers on Inequality, Economists Are Rethinking the Numbers on Inequality.” *The Economist*, Nov. 2019. https://www.economist.com/briefing/2019/11/28/economists-are-rethinking-the-numbers-on-inequality.

Filho, Irineu de Carvalho, and Marcos Chamon. 2012. “The Myth of Post-Reform Income Stagnation: Evidence from Brazil and Mexico.” *Journal of Development Economics* 97, no. 2(Mar): 368–86,. https://doi.org/10.1016/j.jdeveco.2011.06.009.

Folbre, Nancy. 2010. “The Sagging of the Middle Class.” *Economix Blog*, June 14, 2010, https://economix.blogs.nytimes.com/2010/06/14/the-sagging-of-the-middle-class/.

Foster, James E., and Michael C. Wolfson. 2010. “Polarization and the Decline of the Middle Class: Canada and the US.” *The Journal of Economic Inequality* 8(2): 247–73.

Gale, William G. 2019. “Fiscal Policy with High Debt and Low-Interest Rates.” *Aspen Institute Economic Strategy Group.*

Gigliarano, Chiara, and Karl Mosler. 2009. "Measuring Middle-Class Decline in One and Many Attributes." *Universita' Politecnica Delle Marche (I), Dipartimento Di Economia, Working Papers*, Jan. 2009.

Goodnough, Abby, Josh Katz, and Margo Sanger-Katz. 2019. "Drug Overdose Deaths Drop in U.S. for First Time Since 1990." *New York Times,* 17 July 17, 2019. NYTimes.com, https://www.nytimes.com/interactive/2019/07/17/upshot/drug-overdose-deaths-fall.html.

Goos, Maarten, Alan Manning, and Salomons. 2014. "Explaining Job Polarization: Routine-Biased Technological Change and Offshoring." *American Economic Review* 104(8): 2509–26. https://doi.org/10.1257/aer.104.8.2509.

Gottschalk, Peter, and Timothy M. Smeeding. 1997. "Cross-National Comparisons of Earnings and Income Inequality." *Journal of Economic Literature* 35(2): 633–87. JSTOR.

Graham, Carol. 2017. *Happiness for All?: Unequal Hopes and Lives in Pursuit of the American Dream*. Princeton University Press.

Greenlees, John Shearer, and Charles C. Mason. 1997. *Overview of the 1998 Revision of the Consumer Price Index*. US Department of Labor. Bureau of Labor Statistics.

Greenstone, Michael, Adam Looney, Jeremy Patashnik, and Muxin Yu. 2013."Thirteen Economic Facts about Social Mobility and the Role of Education." *The Hamilton Project, Brookings Institution, Washington DC. Available at http://Www.Hamiltonproject.Org/Papers/Thirteen_economic_ Facts_social_mobility_education.*

Greenstone, Michael, and Adam Looney. 2011. "Have Earnings Actually Declined?" *Brookings Institution* March 4, 2011.

Greg J. Duncan, Timothy M Smeeding, and Willard Rodgers. 1991. *Whither the Middle Class'? A Dynamic View.* Levy Economics Institute. https://ideas.repec.org/p/lev/wrkpap/wp_56.html.

Griswold, Daniel T. 2020. "Fail or Flourish: American Workers, Globalization, and Automation." *Mercatus Research Paper Forthcoming*.

Gupta, Sumedha, Laura Montenovo, Thuy D. Nguyen, Felipe Lozano Rojas, Ian M. Schmutte, Kosali I. Simon, Bruce A. Weinberg, and Coady Wing 2020. "Effects of Social Distancing Policy on Labor Market Outcomes." Working Paper No. 27280, National Bureau of Economic Research. https://doi.org/10.3386/w27280.

Hamilton, Bruce W. 1998. The True Cost of Living: 1974-1991. Economics Working Paper Archive 395, Johns Hopkins University, Department of Economics.

Hamilton, Bruce W. "Using Engel's Law to estimate CPI bias." *American Economic Review* 91, no. 3 (2001): 619-630.

Harris, Abram L. 1939. "Pure Capitalism and the Disappearance of the Middle Class." *Journal of Political Economy* 47(3): 328–328. https://doi.org/10.1086/255388.

Hausman, Jerry. 2003. "Sources of Bias and Solutions to Bias in the Consumer Price Index." *Journal of Economic Perspectives* 17(1): 23–44.

Holzer, Harry. 2015. "Job Market Polarization and US Worker Skills: A Tale of Two Middles." *Economic Studies, Brookings Institution.*

Horrigan, Michael W., and Steven E. Haugen. 1988. "The Declining Middle-Class Thesis: A Sensitivity Analysis." *Monthly Labor Review* 111(5): 3–13.

Hunt, Jennifer, and Ryan Nunn. 2019. "Is Employment Polarization Informative About Wage Inequality and Is Employment Really Polarizing?" Working Paper No.26064, National Bureau of Economic Research. http://www.nber.org/papers/w26064.

Janny Scott. 2001. "In 90's Economy, Middle Class Stayed Put, Analysis Suggests - The New York Times." *New York Times*, August 31, 2001. https://www.nytimes.com/2001/08/31/nyregion/in-90-s-economy-middle-class-stayed-put-analysis-suggests.html.

Jones, Charles I., and Peter J. Klenow. 2016. "Beyond GDP? Welfare across Countries and Time." *American Economic Review* 106(9): 2426–57. https://doi.org/10.1257/aer.20110236.

Katz, Lawrence F., and David H. Autor. 1999. "Changes in the Wage Structure and Earnings Inequality." In *Handbook of Labor Economics*, Vol. 3A, edited by O. Ashenfelter and D. Card, 1463–555.

Katz, Lawrence F., and Kevin M. Murphy. 1992. "Changes in Relative Wages, 1963–1987: Supply and Demand Factors." *The Quarterly Journal of Economics* 107(1): 35–78.

Kearney, Melissa S., and Magne Mogstad. 2019. "Universal Basic Income (UBI) as a Policy Response to Current Challenges." *Aspen Institute Economic Strategy Group*, 1–19.

Kena, Grace, William Hussar, Joel McFarland, Cristobal de Brey, Lauren Musu-Gillette, Xiaolei Wang, Xiaolei, Jijun Zhang, et al. 2016. "The Condition of Education 2016. NCES 2016-144." *National Center for Education Statistics,* ERIC.

Klenow, Peter J. 2003. "Measuring Consumption Growth: The Impact of New and Better Products." *Federal Reserve Bank of Minneapolis Quarterly Review* 27(1): 10–23.

Kopczuk, Wojciech, Emmanuel Saez, and Jae Song. 2010. "Earnings Inequality and Mobility in the United States: Evidence from Social Security Data since 1937." *The Quarterly Journal of Economics* 125(1): 91–128.

Kosters, Marvin H., and Murray N. Ross. 1988. "A Shrinking Middle Class?" *Public Interest,* no. 90: 3.

Krueger, Alan. 1999. "Measuring Labor's Share." Working Paper No.7006, National Bureau of Economic Research. http://www.nber.org/papers/w7006.

Krueger, Alan B. 2017. "Where Have All the Workers Gone? An Inquiry into the Decline of the US Labor Force Participation Rate." *Brookings Papers on Economic Activity*, no. 2: 1.

Krueger, Dirk, and Fabrizio Perri. 2006. "Does Income Inequality Lead to Consumption Inequality? Evidence and Theory." *The Review of Economic Studies* 73, no. 1(Jan): 163–93. https://doi.org/10.1111/j.1467-937X.2006.00373.x.

Krugman, Paul. 2005. "For Richer." In *Critical Social Issues in American Education: Democracy and Meaning in a Globalizing World*, edited by H. S. Shapiro and D. E. Purpel, 7–23.

Lazonick, William. 2015. "Labor in the Twenty-First Century: The Top 0.1% and the Disappearing Middle-Class." *Institute for New Economic Thinking Working Paper Series,* no. 4.

Levine, Phillip B., Jennifer Ma, and Lauren C. Russell. 2020. "Do College Applicants Respond to Changes in Sticker Prices Even When They Don't Matter?" Working Paper No. 26910, National Bureau of Economic Research. https://doi.org/10.3386/w26910.

Levy, Frank. 1987. “The Middle Class: Is It Really Vanishing?” *The Brookings Review* 5(3): 17–21. https://doi.org/10.2307/20079981. JSTOR.

Levy, Frank, and Richard J. Murnane. 1992. “U.S. Earnings Levels and Earnings Inequality: A Review of Recent Trends and Proposed Explanations.” *Journal of Economic Literature* 30(3): 1333–81. JSTOR.

Looney, Adam, Jeff Larrimore, and David Splinter. 2020. “Middle-Class Redistribution: Tax and Transfer Policy for Most Americans.” In *Securing Our Economic Future,* edited by Amy Ganz and Melissa Kearney, Aspen Institute Press.

Lybrand, Holmes. 2019. “Fact-checking Warren's claim that her health-care plan won't raise taxes on the middle class.” CNN, November 7, 2019. https://www.cnn.com/2019/11/07/politics/elizabeth-warren-tax-medicare-for-all-middle-class-fact-check/index.html.

Ma, Jennifer, Sandy Baum, and Matea Pender, and CJ Labassi. 2019. *Trends in College Pricing 2019*. New York: College Board.

Markandya, A. 1984. “The Welfare Measurement of Changes in Economic Mobility.” *Economica* 51(204): 457–71. https://doi.org/10.2307/2554230. JSTOR.

Martin, Emmie. 2018. “Nearly 70% of Americans consider themselves middle-class—here’s how many actually are.” CNBC, September 26, 2018. https://www.cnbc.com/2018/09/26/how-many-americans-qualify-as-middle-class.html.

Martinez, Leonardo, and Stephen Slivinski. 2008. “What Income Inequality Measures Can (and Cannot) Tell Us.” *Richmond Fed Economic Brief*, no. 08-02. Nov.

McMahon, Patrick J., and John H. Tschetter. 1986. “The Declining Middle Class: A Further Analysis.” *Monthly Labor Review* 109(9): 22–27.

Meyer, Bruce D., and James X. Sullivan. 2009. “Five Decades of Consumption and Income Poverty.” Working Paper No. 14827, National Bureau of Economic Research. http://www.nber.org/papers/w14827.

---. 2013. “Winning the War: Poverty from the Great Society to the Great Recession.” Working Paper No. 18718, National Bureau of Economic Research. http://www.nber.org/papers/w18718.

Morris, Martina, Annette D. Bernhardt, and Mark S. Handcock. 1994.“Economic Inequality: New Methods for New Trends.” *American Sociological Review* 59(2): 205–19.https://doi.org/10.2307/2096227. JSTOR.

Moshe Buchinsky, and Jennifer Hunt. 1999. “Wage Mobility In The United States.” *The Review of Economics and Statistics* 81(3): 351–68.

Mouw, Ted, and Arne L. Kalleberg. 2010. “Occupations and the Structure of Wage Inequality in the United States, 1980s to 2000s.” *American Sociological Review* 75, no. 3(June): 402–31. doi:https://doi.org/10.1177/0003122410363564.

Muller, Jerry Z. 2019. “The Neosocialist Delusion.” *Foreign Affairs*, Dec. https://www.foreignaffairs.com/articles/2019-12-10/neosocialist-delusion.

Murphy, Sherry L., Jiaquan Xu, Kenneth D. Kochanek, and Elizabeth Arias. 2018. "Mortality in the United States, 2017." NCHS Data Brief No. 328. Hyattsville, MD: National Center for Health Statistics.

Nir Jaimovich, and Henry E. Siu. 2012. "Job Polarization and Jobless Recoveries." Working Paper No. 18334, National Bureau of Economic Research. https://ideas.repec.org/p/nbr/nberwo/18334.html.

Nordhaus, William D. 1996. "Do Real-Output and Real-Wage Measures Capture Reality? The History of Lighting Suggests Not." In *The Economics of New Goods,* edited by Timothy F. Bresnahan and Robert J. Gordon, National Bureau of Economic Research. http://www.nber.org/papers/c6064.

OECD. 2019. Under Pressure: The Squeezed Middle Class. OECD Publishing, Paris. https://doi.org/10.1787/689afed1-en.

Parlapiano, Alicia, Robert Gebeloff, and Shan Carter. 2015. "The Shrinking American Middle Class." *New York Times,* January 26, 2015. NYTimes.com, https://www.nytimes.com/interactive/2015/01/25/upshot/shrinking-middle-class.html.

Pew Research Center. 2015. "Most Say Government Policies Since Recession Have Done Little to Help Middle Class, Poor." Pew Research Center, Washington, D.C. https://www.pewresearch.org/politics/2015/03/04/most-say-government-policies-since-recession-have-done-little-to-help-middle-class-poor/.

Piketty, Thomas, and Arthur Goldhammer. 2014. *Capital in the Twenty-First Century.* Harvard University Press. www.jstor.org/stable/j.ctt6wpqbc. JSTOR.

Piketty, Thomas, and Emmanuel Saez. 2003. "Income Inequality in the United States, 1913–1998." *The Quarterly Journal of Economics* 118(1): 1–41.

---. 2006. "The Evolution of Top Incomes: A Historical and International Perspective." American *Economic Review* 96(2): 200–05.

---. 2014. "Inequality in the Long Run." *Science* 344(6186): 838–43.

Pressman, Steven. 2007. "The Decline of the Middle Class: An International Perspective." *Journal of Economic Issues* 41(1): 181–200.

Quigley, John M., and Steven Raphael. 2004. "Is Housing Unaffordable? Why Isn't It More Affordable?" *Journal of Economic Perspectives* 18(1): 191–214. https://doi.org/10.1257/089533004773563494.

Quoctrung Bui. 2016. "How the Middle Class May Have Gotten a Raise." *New York Times,* August 30, 2016. https://www.nytimes.com/2016/08/30/upshot/how-the-middle-class-may-have-gotten-a-raise.html.

Reich, Robert B. 2011. "Opinion | Jobs Will Follow a Strengthening of the Middle Class." *New York Times*, September 3, 2011. NYTimes.com, https://www.nytimes.com/2011/09/04/opinion/sunday/jobs-will-follow-a-strengthening-of-the-middle-class.html.

Reynolds, Alan. 2007. "Has US Income Inequality Really Increased?" *Cato Institute Policy Analysis Series*, no. 586.

Rosenthal, Neal H. 1985. "The Shrinking Middle Class: Myth or Reality?" *Monthly Labor Review* 108(3): 3–10.

Sacerdote, Bruce. 2017. "Fifty Years Of Growth In American Consumption, Income, And Wages." Working Paper No. w23292, National Bureau of Economic Research. http://www.nber.org/papers/w23292.

Sachs, Jeffrey D., Howard J. Shatz, Alan Deardorff, and Robert E. Hall. 1994. "Trade and Jobs in U.S. Manufacturing." *Brookings Papers on Economic Activity*, no. 1(1994): 1–84. https://doi.org/10.2307/2534630. JSTOR.

Saez, Emmanuel. 2018. "Striking It Richer: The Evolution of Top Incomes in the United States." In *Inequality in the 21st Century*, edited by David Grusky and Jasmine Hill, 39–42. Routledge.

Saez, Emmanuel, and Gabriel Zucman. 2016. "Wealth Inequality in the United States since 1913: Evidence from Capitalized Income Tax Data." *The Quarterly Journal of Economics* 131(2): 519–78.

Sarah Flood, Miriam King, Renae Rodgers, Steven Ruggles and J. Robert Warren. 2020. Integrated Public Use Microdata Series, Current Population Survey: Version 7.0 [dataset]. Minneapolis, MN: IPUMS. https://doi.org/10.18128/D030.V7.0

Searcey, Dionne, and Robert Gebeloff. 2015. "Middle Class Shrinks Further as More Fall Out Instead of Climbing Up." *New York Times*, January 25, 2015. NYTimes.com, https://www.nytimes.com/2015/01/26/business/economy/middle-class-shrinks-further-as-more-fall-out-instead-of-climbing-up.html.

Shapiro, Matthew D., and David W. Wilcox. 1996. "Mismeasurement in the Consumer Price Index: An Evaluation." Working Paper No. 5590, National Bureau of Economic Research. http://www.nber.org/papers/w5590.

Silverman, Dan. 2020. "Walking the Tightrope: Variable Income and Limited Liquidity Among the US Middle Class." In *Securing Our Economic Future*, edited by Amy Ganz and Melissa Kearney, Aspen Institute Press.

Slemrod, Joel. 1995. "High-Income Families and the Tax Changes of the 1980s: The Anatomy of Behavioral Response." Working Paper No. 5218, National Bureau of Economic Research. Published as "High-Income Families and the Tax Changes of the 1980s: The Anatomy of Behavioral Response." In *Empirical Foundations of Household Taxation*, edited by Martin Feldstein and James M. Poterba. University of Chicago Press (1996). https://doi.org/10.3386/w5218.

Spitz-Oener, Alexandra. 2006. "Technical Change, Job Tasks, and Rising Educational Demands: Looking Outside the Wage Structure." *Journal of Labor Economics* 24(2): 235–70. doi:https://doi.org/10.1086/499972.

Snyder, Thomas D., Cristobal de Brey, and Sally A. Dillow.. 2019. *Digest of Education Statistics 2017* (NCES 2018-070). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC.

Tavernise, Sabrina, and Abby Goodnough. 2020. "American Life Expectancy Rises for First Time in Four Years." *New York Times*, January 30, 2020. NYTimes.com, https://www.nytimes.com/2020/01/30/us/us-life-expectancy.html.

Thomas Philippon. 2019. "Causes, Consequences, and Policy Response to Market Concentration." *Aspen Institute Economic Strategy Group,* July.

Thorson, Greg. 2014. "The Rise of Inequality, the Decline of the Middle Class, and Educational Outcomes." Paper presented at the International Conference of the Associate for Public

Policy Analysis and Management (APPAM), September 29–30, 2014 in Segovia, Spain.

Thurow, Lester C. 1984. “Business Forum; the Disappearance of the Middle Class.” *New York Times*, February 5, 1984. NYTimes.com, https://www.nytimes.com/1984/02/05/business/business-forum-the-disappearance-of-the-middle-class.html.

---. 1987. “A Surge in Inequality.” *Scientific American* 256(5): 30–37. JSTOR.

U.S. Bureau of Labor Statistics. *Women in the Labor Force: A Databook*. Report No. 1049.

United States Trade Representative (USTR). n.d. "The People's Republic of China." Accessed on July 29, 2020. https://ustr.gov/countries-regions/china-mongolia-taiwan/peoples-republic-china.

Van Reenen, John. 2019. “Can Innovation Policy Restore Inclusive Prosperity in America?” The *Aspen Institute Economic Strategy Group*, July.

Vaughan-Whitehead, Daniel. 2016. *Europe’s Disappearing Middle Class?: Evidence from the World of Work*. Edward Elgar Publishing.

Weinstein, David E., and Douglas J. Besharov. 2008. *Prices, Poverty, and Inequality: Why Americans Are Better off than You Think*. Aei Press.

Wolfson, Michael C. 1994. “When Inequalities Diverge.” *The American Economic Review* 84(2): 353–58.

Xu, Jiaquan, Sherry L. Murphy, Kenneth D. Kochanek, and Elizabeth Arias. 2020. "Mortality in the United States." NCHS Data Brief No. 355. Hyattsville, MD: National Center for Health Statistics. https://www.cdc.gov/nchs/data/databriefs/db355-h.pdf

Middle-Class Redistribution: Tax and Transfer Policy for Most Americans

AUTHOR

Adam Looney*, Jeff Larrimore, David Splinter*****

ABSTRACT

The "middle class" has benefitted from government redistribution in recent decades. For individuals in non-elderly households in the middle three income quintiles (the middle class), the share of federal taxes decreased, and the share of transfers increased. Between 1979 and 2016, market income per person increased 39 percent. But when accounting for taxes and transfers income increased 57 percent. Middle-class income support, however, is a recent phenomenon. Before 2000, market income and income after taxes and transfers grew together. Since 2000, middle-class income after taxes and transfers grew three times faster than market income. In a revenue-neutral exercise, we explore the limits of further support to the middle class.

* Marriner S. Eccles Institute, University of Utah
** Federal Reserve Board, Washington, DC
*** Joint Committee on Taxation, Washington DC

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Introduction

Government tax and transfer policy has increasingly benefitted the "middle class." The share of federal taxes paid by the non-elderly middle class (which we define as those whose household income places them in the middle 60 percent of the population) has declined over time, while their share of means-tested transfers has risen. Fewer households pay income taxes, and federal tax burdens on low- and middle-income households have declined. At the same time, more middle-income households benefit from government transfers. While middle-class market incomes have grown less quickly than aggregate income, public policies have offset some of this disparity by boosting after-tax, after-transfer income and enhancing economic security. Middle-class market income per person increased 39 percent between 1979 and 2016, their after-tax, after-transfer income increased 57 percent.

The increase in after-tax, after-transfer income from federal policies is mostly the result of two factors. First, federal fiscal policy has increasingly prioritized raising the after-tax, after-transfer income of American households. The long-term decline in defense spending as a share of GDP and a more recent surge in deficit spending has, in the aggregate, allowed Americans to enjoy both lower taxes and increased spending on health and income support programs (DeSilver 2017). Second, the distribution of both taxes and transfers have shifted to the benefit of the non-elderly middle class. The share of total taxes paid by the non-elderly middle class has declined, with an increasing share paid by high-income households. Simultaneously, the share of transfers received by the middle class has increased, with a decreasing share received by low-income households. About one-third of the growth in the after-tax, after-transfer income of middle-class households since 1979 owes to changes in fiscal policy.

While these changes were effective in boosting the after-tax, after-transfer income of non-elderly middle-class households, we are less optimistic they will be sources of future growth for middle-income households. Tailwinds from the "peace dividend" and increasing deficits have largely run their course. Even if deficits could remain at high levels, they cannot *grow* at high rates. Additionally, the aging of the population and the retirement of the Baby Boomer generation results in a headwind against the further expansion of benefits for the non-elderly middle-class. While increases in redistribution through the tax and transfer system are possible, raising the after-tax, after-transfer incomes of the middle class by the magnitudes achieved over the last two decades and financing it by increasing taxes only on top income households would require unprecedented tax rates.

In our analysis of taxes and transfers, we focus on individuals in non-elderly households in the middle three quintiles (60 percent) of the income distribution, whose material living standards provide a broad view of middle-class incomes and changes over time.[1] Although the elderly middle-class is also important, we focus on non-elderly households in order to avoid the challenge of inferring the income class of non-working retirees. Doing so also allows us to examine the taxes paid and benefits received by households during their working and child-rearing years and to abstract from issues related to the aging of the population and the substantial growth in Social Security, Medicare, and Medicaid benefits.

In 2016, according to estimates using data from the Congressional Budget Office (2019), the average income earned from market activities—like employment, business ownership, or interest—was about $71,900 per non-elderly middle-class household. Social insurance and means-tested transfers boosted this group's average income by $7,900 per household, and they paid (or their employer paid on their behalf) $12,600 in federal income, payroll, corporate, and excise taxes—including their contributions to entitlement programs such as Social Security and Medicare. Hence, the net effect of federal income transfers and taxes is to reduce the after-tax, after-transfer income of middle-class households only by about 7 percent. That "net burden" of taxes and transfers is historically low and relieves the middle class from much of the cost of paying for federal public goods or income support to other groups (like poor, disadvantaged, or elderly households).

What federal benefits are non-elderly middle-class households receiving? Mostly subsidized health insurance or health care. Direct assistance comes from programs like Medicaid and the Children's Health Insurance Program (CHIP), and indirect assistance comes from the exclusion of employer-provided and self-employed health insurance costs from taxation. Middle-class households also benefit from other targeted transfers and insurance programs, like the Supplemental Nutrition Assistance Program (SNAP), unemployment insurance, workers' compensation, and Social Security Disability Insurance. On the tax side, income taxes on many households have been eliminated by child-related tax benefits.

Over the last several decades, more federal support flowed to the middle class, while the payments they made for federal programs through taxes have declined. Focusing just on amounts for non-elderly households, between 1979 and 2016, the share of means-tested transfers received by middle-class households increased from 27 percent to 49 percent. Their share of federal taxes paid fell from 45 to 31 percent.

1 There is no consensus definition of the middle class, and alternative definitions are reviewed by Reeves, Guyot, and Krause (2018). For example, some definitions include individuals with higher incomes in the "upper-middle" class. Alternatively, the Pew Research Center defines the middle class as adults with size-adjusted household income that is two-thirds to double the national median, which is narrower than our definition, and Darity, Addo, and Smith (2020) use a wealth-based definition that results in a relatively smaller black middle class.

These changes are partially the result of economic trends, which reduced the share of market income earned by the middle class. However, changes in federal tax policy eliminated income tax liability for more middle-class households and reduced average tax rates on all but the highest-income households. Since 1979, the share of non-elderly adults facing no income tax nearly doubled, to about 40 percent. At the same time, average federal tax rates for non-elderly middle-class households fell about 4 percentage points. Since 1979, the cumulative effect of these policies was to boost the increase in non-elderly middle-class incomes by 18 percentage points. Federal support for middle-class households has clearly improved their economic stability and material well-being.

Whether individuals recognize or value these increased transfers is less clear. One reason is that health insurance represents a growing share of middle-class incomes, both in terms of the share of their compensation earned from employment and the value of federal health benefits. While the Congressional Budget Office (CBO) values in-kind health benefits at their cost, households may value them at lower or higher rates. To the extent that households value health benefits less than more visible forms of consumption or receive excess benefits due to tax subsidies, they will value them at less than their cost. Those with health concerns may value them at well above their cost. More generally, there is widespread concern among economists that America's health-care system is inefficient and that the same health outcomes could be achieved at lower cost. Hence, the value and cost of health benefits are central not just for interpreting the welfare implications of rising federal spending on the middle class but also to the design of federal health policies.

While our analysis mostly focuses on comparisons of households whose income falls into the middle class at specific points in time, a household's income may change from year to year because of events like unemployment or moving to a better job. One implication of this is that a larger share of middle-class households benefits from federal policies, like unemployment insurance, than is apparent in a single year. Likewise, while we refer to comparisons of the average income of the middle class over time as income "growth" and "changes", those comparisons do not necessarily reflect the income growth of individual households because of mobility in and out of the middle class. Indeed, when following the same individuals since 1980, Splinter (2019c) finds that middle-class market incomes grew faster than overall income. Hence, while our analysis compares how much federal policies affect middle-class incomes today compared to the past, it does not assess how those policies affect economic mobility or changes in the income of individual households.

Looking to the future, shifts in federal spending and the increase in tax progressivity over recent decades has left the federal system with a more limited capacity to continue to raise middle-class incomes solely by taxing the top of the distribution. There's no doubt that increases in taxes from high-income taxpayers could raise substantial revenues, and those revenues could be redistributed to increase the incomes of lower-income taxpayers. But in an empirical exercise, we show that fiscal capacity falls substantially when new transfers are extended from just the bottom quintile to also include the middle class. Increasing the material well-being of low-income households requires only modest increases in tax rates on high-income taxpayers. However, meaningfully increasing it for middle-class households requires more dramatic fiscal changes because there are many more middle-class households, they earn higher levels of income, and excluding middle-class incomes from tax-rate increases requires higher marginal rates on high-income groups. Given that America has already spent the "peace dividend," ramped up deficits, and substantially increased tax progressivity, it will be difficult to continue the recent trend of rising fiscal support for middle-class households.[2]

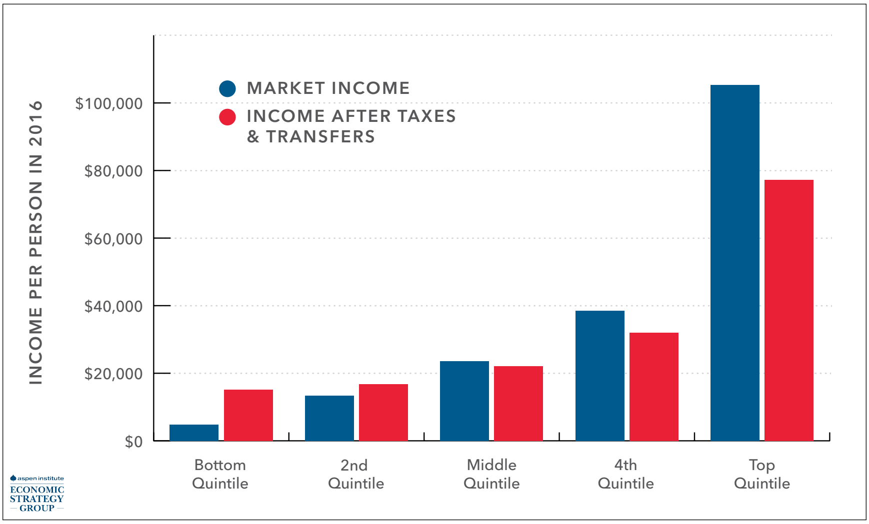
1. Taxes Paid and Benefits Received across the Income Distribution

How do federal taxes, social insurance programs, and means-tested transfers affect the material well-being of the middle class? One way to consider how federal tax and spending policies affect American households is to compare the distributions of income both before and after taxes and transfers. We primarily use data from the CBO (2019), which use a combination of records from the Internal Revenue Service and the Census Bureau to estimate household incomes from a broad range of sources, and we also follow their assumptions on how income is shared within households, the distribution of taxes, and the value of in-kind benefits.

Using these data, Figure 1 ranks non-elderly households by their market income and presents their income before and after the effects of government transfers and federal taxes. Market income includes only the amounts that individuals earn from work, running a business, or investments. Our purpose in ranking by market income (rather than income after social insurance benefits but before taxes and means-tested transfers, which is the CBO convention), is to illustrate the full extent of federal policies on the distribution that would prevail based on market income alone. Furthermore, we present income on a per person basis as a way to adjust for differences in household

2 While we are relatively pessimistic about the prospect of fiscal policy to directly boost the future incomes of all middle-class households, federal policy also affects the well-being of middle-class households by promoting economic growth and human capital development; promoting safety and health; enforcing the rights of citizens and workers; protecting natural resources and the environment; and many other ways beyond the scope of this chapter.

Figure 1. Income per Person in Non-elderly Households before and after Government Transfers and Federal Taxes, 2016



Source: Author's calculations using data from the CBO (2019).
Notes: Quintiles are defined based on household size-adjusted market income of households of all ages.

size and to account for differences in the resources needed for people in large and small households to achieve the same level of well-being. The CBO publishes data corresponding to average household incomes and those averages are not adjusted for differences in household size.[3] A disadvantage of this approach is that comparisons of average household incomes over time can be conflated by changes household size. We focus on income per person as the best available solution.

The grey bars in Figure 1 show that market income of non-elderly households is unequally distributed. For instance, average market income per person in the lowest-income quintile of the population (the bottom 20 percent based on household income) is an average of $4,800 before taxes and transfers. In contrast, among the highest-income quintile the average income per person is $105,000.

But market income presents only a partial view of the material well-being of American households. Transfers and federal taxes affect their after-tax, after-transfer income and provide insurance against adverse outcomes that reduce market income, like

3 For ranking purposes only, CBO adjusts incomes for household size to account for the fact that people living under the same roof and sharing resources can achieve a higher material living standard than those living alone. Once households are ranked by size-adjusted income, each quintile is set to include the same number of individuals. We measure per person income as the aggregate household income of each income group divided by the number of people in that group.

unemployment. The red bars show average income per person after social insurance, transfers, and federal taxes. The after-tax, after-transfer income of individuals in the lowest-income households is lifted to $15,200—hence, federal tax and transfer programs triple the incomes of low-income, non-elderly individuals relative to what they earn in the market alone. For households in the top income quintile, transfers and federal taxes reduce market incomes from an average of $105,000 per person to $77,000—or 27 percent less. This effect is more pronounced for higher incomes, with top 1 percent incomes reduced by 34 percent.

In other words, the net effect of taxes and transfers is to reduce disparities that exist when considering only market income. While these redistributive effects are clearest among the lowest-income and highest-income households because of the progressive tax and transfer system, it is also apparent among middle-class households.

While there is not a formal definition of who is middle class, we focus on the middle three quintiles of the population.[4] Within the middle three quintiles, we focus on non-elderly households. (These are households whose household head is under age 65, although some non-elderly households will contain other individuals who are older.) This group represents about half of Americans and earns a third of total market income. Figure 1 shows that, on average, public policies modestly boost the incomes of non-elderly households in the second quintile (lower-middle class households) and slightly reduce the incomes of upper-middle class households. It is not just the bottom of the income distribution that benefits from the progressive tax and transfer system. Many in the middle class are net beneficiaries as well.

An additional consideration is that a significant share of federal tax revenue is not redistributed to households as means-tested transfers or social insurance, but instead finances federal purchases such as education, roads, defense, and other public goods that yield value to most households. While the value of such public goods is not included in our analysis, the taxes that finance them are. Including the benefits from these public goods would raise the well-being of low- and middle-income households above that measured by disposable income alone.

Furthermore, while CBO estimates capture a relatively broad measure of income, they exclude a number of income sources: undistributed income earned in retirement accounts, imputed rent of owner-occupied housing, and the employee insurance contributions that are excluded from taxable wages.[5] It also excludes the accrual

4 Under this definition, a four-person household is middle class if their income is between $31,400 and $168,200 while a two-person household is middle class if their income is between $22,000 and $119,000.

5 These excluded sources total more than $1 trillion in 2014 (Auten and Splinter 2019b). The CBO also includes some sources of income that should not be thought of as current-year income, such as taxable realized capital gains, which reflect asset appreciation in earlier years (Larrimore et al. 2016). However, we do not attempt to adjust the income definitions and distributional estimates from their data.

of social insurance wealth (e.g., increases in the present value of expected Social Security benefits). Each of these are important sources of middle-class income and accounting for them would boost the level of middle-class income and its growth (Auten and Splinter 2019a; Sabelhaus and Volz 2020).

In this section, we discuss the growth in total transfers and the recent distribution of transfers and federal taxes. We also discuss how tax expenditures and social insurance benefits benefit the middle class, often protecting them from economic insecurity, and why standard approaches may understate the degree to which they accrue to the middle class.

1.a. Transfers Are a Growing Share of Federal Spending

Transfer programs reflect a sizeable share of federal expenditures. In 2019, 23 percent of federal spending paid for Social Security and 15 percent provided insurance through Medicare. Hence, these two social insurance programs reflected 38 percent of all federal spending. An additional 13 percent of federal spending provided health insurance through other programs, including means-tested programs like Medicaid and CHIP. Non-health-care, means-tested programs include SNAP, supplemental security income (SSI), and many in-kind transfers like school lunches, low-income housing, childcare, or help with home heating costs. These programs amounted to 8 percent of federal spending. Other federal spending largely goes to defense (15 percent of the budget), interest (8 percent), and other smaller programs (OMB Budget, FY 2021 Historical Tables). As noted above, standard measures of after-tax, after-transfer income exclude the value of non-transfer spending, which represents a bit less than half of federal spending.

Over time, the amount that the federal government spent on social insurance, transfers, and other investments in material well-being increased both as a share of the federal budget and as a share of the economy. For instance, between 1979 and 2016, the amount that the federal government devoted to human resources—Social Security, health, education, and veterans' benefits—increased from 53 to 73 percent of the budget and from 10.4 to 15.2 percent of GDP. This increase was accommodated largely with reductions in defense spending—a peace dividend—but also lower interest costs and a higher budget deficit. In other words, in 1979 roughly half of government spending was devoted to social insurance, means-tested transfers, or investments in the health, education, and economic security of Americans. In 2016, it was three-quarters. Moreover, total government spending as a fraction of GDP increased. On net, the federal government now devotes more resources to improve the material well-being of Americans than ever before.

This increase in federal spending on social insurance programs partly reflects the aging of the population, as an increasing share of Americans become eligible for Social Security. But the size of transfer programs has increased in recent decades even excluding elderly households. In 1979, non-elderly households received $212 billion in transfers, including $98 billion of means-tested programs (2016 dollars). By 2016, this had grown to $920 billion of transfers, including $601 billion of means-tested transfers. Consequently, the resources devoted to improving the well-being of the non-elderly population has also increased—with a substantial share of this increase going toward those in the middle class.

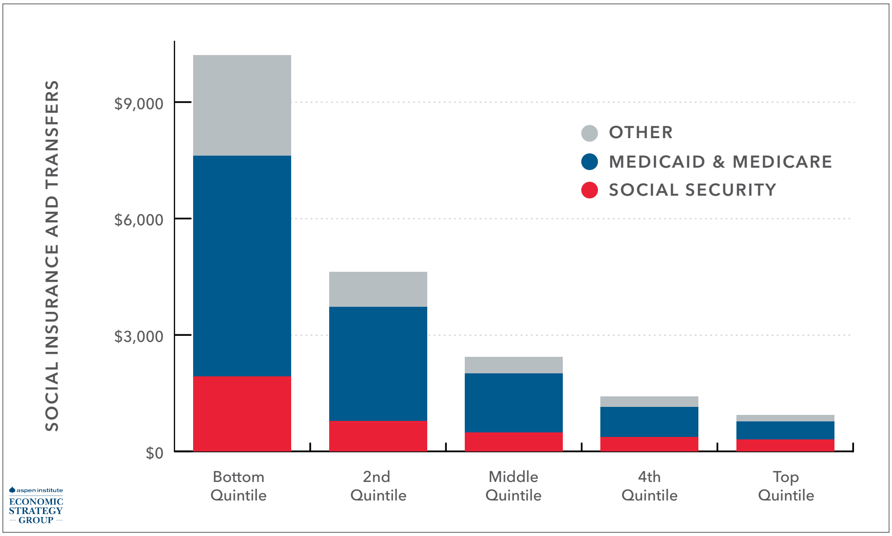
1.b. The Distribution of Social Insurance and Means-Tested Transfer Spending

Households across the income distribution benefit from federal social insurance and means-tested transfers, even when excluding elderly households. Figure 2 shows the average per person value of social insurance benefits and means-tested transfers received by non-elderly households in each income quintile in 2016 based on CBO data.

The largest of these transfers are associated with health coverage. In 2016, non-elderly, second-quintile households received Medicaid benefits that cost an average of $7,300 ($2,500 per person) and other means-tested transfers worth $2,200 ($800 per person). Non-elderly, middle-quintile households received Medicaid benefits that cost an average of $4,700 ($1,600 per person). Some programs, like Social Security Disability Insurance and the Medicare coverage that accompanies it, accrue mostly to low-income households, but disabled members of higher-income households are also eligible for these benefits. Throughout the distribution, a similar share of non-elderly households received unemployment insurance.

Therefore, among non-elderly households, health insurance represents the largest form of benefits accruing not only to low-income households, but also to middle-class households. As we discuss below, it is also the largest source of the increase in transfers to the middle class.

Figure 2: Per Person Benefits from Social Insurance and Means-Tested Transfer Programs in Non-elderly Households, 2016



Source: Authors' calculations using data from CBO (2019).

Notes: Quintiles are defined based on household size-adjusted market income of households of all ages. "Other" includes SNAP benefits, unemployment insurance, SSI, workers' compensation, and other smaller transfer programs. Social Security for non-elderly households includes Social Security Disability Insurance as well as benefits to elderly individuals in households headed by a non-elderly person and survivor benefits.

1.c. The Distribution of Federal Taxes

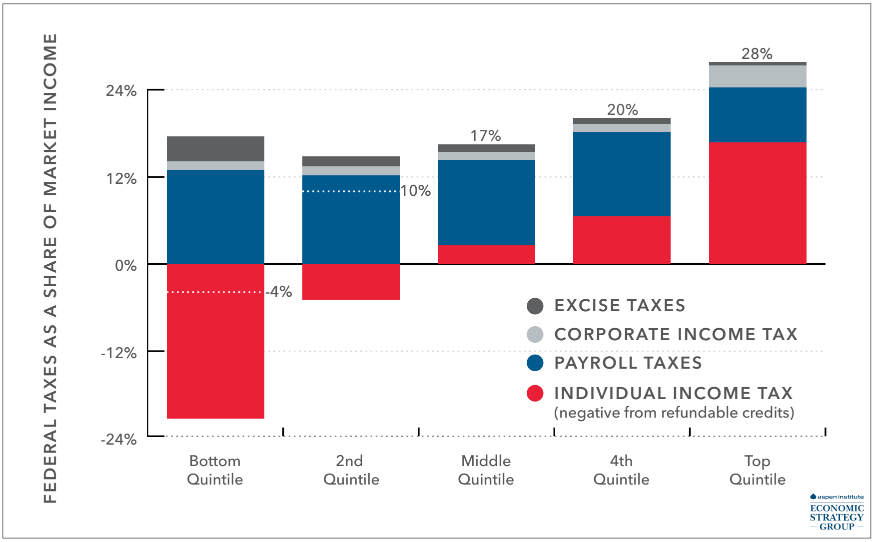
In 2016, Americans paid about $3 trillion in federal taxes. Individual income taxes accounted for about half of federal taxes, payroll taxes for a third, corporate taxes for a tenth, and other taxes for a small share. Figure 3 illustrates the distribution of these taxes across non-elderly households—who pays the taxes, or, for indirect taxes or those withheld by employers, who is burdened by those taxes.[6] The American tax system is progressive. Higher-income households pay a higher share of their income in total federal taxes than do lower-income households.

For instance, in 2016, non-elderly households in the lowest income quintile (ranked by market income) faced a negative tax rate—because of refundable income tax credits, the average household received a refund that exceeded the amounts they paid in other federal taxes. Among the highest-income quintile of non-elderly

6 Corporate taxes ultimately are paid by the owners of businesses, their employees, or their consumers; we follow CBO in assuming most corporate taxes are paid by capital owners, but that a quarter is shifted to workers.

households, the average federal tax burden was equal to about 28 percent of their market income. The top 1 percent paid 34 percent of their market income in federal taxes, or twice as much as the middle class.

Figure 3: The Burden of Federal Taxes among Non-elderly Households, 2016



Source: Authors' calculations using data from CBO (2019).

Notes: White lines and percentages show total federal taxes as a share of market income when accounting for negative income taxes. Quintiles are defined based on household size-adjusted market income of households of all ages.

1.d. Tax Expenditures

The tax burden households face depends on tax rates but also on exclusions, deductions, special rates, or tax credits that reduce tax burdens. These policies are labeled tax expenditures because they often serve a function similar to spending programs. While their effects on household income are incorporated into the tax burdens described above, they are legislated and debated independently. Hence, like social insurance and transfer programs, it is worth understanding how tax expenditures affect households.

The largest tax expenditures are often designed to benefit middle- and high-income households. These tax expenditures support employer-provided health insurance, provide benefits for home ownership, subsidize retirement savings, and provide for the earned income tax credit and child tax credit. Besides the credits, these provisions exclude certain types of income from taxation. They therefore disproportionately benefit higher-income households who face higher tax rates. Even among the tax credits, the child tax credit is still available to nearly all households because phase outs start at high income levels.

Middle-class households receive substantial tax expenditures for homeownership, including preferences for mortgage interest, property taxes, and capital gains. The mortgage interest deduction is the largest of these, but its value has fallen over time. For tax units whose incomes are between $50,000 and $100,000 (including elderly filers), this subsidy was about 0.2 percent of GDP around 1990, before it fell to 0.1 percent since the Great Recession and well below that with the recent doubling of standard deductions (Splinter 2019b). Among those deducting mortgage interest in 2019, Joint Committee on Taxation (2019) estimates suggest that middle-class tax returns (incomes between $40,000 and $100,000 and including elderly filers) received an average subsidy of $800. This amount was similar just before the doubling of standard deductions in 2018, but in earlier years nearly four times more middle-class tax returns deducted mortgage interest (11 million versus 3 million). Even when average mortgage interest deduction subsidies were larger, they had little effect on homeownership levels, but instead increased both debt burdens and the size of houses (Gale, Gruber, and Stephens-Davidowitz 2007; Hanson 2012). We discuss the growth of other major middle-class tax expenditures in the next section.

1.e. Measuring Distributions of Incomes and Taxes: Households versus Tax Units

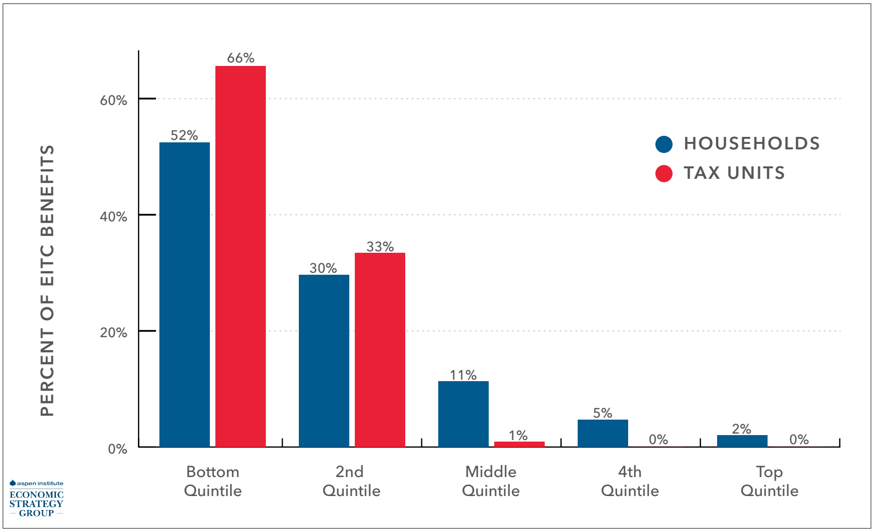
The extent to which means-tested benefits and low tax burdens extend into the middle class may come as a surprise. One reason is that many policies are implemented and designed based on tax units (people who file tax returns together) or families (close relatives who live together) rather than households (people who live together). But many estimates of income inequality or tax burdens use tax units (or families), which tend to disaggregate or split up the incomes of individuals who otherwise live together and share resources.

Although they are often considered interchangeable, households, families, and tax units can be quite different—and these differences matter for policy evaluation. Consider three examples: two married adults living together, a cohabiting couple, and an adult child living with their parents. All three examples represent single households. Yet the cohabiting couple is not a family under the Census definitions, and the cohabiting individuals and the adult child living with their parents are separate tax units.

These distinctions may appear innocuous but can dramatically change the observed distribution of both incomes and transfer policies since there are over 170 million tax units in the United States, but fewer than 130 million households (including elderly households). In 2010, the median pre-tax income of *tax units* was a modest $31,000. But using the same tax data, median pre-tax income of *households* was $51,000 (Larrimore, Mortenson, and Splinter 2019).

The choice of sharing unit can also affect middle-class income shares and growth. Larrimore, Mortenson, and Splinter (2019) estimate that relative to using households as the sharing unit, using tax units lowers the 2010 middle-class income share (including elderly households) by almost 4 percentage points (from 44.3 to 40.7 percent). Due to the growth in cohabitation, where there is one household but at least two tax units, middle-class absolute income increases are under-estimated at the tax unit level. Although these statistics are for pre-tax income of households of all ages, rather than the after-tax, after-transfer income of non-elderly households that we focus on in this chapter, this demonstrates the substantial difference between using households and tax units on middle-class incomes.

Figure 4: Distribution of the Earned Income Tax Credit, 2010



Source: Larrimore, Mortenson, and Splinter (2019).

Notes: Includes households and tax units of all ages, including elderly households. Quintiles are defined based on size-adjusted pre-tax income reported on tax returns.

The CBO has consistently assumed that income is shared within a household for their distributional reports, recognizing that this most closely reflects the resources people have available. Yet, social policies administered through the tax code frequently focus on tax-unit incomes, and may inadvertently shift programs intended for low-income individuals toward the middle class.

When measured at the household level, existing tax policies are targeted less at the bottom of the distribution and more at the middle than is commonly believed. Figure 4 shows that two-thirds of earned income tax credit benefits go to the bottom quintile of the tax-unit distribution, although when considering complete households only about half of these credits accrue to the bottom quintile. Instead, a larger share goes to those in the middle quintiles of the distribution. Although the earned income tax credit remains quite progressive, the ability for low-income tax units in higher-income households to receive these credits erodes a portion of the redistributional effect of the program (Larrimore, Mortenson, and Splinter 2019; Jones and Ziliak 2020).

1.f. Insurance Against Income and Spending Shocks

Federal policies also benefit middle-class households by providing insurance against economic risks that might otherwise send them plummeting down the income distribution. Among households that are typically middle class based on their usual income and employment, many experience temporary bouts of unemployment or economic strain.

The previous discussion only considered households whose annual incomes placed them in the middle class in that particular year. But most people's incomes do not remain the same every year. An additional way in which the tax and transfer system benefits the middle class is through the social safety net, which shields people from substantial declines in their income when faced with an economic hardship. In particular, while individual-level changes in market income are common, as workers move in and out of employment, after-tax household level income shocks are typically far smaller. In part, this reflects that household-level incomes are insulated by other family members' income, but it also reflects the significant insurance through tax and transfer policies that middle-class families receive.[7]

Federal taxes provide income insurance by buffering income changes: after-tax losses are typically smaller than pre-tax losses. Because the tax system is progressive, a 10 percent reduction in pre-tax income results in a less-than-10-percent decline in after-tax income. Taxes can even provide income insurance if a taxpayer initially paid no income tax because of refundable tax credits, which work like a negative rate tax bracket (Dowd and Horowitz 2011). In recent years, middle-quintile, after-tax losses are usually 5 to 20 percent smaller than pre-tax losses.

7 A fifth of workers' earnings have annual decreases of 25 percent or more, while only a tenth of households' incomes decrease that much (non-elderly workers and households only; CBO 2008). But losses are often transitory—nearly half of the middle-quintile with large decreases return to their prior income within a few years (Splinter, Bryant, and Diamond 2009; Larrimore, Mortenson, and Splinter 2016). In this volume, Silverman (2020) discusses other ways that households offset income shocks to smooth consumption.

Transfers also provide important insurance to the middle class, for both targeted programs like unemployment insurance and income-contingent programs like Medicaid, for which middle-class families often qualify, even if only for specific periods. Policies enacted in response to recessions provide additional support. Measures enacted in response to the Great Recession included stimulus payments to individuals, extended periods of unemployment insurance receipt, and a payroll tax holiday (summarized by Larrimore, Burkhauser, and Armour 2015).[8] Similar policies were enacted to address the COVID-19 recession.

Over the course of several years, the amount (and share) of net federal spending that accrues to middle-class households is much larger than annual measures suggest. For example, Table 1 shows that only a modest share of non-elderly tax filers received unemployment benefits each year (around 7 percent), but nearly a third received them at least once over the last decade.[9] Over time, the largest beneficiaries of unemployment insurance are middle-class households.

Table 1: Unemployment Insurance Receipt Rates during Annual and Multi-Year Periods

QUINTILE	ANNUAL	5-YEAR	10-YEAR
Bottom	6%	18%	27%
2	8%	22%	34%
3	7%	21%	33%
4	7%	20%	31%
Top	4%	14%	22%

Source: Authors' calculations using population tax data.

Notes: Income quintiles each have the same number of non-elderly adults (aged 20 to 64 in 2015) and are based on 2015 income (AGI plus adjustments, not size-adjusted) and include those filing between 2013 and 2017. The 5-year period includes 2013–2017 and 10-year period 2008–2017. If either spouse on a joint tax return receives unemployment benefits, then both are counted as receiving them.

8 When capturing the full impact of unemployment insurance and tax policy, the combination of existing and temporary policies almost completely mitigated the rise in poverty over the Great Recession (Larrimore, Mortenson, and Splinter 2020).

9 These results are through 2017 and do not reflect the substantial increase in unemployment insurance claims initiated in March and April 2020 in response to the COVID-19 public health crisis. Were those claims included, the share of filers ever claiming unemployment insurance would likely be even higher.

2. Changes in Middle-Class Taxes and Transfers since 1979

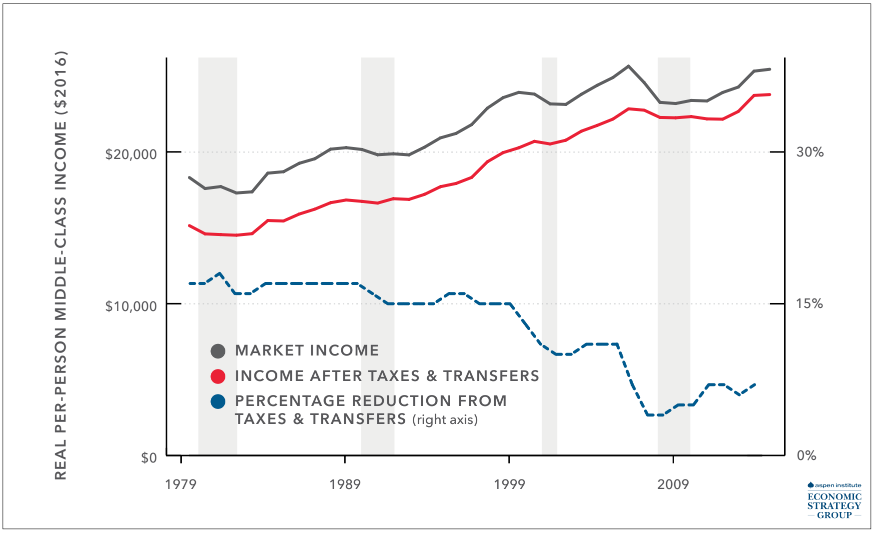
Over the last several decades, market income growth of the middle class has been slow and their share of market income has declined. Between 1979 and 2016, the middle-class share of market income among non-elderly households decreased from 51 to 40 percent. Changes in tax and transfer policies, however, have helped offset some of the slow growth of market income of the middle class.

The middle class benefited from falling tax rates—largely due to tax credit expansions. They have further benefitted from a shifting of tax burdens away from the middle class and toward the top of the distribution, and an expansion of transfers to the middle class. The combined effect of taxes and transfers caused after-tax, after-transfer incomes to increase significantly faster than market incomes, a result previously emphasized by Burkhauser, Larrimore, and Simon (2012). Between 1979 and 2016, real after-tax, after-transfer middle-class incomes increased 18 percentage points more than market income.

For perspective, the relative boost to low-income households over this period from increases in transfers is even larger. Changes in taxes and transfers increased the growth of bottom-quintile after-tax, after-transfer income by 84 percentage points relative to market income (from 33 to 117 percent), even though they are receiving a smaller share of all transfers than they were in 1979. Indeed, changes in tax and transfer policy account for over two-thirds of the increase in after-tax, after-transfer income of such households over this period. In contrast, after-tax, after-transfer income of the top quintile increased at the same rate as market income; policy has neither boosted nor slowed the change in income of this group.

Figure 5 presents a comparison of average middle-class per-person income before and after taxes and transfers. Values are shown in per person terms to control for the declining number of adults per household. Throughout the 1980s and 1990s, the middle class paid substantially more in taxes than they received directly from social insurance and transfers. In 1979, for instance, the average net effect of federal policies was to reduce the after-tax, after-transfer incomes of middle-class households by about 17 percent. That changed starting in the 2000s. By 2016, the net burden on middle-class households had declined to 7 percent.

Figure 5: Effect of Taxes and Transfers on Non-elderly, Middle-Class Income per Person, 1979–2016



Source: Authors' calculations using data from CBO (2019).

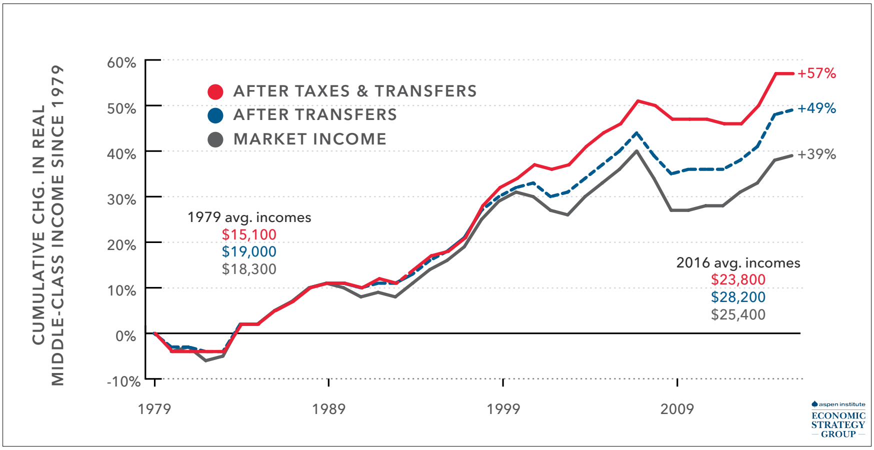
Notes: Transfers include both social insurance benefits and means-tested transfers. Quintiles are defined based on household size-adjusted market income of households of all ages. The middle class includes individuals in non-elderly households in the middle three income quintiles.

The increase in middle-class incomes after taxes and transfers resulted from changes in both tax and transfer policies. Figure 6 shows the separate effect of taxes and transfers on real percentage changes in middle-class incomes between 1979 and 2016. Before taking taxes or transfers into account, average per person middle-class market incomes increased from $18,300 to $25,400 (in 2016 dollars)—an increase of 39 percent.

Adding transfers increases the level of middle-class incomes in all years, but more so recently—boosting real income growth by 10 percentage points. Accounting for federal taxes decreases income levels in all years, but again, less so recently—and results in additional real income growth of 8 percentage points. Taking both taxes and transfers into account, middle-class per person incomes after taxes and transfers increased from $15,100 to $23,800, an increase of 57 percent.

Figure 6 makes clear that the net effect of taxes and transfers on middle-class income growth was negligible from 1979 through 2000 (on average), and since then has become more pronounced. With the 2001 recession, transfers expanded, and with the Bush tax cuts, the child credit amount doubled and tax rates fell. A similar level-shift occurred following the Great Recession. Legislative changes contributed to this effect: the Affordable Care Act increased middle-class Medicaid benefits, and created the premium tax credit, while other legislation increased the generosity of the earned income tax credit and child tax credit.

Figure 6: Real Increases in Average Non-elderly, Middle-Class Incomes per Person, 1979–2016



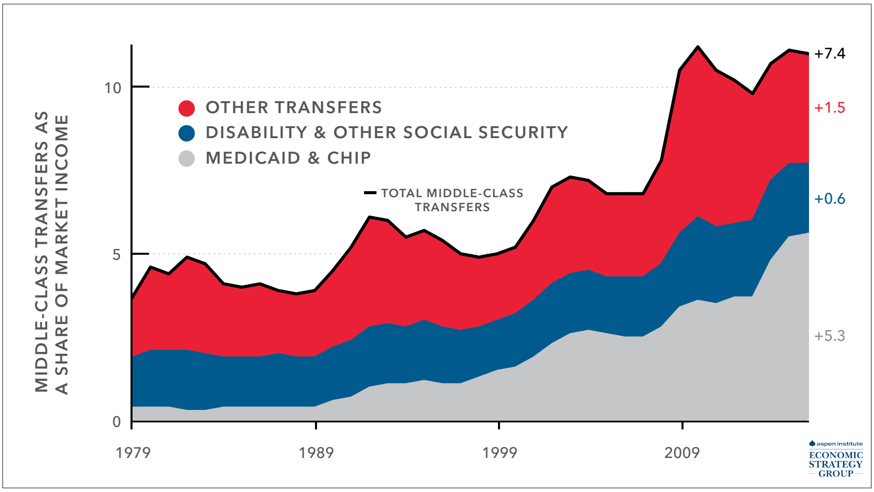
Source: Authors' calculations using data from CBO (2019).

Notes: Transfers include both social insurance benefits and means-tested transfers. Percentage point changes between 1979 and 2016 are shown at the right. Quintiles are defined based on household-size-adjusted market income of households of all ages. Middle class includes individuals in non-elderly households in the middle three income quintiles.

In other words, between 1979 and the late 1990s, after-tax, after-transfer income and market income of the middle class grew at about the same rate. Since 2000, middle-class income after taxes and transfers grew three times faster than market income. In addition to boosting cumulative income growth over this period, Figure 6 shows that federal policy substantially mitigated the temporary sharp declines in middle-class market incomes that occurred during the 2001 and 2007 recessions.

Increasing transfers to non-elderly middle-class households resulted from growth in Medicaid, disability, and other transfers. Between 1979 and 2016, Figure 7 shows that these transfers grew from about 4 to 11 percent of middle-class market income. For the non-elderly middle-class, average real per person transfers increased $1,360 for Medicaid, $250 for disability and other payments from Social Security, and $190 for SNAP and SSI transfers. These increases occurred throughout the middle class, but especially for the lower-middle class. Total transfers among non-elderly average households increased $3,500 for the second quintile, $1,800 for the middle quintile, and $1,000 for the fourth quintile (2016 dollars).

Figure 7: Non-elderly Middle-Class Transfers as a Share of Market Income, 1979-2016



Source: Authors' calculations using data from CBO (2019).

Notes: Transfers include both social insurance benefits and means-tested transfers. Percentage point changes between 1979 and 2016 are shown at the right. Quintiles are defined based on household-size-adjusted market income of households of all ages. Middle class includes individuals in non-elderly households in the middle three income quintiles.

2.a. Falling Middle-Class Tax Burdens

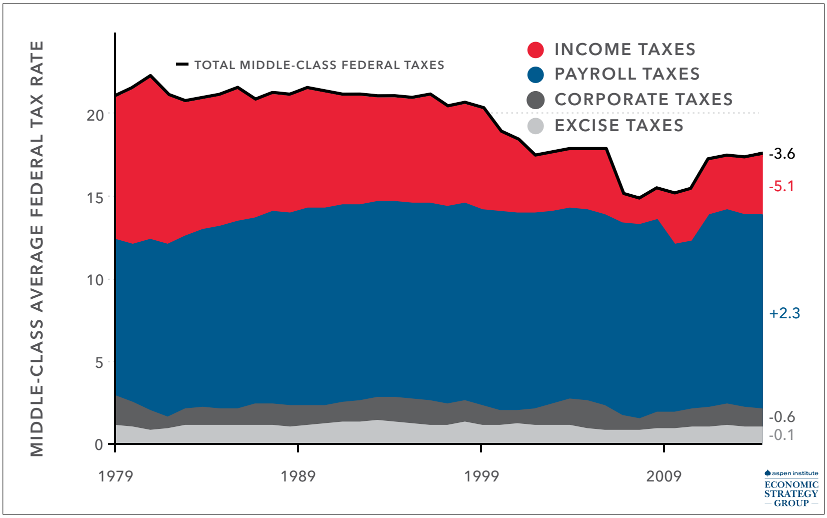
The decline in taxes on the middle class came primarily from declines in federal income tax liabilities, which have fallen significantly since 1979. For non-elderly middle-class households, Figure 8 shows a decrease of 3.6 percentage points in the federal taxes as a share of market income, from 21.1 to 17.5 percent.[10] Most of this decline in middle-class tax burdens resulted from permanent changes to the income tax code. Indexation in 1985 stopped nominal income increases from pushing the middle class into higher marginal rates via bracket creep. Larger standard deductions and numerous expansions to tax credits also lowered middle-class taxes. The short-lived decrease in middle-class taxes following the Great Recession resulted from temporary provisions, including the recovery rebate credit (2008), the making work pay credit (2009–2010), and the payroll tax holiday (2011–2012).

Another factor contributing to falling middle-class average tax rates was the growth in employer-provided health insurance benefits. These benefits are mostly tax-exempt and therefore their increase tends to reduce taxes that would otherwise be owed. According to the Joint Committee on Taxation, the federal income tax reduction (i.e., tax expenditure) due to the exclusion of employer-provided health insurance contributions

10 While including state and local taxes increases middle-class tax rate levels, it does not substantially affect the decrease in middle-class tax burdens. Auten and Splinter (2019a) estimated that average tax rates (federal, state, and local taxes) for the bottom 90 percent fell about 4 percentage points (from 25 to 21 percent).

increased between 1979 and 2016 from about $23 to $155 billion (real dollars) and is forecasted to exceed $200 billion by 2022. When also considering effects on payroll taxes, the exclusion of health and retirement benefits is much larger—reducing annual tax burdens by nearly a trillion dollars, much of which accrues to the middle class.

Figure 8: Non-elderly Middle-Class Federal Taxes as a Share of Market Income, 1979–2016



Source: Authors' calculations using data from CBO (2019).

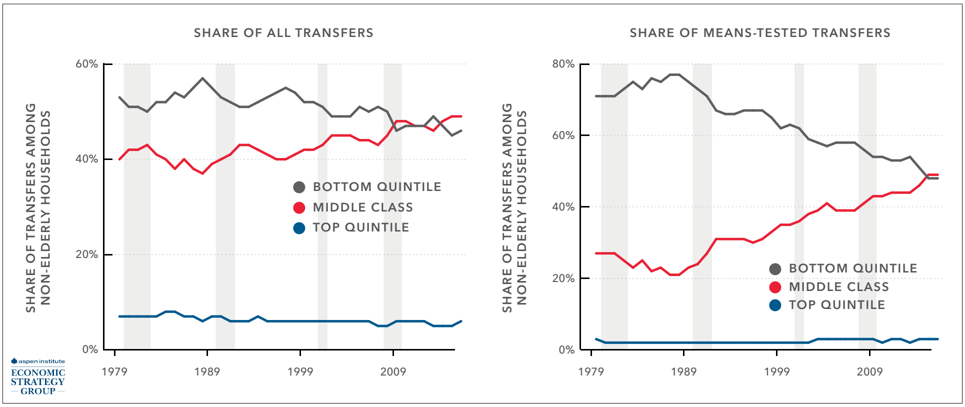
Notes: Transfers include both social insurance benefits and means-tested transfers. Percentage point changes between 1979 and 2016 are shown at the right. Quintiles are defined based on household-size-adjusted market income of households of all ages. Middle class includes individuals in non-elderly households in the middle three income quintiles.

Other middle-class tax expenditures are smaller and had offsetting changes. Middle-class tax units, as described above, saw a real increase in earned income and child tax credits between 1979 and 2016 from a negligible amount to over $30 billion. Tax expenditures for prominent deductions (state and local taxes, charitable contributions, and mortgage interest) fell from about $35 to $25 billion (real dollars). The post-2017 tax changes are expected to reduce the value of these deductions by about $20 billion but increase middle-class child credits by about $25 billion.

The middle-class reduction in taxes and increase in transfers resulted in part from changes in the overall magnitudes of taxes and transfers, but also from changes in the distribution of who pays taxes and who receives transfers. The left-panel of Figure 9 shows the share of transfers going to non-elderly households, divided among the bottom and top quintiles, as well as the middle class. Since 1979, the share of transfers going to the bottom quintile has fallen, while the share going to the middle class has risen from 40 percent to 49 percent.

The shift is even more dramatic when focusing only on means-tested transfers, which mostly consists of Medicaid, SNAP, and SSI. This is shown in the right panel of Figure 9. The middle class received 27 percent of means-tested transfers that went to non-elderly households in 1979. By 2016, the middle class received 49 percent of these transfers.

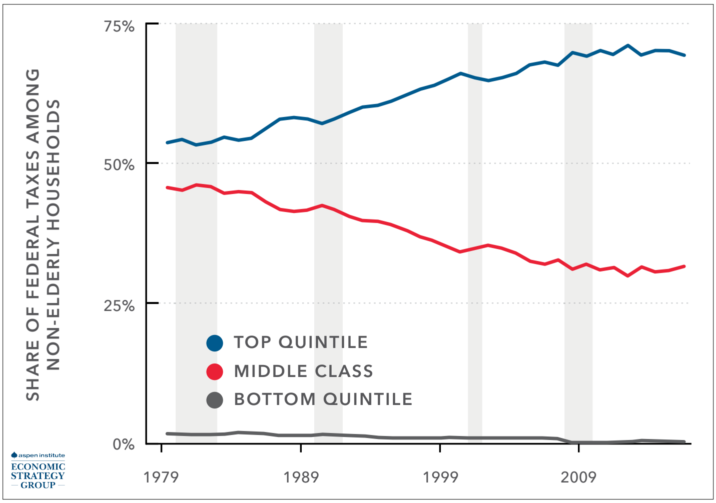
Figure 9. Distribution of Transfers among Non-elderly Households, 1979-2016



Source: Authors' calculations using data from CBO (2019).

Notes: Transfers received by elderly households are excluded. Means-tested transfers include Medicaid, CHIP, SNAP, and SSI, as well as other programs where eligibility is based on income. Quintiles are defined based on household size-adjusted market income of households of all ages. Middle class includes individuals in non-elderly households in the middle three income quintiles.

Figure 10. Distribution of Federal Taxes among Non-elderly Households, 1979-2016



Source: Authors' calculations using data from CBO (2019).

Notes: Quintiles are defined based on household size-adjusted market income of households of all ages. Middle class includes individuals in non-elderly households in the middle three income quintiles.

While the middle-class share of transfers has risen over time, their share of federal tax liabilities has fallen. Figure 10 shows the share of federal taxes paid by the non-elderly middle class, as well as those in higher- and lower-income quintiles. Since 1979, the share of federal taxes paid by the middle class has fallen from 45 percent to 31 percent, while the share paid by the top quintile of the distribution has increased from 53 percent to 69 percent.

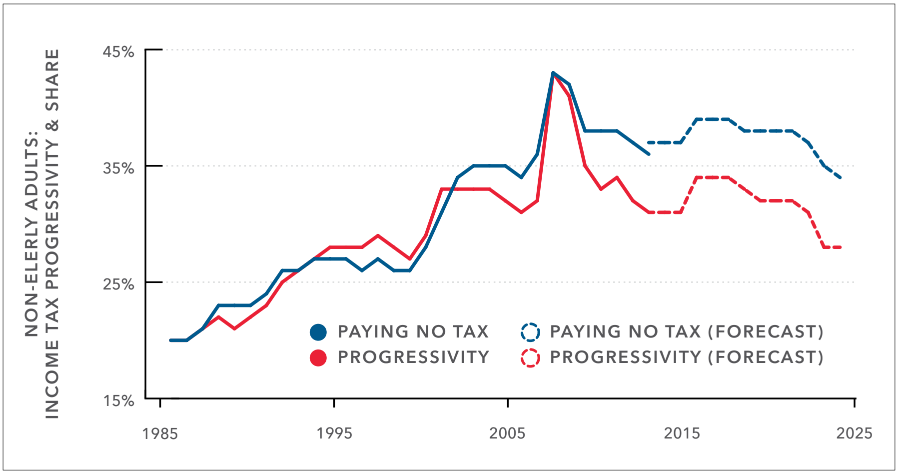
One obvious factor contributing to the increased concentration of tax burdens is the rising concentration of taxable income among high-income households. The increasing concentration of income in top-income households and the fact that a larger share of their income is taxed at the highest rate under a progressive system means that other things equal, these households pay a larger share of taxes. In other words, among non-elderly households, the main reason the share of taxes paid by the top income quintile increased from 53 to 69 percent between 1979 and 2016 is that the share of market income earned by that group increased from 47 to 58 percent.

Yet even when controlling for this effect, taxes have become more progressive in the sense that average tax burdens on middle-class households have declined more than among higher-income households. Since 1979, average federal tax rates for the top 1 percent of non-elderly households decreased almost 1 percentage point and for the bottom quintile decreased 11 percentage points. The larger decrease in the bottom of the distribution implies an increase in tax progressivity.[11]

Figure 11 shows two measures of increasing federal individual income tax progressivity. The Kakwani index (a Gini-like measure of tax progressivity) for non-elderly adults increased between 1985 and 2015 by nearly half. This was almost totally explained by expansions in earned income and child tax credits. Another indication of falling middle-class tax burdens is the share of non-elderly adults paying no income taxes. Between 1979 and 2018, this share increased from 22 to nearly 40 percent. Tax filers with children benefitted most from earned income and child tax credit expansions and this group had the largest increase in the share paying no income tax (Splinter 2019a).

11 These tax rates follow the CBO approach of dividing by market income plus social insurance benefits. Although the post-2017 tax changes are expected to have little effect on tax progressivity (i.e., how taxes are allocated over the income distribution), they should reduce levels of redistribution because federal taxes declined by about a tenth (Kallen and Mathur 2019; Splinter 2019a).

Figure 11: Federal Individual Income Tax Progressivity and Share of Non-elderly Adults Paying No Income Tax, 1985–2025



Source: Splinter (2019a).

Notes: Only includes tax units headed by non-elderly adults.

2.b. Considerations Other than Income for the Well-Being of the Middle Class

The more positive long-run income trends for the middle class that are observed when using after-tax, after-transfer income are also consistent with self-perceptions about their financial well-being and economic progress. The 2018 Survey of Household Economics and Decisionmaking (SHED) found that 56 percent of people felt that they were better off financially than their parents were at the same age, compared to just 19 percent who thought they were doing worse than their parents. These results are nearly the same among people with middle-class incomes between $40,000 and $100,000 per year.

Nevertheless, economic anxieties remain for some households that may not be fully captured by income trends. In particular, some people face a lack of emergency savings, difficulty saving for retirement, or high levels of student loan debt. For example, the SHED suggests that 15 percent of middle-income adults of all ages expected to leave one or more bills partially or completely unpaid in late 2018, and an additional 10 percent would leave bills unpaid if faced with a $400 emergency. Similarly, these data suggest that 16 percent of middle-income non-retirees have no retirement savings. Consequently, while most middle-class households report they are doing at least okay financially, some are stretched financially and struggle both with their immediate expenses and long-term savings goals.

Additionally, some people face anxieties over other expenses that may be higher than for previous generations. The average annual cost for preschool-age childcare averages more than $9,000 (Childcare Aware of America 2019). The costs of childcare have far outpaced the rate of inflation in recent decades (Buffie 2016). Education costs and school debt have also increased rapidly. The net price of tuition, fees, room, and board at a four-year public institution rose by 70 percent in the last two decades, from about $9,000 to over $15,000 in 2019 dollars (CollegeBoard 2019). Consistent with this increase in higher education costs, more students are now borrowing for their education. The Federal Reserve Board (2019) finds that 30 percent of all adults incurred debt from their education, but among young adults (ages 18 to 29), 43 percent had done so.

Despite this rise in student loan debt in recent decades, most people who complete a degree think that the benefits of their education outweigh the costs. Those who feel that their education was not worth the cost are disproportionately people who either did not complete a degree or who went to for-profit institutions, which is consistent with the high rates of student loan default and delinquency found among these borrowers (Looney and Yannelis 2015). High costs of college and rising student loan debt reduce the net benefits of education for students. Yet for most, the net financial return remains positive and college graduates are typically better off financially than those who did not go to college.

Although these rising expenses pose a substantial concern for some middle-class households, subsidies through the tax code (tax expenditures) alleviate some of the burden of these specific expenses. Childcare is subsidized with both the dependent care tax credits and flexible spending accounts. Medical expenses are subsidized with the medical expense deduction. Education expenses are subsidized with the deduction of student loan interest, education tax credits, and section 529 savings plans. Among those receiving each type of subsidy, Joint Committee on Taxation (2019) estimates suggest that middle-class tax units (incomes between $40,000 and $100,000 and including the elderly) received an average of $600 for dependent care credits, $900 for medical expense deductions, and $600 for education credits. Upper-middle-class tax units (incomes between $100,000 and $200,000) have larger average subsides: $800 for dependent care credits, $2,200 for medical expense deductions, and $2,000 for education credits.

