ECONOMIC POLICY

IN A MORE UNCERTAIN WORLD

Foreword by **HENRY M. PAULSON, JR.** and **TIMOTHY F. GEITHNER**

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

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This volume was produced to provide policy-relevant evidence about current challenges confronting the American economy. Authors are invited to share their views about policy issues, which do not necessarily represent those of the Aspen Institute, members of the Aspen Economic Strategy Group, or their affiliated organizations.

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Foreword

Henry M. Paulson, Jr. and Timothy F. Geithner

The Aspen Economic Strategy Group releases its fifth annual policy volume against a backdrop of historic economic and strategic uncertainty.

Supply shocks resulting from a senseless Russian war in Ukraine are exacerbating already soaring energy and food prices. Increasing hostility between the United States and China is accelerating the transition to a world of rival economic blocs. A global energy crisis threatens political upheaval and undermines both economic security and progress toward the world's climate goals.

The upshot is a world economy thrown into an era of uncertainty, unlike any we have seen since the end of the Cold War. How can the United States navigate this new era? The challenge facing economic policymakers is to ensure American firms and workers are able to thrive in the face of these global shifts.

Can US firms continue to innovate the technologies of the future if crucial links to global talent are cut off? Will the recent push for industrial policy help or hurt American firms competing with foreign companies? To what extent can public policy alter America's demographic trends towards an aging population and lower fertility? Can workers adapt to the shifting labor markets caused by the global energy transition?

This policy book examines these questions and highlights potential policy directions that are informed by the evidence. The first section grapples with issues around government-directed science and technology funding, the role of talent in advancing innovation, and the structure of R&D investments.

The second section discusses America's demographic challenges: the causes of America's declining population growth, why it matters, and what can or cannot be done in response.

The third section discusses the challenges confronting US workers and firms. It raises questions and proposes solutions for how to deal with the impact of the green energy transition on the labor force. It also features policy lessons learned from the unprecedented federal aid provided to state and local governments during COVID-19.

This volume is not intended to represent the consensus view of the Aspen Economic Strategy Group membership. Rather, its intent is to bring to bear the best economic research in service of non-partisan policy solutions that can better position the United States for a more uncertain world..

Introduction

Melissa S. Kearney* and Amy Ganz**

December 2022

Economic policymakers are confronting the highest inflation in a generation, energy supply shortages, and shifting geopolitical alliances. These challenges rightfully occupy news headlines and policy debates, but longer-run headwinds in the American economy also warrant focused attention. This volume aims to highlight three such challenges and provide constructive policy options for addressing them: the need to promote long-run productivity growth through investments in science and innovation; US demographic challenges including population aging, declining fertility, and restrictive immigration policies; and ongoing labor market reallocation driven by technological change and the transition to green energy.

This volume is organized into three parts. Part I focuses on *Economic Security, Science Funding, and Innovation Policy,* topics of critical and timely economic importance on which the AESG has now focused for several years. The chapters in this section consider how funding should be directed to advance US scientific innovation. Moving beyond the question of whether the country ought to increase investment in innovation (the consensus being a clear yes), this year's volume addresses *how* to move an innovation agenda forward. Chapter 1 describes macroeconomic economic trends that have hampered US innovation and discusses policies to promote greater competition and innovation. Chapter 2 describes trends in US science and innovation funding.

Part II focuses on *US Demographic Challenges and Potential Policy Responses.* Chapter 3 describes the causes and consequences of declining US fertility and policies to address the decline in births. Chapter 4 describes the current state of US immigration and argues for the expansion of both low- and high-skill immigration to help address US demographic challenges. Chapter 5 discusses the role of population aging in America's fiscal trajectory and the distributional choices policymakers are making to shift America's budget imbalance across and within generations.

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Part III focuses on *Challenges Facing US Workers and Firms*. Chapter 6 describes the local labor market impacts that are expected to result from the transition to green energy and targeted policies to mitigate the costliest impacts. Finally, Chapter 7 gleans lessons from federal aid allocated to state and local governments during the COVID-19 pandemic, highlighting how pandemic aid to individuals and households successfully shored up household balance sheets and in turn stabilized local government tax revenue bases, even before unprecedented federal assistance was provided directly to states and localities.

I. Economic Security, Science Funding, and Innovation Policy

In July 2022, the US Congress passed into law the $280 billion CHIPS and Science Act, which was motivated by mounting alarm over the magnitude of China's industrial policy and emphasis on fortress economics. The legislation provides $81 billion for the National Science Foundation (NSF) to fund translational science and basic research and to invest in STEM education and training, nearly $70 billion for Department of Energy research and development programs, and $11 billion for the Department of Commerce to "build regional innovation and to assist economically disadvantaged communities." The CHIPS Act also revived longstanding debates over industrial policy by providing $52 billion for direct subsidies and tax credits for semiconductor manufacturing.

Along with bolstering national economic security, the bipartisan commitment to increase funding for scientific innovation reflects the widespread recognition that scientific research serves as the backbone to domestic economic growth and global competitiveness. The 2019 AESG paper by Jon Van Reenen described the crucial role of science and innovation in promoting long-run economic growth and productivity. The 2021 AESG paper by Ben Jones described the comprehensive evidence on the high social returns associated with public sector R&D investment in scientific research.

Market competition plays a critical role in spurring innovation. This is a key theme of Chapter 1, *New Insights for Innovation Policy* by Ufuk Akcigit and Sina T. Ates. The authors note that the decline in business dynamism in the United States over the past four decades has been characterized by fewer firm entries and exits, less representation of young firms as a proportion of economic activity, lower levels of labor reallocation, and a greater dispersion in productivity and growth among firms within industries. Importantly, the changing structure of industries and their competitive dynamics has resulted in a slowdown in knowledge diffusion between market leaders and their competitors, a phenomenon that both contributes to and

is the result of decreased competition.[1]   The authors describe how patents and inventors are increasingly clustered in larger firms, suggesting that market leaders are further insulating themselves from competition.

Akcigit and Ates then highlight market-based policies that might better harness market forces to promote competition and innovation. Specifically, as industry structures evolve such that leaders have fewer domestic rivals, foreign competition is increasingly important. The authors emphasize the positive effects of trade liberalization on innovation and productivity growth, particularly in response to domestic market dynamics that might naturally lead to greater concentration and less competition. They further highlight the creation of a secondary market for patents, which would both encourage knowledge diffusion and promote patent ownership by the most productive users.

The authors also address recent concerns over foreign investment in young US technology companies. Their research suggests that foreign investment is likely easing capital constraints, as evidenced by observed increases in patenting activity by US start-ups after receiving foreign investment. They conclude that security concerns associated with reverse technology transfers must be balanced with foreign investment's substantial benefits for competition and innovation.

Akcigit and Ates highlight several relevant findings for policymakers from their research on patents, immigration, and education. First, they note that foreign inventors are highly responsive to changes in income tax policy. Substantial increases in top income taxes are therefore likely to dissuade innovators from staying in the United States. Next, they note a strong complementarity between high-quality education and innovation. Children in the top 5 percent of US households by parental income are far more likely to become inventors than are children in the remainder of the distribution. However, this effect disappears once the children's educational attainment is accounted for, suggesting that improvements in the quality of education throughout the country could invigorate innovation. Finally, the authors observe that innovating countries ought to take advantage of global talent pools to remain competitive, especially as cultivating more native-born talent requires substantial investment and time.

Chapter 2, *Seven Recent Developments in US Science Funding,* prepared by AESG staff Amy Ganz and Emily Vincent, provides an overview of the composition and structure of US scientific funding and performance. The United States spends over $700 billion on R&D annually, a figure that has grown in real terms by an average of 6 percent per

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1   A set of papers published by the AESG in 2019 described trends in US market concentration and how they may impact competition and innovation (Philippon, 2019; Rose, 2019).
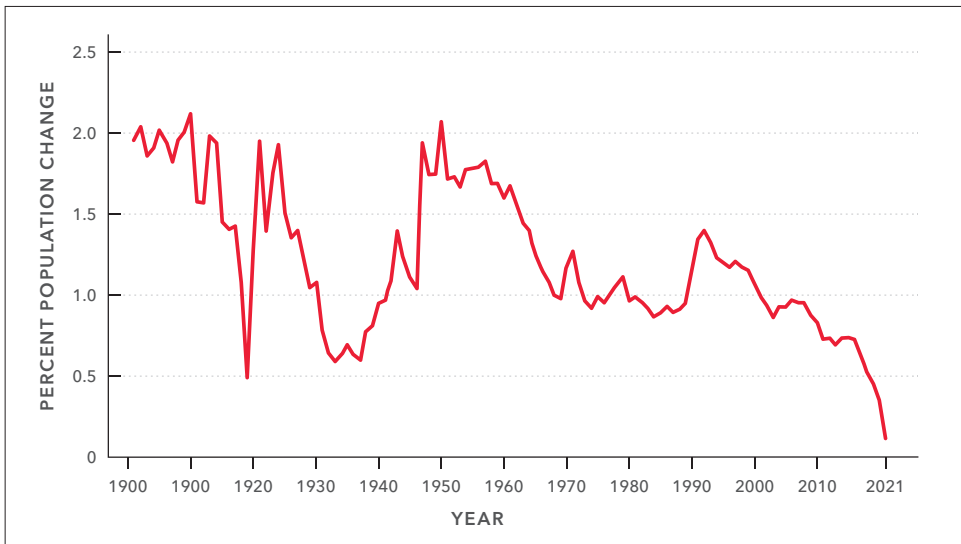
year over the past decade. Most of this growth has been driven by the business sector, which spends proportionately more on later-stage applied and experimental research than it does on early-stage basic research. Since the late 2000s, federal expenditures on R&D have also shifted toward tax incentives and away from direct financing. Prior to the passage of the CHIPS and Science Act, which authorized approximately $70 billion above baseline spending levels for R&D between 2023 and 2028,[2] the federal government had authorized roughly $170 billion in 2022 for direct R&D expenditures. That figure excludes the cost of the R&D tax credit, which is estimated to be $16 billion in 2022 (Joint Committee on Taxation, 2020).

This chapter also describes the distribution of federal R&D funding across federal agencies. Roughly 95 percent of federal R&D funds are concentrated among five departments or agencies: the Department of Defense, the National Institutes of Health, the Department of Energy, NASA, and the National Science Foundation. Finally, the chapter compares and contrasts various approaches taken by federal departments and agencies to allocate research funding, particularly peer review and portfolio approaches.

II. US Demographic Challenges

US population growth has been shrinking for over a decade, and underlying trends suggest that no reversal is in sight. Figure 1, reproduced from the US Census, shows a large decline in US population growth in 2020, due in significant part to more than one million excess deaths resulting from the COVID-19 pandemic (per CDC mortality estimates). But the figure also clearly illustrates that the slowdown in US population growth is a secular phenomenon—population growth has trended downward for nearly two decades. Census estimates show that annual population growth has been below 1 percent for many years now. The US resident population grew by less than 0.5 percent in 2019, possibly the slowest peacetime rate the country has ever experienced. Aside from during the Spanish Flu episode of 1918-1919, the Great Depression, and WWII, annualized US population growth has rarely fallen below 1 percent.

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2   We include in this total the $36 billion over baseline for NSF translational and basic research, $2.8 billion for National Institutes of Standards and Technology (NIST) research, and $30.5 billion over baseline for the Department of Energy's Office of Science and additional Science and Energy (S&E) innovation.

Figure 1. Annual Percent Change in the US Population, 1900–2021

Though some observers cheer this decline, contending that a smaller population is good for the planet (a claim that echoes the Malthusian sentiments of the 18th century), the overwhelming weight of economic reasoning and data suggest that slowdown in US population growth poses a range of economic challenges, as discussed below.

The slowdown in US population growth is attributable to three factors: falling fertility, falling net international migration, and rising mortality due to an aging population. Figure 2, also reproduced from the US Census, shows how these factors have contributed to the slowdown.

Figure 2. Population Change and Its Components, 2001–2021

*Components of change include births, deaths, and net international migration.

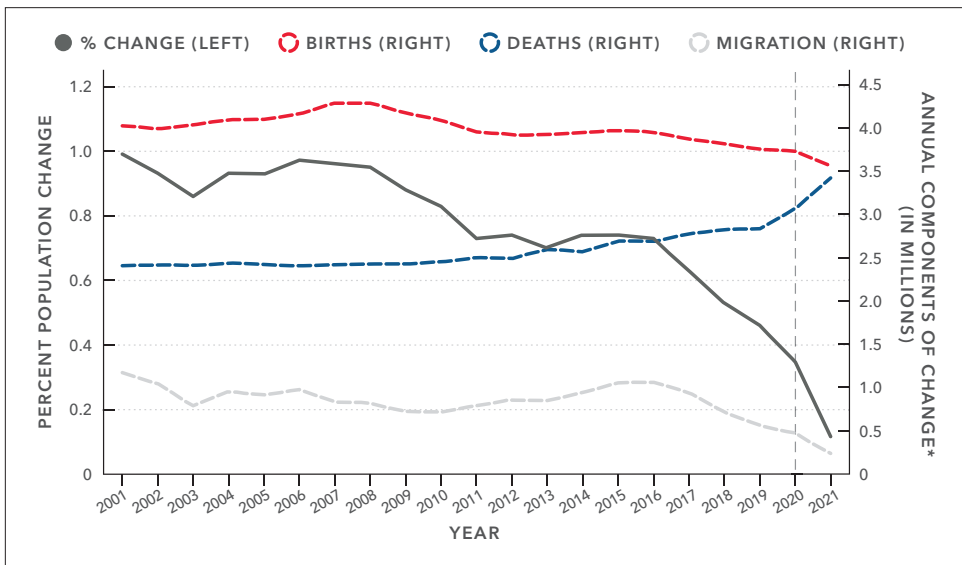**Sources:** Rogers (2021); US Census Bureau, Vintage 2020 Estimates; Vintage 2021 Estimates; 2000–2010 Intercensal Estimates.

Note: Only data to the right of the vertical dashed line are from Vintage 2021.

The US birth rate has been falling almost continuously since 2007. COVID-19 led to a larger than expected drop in 2020 and somewhat of a rebound in 2021, but this COVID effect is just a small blip on an otherwise steady downward trend. In Chapter 3, *The Causes and Consequences of Declining US Fertility*, Melissa S. Kearney and Phillip B. Levine document that births are down by 18 percent since 2007 and that the US total fertility rate is now considerably below replacement level. These demographic shifts bring the country into trend with many other high-income nations, which have experienced declines in population growth for several decades.

The decline in the US fertility rate reflects widespread declines in childbearing across women of different races, ethnicities, and education levels, as well as across geographic regions. Women are not merely delaying childbearing to older ages, but are having fewer children over their childbearing years. Looking across cohorts, the authors document a clear downward shift in lifetime fertility across recent generations of women.

Kearney and Levine argue that there is no evidence that any particular policy, cost, or economic factor has changed in recent years in a way that could explain the steady, widespread decline in US birth rates. Rather, they propose that broader social factors

are at play, and have led to "shifting priorities" among young American adults such that they are choosing in greater numbers to remain childless or to have smaller families than had their predecessors. In this way, the US fertility rate is converging toward those of other high-income countries, including many European countries that have sustained total fertility rates below the replacement level (approximately 2) for multiple decades.

Based on existing evidence, the authors suggest that the types of pro-natalist policies that have been implemented and evaluated in the United States and in other high-income countries—including modest child allowances, tax credits, paid family leave, and subsidized childcare—are unlikely to lead to substantial or sustained increases in the birth rate such that the US total fertility rate would rebound to replacement level. Barring a reversal in the fertility decline, the authors note that the country could instead maintain its working-age population with a sizable increase in immigration. Of course, US immigration policy poses its own set of challenges.

Chapter 4, *Why and How to Expand US Immigration* by Tara Watson, addresses upcoming challenges and opportunities for US immigration policy. Annual net inflows of migrants have fallen since 2016, and the foreign-born population has stagnated over recent years. While annual net immigration to the United States had exceeded 1 million people less than a decade ago, that number has fallen steeply: the US Census reports net migration in 2019 of 477,000 people, and only 247,000 in 2020. Watson attributes the decline since 2016 to Trump-era policy decisions and rhetoric, bureaucratic backlogs, and pandemic-related restrictions, among other factors. She observes that inflows will presumably rebound to some degree as pandemic restrictions and conditions ease, but that current policy decisions will shape the size and composition of future immigrant inflows.

The author highlights the many economic benefits of immigration, including the outsized role that immigrants play in innovation and entrepreneurship. However, while the author emphasizes the positive case for increased US immigration, she cautions that sensible policy will acknowledge that certain communities and groups of workers—particularly those at the bottom of the wage distribution—are likely to be adversely impacted. Policy design should take seriously the potential for large increases in immigration to create negative distributional impacts and to impose fiscal costs on some local governments. Were policymakers more responsive to the system's unevenly distributed gains and losses, the United States could, Watson writes, "expand immigration in a way that is both politically palatable and economically sensible." This issue particularly relates to topics in AESG's third session, described below, on the role of state and local governments in funneling assistance to US workers and firms.

Watson addresses three interconnected questions aimed at improving US immigration policy: how many legal permanent migrants should the United States accept, and how should that class be composed; how can the temporary visa system operate most efficiently; and how should the country respond to unauthorized migration and support immigrant integration? Watson answers these questions by proposing principles that might guide reforms, including an increase in legal permanent immigration beyond current levels, less restrictive country-specific caps, and employment-based immigration formulas that respond more sensitively to economic conditions. She suggests employing temporary migration pathways to address seasonal and short-term needs, and reserving permanent pathways for addressing longer-term labor-force challenges. After proposing steps toward addressing illegal immigration, Watson advocates for increasing financial support for the immigration bureaucracy to address backlogs, which are at record levels. In stark terms, Watson observes that "Congress has abdicated its responsibility to address immigration in a responsible way. The result has been a chaotic and often cruel system."

Returning to the overarching challenge of US population growth decline, a population characterized by declining birth rates and decreasing or stagnant immigration will skew older and ultimately have a smaller workforce, which, all else equal, will lead to less economic output (lower GDP). Lower national output would mean lower GDP per capita, and consequently, less public good provision and a lower standard of living. Furthermore, a smaller workforce could lead to lower output per worker (not just per capita), as it brings less scope for specialization and less talent to spur innovation. This would mean a decline in both total productivity and labor productivity – as well as missing technological, medical, and healthcare advances that might otherwise have occurred with a larger, more dynamic workforce.

Lower population growth can also lead to lower business investment, with associated negative growth consequences. Slower population growth means lower future demand for housing and other goods, and hence less need for new business equipment and capital, leading to lower levels of investment and interest rates. This possibility relates to worries about stunted economic growth or "secular stagnation," a condition that Alvin Hansen warned about in 1939 in his address to the American Economic Association, in which he argued that the collapse in birth rates and immigration were contributing to a decline in investment opportunities and economic progress.

An aging population also puts pressure on social insurance programs, including Social Security and Medicare, since these programs provide benefits to those outside the workforce funded through payroll taxes on workers. The striking decline in birth rates since 2007 means that predictions made at that time about the long-run fiscal sustainability of those programs were overly optimistic (Office of the Chief Actuary, 2021).

In Chapter 5, *Will Population Aging Push Us over a Fiscal Cliff,* author John Sabelhaus looks to advance the policy discussion beyond merely responding to population aging's upward pressures on public spending and government deficits. He argues that in addition to considering well-understood transfers across generations, policy decisions should also be informed by broader distributional measures that account for distributional consequences within generations.

Sabelhaus documents that although programs such as Social Security and Medicare have grown as a share of GDP—due to both population aging and increasing health costs—that growth is not the sole factor driving recent trends in deficit spending. For example, the federal government responded to the COVID-19 pandemic with a spike in outlays, while changes to income tax policy have slowed the growth of revenues. Next, Sabelhaus describes Social Security and Medicare's redistributive impacts, both within generations (from lifetime high-earners to lifetime low-earners) and across generations (from those currently in the workforce to those outside it receiving benefits), and he observes that the determinants of redistribution are resolved only ex-post. For example, the projected exhaustion of the Social Security trust fund will ultimately be resolved by raising taxes, reducing benefits, or some combination of the two, with some realized distribution within and across generations.

As a principle to guide government spending, Sabelhaus proposes that government spending programs be evaluated based not only on their efficiency but also their distributional impacts, characterized through the lens of fiscal winners and losers. In his view, the principle of fairness suggests that the subset of the population that benefits most from a social insurance program or from public investments should be responsible for the costs when the investment returns are realized. Finally, he discusses how the distributional perspective on government deficits and debt should affect policy views about fiscal policy in response to the population aging. He argues that if the public debate ignores the other drivers of government deficits and debt—including a shrinking of the income tax base—and focuses only on changes to aging-related programs including Social Security and Medicare, then the country runs the policy risk of undoing or foregoing otherwise desirable government policies.