3. Implications

3.a. The Role of Health-Care Spending in Middle-Class Economics

Health-care spending has clearly played a major role in the financial well-being of the middle class in recent decades. A substantial share of transfers is in the form of health insurance benefits, and the exclusion of employer-provided health insurance from taxation represents the largest tax benefit to middle-class households. Hence, healthcare costs increase the pressure on federal budgets as the cost of insurance has risen over time.

In addition, the rising cost of health care and health insurance is also one contributing factor to slower growth in middle-class cash wages over time. The average cost of health insurance to employers in 2019 was about three dollars per hour worked, or $6,365 per year for a full-time worker (Bureau of Labor Statistics 2019). This is up from $4,930 in 2009. Although this is a benefit that is valuable to employees, these health insurance contributions are a substitute for cash wages. As a result, to the extent that the cost of health insurance benefits has risen faster than inflation, it has slowed the growth in cash wages for workers.

While the design of federal health-care policy is beyond the scope of our analysis, we highlight health-care spending because of its outsized role in both government and middle-class budgets, and because many health economists believe the U.S. health-care system is uniquely inefficient. To the extent that health-care spending could deliver the same health outcomes and lower costs, efficiency enhancements could improve middle-class well-being and improve federal (and state) budgets.

3.b. Will Federal Tax and Transfer Policies Continue to Boost Middle-Class Incomes?

The boost to middle-class incomes from federal policy is partially the result of changes in the budget that are unlikely to continue, like the reduction in defense spending as a percent of GDP and the increase in budget deficits over the last two decades. Government spending on public goods like defense, infrastructure, and research and development have already been reduced to historical lows, which means there is less capacity (and political interest) to swap "guns for butter." Whether recent levels of deficit spending are sustainable is unclear. But perpetual increases in deficits are clearly unsustainable. Hence, it is not possible that aggregate increases in net federal spending alone will fund increasingly generous middle-class transfers.

Absent aggregate increases in net transfers, the other avenue to boost the incomes of low- or middle-class households is through redistribution from higher-income households. While more redistribution is certainly feasible, there are also practical limitations to using taxes and transfers to increase material well-being, particularly for the middle class. The key limitations governing the capacity to tax higher-income households and transfer to lower-income households are the relative number and incomes of those households.

For instance, raising the incomes of poor households by "taxing the rich" is straightforward when the number of poor households receiving transfers is a relatively small share of the population. As these poor households earn only a small share of total income, meaningful increases in income can be financed with modestly higher taxes on the remaining tax base. However, increasing the number of households that benefit from transfers (or tax cuts) is costly for two reasons: First, it mechanically increases the number of recipient households and reduces the number of paying households. Second, it requires higher marginal tax rates on paying households that cause a narrowing of the tax base due to avoidance and behavioral changes.

Table 2 provides the results of a simple empirical exercise examining this tradeoff: If you raise the income of specified households by 10 percent and fund these transfers with taxes on higher-income households, what is the necessary tax rate? This illustrates upper bounds on the level of taxes and transfers. In the exercise, we assume that the new tax applies to a broad tax base, inclusive of all market income (including elements of market income currently excluded from tax or taxed at low rates, such as tax-exempt interest or capital gains and dividends), and abstract from practical considerations like how the transfer would be phased out. In practice, if the tax base is narrower or if transfer policies are phased out above the income thresholds we specify, then implied tax rates would be even higher. We also include households of all ages in this exercise, and not just the non-elderly households discussed above. Additionally, we assume a constant elasticity of taxable income, but to the extent that behavioral responses such as tax sheltering are non-linear, this could further underestimate the necessary implied tax rates.

Each panel of Table 2 shows a policy that boosts the income of a low-income group by 10 percent and pays for it by raising the tax rate on higher-income groups, where only income above the group's threshold is subject to the new tax. For instance, the top panel examines the policy of boosting the incomes after taxes and transfer of the bottom quintile of households by 10 percent. We estimate that this policy requires $87 billion in new revenues. Each row assumes that the increase in taxes applies to different income groups, starting with taxpayers in the top 80 percent and culminating with the top 1 percent (i.e., the tax applies to income above the 20th and 99th percentiles, respectively). For reference, the first column shows the current average (or effective) tax rate of higher-income taxpayers. The second column shows the new required average tax rate. The third and fourth columns show the increases in average and marginal tax rates; the latter equals the increase in the tax bracket rate if applied to all market income above the income group threshold. The final column shows the minimum post-reform average marginal tax rate that must apply to all income above the threshold to achieve the required revenue.

When bottom-quintile households receive the transfer and taxes are increased for the top 80 percent, average and marginal tax rates of the higher-income group must increase by about 1 percentage point. With a modest fiscal cost and a broad tax base, only small changes in fiscal policy are needed to boost the material well-being of low-income households. Even when the tax increase is confined to the top 10 percent of households, their average tax rates must increase by 2 percentage points to fund the transfer; and when only taxing the top 1 percent, their average tax rates must increase by 6 percentage points.

However, expanding the transfer up the income distribution roughly doubles the cost for each additional quintile. And, it also narrows the available tax base (as income amounts under that threshold are no longer subject to tax, even if earned by higher-income households). For instance, when households in the bottom two quintiles are recipients of the transfer (which now costs $212 billion per year), as shown in Panel B, increases in average tax rates for the top 10 percent and 1 percent are 6 and 15 percentage points (and require increases in the marginal rates of 11 and 20 percentage points).

Table 2: Average Federal Tax Rates to Increase Certain Incomes by 10 Percent

Tax increase group	Average tax rates of tax increase group			Marginal tax rate increase	Post-reform average marginal tax rate
	Original	Post-reform	Increase		
Panel A: Increase incomes by 10 percent for bottom quintile. Cost: $87 billion					
Top 80%	27	28	1	1	32
Top 60%	28	29	1	2	34
Top 40%	30	31	1	2	37
Top 20%	32	33	2	3	40
Top 10%	33	36	2	4	42
Top 5%	35	38	3	5	43
Top 1%	37	43	6	8	48
Panel B: Increase incomes by 10 percent for bottom two quintiles. Cost: $212 billion					
Top 60%	28	31	3	4	37
Top 40%	30	33	3	6	41
Top 20%	32	36	4	9	45
Top 10%	33	39	6	11	48
Top 5%	35	43	8	13	51
Top 1%	37	52	15	20	60
Panel C: Increase incomes by 10 percent for bottom three quintiles. Cost $378 billion					
Top 40%	30	35	6	11	46
Top 20%	32	39	8	16	53
Top 10%	33	44	11	20	58
Top 5%	35	50	15	25	63
Top 1%	37	68	30	43	83
Panel D: Increase incomes by 10 percent for bottom four quintiles. Cost $607 billion					
Top 20%	32	44	13	27	64
Top 10%	33	52	18	36	74
Top 5%	35	61	26	46	85
Top 1%	37	infeasible	infeasible	infeasible	infeasible

Source: Authors' calculations using data from CBO (2019).

Notes: Incomes and taxes are for 2016. Only income above the tax increase group threshold is subject to the tax increase. An elasticity of taxable income of 0.35 is used to estimate new revenue-neutral tax rates and original marginal tax rates are assumed to equal average tax rates. No behavioral effects are included among transfer recipients. Income increases of 10 percent are based on after-tax, after-transfer income, which deducts federal taxes and includes all social insurance benefits and means-tested transfers. Quintiles are defined based on household size-adjusted market income of households of all ages, and individuals of all ages are included in these calculations. The bottom quintile excludes those with negative incomes. Although not accounted for, this simple exercise would result in some re-ranking of households.

When extending transfers to cover the middle class, the cost of the transfer increases substantially. This is because, in addition to increasing the number of recipients, the newly eligible households have higher incomes that require additional resources to raise their incomes by 10 percent. Furthermore, because the increase in tax rates must start at a higher income level (and thus, on a narrower base) the required tax rate increase is substantially greater. Panel D shows how increasing incomes of all households in the bottom four quintiles (i.e., below the 80th percentile) affects average tax rates. This policy costs $607 billion per year. Taxing households in the top 10 percent to fully fund this transfer would increase this group's average tax rate by 18 percentage points, but require their marginal tax rate to increase by 36 percentage points to 74 percent. There is no historical precedent for applying marginal rates of this magnitude to a significant fraction of the population, which would be necessary to fund a 10 percent increase in middle-class incomes.[12] Finally, the top 1 percent could not pay for this middle-class income increase, because the necessary marginal tax rate would exceed 100 percent. While the analysis shows that increases in progressivity and government revenues are clearly feasible, it also suggests larger tax increases concentrated among narrower groups of taxpayers require increasingly outsized changes in tax rates.

Conclusion

On average, non-elderly, middle-class households pay slightly more in taxes than they receive in current transfers and social insurance benefits. While this might suggest that federal policies are neutral—taking in the same amount in taxes as it provides in benefits—several caveats apply.

First, federal policies redistribute across different types of middle-income households and over the course of their lifetimes. For instance, other things equal, households with children benefit more from federal policies as does the lower-middle class as compared to the upper-middle class. Moreover, a substantial fraction of the current tax burden on non-elderly households is in the form of payroll taxes that fund Social Security and Medicare benefits those households will draw on in the future. An implication is that the annual burden from payroll taxes exaggerates the lifetime burden on these households.

Second, federal policies provide substantial insurance to middle-class households against unemployment, disability, or spending needs. Many middle-class households experience such risks temporarily. Hence, a sizable share of benefits from means-

12 When top individual income tax rates were on this order in the early 1960s, only a few thousand tax returns (less than 0.01 percent) were subject to these rates, in part from the tax sheltering that they caused (Splinter, 2020).

tested transfers and low-income tax provisions accrue to middle-class households over the course of their lives.

Finally, changes in transfers and federal tax policies have increasingly boosted the incomes of the middle class over time. Increasing means-tested transfers (primarily related to health care and disability) and decreasing income taxes largely explain this trend. Since 2000, non-elderly, middle-class incomes grew three times faster when accounting for transfers and federal taxes.

References

Auten, Gerald, and David Splinter. 2019a. "Income Inequality in the United States: Using Tax Data to Measure Long-term Trends." Working paper. Available at davidsplinter.com/AutenSplinter-Tax_Data_and_Inequality.pdf

---. 2019b. "Top 1% Income Shares: Comparing Estimates Using Tax Data." *AEA Papers and Proceedings* 109: 307–311.

Bee, Adam, and Joshua Mitchell. 2017. "Do Older Americans Have More Income Than We Think?" SESHD Working Paper No. 2017-39. www.census.gov/content/dam/Census/library/workingpapers/2017/demo/SEHSD-WP2017-39.pdf

Bee, Adam, and Jonathan Rothbaum. 2019. "The Administrative Income Statistics (AIS) Project: Research on the Use of Administrative Records to Improve Income and Resource Estimates." SESHD Working Paper No. 2019-36. www.census.gov/content/dam/Census/library/workingpapers/2019/demo/sehsd-wp2019-36.pdf

Bollinger, Christopher R., Barry T. Hirsch, Charles M. Hokayem, and James P. Ziliak. 2019. "Trouble in the Tails? Earnings Non-Response and Response Bias across the Distribution." *Journal of Political Economy* 127(5): 2143–2185.

Buffie, Nick. 2019. "Child Care Costs Continue to Outpace General Inflation." Center for Economic and Policy Research. Available at https://cepr.net/prices-2016-08/

Bureau of Labor Statistics. 2019. "Employer Costs for Employee Compensation (ECEC)" https://www.bls.gov/ect/

Burkhauser, Richard V., Kevin Corinth, James Elwell, and Jeff Larrimore. 2019. "Evaluating the Success of President Johnson's War on Poverty: Revisiting the Historical Record Using a Full-Income Poverty Measure." Working Paper No. 26532. National Bureau of Economic Research.

Burkhauser, Richard V., Shuaizhang Feng, Stephen P. Jenkins, and Jeff Larrimore. 2011. "Estimating Trends in US Income Inequality Using the March Current Population Survey: The Importance of Controlling for Censoring." *Journal of Economic Inequality* 9(3): 393–415.

Burkhauser, Richard V., Jeff Larrimore, and Kosali I. Simon. 2012. "A 'Second Opinion' on the Economic Health of the American Middle Class." *National Tax Journal* 65(1): 7–32.

CollegeBoard. 2019. "Trends in College Pricing 2019" https://research.collegeboard.org/pdf/trends-college-pricing-2019-full-report.pdf

Congressional Budget Office. 2008. "Recent Trends in the Variability of Individual Earnings and Household Income." Washington, D.C.: Congressional Budget Office.

---. 2019. "The Distribution of Household Income, 2016." Washington, D.C.: Congressional Budget Office.

Darity, William Jr., Fenaba R. Addo, and Imari Z. Smith. 2020. "A Subaltern Middle Class: The Case of the Missing 'Black Bourgeoisie' in America." *Contemporary Economic Policy*. Advanced online publication. https://doi.org/10.1111/coep.12476.

DeSilver, Drew. 2017. "What does the federal government spend your tax dollars on? Social insurance programs, mostly." Pew Research Center. https://www.pewresearch.org/fact-tank/2017/04/04/what-does-the-federal-government-spend-your-tax-dollars-on-social-insurance-programs-mostly/

Dowd, Tim, and John B. Horowitz. 2011. "Income Mobility and the Earned Income Tax Credit: Short-Term Safety Net or Long-Term Income Support." *Public Finance Review* 39(5): 619–652.

Federal Reserve Board. 2019. "Report on the Economic Well-Being of U.S. Households in 2019." www.federalreserve.gov/publications/files/2018-report-economic-well-being-us-households-201905.pdf

Gale, William G., Jonathan Gruber, and Seth Stephens-Davidowitz, 2007. "Encouraging Homeownership through the Tax Code." *Tax Notes* 115(12): 1171–89.

Gale, William G., Melissa S. Kearney, and Peter R. Orszag, 2015. "Would a significant increase in the top income tax rate substantially alter income inequality?" Economic Studies at Brookings. www.brookings.edu/wp-content/uploads/2016/06/would-top-income-tax-alter-income-inequality.pdf

Hanson, Andrew, 2012. "The Incidence of the Mortgage Interest Deduction: Evidence from the Market for Home Purchase Loans." Public Finance Review 40(3): 339–59.

Heim, Bradley T., Ithai Z. Lurie, and James Pearce. 2014. "Who Pays Taxes? A Dynamic Perspective." *National Tax Journal 67*(4): 755–778.

Joint Committee on Taxation. 2019. "Estimates of Federal Tax Expenditures for Fiscal Years 2019-2023." JCX-55-19. Available at www.jct.gov/publications.html?func=startdown&id=5238

Jones, Maggie, and James Ziliak. 2020. "The Antipoverty Impact of the EITC: New Estimates from Survey and Administrative Tax Records." Working Paper 19-14, Center for Economic Studies, U.S. Census Bureau.

Kallen, Cody, and Aparna Mathur. 2019. "Estimating the Distributional Implications of the Tax Cuts and Jobs Act." AEI Economics Working Paper 2019-07.

Larrimore, Jeff, Richard V. Burkhauser, Gerald Auten, and Philip Armour. 2016. "Recent Trends in U.S. Top Income Shares in Tax Record Data Using More Comprehensive Measures of Income Including Accrued Capital Gains." Working Paper No. 23007, National Bureau of Economic Research.

Larrimore, Jeff, Richard V. Burkhauser, and Philip Armour. 2015. "Accounting for Income Changes over the Great Recession Relative to Previous Recessions: The Impact of Taxes and Transfers." *National Tax Journal* 62(2): 281–318.

Larrimore, Jeff, Jacob Mortenson, and David Splinter. 2016. “Income and Earnings Mobility in U.S. Tax Data” In *Economic Mobility: Research & Ideas on Strengthening Families, Communities & the Economy,* edited by Alexandra Brown David Buchholz Daniel Davis Arturo Gonzalez, 481–516. Federal Reserve Bank of St. Louis and the Board of Governors of the Federal Reserve System.

---. 2019. “Household Incomes in Tax data: Using Addresses to Move from Tax Unit to Household Income Distributions” *Journal of Human Resources*. Advance online publication. https://doi.org/10.3368/jhr.56.2.0718-9647R1.

---. 2020. “Presence and Persistence of Poverty in U.S. Tax Data.” In *Measuring and Understanding the Distribution and Intra/Inter-Generational Mobility of Income and Wealth*, edited by Raj Chetty, John N. Friedman, Janet C. Gornick, Barry Johnson, and Arthur Kennickell. Cambridge, MA: National Bureau of Economic Research.

Larrimore, Jeff, and David Splinter. 2019. “How Much Does Health Insurance Cost? Comparison of Premiums in Administrative and Survey Data.” *Economics Letters* 174: 132–135.

Looney, Adam, and Constantine Yannelis. 2015. “A Crisis in Student Loans?: How Changes in the Characteristics of Borrowers and in the Institutions They Attended Contributed to Rising Loan Defaults.” *Brookings Papers on Economic Activity* 2015(2): 1-89.

Reeves, Richard V., Katherine Guyot, and Eleanor Krause. 2018. “Defining the Middle Class: Cash, Credentials, or Culture.” Brookings Institution. www.brookings.edu/research/defining-the-middle-class-cash-credentials-or-culture/

Sabelhaus, John, and Alice Henriques Volz, 2020. “Social Security Wealth, Inequality, and Lifecycle Saving.” Working Paper No. 27110, National Bureau of Economic Research.

Silverman, Dan. 2020. “Walking the Tightrope: Variable Income and Limited Liquidity among the US Middle Class.” In *Securing Our Economic Future*, edited by Amy Ganz and Melissa Kearney, Aspen Institute Press.

Splinter, David. 2019a. “Who Pays No Tax? The Declining Fraction Paying Income Taxes and Increasing Tax Progressivity.” *Contemporary Economic Policy* 37(3): 413–426.

---. 2019b. “The Mortgage Interest Deduction: Causes of Fluctuations in a Procyclical Tax Expenditure.” *Public Finance Review* 47(5): 807–827.

---. 2019c. “Progressive Growth: Comparing Cross-Sectional and Panel Approaches.” Working Paper.

---. 2020. “U.S. Tax Progressivity and Redistribution.” Working Paper.

Splinter, David, Victoria Bryant, and John Diamond. 2009. “Income Volatility and Mobility: U.S. Income Tax Data, 1999–2007.” Proceedings of the 102nd Annual Conference of the National Tax Association.

Walking the Tightrope: Variable Income and Limited Liquidity Among the US Middle Class

AUTHOR

Dan Silverman*

ABSTRACT

The Great Recession, and now the economic upheaval surrounding COVID-19, have intensified focus on the financial tightrope that many American families walk. Even outside of a crisis, large fractions of U.S. households face substantial variation in their incomes, with only small buffers of liquid savings. This chapter describes a body of evidence, drawn mostly from administrative data that have recently become available for academic research, showing that large fluctuations in household income are commonplace both across and within years. Even while employed, many U.S. households do not receive very steady streams of income. At the same time, these households maintain low levels of liquid savings. On the day before their paycheck arrives, fewer than 30 percent of households with at least one member working for salary have enough in their checking or savings accounts to cover 10 days of typical spending. In this way, it appears that millions of U.S. households are badly insecure. They have few resources to weather even moderately sized shocks to income or spending. Their reactions to shocks reveal, however, substantial resilience. Household

*Arizona State University and National Bureau of Economic Research

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spending declines sharply in response to big declines in income, but many find ways to re-arrange obligations and maintain large fractions of consumption. The response of spending to predictable changes in income also indicates that households prefer to rearrange spending when required, rather than reduce consumption to accumulate a buffer of savings. This implies that interventions intended to increase liquid savings buffers will have limited success and household spending will continue to move with the vicissitudes of income. These findings indicate that policy should focus on limiting the uninsured risks families face, rather than try to promote self-insurance through the accumulation of liquid savings.

Introduction

The Great Recession, and the economic upheaval surrounding COVID-19, have intensified focus on the financial tightrope that many American families seem walk. The consequences of these crises for employment, income, and other indicators of well-being, have stoked concern about the precarious financial position of many working- and middle-class households. Even in normal times, working Americans often face substantial volatility in their incomes and have only very limited liquid savings to buffer it. Especially since the Great Recession, observers have drawn more attention to these patterns and warned that many U.S. households appear to remain badly insecure, perhaps just one missing paycheck or one costly car repair away from major and lasting economic hardship (Lusardi, Schneider, and Tufano 2011; Kristof and WuDunn 2020; Morduch and Schneider 2018; Hasler, Lusardi, and Oggero 2018).

Anonymized administrative data on both income and liquidity, recently made available for academic research, have enriched and clarified the picture on financial insecurity in the United States and elsewhere. In many ways, these new data reinforce the findings of prior surveys, focus groups, and interviews. Long, individual- and household-level histories of tax records, and similar panels of individual-level bank records, show that income varies in important ways, both across and within years. These records indicate that income volatility is not, however, a new phenomenon driven by recent changes in the structure of labor markets and the nature of work. The administrative files show little or no increase in the volatility of income in the past 25 years or so.

Despite the variability of income, or perhaps because of it, recent studies of detailed bank records show that large fractions of U.S. households maintain very limited balances in their liquid checking and savings accounts. By one recent measure, on the day before their paycheck arrives, fewer than 30 percent of families working for salary have enough in their checking or savings accounts to cover 10 days of typical spending.

These same kinds of data reveal, however, another set of facts about income, assets, and spending, that complicate the view of the financial tightrope. In particular, recent examinations of the various ways in which households respond to unexpected changes in income show that many households, despite little liquidity, exhibit substantial resilience. Detailed studies of the responses of federal workers to the big drop in pay from a government shutdown show that households use many different, and sometimes overlooked channels to cope with these often very large income shocks. Households hit by big income shocks do reduce their spending substantially. But they also defer paying bills, often at relatively modest, long-term cost or increases in debt when, as is typical, some forbearance is offered. When the negative income shocks are more persistent, these households often turn to government and social safety nets (see, Looney, Larrimore, and Splinter 2020, in this volume), but also to greater labor supply. When the shocks to income are positive, there too we see adaptation of spending and relatively little evidence of additional saving.

The same financial records that show both nimble responses to seemingly large and unexpected changes in income, and low levels of liquid assets, also reveal substantial sensitivity of spending to the arrival of even highly predictable income. Even for individuals who receive a regular paycheck, spending rises sharply on payday and the four or five days that follow. This is not just a phenomenon of the lowest-income households. Many working-class, middle-class, and high-income households maintain relatively little cash in their savings and checking accounts and spend much more in the few days after payday than they do in the few days before.

This evidence on the nimbleness of households in the face of income shocks, and on the low liquid assets and sensitivity of spending to predictable income across the income spectrum, gives perspective on the financial tightrope so many seem to walk. It suggests that the emphasis of economic theory on precautionary saving and maintaining steady levels of consumption, or "consumption smoothing," may be misplaced. While the vast majority of working families would undoubtedly prefer greater certainty in their financial lives, they are perhaps understandably unwilling to give up a great deal of consumption in order to obtain it. They are not, in other words, willing to sacrifice a lot of important spending now—a home near good schools, decent clothes for work, replacements for bald tires—in order to secure a large liquid buffer to rely on when income is low. This appears to be due in part because many households do not seem to value consumption smoothing that much, but also because they can often use other mechanisms to help them get by.

From this perspective, well-intended efforts to improve the financial knowledge of working families, or to incentivize them to build liquid savings buffers, or to reduce imperfections in the markets in which they borrow and save, are unlikely to succeed at getting many off the tightrope. In-depth interviews and first-hand accounts make clear that balancing in such a precarious financial position produces major strain, diminishes many aspects of well-being, and can result in lasting financial damage. At the same time, many working families seem to be remarkably adept at it, are able to lean far without falling off entirely, and do not accumulate large savings buffers even as their incomes rise. It thus seems that, when given the choice between a steady, but substantially lower, level of consumption throughout the year, or a higher average level of consumption that involves the potential for significant highs and lows, many people seem to prefer the more precarious route.

This view suggests that the path to greater financial security for middle-class households is not through efforts that encourage self-insurance with liquid savings or their fintech equivalents. Instead, the evidence on income volatility, liquid savings, and the spending response to income changes indicates that efforts to improve the financial security of middle-class households should focus on reducing the uninsured risk that they face. Those efforts might take traditional forms of social insurance, such as public unemployment and disability insurance, or mandatory paid sick-leave policies. Innovations like the emergency rental assistance program proposed in Ellen, O'Regan, and Ganz (2020) would also fall under this heading. Alternatively, policy could require or encourage employers to bear more of the income risk that their employees now face. Minimum wage policies are one form of reducing such risk at the low end of the earnings distribution. Others include predictable scheduling requirements.

As always, policymakers should consider the social cost of policies and interventions designed to reduce the income risk that workers face. That cost may be borne by taxpayers who fund social insurance programs, or by the workers themselves who may need to accept lower wages, fewer hours, or longer periods of unemployment in exchange for more stable incomes. The costs of self-insurance in terms of near-term consumption forgone are, it seems, too high for many households to accept.

1. Benchmark Theories of Spending, Saving, and Consumption

Economic analyses of household spending, saving, and consumption have been guided, in large part, by theories of consumption smoothing and precautionary saving. These theories, including the permanent income hypothesis (Friedman 1957; Hall 1978), and the buffer-stock saving model (Carroll 1997), are based on the intuitive notion of a diminishing marginal utility of consumption. When consumption is already high, there is less value from having a bit more. Conversely, when the level is low, the value of additional consumption is high. This natural assumption often implies a preference for consumption smoothing. Better to have average consumption somewhat lower but coming at a steady rate, than to have it higher on average, but subject to serious highs and lows. When income is volatile, the value of consumption smoothing motivates, in turn, precautionary saving. Households seeking to keep their consumption smooth should forgo some spending in order to build and maintain a buffer of liquid assets to spend when income is low.

As analysts use these benchmark theories to understand data on household finances, three central issues emerge. First, the theories focus on smoothing *consumption*, not spending. Data on consumption are, however, much harder to obtain than data on spending. Indeed, it is sometimes difficult to even conceive of what the right measure of consumption of some goods, like housing, cars, or appliances, should be. Testing the theories with spending data must therefore be done with care.

Second, the benchmark prediction of consumption smoothing relies on households not being "liquidity constrained." Consumption is predicted to remain steady only if households either have enough of a savings buffer built up, or if they have access to credit markets to make up the difference when both income and savings are too low. In reality, many households may be liquidity constrained because credit markets are incomplete and, as a result, the cost of a loan may be too high relative to the value of keeping consumption smooth.

Third, the benchmark theories imply that the spending and consumption responses to income changes should depend on the extent to which those changes are predictable and persistent. In the absence of liquidity constraints, the theories predict that spending should not much respond to long-anticipated changes in income. Spending should not jump, for example, with the first paycheck after a raise associated with years of service on the job. The theory says that increase should have been largely anticipated and consumption smoothed accordingly. Similarly, a one-time and entirely surprising "transitory" change in income should also result in only a modest change in spending. As long as they weren't liquidity constrained, the household should smooth out most of that shock to income over time. A primary exception to this consumption smoothing rule is when the household thinks of the shock to income as highly persistent or "permanent." If something changes and from now on the household anticipates its income will be persistently higher (lower), the theory predicts spending to jump (fall) with the news.

2. Data Sources on Income and Assets

It has long been challenging for researchers to measure the variability of individual or household incomes, and the extent to which that variability is unpredictable. It has been similarly difficult to measure the liquid assets that households keep on hand to cover their expenses when income is low. Evidence about these aspects of household finances have improved, however, in recent years as administrative records have been made available to augment the self-reports of survey respondents. As a result, researchers now have a more complete picture of how variable and unpredictable household income is, and how well-buffered households are against downturns in income. In the appendix to this chapter, I offer some background on how measurement of these elements of household finance have changed. The main text focuses on some key facts that have emerged from the new sources of data.

3. Facts about Income Variability from Administrative Data

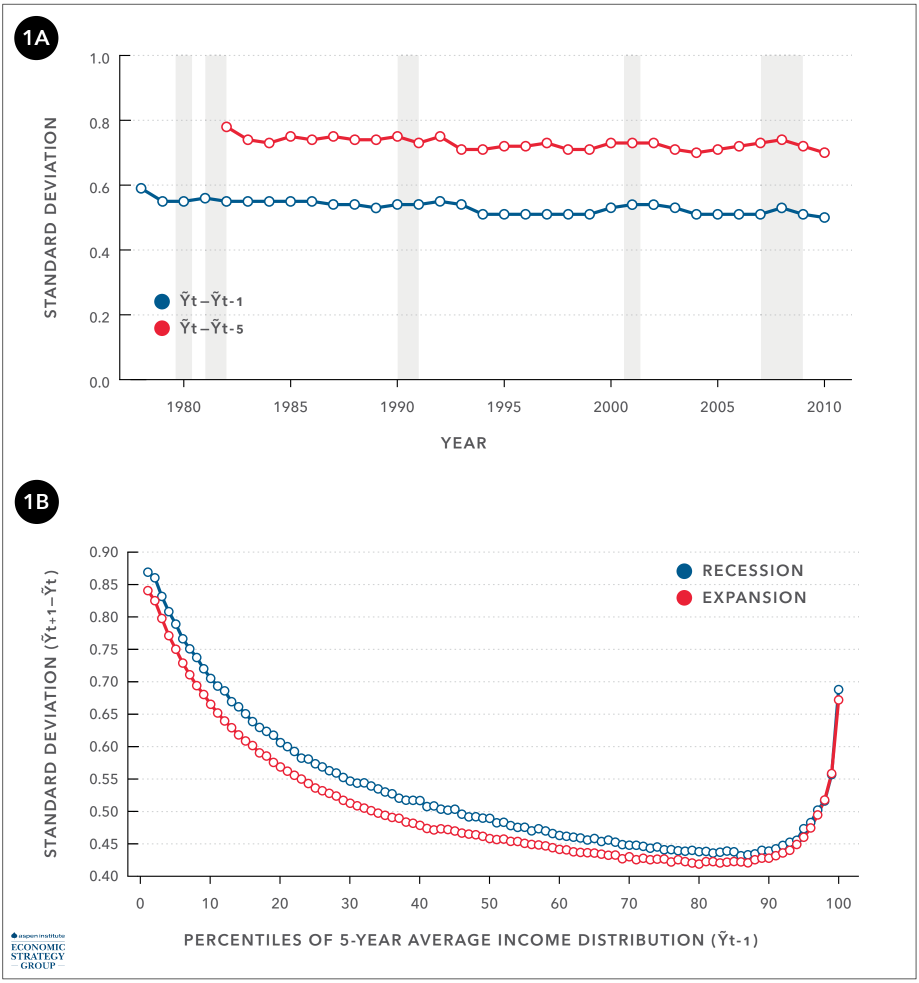
Recent studies based on administrative data cast doubt on both the idea that being middle class means receiving steady earnings year-to-year and the idea that earnings have become increasingly variable since the 1980s. In one especially influential study using U.S. Social Security Administration (SSA) records, Guvenen, Ozkan, and Song (2014), study the volatility of individual male earnings alone in order to isolate the effects of the macro economy on income volatility, as opposed to the influence of labor supply decisions related to childbirth and child rearing, which are concentrated among women. Figure 1(a), copied from Guvenen, Ozkan, and Song (2014), plots in blue show the standard deviation of "transitory" income shocks—that is, year-to-year changes in income from 1979 to 2011.[1] The plot in red similarly shows the standard deviation of "permanent" income shocks over the same period, measured as five-year changes in income. The average of the first difference tends to track the change in average earnings quite well, so it is usually close to zero. Thus, this figure gives a good sense of the distribution of the percentage changes in annual income year to year.

Notably, the standard deviation ranges from approximately 0.50 to 0.60 over the 33 years covered in the study and appears to decline somewhat over time. A standard deviation of log earnings of 0.5 implies about a third of the population experiences an increase in annual income greater than 50 percent or a decline of more than 40 percent.[2] Taking a longer horizon, the plot of the standard deviation of five-year differences in the log of annual earnings tells a similar story.

1 Because Guvenen, Ozkan, and Song (2014) are focused on how earnings risk depends on the macro economy, they delineate (in grey) recessionary periods. Other income, such as self-employment, business income, or asset earnings, is not be included. Recall that calculating household earnings from just the SSA files is difficult.

2 To translate the standard deviations into fractions of the population, it helps to know that the distribution of log earnings is approximately normal and, thus, so is the distribution of annual differences in earnings.

Figure 1: The Standard Deviation of Percentage Changes in Annual Income, Over Time and by Percentile of the Average Income Distribution



Source: Guvenen, Ozkan, and Song (2014)

Figure 1b, also copied from Guvenen, Ozkan, and Song (2014), shows that the variation in annual income is greatest at the very high and low ends of the income distribution. At the 10th percentile of the age-adjusted income distribution, for example, the standard deviation of the log of annual income is approximately 0.7. At the median of the income distribution this number is 0.45, and at the 99th percentile it rises again to nearly 0.7.

These results cast doubt on the idea that being middle class means receiving steady earnings year to year. The tax records show instead that, for many years now, large changes in annual earnings are not rare, including for those around the middle of the earnings distribution.

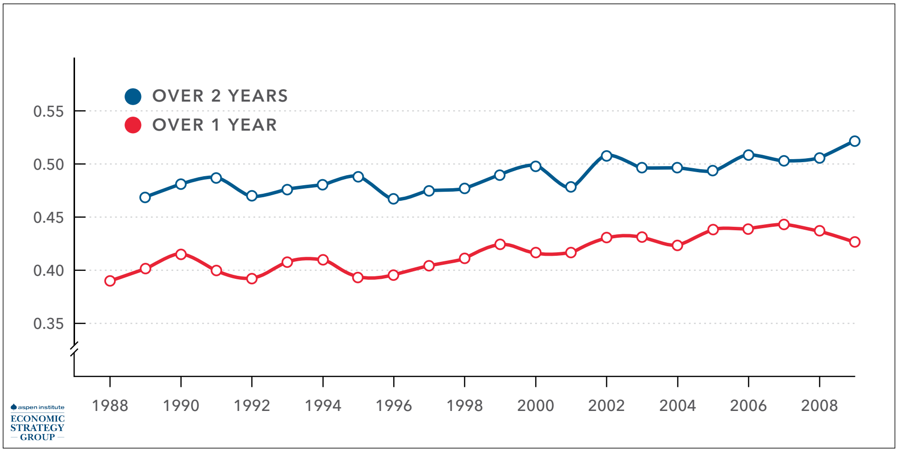
The focus on men's earnings alone could, however, be misleading about the volatility of household income. Large declines in an individual's annual earnings may, for example, be due to spells of unemployment. According to the Current Population Survey, about 70 percent of unemployed people live with someone who is currently employed, and 61 percent with someone working full time. As a result, the percentage change in the annual income of the whole household might be more modest. Alternatively, if the variation in earnings derives largely from factors besides unemployment, and if the income of household members is highly correlated, then we would expect household income to be about as variable as individual earnings.

DeBacker et al. (2013) assess this question using panel income data from tax returns over the years 1997–2009. First, isolating men's earnings from these tax returns, that study finds a similar, if somewhat smaller, degree of volatility in that source of income than what Guvenen et al. (2014) show.[3] In the tax return data, the standard deviation of percent changes in men's annual earnings rises from around 0.40 to around 0.43 over this period—lower than what the SSA records in Guvenen et al. (2014) reveal, but not dramatically so. Adding up over all sources of income in the household does not change the story. Figure 2, reproduced from DeBacker et al. (2013), shows that the standard deviation in total household income is similarly volatile, ranging from about 0.39 to 0.43 over the period. In this way, the presence of multiple employers and multiple workers does not appear to reduce importantly the volatility of a household's income.[4]

3 Splinter (2019) argues that the DeBacker et al. (2013) analysis understates income volatility because it excludes individuals with very low earnings in any of the years under study.

4 Pruitt and Turner (2020) also study income tax returns and find more evidence that spousal earnings function to provide a buffer against the volatility of men's earnings. Especially during recessions, and especially at the extremes of the average household income distribution, they find that the dispersion of the distribution of longer (four-year) changes in household earnings is substantially lower than that for men's earnings alone.

Figure 2. Standard Deviation of the Percentage Change in Income



Source: DeBacker et al. (2013)

3.a. Uncertain or Simply Variable?

A key issue surrounding measures of individual and household income volatility is the extent to which these the changes in income are predictable. Some of the increases and decreases in income must be foreseeable by households—but how many, and by when could they have known these changes would occur? Understanding the extent to which movements in income come as a surprise is important because anticipated income increases or decreases have different implications for household finances and well-being than similarly large but surprising changes in income.

Relevant examples of predictable income movement include changes in household earnings on account of seasonal work—say, among construction workers or workers in temporary tourist jobs. These kinds of changes are different from those associated with, for example, an unanticipated decline in hours or sales, or even a layoff, and we would expect households to react to such changes differently. Workers can also often anticipate, at least with some advance warning, a boost to earnings from a job promotion, or an increase in pay associated with years on the job. Reductions in income associated with a move to part-time work can sometimes be anticipated as well. The same is true for movements in individual or household earnings associated with changes in family structure, including marital status or number of children living at home. These often large changes in income may have very different consequences for a household's balance sheet than similar-sized changes attributable to changes in hours or wages at work.

It is challenging to determine from even the best available data the extent to which households anticipate the changes in income that they encounter. Statistical models, augmented by economic theory, can identify changes in income that households ought to have been able to predict, or that they act as if they did predict (e.g., Blundell and Preston 1998; Moffitt and Gottschalk 2002; Primiceri and van Rens 2009; Gelman et al. 2020.) The estimates of the predictable percentage of income volatility that emerge from these approaches are sensitive to the assumptions made and methods used, and they cover much of the range from zero to 100 percent. This makes sense in part because the expectations or behavior of households might reasonably differ from those derived from a particular, even very flexible econometric or theoretical model. Decompositions of income volatility, as in Larrimore, Mortenson, and Splinter (2016), which quantify the extent to which household income movements are associated with easily anticipated events like marriage or the birth of a child, suggest that substantial fractions of annual income volatility are predictable, but a comprehensive and robust quantification remains elusive.

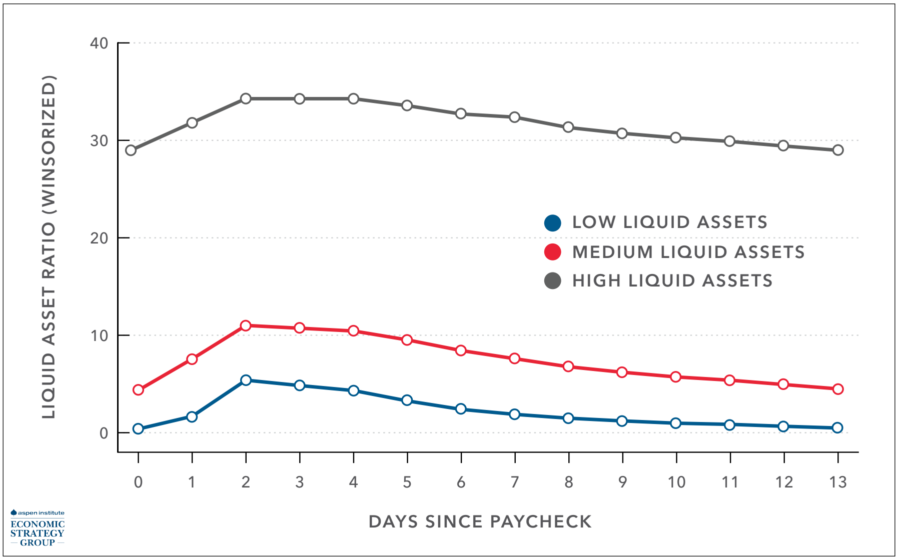
4. Recent Facts about Liquid Asset Holdings

Even if substantial fractions of the changes in income were predictable, we would still expect households to maintain substantial liquid assets to buffer against unpredictable changes or simply in anticipation of predictable declines in income. For a large fraction of households, especially middle-income ones, this is not the case. Many live, more or less, from paycheck-to-paycheck.

A recent study using de-identified data from the users of a financial aggregation app, examines the levels and high-frequency variation in liquid asset holdings. That paper examines how liquid asset holdings change over the days between paychecks (the pay cycle). Figure 3, taken from that paper, shows median liquid assets over a two-week pay cycle, by terciles of the distribution of liquid assets.[5] To make the measurement of liquid asset levels more comparable across income groups, the measure is expressed as a ratio of checking and savings account balances to average daily total spending.

5 In these data, liquid asset balances peak two days after a payday. The balance data are based on funds available, so liquid assets should lag behind payday according to the banks' funds-availability policy. There is at least a one-day lag built into the data because the aggregator application collects balance information during the day, and will reflect a paycheck posted only on the previous day. Note too that liquid asset balances reflect the net inflows and outflows. Spending done just after the receipt of paycheck will therefore lead daily balances to understate gross asset balances right after the receipt of the paycheck.

Figure 3: Median Liquid Assets over the Paycheck Cycle for the First, Second, and Third Terciles of the Liquid Assets Distribution



Source: Gelman et al. (2018)

This figure shows that households in the top third of the liquid asset distribution are in a different situation from the rest. Over all days, this group maintains a median of 32.1 days of average expenditure in liquid assets. Without tapping into credit, or illiquid forms of savings, or any social or government support, this group could go more than a month without income and still maintain their usual levels of spending. Even on the day before their paycheck arrives, this part of the population has a substantial buffer in their liquid checking and savings accounts.

For the bottom two-thirds of the liquid assets distribution, however, the financial situation looks much less secure. The money in their checking and savings accounts are not adequate for maintaining their typical levels of spending, even for a single pay period. The median number of days of average expenditure maintained in liquid assets is nearly eight for the middle tercile and three for the lowest tercile. Liquid assets are especially low the day just before a paycheck arrives, when the bottom third has a median balance of zero in their checking and savings accounts, and middle third has only four days. Despite, or perhaps because of, substantial income variation, this large part of the population lives, in effect, from paycheck to paycheck.

5. How Do Households Respond to Large, Unexpected Income Shocks?

The findings about income volatility and liquidity described above are not easily reconciled with standard frameworks of household finance. If income is subject to large movements, why wouldn't most households maintain a larger buffer and make consumption less subject to changes in income?

Insight can be gathered from studying how household finances respond to large and unambiguously unexpected shocks. One study examined how federal employees responded to the U.S. government shutdown of 2013. At the time, the federal government employed about 2.1 million affected workers, each of whom saw one paycheck in October of 2013 reduced by about 40 percent, or roughly four working days out of the 10 in a typical pay cycle. Only about 800,000 of these workers were furloughed. The rest had to work for at least part of the shutdown, and so we would expect their work-related expenses to be little changed. While they did not know how long the shutdown would last, federal employees should have expected their missing earnings to be recouped as soon as the shutdown ended. In the past, Congress had always done that, even for furloughed employees.

As a group, the federal workforce might reasonably be described as (upper) middle class. At the time, the average federal worker earned about $82,000 a year. Like the households described above, they also maintained quite limited liquid assets. At least two-thirds didn't have enough in their checking and savings accounts to cover what was missing from this paycheck. So, what did they do?

They adjusted. They spent less, briefly delayed making payments on mortgages, rent, and credit card balances, and most emerged without lasting damage to their finances. As a result, while spending decreased, consumption likely moved much less as households managed their bills in order to meet most of their usual needs.

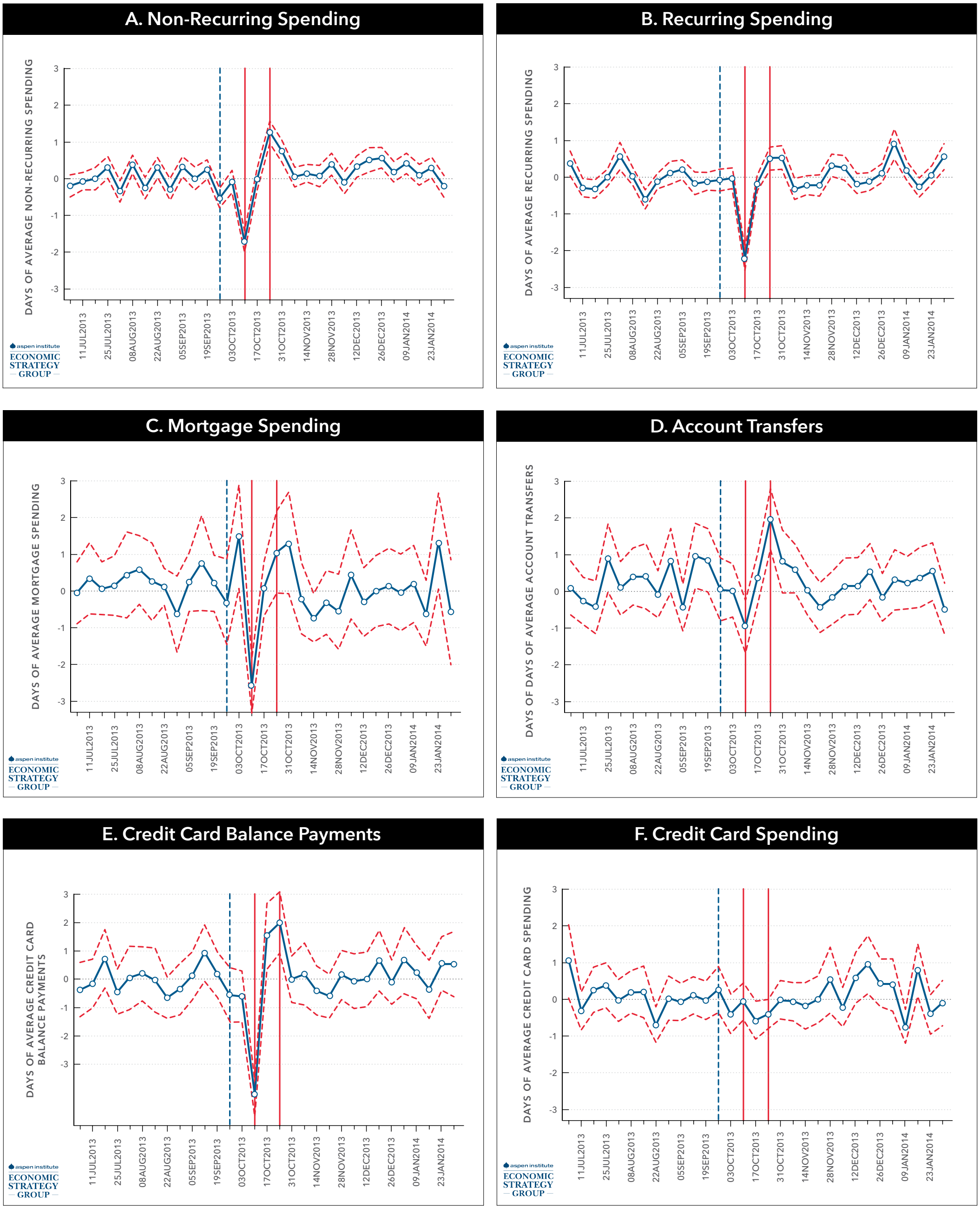
Figure 4 shows the details. In each panel, the dashed blue line marks the start of the shutdown, the first red line indicates the week when the smaller-than-usual paycheck arrived, and the last red line marks the end of the shutdown and the recouping of that missing pay. In panel (A), we see the response of "non-recurring" expenditures, a large category of spending that is arguably more discretionary in that it excludes things like rent, mortgages, and other bills that are paid in very regular amounts and with very regular frequency. Non-recurring expenditures dips by about a day and a half of average spending in this category and bounces right back up when the missing pay is received. The recurring expenditures category, which includes rent, mortgages, etc., is different. In panel (B) we see it drops more sharply, by more than two days of average spending, and recovers only incompletely when the missing pay arrives. Panel (C) isolates a particularly important part of recurring spending: mortgage payments. The panel shows too that these payments are delayed substantially by the missing pay, and take some time to recover once the missing pay is recouped.

The rest of the evidence paints the picture of what federal workers did to weather this shock. They didn't bolster spending by making transfers from other accounts to their checking accounts (panel D), and they didn't use their credit cards much more to cover the gap (panel F). Instead, they deferred the payments they would have otherwise made on the credit cards and floated a couple more weeks until they got paid. As with the delayed mortgage payments, this was an important way that households found to meet their consumption needs despite the fact that they had few liquid assets to rely on.

Delaying payments on mortgages, rent, or credit cards can be costly, including late fees and interest on the credit being extended and the potential for damage to credit scores. This study showed, however, little lasting damage from delayed payments, in part because most mortgages and rent typically allow a grace period during which late fees are not charged. For many households, these costs were also avoided because they tend to pay their mortgages and credit card bills whenever they are liquid, not when the bills are due. This sometimes involves making multiple payments per month. As a result, many households affected by the shutdown, who normally would have made a full payment on their bills as soon as they were paid, still had time to wait before those bills came due.

A recent study of a very different episode, this time involving an unexpected rise in disposable income, shows similar adaptation and a sensitivity of spending to income. The study uses administrative data from a financial aggregator to examine how household spending responded to a large decrease in gasoline prices in 2014. Gasoline is an important part of the budget for many, especially middle-class, households. Depending on the survey method, the median household spent $2,000-$3,000 per year on gasoline in the months leading up to the price decline. During the October 2014 episode, the price rapidly dropped by almost half.

Figure 4. Estimated Response of Spending Categories to Government Shutdown



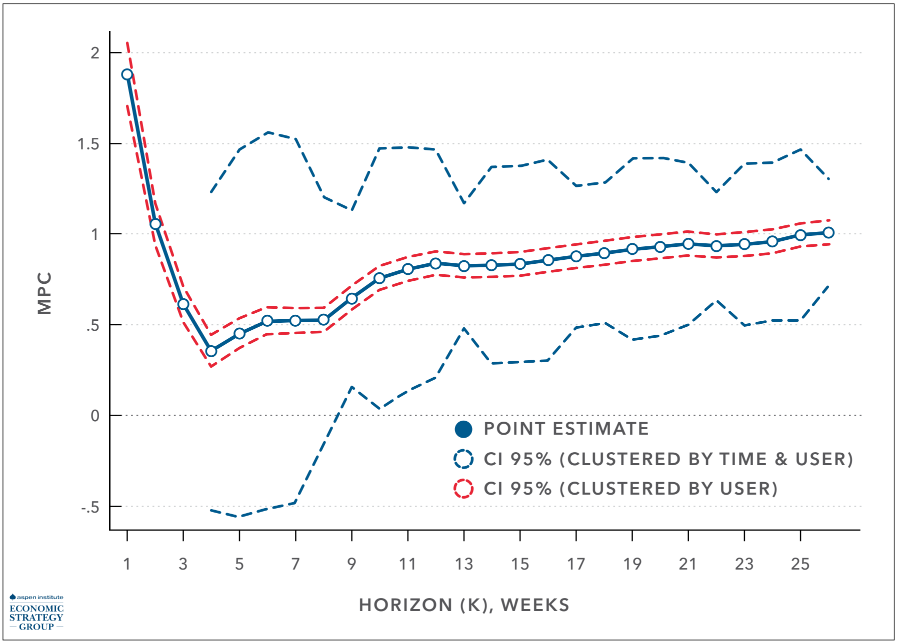
Source: Gelman et al. (2018)

Notes: The spending, payment, or transfer category in each panel is normalized by the individual-level daily average for that category. N = 3,804 and N= 94,680 for the treatment and control groups, respectively.

The short- and medium-run elasticity of gasoline spending to changes in price is quite low. Over periods of less than a year, people do not drive much more or less, or switch modes of transportation in response to gasoline prices. As a result, the 2014 gas price drop was like a substantial increase in the after-tax income of households. How did they react?

Figure 5, reproduced from that study, shows that within three to five months, households adapted to this new-found cash made available from gas savings, and spent it on other things. The figure shows, in particular, the estimated marginal propensity to spend (often called the marginal propensity to consume or MPC) of this new-found discretionary income. When the MPC equals zero, that means every penny of savings from a less expensive gasoline is saved; the data do not show it being spent on other things. When the MPC equals 1, that means every penny saved on gas is spent on something else. Figure 5 shows that three months after the price decline, households are already spending the vast majority of those savings on other things. By five months, the point estimate of the MPC is effectively 1.

Figure 5: The Propensity to Spend an Increase in Discretionary Income Deriving from a Large and Sustained Reduction in the Price of Gasoline



Source: Gelman et al. (2019)

Notes: The figure reports estimates of the marginal propensity to consume (MPC) out of a large and sustained reduction in gasoline prices in 2014 as a function of the time, in weeks, since the reduction. Dashed lines show 95 percent confidence interval. See text for further details.

The spending response to this large decline in gas prices thus indicates, again, a tendency for household consumption to track income quite closely. When extra discretionary income arrived in the form of lower gas prices, households tended to spend it rather than save a portion of it in case of a change for the worse.

6. How Do Households Respond to Predictable Changes in Income?

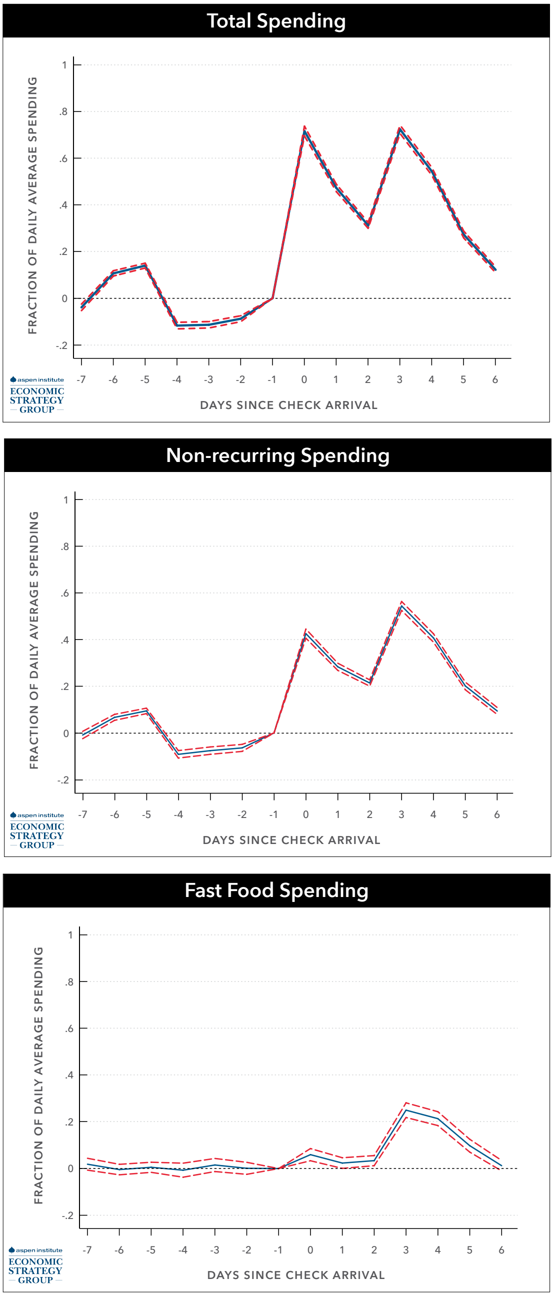
The preceding evidence on the responses of households to unexpected changes in (discretionary) income shows that the spending of many households follows their income more closely than benchmark theories of household finance would predict. Given the evidence on liquid asset balances, this is less of a surprise. If households maintain such a small buffer of cash in their checking and savings accounts, it makes sense that shocks to income will produce a sizeable spending response. The seeming ability of households to maintain much of their usual consumption (if not spending) despite a large, if brief, decline in income helps explain why.

Another reason why spending follows income more closely than benchmark theories might predict is suggested by the response of expenditures to even very predictable changes in income. By way of reminder, the standard model used in neoclassical economics predicts that if changes in income are expected, households will choose to smooth consumption across periods of varying income. But high frequency data on household consumption show that is *not* what households choose to do. These results indicate that for many households consumption smoothing may not be as valuable as those standard theories assume.

Figure 6 is taken from another study of financial aggregator data which examined how spending by different households responded to the arrival of paycheck income. Here, paycheck income is defined so as to be especially predictable—regular in its timing (every two weeks) and amount. As the first panel shows, total spending responds sharply—up nearly 75 percent above average daily expenditure—to the arrival of a paycheck and then settles down for the second week until the next paycheck arrives.

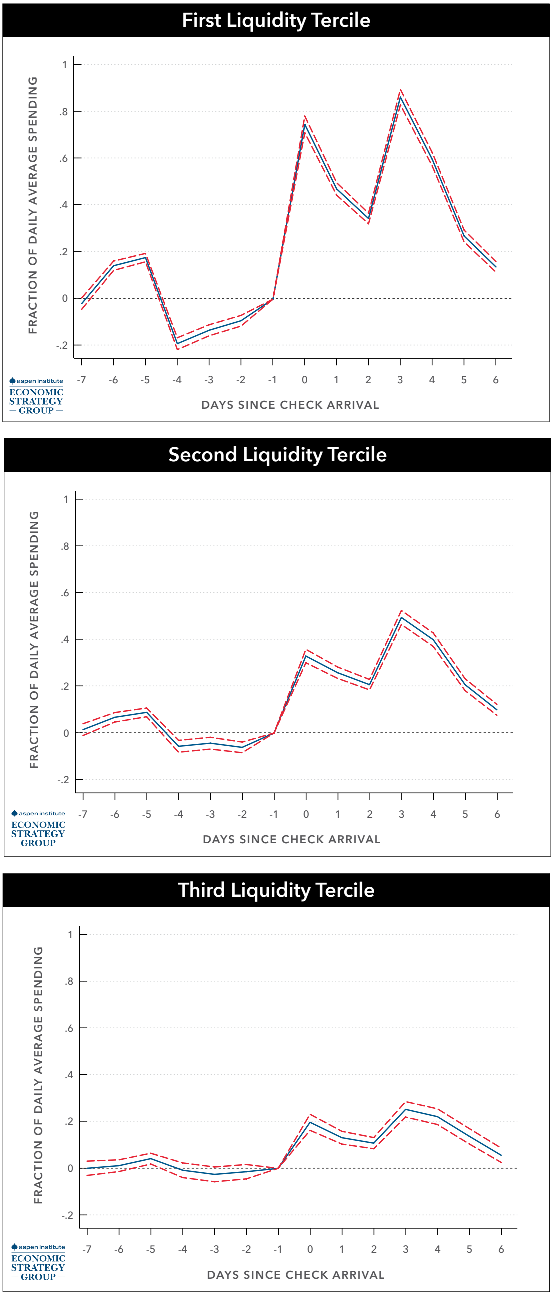
Some of this response of total spending can be explained by the coordination of bills like rent, mortgages, or utilities, with the arrival of paycheck. This kind of coordination is not a refutation of the value of consumption smoothing, just a sensible method of avoiding problems of liquidity. But the second panel shows that non-recurring spending also responds, though less sharply, to the arrival of a paycheck. It too rises by 40 to 50 percent of average daily spending in this category when the check arrives, before returning to more normal levels later in the week. Only spending on items like fast food, in the third panel, seems to follow the standard prediction that consumption should be smooth over the pay cycle.

Figure 6. Estimated Response of Spending Categories to the Arrival of Predictable Paycheck Income



Source: Gelman et al. (2014)

Figure 7. Estimated Response of Non-recurring Spending to the Arrival of Predictable Paycheck Income, by Liquid Asset Tercile



Source: Gelman et al. (2014)

Figure 7, taken from that same study, shows an interesting link between smoothing and maintaining a liquid asset buffer. The non-recurring spending of households in the bottom third of the liquid assets distribution is much more responsive to the arrival of a predictable paycheck than is the spending of those with larger buffers. Notably, however, even those in the highest liquid assets tercile, who typically maintain more than a month of average spending in their checking and savings accounts, still spend in response to the arrival of their paychecks. Their non-recurring spending is about 20 percent higher than usual on the day the check arrives and remains higher for about a week before settling down for the week before the next paycheck arrives. Even this group, it seems, does not seek perfectly smooth spending at this frequency.

7. Discussion and Implications for Policy

This chapter described new sources of administrative data on income, spending, liquid assets and debt that provide a novel perspective on the finances of millions of households. Those data show that individual and even household earnings vary in important ways from year-to-year. Despite, or perhaps because of, those large movements in annual income, echoed in higher frequency variation, the same kinds of data show that many middle-class families maintain very little by way of liquid assets. If, for example, they were to miss just one paycheck by surprise, large majorities could not use their checking or savings balances to cover their usual levels of spending until the next paycheck arrives. This is not just a phenomenon of very low-income households. The tendency to maintain relatively few liquid assets is pervasive well into the middle of the income or spending distribution.

While they face large movements in income with little liquid assets, households also display significant resilience to income shocks. Integrated financial records show that middle-class households use often overlooked methods of lowering expenditures without dramatically reducing consumption, and find ways to get through at least short-term but large declines in income. Even in “normal” times, however, spending often reacts sharply to the entirely predictable arrival of income, like a regular paycheck.

Taken together, these findings indicate that standard economic analyses may have over-emphasized the value to many households of maintaining precautionary saving to keep spending and therefore consumption smooth. Most working families would, undoubtedly, be glad to trade the ups and downs of living paycheck-to-paycheck for a steady income and a nice rainy-day fund. But, in reality, there are likely to be substantial costs of making that trade. A steadier income might require accepting a lower income on average (a lower wage or fewer hours). Saving a substantial buffer often means very careful budgeting with unpleasant and certain sacrifices now in anticipation of the possibility that things may be even worse later. For many, it seems, those costs to total income or nearer-term spending are not worth bearing in part, perhaps, because they can often use other mechanisms to help them get by when income is low.

In this view, policy aimed at promoting greater financial security for the middle class would do better to reduce its emphasis on efforts to encourage self-insurance through accumulating precautionary saving buffers or their fintech equivalents. Financial education and realistic subsidies for liquid savings would seem to have only limited potential to move many families away from having their consumption move closely in time with their income.

Instead, efforts to improve the financial security of middle-class households would seem to do better by focusing on the uninsured risk these households face. Traditional forms of social insurance have this feature. Public unemployment, disability, and health insurance, or mandatory paid sick leave policies help reduce large movements in (effective) income due to uncertain employment or health. Alternatively, public or private policy could lead employers to bear more of these risks that their employees now face. Predictable scheduling requirements or work sharing policies have this feature.

These conclusions derive from analysis of vast, impersonal, administrative datasets reflecting the behaviors and outcomes of millions of Americans. Notably, the detailed, personal, more ethnographic analyses like those in Morduch and Schneider (2018) come to similar policy conclusions, though for different reasons. Those much more intimate and contextualized analyses of middle-class finances also conclude that efforts at financial literacy or facilitating the management of liquid savings are better replaced by policies to shift risk from worker to firm or, perhaps by payment systems that facilitate smoothing even when paychecks fluctuate. This is in part because they think firms have recently shifted more of the financial risk onto their employees, and because managing such high levels of income volatility is too challenging, even for those who are very sophisticated about financial matters (Ogden and Morduch 2017).

The evidence summarized in this chapters suggests that income volatility is not such a new phenomenon and that recent moves toward more unpredictable hours are unlikely to be driving it. Similarly, the findings described here suggest that the lack liquid savings has less to do with the challenges of determining how to accumulate a buffer than with the profound costs doing so, and the alternatives available for weathering downturns in income.

If, indeed, moves to reduce the uninsured risks that middle-class families face are the better path, policy makers must then confront the costs of doing so. Those costs may be to taxpayers who fund social insurance programs, or to the workers themselves who may need to accept lower wages, fewer hours, or longer periods of unemployment in exchange for more stable incomes. The hope is that by providing such insurance at scale the costs will be less than those of self-insurance which, it seems, are too high for many households to accept.

References

Blundell, Richard, and Ian Preston. 1998. "Consumption Inequality and Income Uncertainty," *The Quarterly Journal of Economics* 113(2): 603–640.

Bound, John, Charles Brown, Greg J. Duncan, and Willard L. Rodgers. 1990. "Measurement Error In Cross-Sectional and Longitudinal Labor Market Surveys: Results From Two Validation Studies." In J. Hartog, G. Ridder, and J. Teevwes, eds., *Panel Data and Labor Market Studies,* Elsevier, 1-19.

Christopher D. Carroll. 1997. Buffer-Stock Saving and the Life Cycle/Permanent Income Hypothesis, *The Quarterly Journal of Economics* 112(1): 1–55.

DeBacker, Jason, Bradley Heim, Vasia Panousi, Shanthi Ramnath, and Ivan Vidangos. 2013. "Rising Inequality: Transitory or Persistent? New Evidence from a Panel of U.S. Tax Returns," Brookings Papers on Economic Activity, Spring: 67–142.

Ellen, Ingrid Gould, Katherine O'Regan, and Amy Ganz. 2020. "A Renter Safety Net: A Call for Federal Emergency Rental Assistance." In *Securing Our Economic Future*, edited by Amy Ganz and Melissa Kearney. Aspen Institute Press.

Friedman, Milton. 1957. *A Theory of the Consumption Function*. Princeton University Press: Princeton, N.J.

Gelman, Michael, Shachar Kariv, Matthew D. Shapiro, and Dan Silverman. 2020. "Rational Illiquidity and Consumption: Theory and Evidence from Income Tax Withholding and Refunds." Working Paper No. 25757, National Bureau of Economic Research.

Gelman, Michael, Shachar Kariv, Matthew D. Shapiro, Dan Silverman, and Steven Tadelis. 2014. "Harnessing Naturally Occurring Data to Measure the Response of Spending to Income," Science 345(6193): 212–215.

---. 2018. "How Individuals Respond to a Liquidity Shock: Evidence From the 2013 Government Shutdown," Forthcoming, *Journal of Public Economics*.

Gelman, Michael, Yuriy Gorodnichenko, Shachar Kariv, Dmitri Koustas, Matthew D. Shapiro, Dan Silverman, and Steven Tadelis. 2019. "The Response of Consumer Spending to Changes in Gasoline Prices." Working Paper No. 22969, National Bureau of Economic Research.

Guvenen, Fatih, Serdar Ozkan, and Jae Song. 2014. "The Nature of Countercyclical Income Risk." *Journal of Political Economy* 122(3): 621–60.

Hall, Robert E. 1978. “Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence.” *Journal of Political Economy* 86(6): 971–987.

Hasler, Andrea, Annamaria Lusardi, and Noemi Oggero. 2018. “Financial Fragility in the US: Evidence and Implications.” GFLEC Working Paper No. 2018-1.

J.P. Morgan Chase Institute. 2015. *How Falling Gas Prices Fuel the Consumer: Evidence from 25 Million People*. Available at https://www.jpmorganchase.com/corporate/institute/document/jpmc-institute-gas-report.pdf.

Kaplan, Greg, Giovanni L. Violante, and Justin Weidner. 2014. “The Wealthy Hand-to-Mouth,” Brookings Papers on Economic Activity 45 (Spring): 77–153.

Kristof, Nicholas, and Sheryl WuDunn. 2020. *Tightrope: Americans Reaching for Hope*. Knopf Doubleday Publishing Group. New York City, NY.

Larrimore, Jeff, Jacob Mortenson, and David Splinter. 2016. “Income and Earnings Mobility in U.S. Tax Data.” In *Economic Mobility: Research & Ideas on Strengthening Families, Communities & the Economy,* edited by Federal Reserve Bank of St. Louis and the Board of Governors of the Federal Reserve System, 481–516.

Looney, Adam, Jeff Larrimore, and David Splinter. 2020. “Middle-Class Redistribution: Tax and Transfer Policy for Most Americans.” In *Securing Our Economic Future*, edited by Amy Ganz and Melissa Kearney. Aspen Institute Press.

Lusardi, Annamaria, Daniel Schneider, and Peter Tufano, 2011. "Financially Fragile Households: Evidence and Implications," *Brookings Papers on Economic Activity,* Economic Studies Program, The Brookings Institution 42(1): 83-150.

Meyer, Bruce D., and Nikolas Mittag. 2019. “Using Linked Survey and Administrative Data to Better Measure Income: Implications for Poverty, Program Effectiveness, and Holes in the Safety Net.” *American Economic Journal: Applied Economics* 11(2): 176–204.

Moffitt, Robert and Peter Gottschalk. 2002. “Trends in the Transitory Variance of Earnings in the United States.” *Economic Journal* 112: 68–73

Morduch, Jonathan, and Rachel Schneider. 2018. *The Financial Diaries: How American Families Cope in a World of Uncertainty*. Princeton University Press: Princeton, N.J.

Ogden, Timothy, and Jonathan Morduch. 2017. “Too Many Americans Suffer from Financial Instability. Their Employers Can Help Fix It.” *Harvard Business Review,* December 14.

Parker, Jonathan A. 1999. “The Reaction of Household Consumption to Predictable Changes in Social Security Taxes,” *American Economic Review* 89(4): 959–973.

Primiceri, Georgio and Thijs van Rens. 2009. “Heterogeneous Life-Cycle Profiles, Income Risk and Consumption Inequality.” *Journal of Monetary Economics* 56(1): 20–39.

Pruitt, Seth, and Nicholas Turner. 2020. “Earnings Risk in the Household: Evidence from Millions of US Tax Returns.” *American Economic Review: Insights* 2(2): 237–254.

Splinter, David. 2019. “Income Mobility and Inequality in the United States: Evidence from Tax Data since 1979.” Working paper.

Appendix: Background on Sources of Data for Income and Assets

A.1. Self-Reports on Surveys Have Long Provided the Best Measures

In the past, most efforts to measure the variability of different sources of income, or the levels of household liquidity, have relied on self-reports in survey responses. The organizations that collect these surveys expend substantial effort and resources to obtain representative samples and accurate measures, but they face important obstacles on both fronts.

For purposes of measuring income and its changes, the leading survey instruments include the Panel Study of Income Dynamics, conducted by the University of Michigan, the Survey of Income and Program Participation, conducted by the U.S. Census Bureau, and the Current Population Survey also conducted by the Census Bureau on behalf of the Bureau of Labor Statistics. These surveys have long collected household and individual income information via self-reports and mostly by the phone. The cost of implementing high-quality surveys make it difficult to collect income information at high frequency. In addition, and despite both sincere efforts to report accurately and encouragement to use paystubs and tax records, survey participants naturally struggle to recall their incomes with precision. Self-reports are prone to heaping on round values and to relatively stickiness, year-to-year. Validation studies of survey data like these, such as Bound et al. (1990), or Meyer and Mittag (2019) indicate substantial, if mostly non-systematic, measurement error. In Bound et al. (1990), for example, when survey responses were compared to administrative income records, the error to variance ratio was as high as 0.3 and higher-income earners tended to underreport their income and lower-income households tend to overreport.

These errors and biases can be especially important when trying to measure the variability of income. On the one hand, some of what appears like fluctuations could actually represent the challenges of accurate recall—forgetting about some income in one time period, overstating it in another. On the other hand, the tendency to approximate current income by past income might dampen true fluctuations.

Using surveys to collect accurate data on liquid assets is, perhaps, even more challenging than collecting income information. Leading studies of wealth, debt, and liquidity, such as the U.S. Federal Reserve Board's Survey of Consumer Finances (SCF), are conducted mostly in-person in order to obtain a more accurate picture of a household's financial situation. Taking an inventory of a household's accounts and accurately measuring their balances, in person, takes time. The SCF typically requires about 80 minutes to complete. The expense of getting this kind of information means such studies must be limited in their frequency and sample size. The SCF, for example, is conducted only every three years with a sample of approximately 6,500.

A.2. Measures Drawn from Administrative Records Are Now Common

The many challenges of obtaining accurate information on income levels and volatility, and on and liquid assets from surveys have, especially over the past 10 years, led researchers to develop administrative datasets for these and other purposes. These new datasets avoid many of the difficulties that surround self-reports and are often enormous in size. In some cases, these data are collected not just from a representative sample of the United States, but include nearly the entire population of U.S. households. In other cases, the datasets are orders of magnitude larger than even the largest survey samples, but include only those individuals or households who hold accounts with certain (large) financial institutions or who choose to integrate their many financial accounts with one financial aggregating platform. The accuracy and size of these administrative data sources are usually limited. Compared with comprehensive surveys, these administrative data sets typically contain relatively little information about the demographic, social, and other characteristics of the individuals and households from which they draw.

The initiatives of several financial services firms have been especially important in improving the measurement of income and liquid asset holdings. Firms like JP Morgan Chase, through its JP Morgan Chase Institute, and the Vanguard Group through its Vanguard Research Initiative, have collaborated with academics and begun using de-identified and aggregated data from their millions of account holders to provide publicly available research on the savings buffers that individuals and households maintain. Financial aggregator firms, such as Mint, Mint Bills, Meninga, and Yodlee have also collaborated with academics to make similar research possible.

There are many distinctions of these data from financial services firms, even when compared with other sources of administrative records such as tax records. Because they often integrate records from an individual's or household's many different accounts, including checking, savings, and credit, these files can give a remarkably complete view of a household's financial situation. They allow, in particular, the simultaneous measurement of income, liquid asset holdings, liquidity more generally, spending, debt, and even credit scores. These data are also often available at very high (even daily) frequency and in real time. They can thus be used to bring a laser-sharp focus to the financial consequences for particular groups of people or specific events and times.

Administrative data from financial services firms have limitations as well. Non-random selection into the provider can be important, especially for aggregators which require motivated opting in. The administrative data from financial services firms also make it difficult to determine the unit of observation. If the data come from just one firm, joint accounts can be identified but the existence of accounts outside the firm usually cannot be ruled out. Aggregators can provide more comprehensive data, but they rarely provide information about whether these accounts are jointly held and, unless aggregator users do it themselves, it is usually impossible to determine which accounts ought to be gathered in one household. For nearly all such data, income measures must be after income tax withholding and any pre-tax purchases or saving. These features make it more difficult to pin down the level of pre-tax income with which many observers are concerned. These relative limitations lead many researchers to specialize somewhat: relying on tax records for measuring income and financial services records for measuring liquidity and spending.

Before de-identified financial services records became available for research, the leading source of administrative data on income was government tax records. For example, the U.S. Social Security Administration's (SSA's) earnings data, used to calculate payroll taxes and benefits, have been made available to qualified researchers and used for many years to study the lifetime dynamics of income. More recently, those records have also been used to study the volatility of income.

Because they are derived from W-2 forms, however, the SSA's earnings file will not include many potentially important sources of income volatility. These sources include self-employment income, business income, asset income, and government benefits. In addition, because the SSA collects these records largely for purposes of calculating payroll tax receipts and eventual Social Security benefits, the records are organized at the individual rather than the household level. These data are therefore best suited to studying fluctuations in the earnings, but not the total income, of individuals and not of households.

Data from income tax returns and associated reporting to the U.S. Internal Revenue Service (IRS) have most of the same advantages of the SSA data and more. The IRS tax return data that have been made available for academic study (under strict confidentiality agreements and data safety protocols) tend to include shorter time periods. The IRS data include both large majorities of U.S. workers plus anyone who files a tax return. Thus, the IRS tax return data allow researchers to study total income (not just earnings) fluctuations. As important, the IRS data are organized for purposes of calculating and collecting income taxes that often depend on family structure. This organization of the data makes it much easier to study income fluctuations at both the individual and the household level.

PART II

GEOGRAPHIC DIVERGENCE AND PLACE-BASED ECONOMIC DEVELOPMENT

The Faltering Escalator of Urban Opportunity

AUTHOR

David Autor*

ABSTRACT

Since 1980, college-educated workers have been steadily moving into affluent cities while non-college workers have been moving out. One likely reason is that employment and earnings opportunities in urban labor markets for non-college workers (defined as workers without a bachelor's degree) have substantially deteriorated over the past three decades. As U.S. employment has "polarized" into high-education, high-wage occupations and low-education, low-wage occupations, non-college urban workers have been increasingly shunted out of blue-collar production jobs and white-collar office and administrative jobs into low-paid services, such as food service, cleaning, security, transportation, maintenance, and health aide positions. Simultaneously, the formerly robust urban wage premium paid to non-college workers has eroded. Urban occupational polarization and wage declines are far more pronounced among Hispanic and Black workers than among Whites, and most severe among Black males. Thus, for the majority of non-college workers -- but especially for minorities – U.S. cities no longer appear to offer the escalator of skills acquisition and high earnings that they provided in earlier decades.

* Ford Professor of Economics; Director, National Bureau of Economic Research, Labor Studies Program; Co-Chair, MIT Task Force on Work of the Future; dautor@mit.edu: 50 Memorial Drive, Morris and Sophie Chang Bldg., E52-438, Cambridge, MA 02142.

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Introduction

For much of modern U.S. history, workers were drawn to cities by opportunities for the more enriching work offered there and the higher pay that came with it. As the eminent urban economist Edward L. Glaeser observed, "...cities have been an escape route for the underemployed residents of rural areas, such as the African-Americans who fled north during the Great Migration" (Glaeser 2020). But an important aspect of this opportunity escalator has broken down in recent decades. The migration of less-educated and lower-income individuals and families toward high-wage cities has reversed course (Ganong and Shoag 2017): Since 1980, college-educated workers have been steadily moving into affluent cities while non-college workers have been moving out.

This historic reversal is little studied yet undeniably important.[1] If non-college workers are steering clear of thriving high-wage cities despite the escalator of economic opportunity these cities offer, then policymakers should work to redress the economic, social, and informational barriers that inhibit these beneficial moves. Alternatively, if non-college workers are fleeing cities because the urban opportunity escalator is faltering, then policymakers need to understand what has changed and shift policy toward either restoring urban opportunity or redirecting workers elsewhere.

This research brief explores how the structure of opportunity offered by urban and non-urban labor markets to college and non-college workers has changed since 1980.[2] At the core of understanding why non-college workers are no longer flocking to the cities is the question of *push* versus *pull*. Are economic forces pushing non-college workers out of thriving cities that otherwise offer strong labor market opportunities? Or, are the opportunities offered by these places eroding—meaning that their pull is weakening? Or are both forces interacting? And how should policy respond to these changing dynamics, if at all?

The most widely accepted explanation of why non-college workers are steering clear of thriving, high-wage cities is that steep and rising housing costs are pushing them away (Glaeser, Gyourko, and Saks 2005; Ganong and Shoag 2017). This explanation is surely correct, but as shown below, it is incomplete: The economic pull of urban labor markets for non-college workers—seen most immediately in the urban non-college wage premium—has weakened or disappeared.

1 An important exception to this generalization is the insightful work by Ganong and Shoag (2017).

2 Building on work reported in David Autor (2019), this brief adds a race, ethnicity, and gender dimension to the analysis that was absent from earlier work and, additionally, considers the role of local living costs in affecting real wage levels.

From where did this urban pull arise? It is a well-established fact that urban workers earn more than observably similar non-urban workers (Glaeser and Mare 2001; Moretti 2004; Glaeser and Resseger 2010). Given that land prices are intrinsically higher in cities, it seems only logical that urban wages must compensate workers for the elevated cost of city living. For this to be economically sensible, however, urban workers must be proportionately more productive to cover their higher costs—otherwise, firms would locate elsewhere. Much evidence suggests that workers are more productive in cities (Glaeser and Gottlieb 2009; Hsieh and Moretti 2019), and it is not hard to see why: Highly educated and specialized workers cluster in cities, and invention and innovation thrive in these places (Glaeser 2011).[3] High urban wages have not, however, historically been limited to highly educated workers. Non-college workers—meaning workers with less than a four-year college degree—have also tended to earn more in cities.

But these favorable circumstances began eroding several decades ago. In the United States, as in most industrialized countries, employment has become increasingly concentrated in high-education, high-wage occupations and in low-education, low-wage occupations, at the expense of traditionally middle-skill career jobs (Autor, Katz, and Kearney 2006; Autor, Katz, and Kearney 2008; Goos and Manning 2007; Autor 2013; Michaels, Natraj, and Van Reenen 2013; Goos, Manning, and Salomons 2014). Economists refer to this phenomenon as employment polarization. While its causes are multifarious, they are in part rooted in both automation and computerization, which have taken over many routine production and office tasks, and in globalization, which has substantially reduced labor-intensive manufacturing work in high-wage countries.[4] As polarization has advanced, non-college workers have been shunted out of blue-collar production jobs and white-collar office and administrative jobs into services, such as food service, cleaning, security, transportation, maintenance, and low-paid care work.

These trends are widely recognized. What is much less widely known is that the polarization of work has been overwhelmingly concentrated in cities.[5] In the initial decades following WWII, U.S. cities offered a distinctive skills and earnings escalator to less-educated workers. A likely reason why is that, in these decades, adults without college degrees performed higher-skilled, more specialized jobs in cities than their

3 An extensive economic literature, reviewed by Glaeser and Gottlieb (2009), studies the forces that potentially make workers more productive in cities.

4 On the role of automation and trade in reducing employment in production, administrative, and clerical work, see Autor (2015) and Autor, Dorn, and Hanson (2016).

5 It has long been understood that cities and skills are deeply entwined (Glaeser and Mare 2001; Florida 2002). And, to be sure, I am not the first to study differential polarization across places (cf. Autor 2013; Mazzolari and Ragusa 2013; Akerman, Gaarder, and Mogstad 2015). The goal of this research brief is to demonstrate the centrality of geography to both the prevalence of middle-skill jobs in earlier decades and their steep decline in recent decades.

non-urban counterparts. Laboring in urban factories and offices, they staffed middle-skill, middle-pay production, clerical, and administrative roles, where they worked in close collaboration with highly educated professionals (e.g., engineers, executives, attorneys, actuaries, etc.). These collaborative working relationships often demanded specific skills and shared expertise, and likely contributed to the higher wages (and higher productivity) of urban non-college workers. These jobs were comparatively scarce in suburbs and rural areas, far away from the office towers and (at one time) bustling urban production centers.[6] Urban labor markets accordingly provided an escalator of opportunity and upward mobility for immigrants, minorities, less-affluent, and less-educated workers.

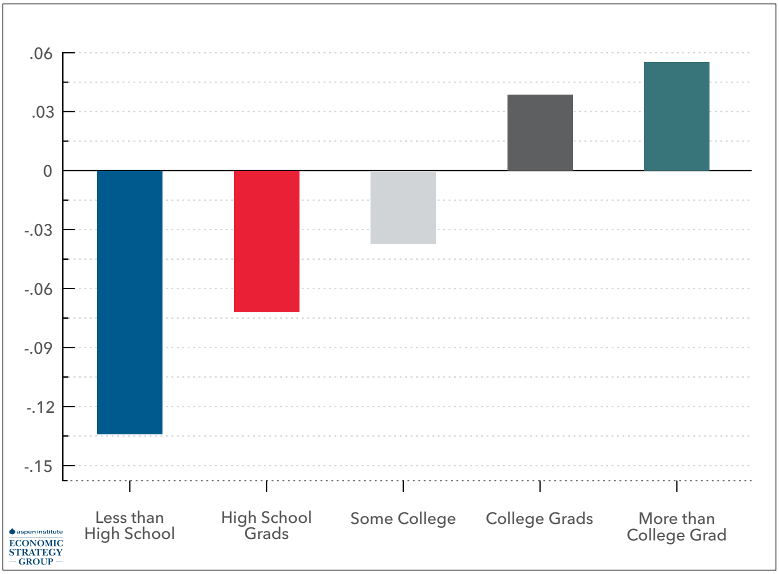
In the decades since 1980, however, this distinctive feature of urban labor markets has diminished. As rising automation and international trade have encroached on employment in urban production, administrative support, and clerical work, the non-college urban occupational skill gradient has diminished and ultimately disappeared. While urban residents are on average substantially more educated—and their jobs vastly more skill-intensive—than four decades ago, non-college workers in U.S. cities perform substantially less specialized and more skill-intensive work than they did decades earlier. Polarization thus reflects an unwinding of the distinctive structure of work for non-college adults in dense cities and metro areas relative to suburban and rural areas. And as this distinctive occupational structure has receded, so has the formerly robust urban wage premium paid to non-college workers.

This reality is depicted in Figure 1, which plots percentage changes in inflation-adjusted hourly wages in urban versus non-urban labor markets between 1980 and 2015 for workers grouped by education level: less than high school; high school graduate; some college, less than a four-year degree; four-year college graduate; and post-college education. Among the highest two education groups—workers with a four-year college degree or post-college education—real wages rose by 5 to 6 percent more in urban and non-urban labor markets during this 35-year period. For workers without a college degree, however, the opposite occurred: Relative to similarly educated workers in non-urban labor markets, real urban wages fell by 3 percentage points among workers with some college; by 7 percentage points among workers with a high school diploma; and by fully 13 percentage points among workers with less than high school. While urban labor markets remain vibrant for college graduates, even in the most-educated U.S. cities, less than half of working-age adults have a college degree (Autor 2019).

6 Of course, non-college workers in both urban and non-urban labor markets performed traditionally low-education, low-wage manual labor, transportation, construction, and in-person service jobs. Distinctively, many non-college workers in urban labor markets held middle-skill jobs.

As documented below, this deterioration has been even more pronounced for blacks and Hispanics than for whites, and, distressingly, most pronounced for black males. While occupational polarization and falling relative wages are broadly evident among all three groups, occupational polarization and relative wage decline are more extreme among non-whites. And uniquely among workers with college degrees, these patterns disproportionately afflict black male college graduates (as well as well as non-college workers). Indeed, occupational polarization among black college-educated men has been comparable to that among white non-college men, with similar relative wage decline. While this brief does not identify why these trends have been especially adverse among black men, these findings are consistent with a panoply of evidence that black men are faring poorly in U.S. cities. Thus, for the majority of U.S. workers—but especially for minorities—cities no longer appear to offer the escalator of skills acquisition and high earnings that they provided in earlier decades.

Figure 1: Percentage Changes in Real Wage Levels (Not Adjusting for Local Costs of Living) in Urban vs. Non-urban Labor Markets by Detailed Educational Level, 1980-2015



Note: Figure is constructed using U.S. Census of Population data for 1980 and pooled American Community Survey (ACS) data for years 2014 through 2016. Each bar represents the contrast between the change in mean log wages between 1980 and 2015 among the indicated education group residing in the top quartile of most-urban labor markets versus the bottom quartile of least-urban labor markets.

How should policy respond? Because the underlying economic forces that drive these trends appear to be pervasive and longstanding, there is no single policy remedy that can correct them. But this does not mean that policy cannot help. There are at least two arenas where policy can constructively focus, one on places and the other on people. A first, place-based, policy would seek to restore some of the lost earnings power of non-college workers laboring in cities. One feasible and impactful way to accomplish this goal is by setting appropriately calibrated city-specific minimum wages. While almost all economists agree that raising the minimum wage too aggressively risks curtailing employment, the U.S. federal minimum wage is lower at present than four decades earlier (Congressional Budget Office 2019). And the best available evidence finds that federal and state minimum wage laws enacted over the last several decades have substantially boosted earnings in low-paid jobs without reducing employment (Cengiz et al. 2019; Dube and Lindner 2020).[7] It is therefore likely that there is headroom in many U.S. cities to improve earnings of low-paid urban workers at little cost to their employability. To be clear, boosting wages through minimum wage hikes is not a free lunch: Minimum wage increases are passed on to consumers in the form of higher prices, and sharp hikes may tend to put low-productivity employers out of business (Aaronson 2001; Dustmann et al. 2020). Policymakers should consider these tradeoffs when calibrating minimum wage levels.

A second, people-based, policy that can make a substantial difference over the long run is assisting families to choose neighborhoods with good earnings opportunities relative to living costs. The celebrated Moving to Opportunity (MTO) experiment, launched in the mid-1990s, demonstrated that moving families from high-poverty public housing projects to low-poverty neighborhoods had substantial, positive long-term benefits for the educational attainment, earnings, and well-being of household members (Ludwig et al. 2013; Chetty, Hendren, and Katz 2016; Chetty and Hendren 2018). Recent policy experiments have built on these findings by assistant recipients of subsidized housing vouchers to select low-poverty neighborhoods in which children have historically thrived (Bergman et al. 2019). Bearing in mind the diminishing earnings opportunities facing non-college workers in U.S. cities, policymakers might consider fostering moves to neighborhoods that are not only *less impoverished* but also *less urban* than might have seemed warranted some decades earlier.[8]

As discussed in the concluding section of this brief, the current COVID-19 crisis appears likely to exacerbate these adverse trends by reducing demand for non-college workers in the urban hospitality sector (i.e., air travel, ground transportation, hotels,

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7 Cengiz et al. (2019) find that binding minimum wages do tend to reduce employment in traded industries, such as manufacturing, which is logical since these sectors face direct overseas competition. However, most low-wage urban jobs are in non-tradable services (e.g., food service, cleaning, security, personal care, construction, transportation, maintenance, repair), where the possibility of import substitution is not relevant.

8 An influential literature identifies neighborhoods that foster positive adult outcomes relative to family circumstances among children who grow up in these locations (Chetty and Hendren, 2018; Chetty et al., 2020). This body of work does not directly consider contemporaneous earnings of adults working in those locations, nor does it explore how working conditions in these locations have evolved in the intervening years between child-rearing of now-adult children and the present.

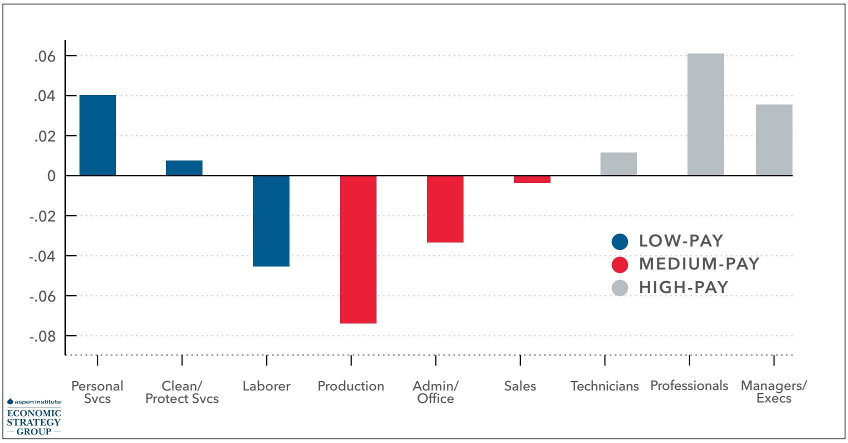
restaurants) and in urban business services (i.e., cleaning, security, maintenance, repair, and construction) will not likely recover to its previous trajectory. While this trend reversal may spur a depolarization of urban employment, this would not, ironically, augur good news for urban non-college workers. Reducing demand for non-college workers in low-paid urban jobs will not, unfortunately, restore demand for these same workers in middle-paid urban jobs.

Although policy cannot turn back the tide of urban polarization, it can improve the quality of urban non-college jobs on the margin, while simultaneously encouraging adults to seek work outside of those urban labor markets where the quality of jobs has not kept pace with the cost of living.

1. Occupations, Wages, and Cities

1.a. The Big Picture

Figure 2: Changes in Occupational Employment Shares among Working-Age Adults, 1980–2015



Note: Figure is constructed using U.S. Census of Population data for 1980, 1990, and 2000, and pooled American Community Survey (ACS) data for years 2014 through 2016, sourced from IPUMS (Ruggles et al. 2018). Sample includes working-age adults ages 16–64 excluding those in the military. Occupational classifications are harmonized across decades using the classification scheme developed by Dorn (2009).

Before exploring the changing geography of work, it is useful to review the picture of aggregate occupational change for the United States. Figure 2 plots the widely discussed polarization of the occupational structure of the U.S. labor market between

1980 and 2015.[9] The nine exhaustive and mutually exclusive occupational categories depicted in this figure are ordered from lowest to highest by mean wage level. The "barbell" shape of this figure reflects the secular bifurcation of the occupational structure in the United States (mirroring many other industrial economies) into high-education, high-wage professional, managerial, and technical occupations, on the one hand, and non-credentialed and typically low-paid service and laborer occupations, on the other hand (Autor, Katz, and Kearney 2006; Goos and Manning 2007; Goos, Manning, and Salomons 2014; Autor 2015; Alabdulkareem et al. 2018; Acemoglu and Restrepo 2019).[10]

Figure 3 brings these patterns into sharper focus by aggregating the nine occupation categories into three broad clusters: manual and service occupations ("low pay"); production, office, and sales occupations ("middle pay"); and professional, technical, and managerial occupations ("high pay"). At the start of this interval (in 1980), U.S. employment was roughly evenly divided among these three categories: 33 percent of workers were in low-pay occupations, 38 percent were in middle-pay occupations, and 30 percent were in high-pay occupations. The first panel of Figure 3 shows that over the subsequent three-and-a-half decades, middle-skill employment fell steeply—by 11 percentage points. This trend might be concerning were it not the case that almost the entirety of this fall was offset by rising employment in high-wage, high-skill occupations. In fact, the share of workers employed in typically low-paying occupations barely budged. Thus, in aggregate, occupational polarization appears to be a case of the middle class joining the upper class, which should not be a concern for policy.

The next two panels of Figure 3 temper this conclusion. Among non-college workers—those with less than a four-year degree—the picture is radically different. In 1980, employment of non-college workers was roughly split between low- and middle-paying occupations, with 39 percent in the former category, 43 percent in the latter, and the remaining 18 percent in high-paying occupations. Over the ensuing decades, the share of non-college employment in middle-paying occupations fell by more than 10 percentage points, with two-thirds of this fall reflecting the movement of non-college workers out of middle-paying occupations and into traditionally low-paying occupations.

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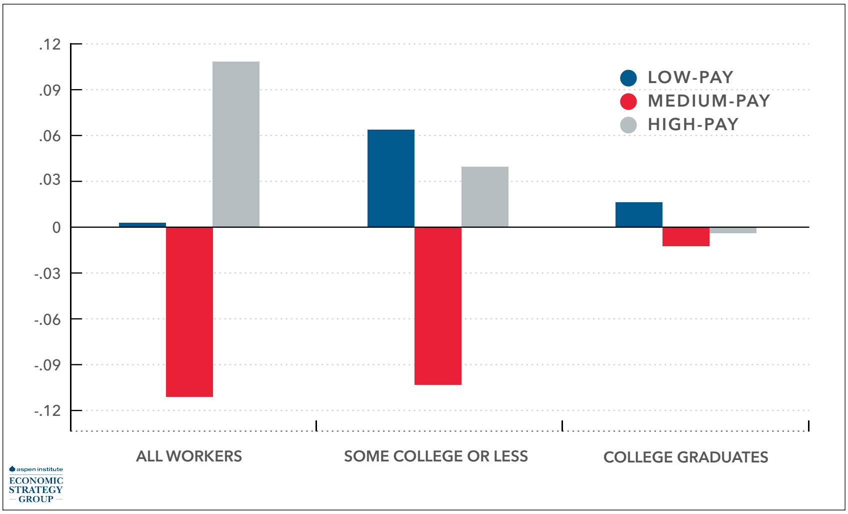
9 This figure, and those that follow, is constructed using U.S. Census of Population data for 1980, 1990, and 2000, and pooled American Community Survey (ACS) data for years 2014 through 2016, sourced from IPUMS (Ruggles et al. 2018). Samples include working-age adults ages 16–64, excluding those in the military. Occupational classifications are harmonized across decades using the classification scheme developed by Dorn (2009).

10 Plotted bars correspond to the proportional change in the share of employment in each category; smaller categories can have large growth rates without accounting for a large change in employment and vice versa for larger categories.

Figure 3: Changes in Occupational Employment Shares among Working-Age Adults, Overall and by Educational Attainment, 1980-2015



Note: Figure is constructed using U.S. Census of Population data for 1980, 1990, and 2000, and pooled American Community Survey (ACS) data for years 2014 through 2016, sourced from IPUMS (Ruggles et al. 2018). Sample includes working-age adults ages 16–64 excluding those in the military. Occupational classifications are harmonized across decades using the classification scheme developed by Dorn (2009).

In short, the quality of jobs that non-college workers perform in cities has deteriorated sharply as the middle-pay stratum of occupations has eroded. In the same time interval, there has been a vast increase in the fraction of urban workers who hold college and post-college degrees[11], with no obvious dilution in the quality of the jobs that they occupy.

With these aggregate facts in mind, I turn to the geography of occupational polarization.

1.b. Urban Polarization

The structure of work differs across places: Locations often specialize in particular industries and services, such as manufacturing, education, entertainment, or health care. As noted above, a key predictor of the structure of economic activity is population density—specifically, whether a place is a city, a metropolitan area, a suburb, or a rural area. Some work intrinsically occurs in low-density areas, such

11 Between 1980 and 2015, the share of working-age adults with a college degree rose from less than 30 to more than 40 percent in the densest CZs. In the least urban CZs, this increase was on the order of 5 percentage points (Autor, 2019).

as agriculture. Conversely, U.S. manufacturing was concentrated in large cities at the start of the 20th century, and it slowly migrated toward less dense areas as transportation networks improved (Glaeser 2011). Knowledge-intensive industries tend to locate in dense cities, where educated workers are most prevalent (Glaeser and Mare 2001; Moretti 2004; Berry and Glaeser 2005).

These features of economic geography are well known, but how do they connect to the notion that cities provide a gateway of opportunity? Figure 4 offers the rudiments of an answer. This figure sketches the striking relationship between population density and occupational structure—that is, the type of work that people do—across 722 local labor markets (so-called Commuting Zones, or CZs) that collectively comprise the contiguous United States. Each panel reports the share of employment among working-age adults in 1980, 1990, 2000, and 2015 in one of the three broad occupational categories discussed above: low-pay services, transportation, laborer, and construction occupations; medium-pay clerical, administrative support, sales, and production occupations; and high-pay professional, technical, and managerial occupations.[12] CZs are arranged from most rural to most urban along the x-axis of this figure.[13] Each plotted point in the bin-scatter represents approximately 2.5 percent of the working-age population.

Figure 4 makes three key points. First, cities are much more intensive in high-pay, educationally demanding work than are non-urban labor markets, and this pattern became substantially more pronounced in recent decades. In 1980, the fraction of workers employed in high-paying occupations was approximately 10 percentage points higher in the most-urban versus least-urban labor markets; by 2015, this differential had risen to more than 15 percentage points.[14] Second, urban labor markets are substantially less intensive in low-paid work than are non-urban labor markets. In each decade, the share of workers employed in low-paid service, transportation, laborer, and construction occupations was 10 to 15 percentage points lower in the most-urban versus least-urban labor markets. Third, and perhaps most strikingly, panel B reveals what is both historically distinctive and rapidly changing about urban labor markets: the prevalence of medium-pay clerical, administrative

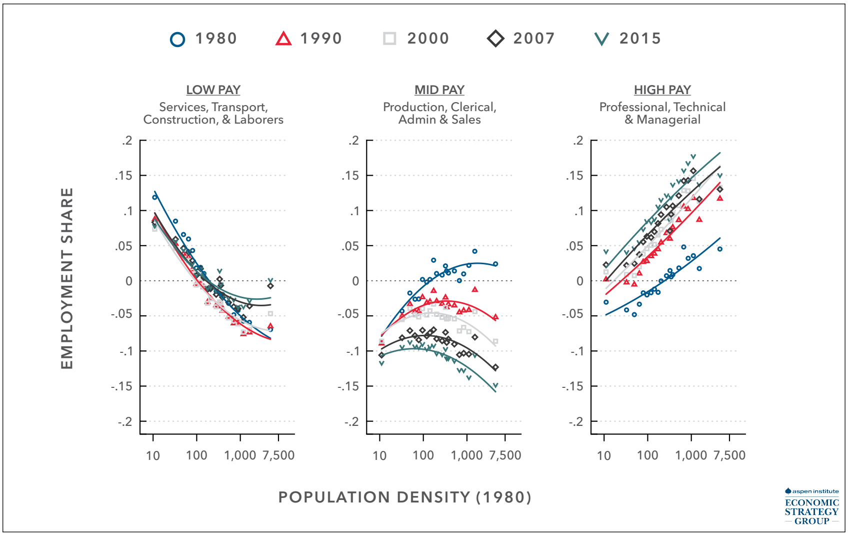
12 In each panel, I subtract the overall working-age mean share of employment in the relevant occupational category in 1980, so the plotted points correspond to the CZ's share of employment in the occupational cluster relative to the aggregate mean share in that cluster in 1980.

13 I measure the rural-urban continuum by arraying CZs according to population density, meaning adults per land area. I apply a log scale so that unit increments denote proportional increases. I use each CZ's population density in 1980 as the x-axis variable for all decades so that CZs are consistently ranked over time. This choice is innocuous, however, since the ranking of CZs by population density is highly stable across decades.

14 Alabdulkareem et al. (2018) document that small U.S. cities are substantially less specialized in hard-to-automate professional, managerial, and technical occupations than are larger cities and thus face greater potential impacts from automation.

support, sales, and production occupations. In 1980, urban labor markets had a substantially larger share of middle-paying occupations than did suburban and rural CZs, with an urban-rural gap of about 10 percentage points.[15] In the ensuing decades, this differential eroded and eventually reversed sign—from positive to negative. While middle-skill work was *overrepresented* in cities and metro areas in 1980, it was *underrepresented* in these same locales 35 years later (and less prevalent everywhere in absolute terms).

Figure 4: Occupational Employment Shares among Working-Age Adults by Commuting Zone Population Density, 1980–2015: Level Relative to 1980 Mean



Note: Figure is constructed using U.S. Census of Population data for 1980, 1990, and 2000, and pooled American Community Survey (ACS) data for years 2014, 2015, and 2016 (to create a 2015 average), sourced from IPUMS (Ruggles et al. 2018). Occupational classifications are harmonized across decades using the classification scheme developed by Dorn (2009) and distilled to the level of 722 consistent local labor markets (or, Commuting Zones) following the procedures in Autor and Dorn (2013). Each plotted point represents approximately 5 percent of the working-age population in the relevant year.

15 In Autor (2019), I document that this pattern was even more pronounced in the 1970s. My focus on this research brief is on 1980 forward because it is more relevant to current policy.

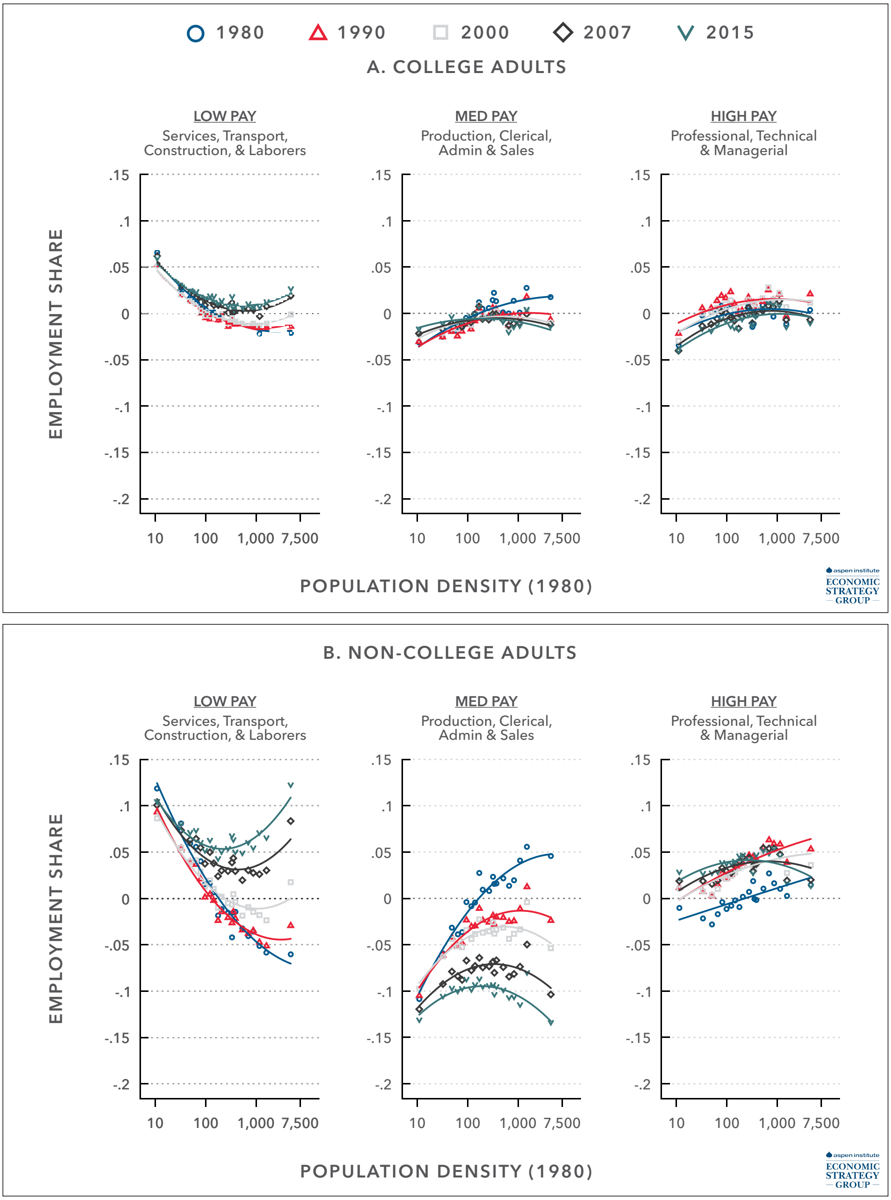
Still, one may legitimately ask: What's the worry? Figure 4 shows that high-paying urban occupations expanded as middle-paying urban occupations contracted, which does not look like bad news. Figure 3 above showed that, in aggregate, the overall shift toward high-wage occupations masks the diverging paths of college and non-college workers, with college-educated workers shifting upward and non-college workers shifting downward.[16] Figure 5 shows that this aggregate phenomenon is *overwhelmingly* concentrated in urban labor markets. In 1980, non-college workers in the most-urban labor markets were approximately 15 percentage points more likely to work in middle-paying occupations—and 15 percentage points less likely to work in low-paying occupations—than were non-college workers in the least-urban labor markets. But this urban occupational differential attenuated and then inverted over the next 35 years. As of 2015, nothing remained of the robust middle of non-college production, office, clerical, and administrative jobs that was a standout feature of urban labor markets less than four decades earlier.[17] In fact, the low-pay employment share among non-college workers was several points higher in the most-urban relative to the least-urban labor markets, and the middle-pay employment share was several points lower. (There was almost no change in the high-pay employment share among non-college workers). Thus, Figures 4 and 5 make clear that the polarization of U.S. employment into high-wage professions and low-wage services is driven by urban labor markets, and that within urban labor markets, the growth of employment in low-wage occupations is driven by non-college workers.[18]

16 It may seem counterintuitive that the overall low-pay share of employment is more or less constant even while the low-pay share among non-college workers is rising. The resolution is that college workers are much less likely than non-college workers to work in low-skill occupations at all times, and the fraction of college versus non-college workers is rising.

17 To be clear, middle-paying jobs remain but they are no longer overrepresented in cities.

18 There was almost no change in the allocation of college degree-holders among low-, medium-, and high-paying occupations, either over time or across geographies (panel A of Figure 5).

Figure 5: Occupational Employment Shares among Workers with and without Four-Year College Degree by Commuting Zone Population Density, 1980–2015: Level Relative to 1980 Mean



Note: Figure is constructed using U.S. Census of Population data for 1980, 1990, and 2000, and pooled American Community Survey (ACS) data for years 2014, 2015, and 2016 (to create a 2015 average), sourced from IPUMS (Ruggles et al. 2018). Occupational classifications are harmonized across decades using the classification scheme developed by Dorn (2009) and distilled to the level of 722 consistent local labor markets (or, Commuting Zones) following the procedures in Autor and Dorn (2013). Each plotted point represents approximately 5 percent of the working-age population in the relevant year.

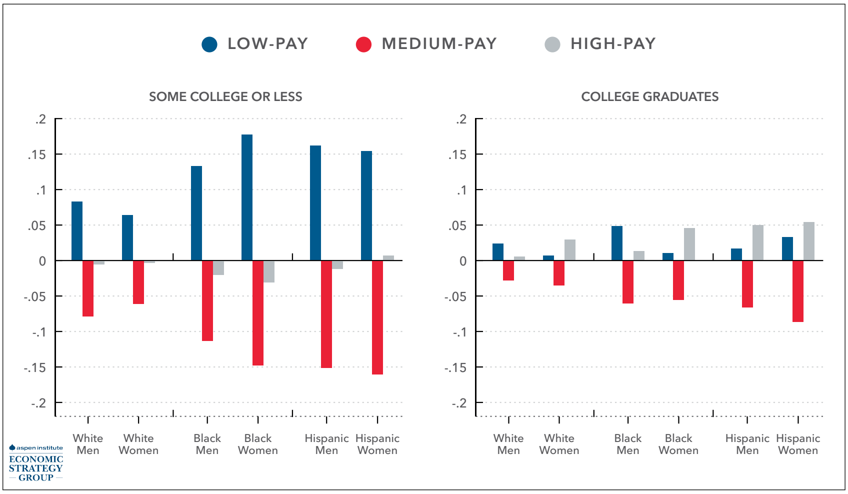
1.c. The Distressing Racial and Ethnic Dimension of Polarization

The urban U.S. workforce is disproportionately college educated, foreign born, and female, and it has become more so in recent decades (Costa and Kahn 2000; Glaeser and Mare 2001; Florida 2002; Moretti 2013; Diamond 2016; Autor 2019). Could it be that the sharp shifts in urban occupational structure documented above are driven by these demographic changes or, alternatively, are concentrated among a subset of urban workers (e.g., minorities, women, adults who have not completed high school)? Figure 6 explores this possibility by plotting changes in occupational structure between 1980 and 2015 in the most-urban versus least-urban labor markets among subgroups of workers defined by education, gender, and race/ethnicity.[19] This figure makes clear that polarization is pervasive across race and gender groups. Panel A shows that among non-college white, black, and Hispanic men and women, urban employment in middle-paying occupations fell by 7 to 15 percentage points between 1980 and 2015, with a corresponding increase in employment in low-paying occupations and almost no change in employment in high-paying occupations. Conversely, panel B shows that, among college-educated workers, urban occupational polarization was small overall, and that the majority of employment declines in middle-paying occupations were absorbed by employment gains in high-paying occupations.

Nevertheless, the demographic contours of occupational polarization were much more pronounced among non-white workers: Polarization among both non-college and college workers was most pronounced among Hispanics; less pronounced, but still substantial among blacks; and substantially more moderate among whites. (In Autor (2019), I document that polarization is also more concentrated among foreign-born than native-born workers, which is consistent with the greater degree of polarization among urban Hispanics than urban whites.) Most disconcerting is the experience of black male college graduates. Their employment share in mid-paying occupations fell by 7 percentage points and their share in low-paying occupations rose by almost 5 percentage points. Thus, despite high levels of educational attainment, they exhibited downward occupational mobility in urban versus non-urban labor markets. This stark finding is consistent with Derenoncourt (2019), who shows that upward mobility deteriorated among urban black residents following the Great Migration, and with Chetty et al. (2020), who document the exceptionally poor labor market outcomes of black men raised in poor urban U.S. neighborhoods.

19 Formally, I contrast changes in occupational structure between labor markets with the highest versus lowest quartile of population density. Quartiles are constructed by ranking CZs by their 1980 population density, then dividing CZs into four density quartiles, each containing approximately one-fourth of the 1980 working-age population.

Figure 6: Change in Occupational Employment Shares in Urban vs. Non-urban Labor Markets by Education, Gender, and Race/Ethnicity, 1980-2015



Note: Figure is constructed using U.S. Census of Population data for 1980 and pooled American Community Survey (ACS) data for years 2014, 2015, and 2016 (to create a 2015 average). Each bar represents the contrast between the change in occupational employment share (in percentage points) between 1980 and 2015 among the indicated demographic group residing in the top quartile of most-urban labor markets versus the bottom quartile of least-urban labor markets.

In summary, the aggregate polarization of the U.S. occupational structure is disproportionately urban, concentrated among workers with some college or lower education levels. Among non-college workers, it is especially acute among Hispanic and black workers. It does not appear to have a distinctive gender component, but urban, black, male college graduates are distinctive among college-educated workers in experiencing polarization with almost no accompanying *upward* occupational movement; whereas urban, black, female college graduates are distinctive in experiencing polarization with no accompanying *downward* occupational movement.[20]

20 As a further check on these conclusions, Figure A1 in the Appendix reports analogous polarization plots, contrasting urban versus non-urban labor markets, for workers subdivided into five detailed education categories: less than high school; high school graduate, no college; some college; four-year degree; post-college education. While urban occupational polarization is detectable among all education groups, it is concentrated among the least educated. Among workers with high school or lower education levels, there is more than a 10-percentage-point fall in middle-skill employment accompanied by over an 11-point rise in low-skill employment. Among workers with some college, the decline in the middle is on the order of 5 points, and the rise in the lower tail is approximately 7 points. Among workers with college or post-college education, the decline in middle-skill employment and the rise in low-skill employment are both 4 or fewer points.

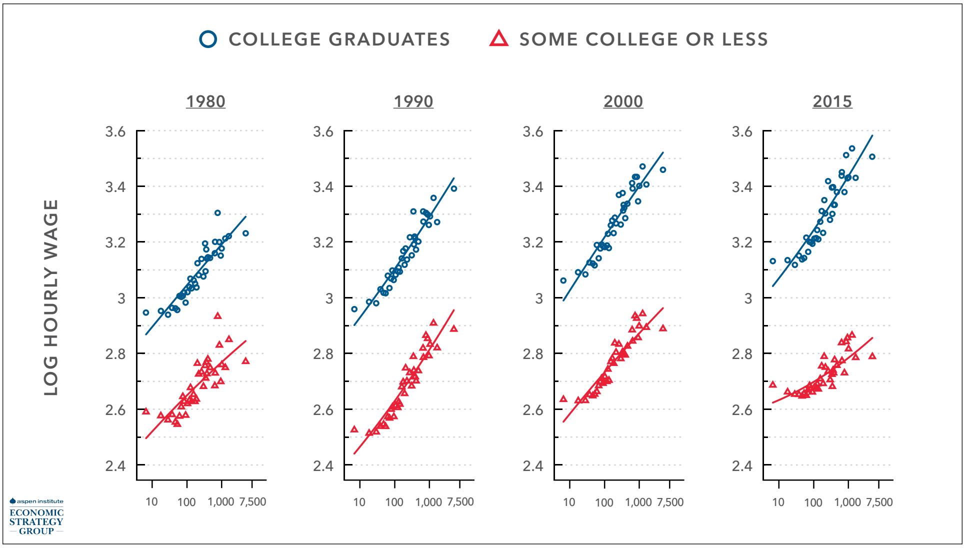
2. The Fading Urban Wage Premium for Non-college Workers

One can be too sentimental about changes in occupational structure. If automation and globalization are spurring urban workers to switch from blue-collar production and white-collar office jobs toward in-person service jobs, perhaps this is progress. Arguably, what matters most is not whether workers are keeping their "old" jobs but rather whether their "new" jobs are as good as the old ones. And the simplest way to make that comparison is via wage levels. As highlighted in the Introduction, both college and non-college workers have historically earned more in cities, and this has been especially true for non-college workers who work in factories and offices alongside professionals, technical workers, and managers (Moretti 2004; Moretti 2012). Thus, the relevant question is whether urban non-college workers have maintained that urban wage advantage as they have transitioned from middle-paying to traditionally lower-paying occupations.

The short answer to this question is no. Figure 7 provides a more detailed answer by plotting inflation-adjusted average hourly wages among college and non-college workers across the full spectrum of urban, metropolitan, suburban, and rural labor markets in the years 1980, 1990, 2000, and 2015. As in Figures 4 and 5, local labor markets in Figure 7 are ordered from least to most urban. Wage levels of college and non-college workers are plotted on a logarithmic scale, so that an increment of 0.10 to the level of the wage corresponds to roughly a 10 percent increase. Although wages in this figure are adjusted for inflation between 1980 and 2015, they do not account for differences in living costs between urban and non-urban areas or between fast- and slow-growing cities. These regional differences are an important part of the story, and I turn to them in the next section.

This figure contains three key results. First, the wages of college graduates are substantially higher in urban rather than non-urban labor markets. In 1980, college graduates in the most-urban quartile of labor markets earned approximately 40 percent more per household than college graduates in the least-urban labor markets. This urban-rural wage differential rose substantially over subsequent decades and reached approximately 55 percent by 2015. Second, the wages of non-college workers are also higher in urban rather than non-urban labor markets. In 1980, average hourly wages of non-college workers in the most-urban labor markets were approximately 35 percent higher than those of non-college workers in the least-urban labor markets, and this gap grew by another 15 percentage points between 1980 and 1990. But, third, unlike for college-educated workers, the urban wage differential among non-college workers substantially collapsed thereafter, plummeting from roughly 50 percentage points in 1990 to 40 percentage points in 2000 to a mere 25 percentage points in 2015—a cumulative drop of one-half.[21] Thus, the urban wage differentials for college and non-college workers moved in opposing directions after 1990, with this premium rising for workers with a college degree and declining dramatically for those without one. This non-college urban wage premium has ebbed as the distinctive structure of non-college urban jobs—specifically, the overrepresentation of blue-collar production and white-collar office and administrative jobs—has receded.

Figure 7: Real Log Hourly Wages of College Graduate and Non-college Graduate Workers by Commuting Zone, 1980–2015



Note: Figure plots real mean log hourly earnings among college graduates and workers with some college or lower education in 1980, 1990, 2000, 2007, and 2015. Wages are normalized to real 2015 levels using the Personal Consumption Expenditure deflator. Each plotted point represents approximately 2.5 percent of the working age population in the relevant year. Source: U.S. Census of Population data for 1980, 1990, and 2000 and pooled American Community Survey (ACS) data for years 2006 through 2008 and 2014 through 2016, sourced from IPUMS (Ruggles et al. 2018).

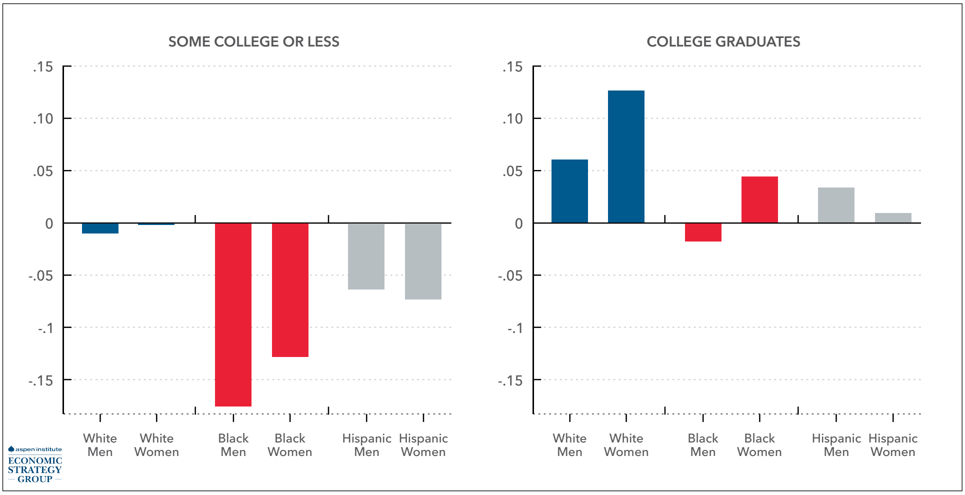
21 The declining non-college urban wage premium was first reported by Baum-Snow, Freedman, and Pavan (2018) in their study of the causes of rising urban wage inequality between 1980 and 2007.

Following the format of the evidence on urban occupational polarization above, Figure 8 explores how these urban wage differentials have played out across demographic groups defined by gender, race, and ethnicity. To make this comparison, the figure contrasts changes in real wages between 1980 and 2015 in the most-urban (top density quartile) versus least-urban (bottom density quartile) labor markets. The findings in Figure 8 affirm the dispiriting picture conveyed by Figure 7. Among non-college whites of both sexes, there was a very slight decline in the urban wage premium. Among nonwhites, however, falls were pronounced. This premium dropped by 5 to 7 percentage points among non-college Hispanics and by 12 to 16 percentage points among non-college blacks.

Among college-educated workers, gains were generally positive. But the racial and ethnic dimension was again less favorable. Gains were larger for whites of both sexes than for blacks and Hispanics of either sex. And, consistent with the adverse occupational shifts plotted above, urban black college-educated men saw their wages fall relative to their non-urban counterparts—a distressing result that deserves far deeper exploration than this brief can offer.

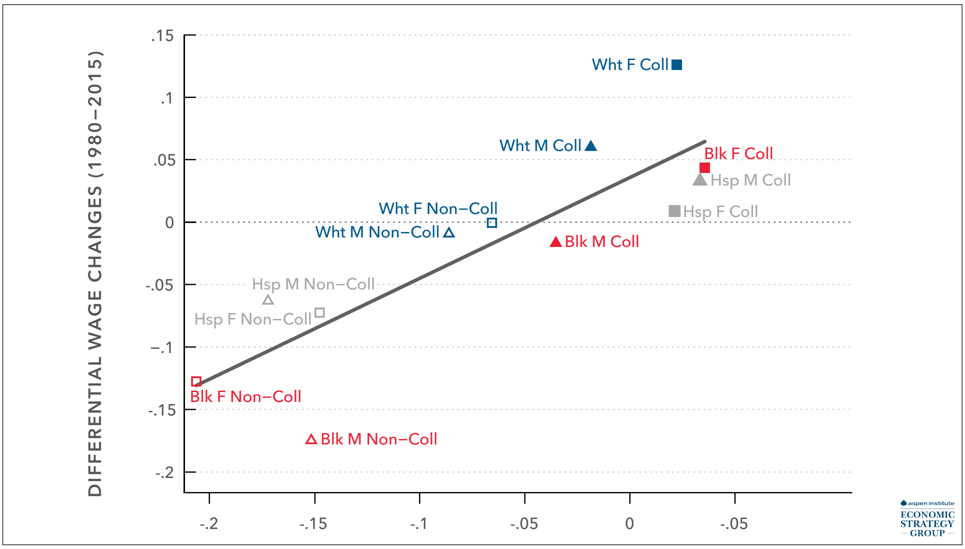
In interpreting this evidence, it deserves emphasis Figure 8 reports changes in urban *relative* to non-urban wage changes by demographic group. Thus, the steep decline in the non-college wage premium could reflect either a fall in urban wages among non-college workers, a rise in non-urban wages among non-college workers, or a combination of the two. As may be seen from close study of Figure 7, both factors are operative: urban non-college wages fell between 1980 and 2015 (particularly after 2000) while non-urban non-college wages rose. Though not visible in this figure, this pattern also holds across race and gender groups: the falling urban premium for non-college blacks and Hispanics reflects weak or negative wage growth among urban minority workers and reasonably strong wage growth among non-urban minority workers. The combination of these two forces means that the urban wage premium has collapsed for non-college blacks and Hispanics.

Figure 8: Percentage Changes in Real Wage Levels (Not Adjusting for Local Cost of Living) in Urban vs. Non-urban Labor Markets by Education, Gender, and Race/Ethnicity, 1980-2015



Note: Figure is constructed using U.S. Census of Population data for 1980 and pooled American Community Survey (ACS) data for years 2014, 2015, and 2016 (to create a 2015 average). Each bar represents the contrast between the change in mean log wages between 1980 and 2015 for the indicated demographic group residing in the top quartile of most-urban labor markets versus the bottom quartile of least-urban labor markets.

Figure 9: Change in Wages and Employment Shares in High- vs. Low-Paying Occupations in Urban vs. Non-urban Labor Markets by Demographic Group, 1980–2015



Note: Figure presents a scatter plot of the relationship between the change in the urban vs. non-urban occupational employment shares of each indicated demographic group on the x-axis (from Figure 6) and the change in the urban vs. non-urban wage gap for that demographic group on the y-axis (from Figure 8). The change in the occupational share for a demographic group is equal to the change in its share in high-wage occupations minus the change in its share in low-wage occupations. (See endnote 21 for further explanation.) Plotted line corresponds to an unweighted OLS regression fit of figure data points. Rubric: Wht, Blk, and Hsp refer to white, black, and Hispanic; F and M refer to female and male; and Coll and Non-Coll refer to workers with and without college degrees.

The striking correspondence between changes in occupation and wage structures in urban versus non-urban labor markets invites the question of whether these are two halves of a whole. That is, did urban occupational polarization cause the non-college urban wage premium to fall? This is a challenging question to answer because these data are correlational in nature. In a hypothetical case where polarization was randomly "assigned" to one city, but not to another, we could directly assess how changes in occupational structure affect wages levels overall and among demographic groups. Lacking such an experiment, Figure 9 offers initial evidence that strongly suggests a connection. This figure presents a scatter plot of changes in urban versus rural wages between 1980 and 2015 among the 12 detailed demographic groups discussed above (college/non-college by male/female by white/black/Hispanic) against the contemporaneous change in their occupational employment shares in urban versus non-urban labor markets.[22]

What is unambiguous from this simple plot is that the education, gender, and race/ethnic groups that saw the largest downward movement in urban versus non-urban occupational employment shares saw the largest declines in urban versus non-urban wages. Similarly, the demographic groups that saw the largest upward movements in occupational employment shares saw the largest wage gains. To be clear, this figure does not constitute proof of cause and effect. What it makes almost indisputable, however, is that these two phenomena share common economic origins.

3. Accounting for the Rising Cost of Urban Living

I began this essay by emphasizing the distinction between *push* and *pull* factors—costs and benefits—that affect the draw of urban labor markets for workers overall and by educational group. The evidence above makes clear that the pull of (formerly) high-wage, urban labor markets for non-college workers has declined as the "quality" of jobs available to non-college workers—measured either by formal skill demands or conventional pay rankings—and as real wage levels have eroded. Although U.S. cities today are vastly more skill-intensive than they were 30 or 40 years ago, urban non-college workers perform substantially less skilled work than decades earlier, and the once robust non-college, urban wage premium has nearly halved. Absent any change in the push side of the urban labor market ledger, non-college workers would have ample reason to reconsider the conventional wisdom that thriving U.S. cities offer a bastion of opportunity to all-comers. Nevertheless, the push aspect of urban labor markets is likely quite important, as discussed in Ganong and Shoag (2017) and Glaeser (2020).

22 Specifically, the occupational employment share variable for a demographic group is the urban-rural relative change in its share in high-paying occupations minus the urban-rural relative change in its share in low-paying occupations. Thus, a demographic group that lost 10 points in middle-paying occupations, gained 3 points in high-paying occupation, and gained 7 points in low-paying occupations would receive an occupational change value of -4 = 3 - 7.

This final section of the research brief stands these push and pull factors alongside one another. To operationalize the push side of the ledger, I turn to Consumer Price Index data compiled by the U.S. Bureau of Labor Statistics.[23] For expositional purposes, I focus on eight urban metropolitan areas, two each in the Northeast, Midwest, South, and West. Within each of these four regions, I include one thriving "superstar" city (New York, Chicago, Houston, or San Francisco) and a second city that is arguably less prominent (Philadelphia, Detroit, Atlanta, or Denver). These data enable comparisons of changes in real wage levels by city and education group accounting for changes in city-specific price levels.

Before turning to wage comparisons, Figure 10 plots patterns of occupational polarization by city and education group. In all eight cities, polarization is much greater among non-college than college workers. Moreover, polarization appears especially pronounced among non-college workers in the "superstar cities" of New York, San Francisco, and Chicago. Thus, the evolution of occupational structure within these major metropolitan areas is consistent with the patterns above.

Figure 10: Change in Occupational Employment Shares among College and Non-college Workers in Eight Major Metropolitan Areas, 1980–2015

Note: Figure presents changes in occupational employment shares in low-, medium-, and high-paying occupations in eight Current Price Index (CPI) metropolitan areas. These areas are harmonized to U.S. commuting zones using data on the county composition of CPI metropolitan areas reported in U.S. Bureau of Labor Statistics (2018).

23 BLS has calculated consistent price index data for multiple decades for approximately two-dozen major metropolitan areas.

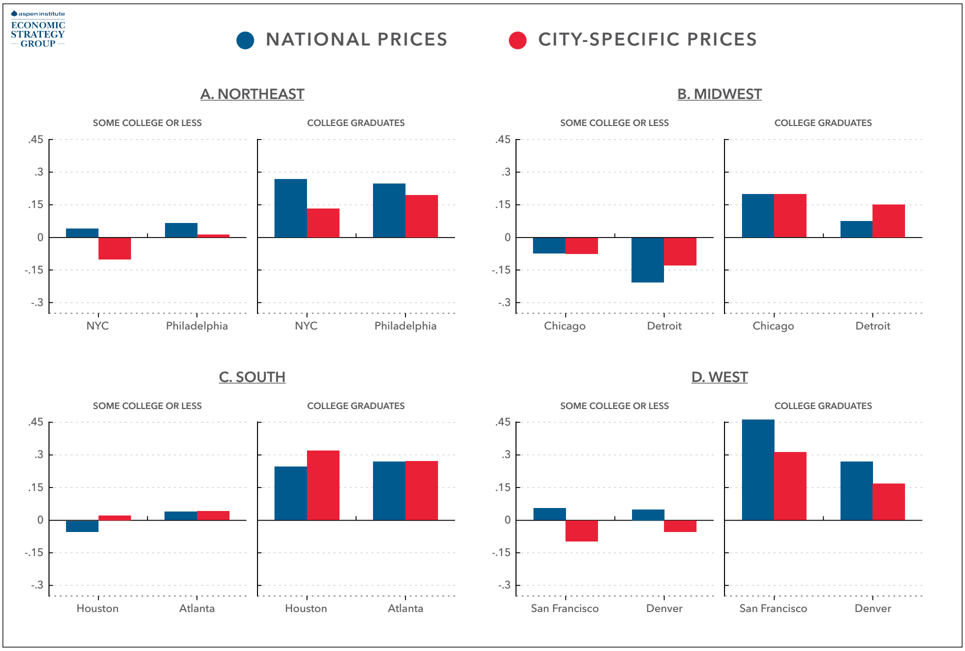
Figure 11 plots real wage changes among college and non-college workers by city between 1980 and 2015 using both national and city-specific price indexes. The message of this figure is clear: Accounting for rising price levels in major metropolitan areas exacerbates the pervasive pattern of eroding real wages among non-college, urban workers shown above. Indeed, in New York City, San Francisco, and Denver, accounting for city-specific prices flips the modest real wage growth of non-college workers between 1980 and 2015 from positive to negative. Accounting for regional price levels, the real wages of non-college workers fall in six of the eight cities in this period. Only in the southern cities of Houston and Atlanta do non-college wages make any net progress in these three-and-a-half decades. Notably, college-educated workers are not immune from these same forces. Steeply rising prices in the booming cities of New York, San Francisco, and Denver also clawed back some of the wage gains made by college workers in these cities during these decades.[24] But wage growth among college graduates was sufficiently robust that net wage gains remained strongly positive.

A key driver of the rising cost of living in thriving cities is the steeply increasing costs of housing—especially in geographically constrained cities like New York and San Francisco. Low-income households spend a substantially larger share of their budgets on housing than do high-income households, reflecting the fact that housing is a necessity like food or clothing.[25] The city-specific price indexes developed by the U.S. Bureau of Labor Statistics and applied in Figure 11 do not, however, account for differences in how low- and high-income households allocate their budgets across goods categories. If it were feasible to make this adjustment, the real wage picture for non-college workers would surely look even less favorable than shown in Figure 11. In short, accounting for the rising real cost of city living further clouds the already dark wage picture for urban non-college workers (Ganong and Shoag 2017).

24 An active economics literature debates whether after accounting for improving urban amenities, changes in inflation-adjusted wage levels in high-wage U.S. cities under- or over-state real earnings growth among college-educated residents of these cities in this time period (see Moretti 2013 and Diamond 2016). There is no debate in this literature, however, that real wage growth among non-college workers in these same locations is reduced by rising living costs.

25 Ganong and Shoag (2017) estimate that the lowest-income households in a typical city spend approximately 32 percent of income on housing versus 15 percent among the highest-income households.

Figure 11: Change in Wage Levels among College and Non-college Workers in Eight Major Metropolitan Areas, 1980-2015, Using National and City-Specific Price Indexes



Note: Figure presents changes in real wage levels deflated using the U.S. Personal Consumption Expenditure deflator for national prices and the Current Price Index series for corresponding metropolitan areas.

Conclusions

The findings in this research brief should be understood in light of both conventional economic wisdom and popular understanding. Both point to affluent, dynamic cities as bastions of labor market opportunity, and they lament the fact that non-college workers are no longer migrating to high-wage U.S. cities (Moretti 2015; Ganong and Shoag 2017; Austin, Glaeser, and Summers 2018). The evidence here suggests that these changing migration patterns reflect the diminishing allure of urban labor markets for workers without advanced degrees. While cities remain vibrant for workers with college degrees, the urban skill and earnings escalator for non-college workers has lost its ability to lift workers up the income ladder. Measured by occupational structures and real wage levels, urban opportunities for non-college workers have deteriorated swiftly and pervasively relative to non-urban labor markets. The declining urban occupational and wage advantage is broadly evident across non-college workers. It is particularly severe among black and Hispanic workers, and even more so among black men. Although, in Edward L. Glaeser's phrase quoted above, cities had historically served as "an escape route for the underemployed residents of rural areas" (Glaeser 2020), there is limited reason to believe that this is still the case.

The data and findings above do not, however, extend to the present, and specifically the ongoing COVID-19 crisis. Although it is premature to make confident forecasts, this crisis appears likely to ultimately exacerbate the challenges afflicting non-college workers in U.S. cities. The primary engine of *job* growth, albeit not *wage* growth, among urban non-college workers over the last several decades has been rising employment in personal services (i.e., food service, cleaning, security, entertainment, recreation, health aides, transportation, maintenance, construction, and repair).[26] The COVID-19 crisis may change this trajectory. It seems probable that employers will learn two durable lessons from the swift, disruptive, and yet surprisingly successful movement of knowledge work from in-person to online: a first is that online meetings are almost as good as—and much cheaper than—time-consuming, resource-intensive business trips; a second is that virtual workplaces can provide a productive, cost-effective alternative to expensive urban offices for a meaningful subset of workers.

If these lessons take root, they will shift norms around business travel and remote work, with profound consequences for the structure of urban labor demand. Already, U.S. employers surveyed during the current pandemic project that the share of working days delivered from home will triple after the pandemic has passed (Altig et al. 2020). Most significantly, the demand for non-college workers in the urban hospitality sector (i.e., air travel, ground transportation, hotels, restaurants) and in urban business services (i.e., cleaning, security, maintenance, repair, and construction) will not likely recover to its previous trajectory. While this trend reversal may spur a *depolarization* of urban employment, this would not, ironically, augur good news for urban non-college workers. Unfortunately, reducing demand for non-college workers in low-paid urban jobs will not restore demand for these same workers in middle-paid urban jobs.

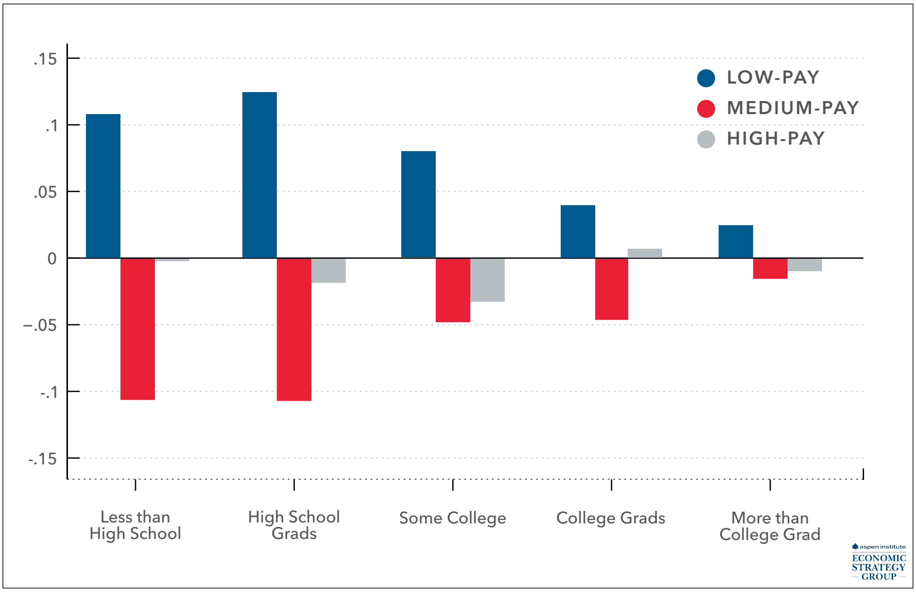
Looking ahead, there are some reasons for tempered optimism. The slowing inflow of non-college workers into urban labor markets highlights one mechanism by which deteriorating conditions may be partly self-correcting. A shrinking pool of non-

26 This is visible in panel B of Figure 5, which shows that the growth of non-college employment in low-paying occupations has been disproportionate in the densest urban areas. In these cities, non-college employment in low-paying occupations has gone from being substantially less prevalent than average in 1980 to substantially more prevalent than average in 2015.

college workers in major U.S. cities will eventually induce employers to compete more vigorously to attract them. This should (slowly) improve wage levels. Simultaneously, the disproportionate aging of the suburban and rural U.S. population during the last four decades (Autor and Fournier 2019) means that there will be rapidly rising demand for many labor-intensive services in suburbs and rural areas, including in-person care, transportation, repair, and other services for the elderly. These secular demographic changes may generate new employment opportunities for non-college workers outside of major cities and could further reduce the long-standing urban non-college wage gradient. Policy can abet this process on two levels. Though policy cannot readily reverse the longstanding economic forces driving urban polarization, it can serve to improve the quality of urban non-college jobs with carefully calibrated minimum wage policies. Simultaneously it can assist workers to seek jobs outside of those urban labor markets where the quality of jobs has not kept pace with the cost of living.

Appendix

Figure A1: Change in Occupational Employment Shares in Urban vs. Non-urban Labor Markets by Detailed Education Level, 1980–2015



Note: Figure is constructed using U.S. Census of Population data for 1980 and pooled American Community Survey (ACS) data for years 2014 through 2016. Each bar represents the contrast between the change in occupational employment share (in percentage points) between 1980 and 2015 among the indicated educational group residing in the top quartile of most-urban labor markets versus the bottom quartile of least-urban labor markets.

References

Aaronson, Daniel. 2001. "Price Pass-Through and the Minimum Wage." *The Review of Economics and Statistics* 83.1.

Acemoglu, Daron and Pascual Restrepo. 2019. "Robots and Jobs: Evidence from US Labor Markets." *Journal of Political Economy* forthcoming.

Akerman, Anders, Ingvil Gaarder, and Magne Mogstad. 2015. "The Skill Complementarity of Broadband Internet." *The Quarterly Journal of Economics* 130(4): 1781–1824.

Alabdulkareem, Ahmad, Morgan Frank, Lijun Sun, Bedoor Alshebli, Cesar Hidalgo, and Iyad Rahwan. 2018. "Unpacking the polarization of workplace skills." *Science Advances* 4(7).

Altig, David, Jose Maria Barrero, Nick Bloom, Steven J. Davis, Brent Meyer, Emil Mihaylov, and Nick Parker. 2020. "Firms Expect Working from Home to Triple." Federal Reserve Bank of Atlanta Macroblog (blog), May 28. https://www.frbatlanta.org/blogs/macroblog/2020/05/28/firms-expect-working-from-home-to-triple.

Austin, Benjamin, Edward Glaeser, and Lawrence Summers. 2018. "Jobs for the Heartland: Place-Based Policies in 21st Century America." *Brookings Papers on Economic Activity* (Spring):151–240.

Autor, David and Juliette Fournier. 2019. "No Country for Old Men: The Inversion of the Rural-Urban Age Gradient." MIT Working Paper.

Autor, David H., David Dorn, and Gordon H. Hanson. 2016. "The China Shock: Learning from Labor Market Adjustment to Large Changes in Trade." *Annual Review of Economics* 8(1): 205–240.

Autor, David H., Lawrence F. Katz, and Melissa S. Kearney. 2006. "The Polarization of the U.S. Labor Market." *American Economic Review Papers and Proceedings* 96(2): 189–194.

---. 2008. "Trends in U.S. Wage Inequality: Revising the Revisionists." *Review of Economics and Statistics* 90(2): 300–323.

Autor, David H. 2013. "The 'Task Approach' to Labor Markets: An Overview." *Journal for Labour Market Research* 46(3): 185–199.

---. 2015. "Why Are There Still So Many Jobs? The History and Future of Workplace Automation." *Journal of Economic Perspectives* 29(3): 3–30.

---. 2019. "Work of the Past, Work of the Future." *AEA Papers and Proceedings* 109: 1–32.

Autor, David H. and David Dorn. 2013. "The Growth of Low Skill Service Jobs and the Polarization of the U.S. Labor Market." *American Economic Review* 103(5): 1553– 1597.

Baum-Snow, Nathaniel, Matthew Freedman, and Ronni Pavan. 2018. "Why Has Urban Inequality Increased?" *American Economic Journal: Applied Economics* 10(4): 1– 42.

Bergman, Peter, Raj Chetty, Stefanie DeLuca, Nathaniel Hendren, Lawrence F. Katz, and Christopher Palmer. 2019. "Creating Moves to Opportunity: Experimental Evidence on Barriers to Neighborhood Choice" Working Paper No. 26164, National Bureau of Economic Research.

Berry, Christopher R. and Edward L. Glaeser. 2005. "The Divergence of Human Capital Levels Across Cities." *Papers in Regional Science* 84(3): 407–444.

Cengiz, Doruk, Arindrajit Dube, Attila Lindner, and Ben Zipperer. 2019. "The Effect of Minimum Wages on Low-Wage Jobs." *The Quarterly Journal of Economics* 134(3): 1405–1454.

Chetty, Raj and Nathaniel Hendren. 2018. "The Impacts of Neighborhoods on Intergenerational Mobility I: Childhood Exposure Effects." *The Quarterly Journal of Economics* 133(3: 1107–1162. Publisher: Oxford Academic.

Chetty, Raj, Nathaniel Hendren, Maggie R. Jones, and Sonya R Porter. 2020. "Race and Economic Opportunity in the United States: an Intergenerational Perspective." *The Quarterly Journal of Economics* 135(2): 711–783. Publisher: Oxford Academic.

Chetty, Raj, Nathaniel Hendren, and Lawrence F. Katz. 2016. "The Effects of Exposure to Better Neighborhoods on Children: New Evidence from the Moving to Opportunity Experiment." *American Economic Review* 106(4): 855–902.

Congressional Budget Office, Congress of the United States. 2019. "The Effects on Employment and Family Income of Increasing the Federal Minimum Wage." Publication No. 55410, July.

Costa, Dora L. and Matthew E. Kahn. 2000. "Power Couples: Changes in the Locational Choice of the College Educated, 1940–1990." *The Quarterly Journal of Economics* 115(4): 1287–1315.

Derenoncourt, Ellora. 2019. "Can you move to opportunity? Evidence from the Great Migration." Princeton University Working Paper.

Diamond, Rebecca. 2016. "The Determinants and Welfare Implications of US Workers' Diverging Location Choices by Skill: 1980–2000." *American Economic Review* 106(3): 479–524.

Dorn, David. 2009. "Essays on Inequality, Spatial Interaction, and the Demand for Skills." PhD thesis. University of St. Gallen. https://www.ddorn.net/data/Dorn_Thesis_Appendix.pdf

Dube, Arindrajit and Attila Lindner. 2020. "City Limits: What Do Local-area Minimum Wages Do?" *Journal of Economic Perspectives* forthcoming.

Dustmann, Christian, Attila Lindner, Uta Schönberg, Matthias Umkehrer, and Philipp vom Berge. 2020. "Reallocation Effects of the Minimum Wage". *CReAM Discussion Paper* (CDP 07/20), p. 60.

Florida, Richard L. 2002. *The Rise of the Creative Class.* New York, NY: Basic Books.

Ganong, Peter and Daniel Shoag. 2017. "Why Has Regional Income Convergence in the U.S. Declined?" *Journal of Urban Economics* 102: 76–90.

Glaeser, Edward L. 2011. *Triumph of the City*. Penguin.

---. 2020. *Urbanization and Its Discontents.* Working Paper No. 26839, National Bureau of Economic Research.

Glaeser, Edward L. and Joshua D. Gottlieb. 2009. "The Wealth of Cities: Agglomeration Economies and Spatial Equilibrium in the United States." *Journal of Economic Literature* 47(4): 983–1028.

Glaeser, Edward L., Joseph Gyourko, and Raven E. Saks. 2005. "Why Have Housing Prices Gone Up?" *American Economic Review* 95(2): 329–333.

Glaeser, Edward L. and David C. Mare. 2001. “Cities and Skills.” *Journal of Labor Economics* 19(2): 316–342.

Glaeser, Edward L. and Matthew G. Resseger. 2010. “The Complementarity Between Cities and Skills.” *Journal of Regional Science* 50(1): 221–244.

Goos, Maarten and Alan Manning. 2007. “Lousy and Lovely Jobs: The Rising Polarization of Work in Britain.” *Review of Economics and Statistics* 89(1): 118–133.

Goos, Maarten, Alan Manning, and Anna Salomons. 2014. “Explaining Job Polarization: Routine-Biased Technological Change and Offshoring.” *American Economic Review* 104(8): 2509–2526.

Hsieh, Chang-Tai and Enrico Moretti. 2019. “Housing Constraints and Spatial Misallocation.” *American Economic Journal: Macroeconomics* 11(2): 1–39.

Ludwig, Jens, Greg J. Duncan, Lisa A. Gennetian, Lawrence F. Katz, Ronald C. Kessler, Jeffrey R. Kling and Lisa Sanbonmatsu. 2013. “Long-Term Neighborhood Effects on Low-Income Families: Evidence from Moving to Opportunity.” *American Economic Review* 103(3): 226–231.

Mazzolari, Francesca and Giuseppe Ragusa. 2013. “Spillovers from High-Skill Consumption to Low-Skill Labor Markets.” *Review of Economics and Statistics* 95(1): 74–86.

Michaels, Guy, Ashwini Natraj, and John Van Reenen. 2013. “Has ICT Polarized Skill Demand? Evidence from Eleven Countries over Twenty-Five Years.” T*he Review of Economics and Statistics* 96(1): 60–77.

Moretti, Enrico. 2004. “Estimating the Social Return to Higher Education: Evidence from Longitudinal and Repeated Cross-Sectional Data.” *Journal of Econometrics* 121(1): 175–212.

---. 2012. *The New Geography of Jobs*. Boston: Houghton Mifflin Harcourt, 294.

---. 2013. “Real Wage Inequality.” *American Economic Journal: Applied Economics* 5(1): 65–103.

---. 2015. “Are Cities the New Growth Escalator?” *The Urban Imperative: Towards Competitive Cities.* Ed. by Edward L. Glaeser and Joshi-Ghani. New Delhi, India: Oxford University Press, 116–148.

Ruggles, Steven, Sarah Flood, Ronald Goeken, Josiah Grover, Erin Meyer, Jose Pacas, and Matthew Sobek. 2018. *IPUMS USA: Version 8.0.*

U.S. Bureau of Labor Statistics. 2018. “Chapter 17. The Consumer Price Index.” *Handbook of Methods*. Washington, D.C: U.S. Bureau of Labor Statistics: Office of Publications & Special Studies. https://www.bls.gov/opub/hom/

Bringing Jobs to People: Improving Local Economic Development Policies

AUTHOR

Timothy J. Bartik*

ABSTRACT

Many local labor markets in the United States suffer from low employment rates, but getting people to move out of these distressed areas is difficult. Moreover, moving people to job-rich regions does not help those left behind, as out-migration destroys jobs in distressed areas. A better way to help the residents of distressed areas is through local economic development policies that boost job growth and employment rates in a sustained fashion. Such policies can successfully encourage local business and job growth through business tax incentives, cash grants, or customized public services, such as advice to small businesses, job training, infrastructure development, or development-ready land. However, there is scope for improvement in how local economic development policies are carried out. I highlight the need for approaches that increase the benefits per job created by better targeting job creation to distressed areas and using workforce programs to link unemployed workers with jobs. There are also ways that local development policies could have a lower cost per job created. For instance, tax incentives and cash grants to a few large projects are less cost-effective in creating jobs than providing a broader array of businesses with public services. Needed reforms to local economic development policies are within the power and resources of state and local governments to accomplish on their own. However, federal intervention could potentially help by capping some of the largest incentives, and by providing distressed areas with funding to carry out their development plans.

* Ford Senior Economist, W.E. Upjohn Institute for Employment Research

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Introduction

This chapter argues for improving one type of "place-based" policy: local economic development policies, which seek to increase the number and/or quality of jobs in a particular local labor market.[1] Reforms can increase these policies' benefits and reduce their costs. To increase benefits, I argue for better targeting the policies, so that a greater share of the local jobs created go to persons who otherwise would not be employed. Targeting can be improved by focusing on distressed local labor markets and by incorporating programs that link jobs with unemployed workers. To reduce the costs per local job created, I argue for reforming local economic development policies so that they rely less on business tax incentives to create local jobs, and more on enhancing local public services that boost business productivity.

"Local economic development" refers to an increase in the number or quality of jobs in a geographic area that constitutes a local labor market. Local labor markets, such as metropolitan areas, are defined as groups of counties that have enough intercommuting that any change in labor demand in one neighborhood will be quickly felt throughout the metro area. For example, the labor market in the Chicago metropolitan area is made up of 14 counties spanning Illinois, Indiana, and Wisconsin with a population of about 9.5 million.