III. Challenges Facing US Workers and Firms

For several years the AESG has highlighted policies to help American workers to succeed in a labor market that places a premium on college-level skills, such as expanding career and technical education programs (Huff Stevens, 2019) and apprenticeships (Lerman, 2019), and improving the capacity and performance of community colleges (see Goolsbee et al., 2019). Central to these questions is how to develop the skill of the American worker to complement advancing technology and automation.

Another foreseeable challenge is the impact of the green energy transition on workers in fossil-fuel-intensive industries. This transition is already well underway, as author Gordon Hanson writes in Chapter 6, *Local Labor Market Impacts of the Energy Transition: Prospects and Policies*. The oil, gas, and coal industries employ roughly a million Americans who work in extraction, refinement, and energy-intensive manufacturing. These workers receive relatively high wages despite most (70 percent) not having obtained a college degree. The transition to green energy is leaving these workers vulnerable to long-term job losses absent sufficient opportunities to re-skill, and subjecting their communities to economic decline absent sufficient investment incentives for new firms and industries to move in.

A large body of research documents the consequences of the 1980s decline of the coal industry and the 2000s decline of traditional manufacturing for the communities in which employment was highly concentrated. As Hanson argues, policy interventions can blunt the worst impacts of concentrated job losses, which otherwise portend long-term unemployment, depressed earnings, and a variety of social ills that accompany concentrated economic distress, including greater risk of child poverty, increased mortality from drug and alcohol abuse, and lower rates of family formation.

Hanson highlights aspects of the social safety net that could be strengthened either to support workers in the short-term or to help them find new employment in the long-term. In particular, to facilitate career transitions into new sectors, Hanson promotes "active labor market policies" which provide training in sector-specific skills demanded by local employers and offer wrap-around services regarding career readiness, career counseling, job placement, and post-placement job advancement.

Hanson's chapter builds on past AESG work focused on place-based policies that would create incentives for business investment in distressed areas. Ziliak (2019) argued for rural labor market revitalization through a combination of people- and place-based programs, the latter of which included a major one-time investment in rural broadband, ongoing loans and grants to enhance entrepreneurship and small business development, and a federal jobs program to modernize rural infrastructure and amenities. Bartik (2020) made the case for place-based economic development policies targeting distressed areas. He argued that cash and tax incentives tend to be expensive and poorly tailored and to favor the largest firms, resulting in escalating costs due to competition among state and local governments. In his view, other local development policies such as infrastructure development and job training partnerships with community colleges, which provide businesses with customized public services, are more cost-effective strategies for increasing long-run employment and worker productivity.

Although Hanson acknowledges similar drawbacks to business tax incentives as those identified by Bartik (2020), he also envisions them as an important tool for helping distressed regions, arguing that their flaws can be mitigated with improved incentives for managing their implementation in ways that are better aligned with social objectives. Hanson next identifies business support systems, including those currently employed by the US Small Business Administration, as a promising avenue for promoting revitalization. While these exact programs have not undergone rigorous evaluation in the United States, results from international development economics are promising. For instance, consulting services to medium-sized businesses in developing counties lead to lasting improvements in performance.

Hanson's discussion of place-based policies highlights the crucial role of state and local governments in addressing economic challenges facing workers and firms. The question of how federal policies and income assistance can and should be funneled through subnational governments was a key issue shaping COVID-19 relief efforts. This year, we focus on this question, which builds on the AESG's previous work examining pandemic relief policies, including the novel business assistance programs (Zwick et al., 2021) and the administration of unemployment insurance benefits (von Wachter, 2021).

Across the CARES Act, American Rescue Plan and other COVID-19 relief measures, the federal government allocated $900 billion in aid to state and local governments. Chapter 7, *Lessons from COVID-19 Aid to State and Local Governments for the Design of Federal Automatic Stabilizers,* authors Jeffrey Clemens and Stan Veuger argue that federal aid for state and local assistance in response to the pandemic was far too generous, and consequently less cost-effective in achieving its economic aims than were comparable past programs. Their empirical analysis finds no impact of this federal aid on macroeconomic outcomes, suggesting state and local aid did not stimulate the economy during the initial downturn. However, they find that state and local aid did help governments manage the public health emergency by improving the equitability of vaccine administration and increasing the volume of tests administered.

The amounts that Congress allocated for state and local aid were based on early forecasts of state and local revenue shortfalls from declining sales and income taxes. These early forecasts, which were finalized prior to the implementation of pandemic relief aid for individuals and businesses, proved overly pessimistic. However, the aid to households and businesses shored up household balance sheets which in turn stabilized state and local revenue bases. To avoid repeating this mistake during future downturns, Clemens and Veuger recommend that the federal government instead develop transparent formulas to deliver automatic aid to states and localities

in times of need. The authors suggest that these formulas be based on measures of aggregate income that more accurately approximate potential revenue losses than do local unemployment rates.

Clemens and Veuger next describe three options for delivering fiscal assistance to states and localities, designed to maintain revenue neutrality over the business cycle in response to shocks to local tax bases. The first option, grants-in-aid, are commonly relied upon but often fail to achieve revenue neutrality when not governed by a pre-specified funding formula. Because the second option, loans, are naturally revenue-neutral, they incentivize states to request only the necessary amount of funding, downplaying the federal government's need to establish funding formulas and to measure shocks as they occur. Through the third option, revenue insurance programs, states would be required to pay in when revenues are robust and allowed to collect payouts as needed during downturns.

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ECONOMIC SECURITY, SCIENCE FUNDING, AND INNOVATION POLICY

New Insights for Innovation Policy
Ufuk Akcigit and Sina T. Ates

Seven Recent Developments in US Science Funding
Amy Ganz and Emily Vincent

New Insights for Innovation Policy

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ABSTRACT

The US economy has been suffering from weak productivity growth, business dynamism, and competition for the past several decades. The loss of a vibrant economy is even more concerning as the economy faces new challenges such as the transition to green energy that call for novel technological advancements. Reduced technological diffusion in the economy has been impairing the competitive environment favoring established market leaders, with patents and inventors being hoarded by these firms, hampering overall innovativeness and dynamism of the economy. We argue that policies to alleviate these concerns and enhance competition can boost overall innovativeness of the economy. Reducing barriers to foreign competition is an effective option to achieve this goal. Similarly, tapping into global talent is a viable policy to improve the level of human capital.

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** Federal Reserve Board; the views expressed are those of the author and do not necessarily reflect those of the Board of Governors or the Federal Reserve System.

1. Introduction

A central tenet of the literature on economic growth is that innovations and consequent gains in productivity are the main sources of a sustained rise in aggregate output. Recent data on average productivity growth in the United States, as measured by total factor productivity (TFP) growth, therefore present cause for concern. TFP growth witnessed a dramatic decline at the turn of the 1980s and has since remained weak except for a short period during the late 1990s and early 2000s (Figure 1). Meanwhile, business dynamism in the US economy—the perpetual process of firms entering, growing, downsizing, and ultimately exiting the market—through which labor and capital are reallocated toward more productive uses, has weakened considerably since the 1980s, as evidenced by declines in firm entry rates and job reallocation rates. This slowdown is alarming; a healthy degree of dynamism reflects a vibrant business environment in which firms are incentivized to outperform their competitors, and in which resources flow to more productive uses, improving overall productivity. Against this relatively stagnant backdrop enter further challenges, such as the transition to green energy, that will require the US economy to demonstrate vibrancy. The need for technological advances and appropriate policies to foster their development has become ever more pressing.

Figure 1. Average TFP Growth in the United States
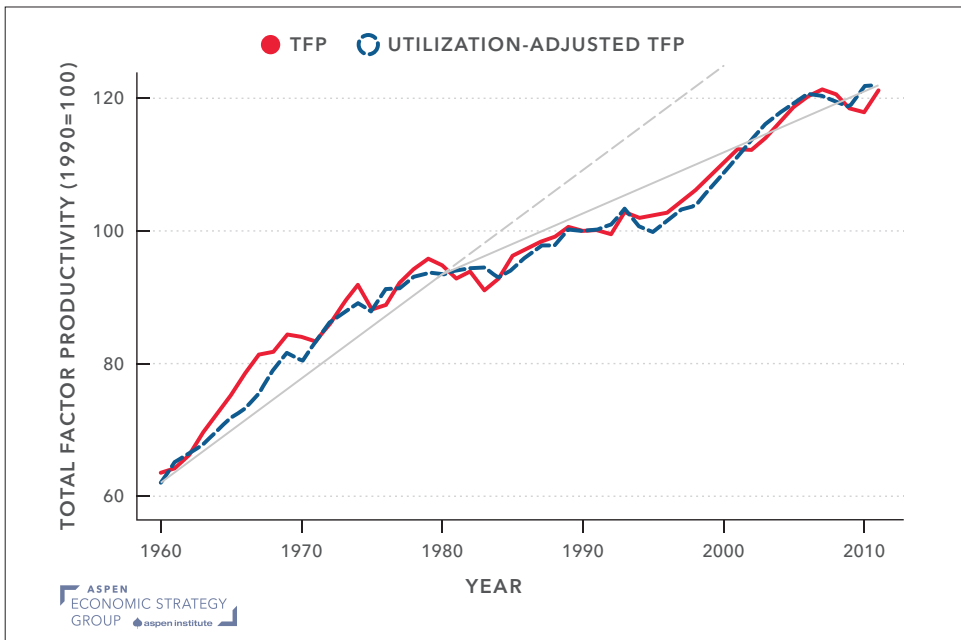
Source: Fernald and Jones (2014).

Note: The thin solid line illustrates the pre-1980 (1960-80) and post-1980 (1980-2011) trends in utility-adjusted TFP growth. The average trend growth declines from 1.57 percent in the earlier period to 0.92 percent in the later. For comparison, the straight dashed line extends the pre-1980 trend into the late 1990s.

In this paper, we first describe the factors that have negatively impacted US business dynamism and productivity growth over the past several decades and then discuss policy proposals to overcome those challenges. While we analyze certain innovation policies as key parts of the industrial toolkit, a central and more nuanced theme in our discussion is how these policies interact with the economy's competitive environment. A large body of empirical work documents that competition and innovation are closely related. As canonical theories of economic growth posit, close competition can incentivize firms to invest in innovations that will help them to outperform their close rivals. But growing distortions in the competitive environment, leading to a widening technological gap between market leaders and followers, are a primary factor depressing US business dynamism. Because innovation subsidies are less necessary in more competitive environments, we emphasize that understanding the link between competition and innovation can help to reduce the cost of policy interventions.

> "*Reducing barriers to foreign investment in domestic firms fosters innovation and growth even in the presence of most national security concerns about technology flows abroad.*"

We start our discussion with a diagnosis of the recent trends in firm entry, growth, and exit dynamics, which point to a marked slowdown accompanied by increases in market concentration across US industries. We also document a reduction in the flow of technical and innovative knowledge from industry leaders to the rest of the market. This reduction in the dissemination of knowledge plays a large role in accounting for these trends, as emphasized in Akcigit and Ates (2022). This widening gap between industry leaders and their competition removes vital incentives for firms to improve and to compete: laggard firms are discouraged, anticipating fewer opportunities to catch up with the industry leader, while leading firms face less competitive pressure to defend their advantages. Relatedly, we discuss empirical evidence that patents and inventors are increasingly concentrated in more established firms.

A primary justification for research and development policies are knowledge spillovers, which create large social returns to innovation, in addition to private returns (Bloom et al., 2013; Lucking et al., 2019; Jones, 2021). Barriers to competition reduce positive knowledge spillovers and thus reduce the return to research and development policies.

Competition from foreign rivals can enhance domestic firms' incentives to innovate. While R&D subsidies are prudent policy options to manage foreign competition, the optimal subsidy rate may be lower in a more globally integrated setting in which

more domestic firms are exposed to foreign competition. By providing the necessary private incentives to innovate, higher competition reduces the need for and cost of government intervention. We subsequently highlight that reducing barriers to foreign investment in domestic firms fosters innovation and growth even in the presence of most national security concerns about technology flows abroad. All told, our analysis of firm dynamics implies that greater foreign competition can serve as an important driver of innovation, especially in the presence of declining domestic competition.

We switch gears in the last part of our analysis and focus on individuals, starting with inventors—the people behind innovations. We begin by noting that immigrant inventors have played key roles in many developed countries' technological evolutions, including in the United States. We then note that immigrant talent responds to incentives just as firms do. Accordingly, we explore policies that affect international talent's choices about where to live and to work. Higher top income tax rates can create significant disincentives for migration, discouraging foreign inventors from relocating and limiting an important source of human capital. We finish by briefly discussing inequality. Although innovation promotes social mobility, it can also exacerbate economic inequality. We argue that some innovation policies, however, may be less prone to these concerns than others.

In sum, countries can benefit from enacting appropriate policies to foster innovation, enhancing competition and human capital in the economy. As productivity measures such as TFP continue to lag behind rates seen in past generations, global resources—whether competitive firms, technology investments, or individual talent—can provide valuable channels to revitalize dynamism and productivity growth in the US economy.

2. Slowing US Business Dynamism: Symptoms and Causes

In this section, we first summarize the empirical trends documented in the literature that demonstrate various symptoms of declining dynamism and increased concentration in the US business environment over the past several decades. We then discuss the underlying drivers of these trends, which point to a particular cause: a decline in knowledge diffusion and a deteriorating competitive environment. Next we present new empirical evidence on patents and inventors that echo our earlier findings: increased concentration of innovative resources and outcomes in the hands of established firms. We lastly turn to policy options that could help to reinvigorate the US economy's dynamism and potential for innovation.

2.a. Recent Trends in US Business Dynamism

Market concentration has increased. The trend toward increased market concentration—as measured by the fraction of sales captured by the largest firms within industries—has been documented (Autor et al., 2017a,b; Philippon, 2019). Concentration, measured by the Herfindahl-Hirschman index, exhibits similar results though some economists, including Rose (2019), have noted that measurement challenges and the need to disambiguate industries makes this conclusion less certain. Grullon et al. (2017), analyzing Standard and Poor's Compustat data, arrive at a similar conclusion, documenting the marked increase in market concentration in most US industries in the post-2000 era.[1,2]

Markups have increased. As documented in Philippon (2019), markups—the amount that firms charge for a good or service above production costs—have been rising in the United States since the 1980s, and more markedly since the early 2000s. Using broader, international data, Calligaris et al. (2018) find a global rise in markups, driven by firms in the top decile of the markup distribution, and a widening average markup gap between digitally intensive firms and other sectors. The research literature pays particular attention to the rise in markups, since markups are thought to serve as a proxy for market power and concentration.[3,4]

Profit share of GDP has increased. The profit share of GDP—total corporate profits of nonfinancial domestic US firms scaled by GDP—has likewise been on the rise. Some recent papers investigate the implications of this trend. Gutiérrez and Philippon (2016) argue that higher within-industry concentration, as measured by profitability, is associated with weaker investment. This result resonates with the findings of Eggertsson et al. (2018), who explore mechanisms that can result in higher profitability and a lower investment-to-output ratio, along with other changes.

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1   For other studies on rising market concentration and its aggregate implications, see Barkai, 2017; Gutiérrez and Philippon, 2016, 2017; Eggertsson et al., 2018, among others. In a similar vein, Azar et al. (2017) document concentration in the US labor market using disaggregated data at the geographical-occupational level.

2   In his *Wall Street Journal* column, Larry Summers suggests that a rise in market power may be driving the symptoms of what he dubs "secular stagnation" (https://wapo.st/1UUF0sm?tid=ss_tw&utm_term=.4df9b0193380). In a recent speech, Stiglitz (2017) emphasizes the role of regulation in the rise of firms' market power across the US economy and discusses the adverse economic and political consequences of this shift, particularly increased inequality.

3   Eggertsson et al. (2018) argue that the rise in firms' market power and markups, coupled with a lower natural rate of interest, are responsible for several macroeconomic and asset-pricing trends in the United States observed since the 1970s. Similarly, Farhi and Gourio (2018) find a notable contribution from rising market power to several macro-finance trends. Barkai (2017) also focuses on the effect of declining competition and establishes a similar link between higher markups and lower capital and labor shares.

4   See Nekarda and Ramey, 2013; De Loecker et al., 2017; Gutiérrez and Philippon, 2017; Eggertsson et al., 2018; Hall, 2018, among others; see De Loecker and Eeckhout (2018) for an international comparison. Some recent work (e.g., Karabarbounis and Neiman, 2018; Traina, 2018) disagrees with the evidence regarding the rise in markups on the grounds of measurement concerns, arguing that earlier work dismissed "selling, general and administrative expenses" from variable input costs when computing markups.

The labor share of output has declined. The United States has witnessed a steady decline in the labor share of output since the early 1980s (Karabarbounis and Neiman, 2013; Elsby et al., 2013; Lawrence, 2015). A study by Kehrig and Vincent (2018) highlights an even more pronounced drop in the labor share of output within the US manufacturing sector between the late 1960s and early 2010s. This trend is also observed internationally, as demonstrated by Karabarbounis and Neiman (2013) and Autor et al. (2017b).

Market concentration and labor share are negatively correlated. Autor et al. (2017b), Barkai (2017), and Eggertsson et al. (2018) document a negative correlation between market concentration and the labor share across US industries.

The labor productivity gap between industry (technology) leaders and other competitors has widened. A widening labor productivity gap between industry leaders in terms of productivity level and other competitors provides key evidence for explaining declines in business dynamism. Figure 2A shows that this gap—measured in real value added per worker—has recently widened (Andrews et al., 2015, 2016).[5] Importantly, the authors also find that the aggregate productivity performance is weaker in industries where the divergence between industry leaders and their competitors is larger. This trend resonates with the findings of Decker et al. (2018), who show that TFP dispersion across US firms has risen, as shown in Figure 2B.

Firm entry rates and the economic share of young firms have both declined. A widely debated symptom of declining business dynamism in the United States is the decline in firm entry (see Decker et al., 2016a; Karahan et al., 2016; Gourio et al., 2014, among others). Figure 3A illustrates this phenomenon using Business Dynamics Statistics data. The pattern is also common to individual industries.[6] Meanwhile, the share of young firms in economic activity has been steadily declining since the early 1980s (Figure 3B).[7] While several other advanced economies have undergone similar shifts (Criscuolo et al., 2014; Bijnens and Konings, 2018), the decline is particularly worrisome given the substantial role that surviving young firms play in job creation.[8]

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5   This figure reproduces the findings of Andrews et al. (2016), who present a cross-country comparison of five percent of firms with the highest labor productivity (the "frontier" firms) against all remaining firms (the "laggards"). Although the Orbis database used in their study has rather limited coverage of US firms, the authors claim in a complementary work that the firms from advanced economies are well represented in the frontier group (Andrews et al., 2015).

6   Gourio et al. (2014, 2016) find substantial losses in employment and output growth owing to the forgone "missing generations" of firms.

7   Goldschlag and Miranda (2016) document that the decline has been especially pronounced in tech-intensive sectors in the post-2000 period.

8   See Haltiwanger et al., 2013, in the context of the United States and Bravo-Biosca et al., 2013, for an international comparison.

Figure 2. Widening Labor Productivity Gap

A. LABOR PRODUCTIVITY OF FRONTIER AND LAGGARD FIRMS

● FRONTIER FIRMS ○ LAGGARD FIRMS

B. LABOR PRODUCTIVITY DISPERSION IN THE U.S.
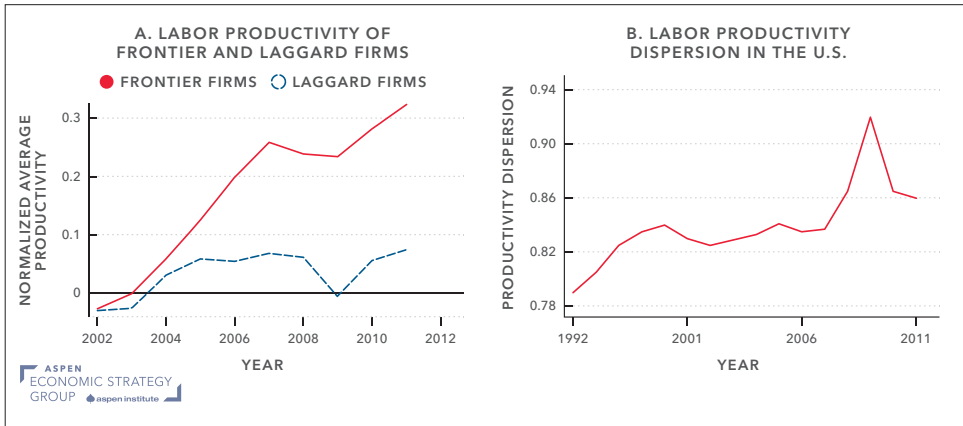
Source: Andrews et al. (2016) for panel A and Decker et al. (2018) for panel B.
Note: Labor productivity is defined as real value added per worker. Panel A derives from OECD countries.

Figure 3. Firm Entry and Exit Rates and the Employment Share of Young Firms in the United States

A. FIRM ENTRY AND EXIT RATES

● FIRMS ○ ESTABLISHMENTS

B. EMPLOYMENT SHARE OF <5-YEAR-OLD FIRMS

Source: Authors' calculations from BDS database for panel A and Decker et al. (2016a) for panel B.

Job reallocation and churn have receded. Figure 4 exhibits the secular decline in the gross job reallocation rate, defined as the sum of job creation and destruction rates, in the United States since 1980 (Decker et al. 2016a). The decline has been apparent in the retail trade and services sectors dating back to the 1980s—due in large part to productivity-enhancing consolidation of activity into larger chains at the expense of mom-and-pop shops—whereas in the information sector, a pronounced decline started in the early 2000s.

Figure 4. Gross Job Reallocation
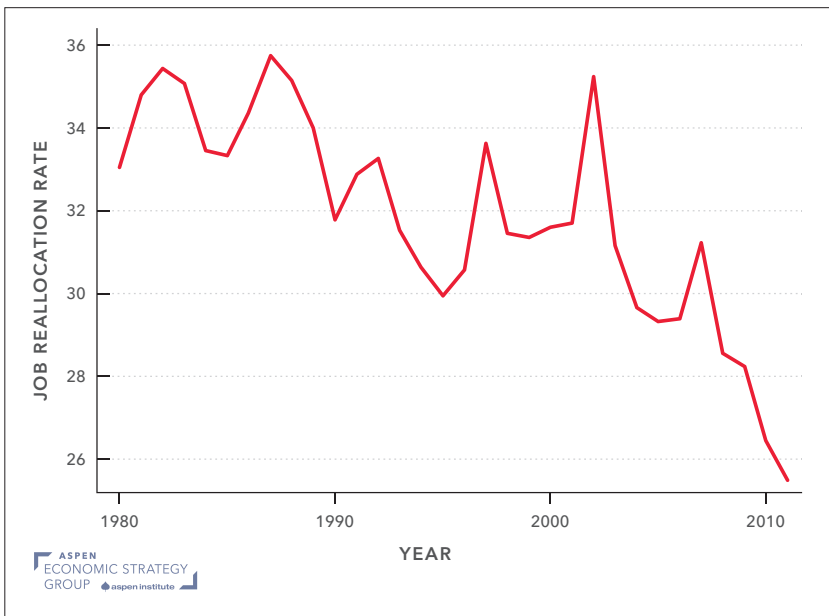
The dispersion of firm growth rates has decreased. As activity by young (and high-growth) firms has declined, the dispersion of firm growth has decreased as well (Figure 5). This shift is particularly notable when juxtaposed against the concurrent rise in the dispersion of productivity across firms. Using data from the US Census Bureau, Decker et al. (2016a) show that the decline in growth dispersion accelerated in the post-2000 period.[9]

Productivity growth has fallen. Finally, a heated debate on which our discussion of declining business dynamism could potentially cast light concerns trends in US aggregate productivity growth (labor or multi-factor) over the past several decades. Except for a short period between roughly the mid-1990s and mid-2000s, US productivity growth appears to have slowed down notably (Gordon, 2012; see Figure 1).[10] Gordon (2016) concludes that broad-impact innovations have been depleted, implying that structurally low aggregate growth will mark the foreseeable

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9   The authors argue that this acceleration can be attributed to the decline in young firm activity in high-tech sectors—the sectors that exhibited high growth dispersion in the earlier decades.

10   Syverson (2017) and Ahmad et al. (2017) refute the argument that the measured slowdown in aggregate productivity growth may reflect measurement problems. The studies conclude that mismeasurement could only account for a small part of the decline, if any.

future, a prediction shared by Fernald (2014). Brynjolfsson and McAfee (2014) and Brynjolfsson et al. (2017) disagree, arguing that the diffusion of new technologies such as artificial intelligence will soon boost productivity growth, whereas Nordhaus (2015) expects the opposite.[11]

Figure 5. Firm Growth Rate Dispersion in the United States
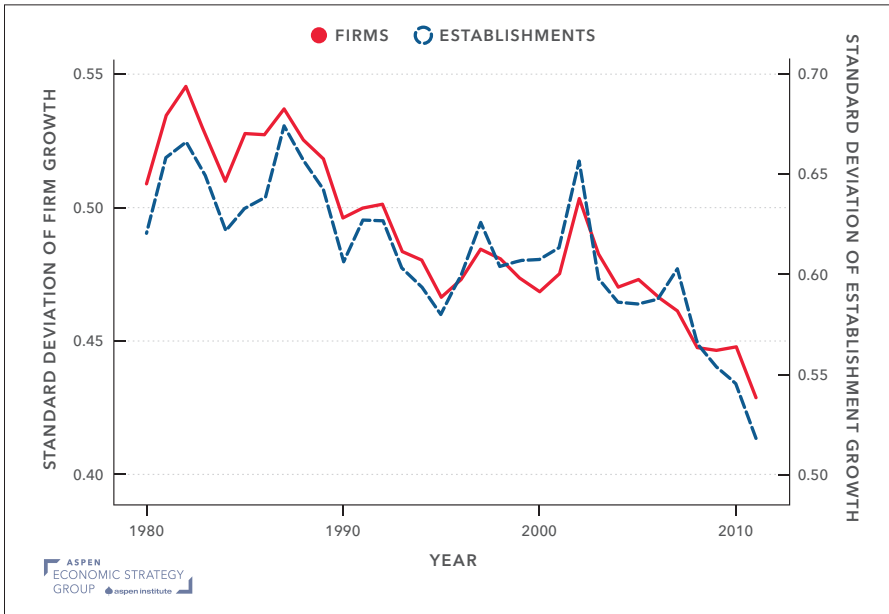
Source: Decker et al. (2016a).

Overall, this body of evidence suggests a decline in business dynamism coincident with weakening competition—that the firm entry rate and the job reallocation rate are falling, among others, while market concentration and markups are rising. Identifying the driving forces behind these trends is still a subject of debate in the academic literature (see Akcigit and Ates, 2021 for a comprehensive review). Our holistic theoretical and empirical approach (Akcigit and Ates, 2022), however, considers all these indicators jointly and examines a variety of potential causes to explain these observations. In the next part, we highlight relevant findings for policy.

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11   Fernald and Jones (2014) also point to a possible pickup in aggregate productivity growth due to AI's productivity-improving contributions. They also mention potential spillovers from R&D conducted in developing countries such as South Korea and China, which are poised to provide vast resources for innovative activity.

2.b. Knowledge Diffusion and US Business Dynamism

In Akcigit and Ates (2022), we use economic theory and computational methods to evaluate several candidate explanations for slowing US business dynamism. Our analysis is premised on the model of a perpetual rivalry between two types of firms within a given industry: a "best" leading firm and the "rest" of the rival followers which are competing for market leadership. Using that rivalry as a baseline, our model explicitly formulates the relationship between market competition and firms' strategic investment behavior. We briefly describe here that theoretical model and its application to data.

An important model component is knowledge diffusion, which is important for follower firms that depend on learning from the best practices and technologies of the market leaders to remain competitive and to grow. When knowledge diffusion slows over time, market leaders are shielded from copycat firms, which helps them to establish stronger market power. When the gap between market leaders and their rivals is substantial, market followers become discouraged; their growth is consequently slowed and the productivity gap between leaders and followers widens even further. The first implication of this widening is that market composition shifts to more concentrated sectors. Second, strong market leaders leverage their market advantage to charge higher markups, increasing the profit share and decreasing the labor share of GDP.

Potential entrant firms are discouraged by the relative strengthening of incumbents, and entry decreases, reducing competitive pressure on the market leader. Facing less of a threat to their business models, market leaders relax and experiment less. Overall dynamism and experimentation in the economy decreases. Lower innovation investment by firms contributes to lower productivity growth over time, causing the equilibrium interest rate to fall.

Using quantitative methods to test this theory, the results mirror the economic trends we describe above: a sharp decline in knowledge diffusion in the US economy that results in greater concentration, higher markups and profits, a lower labor share, and reduced business dynamism as reflected by fewer young firms, less job reallocation, and slower productivity growth.[12]

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12 Akcigit and Ates (2022) account for all economic indicators discussed above in Section 2. Applying quantitative methods, we use the model to mimic salient features of the US economy prior to the 1980s and the shifting dynamics it has exhibited since then. The model replicates the observed shifts in the US economy via changes in certain components of the model such as government policies (including corporate taxes) and knowledge diffusion. We then use the model to run a horse race between a variety of channels that could have contributed to slowing business dynamism. The model allows us to remove each component individually and to ascertain the extent to which each channel could account for the observed dynamics. The results clearly indicate a sharp decline in the knowledge diffusion in the US economy and reveal the dominant role of this margin for accounting for the observed trends.

2.c. Symptoms of Declining Knowledge Diffusion and Potential Drivers

Patents are increasingly being accumulated in the hands of firms that already own the largest shares of them, both via new production or via purchases of existing patents. Both the concentration of patents and the fraction of litigated patents are positively correlated with measures of market power at the industry level. For instance, firms could potentially leverage these large patent arsenals to deter other firms from developing competing inventions, as in the case of patent thickets, which we discuss below. As a mirror image of this patent concentration, we also observe that inventors are increasingly employed in large and established firms rather than at small and young firms. Importantly, such a shift induces a decline in inventors' productivity despite a rise in their wages.

2.d. Patent Concentration and Post-1980 Trends

Patents may limit the flow of knowledge from frontier firms to their competitors. A decline in imitators' ability to copy and to learn from market leaders' technology (or to implement improvements on the existing technologies) due to the leaders' heavier and strategic use of patents reduces knowledge diffusion and its efficient use among firms. Patent and reassignment data from the US Patent and Trademark Office (USPTO) provide a fertile ground for investigating these patterns, as firms rely heavily on patent protection to shield themselves from imitators. Because many indicators of business dynamism suggest a declining trend since the 1980s, coincident with rising market concentration, we first investigate the potential for concomitant changes in patenting concentration. To answer this question, Figure 6A describes the share of patents registered by the 1 percent of firms with the largest patent stocks. The ratio exhibits a dramatic increase. While in the early 1980s about 35 percent of patents were registered by firms sitting on the largest patent stocks, within three decades this ratio reached almost 50 percent.[13] The share of patents registered by new entrants (firms that patent for the first time) meanwhile exhibits the opposite trend: after a small pickup in the early 1980s, there has been a dramatic secular decline in the entrants' share since then, with the ratio falling by more than 50 percent in 25 years, as seen in Figure 6B.

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13   Notice that the increase in this ratio has been larger than the rise in market concentration (see Autor et al., 2017b).

Figure 6. Registry of Patents

A. SHARE OF PATENTS OF THE TOP 1% PATENTING FIRMS

B. ENTRANTS' PATENT SHARE OVER TIME
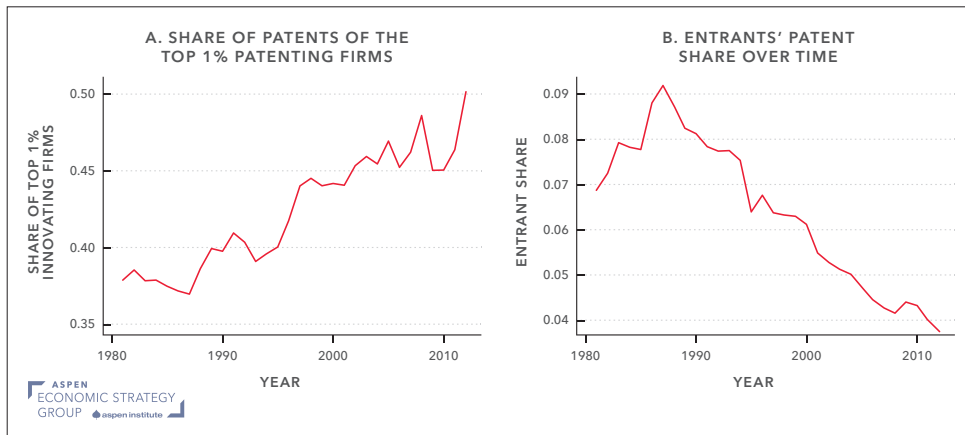
Source: Authors' own calculation using US Patent and Trademark Office data.

A common practice among market leaders is to buy patents in the market to strengthen their intellectual property arsenals. In this way, industry leaders can create a dense web of patents, known as "patent thickets" (Shapiro, 2001), which dissuades competitors from approaching the leader's technology domain and trying to overtake the leader. For instance, Argente et al. (2020) show that while market leaders introduce new products less frequently, they are more likely to patent these inventions, and those patents are associated with a declining rate of product innovation among competitors. The authors also show that as firm size increases, firms are more likely to use their patents to deter competition, with the protective value of their patents rising relative to their productive value.

Figure 7A illustrates the purchasing trends of the 1 percent of firms with the largest patent portfolios. While 30 percent of all transacted patents in the 1980s were reassigned to the firms with the largest patent stocks, the share increased to 55 percent by 2010. This drastic increase has crowded out small players in the market, as illustrated in Figure 7B, which shows the likelihood that a patent is assigned to a small firm, conditional on that patent being transacted from another small firm and recorded.[14] In the past two decades, the fraction of transacted patents that are reassigned to small firms has dropped dramatically from 75 percent to just over 50 percent. All told, the data indicate a shift of patent ownership from small firms to larger competitors.

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14   The designation as a "small business concern" derives from the USPTO's US Patent Grant Maintenance Fee Events database, which records information on patent renewals.

Figure 7. Reassignment of Patents

A. SHARE OF TOP 1% BUYERS OVER TIME

B. SHARE OF SMALL BUYERS OVER TIME
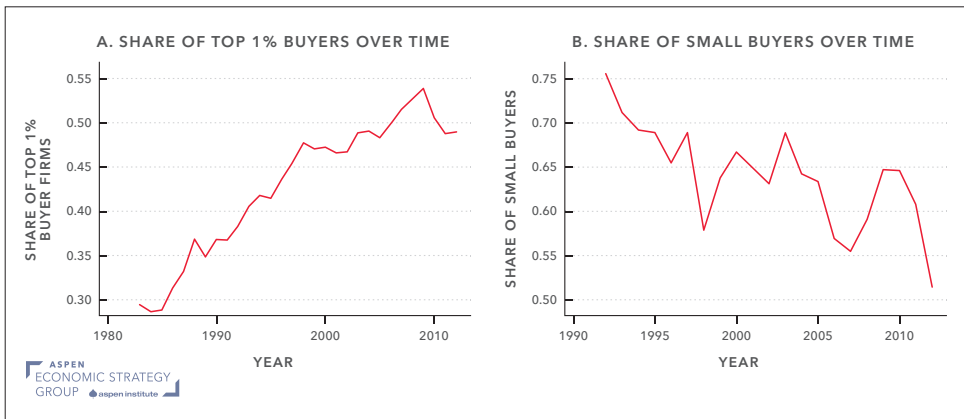
Source: Authors' calculations using US Patent and Trademark Office data.

Concentration in patent production and reassignment has surged, and firms with the largest patent stocks have only further expanded their intellectual property arsenals. Matching patent data with data on patent litigations, we show that the more patents have been subject to litigation within an industry since 2000, the higher market power indicators have surged during the same period. This recent correlation is particularly interesting in conjunction with evidence that Decker et al. (2016b) compiled from Census data indicating that the decline in business dynamism accelerated after 2000, especially in some high-tech sectors. A closer look at the patent data reveals corroborating evidence on the potential strategic use of patents, which we discuss next.

2.e. Trends in the Post-2000 Period: Strategic Use of Patents

Patent records provide useful information for exploring whether firms produce strategic patents—patents firms can potentially use to build thickets around their core businesses and to ensure that those core technologies are not easily adopted or challenged by others. Two key variables in this respect are citations and the text of claims. We explore the strategic aspects of patents by looking at how these two variables have evolved over time.

Firms have the option either to expand into new fields by exploring new areas of research, or to focus on their existing technologies by protecting them in patent thickets. Akcigit and Kerr (2018) dub the former exploratory patents as "external" and the more exploitative ones as "internal" patents. If a firm's aim is mostly to protect its core technology, new internal patents will cite many patents from the firm's existing portfolio. In contrast, if a firm's aim is to expand into new fields, more citations will

be made to patents that are not in the firm's portfolio. In this regard, the fraction of self-citations is informative about whether the patent is internal and how likely it is to serve as one patent among a thicket. Figure 8A explores these self-citation dynamics over time. While patents were becoming more explorative until 2000, this trend then reversed; patents became more exploitative and internal over the ensuing decades.

Similar inferences can be drawn from the length of a patent's claims. We would expect that patents making broad contributions to their field, filed by firms interested in pursuing novel technology, would include a relatively short claim, reflecting the innovation's broader scope. Conversely, we would expect that patents making marginal contributions to an already crowded field, filed by firms interested in tightening their hold on existing technologies, would have relatively longer claims that include details of the incremental contribution but that are much narrower in scope. Figure 8B shows the evolution of average patent claim length over time. Until recent decades, patent claims had been becoming shorter, suggesting that patents were becoming broader in scope; again this trend reversed around 2000. Since then, claim length has been increasing steadily, indicating that patents are becoming narrower in scope and less original.

Figure 8. Self-Citation and Claim Length Patterns
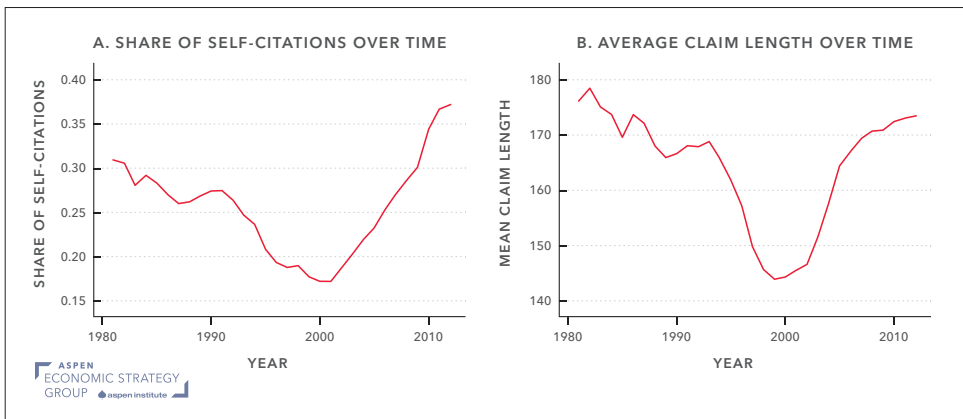
Source: Authors' calculations using US Patent and Trademark Office data.

Our observations on patents filed since 2000 likely imply that patents have recently been used to crowd existing technology fields with incremental additional information, limiting the scope for spillovers to competitors. The timing of these dramatic changes coincides with a period when business dynamism has substantially slowed down. While several measures of business dynamism have indicated a slowdown in most sectors of the US economy since the 1980s, the decline in the high-tech sector has become most visible since the 2000s (Decker et

al., 2016b). As shown in Figure 9, the dispersion of firm growth in high-tech sectors started to decline steadily around 2000. Decker et al. (2016b) document that other measures of business dynamism, such as gross job reallocation, reverberate with this post-2000 pattern, again especially in high-tech sectors. In this regard, our post-2000 findings tell a coherent story with these empirical regularities, suggesting a concurrent slowdown in knowledge diffusion and business dynamism.

In sum, our results constitute strong suggestive evidence that the concentration and use of patents, or intellectual property more broadly, have dramatically changed over time. Patent concentration has been trending up since the 1980s, and by 2000 those patents started to shift toward becoming more internal and narrower in scope, indicating that firms are filing patents for strategic rather than exploratory purposes. These observations are broadly consistent with declining knowledge diffusion from the technology leaders to their followers and have likely contributed to declining business dynamism through the lens of our model.