Local economic development could be affected by almost any policy; for example any tax, spending program, or regulation might affect local jobs. But I define "local economic development *policies*" more narrowly, as policies that meet two criteria: First, the policy's main goal is increasing the number or quality of jobs in a particular local labor market. Second, the policy targets individual businesses or industries, with the goal of catalyzing broader benefits.

As I describe in the next section, these local economic development policies are mainly carried out by state and local governments, at an annual cost exceeding $50 billion, with about three-fourths of this funding from state governments and the rest from local governments. State and local economic development agencies provide firms with incentives (programs that provide firms with cash via tax incentives or cash grants), to induce these firms to locate or expand jobs. Some economic development programs also attempt to induce job creation via public services to business, such as customized job training, business advice, or access roads.

1 This chapter does not discuss another type of place-based policy: "community development" policies to improve a specific neighborhood. Such policies are unlikely to significantly improve neighborhood residents' labor market outcomes. Most people do not work in their neighborhood. Within a metro area, there is enough commuting that more jobs in one neighborhood affect employment rates and wages similarly throughout the metro area.

These economic development programs potentially have large benefits. Local job creation can significantly increase local employment-to-population ratios, also known as the employment rate; these increased employment rates can persist in the long run.

However, current local economic development policies are often poorly designed. Costs are too high, and too few benefits go to those who need the jobs. Thus, reforms are needed in order to lower costs per job created. As I discuss later, based on the research evidence, incentives often do not tip firms' decisions of where to locate. In 9 out 10 cases, firms are receiving a tax incentive for a location decision they would have made anyway, even if no incentive had been provided (T. Bartik 2019b, p. 40 and note 60 on p. 127). As a result, incentives have high costs per local job they actually create and thus should receive less emphasis. Based on the research evidence, lower costs per job created can be achieved by public services to support business development. These public services to business—such as advice to small business and customized training—also tend to enhance the productivity of many small businesses, while firm-specific incentives often go disproportionately to a few large projects, which makes incentives a riskier strategy.

Reforms also need to improve the benefits per job created. Public subsidies for local job creation are rationalized as a way of providing individuals who lack good jobs with better job opportunities. But does this local job creation do enough to help? As I will discuss, the evidence suggests that on average, for every 10 local jobs created, 8 out of those 10 jobs go to in-migrants, and only 2 out of 10 boost employment rates for local residents (T. Bartik 2020b). More jobs will go to nonemployed individuals if local development policy is targeted to places with low employment rates. Nonemployed individuals also can be reached by linking local economic development policies with local workforce programs. As I will later highlight, customized job training programs can help recruit, train, and match local workers with job vacancies, and "success coaches" can help workers retain those job matches.

As I will illustrate with case studies, successful local economic development strategies also tend to avoid focusing on a single dominant firm or industry. Instead, successful strategies seek to encourage local growth more broadly, in a diverse portfolio of many industries.

Reforms to local economic development policies can be done, and have been done, by state and local governments on their own. But governors and mayors are often tempted by the votes gained due to handing out sizable incentives to a few large projects. Moreover, the state and local areas that most need jobs—those with high rates of nonemployment—also are likely to have lower tax bases, which makes it more difficult for these areas to fund local economic development strategies at a sufficient scale.

Potentially, an appropriate federal intervention could help encourage reforms in local economic development policy. Federal policy could encourage capping some of the more excessive incentives to the largest firms. A federal block grant could help distressed areas. I will outline one proposed federal block grant, which would provide $23 billion per year that would go to distressed areas to help finance needed public services to support local business development.

But any federal intervention must respect the diversity of local needs. One size does not fit all, so any federal regulations or grants must avoid micromanaging local economic development strategies. In addition, it is unclear whether the needed reforms to local economic development policies are more politically feasible through federal intervention, or through encouraging continued reforms at the state and local level.

1. The Landscape of Local Economic Development Policies

By "local economic development policies," I mean policies that promote local job creation by targeting specific businesses or industries. Such targeting has some logic, for the benefits of local job creation will vary greatly across different types of businesses.

For example, state and local economic development agencies often target "export-base industries." In regional economics, an export-based industry is one that sells its goods and services outside of the local labor market where they are produced. The sales "base" for the goods or services produced by a business establishment in this industry is typically outside the local labor market, even though the establishment's employment is local. For example, a business establishment that employs Michigan workers, but sells its products in Ohio, would be an "export-base" business for Michigan, even if this business does not export outside of the United States.

By providing tax incentives, cash grants, or customized public services to particular firms in export-base industries, state and local governments hope to induce these firms to create local jobs. The boost to "base" jobs will create a multiplier effect on other local jobs. Local suppliers to assisted firms may experience increased sales, which will increase jobs. Workers in the assisted firms and their local suppliers will spend some of their increased earnings at local retailers, leading to more jobs and earnings in the local economy's non-base sector.

Why target the export-base sector? Consider the opposite scenario: what if a state or local government aids a non-export-base business establishment, that is a business establishment that employs local workers but only sells its goods or services in that same local labor market? For example, suppose assistance is provided to encourage the expansion of a local McDonald's franchise. Even if this assistance works—i.e. the McDonald's franchise location expands its employment in response to the aid—the assistance is unlikely to boost the metro area's total jobs. The increased sales at this McDonald's location will reduce sales at other local restaurants. The added McDonald's jobs are offset by fewer jobs at the Burger King down the street.

In the United States, local economic development policies are mostly run by state and local governments (Table 1). The costliest policies are "incentives," by which I mean tax incentives or cash grants that provide cash to individual firms. In this chapter's discussion, the term "incentive" only applies to such cash incentives; other economic development policies are not labeled as "incentives," even though these other policies may induce job growth. Sometimes this chapter groups both incentives and other local economic development policies under the label of "economic development assistance."

In addition to targeting incentives to firms in base industries, economic developers may also target particular firms within base industries. A firm's targeting may be based on the economic developer's belief that its location decision is more easily tipped. Firms also may be targeted because they pay higher wages or have a higher multiplier. A firm may be targeted for political reasons: a more prominent firm will attract more favorable public attention. I will discuss incentive trends and costs more extensively later in this chapter.

Table 1. Resources Devoted to Local Economic Development Policies in the United States

Policy/program	Annual dollars (in billions)	
CURRENT PROGRAMS		
State and local business tax incentives and other cash incentives	47.1	
Customized training programs	0.6	
Other state economic development programs	2.8	
	Subtotal, state/ local programs	50.6
Manufacturing extension (federal/state/fees)	0.4	
Economic Development Administration (EDA)	0.3	
Economic development portion of HUD's Community Development Block Grants	1.1	
Small Business Administration	0.8	
Other economic development programs in USDA, HUD, Commerce	2.0	
	Subtotal mostly federal spending	4.7
Other tax expenditures that might promote local economic development	2.4	
	Subtotal, federal tax expenditures	2.4
	Total of federal programs and tax expenditures	7.1
	Total of all levels of government	57.8
PAST PROGRAMS		
Appalachian Regional Commission (peak annual spending 1966–1975)	1.6	
Tennessee Valley Authority (peak annual spending 1950–1955)	1.5	

Note: All dollar figures are in billions of 2019 dollars and represent annual resources. State/local tax and cash incentives are based on T. Bartik (2017). Customized training spending from Hollenbeck (2013). Other state economic development expenditures from Council for Community and Economic Research (2018) and include: tourism; film promotion; other special industry promotion; high-tech programs; business finance; entrepreneurial assistance; minority business development; community assistance; business recruitment; trade promotion. Manufacturing extension is from T. Bartik (2018). EDA, HUD, and SBA are based on FY 2017 U.S. federal budget. For CDBG, assume one-third goes to "economic development." Other economic development spending is based on GAO (2012b). Other tax expenditures are derived from GAO (2012a). ARC figures are based on Jaworski and Kitchens (2019). TVA figures are based on Kline and Moretti (2013).

But economic development policies are more than handing out cash to businesses via incentives. Some local economic development policies provide businesses with customized public services, which meet specific needs of the firm. These services can include customized job training, such as a local community college that provides training for an individual firm's needs. Another common economic development service is business advice. For example, manufacturing extension service offices, typically funded by some combination of government funding and private fees, provide advice to smaller manufacturers on upgrading their technology or diversifying their markets. Small business development centers are another example of publicly provided advice. Public services to business may also include real estate development and infrastructure improvements to business sites. Industrial parks, business parks, high-tech parks, and business incubators are examples of real estate development that supports business development. Economic development assistance packages to firms often go beyond incentives to include access roads or transit improvements, which help a firm's employees get to work and help the firm to obtain supplies or ship its products.

Although these public services are important in encouraging local business development, they are not the part of local economic development policy that receives the most resources. The most resources go to incentives. As I will discuss later, this emphasis on incentives may be inappropriate, as incentives are often a costly way to create local jobs.

2. Why Local Labor Market Policy Is Needed: Disparities in Local Job Opportunities

But why do we even need local job creation policies? The most compelling reason is this: Local labor markets have *large*—and *persistent*—disparities in job availability. This can be seen in the employment rates for "prime working-age" individuals—defined as those ages 25 to 54—across the 1,468 local labor markets in the United States. (The labor market definition used in this chapter assigns each of the 3,143 counties in the United States to one of these 1,468 local labor markets, with this assignment based on commuting flows.[2]) Even before the current recession, when the economy was in recovery and unemployment rates were low, prime-age employment rates varied greatly.

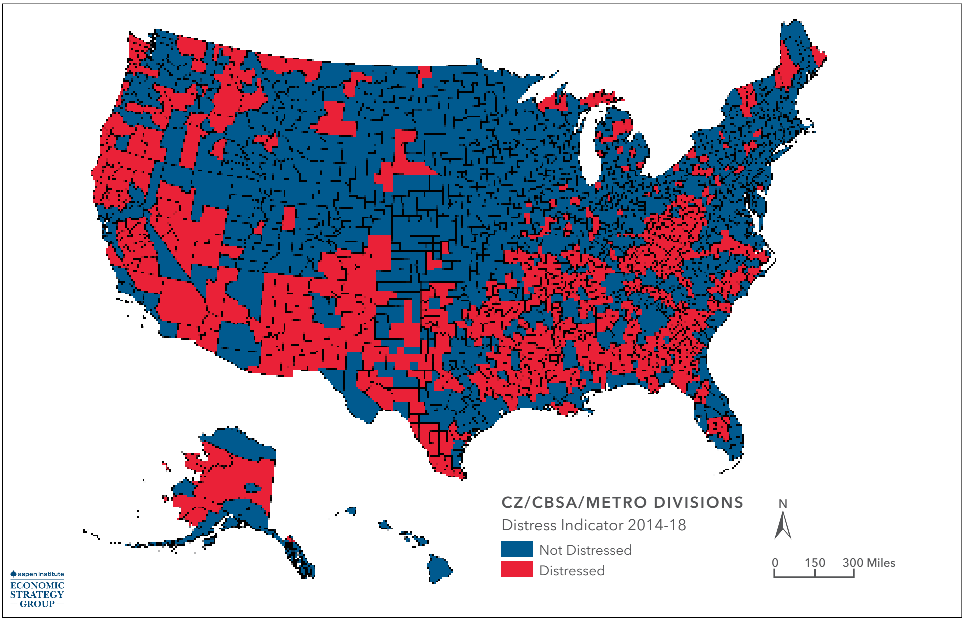
In data from the American Community Survey for the 2014–2018 period—the latest period for which comprehensive county-level employment rate data are available—

2 My local labor market areas are defined starting with the Census Bureau's "metropolitan areas" and "micropolitan areas," both of which are commuting-tied groups of counties. A few large metros are divided into "metro divisions," which are sub-groups of counties with a higher volume of commuting flows. For the remaining rural counties, I use commuting zone designations. More details on definitions and calculations in T. Bartik (2020c).

roughly 15 percent of the U.S. population lived in the 573 local labor markets in which prime-age employment rates were at least 5 percentage points below the U.S. average. Collectively, these 47 million people live in areas where the prime-age employment rate averaged 68.1 percent, 9.6 percentage points below the national average of 77.7 percent. As shown in the map, low-employment-rate areas include much of the South and Appalachia, as well as large parts of the West Coast states outside of the major coastal cities, parts of Michigan, and parts of upstate New York and New England (T. Bartik 2020c). Perhaps surprisingly, the majority of people living in low-employment-rate areas reside in metropolitan areas, not rural areas. Out of the 47 million people in these 573 low-employment-rate areas, 26 million (55 percent) lived in 85 different metropolitan areas. The five largest areas include: Riverside, California, with 4.5 million people; Detroit, Michigan, with 1.8 million people; Fresno, California, with 1 million people; Bakersfield, California with 900,000 people; and McAllen, Texas with 800,000 people.

In contrast, 10 percent of the U.S. population—33 million people—lived in the 239 local labor markets in which the prime-age employment rate was at least 5 percentage points above the U.S. average. The five largest booming areas are: Washington, DC, with 4.9 million people; Minneapolis-St. Paul, with 3.5 million; Denver, with 2.9 million; Cambridge, Massachusetts, with 2.4 million; and Montgomery and Bucks County in suburban Philadelphia, with 2.0 million.

Figure 1. Distressed Local Labor Markets, 2014–2018 Period



Source: American Community Survey (2019) and Author's calculations

In these 239 booming areas, the prime-age employment rate averaged 84.5 percent, 6.8 percent above the U.S. average. Compared to these booming areas, prime-age persons in distressed areas are one-fifth less likely to have a job.[3]

Labor market disparities cause large social problems (Austin, Glaeser, and Summers 2018 and T. Bartik 2020b provide reviews). Local labor market problems lead to problems with mental health, substance abuse, family break-ups, and crime (Autor, Dorn, and Hanson 2018; Diette et al. 2018; Pierce and Schott 2017). Local economic distress also adversely affects children (Bastian and Michelmore 2018). Labor market problems put fiscal stress on state and local governments by reducing tax revenue and increasing public spending needs (Charles, Hurst, and Schwartz 2018). Local economic problems lead voters to support candidates at the political extremes of both parties (Autor et al. 2020).

These local labor market problems are persistent. Across these 1,468 local labor markets, a high correlation is found between their prime-age employment rate in 2000 and in the 2014–2018 period, even with the intervening China manufacturing shock and the Great Recession.[4]

Suppose we look at the local labor markets that were distressed as of 2000. Out of our 1,468 local labor markets, 353 local labor markets were at least 5 percentage points below the national average in 2000. These 353 areas had an average employment rate 8.8 percentage points below the national average, as of 2000. As of 2014–2018, these same 353 areas still had a prime-age employment rate that averaged 5.5 percentage points below the national average. There was some tendency for below-average areas to improve towards the mean, but it was slight.

Some larger areas have improved since 2000, while other smaller areas have declined. In 2000, the 353 areas in which employment rates were 5 percentage points below the national average comprised 19 percent of the national population. In 2014–2018, there were 573 local labor markets in which employment rates were 5 percentage points below the national average, but these areas comprised just 15 percent of the national population. As this comparison suggests, distressed areas over time have tended to include more smaller communities.

Part of the reason for this pattern is that in a few very large coastal cities that were distressed in 2000, employment rates have dramatically increased. For example, the New York Metro Division went from having a prime-age employment rate of

3 68.1 percent in distressed areas divided by 84.5 percent in booming areas = 0.81.

4 The correlation between the 2000 employment rate and the 2014–2018 rate is 0.88.

6.9 percentage points *below* the national average in 2000, to being slightly *above* (0.2 percentage points) the national average in 2014–2018. Los Angeles went from having a prime-age employment rate of 8.2 percentage points below the national average in 2000 to being only 0.7 percentage points below the national average in 2014–2018. These large improvements are the exception to the rule. Of the 353 areas that were distressed in 2000, that is more than 5 percentage points below the national average, 326 of these areas were still distressed in 2014–2018.

Other areas have over time become more depressed. For example, Flint, Michigan, went from a prime-age employment rate that was 1.0 percent below the national average in 2000 to 5.1 percent below the national average in 2014–2018. Such economic problems frequently become evident when a locality experiences a severe recession. Hershbein and Stuart (2020) show that metro areas that experience more severe recessions would typically have lower employment in the long term, compared to a counterfactual world in which the metro area had experienced an average recession. An area that loses 5 percent more employment than the national average during a recession has employment that averages 6 percent lower than comparable areas a decade later, and an employment rate that is 2 percentage points lower.

A recession that targets a particular base industry—whether that industry is travel and tourism, energy, manufacturing, or others—will be particularly damaging to the local economies that specialize in that base industry. But the effects are not just temporary. The local economies that specialize in the hard-hit industries get back on the prior growth track, but they typically do not catch up to where they would have been absent their employment losses, leading their residents to suffer.

Permanent employment losses occur in part because some job losses during a recession reflect permanent structural changes in the demand for a particular industry in the national economy. For example, we might expect persistent, long-run effects of a decline in auto employment in Flint, or coal-mining employment in West Virginia.

But a locally severe recession may also damage local economic assets, thus making the local economy less competitive. Locally severe recessions may damage public services such as education, which may damage the area's future job growth. Locally severe recessions also may cause workers to have greater problems: the recession-induced job loss may lead to a drop in worker skills, and may increase substance abuse and crime. A local area that has experienced multiple negative shocks, either during recessions or over time, will end up having a significantly below-average employment rate, which will often persist for a long time.

As with prior recessions, the current "Pandemic Recession" will unevenly hit different local labor markets. Some areas such as Detroit will find that the pandemic exacerbates their labor market problems. Other areas may find that the current recession may push them over the edge into a severe, job-availability problem. Policymakers should expect these job problems to persist. For example, an area that specializes in tourism may suffer during the current recession. Even if tourism recovers, the short-run job loss may damage the skills and public services of the local area, which may lead to long-run problems.

3. Improving Local Labor Markets: Jobs-to-People Strategies Work Better than People-to-Jobs Strategies

What can be done about local labor market problems? There are two commonly discussed policy approaches: encourage people in distressed areas to move to areas with more jobs (people-to-jobs) or encourage job growth in distressed local labor markets (jobs-to-people). I argue that jobs-to-people is a better solution than the people-to-jobs approach.[5]

3.a. What's Wrong with the People-to-Jobs Approach?

Policies encouraging people to relocate to areas with greater job availability have been proposed numerous times (President's Commission for a National Agenda for the Eighties 1980; Ludwig and Raphael 2010; Brookings discussion of Austin, Glaeser, and Summers 2018; Strain 2019). But people-to-jobs strategies have two problems. First, it's hard to get people to move. Second, moving people out of distressed local labor markets does not help improve employment rates for those left behind in those markets.

On the first point, many studies find that relocation costs are high. The costs to moving extend far beyond the financial outlay of moving expenses. People bear a psychic cost of moving away from family and friends. Many also bear very real economic costs of moving away from supportive family members, who provide many types of in-kind support. People's migration behavior, as well as direct survey evidence, suggests that average "psychological" moving costs exceed 100 percent of annual income.[6]

5 My favoring of "jobs-to-people" over "people-to-jobs" contrasts with an earlier Economic Strategy Group memo by Ziliak 2019. In the context of distressed rural labor markets, Ziliak advocates both types of strategies. To be clear, I am not suggesting that people-to-jobs strategies never help anyone; they do help some people who are helped to move and become more successful as a result. But my argument is that such people-to-jobs strategies only will induce a few people to move and will not help those left behind.

6 T. Bartik 2019a provides a review of this moving cost evidence. Studies inferring such high moving costs from actual moving behavior include Kennan and Walker 2011 and A. Bartik 2018; studies inferring such high moving costs from surveys of what payments would elicit out-migration include Dunn 1979 and Kosar, Ransom, and van der Klaauw 2020.

Negative economic shocks to an area do not increase out-migration by very much. For example, Autor, Dorn, and Hanson (2013) “find no robust evidence that [Chinese trade-induced] shocks to local manufacturing lead to substantial changes in population.” Other research finds that moving from a commuting zone in the 25th percentile of exposure to trade with China to a commuting zone in the 75th percentile increases out-migration over the decade after 2000 by less than 1 percentage point, even though higher exposure to Chinese trade has large effects on lowering local earnings (A. Bartik 2018).

Low outmigration may be due to local labor markets in the same region experiencing similar demand shocks. Out-migrants from distressed metros often move to other distressed metros, in part because many distressed metros are geographically close to other distressed metros (Molloy and Smith 2019). Occupational regulations that vary by state may also inhibit mobility (Austin, Glaeser, and Summers 2018). Housing supply restrictions in booming areas may also discourage the mobility of less-educated workers (Hsieh and Moretti 2019).

But the reluctance to move is not just due to geographic or political barriers. Half of all Americans live within 30 miles of where they were born; in other words, in the same local labor market (Zabek 2019). About 55 percent of all Americans spend most of their career in the metro area where they spent their childhood. This percentage does not drop much for metro areas with lower growth or of a smaller size (T. Bartik 2009).

People have valuable ties to their home area. Local ties have a real value to people that has nothing to do with housing supply restrictions or occupational regulations. We’re deluding ourselves if we think addressing local land-use restrictions or occupational licensing reform will massively increase out-migration from distressed local labor markets.

Even if policies succeeded in getting more people to move out of weak labor markets, this does not serve to reduce disparities in employment-to-population ratios across different local labor markets. Numerous studies show that when migration changes the population of a local labor market by some percentage, employment in the local labor market changes by about the same percentage (T. Bartik 2020b). In other words, when we move people out of a distressed area, employment declines enough that the area’s employment-to-population ratio does not improve. This implies that other local labor market outcomes, such as wages, are also unlikely to improve.

Why do changes in local population have such strong effects on local employment? When people move away, this removes their consumption demand, which hurts local retail jobs. Out-migration also reduces home, commercial, and public construction. The people who move out may be younger and more entrepreneurial; their out-migration may reduce the area's business start-ups and make the area's labor quality less attractive for business growth. Out-migration will reduce local housing values, which reduces consumption by local homeowners (Howard 2020).

In other words, moving people out of Flint does not help Flint. Between 2000 and the 2014–2018 period, the overall population of the Flint metro area declined by 6.1 percent, and the prime-age population declined by 19.2 percent. But despite this large population loss, Flint's prime-age employment-to-population significantly worsened over this time period, as previously noted.

Moving people to jobs only helps relatively few individuals, at best, and in most cases will leave the local distressed area no better off. But can jobs-to-people strategies do better?

3.b. Jobs-to-People Strategies Can Work, Particularly if They Help the Nonemployed Access Jobs

Economic development policies seek to help people in distressed local labor markets by bringing jobs to people. Based on research, jobs-to-people strategies can have large, long-run benefits. Local job increases can raise local employment rates, not only in the short run but the long run, by an amount that is substantively important.[7] In distressed areas, the employment rate impact of more local jobs is greater, which suggests jobs-to-people strategies should be targeted to distressed areas.

Based on research, a local employment increase of 10 percent will on average increase the long-run local employment rate by between 2 and 3 percent (T. Bartik 2020b). This employment rate effect is closer to 3 percent in distressed local labor markets.[8]

What does this imply for the potential of more jobs to help distressed areas? Consider again the 573 local areas that in 2014–2018 had a prime-age employment rate of at least 5 percentage points below the U.S. average. Their prime-age employment rate averaged 68.1 percent. A 3 percent increase in their employment rate would equal an increase of 2 percentage points. Therefore, if we increased these distressed areas' annual job growth rates by only 1 percent, after 10 years we would have a meaningful improvement in these areas' employment rates.

7 The available evidence indicates that these changes in employment rates due to local job shocks are largely due to changes in employment opportunities for the original residents, not due to changes in the composition of the local population (T. Bartik 1993; A. Bartik 2018).

8 Local population growth will also go up, but just not as much in percentage terms as the local job growth, as discussed further below.

These long-run effects imply that jobs-to-people strategies have large dollar benefits per job created. If only 20 percent of jobs created result in long-term increases in local employment rates, the present value of increases in local earnings per capita would be in the hundreds of thousands of dollars per job created.[9]

3.b.1. The Mississippi Balance Agriculture with Industry study and long-run employment rates

To illustrate how local job growth can raise long-run local employment rates, consider a study by Matthew Freedman (2017) of Mississippi's "Balance Agriculture with Industry" (BAWI) program, begun in 1936. BAWI was a pioneering program that led to the modern economic development competition among the states. Mississippi offered Northern manufacturers the following deal: if you locate in Mississippi, we will lease you land and a factory for $1 per year in perpetuity, and, since the land and factory will be "owned" by the state or local government, no property taxes will be due. The northern manufacturers that used this Mississippi program were mainly textiles plants that primarily used female labor. The BAWI program was imitated by other southern states, and then northern states began offering incentives in the 1960s.[10]

To determine whether the program caused an increase in Mississippi's labor force participation, Freedman compared "treatment" counties, which gained these factories, with other Mississippi counties with similar prior trends. Counties that gained factories had higher female labor force participation rates by as much as 4 percentage points over the 20-year period from 1940 to 1960. Effects continued at a diminished rate, with more marginal statistical significance, until at least 1980. Furthermore, although the program did not initially affect male labor force participation rates, male labor force participation rates increased in 1980 and some subsequent years. These results are surprising because most of these textiles plants closed by 1960 or shortly thereafter.

Why do local employment increases have long-run effects on employment rates? Part of the explanation is the effects of short-run employment experience on long-run job skills. The Nobel laureate Edmund Phelps made a similar argument about the long-run effects of national economic booms (Phelps 1972, 79), which can be applied to regional job increases. He highlights that job experience provides workers the opportunity to gain skills—he specifically identifies "skills" such as "getting to work on

9 Suppose the average local full-time-equivalent job paid $60,000. A 20 percent employment rate effect implies that an extra job increases local earnings per capita by $12,000 (0.20 × $60,000). If this effect persists in the long-run, and we discount future earnings per capita increases by a 3 percent social discount rate, the present value of the future earnings per capita increases, per job created, is $400,000 ($12,000 ÷ 0.03).

10 I will later discuss more recent incentive trends, in the context of some of the current problems caused by incentives.

time," and "learning to work with others." A booming labor market also gives workers "the opportunity to acquire skills at more demanding jobs in the skill hierarchy than they could ordinarily qualify for." As a result, a "rise of aggregate demand may gradually lead to a true upgrading in the average quality of the labor force."

In addition to job-specific skills, narrowly defined, there are effects on "human capital," broadly defined: short-run job experience may reduce the odds of a person suffering health problems or substance abuse, or engaging in crime, all of which obviously affect long-run employability.

Beyond effects on the person getting the jobs, higher employment rates may affect the next generation. Earnings are highly correlated across generations (Chetty et al. 2020; Solon 1999). So, the higher employment rates and earnings rates of one generation, due to a job shock to a local labor market, may improve labor market outcomes for the next generation.

In the Mississippi program, individuals who got textile jobs or any of the multiplier jobs in the treatment counties had greater long-run employability as a result. This greater employability effect may have persisted after the original plants had closed and even into the next generation.

3.b.2. In-movers vs. existing residents: who benefits from place-based policies?

The benefits from jobs-to-people strategies depend on the effects of local job increases on employment rates. Logically, an increase in local jobs must result in some combination of an increase in the local employment-to-population ratio, or a change in the local population due to net migration. Local employment must equal the local employment rate multiplied by the local population. If a local job increase of 10 percent increases the local employment rate by 2 percent, then local population must increase by 8 percent, through shifts in net migration. If the local employment rate increases by 3 percent, then local population must increase by 7 percent. In other words, new jobs must ultimately go either to in-migrants or to a local resident who otherwise would not be employed.

But, can't new jobs also go to local residents who are already employed? Yes, new local jobs have the immediate effect of being filled in one of three ways, by: (1) local residents who are already employed; (2) local residents who are not employed, and (3) in-migrants. But if a new job is filled by a local resident who is already employed, that leads to a job vacancy. That job vacancy must be filled in the same three ways. The resulting vacancy chains are only ended when a new job ultimately results in an additional job for a local resident who otherwise would not be employed, or in a job going to an in-migrant who otherwise would not have moved to the local area.

What determines the share of a local employment increase that affects local employment rates versus net migration? This share is determined by the choices that local employers make along the vacancy chains created by new jobs. All along these vacancy chains, employers are deciding whether to hire a nonemployed local resident or an in-migrant for a particular job vacancy.

Both common sense and empirical evidence suggests that in more distressed local labor markets—where the local employment rate is lower, meaning that a higher percentage of nonemployed persons are available—that a higher proportion of vacancies will tend to be filled by hiring the local nonemployed. In a local labor market at the lowest 10th percentile of local employment rates, the effects of a job shock on local employment rates will be at least 50 percent higher compared to a local labor market with an employment rate at the 90th percentile (T. Bartik 2015, 2020b; Austin, Glaeser, and Summers 2018). If 20 percent of a job increase in a booming local labor market is reflected in higher employment rates, then 30 percent of a job increase in the distressed labor market would be reflected in higher employment rates.

Based on this analysis, jobs-to-people strategies have greater benefits for distressed local labor markets—about half again as great (30 percent over 20 percent). State and local governments should be more aggressive in pursuing job creation in distressed areas. If federal policy seeks to encourage jobs-to-people strategies, the benefits of doing so are greater in distressed areas.

However, policies can also increase the percent of jobs that go to the nonemployed by directly linking the nonemployed with jobs. Local economic development policies sometimes attempt to do so using sticks or carrots. Such sticks or carrots are part of economic development agreements that state and local governments reach with firms that are locating or expanding jobs in the area, or in some cases local firms that face competitive threats and are potentially downsizing or relocating jobs. These economic development agreements would typically only be negotiated with firms in base industries, and within the group of "base" firms, those firms that are making location, expansion, or retention decisions that affect local jobs.

An example of a modestly sized "stick" is when a state or local government requires firms that are awarded incentives to have "first-source hiring agreements." A firm that receives incentives is required to consider, for entry-level jobs, applicants that are referred by the local workforce agency. Such first-source hiring agreements have been used in cities such as Portland, Oregon, Berkeley, California, and Boston, Massachusetts. These requirements tend to be more popular in booming areas, which have greater leverage in imposing requirements.

The Upjohn Institute has for many years administered local job training programs in the Kalamazoo (Michigan) area. Some recent programs are designed to alter some features of area labor markets. Two examples are: the Neighborhood Employment Hub program in Battle Creek, funded by the Kellogg Foundation; and the Employer Resource Network, in Battle Creek and Kalamazoo.

Under Neighborhood Employment Hubs in Battle Creek, local workforce operations are decentralized into trusted local institutions in low-income neighborhoods: a local church, a community action agency, and a subsidized housing project. This contrasts with customary practices of locating workforce programs in impersonal offices remote from low-income neighborhoods. If such hubs better involve low-income residents, these residents will be more readily linked to available jobs.

Under Employer Resource Networks, local businesses pay a fee for services from a "success coach," who helps retain workers. The success coach provides case management to link employees to needed services. For smaller businesses, knowledge and resources for accessing social services for their employees may be lacking. As part of ERNs, a local credit union provides expedited loan services to help employees deal with problems such as getting a car fixed. ERNs aim to increase employee retention and lower the costs to employers of high employee turnover. If such a program succeeds, more employers may be willing to take a risk on hiring local residents whom they otherwise would not hire.

An example of a "carrot" is when a state or local government provides customized, job training programs as part of a package of economic development assistance to a firm. Under customized training, a firm that is locating, expanding, or retaining jobs is provided with free training by the local community college, sometimes only for new workers, but in other cases for incumbent workers. In some cases, such programs can encourage a firm to hire nonemployed residents who might not be considered otherwise. These programs also lower the screening and training costs associated with such workers (Osterman and Batt 1993).

However, encouraging hiring of nonemployed workers only at firms that receive economic development assistance is a limited strategy, for at least three reasons. First, such assisted firms make up only a small portion of the local labor market. Second, even if we want to focus on who is hired as a result of the job creation due to assisted firms, these assisted firms may spawn job creation at other firms through multiplier effects, and we need to affect who the multiplier firms hire. Third, even absent multiplier effects, how assisted firms' new jobs affect local employment rates depends upon more than whom the assisted firms hire. It depends upon the entire chain of job vacancies that results from an assisted firm's hiring choices. If we really want to affect whether the local nonemployed get additional job opportunities from new job creation, we need to affect the decisions of all the employers along the resulting vacancy chains.

Whether local firms hire local nonemployed workers is affected by many characteristics of the local labor market, including how the skills of the local nonemployed match available jobs; what information the local nonemployed have about job opportunities; the information that employers have about the local nonemployed; and whether local employers perceive that the local nonemployed will be reliable employees, who will be retained in jobs. Public policy can potentially affect these characteristics, and hence affect hiring patterns.

For example, if a local area has local job training agencies and community colleges that are adequately funded, and that do a good job linking job-seekers with jobs via training and job placement programs, then it is more likely that any new job creation will end up providing more job opportunities for local residents who lack jobs. The sidebar provides two examples of local job training interventions that might affect who employers choose to hire.

4. What Works: Problems with Current Local Economic Development Policies and Better Alternatives

Even if local economic development policies have large job growth benefits, the benefits must exceed job creation costs to provide net benefits. As previously mentioned, current local economic development policies mainly rely on business incentives, by which I mean tax incentives or cash grants to induce businesses to locate, expand, or retain jobs in a local labor market.

Incentives often have high enough per-job costs that their net benefits are questionable. Based on research and case studies, more cost-effective local strategies would focus on improving the quality of local business inputs. These more effective strategies would include public services and regulatory changes that improve the availability and quality of local land, labor, transportation, research and development (R&D), and information. The specific strategies would build on local assets toward promoting a broad range of local industry growth, in both existing and new industries.

4.a. Incentives: Facts and Trends

The "average" incentive package awarded in the United States to a base firm has a present value of 1.4 percent of the "value-added" of a firm.[11] Since the average base firm's value-added is about half of its wages expense, this typical incentive package is equivalent in value to about a 3 percent wage subsidy. Table 2 highlights four main types of incentives.

11 A firm's value-added is equal either to its sales minus its non-labor and capital input purchases, or alternatively the sum of its payments to labor plus capital. This present value calculation considers incentive payments and value-added over 20 years, and assumes the firm uses a real discount rate of 12 percent (Poterba and Summers 1995). See T. Bartik (2017).

Table 2. Different Incentives as Percentage of Value-Added, National Averages

TOTAL	1.36
Job creation credits/grants	0.64
Property tax abatements	0.39
Investment credits/grants	0.20
R&D credits/grants	0.13

Source: T. Bartik (2017).

Property tax abatements are the oldest and most frequently used incentive by local governments, having been used since the southern industrial recruitment of the 1930s. Most other incentives are provided by state governments. The largest and most rapidly growing state incentives are job creation credits, which allow incented firms to keep employees' tax withholdings. If the state's personal income tax is 4 percent, the firm would keep this 4 percent for the incentive term, which is often 10 or more years. These job creation credits can be larger than other business tax breaks because their value often exceeds what the firm pays in business taxes to the state government.[12]

Over the past three decades, the generosity of incentives has escalated dramatically. From 1990 to 2015, the typical incentive package tripled as a percent of the value-added of base firms that are awarded incentives (T. Bartik 2017). Given that national GDP has approximately doubled since 1990, the dollar volume of incentives has increased roughly six-fold. A few recent incentive deals have been even larger. For example, the Foxconn deal agreed to by the state of Wisconsin in 2017 promised incentives per job of about 10 times the size of the typical incentive.

4.b. Concerns about Incentives

Current incentive policies raise several concerns. I highlight four specific concerns: cost escalation; a lack of sensible targeting by region; the lack of sensible targeting by industry; and a systematic favoring of the largest firms.

First, the budgetary cost of incentive packages has been rising over time. The annual cost of economic development incentives is around 3 percent of state and local tax revenue. Absent new revenue, these costs crowd-out funding for other necessary state and local public services. Though 3 percent of state and local tax revenue is not a trivial amount of resources, it does not loom large compared to other challenges facing state and local budgets. For example, a 1 percentage point increase in the unemployment

12 Employee tax withholdings are not a business tax liability, but rather the business collecting tax liabilities of its workers on behalf of the government.

rate in a state or local area is estimated to cause budget problems, largely due to reduced tax revenue, of more than 3 percent of state and local tax revenue (Fiedler, Furman, and Powell 2019; T. Bartik 2020d). Based on this relationship, the current pandemic-induced recession seems likely to cause annual budget problems for state and local governments of more than 10 percent of tax revenue.

However, the average cost in the United States of the typical business incentive package tripled between 1990 and 2015. Furthermore, a few recent incentive offers, by a few states to a few companies, are 10 times as large per job, or as a percent of value-added, compared to the current more typical offer. If these few offers end up setting the pattern for the typical offer, incentive costs would become more burdensome. If the budgetary costs of business incentives were to increase 10-fold from 3 percent to 30 percent of state/local tax revenue, then the awarding of incentives would necessarily require significant cuts in other state and local public services.

Second, variation across states in the size (and cost) of incentive packages is not systematically driven by the level of economic need. For instance, New Mexico, New York, and Louisiana provide the largest incentives (as a percent of a company's value-added) of 3.7 percent, 3.5 percent, and 3.1 percent, respectively. Washington, Nevada, and Virginia each provide the smallest incentives measured by the share of value-added at just 0.02 percent, 0.2 percent, and 0.2 percent, respectively. Cross-state variation is more closely related to politics than to economic need. For example, Indiana's incentives are twice as large as Illinois', and South Carolina's incentives are twice as large as North Carolina's, even though each pair of states have similar employment rates. Incentives are not targeted to creating jobs where they are most needed.

Third, the industrial targeting of incentive packages is not necessarily forward-looking or well-designed from an economic, as opposed to political, perspective. State and local governments target incentives to base industries, such as manufacturing. But within base industries, incentives are not targeted to high-tech industries even though these industries might offer greater local benefits. For example, T. Bartik (2017) looked at how incentives vary among all 31 industries that are plausibly base industries.[13] Among these 31 industries, the two highest in R&D intensity are chemicals manufacturing and computer manufacturing. However, these industries are ranked 24th and 8th, respectively, according to the incentives they receive as a share of value-added, indicating that incentives are not targeted to the most high-tech industries.

13 As detailed in T. Bartik (2017), these 31 industries are defined roughly at the 3-digit NAICS level, and include all 19 manufacturing industries, as well as 12 non-manufacturing industries that sell their goods and services outside local economies, such as software, computer design services, accommodations, warehousing, and professional/scientific/technical services. These 31 industries, out of all private industries, comprise 27 percent of full-time equivalent employment, 34 percent of value-added, and 39 percent of compensation (T. Bartik 2017, Table 2).

Finally, incentives are disproportionately awarded to the largest firms. State and local governments tend to steer discretionary incentives to the largest firms. Smaller firms receive few incentives: less than 10 percent of all incentives go to firms with fewer than 100 employees, even though these firms' account for a third of U.S. jobs (T. Bartik 2020b). The very largest firms are particularly favored. Among new establishments with more than 1,000 employees, more than 36 percent receive incentives, while less than 10 percent are awarded to establishments of 500 to 999 employees, and less than 2 percent are awarded to establishments of 250 to 499 employees. The smallest establishments receive even lower shares of development incentives (Slattery and Zidar 2020).[14]

4.c. Incentives' Effectiveness: Costly per Job Actually Induced

Incentives may be costly, because many of the firms awarded incentives would have made the same location or expansion decision even if no incentives had been provided. This lower effectiveness drives up the cost of each additional local job that is created. So, do incentive costs outweigh the benefits from the local jobs that incentives generate?

Based on research, incentives do tip some of the location decisions by firms, but the success rate is less than the 100 percent often claimed by economic developers. An incentive whose present value is 1 percent of the present value of a firm's value-added—slightly less than the typical incentive package in the United States—will increase the probability that a firm will locate or expand in a particular state or metro area by about 10 percentage points (T. Bartik 2020a).[15] Larger incentives will tip more decisions, but at a higher cost, leaving the cost per job generated about the same.

Why are incentive effects modest? Given that wages make up about half of value-added, a 1 percent cost reduction as a percent of value-added is equivalent to about a 2 percent wage reduction. It is not surprising that in many cases, the differences across states or metropolitan areas in other business costs—wages, business productivity, access to markets, regulatory climate—might easily offset an incentive equivalent to a 2 percent wage reduction.

Consider the recent Amazon Headquarters II competition. Amazon initially chose Northern Virginia and New York, over many competing offers. Virginia offered almost $800 million in incentive dollars. But Amazon could have chosen Maryland, in the

14 Although the Slattery and Zidar data are by establishment size, not firm size, it seems likely that their results imply a heavy concentration in the largest firms as well. They also do some comparisons of firms receiving incentives with publicly listed firms, and these comparisons also suggest disproportionate incentive aid to the largest firms.

15 The typical incentive package is 1.36 percent of value-added over a 20-year time horizon, but about 1.18 percent over an infinite time horizon. The simulation model in T. Bartik (2018b) suggests this will tip between 11 percent and 12 percent of location decisions.

same metro area, and received an incentive of over $3 billion (Simmons 2018). New York offered about $3 billion in incentive dollars. But Amazon could have chosen Newark and received over $7 billion (Shafer 2018). Clearly, Amazon's location decisions were driven by other factors than incentives.

Given their modest effects, incentives will be costly per local job that is created. For a typical incentive package, I estimate a present value cost, per local job created, of $196,000 (T. Bartik 2020b).[16]

As mentioned above, plausible benefits per local job created would likely be several hundreds of thousands of dollars. Therefore, benefits and costs per job created of incentives are likely of a similar order of magnitude. In many cases, benefit-cost ratios will be close to 1, with the exact magnitude depending upon the details of the incentives and the local economy, and on the assumptions made by the analyst doing the benefit-cost evaluation. In my recent book on incentives, I estimate an "average" incentive benefit-cost ratio of 1.5 (T. Bartik 2019b). This estimate is based on the average economic development incentive, in an average metro area, with average local multipliers. This calculation relies on many estimated parameters, all with some uncertainty. Because of this uncertainty, plausible differences in assumptions could lead to a typical incentive having net costs.

Incentives are more likely to pass a benefit-cost test if they are targeted at industries with higher local job multipliers. With higher multipliers, any jobs induced in a firm that receives incentives will generate more total local jobs. Multipliers in high-tech industries are large (Moretti 2010) with some estimates suggesting magnitudes twice as high as those of the average industry in areas that have an above-average share of high-tech (Bartik and Sotherland 2019). These higher multipliers for high-tech occur because of spillover benefits: for example, the ideas and workers of one high-tech firm boost the productivity of nearby high-tech firms.

The benefit-cost ratio for incentives can also be increased by targeting more jobs to nonemployed workers, through targeting distressed areas or better workforce policies.

4.d. More Cost-Effective Job Creation Strategies: Overcoming Local Barriers to Economic Development

Relying less on incentives and more on other types of local economic development policies that have lower costs per job created can be more cost effective. Based on the evidence, local jobs can be more effectively created by addressing local barriers

16 This calculation uses the typical time pattern of incentive offers over 20 years. To get some intuition about why the cost is so high, consider that if an incentive equivalent to a 2 percent wage subsidy tips 10 percent of all location decisions, then the cost of creating a job is equivalent to a 20 percent continuing wage subsidy. The present value of a 20 percent wage subsidy will be high, with the exact cost per job created depending on the time pattern of incentive payments and on the assumed discount rates for both the firm and for society.

to job creation, such as an insufficient quantity or quality of local business inputs. Specific barriers vary locally and can include problems with job training and local skills; a lack of information by small businesses; lack of real estate that is ready for business development; inadequate infrastructure; and insufficient linkage to new R&D ideas. Solving local problems inhibiting business development is effective; a cash incentive to get around the problems is less effective.

To remedy insufficient quantity or quality in business inputs, local public services to business may help. The greater effectiveness of public services to business is documented in research studies of specific programs and case studies of local economies. Customized job training and manufacturing extension can increase assisted firms' productivity by at least five times the program costs. Based on these productivity effects, I estimate the cost per job created of these programs is $34,000 (T. Bartik 2020b). Surveys of firms suggest even lower job creation costs for customized training and manufacturing extension, of no more than $15,000 per job (Ehlen 2001; Hollenbeck 2008). Such low-cost job creation policies would have a very high benefit-cost ratio.

The lower costs associated with these approaches make sense. For example, manufacturing extension helps smaller manufacturers figure out new technologies or move into new markets. Advice is cheap. But if the advice is high-quality, effects on job creation can be high relative to costs.

For customized job training, smaller businesses lack training staff, and may underinvest in training because of fears of losing trained workers. If a community college provides training that meets the firm's needs, the productivity benefits can greatly outweigh the training costs.

Case studies of successful local economies also suggest that strategies that go beyond incentives tend to be the most effective at creating jobs and ushering in lasting economic improvements. In this section I highlight seven cases of effective local economic development policies: the Tennessee Valley Authority (TVA); the Appalachian Regional Commission (ARC); the Lehigh Valley area in Pennsylvania (Allentown/Bethlehem); the Pittsburgh area; Grand Rapids, Michigan; Crosby/Ironton, Minnesota; and the recent Amazon project in Northern Virginia.

These case studies primarily feature distressed areas, except for Grand Rapids and Northern Virginia, which are included as additional examples of innovative strategies that could be relevant to distressed areas. Two common themes run through these success stores: First, these successful local strategies do not primarily rely on handing out large amounts of cash through incentives, but rather relied on improving local infrastructure, land, or public services to business. Second, rather than just aiding one firm or industry, many of these successful strategies were broader, encouraging the growth of many local businesses in many industries.

Tennessee Valley Authority (TVA), 1933–present

The TVA, a New Deal program begun in 1933, was intended—by its principal sponsor, progressive Republican Senator George Norris of Nebraska, and by President Franklin D. Roosevelt—as a model for how to help distressed rural regions (Kline and Moretti 2013). But TVA ended up being unique. The TVA targeted Tennessee plus surrounding areas in Kentucky, Mississippi, Alabama, Georgia, Virginia, and North Carolina. The population of the TVA area is today around 10 million. The TVA built dams and provided reliable electrification. The TVA also invested in roads, public health, agricultural extension, and education and training. The TVA was most active from 1940–1960. The TVA's peak funding was in the early 1950s, with annual average funding of $1.5 billion in 2019 dollars, around $310 per capita.[17] Total TVA funding over the years is $30 billion (again, in 2019 dollars). Kline and Moretti (2013) compare the TVA region to seven other proposed regional authorities, which came close to being federally funded in 1937 and 1945. Based on their research, the TVA generated 250,000 manufacturing jobs at a cost per job in 2019 dollars of $77,000 (T. Bartik 2020b).[18]

Appalachian Regional Commission (ARC), 1965–present

The ARC, begun in 1965, sought to improve economic development in a region that included 13 states, and today contains a population of about 25 million people. Funding peaked in the late 1960s and early 1970s at about $1.7 billion per year in 2019 dollars, or about $85 per capita.[19] Total funding since 1965 has been, in 2019 dollars, about $37 billion. Two-thirds of ARC funding has gone to highways to increase transportation access to remote, rural counties. The ARC highways increased jobs in affected counties by 5.2 percent and per capita incomes by 1.3 percent (Jaworski and Kitchens 2019). The *annual* boost in per-capita incomes is about 16 percent of the highway investment, which is a very high rate of return.

Lehigh Valley, Pennsylvania (Allentown/Bethlehem area)

The Lehigh Valley's economic success is highlighted in Sean Safford's *Why the Garden Club Couldn't Save Youngstown* (2009). Safford contrasts the economic policies of

17 For 1950–1955, annual average TVA spending was $1.51 billion in 2019 dollars (Kline and Moretti 2013). The 1950 population of the TVA region was about 4.9 million. The somewhat-vague TVA region today has a population of 10 million; my 1950 estimate is based on Tennessee's population trends.

18 This calculation allows for a reasonable job multiplier for the manufacturing jobs, estimates TVA costs and jobs created by year, and then calculates a present value per job created, including multiplier jobs.

19 Based on Jaworski and Kitchens (2019). During the ARC's peak, 1966–1975, funding averaged $1.65 billion per year in 2019 dollars. The ARC's 1970 population was about 19.5 million.

the Lehigh Valley to those of Youngstown, Ohio, both of which were economically devastated by the steel industry collapse of the early 1980s. The Lehigh Valley was far more successful than Youngstown in diversifying its economy, broadening its manufacturing sector beyond steel, and growing high-end service industries. More recently, manufacturing in the Lehigh Valley has exceeded national growth by 2 percent annually (T. Bartik 2018a).

As Safford describes, the Lehigh Valley area has long had a broad business, university, and political leadership with an interest in diversifying the area's economy into new industries. Starting in 1959, the Lehigh Valley developed seven industrial parks that today have more than 400 businesses with more than 20,000 workers. When Pennsylvania set up a high-tech program, the Ben Franklin Technology Partnership (BFTP), in the 1980s, the Lehigh Valley's leadership successfully lobbied the state of Pennsylvania to add the Lehigh Valley as a fourth BFTP site. The BFTP program includes a business incubator, applied research grants to encourage business spinoffs from Lehigh University, and a local venture capital fund. The local economic development group, funded by an area hotel tax, has been active in organizing a lending network for smaller businesses, brownfield redevelopment at 21 sites, and education and training initiatives. The local economic development group is currently focused on encouraging growth in key industry sectors such as: (1) high-performance manufacturing, (2) life sciences research and manufacturing, (3) high-value business services, and (4) food and beverage processing.

In contrast, in Safford's view, all the different local business and civic groups in Youngstown were centered around promoting the steel industry. Civic groups that were independent of the steel industry were weak. Youngstown's problem was not that it lacked local organizations or local "social capital." Rather, when steel declined, the local community could not organize any coherent plan for economic diversification. Lobbying for higher steel tariffs was more attractive.

Pittsburgh

Both Pittsburgh and Cleveland were hurt similarly in the early 1980s by the steel industry collapse. Pittsburgh has rebounded as a high-tech center, attracting significant high-tech investment from Google, Apple, Facebook, and Amazon; Cleveland has not (Armstrong 2020).

Pittsburgh's state and local strategy relied on cooperation with Carnegie Mellon University and the University of Pittsburgh to encourage high-tech business growth, which was combined with state and federal investments in that strategy. In 1985, the state of Pennsylvania encouraged both universities, along with the Pittsburgh Mayor and Allegheny County political leaders, to develop a unified high-tech economic development strategy, known as Strategy 21. This strategy helped promote successful applications to the federal government to fund a National Science Foundation Supercomputing Center and a Defense Department Software Engineering Institute. The state of Pennsylvania provided the area with more than $280 million to support Strategy 21. This support included the development of a 48-acre research park, the Pittsburgh Technology Center, with facilities of both universities along with the Supercomputing Center and numerous businesses.

In contrast, as Armstrong (2020) highlights, Cleveland's economic development strategy focused on supporting current manufacturing industries and existing priorities of key research institutions such as Case Western Reserve University and the Cleveland Clinic. Cleveland's major institutions did not cooperate to promote new industries.

Grand Rapids, Michigan

Grand Rapids is perhaps the most successful larger manufacturing-intensive local economy in the United States. The share of Grand Rapids' employment in manufacturing is about twice the national average. Grand Rapids is not a distressed area, but its success may be a model for other manufacturing areas that are experiencing distress due to the challenges facing American manufacturing. From 1990 to 2019, Grand Rapids' manufacturing employment expanded by 16 percent, while national manufacturing employment declined by 27 percent. This strength in Grand Rapids manufacturing is spread across different industries, including chemicals, fabricated metals, and food (T. Bartik 2018a).

Grand Rapids' success reflects investments in both existing and new industries. The area's economic development program, The Right Place program, has convened over a dozen industry clusters to discuss various challenges, such as job training needs, and to try to develop local solutions. The Right Place encouraged the co-location of a branch office of the Michigan affiliate of the national Manufacturing Extension Partnership. The program has also worked with local family owned businesses to encourage continued local control.

Grand Rapids has done extensive private and public investments in expanding life science industries. The area has developed the Medical Mile corridor, starting with a privately endowed health research center (the Van Andel Institute) in 2000, and including several hospitals, community colleges, and related businesses. In 2010, area business leaders put up funds to entice Michigan State University to locate a greater share of its medical school operations in Grand Rapids. The life sciences investment includes a cluster effort, the West Michigan Medical Devices Consortium, which provides advice to promote local industry growth. For example, one auto parts company was able to diversify to produce orthopedic products. A bakery wrappings supplier diversified into making packaging for medical testing kits.

Crosby/Ironton, Minnesota

This small community of 2,400 is on the southwest edge of Minnesota's Iron Range area, but the last iron mine closed in 1984. These open pit mines have since filled with water and become picturesque lakes. The state, responding to local pressure, redeveloped the old mining area into the Cuyuna Country Recreation Area in 1993. Local cyclist groups also lobbied the state to put in 25 miles of mountain biking trails in 2011. Since then, the area has become a popular site for mountain biking races and recreation. Tourism has doubled to over 180,000 visitors per year. This has led to new restaurants, brewpubs, yoga studios, bike shops, and real estate demand to set up Airbnb rentals (Aamot 2017).

Virginia and Amazon

Virginia provided an incentive of up to $770 million to attract a portion of Amazon's Headquarters II project to Northern Virginia. This area is obviously not distressed, but Virginia's approach to providing economic development assistance is a useful model for state and local policymakers around the country, including areas that are distressed. Although the overall price tag of Virginia's incentives to Amazon is large, the total per job is only $20,000 for the estimated 38,000 Amazon jobs expected to be located in Northern Virginia, which is below the average national cost of incentives per job created.

Virginia's assistance package for Amazon placed more emphasis on job skills and transportation infrastructure, with around $1.4 billion in these programs (Virginia Economic Development Partnership 2018). The state is putting up $250 million for a new Virginia Tech campus in Northern Virginia. The state is also investing $125 million in George Mason University for expanded computer science programs and an additional $700 million in computer science programs elsewhere in the state. Finally, the state is investing $133 million in mass transit improvements near the Amazon site, and $162 million in nearby highways.

Although the Virginia case study is focused on one firm, Amazon, Virginia sought to use this project to leverage larger local changes that will benefit business growth in many industries. For example, investments in transportation and skills will be useful even if the new Amazon facility does not live up to its hype. In addition, these skills programs may increase the odds that Amazon jobs go to Virginia residents. Both skills programs and Amazon job experience will increase the job skills of many Virginia residents, which will make the area more competitive for future economic growth.

5. Institutional Inadequacies: Why Current American Institutions Often Fail to Solve the Labor Market Problems of Distressed Areas and How State and Federal Interventions Might Help

If state and local policymakers were to maximize the net benefits for their residents, job creation would be most aggressively promoted where it is most needed: in areas that are distressed. Job creation policies would use the most cost-effective approaches. But this ideal solution is impeded by problems with politics, leadership, and money. Governors and mayors are often tempted by quick fix solutions that provide political wins. Some local labor markets do not have the leadership needed to support and implement sustained local strategies that will broadly encourage growth in a wide variety of businesses and industries. Finally, the most distressed areas often have lower tax bases, which makes it more challenging for them to pay for the needed investments in local economic development.

I discuss state and federal interventions to address these challenges. States can encourage better thinking about economic development, encourage more coordinated local leadership, and better target their distressed areas. The federal government can restrict some of the more wasteful incentives and provide financial resources to promote economic development in distressed areas. Are reforms more feasible at the state or federal level? That is open to debate.

5.a. Political Temptations of Incentives

Based on surveys, voters are more likely to re-elect a governor who offers large incentives to businesses (Jensen and Malesky 2018). Voters appreciate that that their governor is visibly trying to increase job availability. Given the voter appeal of incentives, many governors are tempted to offer large incentives, particularly to highly visible businesses such as Amazon. Alternatives to incentives are harder to sell to voters. Consider alternative job creation policies such as infrastructure, job training, business parks, university-business partnerships, manufacturing extension. Such policies are complex, with a long-term payoff, at best.

5.b. Lack of Unified Local Leadership Focused on the Local Labor Market

Most government institutions, at the state or local level, are not organized around local labor markets, which usually span multiple counties. Local labor markets also often lack business leadership that takes a civic interest in the local economy. In the past, local banks often played such a role, given their natural interest in local economic development; however, that has diminished as banks have consolidated nationally. Local universities and community colleges, local charitable groups, and local hospitals increasingly play a role in local economic development. But these institutions have their own interests, and do not always cooperate well to promote regional interests.

As shown in the above case studies of the Lehigh Valley and Youngstown, and of Pittsburgh and Cleveland, it is sometimes difficult to get local political and business interests to unite around a local labor market strategy that cooperates to improve the overall local economic environment for many local businesses throughout the local labor market. Sometimes, local elites are more inclined to support one key local industry or one key local firm, even if that one industry or firm is declining.

5.c. Lack of Resources

Transforming a local economy and meaningfully increasing job growth requires significant resources. The TVA at its peak spent about $310 per capita. Calculations of plausible job creation costs, and the needed jobs to really help a distressed area, suggest similar figures for needed annual per capita resources for at least a decade.[20] An economic development program of $310 per capita is 14 percent of average local tax revenue. Distressed areas have lower tax bases and problems with legacy costs. Carving out 14 percent of tax revenue for a long-term economic development program is not impossible, but would often be challenging.

At the state level, raising adequate resources for distressed areas is more feasible, from an economic perspective. An economic development program of $310 per capita is 10 percent of average state tax revenue. If a state targeted its neediest quintile of distressed areas, the annual costs would only be 2 percent of state tax revenue.

5.d. Possible State Government Interventions

The most direct way to reform local economic development policies is to reform the practices of state governments. Currently, state governments provide most economic development resources. In the American system, local governments are creatures of the state, with organization and powers set by state governments. State

20 As already mentioned, the average prime-age employment rate from 2014–2018 was 77.7 percent. Suppose we consider an area that was 5 percentage points below this, and we wanted to close half this gap in 10 years, increasing its employment rate from 72.7 percent to 75.2 percent. This is a logarithmic change of 0.0338. If the elasticity of the local employment rate with respect to employment is 0.3, then the log of local employment has to change by 0.1127, which is a percentage change of 11.93 percent. For local labor markets below the national prime-age employment rate by 5 percentage points or more, the average ratio of total civilian employment to total population is 0.3891. So, employment needs to increase by 4.64 percent of the population (= 11.93 × 0.3891). At a cost of $50,000 per job created, this requires job-creation policies that cost $2,321 per capita. Over 10 years, the annual per capita cost is $232.

and local economic development agencies in most states are already enmeshed with each other in jointly planning, financing, and implementing local economic development policies.

State economic development policies can be reformed with better evaluation, more aggressive promotion of local economic development planning, and greater targeting of distressed local labor markets. All these reforms have occurred at some time in some states, just not all the time in all states.

5.d.1. Evaluation

In recent years, evaluation of economic development policies has been pushed by Pew Charitable Trusts, in cooperation with the National Conference of State Legislatures.[21] Almost two-thirds of states have adopted evaluation requirements for economic development programs. Sixteen states are currently actively using evaluations of economic development programs to influence policy development (Goodman and Chapman 2019).

Evaluation practices have improved. For example, in the past, many state evaluation studies simply assumed that incentives' success in inducing jobs was 100 percent. Lower, more realistic success rates of incentives have been used in more recent state evaluations, for example by Rhode Island, Maryland, and Connecticut (T. Bartik 2019b).

Program evaluation has also become more influential in decisions about economic development policy. A recent Pew publication lists examples of evaluation-guided policy changes from DC, Oklahoma, Virginia, Nebraska, Minnesota, Pennsylvania, Indiana, and North Dakota (Goodman and Benz 2019). As another example, consider the Washington state R&D credit. In 2012, the Washington Joint Legislative Audit and Review Committee sponsored an evaluation of this credit by two outside economists, including me. Our evaluation concluded that this R&D credit was relatively expensive per job created (T. Bartik and Hollenbeck 2012). This evaluation contributed to the program's sunset in 2015 (T. Bartik 2019b).

5.d.2. Local labor market planning

Local governments, including local universities and community colleges, are creatures of state governments. A significant portion of their funding is provided by the state government and their powers to raise revenue from taxes and fees are set by the state government. State governments decide the scope of these governments'

21 Full disclosure: some of my research has been supported by Pew.

jurisdiction and set the rules to determine whether these governments can expand their jurisdiction through annexation or consolidation. State governments also decide what services these local governments can provide, and what regulatory power they have over land use or local labor markets.

Given local government dependence upon state legal authority and funding, state governments certainly can take numerous policy actions to encourage local governments to cooperate in pursuing creative local economic development at the local labor market level. State governments can encourage local governments to develop broad strategies to improve a local economy, rather than focusing on a single industry. This is illustrated above by the example of Pennsylvania and Pittsburgh.

5.d.3. Targeting distressed areas

Sometimes states have succeeded in overcoming the political hurdles of targeting distressed areas. For example, North Carolina divides its counties into three tiers, based on county distress, with each tier eligible for different levels of state economic development assistance (T. Bartik 2019b). For many years, these distress tiers resulted in quite large differences in state aid. For example, from 1996 to 2013, the most distressed counties had a job creation credit of over $12,000 per job, and the least distressed counties a job creation credit of less than $1,000 per job (Perez and Suher 2019).[22]

5.e. Possible Federal Interventions

Federal policy could help reform local economic development by discouraging excessive incentives, and by providing federal block grants for economic development in distressed areas. But it is unclear whether a significant federal intervention is politically feasible. Moreover, if federal intervention led to federal micromanagement of local economic development policies, the federal intervention might do more harm than good.

5.e.1. Restrictions on the largest incentives

The federal government could legally restrict the size of incentive packages that a state or local government could offer to an individual business. One model for incentive restrictions comes from the European Union, which regards “regional state aid” as a potential interference with free trade within the EU. Incentive magnitudes

22 Targeting has since been reduced, but distressed counties still have lower match requirements.

are restricted, with the restrictions varying with the distress level of different local regions within countries, and with project size (LeRoy and Thomas 2019). In most of the EU, incentives are limited for large projects to 3.4 percent of the project's investment or 3.4 percent of the first two years of the project's wage bill. In some areas, such as Berlin, incentives are disallowed. In some depressed regions, such as Bulgaria, incentives can be five times larger. In the United States, similar restrictions would rule out the largest incentive offers.[23]

The federal government could potentially take a similar approach: Congress could make it illegal for state and local governments to award "discretionary" incentives to individual businesses that exceed a specified size. The restrictions would only be applied to incentives whose dollar magnitude exceeded some specified dollar value, and whose value as a percent of investment and the wage bill exceeded some specified percentages. In distressed areas, the restrictions could be relaxed to allow for higher discretionary incentives.

By "discretionary" incentives, I mean incentives whose award is decided on by some state or local economic development agency, which may award credits to one firm, but not to another firm in the same industry that is making an investment or job creation decision. Restricting discretionary incentives would not restrict other incentives, which are received as an entitlement under the state's tax law by all firms in an industry making an investment or job creation decision. But discretionary incentives tend to be the largest incentives; state and local governments are reluctant to make incentive offers "automatic" if they are large per job or per dollar of investment. Such discretionary incentives are the incentives that are most likely to go to the largest firms and make up a large portion of incentives' budget costs. Discretionary incentives are also the incentives most likely to be driven by politics rather than long-term economic strategies.

States would still be free to design their business tax systems, including non-discretionary tax credits. Therefore, states would retain authority over the design of their business tax laws, and significant authority over their economic development strategies.

Limiting the restriction to the largest incentives would reduce the administrative burden on the federal government for enforcing these restrictions. These large incentive offers to larger projects are the most politically tempting for governors

23 For example, the Foxconn project was planned to have $10 billion of investment. In most of the EU, its maximum incentive would have been $340 million. Wisconsin offered $3 billion. Amazon's two-year wage bill for its Headquarters II project would be $12 billion. In most of the EU, Amazon's maximum incentive would have been $408 million. Virginia offered almost $800 million, New York offered $3 billion, and other offers exceeded $7 billion. If these projects had been eligible for "Bulgaria-level" incentives, Foxconn could have received $1.7 billion, and Amazon could have received $2.0 billion.

and mayors. Allowing distressed areas to have higher discretionary incentives would help reallocate job growth to these areas.

Such a congressionally enacted restriction would rely on the federal government's constitutional authority to regulate interstate commerce, which forbids state tariffs, and can be construed as allowing federal restrictions on incentives for firms that sell goods and services across state lines. Legal scholars have long argued that Congress taking such action would be well within the power of the federal government to govern interstate commerce (Frickey 1996). Some legal scholars have gone further and argued that the Supreme Court could outlaw some incentives on their own, without congressional action (Hellerstein and Coenen 1995; Enrich 1996).

If outlawing excessive incentives was infeasible, either politically or due to court decisions, the federal government could tax excessive incentives, or cut-off various federal grants if a state's incentives are excessive (LeRoy 2012). For example, Burstein and Rolnick (1994) proposed a 100 percent federal business tax on incentives, which would make them worthless to firms. The federal block grant discussed next could be conditioned on a state and local area being willing to put some restrictions on excessive incentives.

5.e.2. Aid for distressed regions

A second way the federal government could encourage local economic development in distressed areas is through the direct provision of a federal block grant, as it did in the past with the TVA and the ARC.[24] The grant could be used to carry out a wide variety of economic development services, including business advice programs, customized training, infrastructure, and land development.

To determine how large such a block grant should be, we could look to the experiences of the TVA and the ARC. Suppose the amount of aid was similar to that of the TVA at its peak: $310 per capita. Further suppose the block grant were awarded for a 10-year period and went to local labor markets that were 5 percentage points or more below the U.S. average in prime-age employment rates. As mentioned, these 573 local labor markets comprise 14.7 percent of the U.S. population (47 million people). This regional aid program would cost around $15 billion annually, or $150 billion over a decade.

24 We do not currently have such block grant aid. The federal Community Development Block Grant program is focused mainly on housing-related improvements in low-income neighborhoods. CDBG is mostly a community development program which redistributes some economic activity within a local labor market, not a program that promotes economic development of an entire local labor market. Some CDBG dollars for non-metro communities go to state governments, which in some cases use these funds for infrastructure improvements which may support rural economic development. However, CDBG in total is funded at only $3.4 billion annually, of which only a small portion is usable for economic development purposes.

Under reasonable assumptions, this program after 10 years could boost employment in these distressed areas by 3 million jobs. Prime-age employment rates in these areas would be expected to increase from 68.1 percent, 9.7 percentage points below the national average, to 72.3 percent, an improvement of 4.2 percentage points.[25] More could be done over longer time periods, or if there was a state match to these federal dollars.[26]

If such a highly targeted program proved politically infeasible, one could add aid tiers. For example, an additional 29 percent of the American population lives in one of the 352 local labor markets where the prime-age employment rate is below the national average, but by less than 5 percentage points. Suppose aid of $85 per capita was applied to these areas, similar to the ARC at its peak. This would add another $8 billion annually to the cost of the program, for a total of $23 billion per year. This $23 billion program would include more congressional districts.

Any federal aid should be flexible. One size does not fit all. Mountain biking worked for Crosby, Minnesota, but is not a general solution. Not all areas can be high-tech centers. Grand Rapids, Michigan has succeeded by doubling down on manufacturing, but other manufacturing areas might be wiser to diversify. Different local economies have different needs for business advice, training, infrastructure, and land development. The federal government should avoid the political temptation of attaching too many strings to federal aid. The block grant should allow for a broad range of local economic development programs to be supported, based on the local area's needs.

Conclusion

Local job creation yields significantly higher employment rates that persist in the long run. The benefits of job creation in distressed areas are in the hundreds of thousands of dollars per job. Local job creation can be boosted at affordable costs by reforming local economic development policies and focusing on boosting business

25 This calculation assumes that the program could create jobs at $50,000 per job, which seems reasonable for public services to business, based on prior discussion in this chapter. This yields 3 million jobs, which is a large boost from baseline employment in these areas of 18.5 million jobs. I assume that because these areas are distressed, and with policies to help match the local nonemployed to jobs, that the elasticity of the prime-age employment rate with respect to this employment increase would be 0.4.

26 In T. Bartik (2020c) I suggest some administrative details of a similar program. For example, I propose the following: eligible areas would be official local labor markets designated by the United States that have a history of low prime-age employment rates; the eligible entity applying for the grant would be a consortium of local governments and the relevant state governments; grants would be awarded by a formula related to how much job creation is needed in each area to close employment rate gaps versus the national average; grants would be committed to eligible areas for at least 10 years. I also propose evaluating the program by comparing the economic performance of areas that just made or just missed the distress cut-off for assistance.

growth via public services. From the Tennessee Valley Authority of the 1930s to Grand Rapids Michigan, sustained investments in well-designed local economic development policies have had high benefit-cost ratios.

Although new federal regulations or grants could help encourage reformed local economic development policies, such federal intervention may prove politically infeasible. But even without new federal action, reformed local economic development policies should be adopted by state and local governments, acting in their residents' best interests. State and local governments have the collective resources to significantly address the labor market problems of distressed areas. As discussed, a program to help distressed areas might cost $23 billion per year, less than half of the resources that state and local governments currently devote to economic development policies. If the political will is there, state and local reforms to economic development policies are possible.

References

Aamot, Gregg. 2017. "Small Town, Big Wheels: How Mountain Biking Saved a Minnesota Mining Town." *MinnPost*, October 26, 2017.

Armstrong, Ben. 2020. "Industrial Policy and Local Economic Transformation: Evidence from the Rustbelt." Working paper, Brown University.

Austin, Benjamin, Edward Glaeser, and Lawrence H. Summers. 2018. "Saving the Heartland: Place-based Policies in 21st Century America." *Brookings Papers on Economic Activity*, BPEA Conference Drafts, March 8–9.

Autor, David H., David Dorn, and Gordon H. Hanson. 2013. "The China Syndrome: Local Labor Market Effects of Import Competition in the United States." *American Economic Review* 103(6): 2121–2168.

Autor, David H., David Dorn, Gordon H. Hanson, and Kaveh Majlesi. 2018. "When Work Disappears: Manufacturing Decline and the Falling Marriage Market Value of Young Men." Casio Working Paper No. 7010. Munich, Germany: CESifo Group Munich.

---. 2020. "Importing Political Polarization: The Electoral Consequences of Rising Trade Exposure." *American Economic Review.*

Bartik, Alexander W. 2018. "Moving Costs and Worker Adjustment to Changes in Labor Demand: Evidence from Longitudinal Census Data." Working paper, Department of Economics, University of Illinois at Urbana-Champaign.

Bartik, Timothy J. 1993. "Who Benefits from Local Job Growth: Migrants or the Original Residents?" *Regional Studies* 27(4): 297–311.

---. 2009. "What Proportion of Children Stay in the Same Location as Adults, and How Does This Vary Across Location and Groups?" Upjohn Institute Working Paper No. 09-145. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research. https://doi.org/10.17848/wp09-145.

---. 2015. “How Effects of Local Labor Demand Shocks Vary with the Initial Local Unemployment Rate.” *Growth and Change* 46(4): 529–557.

---. 2017. “A New Panel Database on Business Incentives for Economic Development Offered by State and Local Governments in the United States.” Report prepared for the Pew Charitable Trusts.

---. 2018a. “What Works to Help Manufacturing-Intensive Local Economies?” Upjohn Institute Technical Report No. 18-035. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research. https://doi.org/10.17848/tr18-035.

---. 2018b. “Who Benefits from Economic Development Incentives? How Incentive Effects on Local Incomes and the Income Distribution Vary with Different Assumptions about Incentive Policy and the Local Economy.” Upjohn Institute Technical Report 18-034. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research. https://doi.org/10.17848/tr18-034.

---. 2019a. “Should Place-Based Jobs Policies Be Used to Help Distressed Communities?” Upjohn Institute Working Paper 19-308. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research. https://doi.org/10.17848/wp19-308.

---. 2019b. *Making Sense of Incentives: Taming Business Incentives to Promote Prosperity.* Kalamazoo, MI: Upjohn Institute Press.

---. 2020a. “Introduction to Special Issue: Learning More About Incentives.” *Economic Development Quarterly.* https://doi.org/10.1177/0891242420916033. Published online ahead of print.

---. 2020b. "Using Place-Based Jobs Policies to Help Distressed Communities." *Journal of Economic Perspectives*, 34 (3): 99-127.

---. 2020c. "Helping America’s distressed communities recover from the COVID-19 recession and achieve long-term prosperity." Policy Brief. Washington, DC: Brookings Metropolitan Policy Program. https://www.brookings.edu/research/helping-americas-distressed-communities-recover-from-the-covid-19-recession-and-achieve-long-term-prosperity/

---. 2020d. “A Proposal for Timely, Responsive Federal Aid to State and Local Governments During the Pandemic Recession.” Blog post, Upjohn Institute. Accessed June 29, 2020. https://www.upjohn.org/research-highlights/proposal-timely-responsive-federal-aid-state-and-local-governments-during-pandemic-recession.

Bartik, Timothy J. and Kevin Hollenbeck. 2012. “An Analysis of the Employment Effects of the Washington High Technology Business and Occupation (B&O) Tax Credit: Technical Report.” Upjohn Institute Working Paper 12-187. Kalamazoo, MI: W. E. Upjohn Institute for Employment Research.

Bartik, Timothy J. and Nathan Sotherland. 2019. “Local Job Multipliers in the U.S.: Variation with Local Characteristics and with High-Tech Shocks.” Upjohn Institute Working Paper 19-301. Kalamazoo, MI: W. E. Upjohn Institute for Employment Research.

Bastian, Jacob, and Katherine Michelmore. 2018. “The Long-Term Impact of the Earned Income Tax Credit on Children’s Education and Employment Outcomes.” *Journal of Labor Economics* 36(4): 1127–1163.

Burstein, Melvin L., and Arthur J. Rolnick. 1994. *Congress Should End the Economic War Among the States*. Federal Research Bank of Minneapolis.

Charles, Kerwin Kofi, Erik Hurst, and Mariel Schwartz. 2018. "The Transformation of Manufacturing and the Decline in U.S. Employment." *NBER Macroeconomics Annual* 33 (2018): 307-72.

Council for Community and Economic Research. 2018. *State Economic Development Program Expenditures Database*. Online database.

Chetty, Raj, John N. Friedman, Nathaniel Hendren, Maggie R. Jones, and Sonja R. Porter. 2020. "The Opportunity Atlas: Mapping the Childhood Roots of Social Mobility." Working paper, Opportunity Insights Project, Harvard University.

Diette, Timothy M., Arthur H. Goldsmith, Darrick Hamilton, and William Darity. 2018. "Race, Unemployment, and Mental Health in the USA: What Can We Infer about the Psychological Cost of the Great Recession across Racial Groups?" *Journal of Economics, Race, and Policy* 1(2–3): 75–91.

Dunn, L. F. 1979. "Measuring the Value of Community." *Journal of Urban Economics* 6(3): 371–382.

Ehlen, Mark. 2001. "The Economic Impact of Manufacturing Extension Centers." *Economic Development Quarterly* 15(1): 36–44.