Figure 9. 90-50 Differential in High-Tech Sector
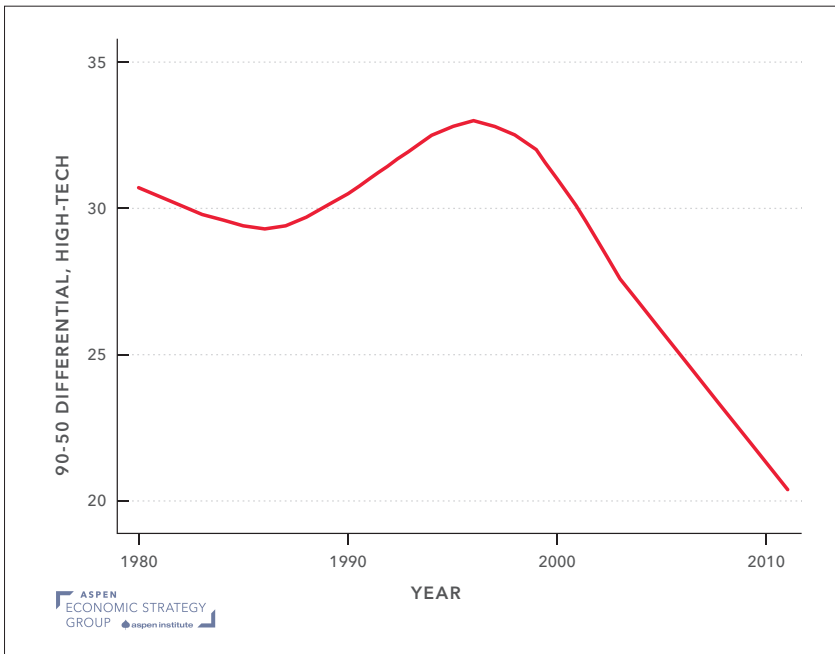
Source: Decker et al. (2016b).

Note: Similar patterns are documented for the 50-10 differential, for the balanced sample of continuers, and for gross job reallocation in the information sector.

2.f. Evidence from Data on Inventors

In this section, we explore how these patterns impact employment dynamics for inventors—the central agents for the generation and flow of ideas through the economy. In particular, we discuss the findings on inventor dynamics in a recent work by Akcigit and Goldschlag (2020), who build a novel data set that compiles detailed information on the population of inventors, linking patents to individuals, businesses, and employee-employer relationships. The results suggest a concentration of inventors in mature incumbent firms, with their innovative output and its quality decreasing.[15]

Figure 10 demonstrates the steady decline in the share of inventors working at young firms (defined as those in existence for five years or less) since the early 2000s. The consequent concentration of inventors at mature incumbent firms parallels our earlier results demonstrating a similar concentration for patents. This shift is not by itself concerning, so long as inventors maintain their productivity. However, Akcigit and Goldschlag (2020) find that inventors who join more established firms apply for fewer patents relative to comparable inventors who join young firms.[16] Moreover, the patents for which inventors apply after switching to a mature incumbent firm receive fewer citations relative to those filed by inventors at young firms, suggesting a deterioration in the quality of innovative output among inventors at incumbent firms. Meanwhile, inventors hired by mature incumbents see increases in their share of self-citations relative to inventors hired by young firms, implying that such patents have more internal and exploitative content, consistent with the theory that the patent plays a more protective role.

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15   Mature incumbents refer to firms that employ more than 1,000 workers and that are older than 20 years.

16   The observation is consistent with the findings of Akcigit and Kerr (2018), that young firms are more R&D- and innovation-intensive than older firms.

Figure 10. Share of Inventors Employed in Young Firms
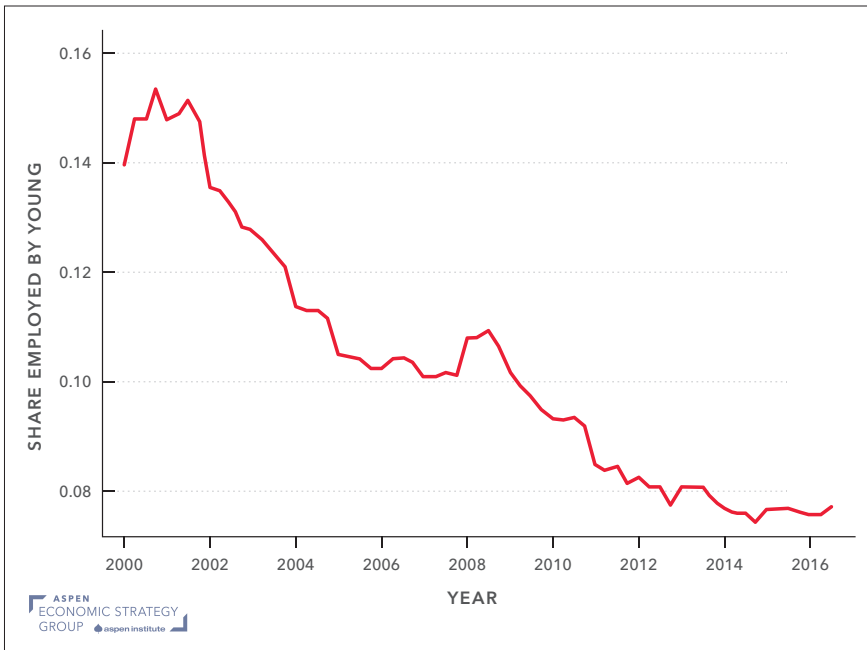
Source: Akcigit and Goldschlag (2020).

While inventors' outputs deteriorate after they accept positions at mature incumbent firms, they increase their earnings by 10 to 15 percent in their new roles (Akcigit and Goldschlag, 2020). That is, the private return for the inventors' activity increases while the public return decreases. Together with the increasing share of inventors at incumbent firms, this finding is concerning from the perspective of aggregate welfare.

Turning back to Figure 10, the falling share of inventors in young firms may be an artifact of the falling share of activity by young firms in the economy (as discussed in Section 2.a). However, the data reveal that US inventors themselves have also become less entrepreneurial over time. This result is particularly worrying for the future of new firms: start-ups founded by inventors exhibit faster employment growth over the first decade of their lives than do start-ups founded by non-inventor entrepreneurs. The reduced frequency of inventor entrepreneurs in the post-2000 era has therefore likely contributed to the declining prevalence of high-growth young firms and the concurrent decline in job reallocation rates.

Altogether, inventors' migration to mature firms, their decreasing innovation output, their increasing earnings in conflict with shrinking public returns, and their slowdown in entrepreneurship suggest a decline in knowledge diffusion and business

dynamism. Empirical evidence meanwhile indicates a growing technological disparity between the country's leading firms and their competitors, with inventors and patents concentrated among the former and the diffusion of knowledge to the latter weakening. These shifts distort the competitive race. Catching up with or overtaking established incumbents has become increasingly difficult for industry followers, thereby reducing all rivals' incentives to make productive investments and consequently causing overall dynamism to backslide.

The natural question becomes: what policies could help to reinvigorate competition, innovation, and dynamism in the US economy? In the absence of domestic solutions, policymakers could instead seek the benefits of trade openness; competitive pressures need not necessarily emerge domestically, and crucial support could potentially stem from overseas. Increased competition from foreign rivals could potentially incentivize US firms to invest in improving their products and processes in order to maintain their market shares (Bloom et al., 2016; Akcigit et al., 2018), boosting domestic productivity growth. The next section addresses the importance of analyzing competitive forces and firm dynamics in an economy open to international competition.

3. International Competition and Industrial Policy

Globalization and ever-expanding international trade routes stiffen the competition for leadership in global markets. Politicians around the world have increasingly shown their discontent with these dynamics, blaming globalization and increased foreign competition for causing various economic problems. Yet openness to trade and foreign competition, when managed by the appropriate institutions with appropriate policies, create incentives for domestic firms to improve their products and their efficiency; indeed, a large literature explores the effect of trade liberalization on innovation and productivity growth (Shu and Steinwender, 2019).[17]

> *"Lower trade costs produce stronger competitive threats for domestic firms, inducing them to innovate more intensively."*

Our previous work (Akcigit et al., 2018; Akcigit et al., 2022) explores in detail how foreign competition and innovation interact, and the implications for trade and innovation policy, aggregate innovation, business dynamism, and economic growth. We find that increased foreign competition *reduces* the need for R&D subsidies aimed at spurring innovation. In particular, as bilateral trade costs decline—that

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17   Akcigit and Melitz (2021) and Melitz and Redding (2021) provide other extensive reviews of empirical work on the nexus of foreign competition, innovation, and economic growth.

is, the world becomes more open—the optimal R&D subsidy rates decrease as well (Figure 11). Lower trade costs produce stronger competitive threats for domestic firms, inducing them to innovate more intensively. The need for R&D subsidies to correct for deficient domestic innovative activity is reduced, as firms are naturally pushed toward optimal innovation effort.

Figure 11. Optimal US R&D Subsidy Over Different Bilateral Tariff Rates
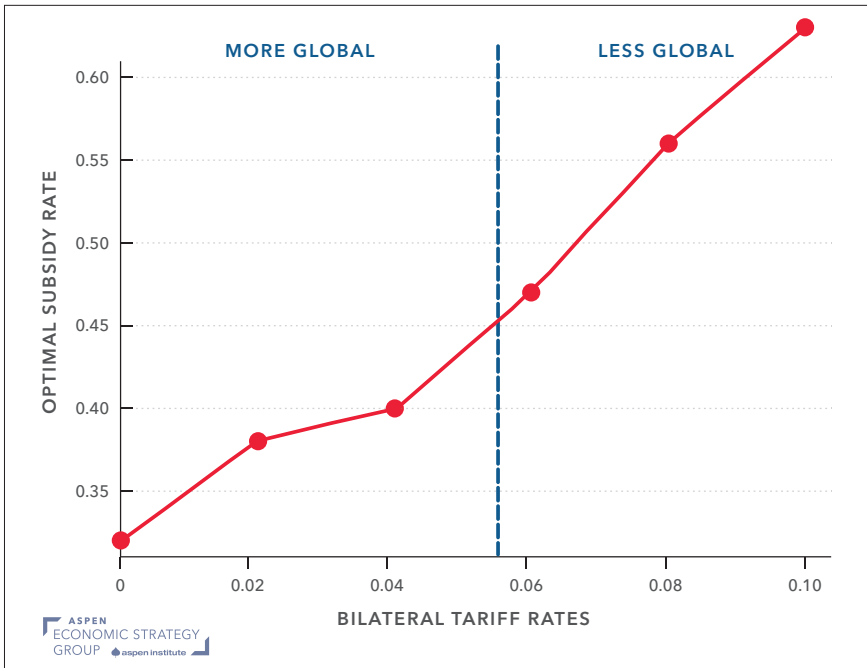
Source: Reproduced from Akcigit et al. (2018).

Note: Figure 11 exhibits optimal R&D policy rates for the United States over a fixed horizon of 35 years subject to varying degrees of globalization. The vertical line denotes the calibrated level of tariffs for either country.

Our work further implies that policymakers ought to slash trade barriers to zero, at all policy time horizons and even unilaterally (Figure 12a). The optimality of removing trade barriers unilaterally is a novel finding in the international trade literature and hinges crucially on the effect of protectionist policies on market competition and innovation incentives.[18] While trade barriers protect some firms

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18   This effect is dominant especially in longer horizons. In the short term, higher trade barriers produce a positive effect on domestic wages, which in turn reduces an economy's competitiveness, proving the trade barriers suboptimal. Even when adjusted to exclude this margin, the model demonstrates that unilaterally removing trade barriers is still the optimal policy for relatively farsighted policymakers (see Akcigit et al., 2018).

in the short run, helping them to retain production and profits, protection from the competitive pressure that foreign rivals could exert reduces domestic firms' incentives to innovate and to improve their products' competitiveness (Figure 12b). Moreover, trade barriers deprive the economy of superior foreign products by creating distortions in relative prices. This negative dynamic effect on innovation incentives translates into lower productivity growth in the economy over time and becomes the dominant margin in policymakers' welfare calculations. Policymakers optimally should choose to curtail trade barriers even unilaterally.

Figure 12. Optimal Tariff Policy and Innovation over Varying Levels of Trade Openness
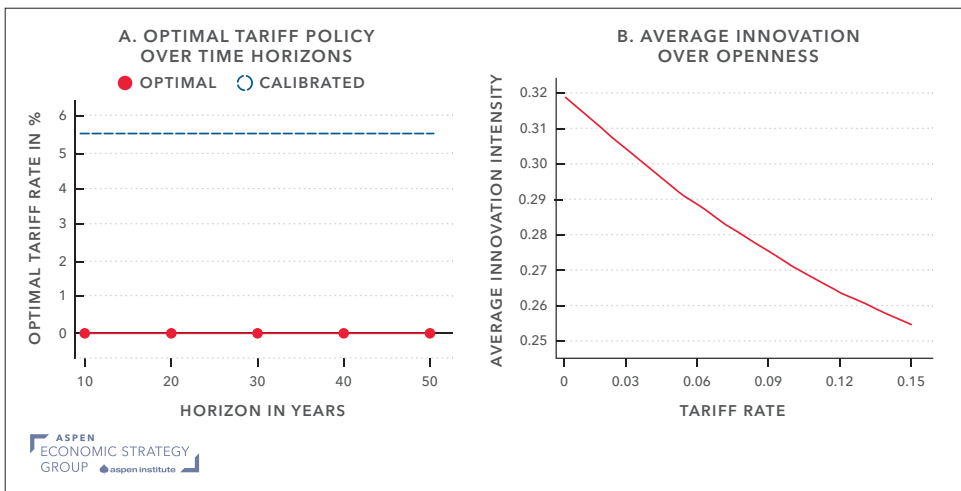
Source: Akcigit et al. (2021a).

Note: Panel A shows the optimal unilateral tariff policy for the United States over various policy horizons. Panel B shows the negative effect of unilaterally higher US tariff rates on US firms' average innovation intensity.

Finally, new findings from a recent complementary study (Akcigit et al., 2022) provide empirical support for the role that increased foreign competition can play in rejuvenating business dynamism. In addition to the well-known effects of foreign presence and market concentration on firm dynamics, we document that in more concentrated industries, higher foreign presence mitigates the negative effect of concentration on firm growth.[19] This result corroborates the insight that enabling more intense foreign competition can help to reinvigorate weakened business dynamism in the United States, complementing other standard innovation policy tools.

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19 Precisely, the coefficient of the interaction term between foreign owned firms' sales share and the initial level of market concentration is positive, when regressing firm growth on these variables and other controls.

4. Foreign Investment and Technology Transfer

Enhanced integration with the global economy, which can help to spur overall innovation and business dynamism, often entails increased cross-border investments in domestic firms. But one of the most contentious issues in public policy debates over the past five years regarding US entrepreneurship has been the treatment of foreign investors. The military community in particular has highlighted the extent of foreign venture investments in Silicon Valley, especially from Chinese corporations, individuals, and financial institutions. These analysts have also emphasized that these investments are often in critical areas, such as artificial intelligence, fintech, robotics, and virtual reality, and have expressed concern that these activities may be leading to technology flows that, while legal, are nonetheless detrimental to US economic and military interests. Corporate venture investments pose a particular concern, since these investors are well-suited to gain insights from their interactions with the companies in their portfolios, and subsequently to exploit these discoveries. Brown and Singh (2018) highlight, for instance, Alibaba's and Enjoyor's investments in Magic Leap, Baidu's purchase of shares in Velodyne, and Lenovo and Tencent's investments in Meta; collectively these companies specialize in areas such as augmented reality, active remote sensing, and artificial intelligence.

The primary policy response by US authorities to these concerns has been to strengthen the mandate of the Committee on Foreign Investment in the United States (CFIUS), an inter-departmental task force that was first established in 1975. The Foreign Investment Risk Modernization Act of 2018 expanded the CFIUS' scope to include reviews of "non-controlling 'other investments' that afford a foreign person an equity in and specified access to information … [about] certain critical technologies." This legislation, and in particular the enabling regulations promulgated by the United States Treasury, Office of Investment Security (2019), raised substantial concerns among the US venture capital community (National Venture Capital Association, 2019). Anecdotal accounts suggest that in response to the new rules, Chinese-based entities' investments in new ventures have dropped sharply even before the pandemic. Similar controversies have played out contemporaneously in, among other nations, Australia, Canada, Germany, and especially Israel (Klein, 2018).

Despite the intense controversy and substantial stakes, economists have paid only modest attention to these issues, and the government's response has been limited. Our work, Akcigit et al. (2020a), seeks to address this gap, examining foreign corporate investment in Silicon Valley from a theoretical and empirical perspective. Our data set identifies transactions involving 344 companies from 32 distinct countries between 1976 and 2015. Figure 13 demonstrates the rapid increase in such transactions. We identify start-up firms' patents, as well as patenting by the corporate investors specifically and by residents of the countries in which they are based.

**Figure 13. Foreign Corporate Venture Capital as a
Share of All US Venture Capital Investment**

Source: Reproduced from Akcigit et al. (2020a).

Our analysis measures patenting activity before and after foreign corporate investment in start-ups. Near the time of the foreign investment, patent applications in the relevant patent classes increased from entities located in the investor's home country (Figure 14A). Citation patterns tell a similar story. As illustrated in Figure 14B, foreign citations in the relevant patent classes increased after a foreign corporate investment. The results suggest that there are benefits from these investments in the form of knowledge spillovers.

The spillover benefits from technologies that the National Science Foundation defines as more "basic"—including research on the atomic structure or the Genome Project and its exploration of human DNA—may be different than those in technology classes that rely more on applied research.[20] These frontiers present special challenges to firms playing catch-up; building capacity to compete with leading firms is notoriously difficult. As a result, the evidence indicates that foreign financing has even stronger effects on patenting patterns for research in these

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20 The National Science Foundation (NSF) of the United States defines basic research as a "systematic study to gain more comprehensive knowledge or understanding of the subject under study without specific applications in mind." Conversely, applied research is defined as a "systematic study to gain knowledge or understanding to meet a specific, recognized need." See Akcigit et al. (2021b) for a thorough analysis of these different types of research.

more "basic" fields (Figures 14C and 14D), consistent with stronger spillovers to entities located in the investor's country in more basic technology classes. Similarly, knowledge flows appear to increase in classes that contain patents subject to a secrecy order from the federal government.

These patterns suggest that real knowledge is being transferred internationally, out of the United States and into foreign countries. And foreign investments in US technology firms are more common when the investor's home country lags further behind the United States in developing the relevant technology, as measured in various ways. The investments appear, at least partially, to be responses to address this technology gap.

Figure 14. Impact of Foreign Investment on Firm Patents and Citations
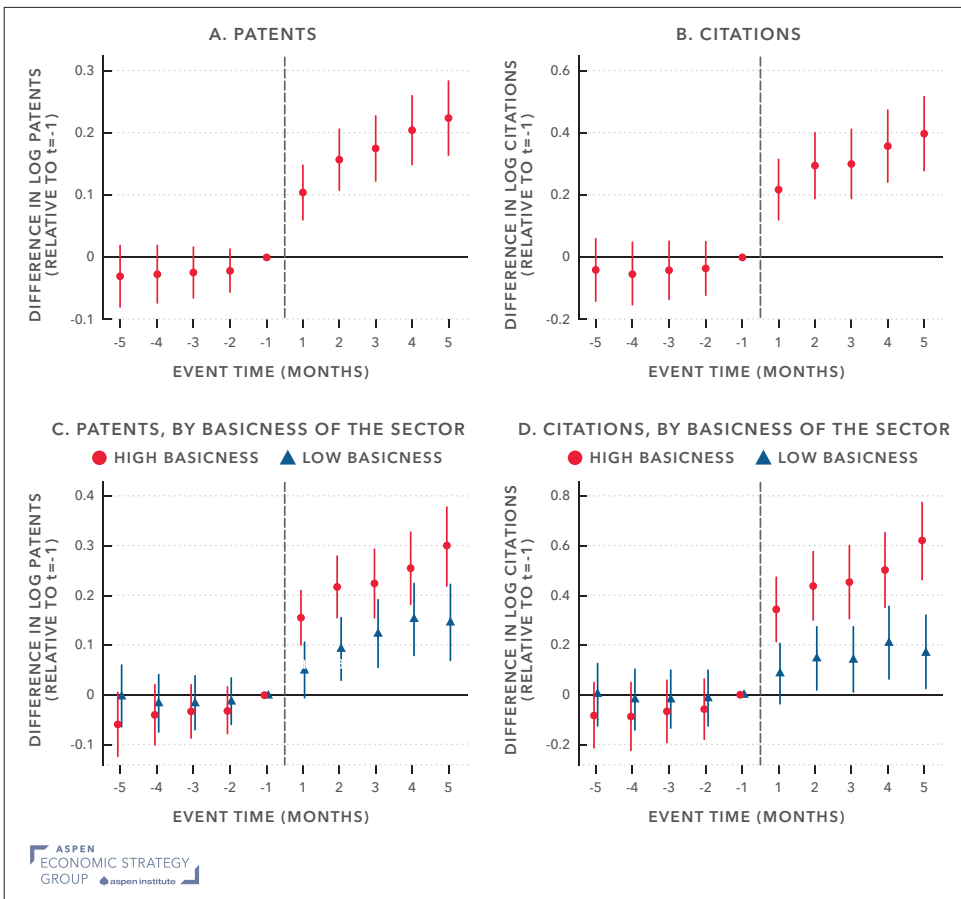
Source: Akcigit et al. (2020a).

Note: The figures show the effect of foreign investment on patenting activity of firms residing in the investing country. The left panels refer to patent counts, and the right panels refer to citations received by those patents. The bottom panels show the different patterns across sectors with low and high basicness levels.

While the evidence cannot demonstrate causality, more foreign investments in firms specializing in a technology class are associated with greater subsequent patenting by US start-ups in the same class (Akcigit et al., 2020a). These results are at least consistent with the hypothesized benefits of such investments in easing capital constraints.[21]

The empirical evidence suggests that US start-ups benefit from the funds enabled by foreign investment, but at the expense of knowledge transfers abroad. Akcigit et al. (2020a) explores optimal policies to manage foreign investment. The results show that decreasing the cost of foreign investment is optimal; the ensuing productivity growth caused by encouraging start-up formation through the increased availability of foreign funds more than offsets the associated costs. Even if national security concerns increase, we recommend that unless and until extreme national security threats arise, cost-raising interventions should not be undertaken lightly. The distortions these interventions exert on firm behavior and the ensuing productivity costs are likely to outweigh potential gains from higher barriers to foreign investment.

> *"The empirical evidence suggests that US start-ups benefit from the funds enabled by foreign investment, but at the expense of knowledge transfers abroad."*

5. Inventors, Immigration, and Tax Policies

A particular group of inventors—migrant innovators—constitute an important part of the scientific workforce in several developed economies, including the United States, where they have been a major force behind productivity growth in the post-war period (Akcigit et al., 2017). What drives people to become inventors, and what incentivizes them to immigrate? Answers to these questions have become all the more important as the global talent pool grows while anti-immigration resistance enforces higher barriers against the movement of human capital.

There is strong complementarity between education and innovation in the United States as shown in Akcigit et al. (2017).[22] The likelihood of becoming an inventor rises dramatically with higher educational attainment. While the literature widely recognizes parental income as a determinant of a child's future in innovation, we find that the data presents a more complicated story. Figure 15 maps a child's probability of becoming an inventor against their parents' income. Strikingly, there is no discernible link between parental income and a child's probability of becoming

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21 That the investments are coming from technologically laggard entities diminishes the possibility that the increase in US patenting stems from technology spillovers from abroad.

22 For international evidence, see Aghion et al. (2017).

an inventor throughout most of the income distribution. However, for the group at the top 5 percent, the correlation becomes extremely strong, indicating that innovation is indeed concentrated among those coming from rich families.

But a key related observation from Akcigit et al. (2016c) is that the strong positive impact of parental income on a child's potential to become an inventor vanishes once the child's education attainment is controlled for. That is, parental resources are an important determinant of their children's innovation chiefly through their influence on education. Providing equal educational opportunities for children outside the very top income percentiles could therefore be a powerful policy to increase innovation.

Figure 15. Inventors and Parental Income
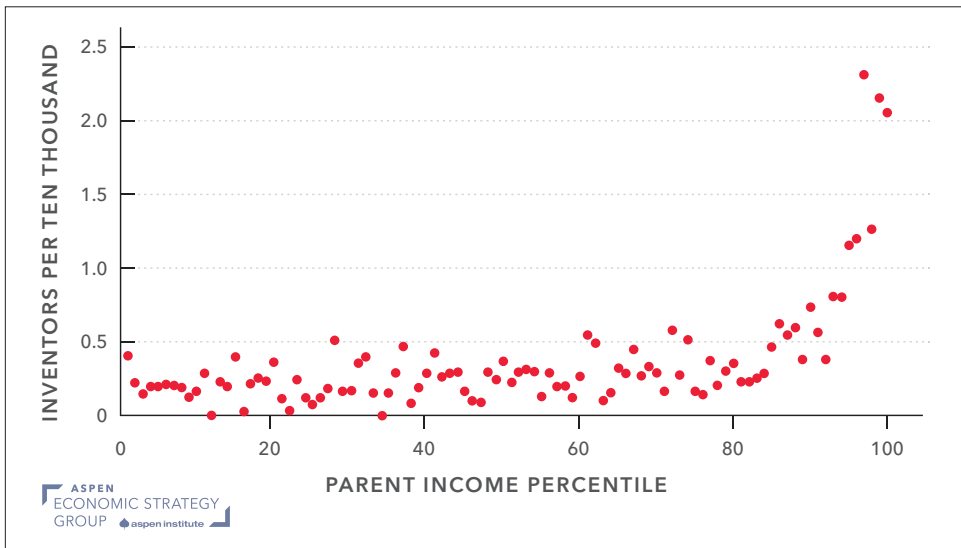
Source: Akcigit et al. (2016c).

While education policy is fundamental for a country's economic growth, its effect on innovation is likely to encounter significant lag. Completing higher education and becoming a prolific inventor takes significant time, as would restructuring the country's education system to better support education for 95 percent of the population equal to what the very richest can afford. In addition, relying only on domestic talent can invite diminishing returns. For instance, Akcigit et al. (2020b) show that the increase in the number of PhD slots following policy changes in Denmark in 2002 produced a significant decline in the average IQ of PhD students.[23]

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23 From 2002 onward, the universities in Denmark were required to increase the availability of PhD slots, as part of a broader initiative to enhance education and innovation.

The result implies substantial heterogeneity in the quality of PhD student pool—as would be expected. The obvious trade-off between the supply of PhD slots and the average talent of the student pool attending these programs makes plain how vital it is for countries to tap the broader pool of international talent. Immigrant innovators must enter the successful economy's expansion plans.

Immigrants have made substantial contributions to US inventions over the past century (Akcigit et al., 2017). Patent records and federal Census data demonstrate broad evidence of the impact of immigrants on US innovation and labor market outcomes. For example, technological areas where immigrant inventors were more prevalent between 1880 and 1940 experienced faster growth over the following six decades—an effect that prevails even after controlling for various variables that could have contributed to economic growth in the latter period. Immigrant inventors were also more productive during their lifecycle than were native-born inventors, even though they received significantly lower wages than their native-born counterparts. Overall, these findings suggest a substantial contribution from foreign-born inventors to US innovation, despite the apparent assimilation frictions in the labor market.

What policies could help governments to take advantage of global worker mobility and to attract successful inventors from abroad? Many prolific inventors around the world are international migrants, and country-specific policies greatly affect their location choices (Kerr and Lincoln, 2010). Notably, high income taxes appear to have significant negative effects on inventor relocation.

In response to the 1986 reduction in the nation's top marginal tax rate, foreign "superstar" inventors—defined as those in the top 1 percent of quality distribution, with quality being measured by total citations received—flocked to the country, implying substantial elasticity in their location choices, as demonstrated in Figure 16. When the country lowered the top tax rate for high-income foreign researchers, the number of foreign inventors migrating into the country rose significantly. These findings, taken together with the results in the previous sections, suggest that ill-devised policies can impose significant costs on societies through their adverse effects on innovation incentives felt by both firms and individuals, hurting economic growth and development.

Figure 16. United States Tax Reform Act of 1986 and Inventor Migration
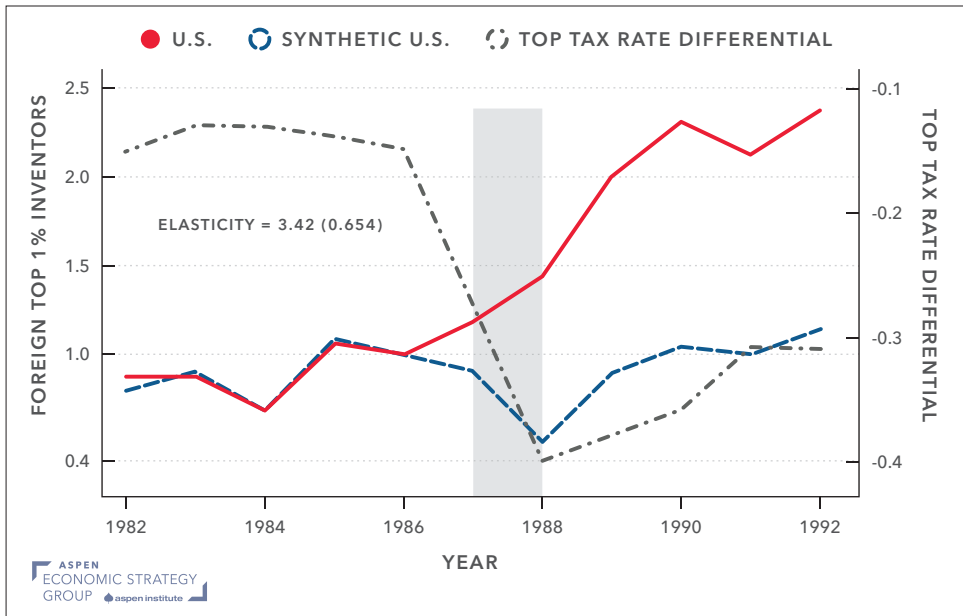
Source: Akcigit et al. (2016a).

6. Innovation and Top Income Inequality

Our analysis concludes with a discussion of innovation's effect on inequality and social mobility—aspects that are usually overlooked in the analysis of innovation and policies meant to encourage it. Aghion et al. (2019) document a strong association between innovation and top income inequality, with returns on innovations boosting the income share of the top 1 percent of income earners, and argue that this relationship is at least partially causal. As a demonstration, Figure 17 highlights the close relationship between the number of patents granted in a given year and the top 1 percent income share in that same year. The authors argue moreover that innovation, especially by entrants, supports social mobility.

Figure 17. Patents and the Income Share of the Top 1 Percent
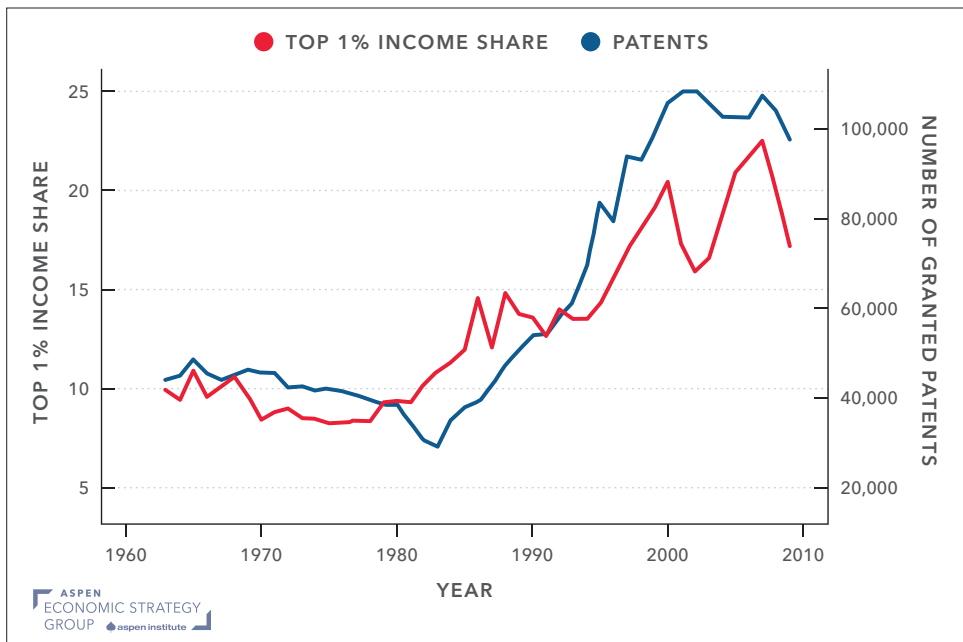
Policymakers therefore ought to be aware of the double-edged sword they potentially wield: policies that promote innovation can also lead to increased inequality. To the extent that increased inequality in turn raises barriers to prospective inventors and start-ups, these policies may have negative unintended consequences for social mobility and business dynamism.[24] Recall that this mechanism echoes our discussion in Section 2—previously successful incumbents can become entrenched in their industries and may find ways to preclude follower firms from competing, restraining innovation and dynamism.

Certain policy options discussed in this paper have less potential than others to produce adverse effects on inequality. First, R&D subsidies that target entrant firms or small and medium enterprises may be more supportive of social mobility than blanket R&D subsidies that are made available equally for all firms. Likewise, tapping into global talent expands the pool of skilled workers and mitigates the quest for scarce human capital, which can reduce inequality. Lastly, exposure to global competitors can dampen entrenched incumbents' advantageous positions

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24   Recall that parental income, through expanding education opportunities for children, is an important determinant of who becomes an inventor (Figure 15).

and enhance the competitive environment, helping to level the field between leaders and followers. Altogether, taking inequality concerns and policies' longer-term implications into consideration will prove vital when crafting policy to promote sustained and inclusive growth.

7. Additional Policy Considerations

Although not at the forefront of our analysis here, some additional issues are worth considering for the design of an optimal innovation environment. First, government spending on R&D as a fraction of GDP has been steadily declining in the United States since the 1970s (Figure 18). This decline is still concerning even though private R&D has increased, since private and public R&D spending are not interchangeable. While government is able to undertake high-risk basic research projects, the private sector, driven by return on investment, predominantly focuses on applied research, and increasingly so (Bloom et al., 2019). Oftentimes major breakthroughs won through basic research clear a path for follow-on applied research, creating significant complementarities between the two (Akcigit et al., 2021b). Engaging the public sector in basic research should therefore be an important aspect of innovation policy; this essential function isn't easily replaced by private-sector spending.

Figure 18. Public R&D Expenditure as a Fraction of GDP
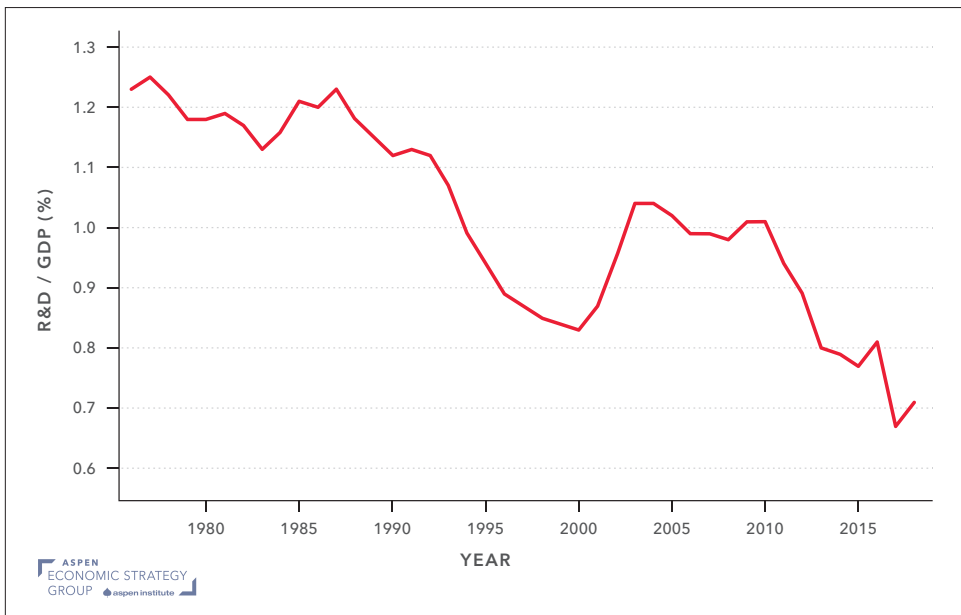
Source: Akcigit et al. (2021b).

Another aspect of the knowledge market for policymakers to consider is the secondary market for the exchange of patents and intellectual property more broadly. Akcigit et al. (2016b) emphasize the key role that the US patent market plays in ensuring the allocation of patents to their most productive users. In light of our discussion in Section 2 regarding the decline of knowledge diffusion in the US economy, enhancing this market should form a vital part of a national innovation policy. That same discussion also informs the need for dynamic, proactive competition agencies, particularly considering that new digital-intensive sectors such as e-commerce allow successful firms to quickly grow into dominant players.[25]

Finally, policymakers should be aware of how firms of different sizes use subsidies differently. Smaller firms, for instance, produce more radical innovations and generate more major innovations relative to their size (Akcigit and Kerr, 2018), providing further support for the importance of targeted measures, in addition to those related to inequality concerns. By contrast, blanket measures, including R&D subsidies available equally to all firms, may disproportionately help larger players. Such was the case, for example, when the United States introduced R&D tax credits during the 1980s. The notable pickup in R&D spending at publicly traded firms was not matched by the path of overall private R&D spending, suggesting that larger firms benefited most from these facially universal measures. Providing a level field conducive to the emergence of competitive, high-growth, small and young firms necessitates more nuanced and targeted approaches.

8. Conclusion

In recent decades the US economy has been suffering from low productivity growth, slower business dynamism, and weaker competition. The technological gap between the frontier firms and the laggards has been widening, with the former hoarding innovative resources and output while the latter face increasingly higher barriers to compete. In this environment, eliminating distortions to competition can foster innovation; renewed competition can provide the right incentives for firms to improve their products and their processes. Appropriate policy responses would remove barriers to competition and take advantage of complementarities between competition, innovation, and dynamism. To achieve those goals, policymakers can look to expand human capital in the economy, reaping benefits from foreign competition as well as the global talent pool. Certain of these policies can also alleviate the inequality concerns that prioritizing innovation might raise.

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25   Digital and online technologies offer firms significant opportunities of scale economies; successful firms can quickly expand their customer base and scale and become a dominant firm in their respective sector.

To summarize the key takeaways for the appropriate innovation policies:

1. Enhanced competition reduces the need for government intervention via R&D subsidies. Lowering barriers to competition from foreign firms is helpful in this regard.

2. Foreign competition appears to be particularly helpful to reinvigorate dynamism in more concentrated sectors.

3. Foreign investment appears to benefit the domestic economy by funding start-ups and promoting increased competition over time, unless the security concerns associated with reverse technology transfer are monumental.

4. While improving the education system and providing equal opportunity to every student is vital for developing human capital in the longer term, policies to attract global inventors can provide a complementary solution, offering an option to expand the talent pool more immediately.

5. As compared to other policy approaches to increasing innovative activity, taking advantage of global forces either by lowering trade tariffs or by attracting human capital can be less prone to causing inequality. Key is to maintain a healthy degree of competition in the economy and to ensure a level field, precluding successful agents—be they firms or individual inventors—from raising barriers to potential competitors.

6. R&D subsidies are useful options to boost innovative investment, but are also prone to increasing top income inequality and are likely to benefit larger firms.

7. Targeted measures could more decisively reinforce laggard or small and young firms.

8. Promoting the exchange of patents in the secondary market would alleviate the problems with knowledge diffusion from which the US economy has particularly been suffering.

9. Ensuring a dynamic and proactive competition agency is key for accelerating competition and innovation, especially as newer, digital-intensive sectors achieve growing market share.

10. Spending on basic research is diminishing. Increasing public expenditure on basic research would likely have outsize ripple effects on the innovation landscape.

These considerations are certainly not all-encompassing, and recent proposals in the literature also consider various education policies as well as changes to the patent system to improve its efficiency (Ouellette and Williams, 2020). But our study emphasizes an important aspect of innovation policy that policymakers oftentimes neglect—that is, the need for a vigorous competitive environment.

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Seven Recent Developments in US Science Funding

AUTHORS

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Over the past century, scientific research and development (R&D) has fueled US economic and military might and propelled the country's status as a global superpower. These investments have helped to launch not only the technologies that define modern life, including the internet, mobile and personal computing, and artificial intelligence, but also the healthcare advances that have extended US life expectancy by nearly 20 years, including vaccines, diagnostic technologies, and novel drug therapies. As Ben Jones described in a 2021 AESG paper, the returns on publicly funded scientific investment are substantial: "effectively, the science and innovation system is akin to having a machine where society can put in $1 and get back $5 or more."