Enrich, Peter D. 1996. "Saving the states from themselves: Commerce clause constraints on state tax incentives for business." *Harvard Law Review* (1996): 377-468.

Fiedler, Matt, Jason Furman, and Wilson Powell III. 2019. "Increasing Federal Support for State Medicaid and CHIP Programs in Response to Economic Downturns." In *Recession Ready: Policies to Stabilize the American Economy* (Heather Boushey, Ryan Nunn, and Jay Shambaugh, editors). Washington, DC: The Hamilton Project, Brookings Institution.

Freedman, Matthew. 2017. "Persistence in Industrial Policy Impacts: Evidence from Depression-era Mississippi." *Journal of Urban Economics* 102: 34–51.

Frickey, Philip P. 1996. "The congressional process and the constitutionality of federal legislation to end the economic war among the states." Minneapolis Federal Reserve Bank, *The Region Jun* (1996): 58-59.

GAO. 2012a. *Limited Information on the Use and Effectiveness of Tax Expenditures Could Be Mitigated through Congressional Attention*. GAO-12-262. Washington, DC: GAO.

---. 2012b. *Economic Development: Efficiency and Effectiveness of Fragmented Programs Are Unclear.* GAO-12-5531. Washington, DC: GAO.

Goodman, Josh, and Shane Benz. 2019. *Governments Increasingly Rely on Evaluations for Tax Incentive Reform*. Washington, DC: Pew Charitable Trusts.

Goodman, Josh, and Jeff Chapman. 2019. *State Tax Incentive Evaluation Ratings.* Washington, DC: Pew Charitable Trusts.

Hellerstein, Walter, and Dan T. Coenen. 1995. "Commerce clause restraints on State business development incentives." *Cornell L. Rev.* 81: 789.

Hershbein, Brad, and Bryan A. Stuart. 2020. "Recessions and Local Labor Market Hysteresis." Upjohn Institute Working Paper 20-325. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research.

Hollenbeck, Kevin. 2008. "Is There a Role for Public Support of Incumbent Worker On-the-Job Training?" Upjohn Institute Working Paper 08-138. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research.

Hollenbeck, Kevin. 2013. "Public Financing of Workforce Services for Incumbent Workers?" Working Paper, School of Public Policy, University of Maryland.

Howard, Greg. 2020. "The Migration Accelerator: Labor Mobility, Housing, and Demand." *American Economic Journal: Macroeconomics*.

Hsieh, Chang-Tai, and Enrico Moretti. 2019. "Housing Constraints and Spatial Misallocation." *American Economic Journal: Macroeconomics* 11(2): 1–39.

Jaworski, Taylor, and Carl T. Kitchens. 2019. "National Policy for Regional Development: Evidence from Appalachian Highways." *Review of Economics and Statistics* 101(5): 777–790.

Jensen, Nathan M., and Edmund J. Malesky. 2018. *Incentives to Pander: How Politicians Use Corporate Welfare for Political Gain*. Cambridge University Press.

Kennan, John, and James R. Walker. 2011. "The Effect of Expected Income on Individual Migration Decisions." *Econometrica* 79(1): 211–251.

Kline, Patrick, and Enrico Moretti. 2013. "Local Economic Development, Agglomeration Economies, and the Big Push: 100 Years of Evidence from the Tennessee Valley Authority." *The Quarterly Journal of Economics* 129(1): 275–331.

Kosar, Gizem, Tyler Ransom, and Wilbert van der Klaauw. 2020. "Understanding Migration Aversion Using Elicited Counterfactual Choice Probabilities." IZA Discussion Papers 12271. Bonn, Germany: IZA Institute of Labor Economics.

LeRoy, Greg. 2012. "What the Country Needs Now, Mr. President." *Planning* (November): 10–11.

LeRoy, Greg, and Kenneth Thomas. 2019. "Lessons for the U.S.: How the EU Controls Bidding Wars for Jobs and Investment." *Shelterforce*, June 17, 2019.

Ludwig, Jens, and Steven Raphael. 2010. "The Mobility Bank: Increasing Residential Mobility to Boost Economic Mobility." Hamilton Project Discussion Paper, Brookings Institution.

Molloy, Raven, and Christopher L. Smith. 2019. "U.S. Internal Migration: Recent Patterns and Outstanding Puzzles." Presented at "A House Divided: Geographic Disparities in Twenty-First Century America" conference, Federal Reserve Bank of Boston.

Moretti, Enrico. 2010. "Local Multipliers." *American Economic Review: Papers & Proceedings* 100(May): 1–7.

Osterman, Paul, and Rosemary Batt. 1993. "Employer-Centered Training for International Competitiveness: Lessons from State Programs." *Journal of Policy Analysis and Management* 12(3): 456–477.

Perez, Jorge Perez, and Michael Suher. 2019. "The Efficacy of Hiring Credits in Distressed Areas." Working paper, Banco de Mexico and Federal Reserve Board.

Phelps, Edmund. 1972. *Inflation Policy and Unemployment Theory.* New York: Norton.

Pierce, Justin R., and Peter K. Schott. 2017. "Trade Liberalization and Mortality: Evidence from U.S. Counties." Working paper. Washington, DC: Board of Governors of the Federal Reserve System.

Poterba, James M., and Lawrence H. Summers. 1995. "A CEO Survey of U.S. Companies' Time Horizons and Hurdle Rates." *MIT Sloan Management Review* 37(1): 43.

President's Commission for a National Agenda for the Eighties. 1980. *Urban America in the Eighties.* Report of the Panel on Policies and Prospects for Metropolitan and Nonmetropolitan America. Washington, DC: U.S. Government Printing Office.

Safford, Sean. 2009. *Why the Garden Club Couldn't Save Youngstown: The Transformation of the Rustbelt.* Cambridge: Harvard University Press.

Shafer, Dan. 2018. "New Jersey Offers $7 Billion Tax Break for Amazon's HQ2." *Seattle Business,* October.

Simmons, Melody. 2018. "Here are the Details of Maryland's Failed $5.84 Billion Bid for Amazon's HQ2." *Baltimore Business Journal*, November 20, 2018.

Slattery, Cailin R., and Owen M. Zidar. 2020. "Evaluating State and Local Business Tax Incentives." Working Paper No. 26603, National Bureau of Economic Research.

Solon, Gary. 1999. "Intergenerational Mobility in the Labor Market." In *Handbook of Labor Economics,* Volume 3, edited by Orley Ashenfelter and David Card, 1761–1800. Elsevier.

Strain, Michael R. 2019. "Pay Workers to Leave Depressed Towns." *Bloomberg Opinion,* December 23, 2019.

Virginia Economic Development Partnership. 2018. "Project Cooper: Briefing for the House Appropriations Committee." November 13.

Zabek, Mike. 2019. "Local Ties in Spatial Equilibrium," Finance and Economics Discussion Series 2019-080. Washington, DC: Board of Governors of the Federal Reserve System.

Ziliak, James P. 2019. "Restoring Economic Opportunity for "The "People Left Behind": Employment Strategies for Rural America". Policy Memo in *Expanding Opportunity for More Americans: Bipartisan Policies to Increase Work, Wages, and Skills* (Melissa Kearney and Amy Ganz, editors). Aspen, CO: The Aspen Institute, Economic Strategy Group.

A Renter Safety Net: A Call for Federal Emergency Rental Assistance

AUTHORS

Ingrid Gould Ellen*, Amy Ganz, and Katherine O'Regan*****

ABSTRACT

For decades, escalating housing costs have outpaced income growth for middle- and lower-income earners. As a result, millions of American households have too little income leftover after paying rent to accumulate a savings buffer to cover other necessary expenses. When unexpected financial shocks occur, such as a drop in earnings or a surprise medical expense, many low-income households may not have sufficient savings and liquidity to pay their full rent at that time, leading many to the brink of eviction or a forced move. In this chapter, we document the costly externalities that such housing instability poses to renters and to society more broadly. To help low-income renters manage temporary shocks, we propose the creation of a Federal Emergency Rental Assistance Program to provide one-time, short-term financial help to low-income renters who face unexpected financial shocks. This short-term assistance would fill a critical gap in the current suite of federal housing programs which promote housing stability by subsidizing homeownership for middle- and higher-income households and providing long-term rental assistance to a small share of eligible, low-income households. Although we emphasize flexibility to allow states and localities to tailor the program to local conditions, we highlight key design features that would promote efficiency. Finally, while the proposed program is designed to address idiosyncratic financial shocks, it could be scaled up to address common shocks when such need arises.

* NYU Furman Center; NYU Robert F. Wagner Graduate School of Public Service

** Economic Strategy Group

*** NYU Furman Center; NYU Robert F. Wagner Graduate School of Public Service

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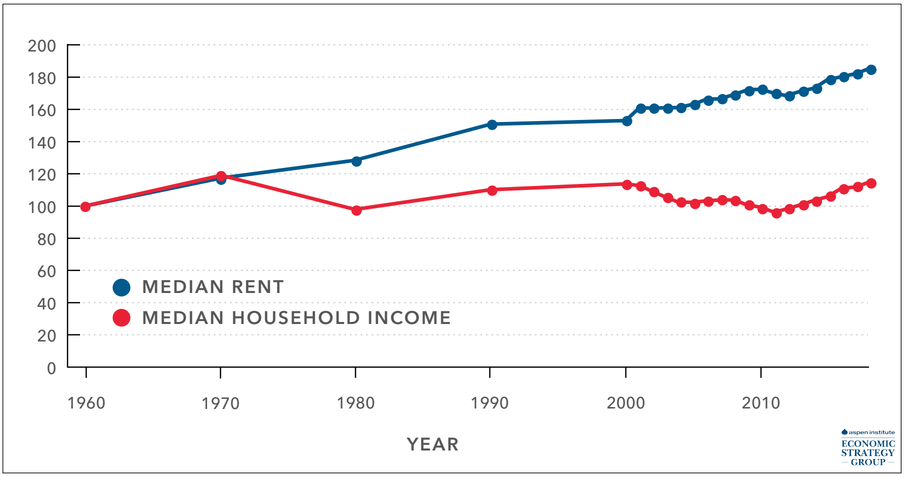
Introduction

Even before the COVID-19 pandemic, renters throughout the country, especially low-income renters, were paying large shares of their incomes on rent. For decades, escalating housing costs have outpaced income growth for middle- and lower-income earners, straining household budgets. Between 1960 and 2018, the real value of the median renter household's rent increased 85 percent, while the median renter's income increased by just 18 percent (Figure 1). And the gap between rent and income growth was even larger for lower-income renters.

Figure 1: Real Median Income versus Real Median Rents, 1960-2018 (Indexed to 100 for values in 1960)



Source: IPUMS USA, University of Minnesota, www.ipums.org.

Note: Values shown are the indexed measures (year 1960=100) of real median income and real median rent adjusted in 2018 dollars using CPI-UX.

While these statistics point to the need to address this long-term structural problem, rising rents also leave renters, especially low-income renters, with razor-thin margins to manage unexpected shocks to their budgets. Renters with incomes below the national median income for all households have seen a significant decline in residual real income (income after housing costs) since 2000. Specifically, our estimates suggest that the typical renter household in the lowest national income quintile had 18 percent (or $1,034) less income left over after paying for housing during 2016 than it did during 2000. (Note that one-third of renters had incomes in the lowest national income quintile in 2018.)

Faced with shrinking residual income, low-income renters have little ability to save and provide themselves with a buffer to weather unexpected income or expense shocks. Even small shocks to income and expenses will leave rent-burdened, low-income households unable to cover rent in certain months and vulnerable to eviction or other involuntary moves, unless landlords are flexible.

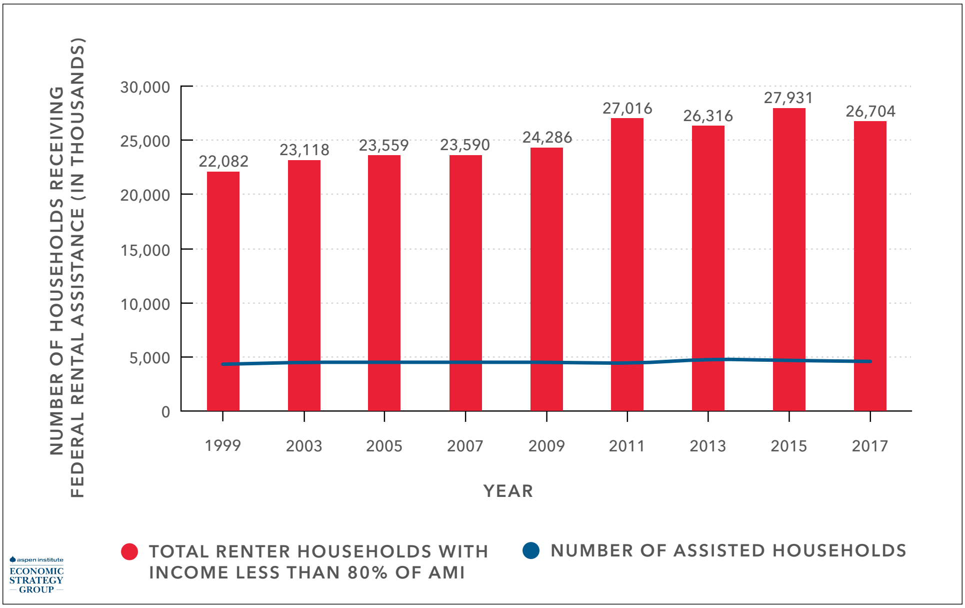
Such instability is costly, both to individuals and society. A large body of research shows that housing instability is associated with poor child outcomes (Galvez and Luna 2014). Importantly, recent causal research (exploiting random assignment to judges in housing court) shows that evictions increase the risk of becoming homeless, heighten residential instability, increase emergency room visits, decrease credit scores, and reduce durable consumption (Collinson and Reed 2019; Humphries et al. 2019).

Unfortunately, housing policies and programs in the United States provide little in the way of help. Our current suite of housing programs are designed to bolster stability through subsidizing homeownership on the one hand, and through providing help to households with incomes consistently too low to afford decent housing on the other.

Homeownership likely encourages stability, though unobserved differences between those who become homeowners and those who do not makes this difficult to prove. Either way, homeownership subsidies disproportionately help higher-income households, with 90 percent of benefits going to those earning more than $100,000 in 2018 (Tax Policy Center Briefing Book). The tax benefits are substantial. The total value of capital gains exclusions from home sales, property tax deductions, and the mortgage interest deduction, even after being reduced by the 2017 Tax Act, still amounted to over $75 billion per year in fiscal year 2019 (Tax Policy Center 2020). This far exceeds the total budget of the U.S. Department of Housing and Urban Development (HUD), which was $44 billion in FY 2019. Research suggests that these tax subsidies do little to raise aggregate homeownership rates, much less help lower income earners (Glaeser and Shapiro 2003; Hilber and Turner 2014). Instead, research both within the United States and elsewhere suggests that such subsidies encourage households to take on more debt and to purchase larger and more expensive homes, which in turn increase energy consumption (Gruber, Jensen and Kleven 2017; Hanson 2012; Poterba and Sinai 2011) and boost the overall cost of housing through heightened demand, at least in supply constrained areas (Hilber and Turner 2014).

As for low-income rental programs, they are clearly more targeted to low earners, and research shows that long-term rental subsidies encourage stability but they do a poor job at reaching those experiencing temporary setbacks. Instead, they provide large, long-term subsidies to a limited set of households. Research suggests these long-term rental subsidies reduce the risk of homelessness and encourage stability (Mills et al., 2006), but only about one in five income-eligible households receives some type of federal rental assistance (Figure 2), but the lucky few who actually receive subsidies get large ones. Consider that a housing choice voucher—the largest subsidy program administered by HUD—provides an effective subsidy of $8,900 per year on average for as long as a household remains income-eligible (HUD 2020).

Figure 2: Renters Eligible for Federal Rental Assistance versus Beneficiaries, 1999-2017



Source: Collinson, Ellen, and Ludwig (2016); Worst Case Housing Needs Report(s) (HUD.gov), 1999, 2003–2017.

Note: Estimates unavailable for year 2001. Beneficiary counts include Tenant-Based Section 8 (Housing Choice Vouchers), Project-based Section 8, and Public Housing Units.

Further, the current system, which provides large transfers to a few and nothing to most, leads to long waiting lists in most places. A 2012 survey of housing agencies suggested that more than 6.5 million households were on waitlists for either public housing or vouchers (Collinson, Ellen and Ludwig 2016). Many housing agencies have closed their waiting lists entirely. Renters facing temporary setbacks have almost no chance of receiving either of these federal rental subsidies in time to help them get through their crises, and there is currently no other alternative at the federal level. Housing programs in the United States are simply not nimble enough to address temporary shocks, and existing programs may provide more than what is needed, in terms of subsidy and duration if they are used for this purpose. To be clear, some households need longer-term assistance, but some may only need temporary help.

To help low-income renters manage temporary shocks, we propose the creation of an emergency rental assistance program that would offer one-time, short-term help to low-income renters who experience unexpected shocks to income or expenses. Households could use the assistance to cover back rent and other housing-related expenses to help them stay in their homes or to cover security deposits to move to new, affordable homes where needed. We estimate the cost would be roughly $4.5 billion per year, assuming an 8 percent take-up rate in a given year across households earning less than 80 percent of their local area median income.[1] We believe this is a small price to pay for the benefits of stabilizing low-income renters and avoiding the cascade of other social problems (and costs) that may follow from evictions and housing instability. By comparison, estimates from the Bipartisan Policy Center suggest that the cost of making the housing choice voucher program (which provides longer-term assistance) an entitlement for the far smaller set of households earning less than 30 percent of their local area median would be roughly $26 billion per year.[2] We discuss below why such temporary rental assistance may be preferable to, or at least more politically feasible than, direct cash payments.

The COVID-19 pandemic has heightened the need for such a short-term assistance program, though the income shock resulting from the pandemic is far more widespread than the normal market volatility and individual-idiosyncratic shocks that our proposal generally targets.

1. Background on Low-Income Renters' Financial Fragility and Forced Moves

We target our proposal on low-income renters, whose housing situations are more precarious due to high rent burdens, and for whom even small financial shocks can be destabilizing. This section reviews what we know about rent burdens, income volatility and forced moves among low-income renters.

1.a. Rent Burdens and Residual Income among Low-income Renters

Although renters across the income spectrum now pay far more in rent than they did in 1970, the rising cost of rent has been particularly challenging for the lowest-income

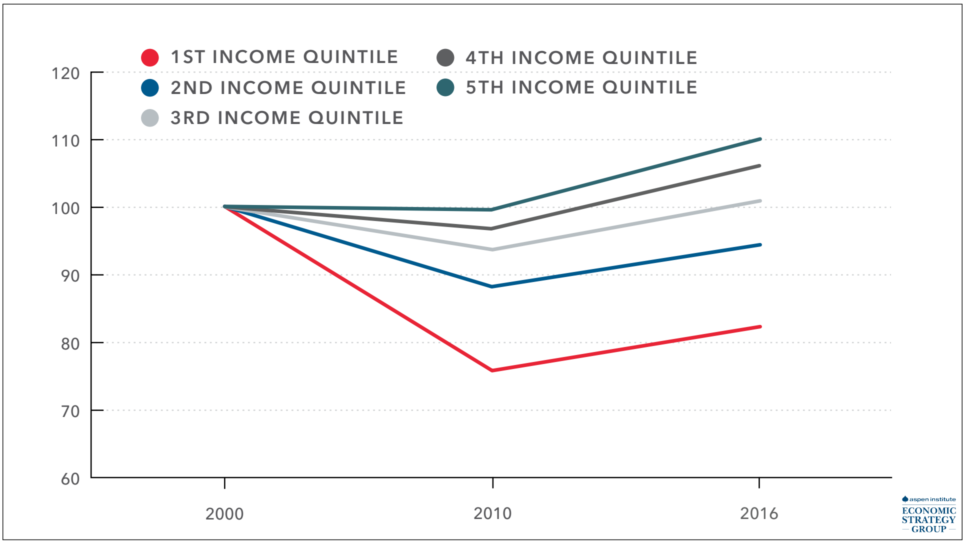
1 The American Community Survey indicates that there were 26.7 million renter households earning less than 80 percent of their local area median income in 2018. The 2017 American Housing Survey reported that 10 percent of renters with incomes below $40,000 could not pay their rent during at least one month in the past year. If we assume that 80 percent of those households would request help in a year, that would amount to 21.4 million households. As for amount of assistance, we assume $2,100 per household, which was the average amount of aid households received through HUD's Homelessness Prevention and Rapid Re-Housing Program, launched as a one-time emergency initiative in 2009 to help households during the Great Recession.

2 The Bipartisan Policy Center estimates that making rental assistance available to all households earning less than 30 percent of their local area median income would require an additional 2.9 million vouchers (assuming 80 percent apply and 70 percent are successful in using their voucher). (See https://bipartisanpolicy.org/report/housing-the-families-who-need-it-most-is-within-our-reach/.) We multiply this by average annual voucher cost of $8,900 to get to $26 billion.

renters, given that the increase compounded pre-existing high levels of rent burden.[3] By 2018, we estimate that nearly 82 percent of renters with incomes in the bottom fifth of households in the country paid more than 30 percent of their income on rent, and nearly two-thirds (61 percent) paid more than half of their income in rent.

Faced with such high rent burdens, households near the bottom of the income distribution have very little left for other expenditures after covering their rent and have little room to save to buffer unplanned reductions in income. Using Census data, we estimate that in 2016, the average renter in the bottom national income quintile had only $400 of income remaining after paying rent each month. In fact, we find that renters in the bottom national income quintile had *nearly 20 percent less* residual income in 2016 in real terms than they did in 2000. We also see a decline for renters in the second national income quintile, who were left with roughly $1,900 of average monthly residual income in 2016. (Together, the bottom two national income quintiles comprise nearly 60 percent of renters across the country.) Larrimore and Schuetz (2017) also report a significant decline in residual real income for renters between 2000 and 2015, and they attribute one-third of that decline to rising rents and two-thirds to declining real incomes.

Figure 3: Change in Residual Income for Renters by National Income Quintiles, 2000–2016 (Indexed to 100 for values in 2000)



Source: IPUMS USA, University of Minnesota, www.ipums.org and Author's calculations.

3 Because household incomes of renters are lower than those of homeowners, nearly two thirds of renters have incomes below 80 percent of their local area median, meeting HUD's definition of low-income.

1.b. Savings Buffers and Financial Shocks

Shrinking residual incomes mean that many renters may struggle to keep up with their monthly expenses and have limited ability to accumulate savings to buffer against a lost job or an unexpected expense. A 2018 Pew analysis of the Panel Survey of Income Dynamics found that nearly two-thirds of rent-burdened households had less than $400 in cash in the bank, and a full half of rent-burdened households had less than $10 in savings across various liquid accounts. Importantly, access to liquid savings also varied substantially by race among rent-burdened households: only half of rent-burdened African American households reported having access to any cash savings, while 84 percent of rent-burdened white households did.

The dual pressures of thin monthly margins and limited savings are reflected in the Federal Reserve's 2019 Survey of Household Economics and Decisionmaking (SHED), with nearly 30 percent of adults reporting that they were either unable to pay their monthly bills or were one modest financial setback away from not being able to fully pay off their monthly bills. Nearly one in six surveyed adults reported that they did not expect to pay all of their bills during the month of the survey. Among those who reported that they could not fully pay off their monthly bills, credit card balances were the bill that households most commonly expected to defer, and 45 percent said they would defer payment or only pay part of their credit card balance. But housing-related expenses were not far behind, with 32 percent expecting to defer a water, gas, or electric bill and 23 percent expecting to defer rent or mortgage payments.

Unexpected expenses or income losses are likely to be particularly difficult for rent-burdened households to absorb. Yet surveys indicate that financial shocks like unplanned expenses or lost income occur frequently. In a 2014 Pew survey, almost 60 percent of U.S. households reported experiencing at least one financial shock—such as job loss, medical expense due to illness or injury, or a major home or vehicle repair—that year and more than half of these households reported that they struggled to pay their bills after the most expensive event. Survey data suggest unexpected medical bills are particularly common. In 2019, more than one in five adults reported having a major, unexpected medical bill and the median bill totaled between $1,000 and $1,999. Nearly one in five adults also reported having unpaid medical debt from previous care that they or a family member received (SHED 2020).

Financial shocks can be particularly problematic for making rental payments, which are a fixed monthly obligation that take up a large share of a low-income household's budget. In contrast to mortgages however, which are typically long-term obligations that can be modified, there is far less leeway to restructure a rent contract, given that leases typically last a single year, and landlords usually do not have as deep pockets or as long time horizons as mortgage holders. Further, data from the Survey of Income and Program Participation suggest financial shocks may undermine a household's ability to pay their rent. Financially insecure households are three times more likely to miss a housing payment and 14 times more likely to be evicted after experiencing an unexpected income shock (McKernan et al. 2016).

Such financial shocks may be important drivers of evictions or other forced moves. Among tenants applying for emergency assistance from the Grand Rapids Eviction Prevention program, 39 percent of applicants applied because of lost employment, and another 25 percent of cases were due to an emergency expense or medical issue (Chartkoff and Rotondaro 2019). Similarly, among tenants who applied for assistance from Chicago's Homelessness Prevention Call Center, 40 percent reported they were applying due to job loss (Evans, Sullivan, Wallskog 2016).

Morduch and Schneider (2017) also argue that high levels of income volatility, combined with unexpected financial shocks and low levels of savings, exacerbate housing instability. In a detailed survey of 235 low- and middle-income households, the authors document the high levels of income and expense volatility that households experience, both month to month and over the course of a year. Large fluctuations in income and expenses, even when they are predictable, affect households' ability to consume due to liquidity constraints. Often, these fluctuations make it challenging for families to cover fixed obligations, including rent. The authors emphasize how high levels of within-job income volatility caused by just-in-time scheduling practices and alternative work arrangements make it especially difficult for working low-income households seeking to manage their bills from month-to-month.

1.c. Forced Moves

Narrow income margins combined with financial shocks may push many families to the precipice of eviction. There is mounting evidence that such forced moves are extremely costly, for households and for society as a whole.

Collinson and Reed (2019) provide some of the strongest causal estimates of the longer-term impact of evictions. They find large and persistent increases in the risk of homelessness and long-term residential instability caused by formal evictions. The likelihood of applying to homeless shelter increased by 14 percentage points following an eviction, while the number of days spent in a homeless shelter in the two years after an eviction increased by 36 days, on average. They also demonstrate a causal link between eviction and emergency room use: the probability of hospitalization for a mental health condition increased by 9 percentage points in the two years following an eviction filing. Their work adds to several descriptive studies (Desmond 2012; Desmond and Kimbro 2015; Desmond 2016) showing strong correlations between evictions and housing instability on employment, earnings, homelessness, and health outcomes.

In a similar study of eviction cases in Chicago, Humphries et al. (2019) find eviction exacerbates preexisting financial distress, by negatively affecting credit access and durable consumption for several years following a filing. However, the effects of eviction are small relative to the financial strain that households experience leading up to the eviction filing.

While forced moves are costly, they appear to be relatively cheap to prevent. Data from 22 states compiled by Princeton's Eviction Lab show that between 2014 and 2016, about one-third of money judgements in housing court were for an amount that was less than the local median rent. Housing court judgements typically include fees beyond rental arrears, suggesting a sizable share of evicted households owe less than one month of rent. Similarly, survey evidence finds that families that have even a small amount of non-retirement savings are less likely to face eviction or miss a housing or utility payment (McKernan et al. 2017).[4] Evans, Sullivan, and Wallskog (2016) show that relatively small infusions of emergency cash assistance provided by a program in Chicago reduced homeless shelter use by 76 percent.[5]

2. Why Housing Rather Than Cash Assistance? Why Prioritize Covering Rental Payments?

A key question is why the government should help at-risk families meet their short-term housing needs by providing housing assistance rather than simply cash transfers. There are several political arguments for providing in-kind support rather than cash, perhaps most notably donor preferences. In the case of housing, taxpayers may prefer to have their dollars spent on goods like housing rather than other types of consumption. There is some evidence for this preference: a 2003 national survey of adults in the United States found that less than 40 percent supported cash payments to poor households without barriers to employment, while 89 percent supported low-income housing assistance (Lennon et al. 2003). A related argument is that housing is a merit good and that people believe that everyone deserves a roof over their head.

4 There is a growing literature considering the potential for small shocks to have large effects on those with inadequate liquid savings (Lusardi 2011) and causal estimates examining responses to small positive shocks such as tax refunds (Parker 2017) and small negative shocks such as traffic fines (Mello 2018).

5 Pardue (2020) shows evidence that housing choice vouchers reduce evictions. While such long-term vouchers are far more expensive, his analysis suggests that about one fourth of the cost is recovered through reducing evictions.

A second set of justifications for in-kind rental assistance center on externalities. If housing instability and evictions impose external costs to society, then providing assistance that keeps renters in their homes may be socially optimal, even if individuals might not choose to spend all of a similarly sized cash grant on rent. As noted above, there is growing evidence that involuntary moves have damaging, collateral effects on individuals (Collinson and Reed 2019; Humphries et al. 2019), and these costs likely in turn impose costs on others. For example, research shows evictions elevate the risk of homelessness, and providing shelter and services to homeless individuals and families is extremely costly for local and state governments, and far more expensive than covering monthly rent. In New York City, the average nightly cost of providing emergency shelter was $190 for families and $120 for single adults in 2018 (Independent Budget Office 2019). The other public costs of homelessness may exceed the direct cost of shelter. Flaming, Toros, and Burns (2015) estimate that Santa Clara County spent an average of $83,000 per year on health and other non-housing public services for every person experiencing homelessness.

Beyond fiscal costs, the presence of people sleeping on the street may also impose social costs. The COVID-19 pandemic has highlighted the public health risks of having a population that cannot shelter in place (Ellen, O'Regan, and House 2020). More generally, people without shelter or homes typically use public spaces and public transit in ways that may reduce the availability or value of those services to others. These external costs are of course difficult to quantify.

Research also shows that evictions increase emergency room use (Collinson and Reed 2019), which is costly to health systems and ultimately taxpayers. In the case of families with children, the instability generated by involuntary moves might be disruptive to other students in their schools. Finally, though perhaps less significant, involuntary moves might also disrupt social networks not only for individuals but for their broader communities.

Some externalities may operate through landlords. Because they bear the cost of missed and late payments, landlords may adopt socially costly strategies to mitigate that risk. They might, for example, conduct more rigorous background checks, require high credit scores, and preclude anyone with even a minor criminal record, all of which might exclude a large set of individuals who would in fact be good tenants and would benefit from housing. Landlords might also demand higher security deposits, which again would restrict some otherwise good tenants who simply don't have the savings to afford the larger, up-front payment. Given many potential tenants will eventually lease-up somewhere, O'Flaherty (2011) argues a significant share of screening simply transfers risk (and costs) from one landlord to another, rather than reducing aggregate risk, and hence is socially wasteful. In addition to potential inefficiencies, such screening strategies are likely to have a racially disparate impact, excluding households of color who have lower credit scores on average (Federal Reserve Board 2007), are more likely to have criminal records, and already face constraints in finding housing due to discrimination and segregation (Acolin, Bostic, and Painter 2016; Ellen and Ross 2018; Hanson and Hawley 2011; Turner et al. 2013).

A third justification for housing subsidies is that housing stability generates private benefits that individuals may not fully understand or appreciate. The existence of such internalities seems particularly likely in the case of families with children, as parents may choose to spend less of any cash transfer on rent than would be socially optimal for their children. Not appreciating the degree to which housing stability would benefit their children, they may choose to spend any provided funds on transportation or other goods and services that they prioritize over housing stability (Olsen 2008). Of course, this paternalistic argument assumes that housing stability provides more benefits to children's long-run well-being than other types of expenditures. There is growing evidence that housing subsidies provide long-run benefits, but the research is surely not definitive (Schwartz et al. 2020; Mills et al. 2006; Gubits et al. 2016; Andersson et al. 2016).

3. Existing Efforts and Proposals

There are existing efforts at the local level to provide emergency rental assistance to families at risk of eviction or homelessness, and there have been a few proposals to offer such assistance at the federal level. This section reviews these existing programs and proposals and what we know about their efficacy.

3.a. Local Emergency Housing Assistance Programs, Idiosyncratic Shocks

Numerous jurisdictions across the country have developed programs to provide short-term or one-time financial assistance for households facing risk of eviction or homelessness (frequently called 'one-shots'). Our review of approximately 10 such programs[6] reveals variation in program details, but identifies several common themes. First, eligibility is generally limited to lower-income households who can document their need for assistance to remain in their housing, e.g. a utility-shutoff notice or an eviction filing. Frequently, a formal eviction filing is a pre-requisite (as in New

6 New York City's "One Shot'; Los Angeles EAPE; Chicago's Homelessness Prevention Call Center (HPCC); Amherst's Rental Assistance; Jacksonville, FL Emergency Assistance Program; City of Grand Rapids Eviction Prevention Program; Phoenix, AZ emergency rental assistance program; Richmond, VA Eviction Diversion Program; San Antonio's Risk Mitigation Fund.

York City's emergency grants and Richmond, Virginia's Eviction Diversion Program). Second, the cause of the hardship typically must be an unexpected emergency, an event beyond the recipient's control. Examples include job loss, unexpected medical expenses, a death in the family, or other large unexpected expenses such as car repairs. Third, the one-time infusion must be adequate to stabilize the household, meaning the funds cover a temporary gap in the ability to pay rent, and that the household will be able to make consistent rental payments moving forward. Finally, there are caps on the amount and frequency of money received, and payments are made directly to the landlords.

There are a few interesting, but less common policy features. For example, some programs aid both renters and homeowners, such as Jacksonville, Florida's Emergency Assistance Program and San Antonio, Texas's Risk Mitigation Fund. While most programs are limited to those with existing housing, some localities, like New York City, also provide short-term assistance to homeless households to cover security deposits or other related costs that help them secure housing.

Some programs require that applicants participate in additional services that are believed to increase housing stability in order to receive cash assistance. Amherst, Massachusetts, for example, requires applicants to connect with a social service agency, while Jacksonville, Florida and Richmond, Virginia require participation in a financial literacy or money management course. Even if these services don't enhance stability in themselves, they may serve as a screening device to weed out households who are less in need of assistance. (Of course, whether they are effective in screening out the right households is unclear.)

While these are all local government initiatives, the California-based Resident Relief Foundation offers a private, philanthropic version of a one-shot program, providing grants to help renters stay in their homes after an unexpected financial emergency. While structured with many of the same features as the public programs, this assistance is limited to the narrower set of tenants who can document five years of timely rental payment prior to the emergency.

Some of the features found in these emergency rental assistance programs (focusing on events beyond the control of recipients and the ability of short-term funding to stabilize housing situations) are similar to features of the Pennsylvania Housing Finance Agency's Homeowners' Emergency Mortgage Assistance Program (HEMAP). HEMAP served homeowners who were sixty-days delinquent in making a mortgage payment, with careful screening to target homeowners expected to be able to resume their mortgage payments within 24 months (or 36 months during periods of high unemployment). Here, the assistance was a low-cost (zero interest) loan rather than a grant.

3.b. COVID-19 Emergency Rental Assistance Programs, Common Shocks

There has been a rapid expansion of emergency rental assistance programs in response to the COVID pandemic and ensuing economic crisis, in part facilitated by federal funding through the CARES Act, but also relying on state, local, and in some cases, private philanthropic funding. As of July 16, 2020, the National Low Income Housing Coalition had cataloged over 190 state and local emergency rental-assistance programs that had been created or dramatically expanded in response to the economic fallout from COVID-19. The Urban Institute's review of 43 such programs and the Local Housing Solutions' review of 10 such programs both provide some insight into early experiences with creating such initiatives and how they differ from emergency assistance programs aimed at idiosyncratic shocks.

Similar to preexisting emergency assistance programs, these COVID-related initiatives include income restrictions, though they differ on whether pre- or post-COVID income is used to qualify. Payments are typically made to the landlord and are capped in terms of dollar amount and frequency or duration. COVID-related programs are less likely to require proof of rental arrears, but they generally require proof of financial hardship or loss of earnings due to COVID. Some of this requirement is driven by the use (or expected use) of federal funding through the CARES Act, which required use for COVID-related expenses. Many of these programs also impose requirements on landlords, such as waiving late fees and interest, providing penalty-free repayment plans for any rental arrears not covered by the program, and refraining from evicting tenants for some period of time. These requirements recognize the weaker negotiation position of landlords during a common shock.

Significantly, these COVID-related programs also have a fundamentally different goal than emergency assistance aimed at idiosyncratic shocks. Emergency housing assistance related to a common shock aims to avoid the potentially quite large-scale housing disruption that event might cause; hence, linking the assistance to hardships arising from the shock. To limit economic fall-out, efforts to address common shocks may also be motivated by a desire to assist landlords, to ensure that they have the revenue to cover basic maintenance and repair costs, make timely mortgage and property tax payments, and most fundamentally, continue to provide rental housing. Owners of smaller buildings are likely to be particularly at risk of budget shortfalls due to non-payment. A survey of 380 small landlords (80 percent of whom own or manage fewer than 20 units) in early July 2020 revealed that one in four landlords had borrowed funds over the past few months to cover operating cost, and only three in five expressed confidence that they would be able to cover their costs in the next three months (Metcalf 2020).

One theme that emerges from the reviews of the new COVID emergency programs is the challenge of scaling new programs quickly. Eight of the 10 new COVID programs in the Local Housing Solutions brief relied on non-governmental partners for program management and operations. Those who were able to leverage an existing program with the capacity to adapt had a clear advantage in implementing quickly. As an example, the state of Florida leveraged an existing State Housing Initiatives Partnership (SHIP) for emergency housing assistance triggered by state emergencies, created in the 1990s. SHIP is more focused on homeowners than renters, but the associated statutes have been waived to use this program and its organizational infrastructure to implement COVID emergency rental assistance. San Antonio, Texas made small modifications to its existing Risk Mitigation Fund, and increased its 2020 budget of $1 million to $25 million through a city council vote in April 2020 (Brnger, Salinas, and Gomez 2020).

Finally, it's worth noting that these new state and local rental assistance programs have been expanded or established in the context of greatly expanded direct cash assistance through the CARES Act. Such direct cash assistance is in all likelihood a first-best policy response to such an economic crisis; emergency rental assistance would complement such assistance (particularly for those not covered or reached by cash benefits, and recognizing that such benefits are not adjusted for variations in the cost of housing), thus playing a secondary but important role in the safety net.

3.c. Evidence on Efficacy

There is some evidence suggesting that short-term emergency rental assistance can prevent or interrupt the downward spiral of eviction. Evans, Sullivan, and Wallskog (2016) evaluated Chicago's Homelessness Prevention Call Center (HPCC), which connects families and individuals facing the threat of homelessness with emergency financial assistance. The authors exploit variation in the availability of funding to explore the extent to which the program prevented homelessness among recipients. Callers were screened for eligibility based on whether a financial disruption—such as job loss, changes in a shared housing situation, or the loss of public assistance—had occurred and whether the individual would be able to make consistent rental payments going forward after receiving assistance. The authors found the policy reduced homeless shelter use by 76 percent.

Palmer, Phillips, and Sullivan (2018) examined the impact of the same emergency financial assistance program on criminal activity, finding a decline in arrests one to two years after individuals receive assistance. Importantly, the authors note "the decline in crime appears to be related, in part, to greater housing stability—being referred to assistance significantly decreases arrests for homelessness-related, outdoor crimes such as trespassing."

There is also evidence that New York City's HomeBase program helps to reduce homelessness. The HomeBase program provides both financial and other assistance to families who believe that they are at risk of becoming homeless. Goodman, Messeri, and O'Flaherty (2016) use the fact that HomeBase started at different times in different neighborhoods to estimate its impacts. Using this quasi-experimental variation, they find that HomeBase reduced shelter entries by between 5 and 10 percent. A more formal evaluation of the program that randomly assigned families to receive HomeBase prevention services also found benefits (Rolston, Geyer, and Locke 2013). The study found that the families assigned to receive HomeBase assistance were 9 percentage points less likely to apply to stay in a homeless shelter over the subsequent 27 months, and spent 23 fewer nights in shelter in aggregate than control group families.

3.d. Federal Proposals

The 2013 Bipartisan Policy Center (BPC) Report Housing America's Future: New Directions for National Policy included a proposal to create a federal emergency rental assistance program, to complement a collection of reforms and funding expansions to increase the supply of rental housing and consolidate federal rental assistance resources among those with the greatest need.The commission proposed to offer households with extremely low income—defined as those earnings less than 30 percent of the area median income (AMI)—a long-term federal rental subsidy in the form of a voucher or public housing. Those programs, however, would no longer provide any assistance to households earning more than this amount. (Households earning up to 50 percent, and in some cases 80 percent of AMI, are currently eligible for federal assistance.) To offset this lower income threshold, the commission also proposed an emergency rental assistance program for households earning between 30 and 80 percent of AMI who suffer temporary financial setbacks. The proposal called for one-time assistance of up to $1,200 to be used to pay security deposits, back rent, and other housing-related costs. Emergency assistance would be administered through HUD's HOME formula grant program with broadened flexibility to provide short-term, tenant-based rental assistance and supplemental funding for that purpose.

More recently, the 2019 Eviction Crisis Act (S.3030), sponsored by Senators Michael Bennet (D-Colorado) and Rob Portman (R-Ohio), proposed creating an emergency assistance fund supported through a federal competitive grant program with matching funds from local governments or private philanthropy. Under the proposed program, extremely low-income tenants could apply for short-term rental assistance. To qualify, tenants would need to demonstrate that they are at risk of homelessness or housing instability by presenting a past-due utility or rent notice, a decline in household income, a family health crisis, or documentation of an unexpected expense. Although the bill does not cap the total amount of assistance provided to each household, it limits the duration of aid to a maximum of 90 days with eligibility resetting each year.

One important distinction between the two proposals is their target population. Under the BPC proposal, the emergency rental assistance would be available to households with income between 30 and 80 percent of AMI (since those earning less than 30 percent of AMI would be offered a long-term rental subsidy). Under the Bennet-Portman proposal, emergency assistance would be provided only to households with extremely low incomes, regardless of whether they receive other federal rental assistance. A second distinction is that the BPC proposal restricts households to receiving emergency assistance just once, while the Bennet-Portman plan would allow households to receive assistance in multiple years, if warranted. A third distinction is that funds would be allocated to all or most localities under the BPC proposal, while the Bennet-Portman Act proposes a competition, resulting in funds going only to a limited set of places.

4. The Policy Proposal: A Federal Short-Term (Emergency) Rental Assistance Program

We propose the development of a short-term rental assistance program to address temporary income and expense volatility that can threaten housing stability. This tool would complement, rather than substitute for, longer-term and deeper rental subsidies, though its existence could prevent some destabilizing events that result in a household needing longer-term rental assistance. In essence, we are proposing to get 'up stream' of costly, destabilizing events, similar in concept to reform proposals to disability insurance, such as recommended by the Hamilton Project (Greenstone et al. 2013). While the program is intended to address idiosyncratic events in renters' lives, emergency rental assistance could also be modified and scaled up to mitigate harm during a common shock, such as a natural disaster or pandemic, much as the unemployment insurance system has been used to respond to the COVID-19 pandemic. As numerous localities around the country have learned this spring and summer, having even a small, preexisting program makes it far easier to stand up a more scaled relief program in a broader emergency.

4.a. Rationale for Federal Support

Unlike the emergency rental assistance programs currently in place, we are proposing a federally-funded program, with funding dedicated to emergency rental assistance.[7] The federal government has greater fiscal flexibility than states and localities, and redistributive programs are most appropriately funded at the federal level. Further, federal funding ensures that the program will be available broadly, not just to those jurisdictions with sufficient resources to establish such programs, eliminating any strategic behavior on the part of individuals to move to jurisdictions that offer more generous, short-term assistance, or on the part of cities that anticipate such mobility responses. To the extent that the federal funding includes some guidance and minimum program and reporting requirements, it may also help to address disparities in local capacity levels. Finally, a federal program can be temporarily expanded to address common shocks, something few localities could manage. That said, while federal funding is key, any federal program should be flexible enough to permit tailoring to local conditions and to enable its use with other state and local programs addressing housing stability.

We propose the program be limited to renters with incomes of 80 percent of AMI or less prior to the income or expense shock, which balances the desire to target to the very neediest households with the interest in serving somewhat higher-income households, for whom short-term help is more likely to be sufficient to prevent a forced move. To ensure the short-term or emergency nature of assistance, renters would be limited to one-time assistance within a specified period. While many program details should be left to states and localities, to permit local innovation, we outline key considerations for an effective and efficient program.

4.b. Distinction from Current Proposals

Our proposed program most resembles the BPC proposal in terms of target population and basic funding structure. But given that we are not proposing a program to complement universal access to rental assistance for households with incomes below 30 percent of AMI, *all* renters with incomes below 80 percent of AMI would be potentially eligible under our proposal, though assistance could be limited to those without other rental assistance. Localities could choose to prioritize those with lower incomes among those who are eligible, or to provide different amounts of support depending on a household's prior income level. As noted below, we also consider strategies for allowing households to receive assistance more than once, while still trying to limit moral hazard.

7 Note that federal funding received through HOME, Emergency Solutions Grants (ESG), and even CDBG can be used by states and localities for emergency rental assistance, as one of numerous permitted uses and out of existing, capped federal funding. There is no existing federal program dedicated to emergency rental assistance.

Similar to the BPC proposal, we propose a federal formula-based funding source (HOME) that allocates funding based on housing need. While a competitive grant program requiring a local match can bring some efficiencies, these come at the expense of broad coverage and redistribution, and HOME's required 25 percent local match ensures some local "skin in the game." HOME may be the most flexible existing federal option, with some modifications to broaden the use of tenant-based rental assistance. This places emergency rental assistance within the "toolbox" of states and localities, along with other affordable housing efforts. The Emergency Solutions Grants (ESG) program could also be expanded for this purpose, as it was under the CARES Act. However, ESG would place the new funding in local homelessness systems and efforts, which in some locations may be less connected with broader affordable housing and stability efforts.[8] One drawback of relying on the HOME infrastructure is that, unlike ESG, it does not currently require activities to be reported separately such that emergency rental assistance can be tracked and monitored. Both the BPC proposal and our proposal require a change in reporting.[9]

A key goal of emergency assistance is to get "upstream," and to provide assistance that can head off a housing shock that could cause collateral damage. One such event is an eviction filing, which can negatively affect households even if they are not formally evicted, as filings are generally publicly reported and some landlords refuse to house people who have received eviction filings in the past (Gold 2016). A number of the existing local programs require proof of such a filing for the applicant to qualify. While this requirement may help to target assistance to tenants at greater risk, it also means that even tenants receiving assistance will still be harmed by having an eviction filing on their record. Further, conditioning assistance on an eviction filing may incentivize tenants to skip payments and landlords to make such filings so that their tenants can access assistance. Our proposed program would make explicit the goal of providing assistance prior to such potentially damaging events. We would also aim for considerable flexibility to permit grantees to innovate and leverage the available funding by combining with other public (and philanthropic) funding sources, as well as by potentially using portions of this funding for zero-cost loans rather than out-right grants. HOME dollars are currently combined with an array of other funding sources and would provide such flexibility.

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8 ESG funds are allocated using the Community Development Block Grant Formula, and receiving jurisdictions must consult with local Continuums of Care (CoCs) in determining the use of funds.

9 In its assessment of the best existing federal program for providing expanded emergency rental assistance, the Urban Institute selected ESG over HOME (Galvez et al., 2020). However, the goal was for addressing the immediate COVID economic crisis, and ESG has a reporting structure in place.

4.c. Design Challenges and Considerations

There are a multitude of challenges and tradeoffs in designing such a rental assistance program. Here we raise several of the key issues states and localities would need to consider.

4.c.1. Simplicity versus oversight

As is the case in all public assistance programs, there is a tradeoff here between simplicity (with its lower administrative costs and ease of access for eligible households) versus oversight to ensure that public resources are being used for the stated goals of the program, and to serve the intended target population. Localities will need to consider the level and form of documenting need for emergency rental assistance, the qualifying event(s) that triggered that need, as well as evidence that temporary assistance is sufficient to stabilize the household. Given the short-term nature of this assistance, and the aim to provide assistance that can meet emergency needs, we would err on the side of simplicity. But some guardrails need to be put in place to protect against fraud and abuse.

4.c.2. Safety net versus moral hazard

Perhaps the greatest challenge in providing this kind of assistance is addressing the threat of moral hazard. On the tenant side, the concern is that low-income renters will be less motivated to pay rent because of the existence of this safety net. Knowing that they can miss a rental payment (or more) with potentially no negative consequences, they may be less apt to economize on expenditures and build up savings. On the landlord side, there could be concern that they would work less hard to collect overdue rent directly from the tenant or be less inclined to offer concessions of small amounts of missed rent, if they know that they can receive full payment through the emergency program.

There are numerous ways to minimize moral hazard through program features. Some existing emergency assistance programs limit assistance to a one-time payment, or a one-time payment within a given time period, mediating both renter and landlord moral hazard. Such limits, of course, reduce the ability of the program to buffer against additional shocks. One way to preserve that ability would be to permit previously assisted households to renew their eligibility for future assistance if they pay back the original subsidy. A time-limited rental assistance program in Chile does just this (Ross and Pelletiere 2014). The program allows subsidy recipients to miss rental payments up to three times during the five-year program, before losing eligibility. A tenant may repay a missed rent in a later month to preserve the ability to access this benefit again in the future, in essence permitting a zero-interest loan.[10] Alternatively, the assistance, or some portion it, could come explicitly in the form of a zero-interest loan, similar to HEMAP. The renter then bears a real cost to accessing the assistance, lowering moral hazard, but again lowering the reach and benefits of the program.[11]

Another way to limit moral hazard is by specifying a set of qualifying events, which involve an unexpected cost or shock beyond the household's control. The qualifying events must also be beyond the landlord's control. For example, tenants could not receive assistance simply because their landlord has increased rent. The program would then require proof that the need is coming from one of these qualifying events.

Another concern is that landlords will simply increase rents in response to the program, thereby capturing some or all of its benefits. The more generous and broad-based the program, the more likely it is that landlords will enjoy a substantial share of benefits. In this case, because the assistance is modest and time-limited, and targeted to those experiencing qualifying events, the risk that landlords will capture significant benefits is somewhat lower. But it is possible, as noted above, that landlords might hold back on offering rent relief in the presence of this program. Covering only part of the rent arrearages (say 80 or 90 percent) would help to minimize such behavior.

4.c.3. Excluding versus including households in subsidized housing

One difficult choice is whether to permit residents of subsidized housing to receive this emergency assistance. On the one hand, households in subsidized housing are less vulnerable to forced moves than those in unsubsidized housing given their lower rent payments (and perhaps more forgiving landlords). Moreover, in the case of a sizable shock to income, their rent payments may be adjusted to compensate.[12] On the other hand, they are not insulated from financial shocks, especially expense shocks. Further, because of their lower rents, short-term assistance is more likely to be sufficient to enable them to stay in their homes in the face of a shock and maintain their long-term subsidy. One possibility would be to exclude public housing residents, but to make voucher holders eligible, since they live in privately owned housing; they often have to pay for their own utilities and appear to struggle with

10 At the end of the five-year subsidy, families receive a share of any unused portion of the three-month buffer, creating a disincentive to simply miss three rental payments regardless of need.

11 As an example, each branch of the military provides emergency financial assistance to active service members, as zero interest loans, grants or a combination depending on the circumstances of the person requesting it.

12 For this discussion, subsidized housing does not include housing financed with the Low Income Housing Tax Credit, in which rents are set for the unit and not by the occupant's income. Hence, rents do not adjust to offset negative shocks in the tenant's income.

making critical utility payments (Sanbonmatsu et al. 2011).[13] It also seems advisable to permit residents of Low Income Housing Tax Credit (LIHTC) developments to receive assistance, since LIHTC rents do not adjust with tenant incomes.

Conclusion

Unexpected financial shocks pose a significant threat to the stability of lower-income renters, because their budgets are increasingly constrained by the combination of stagnant incomes and rising rents, they have limited ability to save, and there are few options to renegotiate leases. Many lower-income renters are now formally or informally evicted as a result of idiosyncratic financial shocks. A federal short-term emergency rental assistance program could help such renters to stay in their homes or to transition smoothly to new, affordable homes where needed. We believe that the costs of such a program would be modest relative to the benefits of stabilizing low-income renters and avoiding the cascade of other social problems (and costs) that may follow from forced moves.

The aim of such a program would be to address idiosyncratic shocks experienced by individual renters. But such a program could also be scaled up to address broader market threats, like the COVID-19 pandemic. In the case of broader market threats, however, direct cash assistance is more likely to be the optimal strategy, with emergency rental assistance playing a secondary role in the safety net.

References

Acolin, Arthur, Raphael Bostic, and Gary Painter. 2016. "A Field Study of Rental Market Discrimination across Origins in France." *Journal of Urban Economics* 95(C): 49–63. https://ideas.repec.org/a/eee/juecon/v95y2016icp49-63.html.

Amherst. n.d. "Resident Assistance Program." Massachusetts Amherst. Accessed August 12, 2020. https://www.amherstma.gov/3493/Resident-Assistance-Program.

Andersson, Fredrik, John C Haltiwanger, Mark J Kutzbach, Giordano E Palloni, Henry O Pollakowski, and Daniel H Weinberg. 2016. "Childhood Housing and Adult Earnings: A Between-Siblings Analysis of Housing Vouchers and Public Housing." Working Paper No. 22721. National Bureau of Economic Research. https://doi.org/10.3386/w22721.

Bipartisan Policy Center. 2013. "Housing America's Future: New Directions for National Policy." Bipartisan Policy Center. https://bipartisanpolicy.org/report/housing-americas-future-new-directions-national-policy/.

13 In the follow-up of the Moving to Opportunity Demonstration, families living in public housing who were randomly assigned to receive a housing voucher were 8 percentage points (and 33 percent) more likely than controls to have received a utility shut-off notice due to non-payment in the past year. (Sanbonmatsu et al. 2011, Exhibit 2.4, p. 55).

---. 2015. “Housing the Families Who Need It Most Is Within Our Reach.” Bipartisan Policy Center. Accessed August 12, 2020. https://bipartisanpolicy.org/report/housing-the-families-who-need-it-most-is-within-our-reach/.

Brnger, Garrett, Rebecca Salinas, and Misael Gomez. 2020. “City Council Approves $25M Emergency Program That Gives Rent, Utilities, Mortgage Assistance.” KSAT. April 23, 2020. https://www.ksat.com/news/local/2020/04/23/mayor-city-council-to-hear-briefing-on-covid-19-to-vote-on-158m-emergency-housing-assistance-program-at-9-am-meeting/.

Central Virginia Legal Aid Society. n.d. “Addressing Evictions in Richmond.” Central Virginia Legal Aid Society. http://www.richmondgov.com/PressSecretaryMayor/robocopy/documents/AddressingEvictionRVA.pdf.

Chartkoff, Shelby, and Gustavo Rotondaro. 2019. “Grand Rapids Eviction Prevention Pilot Program: Year 2 Evaluation Report.” Métrica.

Chicago DFSS. n.d. “Homeless Prevention and Rental Assistance.” Chicago Department of Family & Support Services. Accessed August 12, 2020. https://www.chicago.gov/content/city/en/depts/fss/provdrs/emerg/svcs/homeless_prevention.html.

City of Grand Rapids. n.d. “Eviction Prevention Program.” City of Grand Rapids. Accessed August 12, 2020. https://www.grandrapidsmi.gov/Government/Programs-and-Initiatives/Eviction-Prevention-Program.

City of Jacksonville. n.d. “Emergency Financial Assistance Program.” City of Jacksonville. Accessed August 12, 2020. https://www.coj.net/departments/special-services/behavioral-and-human-services/emergency-financial-assistance-program.aspx.

City of Phoenix. n.d. “Human Services Social Services.” City of Phoenix. Accessed August 12, 2020. https://www.phoenix.gov:443/humanservices/programs/emergency.

Coalition for the Homeless. n.d. “One-Shot Deals.” Coalition for the Homeless. Accessed August 12, 2020. https://www.coalitionforthehomeless.org/get-help/im-in-need-of-housing/one-shot-deals/.

Collinson, Robert, Ingrid Gould Ellen, and Jens Ludwig. 2016. “Low-Income Housing Policy.” In *Economics of Means-Tested Transfer Programs in the United States, Volume 2,* edited by Robert A. Moffitt, 59–126. National Bureau of Economic Research. https://www.nber.org/chapters/c13485.

Collinson, Robert, and Davin Reed. 2019. “The Effects of Evictions on Low-Income Households.” https://drive.google.com/file/d/1uo1i0JxyVB_vim9XJpFfL6XaNgSKSuor/view.

Desmond, Matthew. 2012. “Eviction and the Reproduction of Urban Poverty.” *American Journal of Sociology* 118(July): 88–133. https://doi.org/10.1086/666082.

---. 2016. *Evicted: Poverty and Profit in the American City.* Reprint edition. New York: Broadway Books.

Desmond, Matthew, and Rachel Tolbert Kimbro. 2015. “Eviction’s Fallout: Housing, Hardship, and Health.” *Social Forces.* https://scholar.harvard.edu/files/mdesmond/files/desmondkimbro.evictions.fallout.sf2015_2.pdf.

Ellen, Ingrid Gould, Katherine O’Regan, and Sophie House. 2020. “Housing Policy Must Change in the Wake of COVID-19.” *Shelterforce*, March 24, 2020. https://shelterforce.org/2020/03/24/housing-policy-must-change-in-wake-of-covid-19/.

Ellen, Ingrid Gould, and Stephen L. Ross. 2018. "Race and the City." Working Papers 2018-03. University of Connecticut, Department of Economics. https://ideas.repec.org/p/uct/uconnp/2018-03.html.

Evans, William N., James X. Sullivan, and Melanie Wallskog. 2016. "The Impact of Homelessness Prevention Programs on Homelessness." *Science* 353(6300): 694–99. https://doi.org/10.1126/science.aag0833.

Eviction Crisis Act of 2019. S. 3030, 116th Cong. (2019) https://www.congress.gov/bill/116th-congress/senate-bill/3030/text.

Federal Reserve Board. 2007. "Report to the Congress on Credit Scoring and Its Effects on the Availability and Affordability of Credit." Federal Reserve Board. https://www.federalreserve.gov/boarddocs/rptcongress/creditscore/creditscore.pdf.

---. 2020. "Survey of Household Economics and Decisionmaking." Survey. Federal Reserve Board. https://www.federalreserve.gov/consumerscommunities/shed.htm.

Flaming, Daniel, Halil Toros, and Patrick Burns. 2015. "Home Not Found: The Cost of Homelessness in Silicon Valley." Technical Report. Economic Round Table. https://doi.org/10.13140/RG.2.1.4780.6327.

Galvez, Martha, and Jessica Luna. 2014. "Homelessness and Housing Instability: The Impact on Education Outcomes." Research Brief. Urban Institute. http://www.tacomahousing.net/sites/default/files/print_pdf/Education/Urban%20Institute%20THA%20Homelessness%20and%20Education%202014-12-22.pdf.

Galvez, Martha, Kathryn Reynolds, Jorge Morales-Burnett, Yipeng Su, and Solomon Greene. 2020. "Assessing Options for Federal Rental Assistance during the Pandemic." Research Brief. Urban Institute. https://www.urban.org/sites/default/files/publication/102676/assessing_options_for_federal_rental_assistance_during_pandemic_0.pdf.

Glaeser, Edward L., and Jesse M. Shapiro. 2003. "The Benefits of the Home Mortgage Interest Deduction." In *Tax Policy and the Economy, Volume 17*, edited by James M. Poterba, 37–82. National Bureau of Economic Research. http://www.nber.org/chapters/c11534.pdf.

Gold, Allyson E. 2016. "No Home for Justice: How Eviction Perpetuates Health Inequity among Low-Income and Minority Tenants." *Georgetown Journal on Poverty Law and Policy* 24(1): 59–88. https://go.gale.com/ps/i.do?p=AONE&sw=w&issn=15243974&v=2.1&it=r&id=GALE%7CA488711843&sid=googleScholar&linkaccess=abs.

Goodman, Sarena, Peter Messeri, and Brendan O'Flaherty. 2016. "Homelessness Prevention in New York City: On Average, It Works." *Journal of Housing Economics* 31(March): 14–34. https://doi.org/10.1016/j.jhe.2015.12.001.

Greene, Solomon, and Samantha Batko. 2020. "What Can We Learn from New State and Local Assistance Programs for Renters Affected by COVID-19?" Article. Urban Institute. https://housingmatters.urban.org/articles/what-can-we-learn-new-state-and-local-assistance-programs-renters-affected-covid-19.

Greenstone, Michael, Max Harris, Karen Li, Adam Looney, and Jeremy Patashnik. 2013. "15 Ways to Rethink the Federal Budget." Policy Proposal. The Hamilton Project. The Brookings Institution. https://www.hamiltonproject.org/papers/15_ways_to_rethink_the_federal_budget.

Gruber, Jonathan, Amalie Sofie Jensen, and Henrik Kleven. 2017. "Do People Respond to the Mortgage Interest Deduction? Quasi-Experimental Evidence from Denmark." SSRN Scholarly Paper ID 3007470. Rochester, NY: Social Science Research Network. https://papers.ssrn.com/abstract=3007470.

Gubits, Daniel, Marybeth Shinn, Michelle Wood, Stephen Bell, Samuel Dastrup, Claudia D. Solari, Scott R. Brown, et al. 2016. "Family Options Study: 3-Year Impacts of Housing and Services Interventions for Homeless Families | HUD USER." U.S. Department of Housing and Urban Development. https://www.huduser.gov/portal/sites/default/files/pdf/Family-Options-Study-Full-Report.pdf.

Hanson, Andrew. 2012. "Size of Home, Homeownership, and the Mortgage Interest Deduction." *Journal of Housing Economics* 21(3): 195–210. https://econpapers.repec.org/article/eeejhouse/v_3a21_3ay_3a2012_3ai_3a3_3ap_3a195-210.htm.

Hanson, Andrew, and Zackary Hawley. 2011. "Do Landlords Discriminate in the Rental Housing Market? Evidence from an Internet Field Experiment in US Cities." *Journal of Urban Economics* 70(2–3): 99–114. https://econpapers.repec.org/article/eeejuecon/v_3a70_3ay_3a2011_3ai_3a2-3_3ap_3a99-114.htm.

Hilber, Christian A. L., and Tracy M. Turner. 2014. "The Mortgage Interest Deduction and Its Impact on Homeownership Decisions." *The Review of Economics and Statistics* 96(4): 618–37. https://ideas.repec.org/a/tpr/restat/v96y2014i4p618-637.html.

HUD. 2016. "Homelessness Prevention Rapid Re-Housing Program (HPRP): Year 3 & Final Program Summary." U.S. Department of Housing and Urban Development. https://files.hudexchange.info/resources/documents/HPRP-Year-3-Summary.pdf.

---. n.d. "Affordable Housing & Worst Case Needs Reports to Congress." Accessed August 12, 2020. https://www.huduser.gov/portal/taxonomy/term/43.

HUD Exchange. n.d. "ESG: Emergency Solutions Grants Program." Accessed August 3, 2020. https://www.hudexchange.info/programs/esg/.

Humphries, John Eric, Nicholas S Mader, Daniel I Tannenbaum, and Winnie L van Dijk. 2019. "Does Eviction Cause Poverty? Quasi-Experimental Evidence from Cook County, IL." Working Paper No. 26139. National Bureau of Economic Research. https://doi.org/10.3386/w26139.

Independent Budget Office. 2019. "Governor's Budget Would Add to City's Rising Share of Homeless Shelter Costs." Fiscal Brief. Independent Budget Office. https://ibo.nyc.ny.us/iboreports/governors-budget-would-add-to-citys-rising-share-of-homeless-sheltercosts-fopb-march-2019.pdf.

LA DPSS. 2018. "Emergency Assistance to Prevent Eviction (EAPE) Program Fact Sheet." Los Angeles Department of Public Social Services. http://file.lacounty.gov/SDSInter/dpss/245146_EAPEFactSheet(5-19-16).pdf.

Larrimore, Jeff, and Jenny Schuetz. 2017. "Assessing the Severity of Rent Burden on Low-Income Families." FEDS Notes 2017-12-22. Board of Governors of the Federal Reserve System (U.S.). https://ideas.repec.org/p/fip/fedgfn/2017-12-22.html.

Lennon, Mary Clare, Lauren D. Appelbaum, J. Lawrence Aber, and Katherine McCaskie. 2003. "Public Attitudes Toward Low-Income Families and Children." Research Report 01. National Center for Children in Poverty. http://www.nccp.org/publications/pdf/text_552.pdf.

Local Housing Solutions. 2020. “COVID-19 Emergency Rental Assistance Programs in Ten Localities.” Brief. Local Housing Solutions. https://www.localhousingsolutions.org/covid-19/covid-19-emergency-rental-assistance-programs-in-ten-localities/.

Lusardi, Annamaria, Peter Tufano, and Daniel Schneider. 2011. “Financially Fragile Households: Evidence and Implications.” The Brookings Institution. https://www.brookings.edu/bpea-articles/financially-fragile-households-evidence-and-implications/.

McKernan, Signe-Mary, Caroline Ratcliffe, Breno Braga, and Emma Cancian Kalish. 2016. “Thriving Residents, Thriving Cities: Family Financial Security Matters for Cities.” Brief. Urban Institute. https://www.urban.org/research/publication/thriving-residents-thriving-cities-family-financial-security-matters-cities.

Mello, Steven. 2018. “Speed Trap or Poverty Trap? Fines, Fees, and Financial Wellbeing.” Princeton University. https://mello.github.io/files/jmp.pdf.

Metcalf, Ben. 2020. “NAHREP and Terner Center Survey Highlights the Impact of COVID-19 Pandemic on Small Landlords.” Terner Center for Housing Innovation. July 28, 2020. https://ternercenter.berkeley.edu/blog/nahrep-survey.

Mills, Gregory, Daniel Gubits, Larry Orr, David Long, Judie Feins, Bulbul Kaul, Michelle Wood, et al. 2006. “Effects of Housing Vouchers on Welfare Families.” U.S. Department of Housing and Urban Development. https://www.huduser.gov/portal//Publications/pdf/hsgvouchers_1_2011.pdf.

Morduch, Jonathan, and Rachel Schneider. 2017. *The Financial Diaries.* Princeton: Princeton University Press. https://press.princeton.edu/books/hardcover/9780691172989/the-financial-diaries.

National Low Income Housing Coalition. 2020. “NLIHC COVID-19 Rental Assistance Database.” Database. National Low Income Housing Coalition. https://docs.google.com/spreadsheets/d/1hLfybfo9NydIptQu5wghUpKXecimh3gaoqT7LU1JGc8/edit#gid=79194074.

O’Flaherty, Brendan. 2011. “Rental Housing Assistance for the 21st Century,” Cityscape: A *Journal of Policy Development and Research* 13 (2). https://www.huduser.gov/portal/periodicals/cityscpe/vol13num2/Cityscape_July2011_rental_housing_3.pdf.

Olsen, Edgar O. 2008. “Getting More from Low-Income Housing Assistance.” The Hamilton Project. Washington D.C.: The Brookings Institution. https://www.hamiltonproject.org/assets/legacy/files/downloads_and_links/Getting_More_from_Low-Income_Housing_Assistance.pdf.

Palmer, Caroline, David C. Phillips, and James X. Sullivan. 2018. “Does Emergency Financial Assistance Reduce Crime?” *Journal of Public Economics* 169(C): 34–51. https://ideas.repec.org/a/eee/pubeco/v169y2019icp34-51.html.

Pardue, Luke. 2020. “The Effect of Low-Income Rental Subsidies on Evictions: Evidence from the Housing Choice Voucher Program.” Unpublished Manuscript.

Parker, Jonathan A. 2017. “Why Don’t Households Smooth Consumption? Evidence from a $25 Million Experiment.” *American Economic Journal: Macroeconomics* 9(4): 153–83. https://doi.org/10.1257/mac.20150331.

Pennsylvania Housing Finance Agency. n.d. "HEMAP Fact Sheet." Pennsylvania Housing Finance Agency's Homeowners' Emergency Mortgage Assistance Program. https://www.phfa.org/forms/hemap_factsheet/hemap_fact_sheet.pdf.

Pew Charitable Trusts. 2015. "How Do Families Cope With Financial Shocks?" Issue Brief. Pew Charitable Trusts. https://www.pewtrusts.org/-/media/assets/2015/10/emergency-savings-report-1_artfinal.pdf.

---. 2018. "American Families Face a Growing Rent Burden." Pew Charitable Trusts. https://www.pewtrusts.org/-/media/assets/2018/04/rent-burden_report_v2.pdf.

Poterba, James M., and Todd Sinai. 2011. "Revenue Costs and Incentive Effects of the Mortgage Interest Deduction for Owner-Occupied Housing." *National Tax Journal* 64(2). https://doi.org/dx.doi.org/10.17310/ntj.2011.2S.05.

Rolston, Howard, Judy Geyer, and Gretchen Locke. 2013. "Evaluation of the Homebase Community Prevention Program." https://www.abtassociates.com/sites/default/files/migrated_files/cf819ade-6613-4664-9ac1-2344225c24d7.pdf.

Ross, Lauren, and Danilo Pelletiere. 2014. "Chile's New Rental Housing Subsidy and Its Relevance to US Housing Choice Voucher Program Reform." *Cityscape* 16(July): 179. https://www.huduser.gov/portal/periodicals/cityscpe/vol16num2/ch15.pdf.

Ruggles, Steven, Sarah Flood, Ronald Goeken, Josiah Grover, Eric Meyer, Jose Pacas, and Matthew Sobek. 2020. *IPUMS USA: Version 10.0 [Dataset]. Minneapolis, MN: IPUMS, 2020.* https://doi.org/10.18128/D010.V10.0.

San Antonio NHSD. n.d. "Risk Mitigation Fund Policy." Policy. City of San Antonio Neighborhood & Housing Services Department. https://www.sanantonio.gov/Portals/0/Files/NHSD/RiskMitigation/RiskMitigationPolicy-English.pdf.

Sanbonmatsu, Lisa, Lawrence F. Katz, Jens Ludwig, Lisa A. Gennetian, Greg J. Duncan, Ronald C. Kessler, Emma Adam, Thomas W. McDade, and Stacy Tessler Lindau. 2011. "Moving to Opportunity for Fair Housing Demonstration Program - Final Impacts Evaluation." U.S. Department of Housing and Urban Development. https://www.huduser.gov/portal/publications/pubasst/MTOFHD.html.

Schwartz, Amy Ellen, Keren Mertens Horn, Ingrid Gould Ellen, and Sarah A. Cordes. 2020. "Do Housing Vouchers Improve Academic Performance? Evidence from New York City." *Journal of Policy Analysis and Management* 39(1): 131–58. https://doi.org/10.1002/pam.22183.

Tax Policy Center. n.d. *The Tax Policy Briefing Book.* Tax Policy Center. Accessed July 27, 2020. https://www.taxpolicycenter.org/briefing-book.

Turner, Margery Austin, Robert Santos, Diane K. Levy, Douglas A. Wissoker, Claudia Aranda, and Rob Pitingolo. 2013. "Housing Discrimination against Racial and Ethnic Minorities 2012." U.S. Department of Housing and Urban Development. https://www.huduser.gov/portal/Publications/pdf/HUD-514_HDS2012.pdf.

U.S. Census Bureau. n.d. "American Community Survey." U.S. Census Bureau. Accessed August 3, 2020a. https://www.census.gov/programs-surveys/acs.

---. n.d. "Survey of Income and Program Participation." U.S. Census Bureau. Accessed August 3, 2020b. https://www.census.gov/sipp/.

PART III

THE GLOBAL CLIMATE CHALLENGE AND U.S. POLICY RESPONSE

Climate Convexity: The Inequality of a Warming World
Trevor Houser

Harnessing the Power of Markets to Solve the Climate Problem
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Climate Convexity: The Inequality of a Warming World

AUTHOR

Trevor Houser*

ABSTRACT

In the past two centuries, global fossil fuel combustion has increased carbon dioxide concentration to unprecedented levels, which has increased Earth's temperatures and the frequency of extreme climate events. If left unaddressed, the climate crisis will not only become more costly to global health and to the global economy, but also will exacerbate inequality within the U.S. and around the world. This chapter describes recent changes in the climate and how scientists predict those changes will evolve in the years ahead. I then describe recent advances in econometric research that, when paired with high-resolution climate models, help us understand the impact of those changes in the climate on society. Finally, I conclude with recommendations for how U.S. policymakers can use this research to address the unequal threat of climate change, both domestically and internationally, and build a more just and sustainable future.

* Partner, Rhodium Group; Co-Director, Climate Impact Lab

Disclaimer: The views expressed in this chapter are the author's alone.

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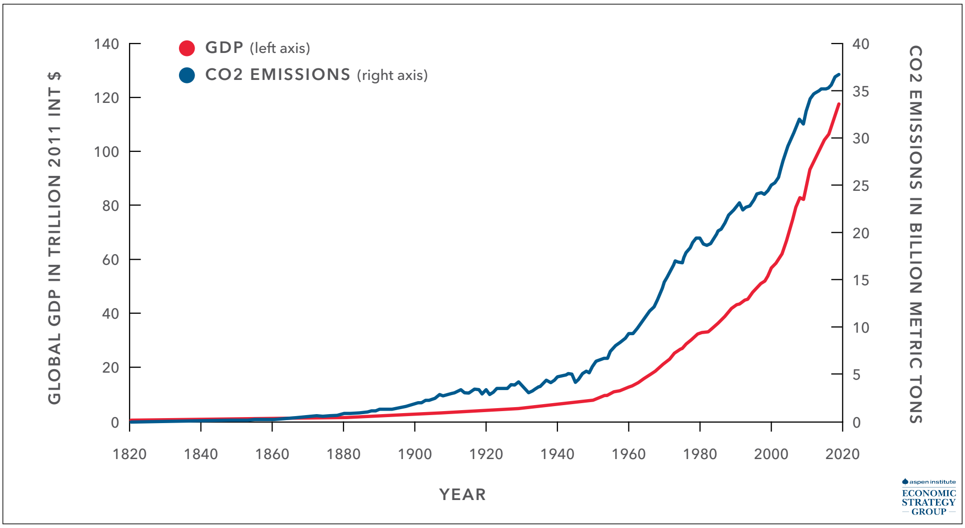
Introduction

Recent research advances at the intersection of climate science and economics make it clear that the cost of inaction on climate change in the United States is not only greater than the cost of action, but that inaction exacerbates income inequality within the United States and around the world. From more frequent heatwaves and wildfires to more destructive hurricanes, an increasingly unstable global climate is already taking a toll on human health and prosperity, and disproportionately impacting the poor. How exposed humans are to future changes will be determined by the actions policymakers take today. Using new research and data, policymakers can counteract the inequality of a warming world.