Vannevar Bush's influential 1945 report *Science: The Endless Frontier* laid the original groundwork for a national science strategy premised on the idea of a triangular partnership among government, academia, and the private sector—rather than a strategy that concentrates research activity within the federal government (Isaacson, 2019). That informal partnership largely remains intact today and is reflected in the

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billions of dollars the National Institutes of Health (NIH) grants each year to academic institutions for medical research; in organizations such as the Defense Advanced Research Projects Agency (DARPA), which produces breakthrough technologies in partnership with industry and academia; and in the National Science Foundation (NSF), which funds roughly a quarter of the basic research conducted at US colleges and universities. But much about the national strategy has also changed—as have its results.

The landscape for scientific funding has evolved since its early days and now comprises a complicated array of government agencies, private ventures, and partnerships between the two. This report casts light on the current state of US science funding and the institutions that support that funding, highlighting seven ways in which the size, composition and structure of US scientific research and development have developed since Vannevar Bush's seminal report. What emerges is a portrait of the complicated arrangements that extend across the federal government, the business sector, higher education, and nonprofits.

1. The United States leads the world in gross R&D domestic investment, but China is quickly narrowing that gap.

US national R&D investment is the highest in the world. At over $700 billion in 2020, US R&D expenditures exceed those of Japan, Germany, South Korea, France, India, the United Kingdom, and Russia, combined. But China is closing the gap. As demonstrated in Figure 1A, which charts gross domestic expenditures on R&D by country in billions of PPP dollars (left axis) and as a share of GDP (right axis), total Chinese annual R&D investment exceeded $500 billion as of 2019—the latest year for which comparable data are available. China's R&D investment has accelerated over the past decade, growing at an average annual rate of 10.6 percent, roughly twice that of the United States over the same period (see Figure 1B). Meanwhile, South Korea and Taiwan, both small, technologically advanced countries, lead the world in R&D investment when measured as a share of GDP.

2. Over the past 30 years, business R&D investment has accelerated while federal investment has plateaued.

Seventy-three percent of American R&D investment is funded by the business sector, which receives tax benefits designed to incentivize such investments. As demonstrated in Figure 2, business investment in R&D accelerated between 2010 and 2020, growing at a pace of roughly 5.8 percent per year, and reached $517 billion

**Figure 1A. Gross Expenditures on R&D (GERD) and R&D Intensity,
Top 17 Countries, 2019 or Most Recent Data Year**
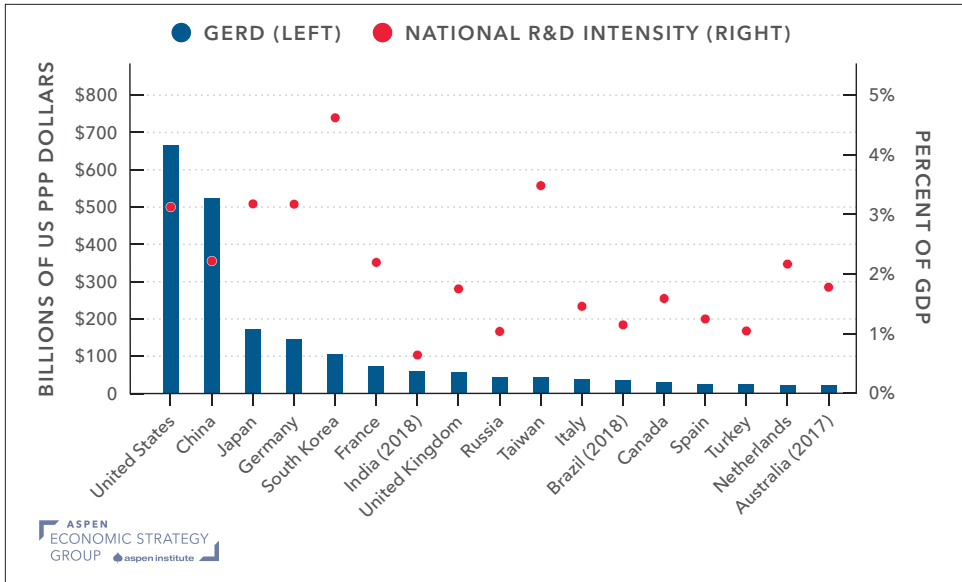
Figure 1B. Gross Domestic Expenditures on R&D by Selected Country, 1990–2019
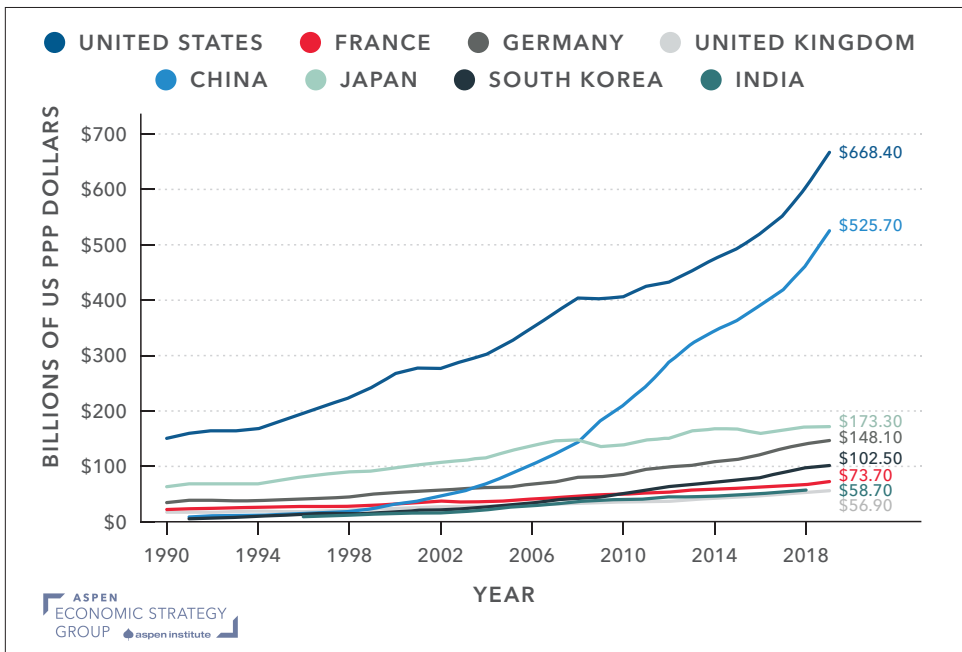
(current dollars) in 2020, nearly four times the amount of federal R&D funding, which has remained relatively flat over the past decade. As a result, federal R&D funding has not kept pace with economic growth and stands near a 60-year low when measured as a share of the overall economy (see Ganz and Vincent, 2021). These trends are noteworthy since business-funded investment tends to favor later-stage R&D while federal investment is more likely to support early-stage, exploratory research. However, direct federal expenditures represent only a portion of total federal support for R&D. Tax subsidies for research expenditures, most notably the R&D tax credit, are expected to total more than $80 billion over 2020-2024 (Joint Committee on Taxation, 2020). The non-profit and higher education sectors meanwhile fund a relatively small share of total R&D expenditures, accounting for $53 billion (current dollars) in 2020.

Figure 2. US R&D Expenditures by Funding Source, 1990–2020
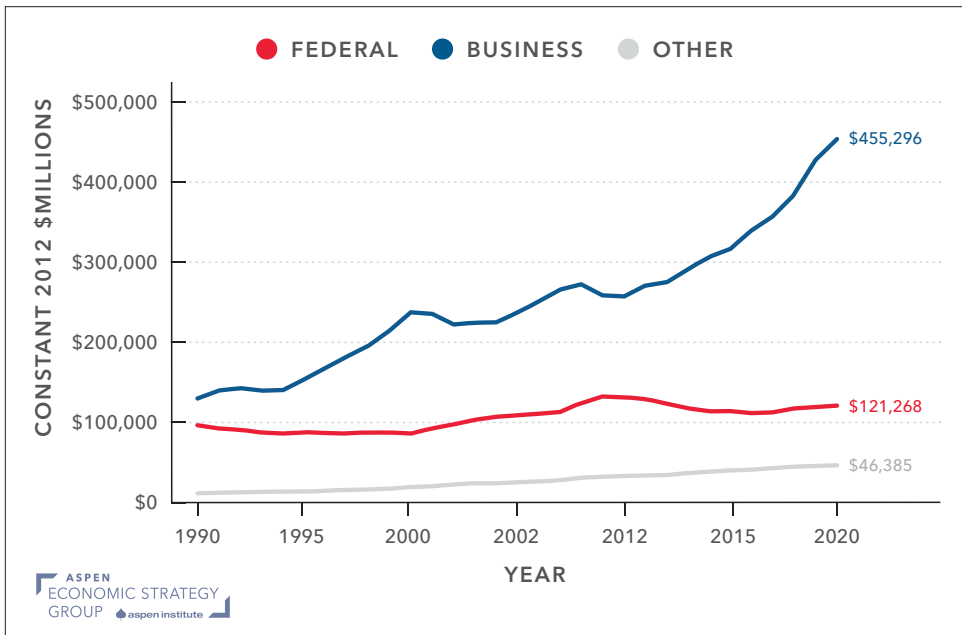
Source: National Center for Science and Engineering Statistics (2022).

3. The federal government is the largest source of funding for basic science R&D, but the business sector is the largest source for applied R&D.

Figure 3. R&D Funding by Type of Funding and Sector, 2019
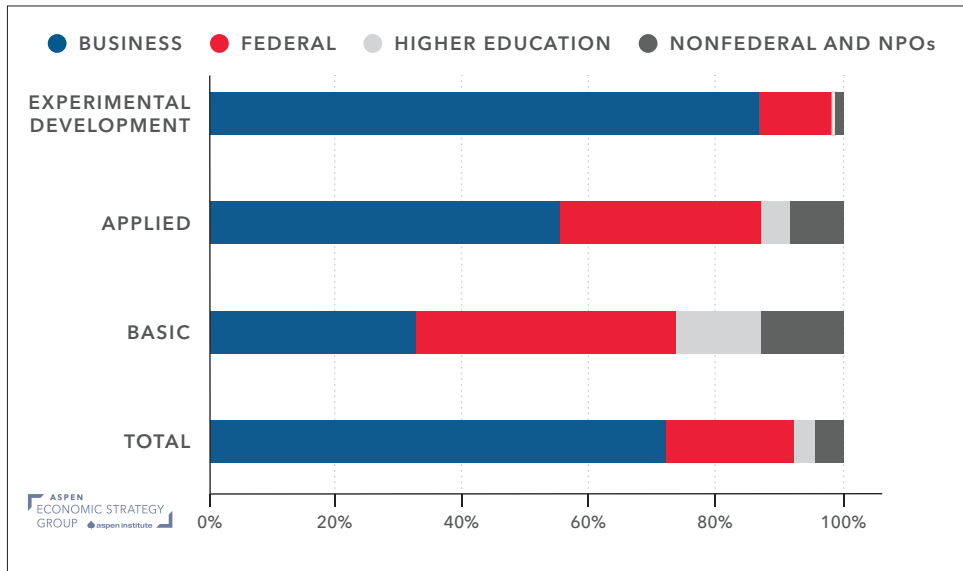
Source: National Center for Science and Engineering Statistics (2022); authors' calculations.

Figure 3 disaggregates R&D by type of research—applied, basic, or experimental development. Each type of research entails a different risk profile in search of different goals. While applied research is directed toward a specific objective or application, basic research is more flexible: results are not committed toward any particular application. Experimental development meanwhile applies existing research, knowledge, and experience to new products, processes, or improvements (NCSES, 2022).

Figure 3 also disaggregates R&D by sector—business, the federal government, higher education, and nonprofits—and demonstrates that the three types of research draw their funding from the various sectors in significantly different proportions. For instance, the federal government is the largest source of funding for basic research (41 percent of the total), followed by the business sector (33 percent), while higher education and nonprofits each contribute around 13 percent of the total. In contrast, business funds the majority of applied research (55 percent), followed by the federal government (32 percent), with the remaining share (13 percent) coming from higher education and nonprofits combined. Finally, the business sector funds 87 percent of all experimental development while the government funds just 11 percent of the total.

The changing composition of the funding landscape in recent decades has shifted the composition of R&D being performed. Increases in the business sector's contribution to total R&D funding over the past decade has led to a 76 percent increase in applied research, as compared against a 42 percent increase in basic research over the same period.

4. The higher education sector is the largest performer of basic science R&D in the United States.

Figure 4. R&D Performance by Type of Funding and Sector, 2019
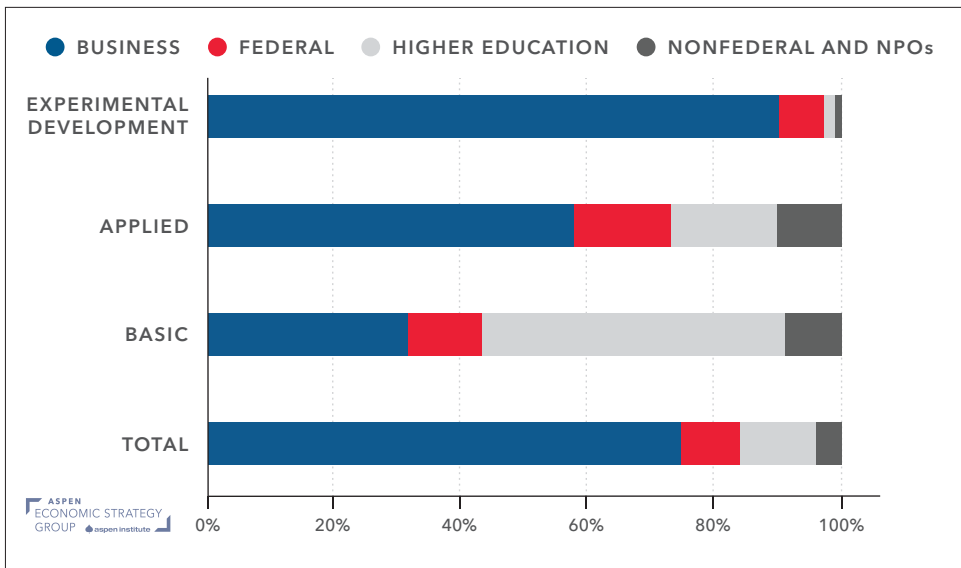
Source: National Center for Science and Engineering Statistics (2022); authors' calculations.

R&D performance differs from R&D funding. In the triangular partnership between business, government, and higher education, the business sector performs three quarters of total R&D, followed by higher education (12 percent) and the federal government (9 percent).

Among the total R&D performed by businesses in 2019, nearly 60 percent was spent on manufacturing, including pharmaceuticals, computers, and electronics. The information industry (22 percent) represented much of the remaining spending (Wolfe, 2021).[1] In contrast, the federal government spends most of its R&D funding on medicine and life sciences, space, defense, and energy.

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1   Data from Wolfe (2021) is extracted from the 2019 Business Enterprise Research and Development Survey and dollar amounts carry minor discrepancies with data used in Figures 3 and 4.

The distribution of funding within each source is not consistent across research types. Higher education performs the greatest share of basic research (48 percent), followed by business (32 percent), the federal government (12 percent), and nonprofits (9 percent). Of the basic research performed by higher education, just over half is funded by the federal government.

The majority of R&D performed by the higher education sector is spent on life sciences (56 percent), followed by engineering (15 percent), physical science (6 percent), geosciences (4 percent), social science (3 percent), and computer science (3 percent) (Gibbons, 2021; NCSES, 2022).[2] Within the life sciences investment, health-related R&D comprised 56 percent of the total.

5. **The Department of Defense accounts for the largest share of federal R&D investment, followed by the NIH, the Department of Energy, and the National Aeronautics and Space Administration.**

Figure 5. Federal R&D Funding Distribution, 2022 ($millions)

Source: Congressional Research Service (2022).[3]

Figure 5 depicts the distribution of federal R&D appropriations across federal agencies. Five agencies receive 95 percent of federal R&D funds.

The Department of Defense (DOD) maintains the largest R&D[4] budget at just under $120 billion,[5] constituting around 55 percent of total federal R&D funding. Fifty-five percent ($65.4 billion) of the DOD's budget is allocated to experimental development activities, which includes larger-scale experimental hardware development, prototypes, and proof-of-concept designs. Non-experimental development, which supports system improvements in existing operational systems, receives 37 percent ($44.2 billion) of DOD R&D funding. DARPA, which is widely celebrated for its contributions to the creation of the internet, GPS, voice recognition, Moderna's COVID-19 vaccine, among countless other breakthrough technologies, has an annual budget of $3.9 billion in 2022, which is less than 4 percent of the total spent on R&D by DOD.

The NIH receives just over 20 percent of all federal R&D funding, the most of any government agency. This appropriation is allocated across 24 different research institutes. The largest funding recipients within the NIH are the Institutes for Cancer ($6.9 billion), Allergy and Infectious Diseases ($6.3 billion), and Aging ($4.2 billion).

The Department of Energy (DOE) received $19.1 billion for fiscal year 2022, allocated across four offices and administrations and to four additional energy programs. Among those offices, the Office of Science, which funds physical sciences research, and the Office of Energy Efficiency and Renewable Energy (EERE), which focuses on renewable energy, low carbon transportation, manufacturing, and weatherization, received the bulk (71 percent) of DOE's federal R&D funding. The CHIPS and Science Act appropriated approximately $30.5 billion in new funding to the DOE over the next five years for basic and applied energy research.

The National Aeronautics and Space Administration (NASA) received $12.5 billion for fiscal year 2022, 6 percent of the total federal R&D budget. Over 60 percent ($7.5 billion) is allocated toward "Science," which includes funding for the recently employed James Webb Space Telescope. Another 23 percent ($2.9 billion) is allocated toward deep space exploration and operation programs.

Of the $7 billion allocated to the NSF, the overwhelming majority (81 percent) is used to fund "Research and Related Activities" (R&RA), which includes early-stage

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4   The R&D budget for the Department of Defense discussed here refers to funding appropriated in Title IV, "Research, Development, Test, and Evaluation" (RDT&E). For consistency, we refer to "RDT&E" as "R&D" throughout this section.

5   The DOD's total R&D budget in Figure 5 includes funding for all budget activities (6.1-6.8) under Title IV. The OMB does not count 6.7 and 6.8 as R&D. For this and other reasons, the total R&D amount discussed in this section does not align with total federal R&D investment figures used elsewhere in this report.

research across all areas of science technology and engineering and mathematics (STEM) (NSF, 2021). The CHIPS and Science Act allocates substantial new resources ($20 billion over baseline over the next five years) to the NSF to establish a new Directorate for Technology, Innovation, and Partnerships (TIP) to accelerate translational research and support STEM-related workforce development. The CHIPS and Science Act also provides an additional $16 billion over baseline over the next five years for basic research and programs to develop the STEM workforce.

The Department of Agriculture allocates most of its $3.7 billion R&D budget to the Agriculture Research Service ($1.8 billion), USDA's in-house basic and applied research agency, and to the National Institute of Food and Agriculture ($1.6 billion), USDA's principal extramural research agency that partners with education institutions, private organizations, and individuals to conduct projects and research. The remainder of the agricultural R&D budget is allocated to the National Agricultural Statistics Service and the Economic Research Service.

The Department of Commerce splits its $2.4 billion R&D budget between two of its major agencies: the National Institute of Standards and Technology (NIST) and National Oceanic and Atmospheric Administration (NOAA). NIST research provides measurement, calibration, and quality assurance techniques to support US commerce, while NOAA produces research relating to ecosystems, atmosphere, and global climate change. The CHIPS and Science Act allocates an additional $2.8 billion over the next five years to research conducted by NIST (Department of Commerce, 2022).

The federal government also provides R&D funding to the Department of Veterans Affairs ($1.6 billion), the Department of Transportation ($1.2 billion), and the Department of the Interior ($1.1 billion). Included in the $2.7 billion funding represented in the "Other" category in Figure 5 are allocations for the Environmental Protection Agency ($781 million), the Department of Homeland Security ($664 million), the Department of Education ($405 million), and the Smithsonian Institution ($332 million).

6. Since the late 2000s, federal expenditure on R&D has shifted toward tax incentives and away from direct financing.

The research and development tax credit, first enacted in 1981 under the Economic Recovery Tax Act, was made permanent in 2015. The credit is calculated based on the change in a firm's R&D expenses over a defined period, rather than on its gross R&D expenses. As Bloom et al. (2019) highlight, this method enshrines the United States among the bottom third least generous of Organisation for Economic Co-operation and Development (OECD) member countries. US tax incentives reduce

the cost of R&D spending by an average of 5 percent, as compared to the 30 percent subsidy in countries with the most generous tax regimes.

Nevertheless, the Joint Committee on Taxation estimates the cost of government tax support for R&D rose from $9.5 billion in 2000 to $22.1 billion in 2018, as measured in 2015 constant dollars. According to the OECD (2021), 91 percent of the total tax subsidy credit is awarded to firms with gross receipts in excess of $50 million. Surveying the literature on the effectiveness of R&D credits, Hall (2019) concludes "that they are generally effective at increasing business R&D, with a price elasticity of minus one." That is, each dollar of tax revenue foregone increases R&D spending by approximately a dollar.

Figure 6. Direct Funding of Business R&D and Tax Incentives for R&D in the United States, 2000–2018
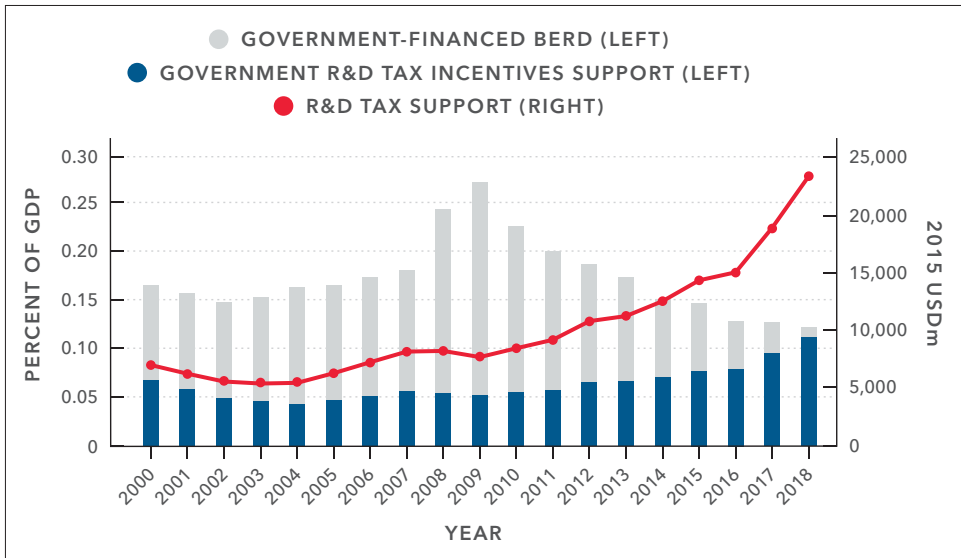
Source: Chart recreated from OECD (2021).

7. Funders now employ a variety of traditional and newer mechanisms to select projects and scientists for funding.

While the federal government funds $160 billion in R&D each year, there remains significant debate over how to maximize that investment's effectiveness. A substantial share of this funding, including an estimated 95 percent of academic medical research (Guthrie et al., 2018), is allocated through agency-led peer review processes at institutions such as the NIH and NSF. But various institutions have

developed alternative models in response to recognized weaknesses in the traditional peer review model. Table 1 highlights the distinguishing features of three prominent project selection models, including the peer review model.

Table 1. Project Selection Models

PROJECT SELECTION MODEL	OVERVIEW	SAMPLE INSTITUTIONS	TIMELINE TO RECIEVE FUNDING
Peer Review	- Funding opportunity announced. - Submitted proposals are subject to multiple rounds of review. - Review teams are supervised by a lead program officer, who receives the team's recommendations about proposal funding.	- NIH - NSF	- NIH: 8 to 20 months after proposal submission. - NSF: Up to 10 months after proposal submission.
Portfolio	- Funds a portfolio of high-risk investments with long time horizons. - Similar to venture capital, the portfolio model manages risk by investing in a wide range of options to increase the chances of success from at least one project. - A "high risk, high reward" approach.	- DARPA - OWS	- DARPA: About 6 months from program approval by the Director. - OWS: All 6 "finalist" companies had signed initial contracts within one month of OWS' formal launch. Further funding is made available for select companies in later phases of development.
People, Not Projects	- Funds individuals or teams of scientists, who are provided autonomy over their research agendas.	- HHMI - ARC - MacArthur Fellows Program	- HHMI Investigator Program: About 2 years after the application submission deadline. - MacArthur Fellows Program: 9 months to several years after nomination.

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Source: NIH (2021a); National Science Foundation (n.d.); Bonvillian (2020, 2021); Congressional Research Service (2021a, 2021b); GAO (2021); HHMI (2022); ARC (n.d.); MacArthur Foundation (2022).

1. Peer Review

The peer review model is a bureaucratic review process used to solicit and to select proposals for specific projects. After applications for a particular project are opened, submitted proposals are subjected to multiple rounds of expert review. Review teams are supervised by a lead program officer, who receives the team's recommendations about proposal funding. If a lead program officer or Director recommends the proposal for award, some agencies will then require a review of business, financial, and policy implications. Once the review is completed, a final decision is made to fund or decline the proposal.

The peer review system's weaknesses are well-known: the process is time-intensive (Publons, 2019); the burden of which falls on applicants who may or may not receive

funding (Rockwell, 2009; Guthrie et al., 2018; Herbert et al., 2013); and there is evidence of bias against the most innovative research and in favor of older or previously funded researchers (Luukkonen, 2012; Ayoubi et al., 2021). While the peer review process outperforms random assignment of science funding, it is a weak predictor of future research performance in some research sectors (Guthrie et al., 2018; Fang et al., 2016). And these critiques are not unique to the United States. In Canada, for example, researchers have observed that the cost of peer review is greater than the cost of awarding all qualifying scientists a $40,000 grant (Gordon and Poulin, 2009).

Researchers (Ricón, 2021; Fang and Casadevall, 2016) have proposed modifying the peer review system by instituting a lottery in instances where the supply of qualified applications exceeds the available funding. Proponents of these modified lottery systems emphasize the mixed results of the peer review process at generating innovative research and highlight that a quasi-randomized system could substantially reduce reviewer bias, improve grantee diversity, and expedite the selection process. The idea has gained momentum internationally, with notable institutions such as the Health Research Council of New Zealand and the Swiss National Science Foundation becoming the latest to experiment with the process (Adam, 2019).

2. Portfolio

The portfolio approach, used most notably by DARPA and Operation Warp Speed (OWS), is geared toward generating new ideas to address novel problems. Unlike the peer review process, the portfolio approach simultaneously funds a variety of projects working to solve the same problem. By investing in a wide range of options (a "portfolio"), organizations increase the chance that at least one project will prove successful, while also accepting the risk that more projects will likely fail. Unlike the peer review model, the portfolio approach encourages funding organizations to invest in "risky" proposals that may otherwise be rejected.[6] Organizations that use the portfolio approach often employ a flat, non-hierarchical structure, allowing them to expedite the project selection process.

DARPA is one of the more prominent examples of an organization using the portfolio approach. Established in 1958 as an agency of the DOD, DARPA aims to maintain and to advance US technical superiority (Congressional Research Service, 2021b). The agency is composed of a Director, a Deputy Director, and approximately 100 program managers (PMs), each of whom serve five-year appointments to create

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6   The newest of the NIH's programs, the Advanced Research Projects Agency-Health, which aims to undertake "agile, risky, transformational biomedical research projects," is using a DARPA-like portfolio model to fund projects rather than the traditional NIH peer review process in order to better "establish a culture of championing innovative ideas" (AAAS, 2021; NIH, 2021).

and oversee ambitious R&D programs. Programs that are approved by the Director and Deputy Director are then issued budgets, and a PM next solicits, reviews, and selects proposals for the program's various components. Once funding recipients are selected, the PM then plays a supervisory role throughout the project's duration. PMs may supervise more than one program at a time, and programs typically last between three and five years. While the PM can often take over a year to research and to design programs, performers typically receive funding around six months after proposals are submitted.

OWS, an interagency partnership between the DOD and the Department of Health and Human Services (HHS) created by the Trump administration in 2020 to facilitate and accelerate the development, manufacture, and distribution of COVID-19 vaccines, also used the portfolio approach. Organizationally, OWS functioned like an accelerated version of the DARPA model, selecting multiple firms to receive funding for vaccine research and development (Bonvillian, 2021). However, unlike DARPA, OWS guaranteed the purchase and distribution of the firms' final product. These guaranteed purchases were instrumental in accelerating vaccine development, but also required that the government incur substantial financial risk. By March 2021, OWS had issued $18.2 billion in contracts for vaccine development and production, in addition to over $950 million for ancillary COVID-19 supplies (GAO, 2021; Congressional Research Service, 2021a). But OWS ultimately delivered vaccines at scale in unprecedented time—by January 2021, only eight months after the program's launch, five of the six contracted vaccine manufacturers had begun commercial manufacturing, and by month's end these companies had released 63.7 million doses of the vaccine.

3. *People, Not Projects*

The "people, not projects" approach focuses the selection process on scientists, rather than on specific projects. It is currently favored by a variety of non-government agencies. For example, The Arc Institute selects "Core Investigators" for renewable, eight-year appointments to operate fully funded labs. Investigators have complete autonomy over their research agenda and "pursue their very best research ideas in accordance with their own judgment, regardless of short-term risk" (ARC). The Howard Hughes Medical Institute (HHMI) adopts a similar approach: HHMI investigators receive renewable seven-year appointments that confer flexible funding for salary, lab staff, and equipment at their primary research institutions. Likewise, the MacArthur Award is a $650,000, "no strings attached" grant to "talented individuals who have shown extraordinary originality and dedication in their creative pursuits," and does not require that recipients affiliate with any particular institution during their fellowship (MacArthur, 2022).

The "people, not projects" approach removes short-term pressures for recipients to reach specific goals within limited timeframes, and instead allows them substantial freedom to construct their own research agendas, enabling them to explore ideas that may not be funded by traditional project selection models. However, critics highlight that the approach, much like the peer review model, tends to favor already prominent researchers. It also often leaves them with little or no accountability for the work they produce (Ioannidis, 2011; Ricón, 2020).

Conclusion

The triangular partnership that Vannevar Bush envisioned between government, academia, and the private sector to fund US research and development lives on today in an ever-evolving form and at ever-increasing scale. As Chinese expenditures come to rival American investment, understanding the dynamics of R&D funding will be critical to efficiently allocating resources, and to developing new approaches that address some of the peer review model's drawbacks, including its potential for sluggishness. Recent successes such as Operation Warp Speed provide cause for continued optimism that US innovation will continue as the preeminent source of scientific breakthroughs and widespread economic prosperity.

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US DEMOGRAPHIC CHALLENGES AND POTENTIAL POLICY RESPONSES

The Causes and Consequences of Declining US Fertility

AUTHOR

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ABSTRACT

US births have fallen steadily since 2007 and the total fertility rate is now well below replacement level fertility—the rate at which the population replaces itself from one generation to the next. Our analysis suggests that this trend is unlikely to reverse in the coming years. The decline in births is widespread across demographic groups and it does not merely reflect a delay to older ages. Rather, more recent cohorts of women are having fewer children over the entirety of their childbearing years. We are unable to identify any period-specific social, economic, or policy changes that can statistically explain much of the decline. We conjecture instead that the sustained decline in the US fertility rate more likely reflects shifted priorities across recent cohorts of young adults. A prolonged US total fertility rate this low—specifically, a rate substantially below 2—would lead to slower population growth, which could in turn cause slower economic growth and present fiscal challenges. While the decline presents a fairly new challenge to the United States, other high-income countries have sustained below replacement level fertility for some years now and have attempted policies to mitigate that trend. But the evidence on these pro-natalist policies leads us to conclude that incremental policy responses are unlikely to reverse trends in the US fertility rate. The slowdown in native population growth could be addressed with increased immigration and advances in productivity.

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1. Introduction

Population growth has been slowing in the United States for several years, driven by a decrease in births, an increase in deaths due to an aging population, and lower net immigration. The US population grew by only 0.1 percent in 2021, the slowest rate in the nation's history (Rogers, 2021). While this historically low rate was in part reflective of the unusual conditions brought about by the COVID-19 pandemic, it also continued a sharp downward trend. From the 1970s through the Great Recession, the population grew at roughly a 1 percent annual rate. But the growth rate has been steadily slowing since. Population growth has now reached considerably lower levels than during either World War (the earlier of which coincided with the Spanish Flu's peak spread) or the Great Depression. The Census Bureau reported that in the year 2019, the natural increase in population (births minus deaths) fell below one million for the first time in decades (US Census Bureau, 2022).

In this paper, we focus on the causes and consequences of declining US fertility, a key contributor to declining US population growth. Between 1980 and 2007, the *general fertility rate* (defined as the number of annual live births per 1,000 women of childbearing age, which is usually defined as age 15 to 44 years) fluctuated within a narrow range of roughly 65 to 70.[1] Since then, it has plummeted, falling to 56.6 in 2021.

The decline in the general fertility rate implies a decline in the current period *total fertility rate* (TFR), a simulated measure that calculates expected lifetime births by assuming that women will follow current age-specific birth rates over their childbearing years. This measure is key to population growth. The US TFR declined from 2.12 in 2007 to around 1.65 in 2020 and 2021, the lowest levels ever recorded (Hamilton et al., 2022). Since 2007 it has been consistently below the replacement level of 2.1 (Hamilton et al., 2021).

For reasons we describe below, we conjecture that the US fertility rate is unlikely to substantially rebound in the foreseeable future, and that the country is likely to experience below replacement level fertility in the coming years. We note that forecasting birth rates is notoriously difficult and we put forward our estimates with the requisite humility; the factors that influence birth rates are not entirely well understood and have moreover been observed to swing unpredictably. But attempting an estimate is important for national policy: lower fertility implies lower population growth and eventually a smaller working-age population, which will have consequences for social,

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1   The measures we use to statistically describe birth patterns include: (a) the general fertility rate—births per year per 1,000 women between the ages of 15 and 44; (b) the current period total fertility rate—the total number of births an average woman would have over her childbearing years if her age-specific birth rates matched observed year-specific values; and (3) the cohort total fertility rate—the number of births a woman from a specific birth cohort will have over her childbearing years.

fiscal, and economic conditions. We review some of the current economic thought and evidence about the likely impacts of lower population growth and a smaller working-age population on the US economy and society more broadly.

We also discuss possible policy responses to these demographic challenges, emphasizing the potential reliance on immigration to compensate for a smaller native population, along with investments in human capital and technology that would increase worker productivity. Based on our read of the evidence, we conclude that incremental pro-natalist policies, such as expanded child tax credits or more generous childcare subsidies, might at best have a modest effect on the aggregate US fertility rate, and that they are unlikely to improve it to replacement level. Broader structural changes in US society, including a system of government programs that support residents "cradle-to-grave" along with considerably greater equality in the division of family and home responsibilities between men and women, are more likely to lead to a sizable rebound in the US fertility rate. International evidence, though, suggests there is reason to be skeptical about even those interventions.

2. Recent Trends in US Fertility Rates

In this section we highlight three key facts about declining fertility in the United States, using data on the universe of US births from the Vital Statistics system from 1980 through 2021:

- The US general fertility rate has fallen since 2007, not only for the country as a whole but also among many demographic subgroups of women.

- The decline cannot be explained by women delaying pregnancy until older ages; women are having fewer children over their entire childbearing years.

- The US total fertility rate is converging to that of other high-income countries, after decades as an outlier.

These patterns suggest that the drop in the annual fertility rate will persist. We expand on these observations below.

2.a. The US fertility rate has been falling since 2007.

Figure 1 plots the trend in the US general fertility rate, defined as births per 1,000 women of childbearing age (15-44). The decline began at the onset of the Great Recession and continued during the ensuing recovery, with no signs of reversing. Birth rates fell beyond what one would have expected in 2020 as the result of COVID, but rebounded somewhat in 2021, placing the trend in birth rates back onto its previous downward path (Kearney and Levine, 2022).

Births have fallen for women under the age of 30. They have declined most dramatically over the past four decades among teenagers.[2] The fertility rate for those aged 15 to 19 peaked in 1991 at 61.8 births per 1,000 women. That rate declined slowly through 2007, and then quickly in the following years. Overall, teen fertility rates fell to 41.5 by 2007 and then to 15.3 births per 1,000 teen women in 2020—a 75 percent decline. Births have meanwhile fallen steeply for women in their 20s as well since around 2007. Births by women in their 30s or older remained constant or rose slightly, but not by nearly enough to make up for these large declines at younger ages. These trends are consistent with women having fewer children over their childbearing years, not merely delaying childbearing to older ages.

Figure 1. Trend in US General Fertility Rate
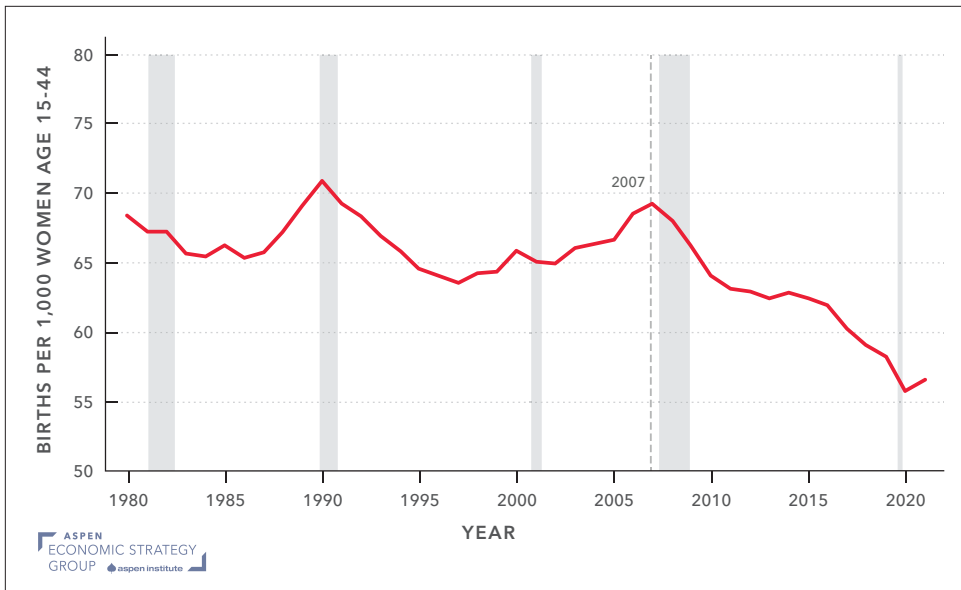
Source: Martin et al. (2012); Osterman et al. (2022); and Hamilton et al. (2021, 2022).

Among racial and ethnic groups, Hispanic women have experienced the most dramatic recent declines in births. In 2007, the fertility rate among Hispanic women was 97.4; it fell to 62.8 by 2020. Birth rates for Black women and for white non-Hispanic women also fell, but by much smaller amounts. The decline in fertility among Hispanic women is driven by Mexican-American women, both foreign- and

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2   We combine Vital Statistics birth data with population data from the Surveillance, Epidemiology, and End Results (SEER) program at the National Cancer Institute to generate rates of birth per 1,000 women between the ages of 15 and 44 by race and ethnicity. Since SEER data does not report population by educational attainment, marital status, and nativity, we use data from the American Community Survey to estimate the number of women in each relevant group in order to construct those fertility rates.

native-born, suggesting that something more than just assimilation and an increase in the native-born share of Hispanics is behind the fall in Hispanic birth rates. Of note is that the birth rate in Mexico has itself fallen dramatically over the past 50 years; it is now only slightly higher than in the United States (World Bank, 2021).

> *"We find that if birth rates had remained constant and only population shares shifted between 2007 and 2019, the birth rate would in fact have risen by 2.6 births per thousand. Fertility declines within groups account for the entire overall decline."*

When we separate women by education level, we see that those with a four-year college degree (36.3 percent of those aged 20 to 44 in 2018) and those without a high school degree (8.1 percent) have experienced the largest declines in fertility rates.[3] The fertility rate among women with a high school degree but not a four-year college degree has been fairly stable since 2007.

During the 1980s and the early 1990s, birth rates for married women were falling and birth rates for unmarried women were rising. That pattern has not held more recently: birth rates have declined in parallel for married and unmarried women since 2007. However, a rising share of women of childbearing age are unmarried—from 58 percent in 2008 to 63 percent in 2018. Because unmarried women have lower fertility, the decline in marriage rates leads to a lower fertility rate overall. The median age at first marriage has meanwhile risen continuously over the past 50 years, from 22.0 in 1980 to 25.6 in 2007 to 28.1 in 2020 (US Census Bureau, 2021). This rise contributes to greater numbers of unmarried women among those of childbearing age, and consequently lower birth rates.

Finally, the country has experienced an increase in childlessness. The decline in births since 2007 is driven more by a decline in initial childbearing (first births) than by a decline in larger families (third and higher order births).