How did we get here? For the past 12,000 years, a period referred to by geologists as the Holocene, our climate has been the most stable and suitable for human development at any point in Earth's four billion year history. While the first Homo sapiens appeared more than 300,000 years ago in Africa, our early ancestors struggled to thrive through three glacial periods, where ice covered much of North America and Northern Europe. It wasn't until Earth emerged from this last glacial cycle into relatively prolonged stability that humans could move from hunting and gathering to farming. In turn, agricultural production gave rise to early human civilizations in the Fertile Crescent, Ancient India, Ancient China, and Mesoamerica. Continued climate stability has enabled human civilization to undergo dramatic expansion in size, geographic breadth, technological sophistication, and cultural richness, giving us the world we know today.

Measured in economic terms, most human development experienced over the past 12,000 years has occurred in just the last two centuries. Between 0 and 1000 AD, the global economy expanded by only 0.1 percent per decade on average, and per capita GDP declined. Between 1000 and 1820, GDP growth accelerated to 1.8 percent per decade. Over the past 200 years, however, the global economy has grown by almost 30 percent per decade on average. Fossil fuels powered that growth, from coal-fired steel mills and power plants to oil-fueled trains, planes, and automobiles. Carbon dioxide (CO2) emissions from fossil fuel combustion have grown even faster than economic output overall—39 percent per decade, on average, over the past 200 years (Figure 1). This emissions growth is now threatening the very stability in the Earth's climate that made the past 200 years of economic development possible.

Figure 1: Global Economic and Emissions Growth

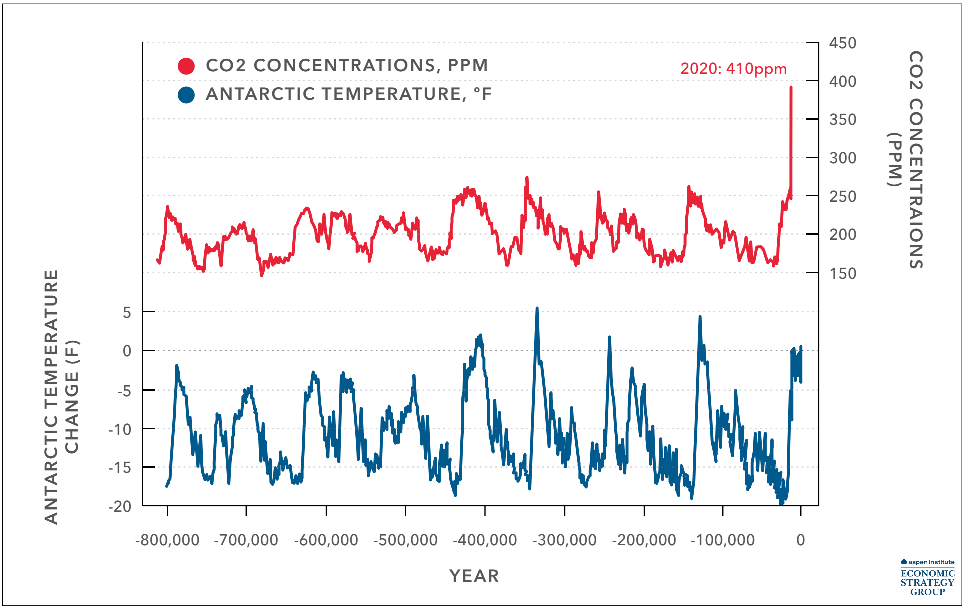


Source: Maddison (2008), Maddison Project Database, version 2018, World Bank, Global Carbon Project, Author's estimates

For the past million years, atmospheric concentrations of carbon dioxide have ranged from 170 to 300 parts per million (ppm), following the Earth's orbit-forced transitions through 100,000 year glacial cycles (Figure 2). For most of the past 12,000 years, atmospheric carbon dioxide concentrations have remained in a tight, comfortable range of 260 to 285 ppm. But fossil fuel combustion over the past two centuries has pushed concentrations above 410 ppm. The last time they were at this level was likely more than three million years ago (Seki et al. 2010).

This rapid growth in carbon dioxide concentrations has already significantly impacted the Earth's climate, both its average temperatures and the frequency and severity of extreme events. The scientific community has studied the relationship between fossil fuel combustion and global climate change for 125 years, and developed increasingly sophisticated climate models to forecast how these changes will unfold in the future under different emissions scenarios. But our understanding of the impact of these changes on society has lagged considerably. Economists only started studying climate change in earnest in the early 1990s. Until recently only a few models existed, each with little empirical basis or geographic detail. A recent explosion of econometric research, mapping climate's relationship to society, is changing that. When paired with high-resolution climate models, this research provides, for the first time, evidence-based estimates of the impact of climate change at a hyper-local level.

Figure 2: Temperature and Carbon Dioxide



Source: American Climate Prospectus (2014) updated with carbon dioxide data from Manua Loa

While this econometric research is still in its early stages, one core insight is abundantly clear: Climate change's impact, whether on economic output or human health, will be extremely varied from place to place. The poor, both within countries and across countries, suffer more than the rich. This insight comes as policymakers grapple with inequality in economic and health outcomes from a pandemic-driven global recession. Recent findings from climate econometrics suggest that if humanity does not address climate change in the next few decades, it will likely drive more devastation and deeper inequality than the current global crisis.

And unlike the current crisis, the inequality of climate change extends to the cause as well as the effect. The carbon dioxide emissions heating the Earth today were emitted over the past two centuries, tied to economic activity that was not evenly distributed around the world. More than half of all global economic output over the past 170 years, and two thirds of all carbon dioxide emissions, have come from countries currently in the top 20 percent of the global income distribution on a per capita GDP basis. These countries are far less vulnerable to the impacts of climate change than the other 80 percent. This is due in large part to their current climate and the convex relationship between temperature and most economic and social outcomes. The climate in rich countries is, on average, colder than in poor countries, and a growing body of climate econometric research shows that a given increase in temperature is much worse for places that are already hot. Compounding this effect is the protective nature of past income growth in richer countries to climate change, made possible by fossil fuel combustion. This inequality exists within national borders as well. Wealthier citizens emit more carbon dioxide and are more protected from the changes in the climate those emissions create, due both to geography and being affluent enough to adapt.

This chapter starts with a description of recent changes in the climate and how scientists predict those changes will evolve in the years ahead. It then describes recent advances in econometric research that, when paired with high-resolution climate models, help us understand the impact of those changes in the climate on society. The chapter concludes with recommendations for how U.S. policymakers can use this research to address the unequal threat of climate change, both domestically and internationally, and build a more just and sustainable future.

1. The State of the Science

Scientific research on the impact of carbon dioxide emissions on the climate dates back almost as far as the combustion of fossil fuels to power industrialization. In an 1856 paper presented to the American Association for the Advancement of Science, New York scientist Eunice Foote argued increasing the amount of carbon dioxide in the atmosphere would increase global temperatures (Foote 1856; Jackson 2019). That year, fossil fuels still played a relatively niche role in the U.S. energy system. Coal accounted for only 14 percent of total consumption, with the rest coming from wood and other forms of biomass (EIA 2020). Commercial oil production would not begin for another three years following the Oil Creek discovery in Titusville, PA.

As fossil fuel production expanded in the late 19th century and early 20th century, climate science continued to improve. In 1894, Swedish scientist Arvid Högbom quantified the amount of carbon dioxide emitted into the atmosphere from the 500 million tons of global coal consumption occurring at the time (Högbom 1894). Two years later, his colleague Svante Arrhenius estimated that a doubling of carbon dioxide concentrations would lead to a 5-6°C increase in global temperatures (Arrhenius 1896). This was the first estimate of what is now known as the "equilibrium climate sensitivity" (ECS). Arrhenius believed, however, that this doubling would take thousands of years to occur, given the rate of carbon dioxide emissions at the time, and could possibly serve as a defense against the Earth entering another glacial cycle.

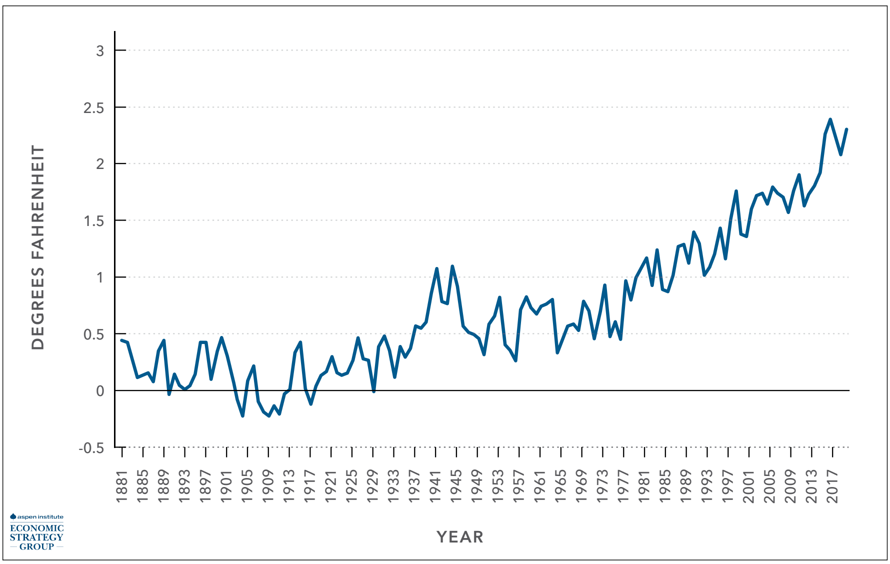
The next major advance in climate change science came in 1938. English steam engineer Guy Stewart Callendar analyzed temperature data and compiled estimates of atmospheric carbon dioxide concentrations from around the world. He estimated atmospheric concentrations of carbon dioxide increased by 6 percent between 1880 and 1935, and that global temperatures had increased by 0.25°C (Callendar 1938). Using a simple model of the climate, Callendar estimated half of the observed increase in temperature was due to 150 billion tons of carbon dioxide from historical fossil fuel combustion. This was the first published empirical evidence of anthropogenic climate change. He wrote:

> *Few of those familiar with the natural heat exchanges of the atmosphere, which go into the making of our climates and weather, would be prepared to admit that the activities of man could have any influence upon phenomena of so vast a scale. In the following paper I hope to show that such influence is not only possible, but is actually occurring at the present time.*

Callendar, like Arrhenius, significantly underestimated future carbon dioxide emissions growth in projecting potential warming. He assumed that fossil fuel production levels in the 1930s would remain constant as efficiency improvements offset rising demand. Instead, global consumption of fossil fuels exploded. In 1938, the word emitted 4.2 million tons of carbon dioxide per year from coal, oil, and natural gas combustion (Global Carbon Project 2019). That number doubled by 1958, and more than doubled again by 1978. In 2019, the world emitted 36.8 billion tons, a nine-fold increase from the year in which Callendar's article was published. As a result of that growth in emissions, global average temperatures have increased by 1.28°C, or 2.31°F, relative to pre-industrial levels (Figure 3).

Figure 3: Change in Global Average Temperatures

Degrees Fahrenheit relative to pre-industrial (1850-1900) levels



Source: NOAA

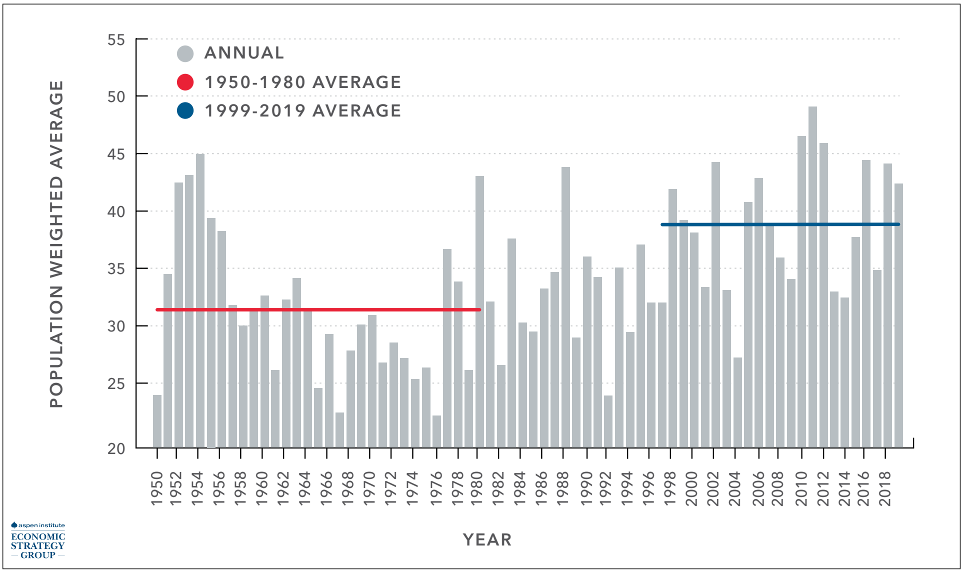
1.a. How Climate Change Is Felt

Statistics on changes in global average temperatures do a poor job of communicating the significance of the shift in the climate that's occurred over the past few decades. A relatively modest increase in *average* temperatures is accompanied by a much larger increase in temperature *extremes*. In the United States, for example, average annual temperatures were 3 percent higher between 1999 and 2019 than between 1950 and 1980. But the number of days above 90°F the average American experienced rose by 23 percent between those two time periods (Figure 4).

Heat alone is not nearly as threatening as the combination of increased heat and humidity (referred to as "wet-bulb temperature"). Humid heat limits the human body's ability to cool itself through perspiration. Body temperatures can rise rapidly when heat stress occurs, damaging the brain and other vital organs. Heat stroke, the most severe heat-related illness, can kill or permanently disable its victims without emergency treatment. At wet-bulb temperatures above 79°F (26°C), strenuous physical activity can be dangerous. If wet-bulb temperatures rise above 91°F (33°C), even during rest fit health individuals will have difficulty controlling their core temperature. During the Chicago heat wave of 1995, which resulted in more than 600 excess deaths and 3300 excess emergency room visits (Dematte et al. 1998), wet-bulb temperatures reached 85°F. The highest wet-bulb temperature every recorded on earth was 95°F (35°C), temperatures even very healthy people cannot survive for more than a few hours. Researchers estimate that recent changes in the climate have already expanded the number of people who experience at least one day a year with wet-bulb temperatures above 91°F from 97 million to 275 million, and those exposed to wet-bulb temperatures above 95°F at least once a decade from 0 to 9 million (Li et al. 2020).

Warmer temperatures expand the water-holding capacity of the atmosphere. As the climate grows more unstable some parts of the United States and the world are getting dryer, other regions are getting wetter, and a greater share of annual rainfall is occurring during extreme precipitation events. The frequency of extreme precipitation events in the United States, as tracked by the National Centers for Environmental Information (NCEI), was 60 percent higher over the past 20 years than between 1950 and 1980 (Figure 5). This increases the frequency and severity of surface flooding (pluvial), by overwhelming urban drainage systems, and flooding along streams or rivers (fluvial).

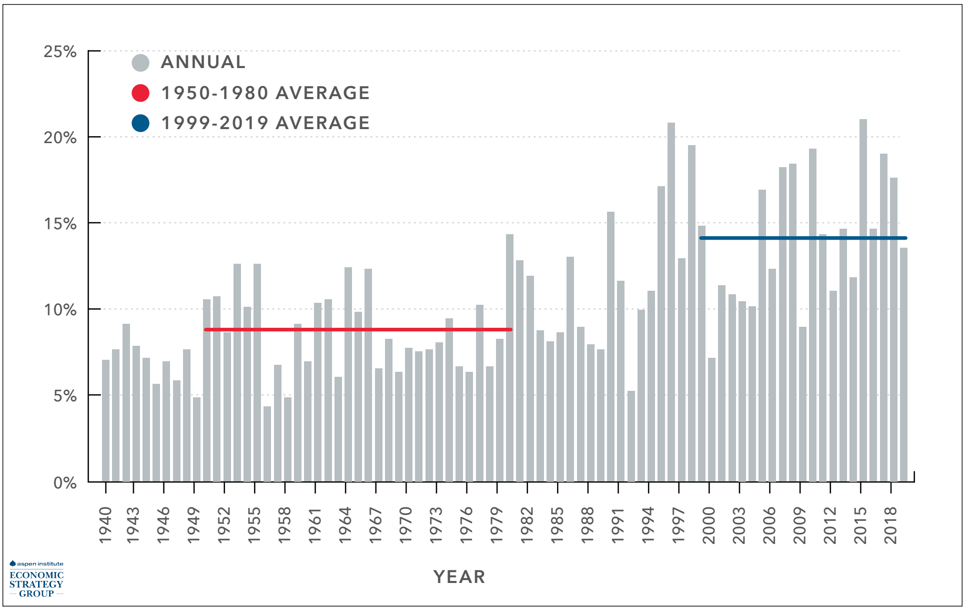
Figure 4: Number of Days above 90F Experienced by the Average American



Source: Rhodium Group

Figure 5: Extreme 1-Day Precipitation Events

Percent of contiguous United States with significant portion of total annual rainfall coming from extreme single-day precipitation events



Source: NOAA U.S. Climate Extremes Index, Step 4

A warmer atmosphere means warmer oceans. That leads to sea level rise both through thermal expansion of the oceans and melting ice sheets around the world. Global average sea levels have risen by 8 to 9 inches since pre-industrial levels, and by more than 3 inches since 1993 alone.[1] In parts of the United States, sea levels are rising at rates three to four times as fast as the global average.[2] As sea levels increase, so do the number of tidal flooding events. Nationally, the number of "High-Tide Flooding events," as defined by NOAA, were 350 percent greater between 2015 and 2019 than between 1995 and 1999.[3]

Higher sea levels also result in more flooding during hurricanes. Climate change has also increased the frequency and severity of the most extreme storms. Over the past 40 years, the probability that any given hurricane will become a Category 3-5 storm has grown by 8 percent per decade globally, and even higher in the North Atlantic (Kossin et al 2020). The amount of rainfall associated with any given hurricane has increased as well. For example, scientists estimate that warming over the past four decades increased the probability of the amount of rainfall experienced during Hurricane Harvey in 2017 six-fold (Emanuel 2017).

1.b. What's in Store in the Future

How will the changes in the climate we've witnessed over the past few decades evolve in the future? Since we only have one Earth and cannot run controlled experiments, scientists rely on increasingly sophisticated, computerized climate models. First developed in the 1960s through the 1980s, climate models use mathematical formulas to simulate atmospheric and oceanic dynamics. More recent models incorporate biogeochemical cycles as well.

Projections made by some of the earliest climate models have done a remarkably good job of predicting the increase in global average temperatures witnessed over the past few decades (Hausfather et al 2019). Even projections using Callendar's model, one of the very earliest, come within 15 percent of actual temperature increases experienced between 1938 and 2000, when adjusted for the growth in emissions that actually occurred (Anderson, Hawkins, and Jones 2016). Early climate models, however, had very little temporal or geographic granularity. But over the past couple

1 Lindsey, Rebecca. 2020. "Climate Change: Global Sea Level." Retrieved from https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level.

2 NOAA. n.d. "Sea Level Trends - NOAA Tides & Currents." Retrieved from https://tidesandcurrents.noaa.gov/sltrends/.

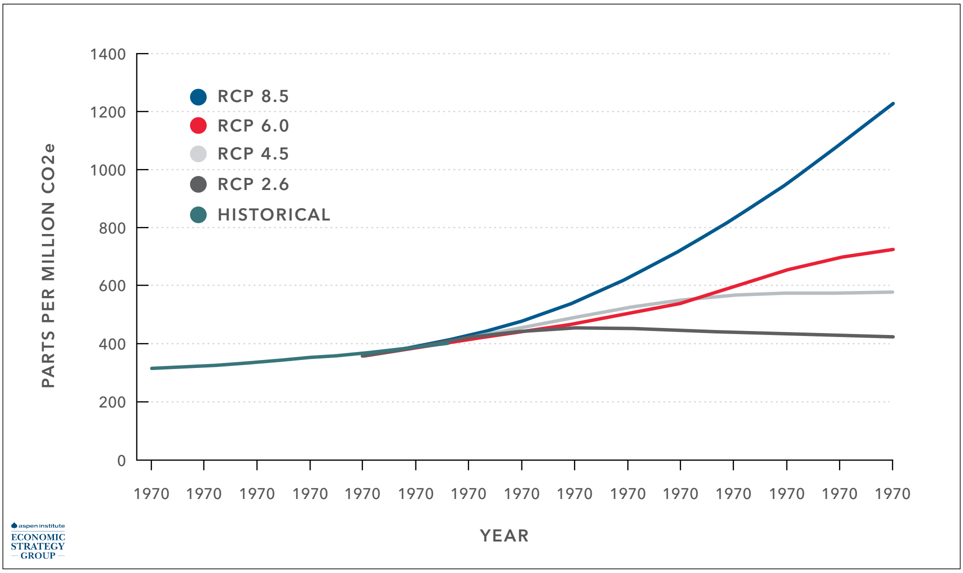
3 NOAA. 2020. "2019 State of U.S. High Tide Flooding with a 2020 Outlook." Technical Report. NOAA. Retrieved from https://tidesandcurrents.noaa.gov/publications/Techrpt_092_2019_State_of_US_High_Tide_Flooding_with_a_2020_Outlook_30June2020.pdf.

of decades, more than 20 high-quality research teams around the world, from NOAA's Geophysical Fluid Dynamics Laboratory in the United States to the Met Office in the United Kingdom to the Meteorological Research Institute in Japan, have invested millions of person hours and trillions of CPU hours each year, improving the ability of climate models to project changes in temperature, precipitation, storm patterns, sea levels, and other climate variables at increasingly high levels of resolution.

Every six to eight years, these research groups model a harmonized set of emissions scenarios. This work is coordinated through the Coupled Model Intercomparison Project (CMIP) and feeds into the Intergovernmental Panel on Climate Change (IPCC's) big assessment reports. The last round of this modeling (known as CMIP5) focused on four emissions scenarios, or "representative concentration pathways," defined in terms of total radiative forcing—a cumulative measure of human emissions of greenhouse gases (GHGs) from all sources expressed in Watts per square meter. In the high-emissions scenario (RCP 8.5), atmospheric concentrations of carbon dioxide and other GHGs exceed 1,200 ppm by the end of the century. In the more moderate RCP 6.0 and RCP 4.5 scenarios, concentrations reach 728 and 581 ppm respectively by 2100. In the low-emissions RCP 2.6 scenario, concentrations peak at just over 450 ppm in 2040, and then decline to 427 ppm by 2100.

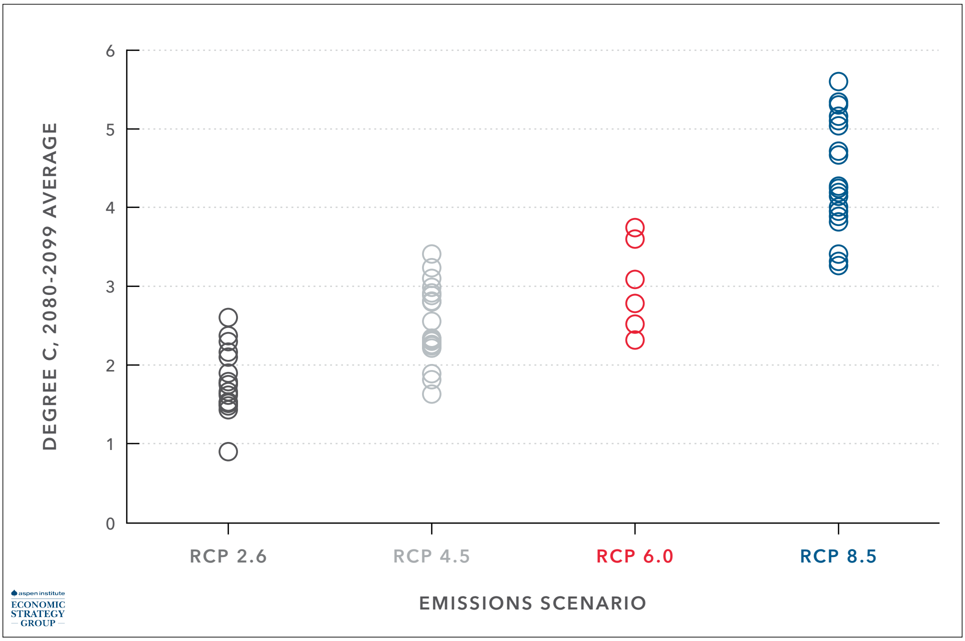
There remains considerable uncertainty around the ECS—how much global average temperatures will increase if carbon dioxide concentrations double. Arrhenius estimated a 5-6°C increase. Callendar's model implies 1.6°C. In 1979, a group of leading scientists estimated a likely range of 1.5° to 4.5°C in the landmark study known as the Charney Report (Charney et al. 1979). That spread has remained roughly the same across climate models over the past 40 years, and can be seen in the range of end-of-century temperature projections from CMIP5 model output in Figure 7 (though new research may have narrowed the range) (Sherwood et al. 2020). In a high-emissions scenario, this collection of models predict global average temperature increases of anywhere between 3.3° and 5.6°C relative to pre-industrial levels (or a 2° to 4.3°C increase relative to where we are today). Under a more moderate-emissions scenario (RCP 4.5), that range falls to 1.6° to 3.4°C.

Figure 6: Atmospheric Concentrations of all Greenhouse Gas Emissions



Source: Integrated Assessment Modeling Consortium

Figure 7: Increase in Global Mean Surface Temperature Relative to Pre-industrial Levels



Source: Rhodium Group analysis of CMIP5 GCM output

How will these changes in average temperatures manifest in the day-to-day weather we experience? Given changes in the climate that have already occurred, the average American is expected to experience between 42 and 51 days above 90°F each year. Under a high-emissions scenario, this likely grows to 56 to 80 days by 2050 and 77 to 126 days by the end of the century (assuming geographic allocation of the population remains at current levels). Under a moderate-emissions scenario, the number of extremely hot days experienced by the average American likely grows to between 52 and 67 days per year by 2050, and to 56 to 82 days by the end of the century.

Dangerously high levels of humidity are also projected to increase as well. Under a high-emissions scenario, researchers estimate that an additional 2.3 billion people around the world will experience at least one day a year where wet-bulb temperatures exceed 91°F by the end of the century (Li, Yuan, and Kopp 2020), even without any population growth. The number of people projected to experience at least one day with wet-bulb temperatures exceeding 95°F is projected to grow by 1.5 billion. Even under a moderate-emissions scenario the number or people exposed to 91°F wet-bulb temperatures annually is expected to grow by 950 million, and the number of those exposed to 95°F wet-bulb temperatures at least once a decade is projected to grow by 700 million.

Global sea levels will likely rise 9 to 13 inches by midcentury under a high-emissions scenario, and 24 to 40 inches by the end of the century relative to year 2000 levels (Kopp 2014). The center point of this range would put the current homes of 120 million people globally below high tide (Kulp and Strauss 2019). If ice sheets melt more quickly, this could grow to 43 to 83 inches (Kopp 2017). The center point of this range would put the current homes of 230 million people globally below high tide. Under a moderate-emissions scenario, sea levels will likely rise by 8 to 12 inches by mid-century, and 17 to 31 inches by the end of the century (putting 90 million current homes below high tide). With faster ice sheet melt, this could grow to 26 to 49 inches (putting 140 million current homes below high tide).

Higher sea levels will make tropical cyclones more damaging, and the frequency of the most severe storms is also projected to continue increasing. Under a moderate-emissions scenario, the frequency of major tropical cyclones is expected to increase by 11 percent globally between 2016 and 2035, relative to 1986–2005 averages, growing to 20 percent by the end of the century (Bhatia et al. 2018). Under a high-emissions scenario the frequency of major tropical cyclones is projected to grow by 40 percent (Emanuel 2013).

1.c. All Climate Is Local

The national or global average projections outlined above mask stark variation across local geographies. For example, Houston, Texas will experience 21 to 29 more extremely hot days annually over the next 30 years, while Portland, Maine will only experience 1 to 6 more. Meanwhile, Portland will likely experience 13 to 22 fewer days below freezing over that period of time, while Houston will only experience 3 to 4 fewer. Globally the vast majority of those exposed to dangerously hot and humid days will be in India and the Middle East, along with parts of China, Australia, North and West Africa, the Midwest and Gulf Coast of the United States, and parts of Latin America.

While the overall amount of precipitation globally increases as the climate warms, some parts of the United States and of the world are projected to get drier, increasing the risk of drought, wildfires, and water scarcity, while others get wetter, increasing the risk of flooding. Sea level rise projections vary dramatically around the world as well. Under a high-emissions scenario (but with more moderate ice sheet melt), local mean sea level will likely rise by 28 to 54 inches in the Chesapeake Bay by the end of the century. Meanwhile, in Juneau, Alaska local mean sea levels will likely *decline* by 27 to 45 inches.

Projected changes in the frequency and severity of tropical cyclones vary around the world as well. Under a moderate-emissions scenario, the frequency of major tropical cyclones is projected to increase by 14 percent in the Atlantic Ocean between 2016 and 2035 relative to 1986–2005 averages (Bhatia et al 2018), by 12 percent in the South Indian Ocean and by 41 percent in the South Pacific. By the end of the century, this grows to 29 percent, 28 percent, and 66 percent respectively.

This local variation in how changes in the global climate manifest is a major factor in shaping the economic impact of climate change around the world.

2. Understanding the Economic Impact of Climate Change

It is only in the past few decades that economists have developed tools to measure and document the economic ramifications of the climate changes that are happening as a result of human activity. It is important to understand the basics of these research advances, in order to understand both the nature of the risks we face without policy action as well as how to design the policy response to climate change in an effective and equitable manner.

Compared to the 160-year history of climate science scholarship, research on the economic impact of climate change is still in its infancy. The first significant contributions were made in the early 1990s by Yale professor William Nordhaus (1991) and Peterson Institute for International Economics fellow William Cline (1992)—more than a half century after Callendar proved fossil fuel combustion was warming the climate. As Nordhaus said in his 1991 article for *The Economic Journal*, "we now move from the terra infirma of climate change to the terra incognita of the social and economic impacts of climate change." Nordhaus divided U.S. economic sectors into three groupings based on their expected sensitivity to warmer temperatures, and offered a rough estimation of how much aggregate economic activity might decline if global temperatures increased by 3°C—0.25 percent. Acknowledging this was likely an underestimate, he rounded up to 1 percent, noting, "it is not possible to give precise error bounds around this figure, but my hunch is that the overall impact upon human activity is unlikely to be larger than 2% of total output." Cline's estimates for the United States were broadly similar—1.1 percent of GDP loss for a 2.5°C increase in global temperatures.

With this early work, Nordhaus and Cline launched the field of climate economics (for which Nordhaus was awarded the Nobel Prize in 2018). The field's initial focus was on developing simplified "integrated assessment modes" (IAMs) that could be used to compare the cost of reducing GHG emissions to the cost of continued warming of the climate. The first IAMs were developed by Nordhaus (1992), University of Cambridge professor Chris Hope (1993), and University of Sussex professor Richard Tol (1995). These three models continue to be among the most often used, though others have been developed.

Simplified IAMs have provided the economics community and policymakers with a useful framework for understanding the relationship between economic activity and the global climate, but relatively little progress has been made since the 1990s in improving their estimate of the economic impact of warming, known as the "damage function." As the National Academies of Sciences, Engineering, and Medicine noted in 2017, "much of the research on which they are based is dated" with the majority coming from the 1990s and early 2000s. The IAMs also have very little geographic resolution, which limits their utility in understanding the distribution of climate damages around the world or their ability to inform investments in resilience that would reduce future climate damages. The DICE model developed by Nordhaus has one global region, the PAGE model developed by Hope has eight regions, and the FUND model developed by Tol has 16 regions. Finally, both the IAMs and the studies on which they are based look at the impact of changes in average annual temperature only, which misses the effects of climate-driven changes in the frequency and severity of extreme events.

2.a. The Empirical Revolution Comes to Climate Economics

In the late 2000s, a new approach to researching the economic impacts of climate change emerged—"climate econometrics" (Hsiang 2016). Exploiting natural variability in the climate, econometricians began developing statistical models of the relationship between temperature, precipitation, storm activity, and other weather variables and social and economic outcomes of interest. Early empirically based damage functions were developed for agricultural production (Deschênes and Greenstone 2007; Schlenker and Roberts 2009), human mortality (Deschênes and Greenstone 2011; Barreca et al. 2015), labor productivity (Hsiang 2010; Graff Zivin and Neidell 2014), crime rates (Jacob, Lefgren, and Moretti 2007; Ranson 2014), electricity demand (Auffhammer and Aroonruengsawat 2011), and other climate impact categories.

One of the powerful features of this "bottom-up" econometric research, the volume, scope and sophistication of which has exploded over the past 15 years, is that it can be combined with increasingly high-resolution global climate models to provide evidence-based projections of the impact of climate change at a hyper-local level. This requires interdisciplinary collaboration between climate scientists and economists, and significant computational resources. The first comprehensive attempt at this was made by a group of researchers at the University of California at Berkeley, Rutgers University, and Rhodium Group in 2013. The team combined output from 33 global climate models with sector-specific empirical damage functions and detailed process models.

Published in book form in 2015 (Houser et al.) and as a research article in Science in 2017 (Hsiang et al.), this work (dubbed the "American Climate Prospectus") provided the first detailed estimate of the economic impact of climate change across the United States. At the national level, combined damage from the six impact categories quantified (energy, mortality, commodity agriculture, coastal property, and crime) is estimated to be roughly 1.2 percent of GDP per 1°C of warming. That's considerably higher than projections from FUND or PAGE of the total cost of climate change for the United States (DICE only includes global damages), even though it is a decidedly conservative estimate (it only covers six impact categories, and only the direct effect of single-year climate shocks).

Complementing bottom-up climate econometrics is "top-down" research that develops empirically based models of how overall macroeconomic performance responds to changes in temperature or tropical cyclone activity. Top-down research provides a more holistic measure of market damages, but without knowledge of the underlying mechanisms generating those losses (and without capturing non-market damages like impacts to human health or ecosystem services). For example, Deryugina and Hsiang (2017) find a strong statistical relationship between per capita income and daily temperatures. Hsiang and Jina (2014) find that tropical cyclones have a large and persistent impact of GDP.

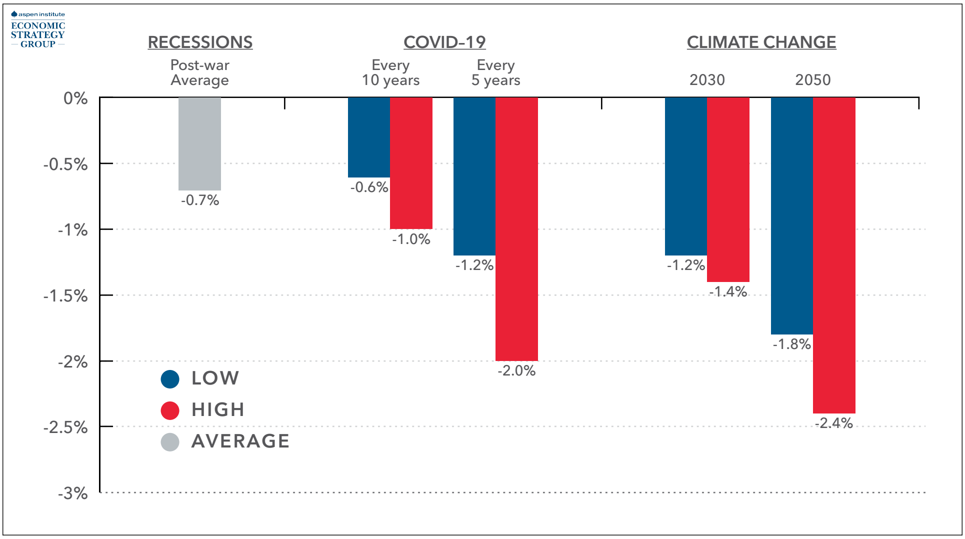
2.b. Climate Change Compared to Other Economic Risks

Combining these top-down damage functions with the same high-resolution probabilistic climate model projections used in the American Climate Prospectus, my colleagues and I estimate the impact of both recent and projected changes in the climate on U.S. GDP. We find that around 2030, climate-driven changes in temperature and hurricane activity cost the U.S. economy 1.2 percent of GDP in a moderate-emissions scenario (RCP 4.5, median estimate), rowing to 1.8 percent of GDP by mid-century. In a high emissions scenario (RCP 8.5, median estimate) we estimate climate change costs the U.S. 1.4 percent of GDP by 2030, growing to 2.4 percent of GDP by mid-century.

These are not one-time events, but the annual average of shocks that will be higher in some years and lower in others. They also exclude the compounding effects of shocks in previous years. If measured on a cumulative basis, the impacts would be even higher. To put these numbers in context, we calculate the impact of post-war U.S. recession in the same way. We measure the impact of each recession as the reduction in output during the period in which the recession occurred (as defined by the National Bureau of Economic Research) relative to what it would have been at the pre-recession growth rate. We then average the economic impact during quarters with recessions over the full 1947–2019 period, but exclude any effects on economic growth that persist after the recession ends. The result is an average annual cost of U.S. recessions of 0.7 percent of GDP (Figure 8). To draw another comparison, economists currently project that COVID-19 will cost the U.S. economy between 6 percent and 10 percent of GDP in 2020. That means by 2030, the economic cost of climate change to the United States could be on par with a COVID-19-style disruption once every 10 years, and every five years by mid-century.

Figure 8: Economic Impact of Climate Change versus COVID-19 and Post-War Recessions

Average annual impact on US GDP



Source: NBER, CBO, Bloomberg and Rhodium Group estimates

Note: For climate change, "Low" is RCP 4.5 median estimates and "High" is RCP 8.5 median estimates.

2.c. Estimating the Global Impacts of Climate Change

While it began focused on the United States, climate econometrics research has expanded globally. Top-down studies were the first to achieve global coverage, because of the relative ease of obtaining historical macroeconomic outcome data for a wide range of countries. For example, Hsiang and Jina's 2014 hurricane research was global in scope, analyzing the impact of 6,700 historical storms on aggregate economic output over time. Burke, Hsiang, and Miguel (2015) develop an empirical model of the relationship between temperature and GDP growth, and found that under a high-emissions scenario, global GDP declines by 23 percent (median estimate) by the end of the century relative to a "no climate change" counterfactual. That's considerably higher than what's projected by traditional IAMs. Employing a slightly different top-down econometric model, Kalkhul and Wenz (2020) estimate global economic damage of 14 percent by the end of the century in the same emissions scenario.

Bottom-up, global climate econometrics is more challenging due to the need to collect and harmonize granular social and sector-specific outcome data from a wide range of countries. The Climate Impact Lab (the team behind the American Climate Prospectus, expanded to include the University of Chicago) has been leading the charge on this effort. The Lab's model has just under 25,000 geographic regions around the world, each sized to have the rough population equivalent of a U.S. county. Research underway quantifies the impact of climate change on energy costs, agricultural production, labor productivity, manufacturing output, infectious disease, wind, flood, and wildfire damage to property and infrastructure, and other impact categories.

Initial output from the Lab's global research was published this summer, providing the first ever empirically based estimate of the impact of temperature on mortality rates at a hyper-local level around the globe (Carleton et al. 2020). To do this research, the team had to start by compiling the largest sub-national vital statistics database in the world, detailing 399 million deaths across 41 countries accounting for 55 percent of the global population. Lab researchers exploited the heterogeneity in income and climate within and across these countries to estimate mortality damage functions for those parts of the world where subnational mortality statistics are not available. The mortality model also captures the potential for reducing temperature-driven deaths through adaptation, as well as the cost of those adaptive measures. Under a high-emissions scenario, the cost of climate-driven changes in death rates, along with the cost of adaptive measures in prevent further deaths, totals 3.2 percent of GDP by the end of the century (median estimate). That's equivalent to the estimated global cost of all climate impact categories under the same emissions scenario in the current DICE model (Nordhaus 2018).

3. The Inequality of Convexity

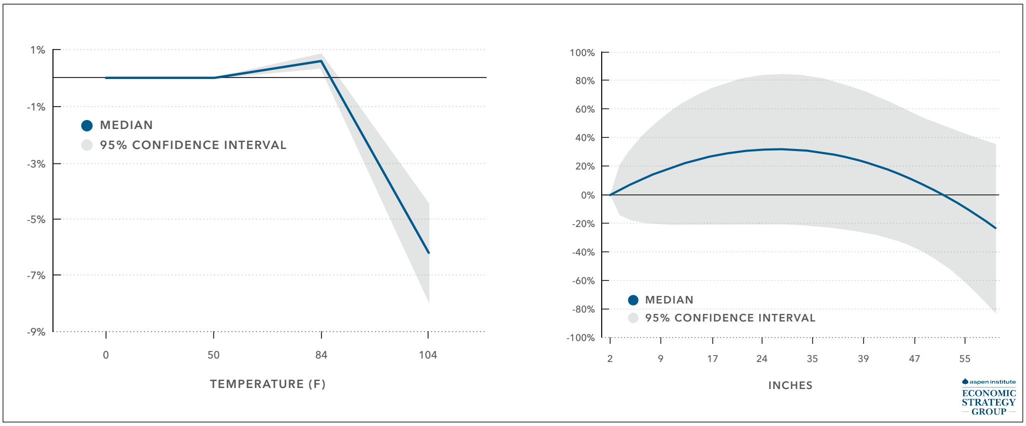
The most significant insight from coupling high-resolution climate models with econometric damage functions isn't the magnitude of the economic and damage at a global level, but just how unequally that damage is distributed, both within the United States and around the world. This is due to two factors. First, in both the bottom-up and top-down literature, most of the damage functions are convex, meaning that the directional impact of warming on various social or economic outcomes depends on the starting climatology of a given place. Second, the ability to adapt to these changes, at an individual, community, or country level, is dependent on income. The richer you are, the more protected you will be from a changing climate.

3.a. Impacts Are Unequal within the United States

Take, for example, the response of U.S. corn yields to changes in temperature and precipitation shown in Figure 9 from the American Climate Prospectus. There is an optimal temperature and level of precipitation for growing corn. If the place you live is below that optimal today, and climate change makes it warmer and wetter, than yields will likely increase. If you are at or above the optimal level today, then the same percent increase in temperature and precipitation will likely lead to a decrease. Humans have an optimal temperature as well. Warming leads to a net decline in mortality rates in colder parts of the country, because the decrease in cold-related deaths outweighs the increase in heat-related deaths, and a net increase in warmer parts of the country. The same dynamic plays out in energy costs. Warming reduces heating costs and increases cooling costs. Homeowners and renters in colder parts of the country will likely see a net reduction their total energy bill due to climate change, while those in warmer parts of the country will likely see a net increase. There are other reasons why climate damages are geographically dependent as well. Sea level rise and changes in hurricane activity impact coastal communities much more than inland communities. Location-specific wildfire risk is a function both of climatology and the type and supply of forest fuels.

Figure 9: U.S. Corn Production Damage Functions

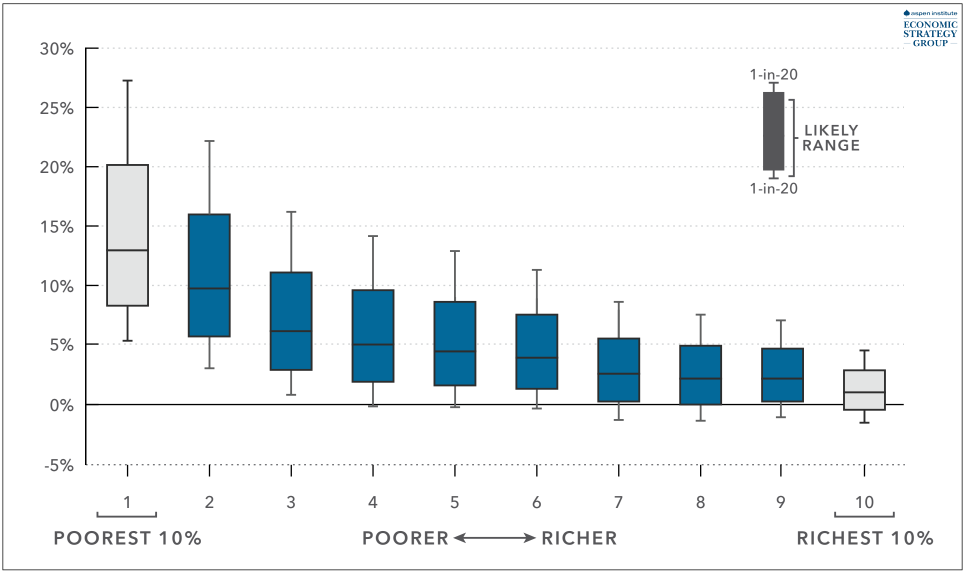
Change in yields as a function of daily temperature (left)
and as a function of seasonal precipitation (right)



Source: Hsiang et al. (2017), Schlenker and Roberts (2009), and McGrath and Lobell (2013)

The combined bottom-up economic cost of all six impact categories in the American Climate Prospectus varies by an order of magnitude across states, based on their current climate and their proximity to the coast. For example, under a high-emissions scenario, the combined cost is likely 10 to 24 percent of Gross State Product in Florida by the end of the century, while Vermont sees a 1 to4 percent gain. Because hotter counties tend to be poorer in the United States, climate change exacerbates income inequality as well. The poorest 10 percent of counties in the United States face likely damages of 9 to 20 percent of income, while the richest 10 percent see between a 3 percent loss and 0.4 percent gain (Figure 10).

Figure 10: Poorest U.S. Counties Are Most at Risk from Climate Change
Damage as a percent of county income under RCP 8.5, 2080-2099



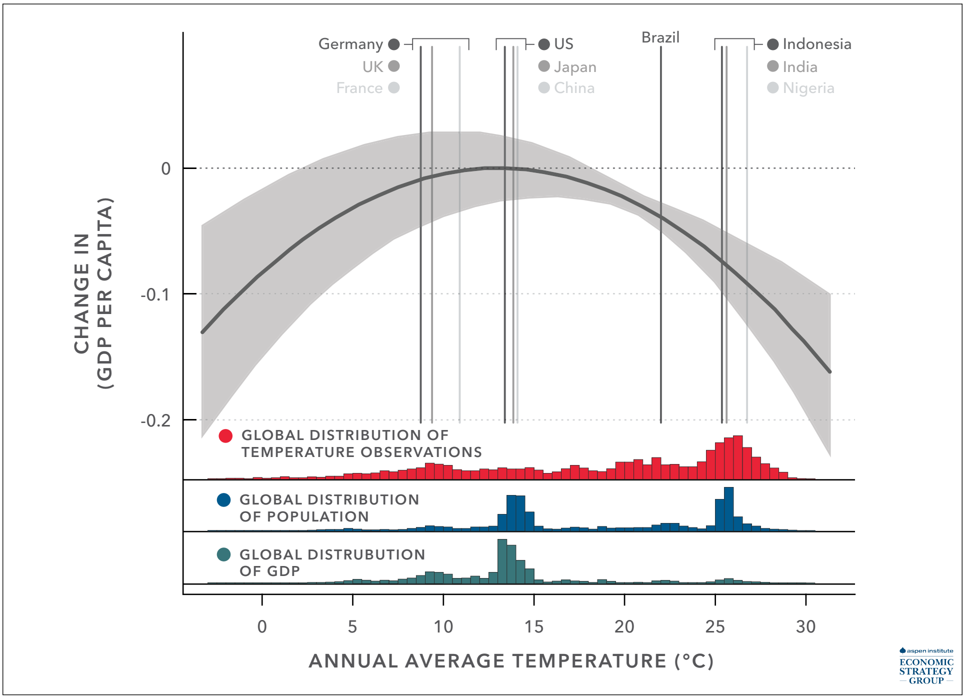
Source: Hsiang et al. (2017)

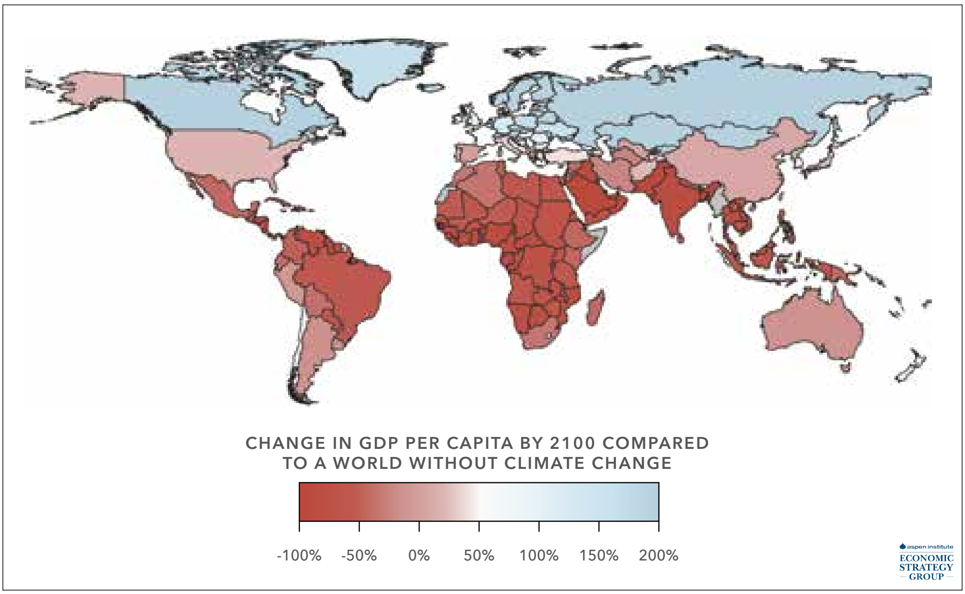
Geography is not the only factor that drives inequality in climate impacts. Even within the same place, poor Americans are often more vulnerable to changes in the climate. Factors include less access to insurance to protect against increasingly frequent and severe weather events, or less access to federal emergency support in the wake of a storm. Income is a major determinant of the likelihood of dying from a heat wave, something demonstrated empirically in Carleton et al. (2020).

3.b. But Even More Unequal across the World

The equity implications of climate convexity are even more profound at a global level. Take, for instance, Burke, Hsiang, and Miguel's top-down estimate of the relationship between temperature and GDP growth rates around the world (Figure 11). Up to a certain average starting temperature, warming increases economic output. Beyond that, it decreases output. This has a similar shape to the top-down, income damage functions in the United States. In general, today's developed countries are currently colder than developing countries. That results in dramatic growth in global income inequality as warming occurs. Burke, Hsiang, and Miguel estimate that while global GDP declines by 23 percent in a high-emissions scenario on average (median estimate), for the poorest 40 percent of the global population it falls by 75 percent (Figure 11). Kalkuhl and Wenz (2020) find similar geographic distribution of temperature-driven economic damages.

Figure 11: Temperature-GDP Damage Function and Projected Decline in Per Capita GDP





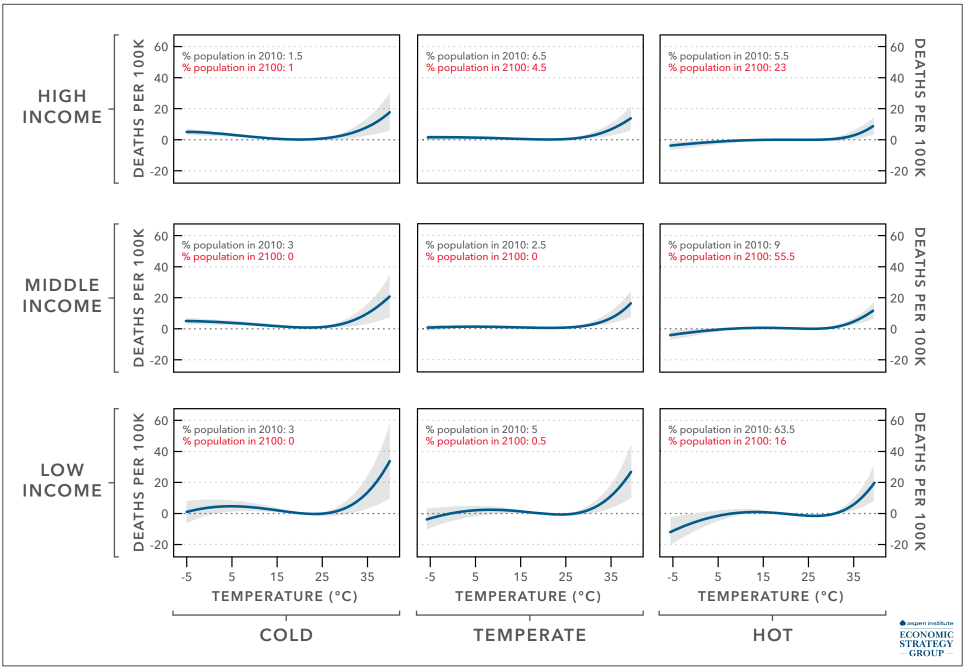
Source: Burke, Hsiang, and Miguel (2015)

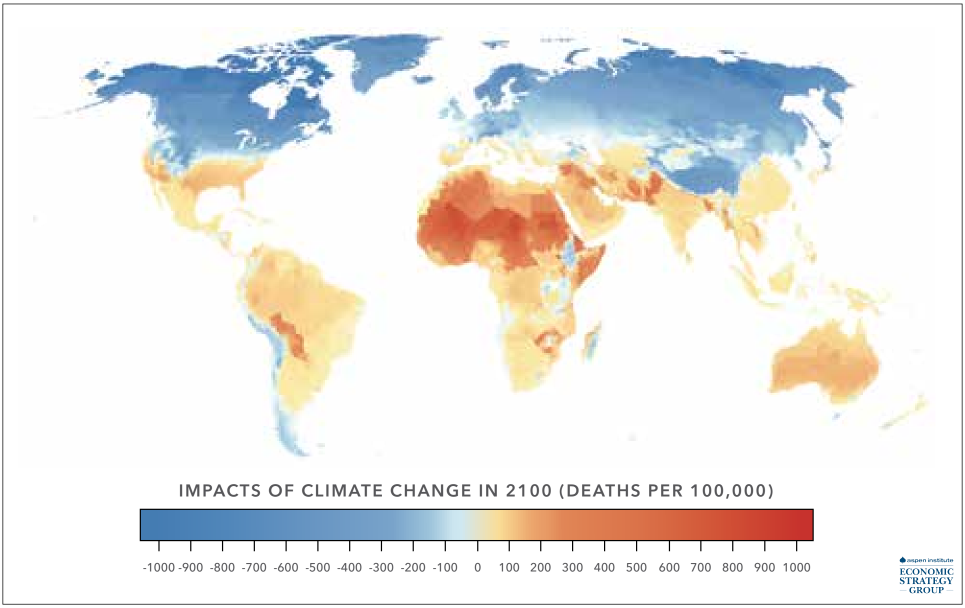
Note: High-emissions scenario, end of century.

GDP is a narrow and sterile measure of human welfare. The inequality in climate-driven mortality rates around the world is much more stark. Carleton et al. (2020) find that in a high-emissions scenario, climate-change-driven increases in temperature raise global death rates by roughly 74 per hundred thousand by the end of the century. This is after accounting for the reduced vulnerability that comes from projected income growth and adaptive measures. Seventy-four deaths per hundred thousand is on par with the current death rate for all infectious diseases—including tuberculosis, HIV, malaria, dengue, yellow fever, and diseases transmitted by ticks, mosquitos, and parasites—combined.

As with GDP, climate-driven changes in mortality rates vary dramatically around the world with poor countries bearing most of the impact. Hotter places suffer more than colder places, and as already mentioned, developed countries tend to be colder than developing countries. But wealth itself is also protective against temperature-driven mortality, through greater access to air conditioning, indoor service sector employment, and other adaptive measures (Figure 13). Because of these two factors combined, the poorest 20 percent of the world's population sees an increase in death rates of 142 per 100,000 by the end of the century (twice the global average), while the richest 20 percent see their death rates decline.

Figure 12: Mortality Damage Function and Projected Change in Death Rate

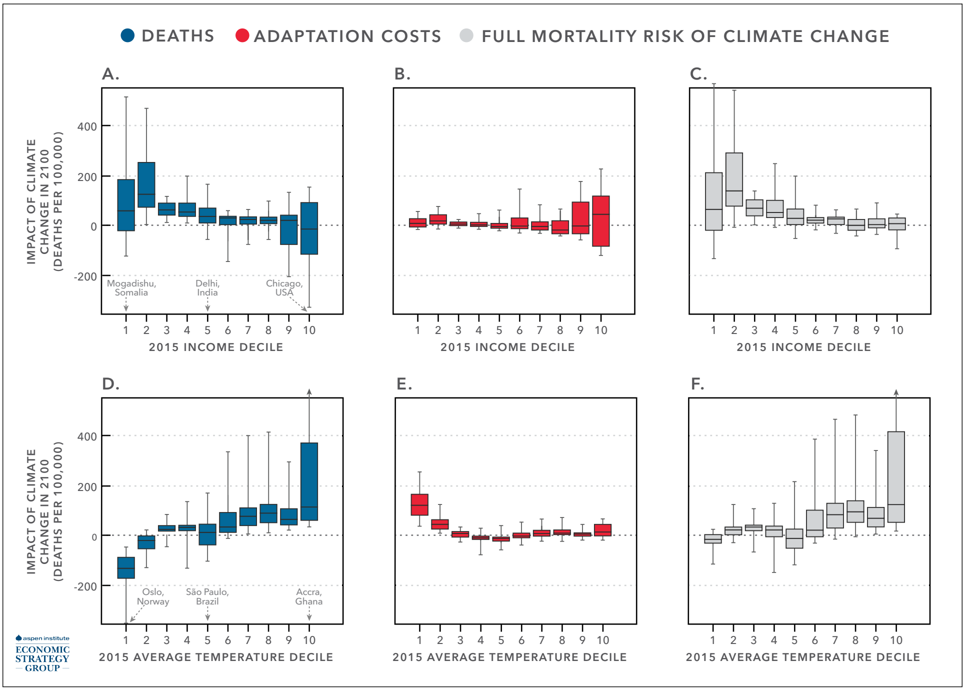




Source: Carleton et al. (2020)

Note: High-emissions scenario, end of century.

Figure 13: Climate Change Mortality Impacts by Current Income Decile



Source: Carleton et al. (2020)
Note: High-emissions scenario.

3.c. Inequality in Both Cause and Effect

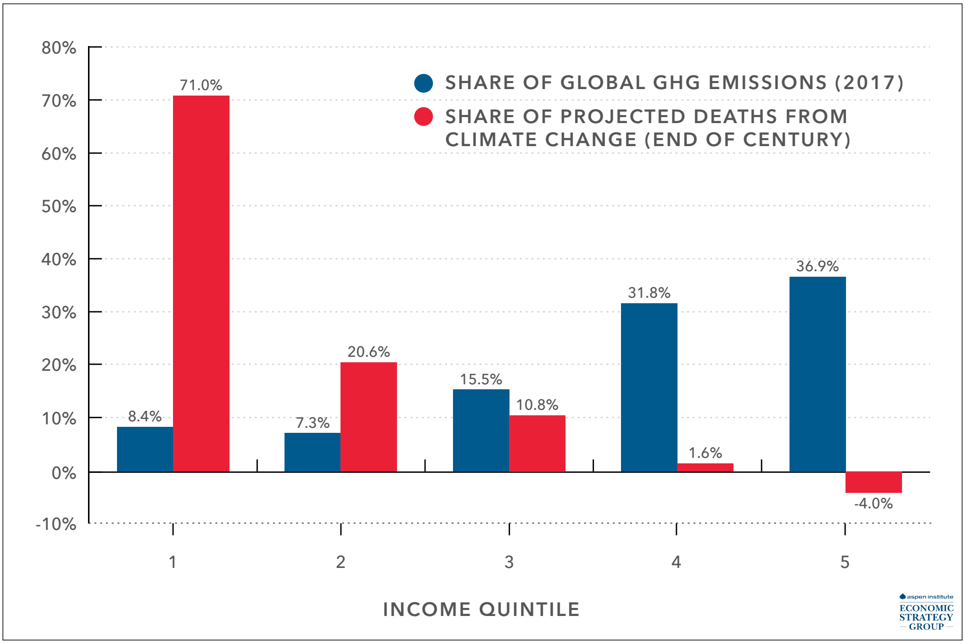
Climate change is obviously not unique in the unequal way in which it impacts human society. COVID-19 has highlighted stark differences in health outcomes within the United States, both by race and income. Globally, the deadliest infectious diseases—tuberculosis, HIV, and malaria—kill far more people in developing countries than in developed countries. But for very few other large-scale threats to human health and welfare is there such a stark difference between those creating the problem and those directly impacted by it.

Within the United States, carbon dioxide emissions from residential energy consumption are 25 percent higher for high-income households than low-income households, due primarily to larger house size (Goldstein, Goundaridis, and Newell 2020). Accounting for all sources of emissions, Song et al. (2019) find that carbon footprint of the wealthiest U.S. households is nearly five times that of the poorest households. These more affluent households are more likely to be protected from the changes in the climate their emissions help create due both to geography and the greater adaptive capacity higher income levels create.

The disparity is even starker internationally. People currently living in countries in the bottom fifth of the global income distribution emit 2.8 metric tons of GHG emissions per year on average and account for 8.4 percent of total emissions globally (Figure 14). In contrast, those living in countries in the top fifth of the global income distribution emit five times that amount—12.6 metric tons per year on average (Figure 14). Americans emit 17.8 metric tons per person. Yet for those countries in the top fifth of the global income distribution, climate change will likely reduce temperature-driven mortality rates on average (though some countries and some parts of others will see net increases). In contrast, countries in the bottom fifth of the global income distribution account for 71 percent of projected increases in all temperature-driven mortality around the world.

Figure 14: Those Least at Fault Are Most at Risk

Countries' share of current GHG emissions and projected increases in mortality from climate change by income quintile



Source: Rhodium Group and Carleton et al. (2020). Income quintiles are based on national per capita GDP and binned by combined population.

The same disparity exists for climate change's impact on economic output. Under Burke, Hsiang, and Miguel's (2015) model of the relationship between temperature change and economic growth, a disproportionate share of global economic damage occurs in countries that account for a very small share of global emissions.

3.d. Indirect Risks for Higher Income Countries and Communities

More affluent countries and communities have a moral obligation to mitigate climate damage caused by their emissions in lower-income countries and communities. But doing so is in their self-interest as well. Extreme weather events are already the leading cause of forced human displacement around the world (Yayboke et al. 2020). Increasingly frequent and severe heat waves, storms, and wildfires will only increase this in the years ahead. In addition to this temporary displacement, climate change will drive permanent displacement as well, whether from cities inundated by rising seas, long-term agricultural failure from rising temperatures, or communities crossing wet-bulb thresholds that make safe inhabitation impossible.

Displacement within the United States will disproportionately impact lower-income households, but will impose costs—both fiscal and economic—on all Americans. Federal government spending on disaster relief is growing due to climate change, a cost borne by all taxpayers. Forced displacement puts strains on state and local government services and erodes local tax bases. Abandoned homes and other capital stock create a drag on economic growth, not just in the community in which they exist but in the country more broadly.

Forced displacement in developing countries will increase refugee flows into the United States and other developed countries. Econometric research quantifying the impact of climate change on human migration is still in its early stages, but one of the early areas of focus is on the impact of climate change on conflict, and the impact of that conflict on migration patterns. Through a meta-analysis of more than 50 existing quantitative studies, Burke, Hsiang, and Miguel (2015b) find that higher temperatures meaningfully elevate the risk of both interpersonal and intragroup conflict. Analyzing the relationship between weather variations in source countries and asylum applications in the European Union, Missirian and Schlenker (2017) estimate that climate-related increases in conflict could raise EU asylum applications by between 28 percent and 188 percent by the end of the century.

Forced displacement is only one way in which conflict made more likely by a changing climate will impact the United States and other developed countries. In 2015, the U.S. Department of Defense (DoD) published a report on the risks to U.S. national security and found "a changing climate increases the risk of instability and conflict overseas, and has implications for DoD on operations, personnel, installations, and the stability, development, and human security of other nations."[4]

4 "National Security Implications of Climate-Related Risks and a Changing Climate." 2015. Department of Defense. https://archive.defense.gov/pubs/150724-congressional-report-on-national-implications-of-climate-change.pdf.

4. Policy Recommendations

Recent advances in climate econometric research make it clear that the cost of inaction on climate change in the United States is greater than the cost of action. The more important insight from this research for American policymakers, however, is how unequally the cost of climate change is distributed, both within the United States and around the world. There are four concrete ways to incorporate this knowledge into domestic and international climate policymaking that will help create a more just and sustainable future, both within the United States and around the world.

4.a. On the Path to Zero, Remember Every Ton Counts

The most significant step the United States can take to reduce the impact of climate change on human health and economic welfare in developing countries is taking aggressive steps to move quickly to reduce GHG emissions at home, and reengage other developed and emerging economies in efforts to do the same, both bilaterally and multilaterally.[5]

Because of the length of time carbon dioxide emissions remain in the atmosphere, the only way to ultimately stabilize global concentrations is to reduce the net addition from human activities to zero (or very near zero). That means reducing the amount of carbon dioxide and other GHGs added to the atmosphere from fossil fuel combustion and other activities as much as possible, and increasing the amount removed from the atmosphere (whether through technical or natural sequestration) to cover the rest.

In 2018, the IPCC published a major report indicating that to limit global temperature increases to 1.5°C (an aspiration set out in the 2015 Paris Agreement), the world will likely need to achieve net-zero carbon dioxide emissions on a global basis between 2045 and 2055, along with deep reductions in other GHG emissions (IPCC 2018). Following this report, a number of U.S. states adopted goals of achieving net-zero emissions by mid-century. The House Select Committee on the Climate Crisis has set a similar goal at a national level, as has Vice President Joe Biden's presidential campaign.

As officials at both the federal and state level develop policies to achieve a net-zero target, its important to remember that in avoiding climate damage, the path to zero matters as much as the end point. A non-linear damage function means the first tons reduced have the most benefit, and the sooner they are reduced the better. This is particularly true for low-income communities and countries.

5 For examples of emission reducing policy and technology options, see Keith and Deutch (2020) and Metcalf (2020)

4.b. Address Inequality in Mitigation Policy Design

Inequality can also be directly addressed in policies designed to reduce emissions. Regulations to reduce pollution in the United States require benefit-cost analysis (BCA), where the benefits of the regulation are compared to its costs. This includes regulations to reduce GHG emissions, where the benefits of avoided climate damage are measured using the Social Cost of Carbon (SCC). To date, the U.S. government has used the DICE, FUND, and PAGE IAMs to estimate the SCC. Because of their regional aggregation, these models value future climate damages based on their average impact. For example, let's say climate change will lead to a 1 percent increase in income for nine communities, but a 9 percent decrease in income for one community, these IAMs would indicate that climate change has no cost. Policymakers are often rightly interested in avoiding such unequal outcomes, and the adoption of high-resolution climate econometric models in developing the SCC will help them do so in the regulatory process.

Climate change is not the only negative externality from fossil fuel production. Sulfur dioxide, mercury, particulate matter, and other air pollutants from coal, oil, and gas combustion impose billions of dollars in public health costs each year. These costs are not evenly spread, and as with climate impacts, disproportionately impact low-income households. In 2015, the Environmental Protection Agency (EPA) developed the EJSCREEN database, which tracks exposure to these and other environmental hazards at the census tract level. These data are used by the EPA and other agencies to comply with Executive Order 12898, which directs federal agencies to "identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations, to the greatest extent practicable and permitted by law." Incorporating high-resolution climate econometric data into this tool will help legislators and regulators design policy that addresses environmental inequalities more holistically.

Finally, the opportunities for addressing inequality in U.S. mitigation policy design extend beyond America's borders. The United States and other developed and emerging economies had the luxury of relying on fossil fuels to power industrialization, something less available to low-income countries now, if the world is going to limit global temperature increases to less than 2°C or 1.5°C. U.S. investment in bilateral and multilateral efforts to support clean energy deployment, low-GHG agriculture, and other emission-reducing activities in these countries can help provide them with an alternative pathway to industrialization, while having material benefits for the United States through reduced warming and avoided climate damages.

4.c. Improve Resilience, Both at Home and Abroad

No matter how successful the world is in reducing GHG emissions, some level of continued warming of the climate is already baked in. For example, even in a low-emissions scenario with modest ice sheet melt, global sea levels will still likely rise by 14 to 26 inches by the end of the century, putting the current homes of 90 million people around the world below high tide. Improving the resilience of our communities and economy to those climate impacts that are certain to occur, as well as preparing for those that might occur if emission-reductions fall short, is a critical task facing policymakers around the world. Some level of adaptation will happen automatically, but much less than people often assume and at much higher cost. The fact that climate change is expressed through increased frequency and severity of extreme events creates behavioral barriers to adaptation, as do existing policy regimes that incentivize living and working in high-risk areas. Adaptation is even more challenging for low-income communities and countries, which often lack the resources to make the kind of up-front investment in protective measures required.

Within the United States, there are four priority areas of policy focus. The first is to make coastal communities more resilient to rising seas and more intense storms. This includes updating Federal Emergency Management Agency (FEMA) maps to more accurately reflect current flood risk, reforming the National Flood Insurance Program to reduce incentives to live in high-risk areas while offsetting the impact of such changes on low-income households currently in flood zones, and more federal funding for municipal and state-level investments in coastal resilience. The second is to make low-income households and those with co-morbidities less vulnerable to increasingly frequent heat waves. This includes expanding access to efficient and low-cost air conditioning, particularly in those parts of the country that are currently systematically under-air-conditioned relative to what's required for health and safety in the years ahead, given current climate projections. The third is support for agricultural communities in the South and lower Midwest, where climate change is threatening the viability of the crops on which they traditionally rely. This includes changes to federal crop insurance to remove incentives for maladaptation and investment in economic diversification, both into other crops and other sectors. The fourth is reducing wildfire risk in the western United States. Research suggests that half of the growth in wildfire burn area over the past 30 years was due to climate change. Policy action is required both to reduce the amount of burn area in the years ahead, and to mitigate risk to homes and businesses when burns occur.

There are important steps the United States can take to improve resilience in vulnerable countries around the world, through United States Agency for International Development (USAID), bilateral credit agencies, and multilateral development banks and organizations. The economies of the Least Developed

Countries (LDCs) are far more reliant on agriculture than the global average, and many of these countries have climates where global warming will significantly reduce, rather than increase, yields. In the 1960s and 1970s, international collaboration on agricultural technology and practices helped increase rice and wheat yields around the world to accommodate rapid population growth while avoiding mass famine. Similar collaboration today can help make agricultural production more resilient to changes in the climate.

A key component of this will be better water management, both in parts of the world getting drier as a result of climate change and in parts of the world getting wetter, which may experience more extreme precipitation events. The benefits of better water management extend beyond agriculture as well. Many urban centers in developing countries are facing severe ground water shortages, made worse by changes in the climate. Flooding is the largest single source of forced displacement around the world, and it will only get worse in the years ahead.

Sea level rise is an enormous risk for many developing countries, and an existential threat for Small Island Developing States (SIDS). Under a high-emissions scenario, but with modest ice sheet melt, the current homes of 27 million people in Bangladesh will be submerged by high tide by the end of the century, compared to 1.3 million in the United States. The U.S. Army Corp of Engineers has expertise in coastal and structural defenses that can be deployed to help keep the seas at bay, along with development assistance to finance new infrastructure projects.

International development assistance aimed at access to affordable, high-efficiency air conditioning in those developing countries most vulnerable to extreme heat could save thousands of lives around the world, as could increased funding for conflict prevention through the State Department, USAID, international governmental organizations, and non-governmental organizations (NGOs).

With interest rates at record lows and unemployment at record highs, this is a unique opportunity to invest in climate resilience both in the United States and around the world. Such investments will accelerate economic recovery and deliver financial dividends through avoided climate damage in the future.

4.d. Prepare for Climate Displacement

No matter how successful the United States and other major economies are in reducing emissions and improving resilience, large amounts of climate-driven, forced displacement will occur in the years ahead. Domestically we have existing programs, through FEMA and other channels, that help provide those displaced by extreme weather events with temporary housing and assistance. These will need to be significantly strengthened and expanded to effectively respond to climate-driven increases in temporary displacement in the years ahead. There is no policy framework in place, however, for those who could be permanently displaced in the future, whether from sea level rise, widespread agricultural failure, or uninhabitable temperatures. Effective and equitable resettlement will require significant fiscal resources and extensive federal-state coordination.

Internationally, climate migrants currently have little protection under the United Nations frameworks that govern refugee resettlement or U.S. immigration law. If someone is displaced from their home due to a conflict made more likely by climate change, they may be eligible for refugee status or able to claim asylum within the United States. But those directly displaced, either temporarily by extreme weather events or permanently by sea level rise or temperature increases that make continuing to live in their community impossible, have very few pathways for protection.

Yayboke et al. (2020) identify a number of legal changes the United States should make to resettle climate migrants in the United States and provide them with legal protections. This includes Climate Temporary Protective Status for those displaced by a storm, flood, or wildfire made significantly worse by climate change, but who are ultimately interested in returning home, and a Climate Migrant Resettlement Program for those permanently displaced by climate change. Yayboke et al. also recommend the United States take a leadership role in strengthening protections for climate migrants within existing international frameworks and organizations.

Embracing climate migrants is our moral responsibility, but it also helps us build a stronger country in line with our founding ideals. Immigration is not only an intrinsic feature of America's national identity, but has been essential to the country's economic success. Many past waves of immigrants were fleeing disasters at home, and found both refuge and opportunity in the United States. Thanks to our wealth of land and natural resources, a growing population has been a source of economic dynamism rather than scarcity. This continues to be the case with this coming wave of migrants seeking refuge, and from a storm we helped create.

Conclusion

As climate scientist Kate Marvel often notes, we are living in "the good place."[6] The odds of a planet forming the right distance from a star and with the right atomic composition to support life are extremely low. And even once that planet is formed, there is no guarantee it will develop a climate suitable and stable enough to support

6 Klein, Ezra. n.d. "We Live in The Good Place. And We're Screwing It up." The Ezra Klein Show. Retrieved from https://www.stitcher.com/s?eid=64883521.

robust human development. For Earth, that has only occurred in the last 12,000 years—roughly 0.00002 percent of the planet's existence. Over the past 200 years, economic growth and technological progress have created dramatic improvements in our life expectancy and daily living conditions. These gains have been fastest among developed and emerging economies, but over the past few decades, low-income, developing countries have also experienced meaningful improvements.

Unfortunately, one of the primary engines of our past economic success—fossil fuel combustion—is threatening the benign and stable climate that has enabled human progress. Most of this combustion occurs in developed and emerging economies, but the growing body of research outlined in this brief shows that the costs of continuing on our current path will fall disproportionately on poor countries, and poor households within rich countries. The magnitude of the threat is large enough to significantly slow, if not halt, the pace of human development in the most vulnerable countries and communities, with spillover effects around the world.

This future is not set in stone. Quick action to reduce emissions can save millions of lives per year and dramatically improve the economic development prospects for billions of people around the world. Large-scale investment in resilient agriculture, buildings, infrastructure, and social systems will help protect vulnerable populations from those changes in the climate that do occur. And reforming domestic immigration law and international migration frameworks can help ensure those who are displaced still have a chance at safety and prosperity. U.S. leadership is essential for this to succeed, and with it we have a fighting chance of preventing the benefits of a stable climate from being lost, particularly to those who haven't yet had the opportunity to fully thrive and develop.

References

Anderson, Thomas, Ed Hawkins, and Philip Jones. 2016. "CO2, the Greenhouse Effect and Global Warming: From the Pioneering Work of Arrhenius and Callendar to Today's Earth System Models." *Endeavour* 40(3): 178–187. Retrieved from http://dx.doi.org/10.1016/j.endeavour.2016.07.002

Arrhenius, S. 1896. *On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground.*

Auffhammer, Maximilian, and Anin Aroonruengsawat. 2011. "Simulating the Impacts of Climate Change, Prices and Population on California's Residential Electricity Consumption. *Climatic Change* 109(1), 191-210.

Barreca, Alan, Karen Clay, Olivier Deschênes, Michael Greenstone, and Joseph Shapiro. 2015. "Convergence in Adaptation to Climate Change: Evidence from High Temperatures and Mortality, 1900-2004." *American Economic Review 105*(5): 247-51.

Bhatia, Kieran, Gabriel Vecchi, Hiroyuki Murakami, Seth Underwood, and James Kossin. 2018. "Projected Response of Tropical Cyclone Intensity and Intensification in a Global Climate Model." *Journal of Climate 31*(20): 8281-8303.

Burke, Marshall, Solomon Hsiang, and Edward Miguel. 2015a. "Global Non-linear Effect of Temperature on Economic Production." *Nature, 527*(7577): 235-239.

---. 2015b. "Climate and Conflict." *Annual Review of Economics 7*(August): 577¬–617.

Callendar, Guy Stewart. 1938 The Artificial Production of Carbon Dioxide and its Influence on Temperature. *Quarterly Journal of the Royal Meteorological Society.* Retrieved from 10.1002/qj.49706427503

Carleton, Tamma, Amir Jina, MichaelDelgado, Micheal Greenstone, Trevor Houser, Solomon Hsiang, Andrew Hultgren et al. 2020. "Valuing the Global Mortality Consequences of Climate Change Accounting for Adaptation Costs and Benefits." Working Paper No. 27599, National Bureau of Economic Research.

Charney, Jule, Akio Arakawa, D. James Baker, Bert Bolin, Robert Dickinson, Richard Goody, Cecil Leith et al. 1979. *Carbon Dioxide and Climate: a Scientific Assessment* (p. 22). National Academy of Sciences, Washington, DC.

Cline, William. 1992. The Economics of Global Warming (p. 399). Washington, DC: Institute for International Economics.

Dematte, Jane, Karen O'Mara, Jennifer Buescher, Cynthia Whitney, Sean Forsythe, Turi McNamee, Raghavendra Adiga, and Maurice Ndukwu. 1998. Near-fatal Heat Stroke During the 1995 Heat Wave in Chicago. *Annals of Internal Medicine 129*(3): 173-181.

Deryugina, Tatyana and Solomon Hsiang. 2017. "The Marginal Product of Climate." Working Paper No. 24072, National Bureau of Economic Research. Retrieved from https://www.nber.org/papers/w24072.pdf

Deschênes, Olivier, Michael and Greenstone. 2007. "The Economic Impacts of Climate Change: Evidence from Agricultural Output and Random Fluctuations in Weather." *American Economic Review* 97(1): 354-385.

---. 2011. "Climate Change, Mortality, and Adaptation: Evidence from Annual Fluctuations in Weather in the US." *American Economic Journal: Applied Economics* 3(4): 152-85.EIA. 2020. Annual Energy Review. Retrieved from https://www.eia.gov/totalenergy/data/annual/

EIA. 2020. *Annual Energy Review.* Retrieved from https://www.eia.gov/totalenergy/data/annual/

Emanuel, Kerry. 2013. "Downscaling CMIP5 Climate Models Shows Increased Tropical Cyclone Activity over the 21st Century." *Proceedings of the National Academy of Sciences 110*(30): 12219-12224.

---. 2017. "Assessing the Present and Future Probability of Hurricane Harvey's Rainfall." *Proceedings of the National Academy of Sciences 114*(48): 12681-12684.

Foote, Eunice. 1856. "Circumstances Affecting the Heat of the Sun's Rays." *American Journal of Science and Arts 22*(Nov): 382–383.

Global Carbon Project. 2019. *Supplemental Data of Global Carbon Budget 2019 (Version 1.0)* [Data set]. Global Carbon Project. Retrieved from https://doi.org/10.18160/gcp-2019

Goldstein, Benjamin, Dimitrios Gounaridis, and Joshua Newell. 2020. "The Carbon Footprint of Household Energy Use in the United States." *Proceedings of the National Academy of Sciences 117*(32): 19122-19130.

Graff Zivin, Joshua, and Matthew Neidell. 2014. "Temperature and the Allocation of Time: Implications for Climate Change." *Journal of Labor Economics 32*(1): 1–26.

Hausfather, Zeke, Henri Drake, Tristan Abbott, and Gavin Schmidt. 2020. "Evaluating the Performance of Past Climate Model Projections." *Geophysical Research Letters 47*(1).

Hope, Chris, John Anderson, and Paul Wenman. 1993. "Policy Analysis of the Greenhouse Effect: an Application of the PAGE Model." *Energy Policy 21*(3): 327–338.

Houser, Trevor, Robert Kopp, Solomon Hsiang, Michael Delgado, Amir Jina, Kate Larsen, James Rising, et al. 2014. "American Climate Prospectus: Economic Risks in the United States." Rhodium Group.

Houser, Trevor, Solomon Hsiang, Robert Kopp, Kate Larsen, Michael Delgado, Amit Jina, James Rising, et al. 2015. *Economic Risks of Climate Change: an American Prospectus*. Columbia University Press.

Hsiang, Solomon. 2010. Temperatures and Cyclones Strongly Associated with Economic Production in the Caribbean and Central America. *Proceedings of the National Academy of Sciences 107*(35): 15367-15372.

---. 2016. "Climate Econometrics." *Annual Review of Resource Economics 8*: 43–75.

Hsiang, Solomonand Amir Jina. 2014. "The Causal Effect of Environmental Catastrophe on Long-run Economic Growth: Evidence from 6,700 Cyclones." Working Paper No. 20352, National Bureau of Economic Research. Retrieved from https://www.nber.org/papers/w20352.

Hsiang, Solomon, Robert Kopp, Amir Jina, James Rising, Michael Delgado, Shashank Mohan, D.J. Rasmussen, et al. 2017. "Estimating Economic Damage from Climate Change in the United States." *Science* 356(6345): 1362–1369.

Högbom, Arvid. 1894. *On the Probability of Global Changes in the Level of Atmospheric CO2*.

IPCC. 2018. Summary for Policymakers. In: *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty* [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.

Jackson, Roland. 2019. "Eunice Foote, John Tyndall and a Question of Priority." *Notes and Records 74*(1). Retrieved from http://doi.org/10.1098/rsnr.2018.0066.

Jacob, Brian, Lars Lefgren, and Enrico Moretti. 2007. "The Dynamics of Criminal Behavior Evidence from Weather Shocks." *Journal of Human Resources 42*(3): 489–527.

Kalkuhl, Matthias and Leonie Wenz. 2020. "The Impact of Climate Conditions on Economic Production. Evidence from a Global Panel of Regions." *Journal of Environmental Economics and Management 103*(September).

Keith, David and John Deutch. 2020. "Climate Policy Enters Four Dimensions." In *Securing Our Economic Future*, edited by Amy Ganz and Melissa Kearney, Aspen Institute Press.

Kopp, Robert, Solomon Hsiang, and Michael Oppenheimer. 2013. "Empirically Calibrating Damage Functions and Considering Stochasticity when Integrated Assessment Models are Used as Decision Tools." *Impacts World 2013,* International Conference on Climate Change Effects, Potsdam, May 27-30, 2013. Retrieved from https://doi.org/doi:10.7282/T35X2BRQ.

Kopp, Robert, Radley Horton, Christopher Little, Jerry Mitrovica, Michael Oppenheimer, D.J. Rasmussen, Benjamin Strauss, and Claudia Tebaldi. 2014. "Probabilistic 21st and 22nd Century Sea-level Projections at a Global Network of Tide-gauge Sites. *Earth's Future* 2(8): 383–406.

Kopp, Robert, Robert DeConto, Daniel Bader, Carling Hay, Radley Horton, Scott Kulp, Michael Oppenheimer, David Pollard, and Benjamin Strauss. 2017. "Evolving Understanding of Antarctic Ice-sheet Physics and Ambiguity in Probabilistic Sea-level Projections." *Earth's Future* 5(12): 1217–1233.

Kossin, James, Kenneth Knapp, Timothy Olander, and Christopher Velden. 2020. "Global Increase in Major Tropical Cyclone Exceedance Probability over the Past Four Decades." *Proceedings of the National Academy of Sciences 117*(22): 11975–11980.

Kulp, Scott, and Benjamin Strauss. 2019. "New Elevation Data Triple Estimates of Global Vulnerability to Sea-level Rise and Coastal Flooding." *Nature Communications* 10(1): 1–12.

Li, Dawei, Jiacan Yuan, and Robert Kopp. 2020. "Escalating Global Exposure to Compound Heat-humidity Extremes with Warming." *Environmental Research Letters.*

Maddison, Angus. 2008. "The West and the Rest in the World Economy: 1000-2030." *World Economics 9*(4): 75–99.

Maddison Project Database. 2018. Bolt, Jutta, Robert Inklaar, Herman de Jong and Jan Luiten van Zanden. Retrieved from https://www.rug.nl/ggdc/historicaldevelopment/maddison/data/mpd2018.xlsx

Manabe, S. and Wetherald, R. T. 1967. "Thermal Equilibrium of the Atmosphere with a Given Distribution of Relative Humidity." *Journal of Atmospheric Sciences* 24(3); 241–259.

McGrath, Justin, and David Lobell. 2013. "Regional Disparities in the CO2 Fertilization Effect and Implications for Crop Yields." *Environmental Research Letters* 8(1).

Missirian, Anouch, and Wolfram Schlenker. 2017. "Asylum Applications and Migration Flows." *American Economic Review 107*(5): 436–40.

Metcalf, Gilbert E. 2020. "Harnessing the Power of Markets to Solve the Climate Problem." In *Securing Our Economic Future*, edited by Amy Ganz and Melissa Kearney, Aspen Institute Press.

National Academies of Sciences, Engineering, and Medicine. 2017. *Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide.* Washington, DC: The National Academies Press. Retrieved from https://doi.org/10.17226/24651.

Nordhaus, William. 1991. "To Slow or Not to Slow: The Economics of the Greenhouse Effect." *Economic Journal*, 101(407): 920–937. Retrieved from http://www.jstor.org/stable/2233864

---. 1992. "An Optimal Transition Path for Controlling Greenhouse Gases." *Science* 258(5086): 1315–1319.

---. 2018. "Projections and Uncertainties about Climate Change in an Era of Minimal Climate Policies." *American Economic Journal: Economic Policy 10*(3): 333–60.

Ranson, Matthew. 2014. "Crime, Weather, and Climate Change." *Journal of Environmental Economics and Management 67*(3): 274–302.

Schlenker, Wolfram, and Michael Roberts. 2009. "Nonlinear Temperature Effects Indicate Severe Damages to U.S. Crop Yields under Climate Change." *Proceedings of the National Academy of Sciences* 106(37): 15594–15598

Seki, Osamu, Gavin Foster, Daniela Schmidt, Andreas Mackensen, Kimitaka Kawamura, and Richard Pancost. 2010. "Alkenone and Boron-based Pliocene pCO2 Records." *Earth and Planetary Science Letters* 292(1-2): 201–211.

Sherwood, S., Webb, M., Annan, J., Armour, K., Forster, P., Hargreaves, J., Hegerl, G., et al. 2020. "An Assessment of Earth's Climate Sensitivity Using Multiple Lines of Evidence." *Reviews of Geophysics*,https://doi.org/10.1029/2019RG000678.

Song, Kaihui, Shen Qu, Morteza Taiebat, Sai Liang, and Ming Xu. 2019. "Scale, Distribution and Variations of Global Greenhouse Gas Emissions Driven by US Households." *Environment International* 133(A): 105137.

Stern, Nicholas. 2006. *The Economics of Climate Change: The Stern Review.* Cambridge University Press.

Tol, Richard. 1995. "The Damage Costs of Climate Change: Toward More Comprehensive Calculations." *Environmental and Resource Economics* 5(4): 353–374.

---. 1997. "On the Optimal Control of Carbon Dioxide Emissions: an Application of FUND." *Environmental Modeling & Assessment* 2(3):151–163. Retrieved from http://dx.doi.org/10.1023/A: 1019017529030

Yayboke, Erol, Trevor Houser, Johannes Staguhn, and T. Salma. 2020. *A New Framework for U.S. Leadership on Climate Migration*. Center for Strategic and International Studies.

Harnessing the Power of Markets to Solve the Climate Problem

AUTHOR

Gilbert E. Metcalf*

ABSTRACT

If the United States is serious about addressing the climate change problem, it will have to put in place a range of policies that reduce its reliance on fossil fuels, with the ultimate goal of achieving a zero-carbon economy. Whatever the mix of policies, putting a price on U.S. carbon pollution will be a necessary element. This chapter offers suggestions for how to design a carbon tax as a centerpiece of a federal climate policy agenda. Any carbon tax proposal should address economic concerns about trade competitiveness, as well as environmental concerns about whether the tax will reduce emissions sufficiently. I discuss how border carbon adjustments could address the trade issue and how an Emissions Assurance Mechanism could address the environmental concerns. I also discuss other policies that will be necessary in addition to a carbon tax to move the United States toward a zero-carbon economy. Finally, I review the economic evidence on the macroeconomic impact of a carbon tax. The evidence demonstrates that a carbon tax need not adversely affect economic growth or job creation, but it will lead to significant changes in the composition of jobs in the economy. Modest amounts of revenue raised by the tax can be used to help with the transition to a new economy.

* Tufts University

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Introduction

The climate crisis is a global problem that requires country level policies. These policies require significant short-term costs to obtain benefits that are not easily understood by the public. The varying responses to the crisis by different political leaders indicate the importance of strong and steady leadership, guided by science and transparency. The current COVID-19 pandemic illustrates many of the politically difficult decisions that we must also confront with the climate crisis. Given the highly infectious nature of the virus, it is a global problem with huge negative spillovers between countries. In this sense it is similar to the global climate challenge.

Confronting climate change effectively will require policies that the public can understand and rally behind. One element that can build trust for a national policy to reduce our greenhouse gas (GHG) emissions is cost-*effectiveness*. A policy is cost effective if it achieves a given environmental goal at minimum cost to society. In addition, the policy should share the burden in an equitable fashion among members of society.

In the United States, polling shows strong support for putting a price on our carbon pollution. Fifty-nine percent of registered voters support a carbon fee with revenue returned to households through a carbon dividend, as proposed by the Climate Leadership Council, a bipartisan group led by prominent Republican and Democratic thought leaders. An even higher percentage—69 percent—support a carbon tax with revenues used to lower other taxes.[1] Climate policy continues, however, to be highly partisan. Though overall 7 in 10 voters support a revenue-neutral carbon tax, support is not uniform across party affiliation. Only half (48 percent) of Republicans support such a policy, as compared to 87 percent of Democrats and 58 percent of Independents.

Despite disagreement over the specifics of policy, most voters are concerned about climate change and support Congress taking action to develop clean, renewable energy sources. A more recent poll shows stronger support for providing financial bailouts in response to the pandemic for the renewable energy industry (67 percent strongly or somewhat approve) than for oil and gas companies (49 percent strongly or somewhat approve). Three-quarters of registered voters support prioritizing stimulus money for the clean energy industry rather than for the fossil fuel industry. [2]

Any cost-effective set of policies to reduce U.S. GHG emissions should include putting a price on our carbon pollution. A carbon tax is a straightforward way to do that. But while a carbon tax is an essential part of any sensible, cost-effective solution, it is not a sufficient policy instrument for achieving the long-term policy goal of net-zero

1 Polling results are from Leiserowitz et al. (2019). The poll was conducted in November of 2019.

2 Yale-George Mason-Nexus poll conducted in April 2020.

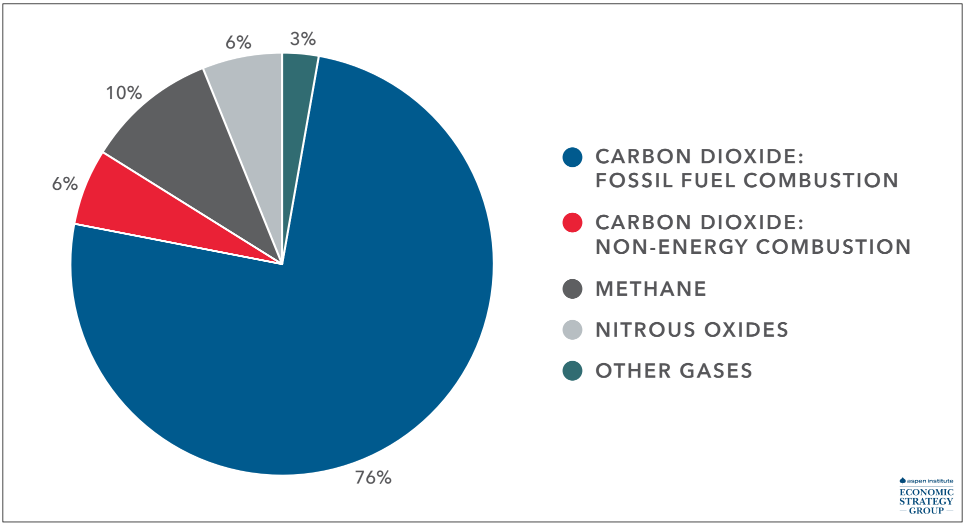
carbon emissions. We will also need smart regulation of emissions that are difficult to tax, policies to reduce barriers to the development of a national electricity grid better suited to higher shares of solar and wind generated electricity, and significantly more funding for research and development to bring online affordable, zero-carbon technologies. This policy brief makes the case for a carbon tax, explains how best to design it, and discusses what other policies are needed (as well as those policies no longer needed) to move us toward a zero-carbon economy.

Section 1 addresses the key design issues for a carbon tax. Section 2 describes what other policies should be kept or put in place at the national level. Section 3 describes key efficiency and distributional impacts of a carbon tax.

1. Carbon Tax

The centerpiece of any national policy to reduce our GHG emissions should be a carbon tax. Pricing our carbon pollution—whether through a tax or cap-and-trade system—is a cost-effective way to reduce emissions.[3] A carbon tax is a tax on fossil fuels and other sources of GHGs according to their emissions (measured in carbon dioxide equivalents). Figure 1 shows U.S. emissions from various sources for 2017.

Figure 1: U.S. Greenhouse Gas Emissions: 2017

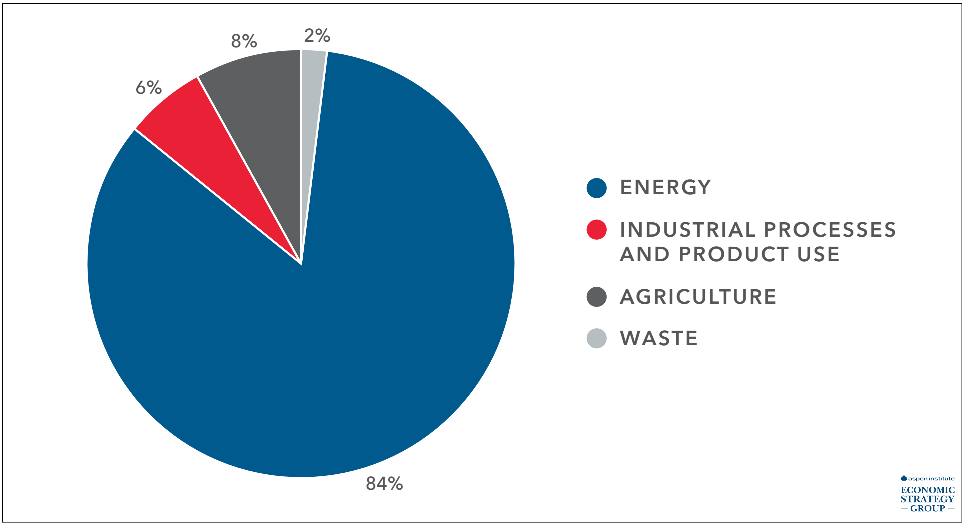


Source: U.S. Environmental Protection Agency (2019)

3 I make the case for a carbon tax rather than a cap-and-trade program in Metcalf (2019b). Either approach, however, would be more efficient than piecemeal regulation.

Three-quarters of U.S. GHG emissions are carbon dioxide emissions from the burning of fossil fuels for energy production. Another 6 percent of emissions are carbon dioxide from other processes including petrochemical and cement production, among other things. Methane emissions account for a further 10 percent of total emissions, and nitrous oxides another 6 percent. A variety of other gases, including hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs), account for the remainder. Focusing on the sectors producing emissions, energy is the dominant sector accounting for 85 percent of emissions (see Figure 2). Agriculture is the next significant source (8 percent). Emissions in this sector arise primarily from agricultural soil management practices and enteric fermentation.

Figure 2. Emission Sources



Source: U.S. Environmental Protection Agency (2019)

The bottom line is that a carbon tax is essentially a tax on energy-related fossil fuel emissions, which encompasses three-quarters of U.S. GHG emissions. It is possible to include between 5 and 10 percent of remaining emissions in a carbon tax regime. Other emissions (e.g., process emissions in cement and steel production and agricultural emissions) are more difficult to tax and may be more amenable to regulation. Some emissions will be very difficult if not impossible to eliminate at reasonable cost. Negative emission technologies (e.g., direct air capture and bioenergy with carbon capture and storage) may be cheaper than trying to eliminate all emissions.[4] I next turn to key design features of a carbon tax.[5]

4 Any emissions captured and permanently stored should not be taxed. Depending on the locus of taxation, these emissions can either be excluded from the tax base or a rebate of the tax paid at a previous stage of production can be provided to anyone engaging in approved capture-and-sequestration techniques.

5 This draws on, among other sources, Metcalf (2017).

1.a. The Tax Base and Point of Taxation

Fossil fuels can be taxed at any point along the chain from extraction to consumption, as the carbon content of each fuel is essentially constant at each stage of the process.[6] That provides flexibility for administering a carbon tax: the emissions can be taxed as they are created; at the point of consumption; or earlier in the production chain at a more convenient point. Finished petroleum products, for example, could be taxed at the wholesale distribution point (the rack); since federal fuel excise taxes are collected at the wholesale rack, this would require very little additional administrative burden.[7] Upon extraction, all coal is taxed to fund the Black Lung Program and Black Lung Disability Fund. As with petroleum products, the carbon tax could piggy-back on this existing federal excise tax.[8] Natural gas is currently not subject to federal excise taxation. Elsewhere, I argue (Metcalf 2019c) that natural gas can most easily be taxed at the roughly 1,300 local distribution companies (for residential, commercial, and small industrial customers) and at larger users purchasing gas directly from the pipeline (for electric generating plants and larger industrial customers).

Some other energy-related GHG emissions can be included in the tax base but emissions from coal, natural gas, petroleum extraction and distribution, petrochemical production, and other sources, which combined account for 7 percent of U.S. emissions are likely more amenable to regulation than taxation as discussed below. Some industrial process emissions may also be amenable to taxation (especially HFCs and PFCs that substitute for ozone depleting substances) but other emissions are more likely amenable to regulation—as are agricultural emissions (8 percent of total emissions).

1.b. The Tax Rate

Economic efficiency dictates that the tax rate would be set equal to the social marginal damages from emissions—the so-called Social Cost of Carbon (SCC). This would include all damages, both domestic and international.[9] The central estimate

6 The carbon content of coal and oil varies by grade. The variation, however, is not large, and tax rates per unit of fuel could be established for broad categories of fuel.

7 Assuming finished petroleum products are taxed as opposed to the unrefined oil, the oil consumed at the refinery should also be subject to tax.

8 Exported coal is not subject to the Black Lung excise tax currently and presumably would not be subject to a carbon tax if the tax is imposed on emissions associated with domestic activity. Lignite is not subject to the federal excise tax but should be subject to the carbon tax.

9 For purposes of regulatory rulemaking, Gayer and Viscusi (2016), among others, have argued that the SCC should only take into account domestic damages "based on statutory guidance, administrative requirements for regulatory analysis, and standard practice of benefit-cost analysis" (p. 261). Whether their view is correct or not in the context of regulatory policy, I'd argue that it is irrelevant for purpose of setting a tax on our carbon pollution if our goal is to follow the Pigouvian efficiency prescription of setting the tax equal to the social marginal damages of pollution (Pigou 1920).

of the SCC for 2020 from the last computations by the Obama Administration Interagency Working Group on Social Cost of Greenhouse Gases (2016) was $53 per ton (in 2020 dollars). This estimate comes from various runs of three leading integrated assessment models (IAMs). As I describe in Metcalf (2020b), the estimates of the SCC from IAMs is highly sensitive in three key areas, each of which is subject to considerable uncertainty or disagreement: climate sensitivity, the discount rate, and the magnitude of economic damages.

Climate sensitivity refers to the relation between the stock of GHGs in the atmosphere and the global mean temperature increase. Equilibrium climate sensitivity (ECS) measures the change in temperature from a base year (say 1900) due to a doubling of the stock of carbon dioxide in the atmosphere relative to that base year. The Intergovernmental Panel on Climate Change provides a good summary of our understanding of this key parameter. In its most recent Assessment Report (AR5, 2013), it states that the ECS is "*likely* in the range 1.5°C to 4.5°C *(high confidence)*, *extremely unlikely* less than 1°C (*high confidence*), and *very unlikely* greater than 6°C (*medium confidence*)." The report also notes that no best estimate of ECS can be given "because of a lack of agreement on values across assessed lines of evidence and studies" (IPCC 2013, 16). This leaves what Weitzman (2015) describes as a "worrisome amount of probability in the upper tail of the probability distribution of climate sensitivity (i.e., above 4.5°C)" and complicates estimating the SCC.

To illustrate the importance of this parameter, consider an estimate of the SCC for the year 2050 from the 2015 update to the Interagency Working Group's estimates of the SCC. William Nordhaus's DICE Model, one of the three IAMs used by the Working Group, reports an SCC for a business-as-usual economic scenario ranging from $16 per ton to $398 per ton. The median estimate is $73, while 10 percent of the 10,000 model run estimates exceed $130 per ton and 10 percent are less than $43 per ton.[10] This is a conservative range, as it only accounts for uncertainty about the value of the ECS and does not factor in uncertainty about damages or considerations of the appropriate discount rate.

The discount rate is also a key parameter given the long-lived nature of GHGs, and the fact that emissions today can cause damages hundreds of years into the future. Broadly speaking, the discount rate is typically chosen either by observing market rates and choosing a rate that reflects the appropriate time horizon and level of risk (a descriptive approach) or by applying the Ramsey growth model and its discount

10 The 10,000 runs are from the DICE model's estimate of the SCC in 2050 running the IMAGE economic scenario and assuming a 3 percent discount rate. Model run data were downloaded from https://obamawhitehouse.archives.gov/omb/oira/social-cost-of-carbon on February 20, 2020.

rate, which is a function of key underlying economic and ethical parameters, the latter reflecting how society should treat different generations in the welfare analysis (a prescriptive approach). In general, the descriptive approach leads to higher discount rates than the prescriptive approach. Nordhaus (2017) is a good example of the descriptive approach with a discount rate of 4.25 percent. Stern (2007) is a good example of the prescriptive approach with a discount rate of 1.4 percent. This range of discount rates has a large effect on distant damages from climate change. Damages of $1 million in 150 years have a present discounted value today of nearly $125,000 when discounted at 1.4 percent. At 4.25 percent, the value of those damages is less than $2,000 today. Again, there is no settled view on which approach is more appropriate.[11]

The third area of uncertainty is damages. In the DICE model, rising temperatures reduce GDP in a quadratic manner. This approach is a shorthand for the complex impacts of warming on our economy (lower agricultural productivity, rising need for cooling to compensate for hotter summers, higher death rates from heat and diseases, etc.). Modeling damages as quadratic suggests two questions: (1) Is this an accurate approach and does it accurately capture all the non-economic climate impacts, such as loss of species, large-scale drought-driven migration, and other geopolitical risks, to name a few?; and (2) is it reasonable for low-probability, high-impact events arising from unexpectedly high increases in temperature (so-called catastrophes)? While economists are making great strides at measuring the damages from climate change (see, for example, Hsiang et al. (2017)), there is little agreement on how to model catastrophic damages in IAMs.

Given these three areas of uncertainty, it may well be that in the end, IAMs will be instructive to the policy process of setting a carbon tax rate, but other factors will also be relevant for setting a tax rate. Two approaches stand out: revenue targeting and emissions reduction targeting.

A revenue targeting approach would set a tax rate to hit a revenue target over a 10-year budget window. A U.S. Department of the Treasury study projects that a carbon tax starting at $49 a metric ton in 2019 and rising at 2 percent (real) annually would raise $2.2 trillion in net revenue over the 10-year budget window (Horowitz et al. 2017). This is net of reductions in other tax collections due to the carbon tax. An emissions targeting approach sets a tax rate to achieve a given reduction in emissions over some timeframe. International climate negotiators have long focused on a global goal of reducing emissions by 80 percent relative to 2005 levels by 2050. The United States set this as an aspirational goal in its Intended Nationally Determined

11 Recently, economists have suggested that a declining discount rate is more appropriate for situations where benefits and costs can extend far into the future (e.g., Arrow et al. (2014)). This suggests a way of bridging the gap between the two approaches.

Contribution (INDC) made in 2015 as part of the international climate negotiations leading up to the Paris Agreement. More recently, focus has been placed on net-zero emissions by 2050. Either goal will be challenging. Economic and engineering analyses suggest that an 80 percent reduction by 2050 is possible, but would require significant advances in technology along with strong political will.

IAMs are well suited to provide tax rate profiles to achieve either a revenue or an emissions target. Unlike the use of IAMs to calculate the SCC, modeling tax rate profiles to achieve a given revenue or emissions target does not involve issues of discounting, damages, or climate sensitivity.[12]

Many of the carbon tax proposals that were introduced in the 116th Congress have starting rates ranging (in most cases) between $25 and $50 per ton of carbon dioxide. The Bipartisan Climate Leadership Council's carbon tax has an initial rate of $40 (in 2017 dollars) which rises in real terms by 5 percent per year.

1.c. Trade and Competitiveness

A carbon tax can be designed on a production or consumption basis. A production-based carbon tax levies a tax on all fossil fuels extracted in the United States, regardless of where they are consumed. A consumption-based carbon tax levies the tax on carbon emissions associated with goods consumed in the United States, regardless of where they are produced. It does this by taxing the carbon embedded in all imports and not taxing carbon embedded in exports (or rebating the tax on export-related carbon if paid at a previous stage of production). A production-based carbon tax is easier to administer in that there is no need to measure emissions associated with imported, carbon-intensive goods. It raises competitiveness concerns, however, since imports are not subject to carbon tax and the tax creates incentives to offshore production in carbon intensive manufacturing sectors to low (or no) carbon tax countries and import the manufactured goods. In principle, a consumption-based carbon tax avoids this problem since a ton of steel (for example) will face the same tax on its embedded carbon whether it is produced in China, Korea, or Pittsburgh.

In practice, levying a carbon tax on a consumption basis is complicated. Taxing fossil fuel imports (and rebating the tax on exports) is straightforward. Taxing the embedded carbon dioxide in imported goods and services, however, is more difficult. Fortunately, this is only an issue for a small share of imported goods. Gray and Metcalf (2017) document that roughly 95 percent of the value of manufacturing shipments has very low carbon content. We need only concern ourselves with a

12 For that matter, an IAM is not really necessary; all that is needed is a general equilibrium model of the economy with sufficient detail on the energy sector to track how fossil fuel use would change as the tax is imposed.

handful of carbon-intensive intermediate and final goods. Ideally, a U.S. carbon tax would tax this select group of carbon-intensive imports based on the actual carbon emissions associated with their production. Kortum and Weisbach (2017) point out the fundamental difficulty of actually measuring marginal emissions for different goods imported from different countries.

In previous work (Metcalf and Weisbach 2009), I have proposed levying a tax on select carbon-intensive imported goods based on the carbon content of like domestically produced goods. The advantage of this approach is that it is much simpler to implement. It also avoids any potential problem with its legality under World Trade Organization rules (Trachtman 2017). The disadvantage is that it provides no incentive for firms to reduce emissions to avoid the U.S. tax. This may not be a big problem for most carbon-intensive traded goods, since the bulk of those goods tend to be consumed domestically. China, for example, exports roughly 6 percent of its steel production (with little of that going to the United States) and less than one-tenth of 1 percent of its cement.[13] Cicala, Hémous, and Olsen (2020) suggest setting a base tariff on select carbon-intensive imports from a country on the basis of the country's average carbon intensity for that good, while allowing firms to pay a lower rate by certifying that their emissions are lower than the national average. The base tariff is then recalculated (in subsequent periods) after excluding production and emissions from certifying firms. Assuming only firms with below-average emission rates will certify, the base tariff rises over time, creating incentives for more firms to certify their emissions, thereby creating a virtuous cycle.[14]

1.d. Targeting Emission Reduction

A carbon tax puts a price on carbon pollution and uses the power of the market to achieve emission reductions. After all, demand curves slope down, so raising the price of fossil fuels will lead to lower consumption. But not everyone trusts market participants to follow the rules of Econ 101. At worst, taxing pollution could be construed as simply giving firms the right to pollute.[15] Moreover, as noted

13 Steel statistics from U.S. Department of Commerce (2020). Cement statistics from Statista and the U.S. Geological Survey, *Mineral Commodities Survey.*

14 An alternative approach is the Climate Club idea due to Nordhaus (2015). Countries that agree to a minimum price on their emissions (either through a tax or cap-and-trade system) would be members of the club. Imports to club member countries from non-club member countries would be subject to a small tariff (say, 2 percent of value). Nordhaus shows that this tariff—on all goods, not just carbon-intensive goods—would provide a significant incentive to join the club by pricing emissions. If all (or most) trading partners price emissions, the competitiveness concern goes away. It does require joint action by multiple countries, unlike border adjustments as described in the text. And it likely runs afoul of the WTO.

15 Sandel (1997) is perhaps best known for this objection, which he raised in the context of cap-and-trade programs: "[T]urning pollution into a commodity to be bought and sold removes the moral stigma that is properly associated with it. If a company or a country is fined for spewing excessive pollutants into the air, the community conveys its judgment that the polluter has done something wrong. A fee, on the other hand, makes pollution just another cost of doing business, like wages, benefits and rent."

above, politicians tend to focus on targeted reductions, as illustrated by the Obama Administration's commitment in its INDC to reduce emissions "by 26-28 percent below its 2005 level in 2025 and to make best efforts to reduce its emissions by 28%" and set an aspirational target of an 80 percent reduction by 2050.[16] Increasingly, there is a political focus on achieving net-zero emissions by 2050.[17] This all leads to an important question: how can we be sure that a carbon tax will achieve desired emission reductions?[18]

One could argue that any target could be met with a carbon tax. However, this would likely require frequent legislative updating of the tax rate to respond to changes in economic conditions and shifts in the cost curves for emission reduction. Assuming the political momentum reaches the point that the U.S. Congress enacts a carbon tax, it would be unlikely to have the political appetite for frequent legislative revisions of the tax rate to ensure that long-run targets are met. If Congress has only one opportunity to enact a carbon policy, it would be better to design a carbon tax that bakes in a design mechanism to achieve any desired emission-reduction goal.

I propose such a mechanism in Metcalf (2020a) called an Emissions Assurance Mechanism (EAM). Any carbon tax legislation will almost certainly be enacted with an initial tax rate and a default annual growth rate for that tax rate. The Whitehouse-Schatz *American Opportunity Carbon Fee Act of 2019* (S. 1128) sets an initial rate of $52 per ton and an annual growth rate of 6 percent over inflation. The EAM sets a target emissions-reduction goal for a future year, say 15 years out. The EAM then tracks emissions over that 15-year period relative to a benchmark emissions path. If cumulative emissions exceed cumulative emissions along the benchmark path, the carbon tax rate grows at a higher annual rate of increase than the default growth rate. If cumulative emissions are well below cumulative emissions along the benchmark, the tax rate is held constant in real terms. Treasury, in conjunction with other government agencies, would update the tax rate based on emissions relative to the pathway. At the end of the 15-year period, a process for setting a target for the subsequent 15-year period is set. In effect, the EAM acts as a policy thermostat, with the tax rate growing more rapidly over time if emission reduction targets are not being met and growing more slowly if targets are being met or exceeded.

16 Paris Agreement INDCs are available at https://www4.unfccc.int/sites/submissions/INDC/Submission%20Pages/submissions.aspx.

17 See, for example, the Intergovernmental Panel on Climate Change (IPCC) (2018) special report on the impacts of global warming of 1.5° C. As another example, the U.S. House Committee on Energy and Commerce released a memo describing the Climate Leadership and Environmental Action for our Nation's (CLEAN) Future Act which calls for net-zero emissions by 2050.

18 Economists would argue that this is the wrong question. Rather, they would point out that the socially optimal focus should be on setting the tax rate equal to the social marginal damages from pollution. But as I've argued above, at best we can only put an imprecise range on that number. Moreover, the politics are such that a focus on targeted emission reductions is simply unavoidable.

While this mechanism does not guarantee the target will be achieved, it raises the probability that the target will be hit. By allowing for a pause in escalation if cumulative emissions fall well below the target emissions pathway, the proposed program would have the necessary flexibility to respond to unexpected technological or economic shocks. Any target set out in carbon tax legislation could be conditioned on OECD member countries also committing to this goal within a short time frame and the major non-OECD emitting countries committing to this goal within, say, a decade. This could be combined with the Nordhaus (2015) "climate club" idea for those countries not choosing to place substantive prices on their carbon pollution.

In simulations of this proposal with a 45 percent reduction from 2005 levels by 2035, Hafstead and Williams (2020) provide results suggesting that the probability of hitting the target increases from 58 percent—assuming a 5 percent (real) annual carbon tax rate—to 69 percent when the EAM is included. Moreover, it reduces the probability of very high emissions and reduces the uncertainty of emissions (measured as the standard deviation in the simulation runs). Including the higher escalator in carbon tax legislation should also help to reduce concerns about policy uncertainty that could undermine support for a carbon tax. Similarly, by allowing for a pause in escalation if cumulative emissions fall well below the target emissions pathway, the proposed program would have the necessary flexibility to respond to unexpected technological or economic shocks.

The Climate Leadership Council has included an EAM as one of the key design elements in its carbon dividends plan. So do a number of other carbon tax bills in one form or another that have been filed in the U.S. Congress (Metcalf 2020a).

1.e. Use of Revenue

A carbon tax could collect significant amounts of revenue. A 2017 U.S. Department of the Treasury study projected that a carbon tax starting at $49 a metric ton in 2019 and rising at 2 percent (real) annually would raise $2.2 trillion in net revenue over the 10-year budget window (Horowitz et al. 2017). This is net of reductions in other tax collections due to the carbon tax. Elsewhere (Metcalf 2019c; Metcalf 2019b) I have argued that a carbon tax should be implemented in a revenue-neutral way, with tax collections being returned to households either through other tax cuts or through a carbon dividend along the lines of the one proposed by the Climate Leadership Council. Using revenues for tax cuts could increase the efficiency of the tax code, while carbon dividends would be highly progressive. Revenue neutrality ensures that long-contentious partisan differences over the size of the federal budget should not be allowed to affect the climate policy debate. A revenue-neutral carbon tax reform disentangles these two issues and may ensure greater bipartisan support for a carbon tax. This, however, is a political decision beyond the scope of this chapter.

Two areas of potential revenue use are worth mentioning. The first concerns transitional assistance to especially affected industries and workers. Coal miners and coal mining communities are one such group. Coal mining production and employment has fallen sharply since the early 1980s. Employment has fallen by roughly two-thirds over that period, initially through productivity improvements and the shift from Eastern to Western coal mining, where coal production per worker is an order of magnitude greater given the ability in the West to use much more heavy equipment to remove coal in large surface mines. Cheap natural gas due to the fracking revolution has accelerated the trend away from coal in electricity production and led to further employment losses.[19] Coal mining still accounts for about 55,000 jobs as of mid-2020. Morris, Kaufman, and Doshi (2020) point out that even a modest carbon price is likely to drive coal production to zero in many parts of the country. The economic consequences for workers and for communities heavily reliant on coal-based tax revenue could be severe. Some time-limited, transitional assistance for coal miners would be important and need not be very expensive. There are 27 coal mining-dependent counties—defined as counties with at least 8 percent of its employment in the coal mining industry (Morris, Kaufman, and Doshi 2020)—among the 3,000 counties in the United States. The public finances of the local governments in these counties will be severely impacted by the loss of coal jobs; again, assistance to these communities need not be very expensive.[20]

A second possible use of revenue would be to finance Green New Deal initiatives. While the Green New Deal is mainly aspirational and short on specifics, it is likely that any effort to operationalize the resolution will involve major green infrastructure spending (public transit, energy efficiency retrofits, etc.). While it's beyond the scope of this chapter to propose specific spending initiatives, one could argue that the current historically low interest rates for federal borrowing suggest borrowing for green capital spending would be fiscally prudent and repay dividends through future saved energy costs and a richer range of commuting and travel options for Americans, as opposed to using carbon tax revenues to fund Green New Deal initiatives.

Whether green infrastructure should be funded out of a carbon tax or public borrowing is perhaps more a political and messaging issue than an economic one, but there is a certain logic to financing infrastructure with long-term bonds and reserving the carbon tax revenue for more direct consumer and business relief.

19 These trends are documented in Metcalf and Wang (2019) and Morris et al. (2020), among other places.

20 See Bartik (2020) for suggestions on improving local economic development assistance programs.

1.f. State-Level Policies

California has a statewide cap-and-trade system. Meanwhile the Regional Greenhouse Gas Inventory (RGGI) puts a price on emissions from electricity generation in the Northeast. There is discussion about pricing transportation emissions in this region through the Transportation Climate Initiative (TCI). How should a federal carbon tax interact with state-level carbon-pricing programs?

One view is that having a state-level carbon tax alongside a federal carbon tax is double taxation and should be avoided. Based on that view, state-level carbon-pricing programs, whether a tax or cap and trade, should be preempted by a federal tax. There is much to be said for having a uniform carbon price nationwide. On the other hand, federal and state income tax systems have coexisted for decades, so there is no reason to assume we can't have a similar relationship with federal and state carbon-pricing programs. It would simply mean that in states with a higher carbon tax, the ultimate price of carbon would be greater than in a state with a lower one, as is the case with variation in state income taxes.[21]

The flaw in this argument is that state-level carbon-pricing programs are typically cap-and-trade programs rather than carbon taxes. Implementing a carbon tax will drive down allowance prices in state or regional programs by the amount of the tax (assuming the programs don't adjust their caps). Allowance prices in these programs would go to zero, except for the fact that RGGI and the California cap-and-trade system have floor prices on their allowances. RGGI has implemented a floor price (called an Emissions Containment Reserve or ECR price) effective as of 2021. The price is $6 per ton.[22] California's floor price for 2020 is $16.68 per ton.[23]

A cap-and-trade system operating at a floor price is effectively operating as a tax. But the decline in price could have an adverse revenue impact for the state. This is unlikely to be a problem for RGGI given current allowance prices. In its most recent auction (June 3, 2020), the clearing price for RGGI allowances was $5.75, well below the ECR floor price set for next year. The story is a bit different for California. The clearing price in its February 2020 auction was $17.87, just over one dollar above the floor. The revenue impact is not trivial. Had allowance prices cleared at the floor

21 One might worry that states might compete for carbon-intensive businesses by lowering tax rates in a race to the bottom. The federal tax rate serves as a lower bound on the tax rate for businesses in any state. States would be free to raise the rate if they think a higher rate is desirable (perhaps through a mix of environmental concern and revenue considerations) but they would have to balance the higher rate against any state-to-state competitiveness concerns.

22 More precisely, up to 10 percent of allowances in the quarterly auction will be withheld from sale if the settlement price falls below $6 per ton. The reserve price rises at an annual rate of 7 percent. See the table of ECR prices at the RGGI website here.

23 Price from May 2020 Auction Notice.

price, California would have collected $57 million less in revenue.[24] Given this is one of four auctions held per year, that comes to over $225 million per year in lost revenue. Consideration should be given to transitional assistance to address lost state emissions revenues should the federal government enact a carbon tax.

2. Other Policies

A carbon tax efficiently addresses the central problem of climate change that the social cost of burning fossil fuels exceeds the private, market cost. It uses the power of markets to effect change by millions of households, businesses, and other energy consuming groups. Although pricing our carbon pollution is a necessary element in a cost-effective climate policy, it is not a sufficient policy for a number of reasons. Other market failures (e.g., local pollution and pure research as a public good), the existence of GHG pollutants not amenable to taxation, and institutional barriers suggest the need for additional policies.

2.a. Regulation of Untaxed Emissions

As noted above, not all emissions are amenable to taxation. Some, however, may be amenable to regulation. One example is methane emissions from oil and gas fields. Trying to measure and tax them is unrealistic; requiring technologies that reduce the leakage is more effective. The Environmental Protection Agency under the Obama Administration had put rules in place requiring oil and gas companies to install equipment to detect methane leaks from wells, pipelines, and storage facilities. Once detected, the companies were required to eliminate the leaks. Under the Trump Administration, the Environmental Protection Agency (EPA) moved in August of 2019 to eliminate that regulation (Friedman and Davenport 2019). Many emissions from agriculture and land use and some industrial process emissions are better suited to regulation than to taxation. While beyond the scope of this chapter, it would be useful to break down U.S. GHG emissions between those amenable to taxation and those more suitable to regulation or some other form of control.

2.b. Current Environmental Regulation of Greenhouse Gas Emissions

A 2007 Supreme Court decision allowed the EPA to regulate GHG emissions under the Clean Air Act if the Agency determines they endanger public health. Following the Agency's determination that they do indeed endanger public health in 2009, it began to promulgate regulations to lower GHG emissions, most notably through

24 The sharp economic downturn has dampened demand for allowances. The May 2020 auction cleared at the floor price.

its Clean Power Plan to reduce emissions from the power sector. While the Trump Administration has moved to roll back those regulations, it is likely that the next Democratic administration will move once more to regulate GHGs under the Clean Air Act. This suggests a possible political bargain: remove EPA authority over GHGs under the Clean Air Act in return for a carbon tax.

Although the idea of replacing an inefficient regulatory approach with an efficient pricing mechanism is appealing, the Clean Air Act has been a powerful tool for improving environmental quality in this country over the past half century. Simply giving up Clean Air Act oversight of carbon pollution is politically unacceptable to environmental groups, given the potential for Congress to pass a carbon tax today only to have a future Congress repeal the tax. The challenge is to construct a carbon tax that provides the assurances that we will meet environmental goals over the course of this century. The Emissions Assurance Mechanism described above is one approach to ensure that the tax will lead to significantly lower emissions.

An additional policy approach would be to preserve the EPA's regulatory authority over GHG emissions, but suspend any regulatory action for emissions covered by a carbon tax as long as demonstrable progress in reducing emissions is being made. This, of course, requires that we define "progress." Progress could be defined as a reduction in emissions at least as great as would have occurred under regulation. Failure to hit the targeted emission reductions would automatically trigger resumption of the EPA's regulatory process under the Clean Air Act (so-called regulatory snapback). An independent commission or advisory group established under law could oversee progress toward the emission reductions. This also adds credibility to the EAM policy tool. Regulatory snapback could also be triggered by Congressional changes to the tax rates in ways that weaken the carbon tax.

2.c. Supporting Public Research and Development

The global transition to a zero-carbon economy will require new inventions and production processes. Research and development will be key to the successful diffusion of these technologies. Information and new knowledge are pure public goods that are underprovided in a market economy. A carbon tax should be complemented with a major increase in zero-carbon energy research to help develop cost-effective replacements for fossil fuels.

2.d. Addressing Regulatory and Institutional Barriers

In addition, various regulatory and other institutional barriers impede the transition to a zero-carbon economy. Resistance by states to interstate transmission lines passing through their state can limit the use of zero-carbon electricity (for example, wind from the Midwest and hydropower from Canada). The lack of clear legal and financial liability rules for carbon capture and sequestration will also impede the growth of this technology when and if it becomes cost-competitive.

2.e. Providing Consistency in Regulatory Analysis

Cost-benefit analysis is an important element in the promulgation of federal regulations. Two areas, in particular, stand out where federal rule making has been inconsistent across administrations. The first is the calculation of damages from GHG emissions. The Obama Administration first systematized the inclusion of damages from GHG emissions in regulatory analysis through the construction of a social cost of carbon by an Interagency Working Group in 2010. The Trump Administration has undermined its use by focusing only on domestic damages in an arbitrary way and by applying a high discount rate based on a narrow reading of OMB Circular A4. Similarly, it has developed inconsistent guidance on the treatment of co-benefits with an eye to reducing the benefits from proposed regulations to improve air quality as documented in Aldy et al. (2020). It will be important that the next Administration provide more rigorous rule making procedures and guidance for regulations that either directly or indirectly affect GHG emissions. The National Academies of Sciences (2017) report on measuring the social cost of carbon has valuable recommendations worth implementing and Aldy et al. (2020) has useful suggestions for the treatment of co-benefits in rule making.

2.f. Reforming Energy Provisions in the U.S. Tax Code

A carbon tax allows us to eliminate many energy-related tax breaks, starting with tax preferences for oil and gas production in the United States, which run counter to good environmental and climate policy (Metcalf 2018). Next, we can remove various investment and production tax credits for renewable energy projects. These tax preferences only make sense to support renewable energy investment and production if we cannot tax carbon pollution. The existing tax breaks are a way to level the playing field between carbon-polluting fuels and carbon-free fuels. If we cannot raise the cost of the polluting fuel, then the next best thing is to lower the cost of the nonpolluting fuel. But if we enact a carbon tax, a reasonable bargain is to eliminate *all* those tax preferences (both for fossil and renewable fuels), for a savings of roughly $10 billion a year.[25]

25 This is the 10-year average (over 2020–2029) of the energy tax expenditures as reported in the President's Fiscal Year 2021 Budget Submission. A better measure would be the revenue impact of repeal of these provisions as historically would be reported in the Treasury Green Book. Such an estimate is not available. Metcalf (2018) points out that the tax expenditure measure underestimates the value of these tax preferences to the firms receiving them since the measure ignores the time value of money.

3. Economic Assessment

3.a. Macroeconomic Impacts of a Carbon Tax

A major concern with environmental policy is its potentially negative impact on employment and economic growth. There is less reason to be worried about such costs with a carbon tax, as compared to regulatory policy. Unlike regulatory policy, a carbon tax raises revenue that can be distributed back to businesses and households through tax cuts or household dividends. The cost of a carbon tax is not the tax itself, but the cost of shifting away from fossil fuels and other sources of GHG emissions. Recent research suggests that the macroeconomic impacts of a small carbon tax are at worst only weakly negative, and could be weakly positive depending on how the revenue from the tax is recycled in the economy.

Much of the evidence leading to this "no impact" result comes from analyses of British Columbia's province-wide carbon tax. British Columbia enacted a broad-based carbon tax in 2008 starting at $10 (Canadian; hereafter, C$) per metric ton of carbon dioxide and increasing by C$5 per year to its current C$40 (as of 2020), equivalent to US$28.[26] The tax is a broad-based tax on the carbon emissions of all hydrocarbon fuels burned in the province. Given the existing federal and provincial taxes already in place, the carbon tax raised the overall excise tax on gasoline by roughly one-fifth. The tax collects over C$1 billion annually—over 5 percent of provincial tax collections—and all the revenue is returned to businesses and households through a combination of tax rate reductions, grants to businesses and households, and other business tax breaks as described in Metcalf (2019b).

Yamazaki (2017) analyzed the employment impact of the British Columbia carbon tax and found a modest positive and statistically significant impact on employment, on the order of 0.75 percent. Not surprisingly, he found a significant shift away from jobs in carbon-intensive and trade-sensitive sectors to other sectors. Chemical manufacturing, for example, experienced the largest decline in employment, while health care had the largest increase.

Focusing on GDP, Metcalf (2019b) found no adverse GDP impact of the British Columbia carbon tax based on a statistical analysis of a panel of Canadian provinces over the time period 1990–2016. More recently, Metcalf and Stock (2020a) and Metcalf and Stock (2020b) investigated the employment and GDP growth impacts

26 All currency conversions to U.S. dollars (C$1 = US$ 0.72) use exchange rates as of late May 2020. The tax is scheduled to increase by C$5 per year until it reaches C$50 per ton in 2021. In response to the COVID-19 pandemic, the province has frozen the rate at C$40 until further notice, as per https://www2.gov.bc.ca/gov/content/environment/climate-change/planning-and-action/carbon-tax. In addition, it increased the climate action tax credit significantly.

of European carbon taxes. They focused on the 31 countries in Europe that are part of the EU Emission Trading System (ETS). The ETS puts a carbon price on emissions from electricity generation and some carbon intensive industries. Fifteen of those 31 countries also impose carbon taxes on some portion of their remaining emissions. By focusing only on countries that are part of the ETS, Metcalf and Stock can identify growth impacts of the carbon tax separate from any impact of the EU ETS. There is considerable variation in tax rates and coverage across the 15 countries with rates (in 2018), ranging from less than $1 a ton (Poland) to nearly $130 a ton. They find a zero to modest positive impact on GDP and total employment growth rates. More importantly, they find no robust evidence of a negative effect of the tax on employment or GDP growth. They also consider the impact of the taxes on emission reductions and find a cumulative reduction on the order of 13 to 14 percent for a carbon tax of $40 per ton. They argue that this is likely to be a lower bound on reductions for a U.S. carbon tax, since European carbon taxes do not include in the tax base those sectors with the lowest marginal costs of carbon pollution abatement.

3.b. Distributional Impacts

A carbon tax is effectively an excise tax on energy consumption and, as such, is commonly viewed as a regressive tax since energy is a higher share of budgets for lower income households.[27] The regressivity argument is wrong for a number of reasons. The first and most significant issue is that it ignores the use of revenue. What matters is the distributional impact of a carbon tax reform, rather than the carbon tax in isolation. As Goulder et al. (2019) (and many others) have shown, the use of revenue can lead to a progressive, neutral, or regressive tax reform. In fact, the Goulder et al. study finds that the carbon tax with revenue refund is proportional to progressive in all their scenarios. The tax reform is progressive when revenue is used to finance payroll tax and personal income tax reductions as well as carbon dividends along the lines of the Climate Leadership Council's proposal. Even when revenue is used to finance cuts to the corporate income tax, the reform looks at worst proportional, but certainly not distinctly regressive.

Contributing to the progressivity of a carbon tax is the impact of the tax on factor prices and other income sources. Goulder et al. (2019) show that, with a lump-sum rebate of the tax, the after-tax return to capital falls more than the after-tax wage in most instances.[28] Given the concentration of wealth at the top of the income

27 This section draws heavily on Metcalf (2019a). A tax is regressive (progressive) if the share of the tax in income falls (rises) with income.

28 Rausch, Metcalf, and Reilly (2011) also find that, on average, returns to capital fall more than wage rates. Their study allows for regional variation in wage responses to the carbon tax. The U.S. Treasury analysis by Horowitz et al. (2017) assumes changes in factor incomes that contribute to the tax's progressivity.

distribution, this source-side effect adds progressivity to the carbon tax. Moreover, transfers are typically indexed against changes in the general price level; as a result, transfer recipients will be less burdened by the carbon tax's impact on consumer prices. Since transfers are disproportionately received by lower income households, indexed transfers contributes toward greater progressivity.[29] Together these source-side impacts add considerable progressivity to a carbon tax that more than offsets any regressivity when simply focusing on changes in consumer prices (use side impacts).[30]

Conclusion

A carbon tax is a necessary and key component of any cost-effective federal policy to limit U.S. GHG emissions. A tax starting with a tax rate in the neighborhood of $50 per ton of carbon dioxide could raise roughly $200 billion annually. That revenue could be returned to taxpayers through tax cuts or carbon dividends, after setting aside a modest portion of it for transitional assistance and federal clean energy research and development. Meanwhile, federal borrowing at what are historically low interest rates could finance important green infrastructure improvements that would help businesses and households transition away from their reliance on fossil fuels.

While a necessary part of any federal program to cut our carbon pollution, a carbon tax is not sufficient to move the United States significantly toward a zero-carbon economy. Other policies will be needed to complement the tax, including policies to encourage greater amounts of zero-carbon research and development, regulations to reduce GHGs not easily included in a carbon tax, and various initiatives to reduce barriers to the transition away from fossil fuels toward zero-carbon fuels.

A carbon tax can be designed to respond to two frequent criticisms: that it harms American competitiveness and that it will not guarantee we reduce emissions as much as is needed. Border carbon adjustments can be included in a carbon tax to address the first issue. An Emissions Assurance Mechanism can be built into the carbon tax legislation to address the second issue.

29 Transfers have been analyzed by Rausch, Metcalf, and Reilly (2011), Fullerton, Heutal, and Metcalf (2011), Cronin, Fullerton, and Sexton (2019), and Goulder et al. (2019), among others.

30 An earlier literature focused on the fact that excise taxes (such as an excise tax on fuels) are biased toward regressivity when annual income is used to sort households. This has been pointed out by Poterba (1991), Hassett et al. (2009), and Mathur and Morris (2014), among others. Most of these studies find that a carbon tax is at worst mildly regressive and could, in fact, be progressive once lifetime income measures are used to sort households.

References

Aldy, Joseph E., Matthew J. Kotchen, Mary Evans, Meredith Fowlie, Arik Levinson, and Karen Palmer. 2020. "Co-Benefits and Regulatory Impact Analysis: Theory and Evidence from Federal Air Quality Regulations." National Bureau of Economic Research, Cambridge, MA.

Arrow, Kenneth J., Maureen L. Cropper, Christian Gollier, Ben Groom, Geoffrey M. Heal, Richard G. Newell, William D. Nordhaus, Robert S. Pindyck, William A. Pizer, Paul R. Portney, Thomas Sterner, Richard S. J. Tol, and Martin L. Weitzman. 2014. "Should Governments Use a Declining Discount Rate in Project Analysis?" *Review of Environmental Economics and Policy* 8(2): 145-163.

Bartik, Timothy J. 2020. "Bringing Jobs to People: Improving Local Economic Development Policies." In *Securing Our Economic Future*, edited by Amy Ganz and Melissa Kearney, Aspen Institute Press.

Cicala, Steve; David Hémous, and Morton Olsen. 2020. "Adverse Selection as a Policy Instrument: Unraveling Climate Change," Universities of Chicago, Zurich, and Copenhagen.

Cronin, Julie-Anne, Don Fullerton, and Steven E. Sexton. 2019. "Vertical and Horizontal Redistributions from a Carbon Tax and Rebate." *Journal of the Association of Environmental and Resource Economists* 6(S1): S169-208.

Friedman, Lisa and Coral Davenport. 2019. "Curbs on Methane, Potent Greenhouse Gas, to Be Relaxed in U.S." *New York Times*, August 29, 2019.

Fullerton, Don, Garth Heutel, and Gilbert E. Metcalf. 2011. "Does the Indexing of Government Transfers Make Carbon Pricing Progressive?" *American Journal of Agricultural Economics* 94(2): 347-353.

Gayer, Ted, and W. Kip Viscusi. 2016. "Determining the Proper Scope of Climate Change Policy Benefits in U.S. Regulatory Analyses: Domestic Versus Global Approaches." *Review of Environmental Economics and Policy* 10(2), 245-263.

Goulder, Lawrence H., Marc A. C. Hafstead, GyuRim Kim, and Xianling Long. 2019. "Impacts of a Carbon Tax across US Household Income Groups: What Are the Equity-Efficiency Trade-Offs?" *Journal of Public Economics* 175: 44-64.

Gray, Wayne, and Gilbert E. Metcalf. 2017. "Carbon Tax Competitiveness Concerns: Assessing a Best Practices Income Tax Credit " *National Tax Journal* 70(2): 447-468.

Hafstead, Marc and Roberton C. Williams, III. 2020. "Designing and Evaluating a Carbon Tax Adjustment Mechanism." *Review of Environmental Economics and Policy* 14(1), 95-113.

Hassett, Kevin A., Aparna Mathur, and Gilbert E. Metcalf. 2009. "The Incidence of a U.S. Carbon Tax: A Lifetime and Regional Analysis." *The Energy Journal* 30(2): 157-179.

Horowitz, John, Julie-Anne Cronin, Hannah Hawkins, Laura Konda, and Alex Yuskavage. 2017. "Methodology for Analyzing a Carbon Tax." Working Paper 115, U.S. Department of the Treasury, Office of Tax Analysis: Washington, DC.

Hsiang, Solomon, Robert Kopp, Amir Jina, James Rising, Michael Delgado, Shashank Mohan, D. J. Rasmussen, Robert Muir-Wood, Paul Wilson, Michael Oppenheimer, Kate Larsen, and Trevor Houser. 2017. "Estimating Economic Damage from Climate Change in the United States." *Science* 356(6345): 1362-1369.

Interagency Working Group on Social Cost of Greenhouse Gases. 2016. "Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866." Washington DC.

Intergovernmental Panel on Climate Change (IPCC). 2013. Climate Change 2013 - *the Physical Science Basis.* Cambridge, UK and New York, NY: Cambridge University Press.

Intergovernmental Panel on Climate Change (IPCC). 2018. "Summary for Policy Makers," V. Masson-Delmotte, P. Zhai, H.-O. Portner, D. Roberts, J. Skea, P.R. Shula, A. Pirani, W. Moufouma-Okia, C. Pean, R. Pidcock, S. Conners, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor and T. Waterfield, *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways.* Geneva, Switzerland: World Meterorological Organization,

Kortum, Sam, and David Weisbach. 2017. "The Design of Border Adjustment for Carbon Prices." *National Tax Journal* 70(2): 421-446.

Leiserowitz, Anthony, Edward Maibach, Seth Rosenthal, and John Kotcher. 2019. "Politics & Global Warming, November 2019." Yale University and George Mason University, New Haven, CT.

Mathur, Aparna, and Adele C. Morris. 2014. "Distributional Effects of a Carbon Tax in Broader U.S. Fiscal Reform." *Energy Policy* 66(March): 326-334.

Metcalf, Gilbert E. 2017. "Implementing a Carbon Tax," Resources For the Future, Washington, DC.

---. 2018. "The Tax Treatment of Oil and Gas Production in the United States: Assessing the Options." *Journal of the Association of Environmental and Resource Economists* 5(1): 1-37.

---. 2019a. "The Distributional Impacts of U.S. Energy Policy." *Energy Policy* 129: 926-929.

---. 2019b. "On the Economics of a Carbon Tax for the United States." *Brookings Papers on Economic Activity* (Spring): 405-458.

---. 2019c. Paying for Pollution: Why a Carbon Tax Is Good for America. New York: Oxford University Press.

---. 2020a. "An Emissions Assurance Mechanism: Adding Environmental Certainty to a Carbon Tax." *Review of Environmental Economics and Policy* 14(1): 114-130.

---. "What Should Carbon Cost?" *Scientific American.* New York: 62-69.

Metcalf, Gilbert E., and James H. Stock. 2020a. "The Macroeconomic Impact of Europe's Carbon Taxes." Working Paper No. 27488, National Bureau of Economic Research.

---. 2020b. "Measuring the Macroeconomic Impacts of Carbon Taxes." *American Economic Association: Papers and Proceedings* 110(May): 101-106.

Metcalf, Gilbert E., and Qitong Wang. 2019. "Abandoned by Coal, Swallowed by Opioids?" Working Paper No. 26551, National Bureau of Economic Research, Cambridge, MA.

Metcalf, Gilbert E., and David Weisbach. 2009. "The Design of a Carbon Tax." *Harvard Environmental Law Review* 33(2): 499-556.

Morris, Adele C., Noah Kaufman, and Siddhi Doshi. 2020. "Revenue at Risk in Coal-Reliant Counties," Working Paper No. 27307, National Bureau of Economic Research, Cambridge, MA.

National Academies of Sciences, Engineering, and Medicine. 2017. *Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon.* Washington, DC: The National Academies Press.

Nordhaus, William D. 2015. "Climate Clubs: Overcoming Free-Riding in International Climate Policy." *American Economic Review* 105(4): 1339-1370.

---. 2017. "Revisiting the Social Cost of Carbon." PNAS 144(7): 1518-1523.

Pigou, Arthur C. 1920. *The Economics of Welfare.* London: Weidenfeld and Nicolson.

Poterba, James. 1991. "Is the Gasoline Tax Regressive?" *Tax Policy and the Economy* 5: 145-164.

Rausch, Sebastian, Gilbert E. Metcalf, and John M. Reilly. 2011. "Distributional Impacts of Carbon Pricing: A General Equilibrium Approach with Micro-Data for Households." *Energy Economics* 33: S20-S33.

Sandel, Michael. 1997. "It's Immoral to Buy the Rights to Pollute," *New York Times*.

Stern, Nicholas. 2007. *The Economics of Climate Change: The Stern Review.* Cambridge: Cambridge University Press.

Trachtman, Joel P. 2017. "WTO Law Constraints on Border Tax Adjustment and Tax Credit Mechanisms to Reduce the Competitive Effects of Carbon Taxes." *National Tax Journal* 70(2): 469-494.

U.S. Department of Commerce. 2020. "Steel Exports Report: China," International Trade Administration: Washington, DC.

U.S. Environmental Protection Agency. 2019. "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017," Washington,DC.

Weitzman, Martin L. 2015. "A Review of William Nordhaus' the Climate Casino: Risk, Uncertainty, and Economics for a Warming World." *Review of Environmental Economics and Policy* 9(1): 145-156.

Yamazaki, Akio. 2017. "Jobs and Climate Policy: Evidence from British Columbia's Revenue-Neutral Carbon Tax." *Journal of Environmental Economics and Management* 83: 197-216.

Climate Policy Enters Four Dimensions

AUTHORS

David W. Keith* and John M. Deutch**

ABSTRACT

This chapter addresses what needs to be done to craft a politically stable and economically sound climate policy that includes balanced reliance on the four mechanisms to manage climate risks, which we call the climate control mechanisms: emissions reduction, adaptation, carbon dioxide removal, and solar radiation modification. Assessing the balance requires attention to (1) technology development, performance, and cost over a range of control options, (2) integration of the technology architecture with the prevailing economic, regulatory, and policy context, (3) public attitudes to climate policies and programs, and (4) implementation of a planning programing system to implement the new balanced climate policy. If the United States achieved a stable balance it could serve as the basis for extended international agreements.

* Harvard University, School of Engineering and Applied Sciences and Kennedy School

** MIT, Institute Professor of Chemistry Emeritus

Introduction

The climate crisis is a global problem that requires country level policies. These policies require significant short-term costs to obtain benefits that are not easily understood by the public. The varying responses to the crisis by different political leaders indicate the importance of strong and steady leadership, guided by science and transparency. The current COVID-19 pandemic illustrates many of the politically difficult decisions that we must also confront with the climate crisis. Given the highly infectious nature of the virus, it is a global problem with huge negative spillovers between countries. In this sense it is similar to the global climate challenge.

A politically stable and economically sound climate policy should include a balanced reliance on four complementary mechanisms to manage climate risks: emissions reduction, adaptation, carbon dioxide removal, and solar radiation modification. In this chapter we discuss what these measures are and how they could be used to address the global climate challenge.

Before we review the climate science of the four mechanisms we highlight, it is useful to outline the relevant policy context. At the 2015 Paris Conference of the Parties (COP21) to the 1992 United Nations Framework Convention on Climate Change (UNFCCC) world leaders announced the ambitious goal of keeping the rise in global temperature below 1.5°C–2°C. More than 190 nations agreed to participate in a "Nationally Determined Contribution" process to achieve these goals (UNFCCC, n.d.). Yet COP21's ambitious temperature goal obscures the hard truth that the Paris Agreement's voluntary, pledge-and-review emissions reduction process is a step back from the 1997 Kyoto COP's aspirations of binding emissions reduction targets. The United Nations Emissions Gap Report (2019) suggests that several countries (including the United States) will not reach their first tranche of intended NDC's and will not meet their submitted 2020 reduction targets. Indeed, global emissions continued to rise until the COVID-19 crisis.

COP21 also set a goal to increase funding for adaptation, signaling a concern that the world might not reach its ambitious global warming targets based on emission reduction alone (UNFCCC, n.d.-b). Small island nations and some developing countries are particularly concerned because of their vulnerability to sea-level rise, especially as global temperatures increase beyond 1.5°C. UNFCCC parties have agreed that substantial financial flows are needed from parties with resources to more vulnerable parties with fewer resources, but a facilitating mechanism is not yet in place (UNFCCC, n.d.-c). The upshot is a growing consensus among climate policy experts that emission reductions are insufficient to prevent substantial climate damages, and that the climate response must consider tools beyond emission reductions.

While the Trump administration has begun the process of withdrawing the United States from the Paris Agreement, the climate issue has captured greater attention from a much broader segment of the global public. Youth movements like "Fridays for the future" have mobilized a new political generation (Ramzy 2019). Public leaders from across the political spectrum are calling for action. Young progressives, especially on university campuses, are forming activist groups both to advance a low-carbon agenda and to call to proscribe energy companies. Opinions are even shifting among young voters who identify as Republican. New York state, the European Union, and other political entities have passed aspirational laws requiring 100 percent carbon-free economies in their jurisdictions by mid-century. Responding to pressure, many businesses have also begun to take serious steps toward a carbon-free world: auto companies are aggressively moving toward electric vehicles, California utilities are planning on storage and renewable generation to meet anticipated load, and oil and gas companies such as Shell have small, but active programs to develop fossil-free, liquid fuels.

These positive trends face headwinds. The rising tide of nationalism and populism makes crafting international agreements implausible. The COVID-19 pandemic has shifted public attention away from climate and is driving up public debt, which will likely reduce appetite for new investment on climate.

Over the last decade, the climate policy community has widened its field of view, from an exclusive focus on *emissions reduction* to include *adaptation*. In the years since COP21, *carbon dioxide removal* (CDR) from the atmosphere, also referred to *negative emission technologies,* have become a central part of discussions about climate technology and policy. Most recently, the possibility of direct intervention with reflecting particles in the upper atmosphere to reduce incoming solar radiation, referred to as *solar radiation modification* (SRM) have entered the mainstream, climate policy debate. Adaption, CDR, and SRM now need to be considered along with emissions reduction as the four tools for managing climate risk.

The remainder of this chapter discusses these four promising and necessary climate control mechanisms.

CLIMATE SCIENCE PRIMMER

The single most important finding of climate science for policymakers is that climate change is proportional to the *cumulative* emissions of carbon dioxide (CO_2). This means that if emissions are brought to zero, the problem does not get better; it simply stops getting worse, because it takes hundreds of years for carbon dioxide in the atmosphere to equilibrate into the deep ocean. The atmospheric lifetimes of other greenhouse gases are not as long. For example, methane (CH_4), which has a 10-year half-life, produces warming roughly equivalent to its current emissions rate, rather than its cumulative emissions.

Scientists are confident that carbon dioxide emissions and temperature are linearly proportional, but the proportionality constant—the climate sensitivity between the radiation that causes the change in temperature for a given amount of carbon dioxide emissions—is still uncertain by at least a factor of two, despite half a century of research.

The uncertainty about climate sensitivity to carbon dioxide emissions is caused by several feedback mechanisms in atmospheric dynamics, such as clouds, water vapor, and sea ice. The uncertainty is captured by a probability density function for temperature increase that has a "fat tail" due to the non-linearity of the feedback mechanisms that influence the climate sensitivity (Roe and Baker 2007).

1. The Climate Control Toolbox

We discuss four climate-risk control mechanisms:

Emission Reduction: Lowering carbon emissions without reducing economic growth, which is accomplished by reducing the carbon intensity of energy (CO2/E) or lowering the energy intensity of the economy.

Carbon Dioxide Removal (CDR): Technologies that have the potential to transfer carbon dioxide from the atmosphere at gigatonne scales into physical or chemical storage, or into biological sinks, such as biomass or soils.

Adaptation: human-designed programs that aim to protect communities, commerce, and the environment from anticipated damage and adverse impacts from climate change.

Solar Radiation Modification (SRM): The deliberate use of technical methods to alter the Earth's radiative balance.

Each control mechanism has a very different "technology readiness level," a formal classification system that uses specific qualitative parameters to characterize the technology's maturity and readiness for deployment. A vast amount of field data is needed to support cost and performance estimates necessary to plan projects and attract public or private financial support. There also is a vast difference in the maturity of the regulatory frameworks that support each mechanism, and in the public's acceptance of each mechanism (see Table 1).

Table 1: The Climate Control Toolbox

1.a. Emissions Reduction

MECHANISM		TECHNOLOGY READINESS	COST RANK	REGULATORY FRAMEWORK	PUBLIC ACCEPTABILITY
Emission Reduction	First half of emissions	Functioning clean energy market	2	Fed & State established.	Established
	Last third of emissions	No market proven technology for non-electric industrial or heavy freight	4	Strong global markets.	
CDR	Storage in Biological sinks	Some technology and markets exist for forestry and soils but monitoring inadequate and lifetime uncertain	1–3	Weak – verification challenging	Moderate to high
	Physical or chemical storage	No market proven technology, some funding for DAC and BECCS very little for other scalable technologies	4	Limited	Moderate
SRM	Implementation	Technology for some methods exists and costs are low	1	Nonexistent Contentious	Low and uncertain
	Consequences	Efficacy and impacts deeply uncertain	2–4		
Adaptation		Mixed: e.g., markets for managing current agricultural risks but little long-term R&D	2–3	Diverse	High

Emissions reduction has historically been the focus of national and international climate policy. There is a direct relationship between fossil fuel use for energy and emissions. If the proportion of the energy sources remain fixed for the economy, then the growth rate of carbon dioxide emissions and economic growth will be proportional to one another. The purpose of emissions reduction is to lower emissions without reducing economic growth. The famous Kaya identity summarizes the linkage. Over any fixed time period the following relationship must hold:[1]

$$dCO_2/CO_2 = d\,(CO_2/E)/(CO_2/E) + d\,(E/Y)/(E/Y) + d\,Y$$

1 The identity follows from taking the first differential of C = (C/E)(E/Y)Y.

where E is energy use of the economy and Y is the economic activity. If the economy is to experience emission reduction, $d\ CO_2 < 0$, with no loss of economic activity, $dY \geq 0$ there must be a compensating reduction in the carbon intensity of energy (CO_2/E) or in energy intensity of the economy (E/Y).

For both energy and carbon intensity, improvement is realized through change in energy infrastructure that is driven by a combination of market incentives and regulatory mandates. Higher energy or carbon prices encourage firms to adopt more energy-efficient or low-carbon means of production. For example, many U.S. states have adopted renewable portfolio standards (RPS) for electricity generators, while the federal government has adopted fuel economy standards for automobile manufactures. The world has benefited from a remarkable fall in the cost of photovoltaic solar and wind power and from a shift from coal to natural gas electricity generation due to a fall in in the relative price of natural gas.

Deep emissions cuts will be achieved primarily by replacing the high-emission capital stock with low-emission capital stock in the energy system, as when solar or nuclear power are built to replace fossil fuel-based power generation. Because emissions cuts mostly come from the replacement of long-lived capital stock rather than from changes in the use of existing capital or from changes in consumption patterns, there is substantial lag between flows of money and long-term reductions in emissions.

Among the most important measures to reduce emissions is investment in clean energy—the flow of funds that builds up the low-emission capital stock. The massive investment required greatly outstrips the current global effort. Bloomberg-Energy (2020) reports that financial inflow rose rapidly in the first decade of the century to roughly $300 billion per year, but spending levels have been roughly flat since 2010. This represents 0.3 percent of global GDP, which while not insignificant, is perhaps a factor of 10 smaller than it would need to be to have any chance of achieving the goal of "net-zero carbon emissions" by mid-century.

As the energy system becomes more decarbonized, it becomes more costly to further reduce the carbon content. Marginal control costs rise as emissions are squeezed out. Because of the relatively low capacity factor and variability of renewable solar and wind generation, increasing costs at the margin come from systems to compensate for the low capacity factors and to meet load: storage, transmission, and excess solar and wind capacity that is often curtailed. This high cost will be transmitted to a transportation system that will increasingly use electricity to replace fossil fuel. The transition to this new, low-carbon economy will require massive amounts of capital and a very long time period of market adjustment until the benefits of decarbonization are realized.

Government policies in the United States and Europe have strongly supported clean energy innovation. But neither funding for innovation nor emissions cuts lived up to the rhetoric. For example, the Mission Innovation Initiative, announced at COP21 by 24 countries and the European Union, pledged to double public clean energy research, development, and demonstration (RD&D) expenditures over five years (Mission Innovation, n.d.). After three years, 55 percent of the investment commitment has been reached, but not necessarily deployed. While there is some coordination between member countries, in practice each country follows its own program at its own pace, without any overarching strategy (Mission Innovation 2019).

On a global basis, the U.S. Energy Information Agency's (EIA) 2019 International Energy Outlook projects that carbon dioxide emissions will continue to increase through 2050 at an average annual rate of 0.6 percent, due to economic growth in Asia and Africa.

The EIA also predicts that carbon intensity over the period 2018 to 2050 will decline at an average annual rate for the globe by 0.6 percent, with the carbon intensity of the United States, China, and India projected to increase annually by 0.3 percent, 1.2 percent and 1 percent, respectively, while that of OECD countries is projected to decline by 0.6 percent per year.

1.b. Carbon Dioxide Removal (CDR)

As the prospects for emission reductions that are consistent with the temperature goals of the Paris Agreement look increasingly doubtful, attention has shifted to CDR technologies that have the potential to transfer carbon dioxide from the atmosphere at gigatonne scales. There are many who advocate turning to CDR, sometimes referred to as net zero technologies, but some urge caution (Davis et al. 2018; Field and Mach 2017; Krupp, Keohane, and Pooley 2019).

As described in Table 1, CDR technologies may be divided into two broad categories depending on the longevity of the carbon storage.

Technologies that rely on *physical or chemical storage* work by injecting carbon dioxide deep underground or into the deep ocean, forming stable minerals or dissolved salts. Whatever the cost and environmental impacts of operating these technologies, there is confidence that the carbon is stored for geologic timescales (thousands of years). These technologies include bioenergy with carbon capture and sequestration (BECCS); direct air capture (DAC); and carbon mineralization of carbon dioxide (the addition of alkalinity to the ocean).

Technologies that rely on *biological sinks* depend on managing ecosystems to increase the flow of carbon into biomass or soils. Carbon in these systems can readily be returned to the atmosphere in years to centuries, as when a forest burns or a farmer shifts management practices to allow carbon in soils to deplete. They include storage of carbon in coastal ecosystems; enrichment of soil carbon (such as biochar, crop modification, and other agricultural practice); and terrestrial carbon removal and sequestration (including afforestation, reforestation, and forest management).

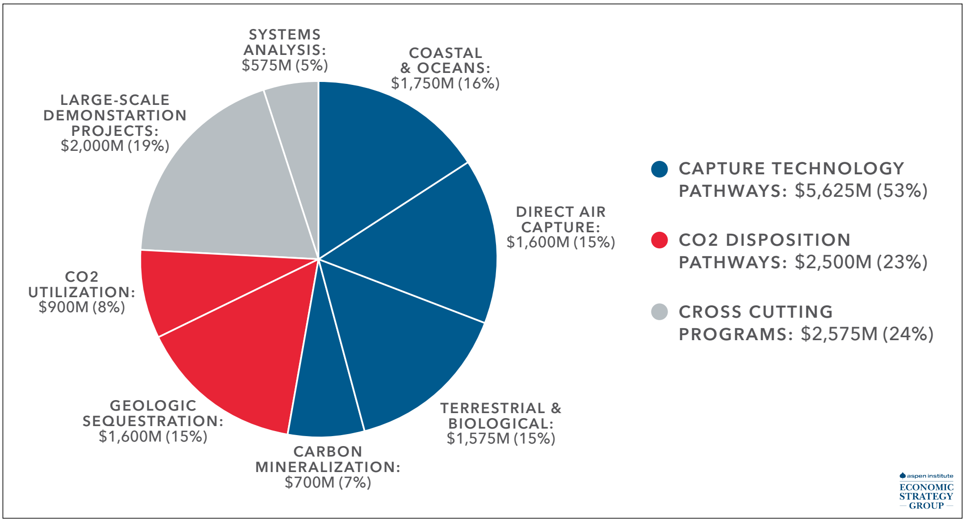
Some of the biological sink technologies are inexpensive, as they involve little more than adjusting existing management practices in forestry or agriculture. Their challenge is measuring the amount of carbon that is stored, and accounting for the fact that carbon can return to the atmosphere on timescales that are relevant for climate policy.

CDR technologies, particularly those that involve physical or chemical storage methods, are at an early stage of technology readiness. If pursued they will need to follow the conventional system development path: first, the candidate CDR technology is assessed for its technical readiness; second, a cost-benefit analysis of the CDR technology is conducted upon deployment; third, an RD&D program is constructed with technical milestones and costs which, if successful, will confirm feasibility; and finally, environmental, health, and safety characteristics are established for the technology.

Having a well-defined development path does not mean the project will be implemented, especially for technologies of gigatonne scales. Crossing the "innovation bridge" requires addressing multiple, interconnected factors relevant to climate policy beyond technical considerations, such as matters of economics, regulation, and market design. Importantly, for a new CDR solution to gain policy approval and access to the necessary resources, advocates must come forward with a practical plan for its management.

The National Academies of Sciences, Engineering, and Medicine (2018) identified four technologies that are ready for development: aforestation/reforestation, forest management, uptake and storage in agricultural soils, and biofuels with carbon dioxide capture and storage (CCS). The study recommended an annual federal RD&D budget in the $300–$400 million range. The Energy Futures Initiative (EFI) (2019) recommended a 10-year, $10.7 billion federal budget as allocated in Figure 1.

Figure 1: CDR RD&D Initiative Proposed Total Funding by Portfolio Categories



Source: Energy Futures Initiative (2019). Report. "Cleaning the Air: A Federal RD&D Initiative and Management Plan for Carbon Dioxide Removal Technologies.

The EFI recommendation is more than twice the amount recommended by the NAS, but the two studies did not address the same programmatic landscape. As a benchmark, the 2019 budget for the Department of Energy's Energy and Science programs was about $12 billion.

Direct air capture (DAC)[2] is the chemical scrubbing processes for capturing carbon dioxide directly from the atmosphere via absorption or adsorption separation. DAC has attracted wide interest, but the process—which requires two steps, separation and compression—is technically challenging because carbon dioxide is so diluted in the atmosphere (about 400 parts per million by volume). There is a wide range of estimates about its cost, from $60 to $500 per metric ton of carbon dioxide captured. Rajan and Herzog (2011) conclude: "Estimates of $27/tCO$_2$) to $136/tCO$_2$ found in the literature for DAC are just not believable." In an engineering cost study biased on commercial engineering development of DAC, Keith et al. (2018) found levelized costs over a range of plant configurations of $92–$232 per ton of carbon dioxide.

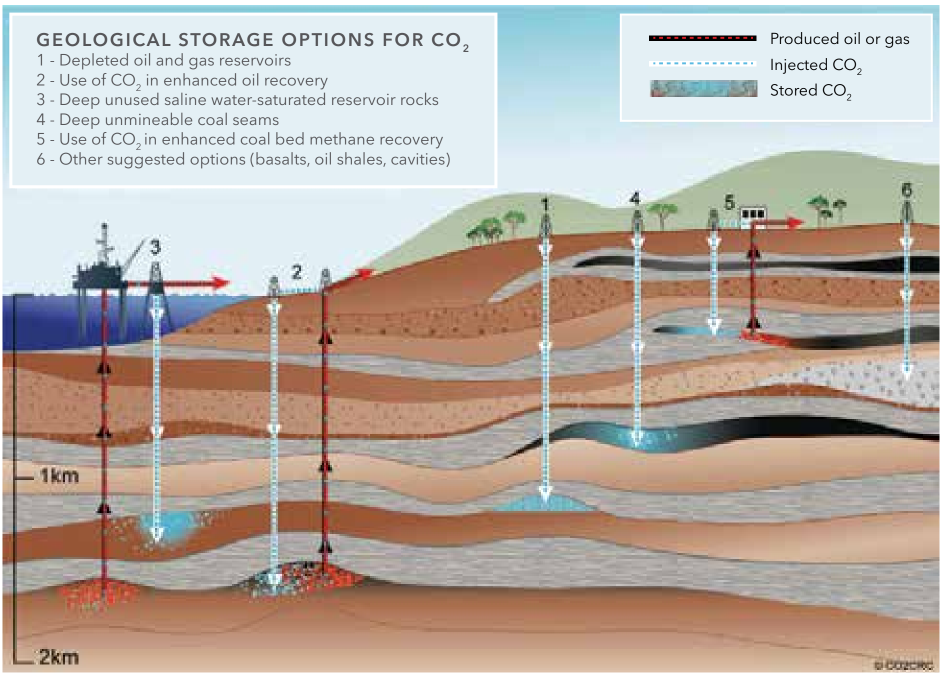
One should view such cost estimates skeptically. If it were possible to accurately assess the cost of future industrial technologies using academic studies or expert panels, financial investors would no-doubt use such studies to make investment decisions.

2 We comment on DAC here because one of us, David Keith, is a long-time researcher of this technology, and the founder of Carbon Engineering, one of the leading DAC firms.

Costs can only be known with confidence once technologies are widely deployed in commercial markets, but that deployment requires huge up-front investments. Government decisions about investment allocation should be informed by cost estimates derived from experts with relevant industrial expertise and commissioned from independent consultancies during the development phase as an intermediate step between academic papers and the commercial market.

Both DAC and the conventional emissions reduction option of the capture of carbon dioxide from fossil fuel-based electricity generation require deposition of the captured carbon dioxide, referred to as carbon capture and storage (CCS). There are a number of deposition pathways including utilization by enhanced oil recovery, chemical transformation, and geological storage in deep underground aquifers. Developing commercial scale (greater than one million metric tons per year of carbon dioxide for each facility) CCS has been a goal among scientists for years. The United Nations Intergovernmental Panel on Climate Change produced a report on CCS in 2005 with an informative graphic, Figure 2, which describes different methods for underground storage of carbon dioxide.

Figure 2: Methods for Storing Carbon Dioxide in Deep Underground Geological Formations



Source: CO2CRC Ltd and IPCC (2020)

It will generally cost more to capture carbon dioxide from the atmosphere than to capture it from point sources such as power plants or cement kilns that have higher carbon dioxide concentrations. But the cost of CCS from power plants has been significantly greater than other emissions reduction options in the electricity sector. CCS will likely become more relevant as attention turns from early penetration of low-cost renewables to harder-to-decarbonize, industrial sectors. The development of CCS and of CDR technologies will be intertwined—sound policy requires integrated treatment of the two technologies. Both large-scale CCS and CDR facilities will raise significant legal, regulatory, and public concerns.

1.c. Adaptation

Adaptation refers to human-launched programs taking action to protect communities, commerce, and the environment from anticipated damage and adverse impacts from climate change. In contrast to CDR, adaptation does not rely exclusively on the development and deployment of technology, but rather on undertaking projects or procedures to reduce environmental damage and associated costs if a destructive event occurs. Chapter 17 of the Working Group II's contributions to the UNFCCC Fifth Assessment report, which addresses *the economics of adaptation*, offers these examples of adaptation:

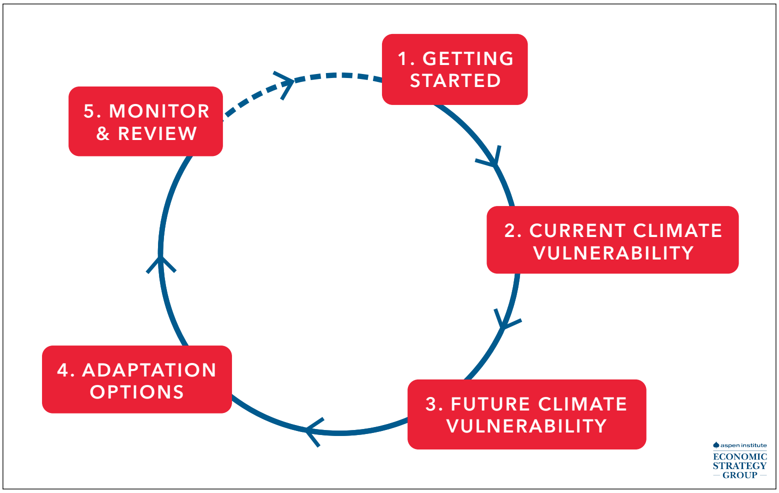
- Altered patterns of enterprise management, facility investment, enterprise choice, or resource use (mainly private)
- Direct capital investments in public infrastructure (e.g., dams and water management—mainly public)
- Technology development through research (e.g., development of crop varieties—private and public)
- Creation and dissemination of adaptation information (through extension or other communication vehicles—mainly public)
- Human capital enhancement (e.g., investment in education—private and public)
- Redesign or development of adaptation institutions (e.g., altered forms of insurance—private and public)
- Changes in norms and regulations to facilitate autonomous actions (e.g., altered building codes, technical standards, regulation of grids/networks/utilities, environmental regulations—mainly public)
- Changes in individual behavior (private, with possible public incentives)
- Emergency response procedures and crisis management (mainly public)

Adaptation does not slow climate change; rather, it acts as an insurance policy that reduces the costs of damage from the impacts of a global temperature increase should it occur. The diversity of adaptation actions presents a challenge to its analysis as a control mechanism and to setting a common scale for comparing the costs and benefits of different proposed adaptation efforts.

Adaptation has co-benefits that give it an advantage over other climate control measures. For example, revising building construction codes to make buildings more resilient to extreme weather events also improves infrastructure by conveying a longer useful life. But adaptation also has a disadvantage compared to emissions reduction. For emissions reduction, the incremental damage attributed by one additional kilogram of carbon dioxide is usually easily attributed to the emitter. This makes it possible to adopt policies that link emissions costs to emitters. Meanwhile, adaptation projects are usually regional (e.g., ambitious New York and Miami resiliency projects to protect their waterfront from anticipated flooding as sea level rise). Such projects are quite costly and it is not evident how these costs should be allocated across all city taxpayers.

The literature on adaptation as a climate control mechanism is vast. Because of the complexity mentioned above, the literature stresses general features: the significance of adaptation, tools required for planning, and the importance of gaining community approval for projects. Chapter 28 of the 2018 Fourth U.S. National Climate Assessment is devoted to describing federal efforts to reduce risks through adaptation actions. The European Commission's approach to adaptation, carried out by the European Environment Agency, is to "share adaptation information across Europe." The agency issues guidelines, methods, and tools for this purpose. However, the narrative is general; there are no quantitative measures that are proposed to evaluate benefits and costs of alternative adaption projects. The UKCIP "adaptation wizard" tool follows five steps summarized on the wheel in Figure 3.

Figure 3: UKCIP Adaptation Wizard Wheel that Describes Five Steps of Adaptation.



Source: European Environment Agency (2020)

A climate policy optimized among four climate control mechanisms requires the ability to investigate the trade-off between adaptation and emissions reduction. Because of the general character of adaptation and precise nature of emissions reduction project analysis, measuring the trade-off(s) between these two important climate control mechanisms is rarely attempted.

A notable exception is the work of de Bruin, Dellink, and Tol (2009), who attempt to modify the emission-centric Dynamical Integrated Model of Climate and the Environment (DICE) model to allow adaptation and emissions to be substitutes, competing for available resources but without explicit consideration of the different time lags for deployment. The AD-DICE study shows that Nordhaus' implicit assumption of optimal adaptation can be replaced with an explicit assumption of optimal adaptation, and that the latter model can be calibrated so that the results do not change. Adaptation is difficult to include systematically in global models of optimal trade-offs because adaptation is intensely local and it is hard to separate money spent on adaptation from general spending on infrastructure that is subject to some environmental risks.

The availability of reliable data is extremely important to climate policy and science. However, empirical data that is sufficiently reliable to support behavioral and system relationships is frequently lacking. Variability in data quality is commonly ignored, although there is almost always a large gap between average and best (or worst) of class performance. The differences between global and regional projections are massive because many countries do not have adequate resources devoted to climate data collection and analysis.

The discussion of the AD-DICE model illustrates data challenges: results are based on a single year (1999); there is no indication of how the global result can be disaggregated to regions; and there is no discussion of how technology will influence economic performance parameters out to 2200. The study does include, as it should, sensitivity analysis to test its conclusion, but only for a few high-level variables: the discount rate; climate sensitivity, which sets the relationship between warming and atmospheric concentration; and adaptation protection costs. Econometric models do provide insights that should guide climate policy deliberations, but the quantitative results do not have sufficient fidelity to support program choices.

A final point concerns adaptation for the rich and poor. The United Nations Department of Economic and Social Affairs policy brief (2016) correctly states:

> Climate change has a differential impact on people and communities. The people at greatest risk are the poor, the vulnerable and the marginalized that, in most cases, have been excluded from socioeconomic progress.
>
> Far reaching, transformative policies are needed which simultaneously address immediate vulnerabilities as well as existing structural inequalities.

Adaptation is the climate mechanism that runs most directly into the vulnerability and adaptive capacity of rich and poor counties. In rich countries, much human adaptation can be expected to be put in place by private sector investment that is guided by a realistic view of future costs and benefits. Firms have access to capital for investment in projects with reasonable expectation of positive financial returns.

In poor countries, where there is inadequate access to capital and many competing demands for public investment such as health, education, and economic growth, adaptation projects are generally unaffordable and do not command high priority. The 2018 UNFCCC *Special Report on Global Warming to 1.5°C* is a comprehensive and eloquent statement of these issues. While the financing problem is acknowledged, there has been little progress toward agreement on the mechanism and pace of the transfer of funds.

1.d. Solar Radiation Modification (SRM)

SRM is the deliberate use of technical methods to alter the Earth's radiative balance. This could be achieved by adding aerosols to the atmosphere to increase the Earth's reflectivity so that the climate absorbs slightly less solar energy, which would partly offset the heat-trapping effect of greenhouse gases. SRM is a deliberate intervention into *Radiative Forcing (RF)*, defined as the net effect of human actions altering the Earth's energy balance. SRM can reduce global temperatures and other adverse climate changes, such as storm frequency and sea level rise, that are produced by accumulated greenhouse gases. The climate effect of SRM can be complimentary to actions that reduce the amount of greenhouse gases.

The technology is not new. SRM has been proposed to combat the risk of climate change at least since a report to President Lyndon Johnson in 1965, and was included in reports on climate change issued by the NAS in 1977, 1982, and 1992. Yet the political attention to climate change that grew after the 1992 United Nations Conference on Environment and Development in Rio de Janeiro, also known as the Earth Summit, placed exclusive attention on emissions reductions, and SRM largely disappeared from discussions of the science and politics of climate change. There were also concerns that SRM presented a "moral hazard," tempting policy makers to choose an apparently easy and cheap SRM solution over emissions reduction efforts. Interest in SRM has risen again over the last few years, in part because it may be needed to meet the goal of keeping global temperature increases below 2°C (or even 1.5°C), and in part because research suggests is might be less risky and more effective than had been commonly assumed.

Plausible methods of solar geoengineering include:

- Stratospheric Aerosols: adding aerosols to the stratosphere, where they reflect some (~1 percent) of incoming sunlight back to space (Irvine et al. 2016; NRC 2015; NAS 1992).
- Marine Cloud Brightening: adding cloud condensation nuclei (a specific class of aerosols) such as sea salt to specific kinds of low-lying clouds over the ocean, with the goal of increasing the reflectivity or lifetime of these clouds (Latham 1990).
- Cirrus Thinning: adding ice nuclei (another class of aerosols) to high-altitude cirrus clouds, with the goal of reducing the density of such clouds (Mitchell and Finnegan 2009).[3]
- Other methods include space-based reflectors, tropospheric aerosols, and increasing the reflectivity of crops or other land cover.

There are natural analogs that provide valuable data for assessing SRM effects. Volcanic eruptions (e.g., Pinatubo, Tambora, Krakatoa) released substantial amounts of stratospheric aerosols into the stratosphere, scattering light and producing a negative radiative forcing change (cooling), similar to that expected from adding aerosols to the atmosphere (Robock 2013).

3 Low clouds tend to cool the Earth's surface, so increasing them has a cooling effect, while high clouds tend to warm the surface, hence reducing them will also tend to cool the surface.

1.d.1. Climate response to solar geoengineering

The radiative forcing from solar radiation modification is not the same as the radiative forcing from greenhouse gases (GHGs), so while it's possible to restore the global average surface temperature, the resulting climate would be different from the climate without GHGs (Kravitz et al. 2013). The question is how different? Or, to what extent can some solar radiation modification reduce important climate changes at the regional level?

Climate model simulations show that if SRM is adjusted to offset roughly half the radiative forcing from GHGs, then the change in important climate variables would be spatially uniform, reduced in most locations, and increased in only a small percentage of the land surface.[4] Other SRM methods, such as marine cloud brightening, are expected generally to produce a more uneven climate response.

Around half of the long-run climate responses to a change in radiative forcing are realized within a decade, which means that rapidly scaling up or ending SRM deployment would produce sudden changes in climate.[5] The consequences of such sudden and large changes are not known, but could be highly damaging.

The uncertainty in climate predictions grows with total radiative forcing. Thus, it is plausible that the climate response to a scenario where SRM offsets some radiative forcing can be predicted with greater confidence than a scenario with an equivalent amount of GHGs alone. Reducing uncertainties in the climate response to radiative forcing from GHGs will also improve our understanding of the climate response to radiative forcing from SRM.

1.d.2. SRM uncertainties could be addressed by research

SRM uncertainties that can be narrowed by research and development can be roughly divided into two major domains: *making* radiative forcing and *predicting the climate* response to that radiative forcing. Some useful R&D can be conducted "indoors," but eventually experimental data confirming theory and simulation needs to be conducted "out of doors."

Making radiative forcing: Developing practical SRM methods that could achieve a substantial reduction in net radiative forcing would require collaboration between science and engineering: Scientists need to evaluate if a proposed intervention would result in a substantial reduction in radiative forcing (e.g., testing under what

4 Our quantitative analysis demonstrating this result is currently under review, but Keith and Irvine (2016) reviews the literature to present an argument why this is likely.

5 See Parker and Irvine (2018) for a discussion of the risks of a so-called "termination shock" arising from a sudden cessation of large-scale SG deployment.

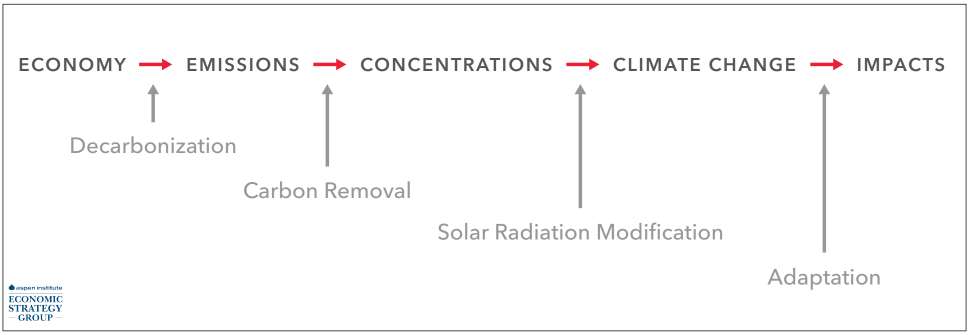
conditions sea-salt aerosols reaching the base of strato-cumulus clouds would result in an increase in cloud albedo), while engineers would need to develop and test the practical means of producing the intervention (e.g., developing and testing a device designed to produce sea-salt aerosols).

Predicting the climate's response to a specific deployment of SRM is a problem closely related to the problem of predicting response to other human influences on climate, most obviously GHG emissions, but also the climate impacts of aerosol pollution. Useful predictions require empirical confirmation from well-specified interventions. This is a challenge for climate science.[6]

2. Idealized Economics of Climate Choices

How might the four instruments be deployed to reduce climate risks? Figure 4 illustrates the causal chain from economic activity to monetized impacts along with the opportunities to disrupt this chain using the four climate control mechanisms.

Figure 4. The Causal Chain



Economic models of global climate choices are often called Integrated Assessment Models (IAMs). While their structure varies substantially, they generally include at least three elements: (1) an energy-economic model of the cost of reducing emissions; (2) a climate model predicting climate change from emissions trajectory; and (3) a model of climate damages. IAMs vary greatly in complexity. The most complex include sectoral and spatially detailed, energy-market models, along with regional models of climate and agriculture. The simplest use just a few equations treating

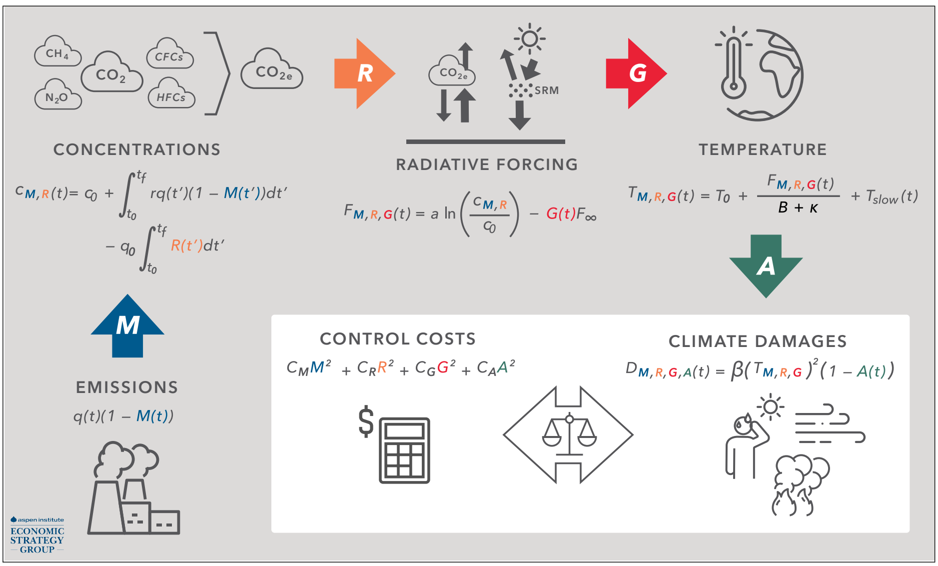
6 Note that David Keith has helped to develop the Stratospheric Controlled Perturbation Experiment (SCoPEx), which aims to reduce uncertainty around microphysics and atmospheric chemistry in stratospheric SRM using a balloon-born experiment that will generate a small aerosol plume .

the world as a single region and specifying a supply curve for emissions mitigation and a single, climate-damage function. The first IAM was the DICE model, developed by Nobel Laureate Bill Nordhaus at Yale University.

IAMs can be used to find an optimal way to allocate scarce resources to maximize welfare by trading off the cost of emissions cuts against monetized climate impacts. Because of the extremely long climate horizon, the enormous number of behavioral relationships, uncertain parameter values, regional variations, and the absence of verifying field data, it is not sensible to take numerical IAM results as a prescription for policy. Yet economic policy models are valuable for policymakers because they reveal linkages, identify structural trade-offs, and expose gaps that inform new research directions. IAMs are also used for regulatory purposes, such as in the United States for calculating the social cost of carbon (SCC)—the environmental damage to the economy from the incremental release of one kilogram of carbon dioxide into the environment.

Most early IAMs considered emissions reduction as the only control mechanism and considered adaptation only implicitly by folding it into estimates of climate damages. Many models now consider some form of CDR, and some have begun to examine SRM. We are both involved in separate efforts to develop simple IAMs that take this more comprehensive view and we report preliminary results here. Figure 5 provides the most important equations in the MARGO model, which illustrate key modeling assumptions in the causal chain of Figure 4.

Figure 5: Modeling Assumptions Underlying the Causal Chain

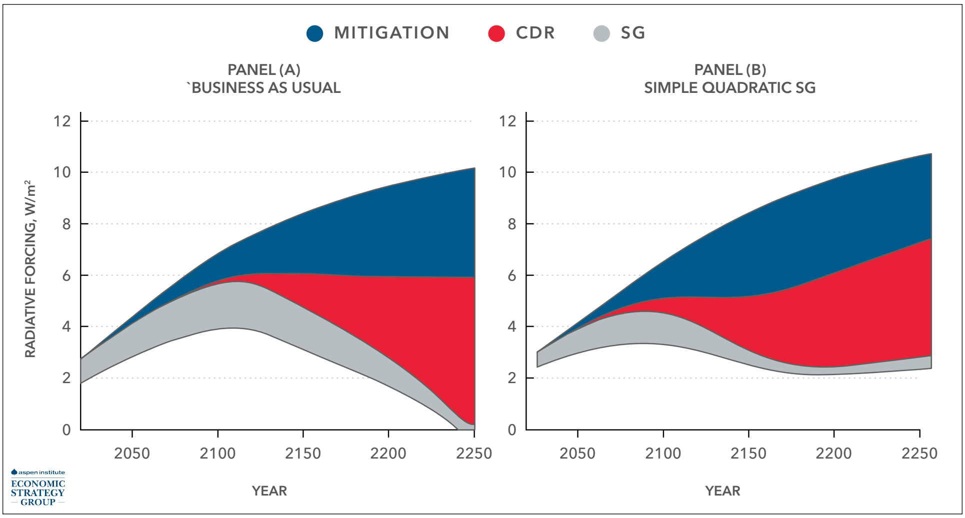


Source: Drake et al. (2020)

Given the deep uncertainties and the structural differences between our models it is surprising and interesting that they agree on the rough time sequence for deployment of emissions reduction, CDR and SRM (Figure 6). Both models find that an optimal policy deploys emission reduction early and uses carbon removal at large scale only after emissions have been substantially reduced while SRM is used for an intermediate period while carbon concentrations are high and is then phased out as concentrations are reduced by CDR.

When the models are tuned to the same simple specification of the damages from SRM they produce quantitatively similar results. Figure 6 shows simulation results from both models for radiative forcing, which is proportional to warming, over a two-hundred-year time horizon. Panel (a) shows results from Belaia, Moreno-Cruz, and Keith (n.d.) using model parameters with a simple quadratic high-end estimate of the damages from SRM chosen for simplicity in matching with MARGO. While in Panel (b) Drake et al. (2020) tuned the MARGO model— a flexible model that allows users to explore various assumptions and compare different cases and parameter values—to the assumptions and parameter values of Keith et al.'s DICE climate model. Perhaps the central lesson is that both models supplement emissions cuts with SRM and CDR to achieve an absolute reduction in temperatures and climate risks within a century—a result that cannot be achieved by emissions cuts alone.

Figure 6. Two Models of the Contributions to Reducing Radiative Forcing from Emissions Reduction "Mitigation," SRM, and CDR



Source: Panel (a) is from Belaia et al. (n.d.); panel (b) Drake et al. (2020)

It is interesting to compare the results for the value of SRM—that is, for the difference between the base model (with SRM) and a version of the same model where SRM is not allowed and only emissions reductions (M) and carbon dioxide removal (R) are included. These results are given in Table 2, which shows the present value (US$ trillions) of baseline damages, control costs, damages after control mechanisms are employed, and the net present benefits for the time period 2020 to 2220 with a 3 percent discount rate. The net present value benefit from including SRM is $39 trillion for MARGO and $58 trillion for modified DICE. The implication here is not the numerical comparison between the two models, but rather confirmation that SRM has significant economic benefit. The benefit is driven by the assumptions of increasing cost of mitigation with penetration and the decreasing cost of CDR with time. Delay in the development or deployment of CDR or SRM may lead to reduction in the social benefit of climate control.

Table 2: Comparison of Optimal Welfare Results for MARGO and Modified DICE.

3% DISCOUNTED PV FOR PERIOD 2020 TO 2220 IN US$ TRILLIONS				
	MARGO		MODIFIED DICE	
	MRG	MR	MRG	MR
Baseline damages	384	384	301	
Control costs	166	176	28	55
Controlled damages	22	51	125	156
Net PV benefits	196	157	148	90

Note: "M" indicates emissions mitigation, "R" indicates carbon dioxide removal, and "G" indicates geoengineering (or solar radiation mitigation). Thus, "MRG" indicates the model includes all three climate control mechanisms, while "MR" excludes SRM.

3. U.S. Policy

Progress controlling climate change requires a massive and rapid increase in the capacity for climate innovation. Innovation refers to the complex process of translating new technology and new business practices into practical application. To be successful, the innovation process must integrate technical, economic, environmental, and regulatory considerations. Increasing R&D spending in federal agencies may be necessary, but it is not sufficient to assure deployment of new climate innovation at scale.

- Successful climate innovation necessitates the mobilization and coordination of a wide range of federal, state, local, and private sector efforts. The traditional federal approach to managing innovation is neither flexible or fast enough especially at the later technology demonstration and first-of-a kind deployment. Changes in climate innovation management we recommend include: Adoption of a multi-year RD&D program plan with input from climate experts, private sector firms, government officials, and the public;
- A single agency with the responsibility and authority to implement the approved program;
- Multi-year climate budgets to finance this program overseen by a single joint congressional climate action committee;
- Adoption of a stable GHG emission charge that will stimulate private sector investment;
- And greater global climate data collection, modeling, and simulation.

We are pessimistic about the likelihood of such fundamental change in the policy landscape. The required changes in the energy economy cover all stages of the innovation process, from idea creation to deployment. This amounts to "industrial policy." We believe government-sponsored innovation initiatives are necessary for advancing climate policy and would benefit the broader U.S. economy. However, there is considerable, thoughtful skepticism toward such "industrial policy." Critics correctly note that the government record in advancing innovation is mixed; the government does not have the expertise that is necessary to make uncertain investment decisions, and the political system has little tolerance for the failures that inevitably occur with RD&D projects. Success is very unlikely unless the changes we recommend in federal innovation management are adopted.

The recent bipartisan *Endless Frontier Act* expands the National Science Foundation's responsibility to maintain U.S. global leadership in innovation, renames the agency the National Science and Technology Agency, and authorizes an additional $100 billion over the next five years. The legislation acknowledges U.S. innovation shortcomings that go well beyond climate change. But the legislation is largely focused on early stage R&D and not the later stages of new technology demonstration and deployment. It will rekindle the ancient debates about creation of an executive department for science and technology, so its passage is far from certain. Other countries are pressing ahead with innovation initiatives. China's strategy is the most comprehensive and impressive. Unsurprisingly, there is great bipartisan concern about the United States maintaining its technical and economic competitiveness.

We next turn to the specific policy issues that arise with management of CDR and SRM. Emissions reduction through clean energy technology and improved energy efficiency will deservedly continue to receive priority attention through established avenues. Expanding adaptation programs deserves high priority, but their structure and implementation depend on local circumstances. Our discussion of CDR- and SRM-innovation policy issues will further underscore the need for fundamental change to how the United States manages innovation.

3.a. Policy Challenges Facing Carbon Dioxide Removal

As discussed above, advancing CDR as a climate control option requires a well-defined development path. However, having a well-defined development path does not mean the project will successfully find funding to cross the "innovation valley of death" to demonstrate commercial viability, especially for technologies that require gigatonne scale to have a substantial impact.

CDR's primary challenges are deployment cost and trusted accounting. Deployment cost is the central barrier for industrial technologies, such as DAC and bioenergy, both of which require carbon capture and sequestration. Trusted accounting is crucial for low-cost, impermanent carbon storage in agriculture or forestry. The private sector cannot be expected to invest in a CDR technology until it has a proven technical performance, an acceptable environmental impact, and a demonstrated market-competitive cost.

The fundamental challenge for policymakers is to design incentives for CDR demonstration that will establish the conditions for future commercial viability of the technology at a time when it is cheaper to avoid emitting a metric ton of carbon dioxide into the environment (or pay an emission charge, if one is in place). Climate models make a clear case that some combination of negative emission technologies or SRM will be needed to limit warming to policy targets such as 20C or 1.50C. Thus, there is a clear public interest in supporting CDR RD&D that will enable this climate control option. We do not believe this readiness can be achieved by exclusive reliance on carbon markets, if they exist, or on mandatory regulation. Some federal support will be required to demonstrate the technical performance of initial, commercial-scale plants.

A number of different federal government-assistance methods are available:

Direct government support for the construction of a first-of-a-kind, commercial-scale demonstration plant on a cost-plus basis: This approach has the disadvantage of requiring the use of Federal Acquisition Regulations that drive costs higher than costs which prevail in the private sector. The government often insists on cost sharing, so contractors have "some skin in the game," and grant intellectual property rights as an incentive to the contractor; a practice which will slow the spread of a successful innovation. This method is widely used by the Department of Defense (DOD) and NASA, but these agencies are single buyers.

Direct government involvement in the planning, structure, and management of a large-scale demonstration project: A pertinent example is CCS, discussed earlier, that supports two key CDR technologies: DAC and BECCS. Absent a carbon emission charge, the private sector cannot be expected to invest in CCS, especially since natural gas-generated electricity is even more economical than coal. On two different occasions, the Department of Energy (DOE) and Congress have chosen to support significant CCS demonstration projects, both of which were not successful (Kelly 2018; Tollefson 2015).

There are several, indirect incentive measures available to the government to provide assistance to CDR demonstration projects that have the advantage of permitting the project to be undertaken on a private-sector basis.

For example, the Renewable Fuel Standard program requirement that motor gasoline must contain 10 percent ethanol, or the Renewable Portfolio Standard program requirement for electric utility generators to dispatch a certain percent of renewables. The latter has been effective in the United States in the great expansion of solar and wind generation and the accompanying dramatic reduction in cost. California's Low Carbon Fuel Standard is a strong incentive for DAC.

Tax credits are an important federal support measure. The 45Q tax credit, as amended in 2019, provides a tax credit of between $35 and $50 per metric ton for the storage or utilization of carbon dioxide. It has a similar intent as federal production tax credits for wind development (KPMG 2020).

Loan guarantees. The government extends guarantees for the debt portion required for project financing. Congress likes this mechanism because it gives the illusion of not requiring a budget outlay. In fact, loan guarantees are scored as a budget outlay. In all administrations, the Department of the Treasury does what it can to block this mechanism and places onerous conditions on DOE loan guarantees for commercial manufacturing and renewable energy (U.S. DOE 2010). Rural cooperatives that are important in energy and farming in many parts of the country are not private firms, and thus receive no benefits from federal loan guarantee programs. More fundamentally, loan guarantee programs protect failure rather than rewarding success.

Production payments. The conceptual basis for this incentive is that the production payment is compensating for a market imperfection—the gap between the private and public costs of carbon emissions. Public payments are intended to be temporary, until such time that the CDR technology learning drives down costs to the point that the technology becomes market competitive, or until a charge is levied on private producers to internalize the external social costs of emissions, thus repairing the market imperfection.

There are a number of production payments that have been tried in different countries for different purposes. Feed-in tariffs were popular to encourage the installation of solar photovoltaics. The United States has extended a 3¢-per-kilowatt-hour production payment for wind generation. Fancier mechanisms, such as reverse auctions for fixed quantities, have also been proposed.

We believe properly designed production payments are the most efficient assistance method, especially for technologies that operate at large scale that the government wants to develop and demonstrate.

3.b. Policy Challenges Facing Solar Radiation Modification

The political issues bearing on SRM are entirely different and more complicated than the issues bearing on CDR. The key issue with CDR technologies is cost. Meanwhile, the direct costs of the SRM methods that are most likely to be implemented appear to be quite small, with the global annualized costs perhaps under $20 billion per year well into the latter half of the century. By comparison, the damage-reduction benefits could be 100 times this amount. It seems reasonable that the favorable cost-benefit potential of SRM justifies a vigorous public R&D effort and careful consideration of the potential role of SRM in future climate policy. However, this proposition is by no means universally agreed. Many believe the uncertainties and dangers of SRM are so great that the option should be ruled out entirely. We outline key political issues facing SRM that need to be resolved in order to move forward.

First, SRM has global reach, and there is no credible mechanism to preclude one nation from premature deployment because of a perceived or real regional impact that might affect their interests. There is a vigorous debate about the nature of the international governance structure that might be desirable to monitor and deter a potential rogue actor.[7] However, there is no way that a SRM deployment would meet the varying interest of all parties equally, because they live in different regions of the world (Ricke et al. 2013).

Second, the unknown global and regional impacts of an extended SRM deployment and the consequences of stopping a long-term deployment are also central issues.

7 Todd Stern, who served as U.S. chief climate negotiator from 2009 to 2016, has written an eloquent article laying out "How to Shift Public Attitudes and Win the Global Climate Battle," in YaleEnvironment360.

Third, many opponents fear the low cost of SRM will reduce efforts on emissions reduction, and possibly prompt a premature deployment by a rogue nation (Parker 2014). There is opposition to any SRM R&D, either indoor or outdoor, because it might confirm low SRM cost.[8]

Finally, there will be some winners and some losers from even the best-managed SRM system. Implicitly, many countries will assume that SRM is being used by rich countries such as the United States to avoid the expense of relying on emissions reduction and increasing climate risk for poorer countries.

We believe immediate implementation of SRM would be premature and will perhaps never be advisable. However, because of its enormous potential benefit, it is in the United States' interest to undertake an aggressive R&D program to acquire a knowledge base for SRM. Such research is obviously relevant in the event SRM is deployed. Because of the global character of SRM, the U.S. effort should cooperate with the SRM efforts of other countries, but not await or expect agreement on a global governance framework. While global governance of deployment is vital, we see no case for global governance of research and development, with the sole exception being experiments that pose significant trans-boundary risks.

We further believe SRM should not be implemented by firms competing in a commercial market. Rather, governments should directly procure and manage SRM deployment activities, much as the DOD and DOE do for national security programs today.

Availability of SRM does not change the reality that net global emissions (including CDR) must eventually be brought to zero. The results of the global climate model summarized earlier suggest that SRM has an important intermediate role in an optimal, low-cost mix with the other three climate control mechanisms—emissions reduction, adaptation, and CDR—in keeping the global temperature increase below 2°C. If SRM is a cost-effective climate control measure that the world may need, it is important to have as much information as possible about its benefits and risks before climate circumstance might make it the only available measure to meet an unforeseen climate emergency.

3.c. Technology Management

Technology management needs to be tailored to the needs of CDR and SRM if there is to be progress on innovation of these two necessary climate control measures. A management and governance structure must be in place at every stage of the

8 Techno-economic assessments suggest that stratospheric aerosols could be delivered with aircraft at a cost of less than \$10 billion per year for 2 Wm-2 (McLellan, Keith, and Apt 2012).

innovation process, from R&D today to possible deployment in the future. At each stage, there needs to be specification of technical objectives, schedules, anticipated cost, and regulatory constraints as well as periodic, independent evaluation of progress.

At the early stage of innovation (low technology readiness) the current process for managing R&D support by the existing federal agencies—notably the DOE, DOD, NSF, and NOAA—is adequate, but certainly could be improved by introducing greater cooperation among private firms and university, government, and independent laboratories. At the later innovation stages, which involve greater investment, we recommend a new, quasi-public agency of the type described above.

We are far from agreement on a governance and management structure with the decision authority needed to implement any specific objective with regard to technical management, hardware development and testing, and operations and performance evaluation. While the pace of development (if it occurs) will be quite different for the two climate control measures, modeling and simulations based on climate data is needed feedback for the system.

Technology development of SRM has particularly important requirements.

- • Research on SRM needs to be tightly integrated with atmospheric science and earth observation. This suggests that NOAA or NASA should be the host agency for SRM.
- • SRM R&D should be mission-oriented. It must go beyond acquiring background knowledge about means and consequences of human intervention, to design and testing of components and systems, with the prospect of eventual integration into an operational system.
- • The SRM program must be managed in a transparent manner because of its international character. Debate about the governance structure will and should continue. We believe a U.S.-led SRM program should respect future governance arrangements, but not await their creation.

3.d. Costs: Who Pays?

We are neither sufficiently brave nor foolish to open a discussion about anticipated total public and private costs of a transition to an essentially carbon-free economy. We offer three brief comments. First, it will be a lot. The U.S. costs could plausibly exceed the annual investment in the energy sector (net of depreciation). One policy objective is to minimize the sum of damages plus the cost of the four climate control mechanisms. Another goal could be to minimize the these same costs subject to maintaining the global average temperature increase under 2°C or 1.5°C over a given time horizon. There is no agreement on a credible plan to transfer and manage the enormous amount of capital required by many of the less wealthy nations of the world.

References

Belaia, Mariia, Juan B. Moreno-Cruz, David W. Keith. (n.d.) Draft Manuscript. "Optimal climate policy in three dimensions."

BNEF. 2020. "Clean Energy Investment Trends, 1H 2020." BloombergNEF. https://about.bnef.com/clean-energy-investment/.

Chambwera, Muyeye, Geoffrey Heal, Carolina Dubeux, Stéphane Hallegatte, Liza Leclerc, Anil Markandya, Bruce A. McCarl, et al. 2014. "Economics of Adaptation." In *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, 945-977. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap17_FINAL.pdf.

CO2CRC. n.d. "Geological Storage Options for CO2." Retrieved from https://co2crc.com.au/wp-content/uploads/2019/11/7-2.jpg.

Davis, Steven J., Nathan S. Lewis, Matthew Shaner, Sonia Aggarwal, Doug Arent, Ines L. Azevedo, Sally M. Benson, et al. 2018. "Net-zero emissions energy systems." *Science* 360(6396). https://science.sciencemag.org/content/360/6396/eaas9793.

de Bruin, Kelly C., Rob B. Dellink, and Richard S.J. Tol. 2009. "AD-DICE: an implementation of adaption in the DICE model." Climate Change 96: 63-81. doi.org/10.1007/s10584-008-9535-5.

Drake, Henri & Rivest, Ronald & Deutch, John & Edelman, Alan. (2020). A multi-control climate policy process for a trusted decision maker. 10.31223/osf.io/5bgyc.

Energy Futures Initiative. 2019. "Clearing the Air: A Federal RD&D Initiative and Management Plan for Carbon Dioxide Removal Technologies." September. Retrieved from https://energyfuturesinitiative.org/efi-reports.

Energy Information Administration. 2019. "Table: World carbon dioxide emissions by region." In *International Energy Outlook 2019*. https://www.eia.gov/outlooks/aeo/data/browser/#/?id=10-IEO2019&region=0-0&cases=Reference&start=2010&end=2050&f=A&linechart=Reference-d080819.26-10-IEO2019&map=&ctype=linechart&sourcekey=0.

European Environmental Agency. European Climate Adaptation Platform Climate-ADAPT. n.d. "The Adaptation Support Tool - Getting Started." Accessed on July 14, 2020. https://climate-adapt.eea.europa.eu/knowledge/tools/adaptation-support-tool.

Field, Christopher B. and Katharine J. Mach. 2017. "Rightsizing carbon dioxide removal." Science 356(6339): 706-709. https://science.sciencemag.org/content/356/6339/706

Institute of Medicine, National Academy of Sciences, and National Academy of Engineering. 1992. *Policy Implications of Greenhouse Warming: Mitigation, Adaptation, and the Science Base*. Washington, DC: The National Academies Press. https://doi.org/10.17226/1605.

IPCC. 2005. *IPCC Special Report on Carbon Dioxide Capture and Storage*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

---. 2018. *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*. https://www.ipcc.ch/sr15/.

Irvine, Peter J., Ben Kravitz, Mark G. Lawrence, and Helene Muri. 2016. "An overview of the Earth system science of solar geoengineering." *WIREs Climate Change* 7: 815–833. https://doi.org/10.1002/wcc.423.

Keith, David W. and Peter J. Irvine. 2016. "Solar geoengineering could substantially reduce climate risks—A research hypothesis for the next decade." *Earth's Future* 4(11): 549–559. https://doi.org/10.1002/2016EF000465.

Keith, David W., Gernot Wagner, and Claire L. Zabel. 2017. "Solar geoengineering reduces atmospheric carbon burden." *Nature Climate Change* 7: 617–619. https://www.nature.com/articles/nclimate3376.

Keith, David W., Geoffrey Holmes, David St. Angelo, and Kenton Heidel. 2018. "A Process for Capturing CO2 from the Atmosphere." *Joule* 2(8): 1573–1594. https://doi.org/10.1016/j.joule.2018.05.006.

Kelly, Sharon. 2018. "How America's clean coal dream unravelled." *The Guardian*, March 2, 2018. https://www.theguardian.com/environment/2018/mar/02/clean-coal-america-kemper-power-plant.

KPMG. 2020. "Drilling Down: Examining the Section 45Q Tax Credit." KPMG Global Energy Institute, March 5, 2020. https://home.kpmg/us/en/home/insights/2020/03/examining-section-45q-tax-credit.html.

Kravitz, Ben, Ken Caldeira, Olivier Boucher, Alan Robock, Philip J. Rasch, Kari Alterskjær, Diana Bou Karam, et al. 2013. "Climate model response from the Geoengineering Model Intercomparison project (GeoMIP)." *Journal of Geophysical Research* 118(15): 8320–8332. https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1002/jgrd.50646.

Krupp, Fred, Nathaniel Keohane, and Eric Pooley. 2019. "Less Than Zero." *Foreign Affairs,* March/April. https://www.foreignaffairs.com/articles/2019-02-12/less-zero.

Latham, John. 1990. "Control of global warming?" *Nature* 347: 339–340. https://doi.org/10.1038/347339b0.

Lempert, Robert, Jeffrey Arnold, Roger Pulwarty, Kate Gordon, Katherine Greig, Cat Hawkins Hoffman, Dale Sands, and Caitlin Werrell. 2018. "Reducing Risks Through Adaptation Actions." In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II,* 1309-1345. U.S. Global Change Research Program, Washington, DC, USA. http://doi.org/10.7930/NCA4.2018.CH28

McClellan, Justin, David W. Keith, and Jay Apt. 2012. "Cost analysis of stratospheric albedo modification delivery systems." *Environmental Research Letters* 7(3). https://doi.org/10.1088/1748-9326/7/3/034019.

Mission Innovation. n.d. "Joint Launch Statement." Accessed July 14, 2020. http://mission-innovation.net/about-mi/overview/joint-launch-statement/.

---. 2019. "Country Highlights." 4th Mission Innovation Ministerial Meeting. http://mission-innovation.net/wp-content/uploads/2019/05/MI-Country-Highlights-2019.pdf.

Mitchell, David L. and William Finnegan. 2009. "Modification of cirrus clouds to reduce global warming." *Environmental Research Letters* 4(4). https://doi.org/10.1088/1748-9326/4/4/045102.

National Research Council 2015. *Climate Intervention: Carbon Dioxide Removal and Reliable Sequestration*. Washington, DC: The National Academies Press. https://doi.org/10.17226/18805.

National Academies of Sciences, Engineering, and Medicine. 2019. *Negative Emissions Technologies and Reliable Sequestration: A Research Agenda*. Washington, DC: The National Academies Press. https://doi.org/10.17226/25259.

NRC [National Research Council]. 1977. *Energy and Climate: Studies in Geophysics*. Washington, DC: The National Academies Press. https://doi.org/10.17226/12024.

---. 1982. *Carbon Dioxide and Climate: A Second Assessment*. Washington, DC: The National Academies Press. https://doi.org/10.17226/18524.

---. 2015. *Climate Intervention: Reflecting Sunlight to Cool Earth*. Washington: National Academies Press.

Parker, Andy. 2014. "Governing solar geoengineering research as it leaves the laboratory." *Philosophical Transactions of the Royal Society A* 372(2031). http://dx.doi.org/10.1098/rsta.2014.0173.

Parker, Andy and Peter J. Irvine. 2018. "The Risk of Termination Shock From Solar Geoengineering." *Earth's Future,* 6(3): 456–467. https://doi.org/10.1002/2017EF000735.

Ramzy, Austin. 2019. "Students Across the World Are Protesting on Friday. Why?" *New York Times*, March 14, 2019. https://www.nytimes.com/2019/03/14/world/europe/climate-action-strikes-youth.html

Ranjan, Manya and Howard Herzog. 2011. "Feasibility of air capture." *Energy Procedia* 4: 2869–2876. https://sequestration.mit.edu/pdf/2011_GHGT10_Ranjan.pdf.

Ricke, Kate, J.C. Orr, K. Schneider, and Ken Caldeira. 2013. "Risks to coral reefs from ocean carbonate chemistry changes in recent earth system model projections." *Environmental Research Letters* 8(3). https://iopscience.iop.org/article/10.1088/1748-9326/8/3/034003/meta.

Robock, Alan. 2013. "The Latest on Volcanic Eruptions and Climate." *Eos* 94(35): 305–306. https://doi.org/10.1002/2013EO350001.

Roe, Gerard H. and Marcia B. Baker. 2007. "Why Is Climate Sensitivity So Unpredictable?" Science, 318(5850): 629–632. https://science.sciencemag.org/content/318/5850/629.abstract.

Tollefson, Jeff. 2015. "US government abandons carbon-capture demonstration." *Nature News*, February 5, 2015. https://www.nature.com/news/us-government-abandons-carbon-capture-demonstration-1.16868.

UN/DESA. 2016. "UN/DESA Policy Brief #48: Adaption to climate change requires transformative policies." United Nations Department of Economic and Social Affairs Policy Brief #48, September 3. https://www.un.org/development/desa/dpad/publication/wess-policy-brief-adaptation-to-climate-change-requires-transformative-policies/.

UNEP. 2019. "Executive summary." In *Emissions Gap Report 2019,* United Nations Environment Programme, Nairobi. https://wedocs.unep.org/bitstream/handle/20.500.11822/30798/EGR19ESEN.pdf?sequence=13

UNFCCC. n.d.-a "Nationally Determined Contributions." Accessed July 14, 2020. https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement/nationally-determined-contributions-ndcs.

---. n.d.-b "New elements and dimensions of adaptation under the Paris Agreement (Article 7)." Accessed August 25, 2020. https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/new-elements-and-dimensions-of-adaptation-under-the-paris-agreement-article-7.

---. n.d.-c "Climate finance in the negotiations." Accessed August 25, 2020. https://unfccc.int/topics/climate-finance/the-big-picture/climate-finance-in-the-negotiations

U.S. DOE. 2010. "Federal Loan Guarantees for Projects that Manufacture Commercial Technology Renewable Energy Systems and Components." Loan Guarantee Solicitation Announcement. U.S. Department of Energy Loan Guarantee Program Office. https://www.energy.gov/sites/prod/files/2014/03/f14/sol-08-12-10.pdf

White House Science Advisory Committee. 1965. "Restoring the Quality of our Environment." Report of the Environmental Pollution Panel, President's Science Advisory Committee, November.

Author Biographies

DAVID AUTOR

Ford Professor of Economics, Massachusetts Institute of Technology

David Autor is Ford Professor in the MIT Department of Economics, codirector of the NBER Labor Studies Program, and coleader of both the MIT Work of the Future Task Force and the JPAL Work of the Future experimental initiative. His scholarship explores the labor-market impacts of technological change and globalization on job polarization, skill demands, earnings levels and inequality, and electoral outcomes. Autor has received numerous awards for both his scholarship—the National Science Foundation CAREER Award, an Alfred P. Sloan Foundation Fellowship, the Sherwin Rosen Prize for outstanding contributions to the field of Labor Economics, and the Andrew Carnegie Fellowship just last year—and for his teaching, including the MIT MacVicar Faculty Fellowship. In 2017, Autor was recognized by Bloomberg as one of the 50 people who defined global business. In a 2019 article, the Economist magazine labeled him as "The academic voice of the American worker." Later that same year, and with (at least) equal justification, he was christened "Twerpy MIT Economist" by John Oliver of Last Week Tonight in a segment on automation and employment.

TIMOTHY J. BARTIK

Senior Economist, W.E. Upjohn Institute for Employment Research

Timothy J. Bartik is a senior economist at the Upjohn Institute for Employment Research, a non-profit and non-partisan research organization in Kalamazoo. He co-directs the Institute's research initiative on place-based prosperity, Investing in Community. Bartik's research focuses on state and local economic development and local labor markets. His most recent book is Making Sense of Incentives: Taming Business Incentives to Promote Prosperity (2019). Dr. Bartik received his B.A. from Yale, and his Ph.D. in economics from the University of Wisconsin-Madison.

ERSKINE BOWLES

Co-Chair, Economic Strategy Group
President Emeritus, The University of North Carolina

Erskine Bowles is co-chair of the Aspen Economic Strategy Group and the chairman of the board of advisors of BDT Capital Partners. He began his business career at Morgan Stanley and went on to found and lead Bowles, Hollowell, Conner, which became the preeminent investment bank focused on middle market mergers and acquisitions. He subsequently co-founded the middle market private equity firm Carousel Capital, served as a senior advisor for Credit Suisse First Boston, and as a partner with the global buyout firm Forstmann Little & Co. He previously served on the boards of Morgan Stanley (Lead Director), First Union Corporation, Merck, VF, Cousins Properties (Lead Director), Norfolk Southern Corporation, General Motors, Belk and Facebook. In his public sector career, Erskine served in the Clinton Administration as SBA Administrator, Deputy White House chief of staff, and chief of staff. During his time in the White House, he negotiated the first balanced budget in a generation. Erskine co-chaired with Senator Alan Simpson the National Commission on Fiscal Responsibility and Reform, and from 2005-2011, he served as the president of the University of North Carolina.

JOHN M. DEUTCH

Institute Professor, Massachusetts Institute of Technology

John Deutch is an emeritus Institute Professor at the Massachusetts Institute of Technology. Mr. Deutch has been a member of the MIT faculty since 1970 and has served as Chairman of the Department of Chemistry, Dean of Science, and Provost. Mr. Deutch has published over 160 technical publications in physical chemistry, as well as numerous publications on technology, energy, international security, and public policy issues. He served as Director of Central Intelligence from May 1995-December 1996. From 1994-1995, he served as Deputy Secretary of Defense and served as Undersecretary of Defense for Acquisition and Technology from 1993-1994. He has also served as Director of Energy Research (1977-1979), Acting Assistant Secretary for Energy Technology (1979), and Undersecretary (1979-80) in the United States Department of Energy. He is a member of the Aspen Strategy Group.

INGRID GOULD ELLEN

Paulette Goddard Professor of Urban Policy and Planning and Faculty Director of NYU Furman Center for Real Estate and Urban Policy, New York University

Ingrid Gould Ellen is a Professor at NYU's Wagner Graduate School of Public Service and a Faculty Director at the NYU Furman Center for Real Estate and Urban Policy. Professor Ellen's research interests center on housing and urban policy. She is author of Sharing America's Neighborhoods: The Prospects for Stable Racial Integration (Harvard University Press, 2000) and more recently editor of The Dream Revisited: Contemporary Debates About Housing, Segregation and Opportunity (Columbia University Press, 2019). She has written numerous peer-reviewed journal articles and book chapters related to housing policy, community development, and school and neighborhood segregation. Professor Ellen has held visiting positions at the Department of Urban Studies and Planning at MIT, the U.S. Department of Housing and Urban Development, the Urban Institute and the Brookings Institution. She attended Harvard University, where she received a bachelor's degree in applied mathematics, an M.P.P., and a Ph.D. in public policy.

AMY GANZ

Deputy Director, Economic Strategy Group

Amy Ganz is Deputy Director of the Economic Strategy Group. She has worked in several policy research and analysis roles focused on tax policy, housing and urban policy, and state and local finance. She holds a BA in economics and political science from Wheaton College and an MPA in public policy analysis from NYU Wagner School of Public Service.

TREVOR HOUSER

Partner, Rhodium Group

Trevor Houser is a partner with the Rhodium Group and leads the firm's Energy & Climate team. This interdisciplinary group of policy experts, economic analysts, energy modelers, data engineers and climate scientists analyze the market impact of energy and climate policy and the economic risks of global climate change. Trevor also co-directs the Climate Impact Lab, a collaboration of leading research institutions combining climate, economic and data science to quantify climate risk around the world. Through this partnership, Rhodium provides actionable information to policymakers, investors, academics, non-profit organizations and business leaders alike. Trevor also directs the Climate Policy Fellows program at the City College of New York, his alma mater. During 2009, Trevor left Rhodium temporarily to serve as a senior advisor at the US State Department where he worked on international energy, natural resource and environmental policy issues. From 2009 to 2015 Trevor was a Visiting Fellow at the Peterson Institute for International Economics.

MELISSA S. KEARNEY

Director, Economic Strategy Group
Neil Moskowitz Professor of Economics, University of Maryland

Melissa S. Kearney is the Neil Moskowitz Professor of Economics at the University of Maryland. Kearney's academic research focuses on poverty, inequality, and social policy in the U.S. Her work has been published in leading academic journals. She is also Director of the Aspen Economic Strategy Group; a Research Associate at the National Bureau of Economic Research (NBER); and a non-resident Senior Fellow at Brookings. She is a senior editor of the Future of Children, an editorial board member of the American Economic Journal: Economic Policy, Journal of Economic Literature, and Demography, and she was previously co-editor of the Journal of Human Resources. She serves on advisory boards for the Notre Dame Wilson-Sheehan Lab for Economic Opportunities (LEO), Smith Richardson Foundation, and Russell Sage Foundation. Kearney previously served as Director of the Hamilton Project at Brookings and as co-chair of the MIT J-PAL State and Local Innovation Initiative. Kearney teaches Public Economics at both the undergraduate and PhD level at the University of Maryland. She holds a BA in Economics from Princeton University and a PhD in Economics from the Massachusetts Institute of Technology

DAVID W. KEITH

Professor of Applied Physics and Public Policy, Harvard University School of Engineering and Applied Sciences and John F. Kennedy School of Government

David Keith has worked near the interface between climate science, energy technology, and public policy since '91. Best known for his work on the science, technology, and public policy of solar geoengineering, David led the development of Harvard's Solar Geoengineering Research Program. He took first prize in Canada's national physics prize exam, won MIT's prize for excellence in experimental physics, and was one of TIME Magazine's Heroes of the Environment. David is a Professor at the Harvard School of Engineering and Applied Sciences and at the Harvard Kennedy School, and founder of Carbon Engineering, a Canadian company developing technology to capture CO2 from ambient air.

JEFF LARRIMORE

Section Chief, Board of Governors of the Federal Reserve System

Jeff Larrimore is the section chief for the Consumer and Community Research Section at the Federal Reserve Board. At the Federal Reserve, he has worked as the lead economist on the Survey of Household Economics and Decisionmaking since 2014. This survey monitors the financial circumstances of U.S. families, with an emphasis on how low and middle income individuals are faring. Much of Jeff's research focuses on income inequality, income mobility, and the implications of taxes and public transfers on the distribution of economic resources. His recent research uses IRS tax data to explore income trends in the United States since the Great Recession. His work has been featured in the New York Times, the Wall Street Journal, the Washington Post, and other news outlets. Jeff previously worked as a senior economist for the Council of Economic Advisers focusing on employment policies and as an economist for the Joint Committee on Taxation estimating the impacts of tax legislation on federal tax revenues. He received his Ph.D. in economics from Cornell University, his B.A. in economics and political science from Davidson College.

ADAM LOONEY

Executive Director of the Marriner S. Eccles Institute and Professor of Finance at the David Eccles School of Business, The University of Utah, Non-resident Fellow, Brookings Institution

Adam Looney is Executive Director of the Marriner S. Eccles Institute and Professor of Finance at the David Eccles School of Business at the University of Utah and a non-resident fellow at the Brookings Institution. Previously, he was the Joseph A. Pechman senior fellow in Economic Studies at Brookings and the Director of the Center on Regulation and Markets. While at Brookings, he has been called to testify in the Congress by members of both parties on tax and student loan policy, and his research has influenced the development of federal tax policies and education reforms. Earlier, he served as Deputy Assistant Secretary for Tax Analysis at the U.S. Treasury Department. At Treasury, he advised the Secretary on economic issues related to tax policy, analyzed current and proposed legislation, and provided the official receipts forecasts and revenue estimates for the Administration’s budgets. Under his direction, the office initiated research projects on topics including business tax reform, capital gains taxation, and a carbon tax. He also studied the causes and consequences of student loan distress and the economic returns to postsecondary education and played an instrumental role in the advancement of several data-intensive projects including the production of the Department of Education’s College Scorecard. Prior to joining the Treasury, Mr. Looney was policy director of

The Hamilton Project and was a senior fellow in Economic Studies at Brookings from 2010-2013. Previously, he served as the senior economist for public finance and tax policy with President Obama's Council of Economic Advisers and was an economist at the Federal Reserve Board. He received a Ph.D. in economics from Harvard University and a B.A. in economics from Dartmouth College.

GILBERT E. METCALF

John DiBiaggio Professor of Citizenship and Public Service and Professor of Economics, Tufts University

Gilbert Metcalf is the John DiBiaggio Professor of Citizenship and Public Service and Professor of Economics at Tufts University. In addition, he is a Research Associate at the National Bureau of Economic Research and a University Fellow at Resources For The Future. Metcalf's research focuses on policy evaluation and design in the area of energy and climate change. He has frequently testified before Congress, served on expert panels for the National Academies of Sciences and the U.S. Environmental Protection Agency, and served as a consultant to numerous other organizations. During 2011 and 2012, he served as the Deputy Assistant Secretary for Environment and Energy at the U.S. Department of Treasury where he was the founding U.S. Board Member for the UN based Green Climate Fund. He has published extensively in academic journals and books on various topics including energy and tax policy. His most recent book, Paying for Pollution: Why a Carbon Tax is Good for America, was published by Oxford University Press last year. Metcalf received a B.A. in Mathematics from Amherst College, an M.S. in Agricultural and Resource Economics from the University of Massachusetts Amherst, and a Ph.D. in Economics from Harvard University.

KATHERINE M. O'REGAN

Professor of Public Policy and Planning;
Director of Master of Science in Public Policy Program, New York University

Katherine O'regan is Professor of Public Policy and Planning at NYU Wagner. She also serves as Faculty Director of the Master of Science in Public Policy Program and Faculty Director of the Furman Center for Real Estate and Urban Policy. She spent April 2014-January 2017 in the Obama Administration, serving as the Assistant Secretary for Policy Development and Research at the Department of Housing and Urban Development. She holds a Ph.D. in economics from the University of California at Berkeley and spent ten years teaching at the Yale School of Management prior to joining the Wagner faculty in 2000. She teaches courses in microeconomics, poverty, program evaluation, and urban economics, and has received teaching awards from Berkeley, Yale, and NYU. Her primary research interests are at the intersection of poverty and space --the conditions and fortunes of poor neighborhoods and those who live in them. Her research includes work on a variety of affordable housing topics, from whether the Low Income Tax Credit contributes to increased economic and racial segregation, to whether the presence of housing voucher households contributes to neighborhood crime rates. Recent work also includes several projects examining neighborhood transitions over the past few decades, including possible broad causes (changes in federal housing policy, and changes in crime, in particular), and outcomes (including possible displacement, and improvements in neighborhood conditions). Among others, she has served on the board of the Reinvestment Fund, the advisory board for NYU's McSilver Institute for Poverty Policy and Research, and the editorial board for the Journal of Policy Analysis and Management.

HENRY M. PAULSON, JR.

Co-Chair, Economic Strategy Group
Chairman, Paulson Institute

Henry M. Paulson Jr. is the founder and chairman of the Paulson Institute, which aims to foster a United States-China relationship that maintains global order in a rapidly evolving world. He is also the co-chair of the Aspen Economic Strategy Group, and co-chair of the Bloomberg New Economy Forum Advisory Board. Paulson served as the 74th Secretary of the Treasury under President George W. Bush, from July 2006 to January 2009. Prior to that, he had a 32-year career at Goldman Sachs, serving as co-chairman and co-chief executive officer beginning in 1998, and as chairman and chief executive officer beginning in 1999. A lifelong conservationist, Paulson was chairman of The Nature Conservancy Board of Directors and, prior to that, founded and co-chaired the organization’s Asia-Pacific Council. In 2011, he founded the Latin American Conservation Council, comprised of global business and political leaders, which he co-chaired until 2017. He also co-chaired the Risky Business Project from 2013 to 2017, a nonpartisan initiative that quantified and publicized the economic risks of climate change in the U.S. Earlier in his career, he was a member of the White House Domestic Council as well as a staff assistant at the Pentagon. Paulson is the author of three books, most recently Firefighting: The Financial Crisis and its Lessons (with Ben Bernanke and Tim Geithner). Other books include the bestsellers On the Brink and Dealing with China. He graduated from Dartmouth College and received an M.B.A. from Harvard University.

BRUCE SACERDOTE

Richard S. Braddock 1963 Professor in Economics, Dartmouth College

Bruce Sacerdote is the Richard S. Braddock 1963 Professor of Economics at Dartmouth College, a Research Associate at the National Bureau of Economic Research and a co-Director for the Jameel Poverty Action Lab's State and Local Initiative. His current work focuses on the economics of education with an emphasis on helping young adults attend, persist, and graduate from college. He is a principal investigator on a set of experiments designed to encourage more high school seniors to apply to and attend college. A second set of experiments is aimed at helping community college students succeed and graduate. In related work he and coauthors are investigating the long run impacts for Veterans who receive the Post 9/11 GI Bill. All of Sacerdote's projects include a large and hardworking set of undergraduate research assistants, Presidential Scholars and co-authors. Current projects employ twelve different undergraduates including one full time project manager and another who is the first author on the study. Sacerdote teaches a senior seminar in finance. One course highlight are the frequent and lively guest lectures from dedicated Dartmouth alumni who are working in varied aspects of finance. His work has been published in (among other places) American Economic Review, Econometrica, the Quarterly Journal of Economics, American Economic Journal, and the Review of Economics and Statistics. And it has been featured in the New York Times, the Wall Street Journal and National Public Radio. Bruce and his wife Michele live in Hanover with their three children Leo, Sam, Sofia.

DAN SILVERMAN

Professor and Rondthaler Chair, W.P. Carey School of Business, Arizona State University

Dan Silverman is the Rondthaler Professor of Economics at Arizona State University. Prof. Silverman studies public economics and has pioneered the use of financial aggregator data for economics research. Often linking these administrative data to traditional surveys, his work has contributed to how economists think about and measure the quality of decision-making, and his study of economic rationality won the Schmölders Prize in 2016. Prof. Silverman has studied several questions related to social insurance and his analysis of advantageous selection in the Medigap insurance market received the 2009 iHEA Arrow award for the best paper in health economics. He is a Research Associate of the National Bureau of Economic Research and co-editor of the American Economic Journal: Economic Policy. Prior to becoming an economist, Prof. Silverman led outreach programs for a Community Development Credit Union serving low-income communities in Newark, NJ. Prof. Silverman received a B.A. in political science from Williams College, a M.A. in Public Policy from Harvard University, and a Ph.D. in Economics from the University of Pennsylvania.

DAVID SPLINTER

Economist, Joint Committee on Taxation

David Splinter is an economist at the nonpartisan Joint Committee on Taxation, U.S. Congress, where he analyzes tax proposals. He received his PhD in economics from Rice University. His research on income inequality, income mobility, and tax policy is available at davidsplinter.com.

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Henry M. Paulson, Jr.
Founder and Chairman
The Paulson Institute

Erskine Bowles
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The University of North Carolina

ASPEN INSTITUTE CHAIRMAN

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President and CEO
TIAA

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Chairman & CEO
BlackRock

Kristin J. Forbes
Jerome and Dorothy Lemelson Professor of Management and Economics
Massachusetts Institute of Technology

Jason Furman
Professor of the Practice of Economic Policy
Harvard University

Timothy F. Geithner
President
Warburg Pincus

Austan D. Goolsbee
Robert P. Gwinn Professor of Economics
The University of Chicago Booth School of Business

Danielle C. Gray
SVP, Chief Legal Officer & Corporate Secretary
Blue Cross and Blue Shield of North Carolina

Jon Gray
President and Chief Operating Officer
Blackstone

Bill Haslam
49th Governor of Tennessee

Keith Hennessey
Lecturer in Economics
Stanford Graduate School of Business

Fred Hiatt
Editorial Page Editor
The Washington Post

Penny Pritzker
Chairman
PSP Partners

Bruce Reed
CEO and Co-Founder
Civic LLC

Robert E. Rubin
Co-Chairman Emeritus
Council on Foreign Relations

Margaret Spellings
President and CEO
Texas 2036

Gene Sperling
Former Director
National Economic Council

William Spriggs
Professor
Howard University
Chief Economist
AFL-CIO

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Chairman
Perella Weinberg Partners

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President Emeritus and Charles W. Eliot University Professor
Harvard University

Phillip Swagel
Director
Congressional Budget Office

Kevin Warsh
Shepard Family Distinguished Visiting Fellow
Stanford University

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Chairman, President & CEO
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Janet Yellen
Distinguished Fellow in Residence
Brookings Institution

Robert Zoellick
Senior Counselor
Brunswick Group