The decline in the US general fertility rate is driven by a decline in births within age, race/ethnicity, and education groups, as opposed to changes in the population composition. As described in detail in Kearney, Levine, and Pardue (2022), we perform a statistical decomposition of the overall decline in the fertility rate into changes within-group, the contribution of changes in group population shares, and the interaction of a group's changing rates and changing population shares. We find that if birth rates had remained constant and only population shares shifted between 2007 and 2019, the birth rate would in fact have risen by 2.6 births per thousand. Fertility declines within groups account for the entire overall decline.

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3   For these calculations, we restrict the sample to women age 20 and over, since women at younger ages are less likely to have completed their education.

The decomposition analysis also reveals which groups of women account for most of the overall decline. Each demographic group's contribution to the overall decline depends on two factors: the fertility rate decline within that group and that group's share of the overall population of women of childbearing age. Hispanic teens contributed the largest share, explaining 14 percent of the overall decline; though this group represents only 3.1 percent of the female population of childbearing age, its fertility rate fell dramatically, from 82.2 to 24.7 over the period. White women between the ages of 25 and 29 with college degrees account for 12 percent of the overall decline. Their fertility rate fell from 101.1 to 65.1, and they comprise 4.2 percent the female population of childbearing age.

2.b. Women are having fewer births at all ages than did women in previous recent cohorts.

The decline in the US fertility rate could simply reflect a delay in childbearing to older ages. Were that the case, we would expect the recent drop in births to be a temporary trend; more births would occur in the coming years as women eventually "catch up." More formally, the current period general fertility rate may understate the current cohort's likely completed fertility rate.

Childbearing age profiles across successive cohorts of women can help us to gauge the extent to which this delaying explains the observed drop in fertility. We aggregate women into five-year birth cohorts, staring with the 1968-1972 birth cohort and continuing through those women born between 1993 and 1997. For simplicity of exposition, in Figure 2 and below we label these cohorts by the midpoint year in the range. These are the birth cohorts who are in their early 20s in 1992, 1997, 2002, 2007, 2012, and 2017, respectively. We then plot the average number of children ever born by specific ages to the women in these cohorts.

Figure 2 demonstrates that the three cohorts of women who entered their young adult years in 1992, 1997, and 2002 (born between 1968 and 1982), all had similar childbearing age profiles. The cohort of women who entered young adulthood in 2007 (the 1985 birth cohort), had fewer children throughout their 20s and early 30s. The 1990 and 1995 cohorts, who entered their prime childbearing years around 2012 and 2017 respectively, are pulling even further away from earlier cohorts, having fewer children so far.

A comparison of the childbearing age profiles across cohorts suggests that more recent cohorts of women are not simply delaying childbearing. They are having fewer children at all ages. Decreased total completed fertility follows.

Figure 2. Children Ever Born by Mother's Age, by Mother's Birth Cohort
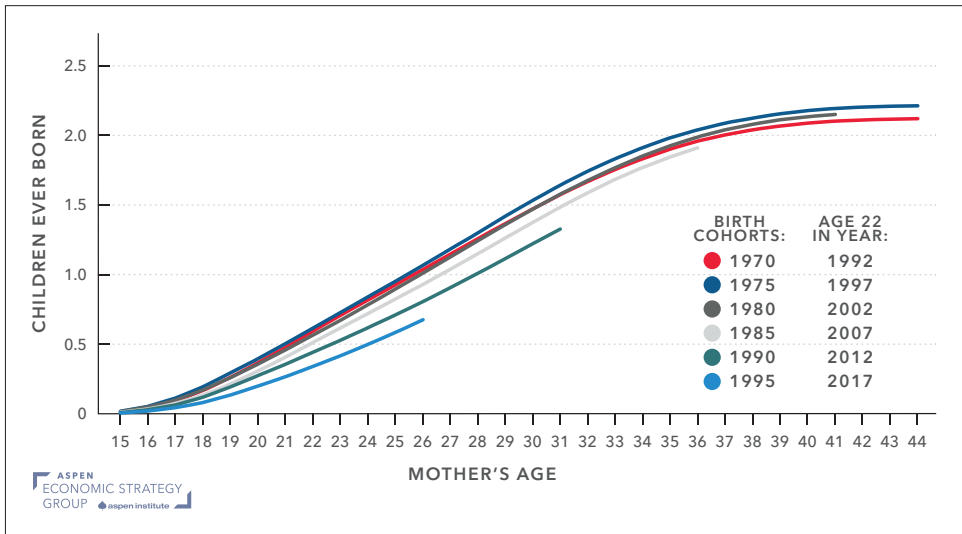
Source: Kearney and Levine (2021).

Based on these data, we project that the total number of children ever born to more recent cohorts of women is likely to fall well below that of previous cohorts, and below the replacement level of 2.1 births per woman (Kearney and Levine, 2021). We extrapolate total completed fertility rates for the younger cohorts of women under three different scenarios. The "conservative" scenario applies the childbearing age profile observed for the 1975 and 1980 birth cohorts to the remaining childbearing years for the 1995 birth cohort. The "moderate" scenario assumes that births for this more recent cohort converge toward the levels observed for the 1975 and 1980 cohorts by age 30 and then follow their age profile in the ensuing years. The "aggressive" scenario assumes that births for this more recent cohort converge by age 30 to a level that is 10 percent higher than that observed for the 1975 and 1980 cohorts and stays similarly elevated after that. The conservative approach yields an estimated total completed fertility of 1.44 births per woman, the moderate approach yields an estimate of 1.77, and the most aggressive approach yields an estimate of 1.92. Even under the most aggressive assumptions—which we consider highly unlikely— fertility in the United States will remain below replacement level.

This analysis implies that US fertility rates are likely to be considerably below replacement level for the foreseeable future. More than a decade of falling birth

rates and declining births at all ages for multiple cohorts of women drive this result. The pandemic-induced reduction in births, described by Kearney and Levine (2022), is an insignificant factor in this longer-term trend. Furthermore, the simulated fertility rates we report in this paper are similar to those observed in virtually all other high-income countries, as we discuss below (Institut National D'études Démographiques, 2021). This evidence leads us to expect that US birth rates and total completed fertility rates are not likely to rebound soon.

> *"A comparison of the childbearing age profiles across cohorts suggests that more recent cohorts of women are not simply delaying childbearing. They are having fewer children at all ages."*

2.c. The US total fertility rate is converging toward that of other high-income countries.

While the decline in the US birth rate is a relatively new phenomenon, birth rates fell substantially in earlier decades in other high-income countries. As shown in Figure 3, total fertility rates in other industrialized nations started falling in the 1980s through around 2000. In that year, TFR was 1.64 in the United Kingdom, 1.49 in Canada, 1.44 in the European Union, and 1.36 in Japan. Although there has been a little variability since then, TFRs today are similar to those in 2000: 1.56 in the United Kingdom, 1.40 in Canada, 1.50 in the European Union, and 1.34 in Japan in 2020.

Even after the US period TFR fell from 2.12 in 2007 to 1.64 in 2020 (the most recent year for which comparable World Bank statistics are currently available), it remained higher than the TFR in each of the United Kingdom, Canada, the European Union, and Japan. Even in Scandinavian countries specifically, with their especially generous system of public support, the total fertility rate is comparable to or below that of the United States. In 2020, these rates were 1.37 in Finland, 1.48 in Norway, and 1.66 in Sweden.

We interpret these trends as evidence that the US fertility rate is belatedly converging toward other high-income countries', including those with greater support systems for families and workers. US exceptionalism in this regard is likely nearing an end.

Figure 3. Total Fertility Rate in the United States and Other High-Income Countries
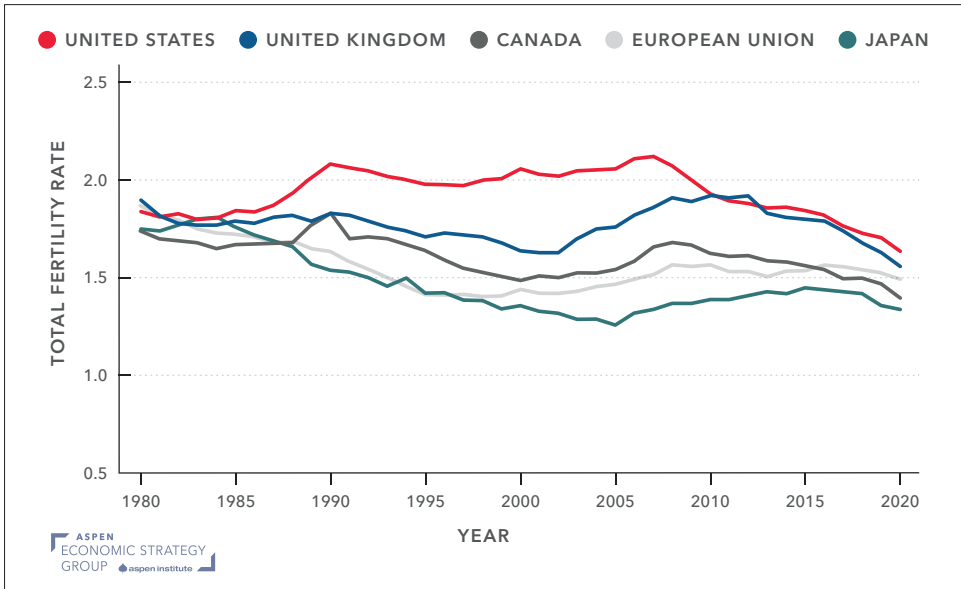
Source: World Bank (2021).

3. Potential Factors Behind the Recent Decline in US Fertility

In this section we describe potential explanations for the recent decline in the US fertility rate. Our read of the evidence is that beyond the temporary effects of the Great Recession, no recent economic or policy change is responsible for a meaningful share of the decline in the US fertility rate since 2007.

3.a. The Great Recession initially contributed to the drop in births.

The pro-cyclical nature of birth rates is a well-established empirical fact in economics and demography.[4] The economic approach to modeling the decision to have a child has its foundation in the seminal work of Becker (1960). In short, people are more likely to choose to become parents when they have more disposable income available to pay for the associated costs of childbearing. Increases in income lead to higher demand for children, holding other factors constant, and increases to the costs of raising children reduce demand for more children.

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4   For instance, see Galbraith and Thomas (1941); Silver (1965); Butz and Ward (1979); Ermisch (1988); Adsera (2005); Currie and Schwandt (2014); Dettling and Kearney (2014); Schaller (2016); and Schaller, Fishback, and Marquardt (2020).

In a more dynamic setting, people decide not only on the number of children to have, but also when over the lifecycle to have children. In a standard economic model with no credit constraints, job loss and transitory changes in income would not be expected to affect when people have children. However, that is not the world we live in. Many people are credit-constrained, and empirical evidence shows that births (more accurately, conceptions leading to live births) increase when the economy is strong and decrease when it is weak.

Figure 1 reveals a noticeable drop in birth rates after the recessions of the early 1980s and the 1990-1991 recession, as well as after the 2007 recession (although it does not show much change in birth rates after the mild recession of 2001). The economic stress of the Great Recession surely contributed to the abrupt downturn in birth rates after 2007. Based on the 5-percentage point increase in the unemployment rate from 2007 to 2010 (from 4.6 percent to 9.6 percent), our analysis described below indicates that one could have expected births to fall by 3.5 percent between 2008 and 2011 (approximating a nine-month gestational lag). Over that period, the birth rate fell 7.2 percent, from 68.1 to 63.2. Although the recession clearly contributed to that decline, other factors must also have been at play. The lack of any rebound in births and, in fact, their continued decline following the end of the recession further suggests a role for factors beyond the Great Recession.

3.b. There is little evidence that current social, economic, and policy factors are important drivers of the recent decline in births.

A substantial number of social, economic, and policy factors, beyond the unemployment rate, plausibly may affect birth rates. We conducted an econometric investigation on the roles that a large set of state-level economic and policy factors might play in explaining changes in birth rates from 2001 to 2019 (Kearney, Levine, and Pardue 2022). Our methods accounted for changes to the birth rate that were not state-specific (year-fixed effects) and for persistent differences across states in average birth rates (state-fixed effects). To draw causal conclusions, this empirical approach requires that changes in the factors we consider are unrelated to other determinants of fertility beyond those for which we control.

Factors that relieve budget constraints—most notably increases in available income—are expected to lead to higher birth rates, while factors that raise the cost of having a child—either in terms of direct expenditures or the cost of parental time—are expected to decrease birth rates. The four economic and policy factors we consider include the aggregate unemployment rate, generosity of welfare benefits, the state minimum wage, and expenditures on child support enforcement. We also consider six reproductive health policies with the potential to affect a woman's ability to

achieve her desired fertility: abortion restrictions in the form of parental notification laws, abortion restrictions in the form of waiting periods, health insurance coverage through Medicaid, mandatory coverage of contraception in private insurance plans, mandatory sex education, and mandatory contraception instruction laws.

Our analysis implies that the combined effect of these 10 factors is around 6 percent of the total decline in the birth rate between 2007 and 2018. That suggests that any effect these policies had on birth rates was too small, or affected too small a set of women, to explain a sizable share of the total change in US births over the past decade and a half.

Casual observers have suggested several other societal pressures that might have exerted a meaningful downward force on birth rates over the past decades. In Kearney, Levine, and Pardue (2022), we considered six such factors:[5]

- *Greater adoption of long-acting reversible contraception.* The percentage of sexually active women who report using long-acting reversible contraception (LARC) increased from 5.5 percent in 2004 to 10.7 percent in 2017.

- *Increasing housing rental costs.* Average monthly rents for a two- to three-bedroom apartment rose 14 percent nationwide from 2004 to 2018. The increase was much larger in states including Colorado and Washington, and the District of Columbia.

- *Increasing childcare costs.* Among families with children under 12 who reported positive childcare spending, annual expenditures on childcare rose nationwide from $5,020 in 2009 to $7,190 for the average of 2015-2019 (all dollar values throughout are measured in constant 2019 dollars).

- *Improving female wages, employment, and occupational prestige.* Although women's economic standing in the labor market is not improving rapidly, gains are slowly being made. For instance, the female-male wage ratio increased from 0.80 to 0.84 between the 2004-2008 and 2015-2019 periods. This increases women's opportunity cost of having children.

- *Rising student debt burdens.* Student debt per capita has increased from $2,500 to $5,400 between the 2004-2008 and 2015-2019 periods. Young adults saddled with debt may feel as if they lack sufficient disposable income to have children.

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5   Popular press articles in outlets including *The Washington Post, The Wall Street Journal, The New York Times, Vox, Business Insider,* and *CNBC*, among others, have suggested that these factors played an important role in the decline. Examples of press reports that mention these factors include the following: contraception (Iati, 2019; DeBarros and Adamy, 2019); the cost of raising children (Miller, 2018; Belluz, 2018); women's economic advancement (Hoffower, 2021; Tavernise et al., 2021); student debt (Dickler, 2018; Snodgrass, 2021); declining religious observance (Douthat, 2020).

- *Declining religious observance.* Greater religiosity is linked to higher fertility, and religiosity is declining in the United States. The percentage of the population who report that religion is at least somewhat important to them fell from 83 percent in 2007 to 78 percent in 2014.

While these trends all could plausibly drive birth rates down, our analysis finds no empirical indication that any of these trends are responsible for the recent decline in US births. Specifically, we find no correlation between state-level changes in birth rates and state-level changes in these factors.

In subsequent, unpublished work, we have also explored the role that concerns about climate change have played in driving down births. We similarly find, though, that this factor does not seem to be linked to the decline in births. Survey evidence in the United States does not suggest that those concerns are growing. Furthermore, states in which Google searches for climate change have increased more are not the states in which births have fallen the most.

> *"In summary, we have had no success finding evidence in favor of any social, economic, or policy factors being important drivers of the recent decline in the US birth rate, other than the appearance of the Great Recession."*

In summary, we have had no success finding evidence in favor of any social, economic, or policy factors being important drivers of the recent decline in the US birth rate, other than the appearance of the Great Recession. Perhaps observers should not be surprised; for any factor to explain much of the birth rate's decline since 2007 (see Figure 1), we would expect that factor to have changed meaningfully around that time. None of these factors exhibit that property.

3.c. A more likely explanation for the decline in US births is "shifting priorities" across cohorts.

We showed above that lifecycle childbearing patterns have shifted across cohorts of women. That finding suggests the possibility that factors behind falling annual birth rates are more about the circumstances related to cohorts, as opposed to the specific years with low birth rates.

We speculate that the key explanation for the post-2007 sustained decline in US birth rates is not about some changing policy or cost factor in recent years, but rather shifting priorities across cohorts of young adults (Kearney, Levine, and Pardue, 2022). These shifted priorities likely reflect differences in the ways more recent generations of young adults were raised, experienced childhood, and had their aspirations and preferences shaped.

One aspect of modern life that may contribute to young adults' views on having children is how the act of "parenting" has evolved over recent decades. Parenting has become more resource- and time-intensive, both in the United States as well as in many other high-income countries (Bianchi, 2011; Kornrich and Furstenberg, 2013; Doepke and Zilibotti, 2019). Changing norms regarding the intensity of parenting might change prospective parents' decisions on how many children to have or whether to have children at all. Such changes are particularly relevant in an era where parents, including mothers, work longer hours outside the home, clashing with career aspirations or a desire for more leisure time. This idea may incorporate choice in the context of trading off how many children parents want to have with how much they want to "invest" in those children (labeled a "quality/quantity tradeoff"). It also may highlight external determinants of what is generally expected or required of parents.

While it's unlikely that career aspirations or parenting norms changed abruptly in 2007, note that women who grew up in the 1990s were the daughters of the 1970s generation, and that women who grew up in the 1970s and 1980s were daughters of the 1950s and 1960s generation. It seems plausible that recent cohorts of women were raised to more strongly expect having life pursuits outside their roles as wives and mothers. Some survey data suggests just that—in the World Values Survey, the percentage of women who report that work is very important to them rose from 32 percent to 47 percent between 2005-2009 and 2017-2020 (Inglehart et al., 2014; Haerpfer et al., 2020).

It also seems likely that the cohorts of young adults who grew up primarily in the 1990s or later —and reached prime childbearing years around or soon after 2007— experienced more intensive parenting from their own parents than did those who grew up primarily in the 1970s and 1980s. This generation may have developed a different idea about what parenting involves. We speculate that these differences in formed aspirations and childhood experiences could potentially explain why more recent cohorts of young adults are having fewer children than previous cohorts.[6]

3.d. The decline in US fertility is unlikely to reverse course in the near future.

Our interpretation of the evidence is that the decline in fertility over the past 15 years is not temporary, and that the United States can expect births below replacement level for the foreseeable future. That conclusion is based on several factors: (a) the

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[6] In a 2018 survey conducted for The New York Times, the leading self-reported reasons for why American adults had fewer children than they planned included concerns about the costs of childcare, the overall expenses of raising a child, and worries about the economy or their own financial instability (Miller, 2018). Other frequently noted reasons included wanting to spend more time with children that they already had or wanting more leisure time. The desire to have more leisure time is also reported as the leading reason among adults who said they did not want to have children or were not sure whether they did. We have been unable to find comparable data from an earlier period to examine whether stated priorities have shifted, but the responses are potentially illuminating even without that comparison.

broad-based nature of the falling fertility rate across demographic groups; (b) the lack of evidence that women are merely delaying pregnancy to older ages, and strong evidence among recent cohorts of women of a longer-term reduction in the number of children ever born; (c) the converging total fertility rates between the United States and other high-income countries; and (d) a plausible hypothesis regarding shifting priorities that is consistent with this empirical evidence. If we are correct, this longer-term reduction in fertility has broader implications for American society, which we address below.

4. Implications for Economic Growth and Fiscal Sustainability

The size of the working-age population has already been stagnant for the past 15 years, as shown in Figure 4. If fertility continues to decline or stabilizes at a low level without a substantial increase in immigration, we can expect the size of the US working-age population to begin declining in the next decade. Absent other adjustments, this decline potentially implies lower economic growth and decreased income per capita. It also has direct implications for the solvency of our Social Security system. We address these issues in this section.

4.a. Lower fertility could negatively impact economic growth.

It is common for discussions regarding economic growth to begin with lessons from the Solow Growth Model (Solow, 1956). That model identifies growth as a movement to a steady-state level of capital determined by equal levels of investment in new capital and depreciation of existing capital. Combining that steady-state level of capital with a predetermined size of the workforce determines the size of the economy. In the model, economic growth occurs during transition periods when the economy is not in equilibrium.

In the Solow model, changing the size of the workforce leads to proportional shifts in the size of the economy. That is, increasing the number of workers leads to greater output, and decreasing the number of workers reduces output. The size of the workforce does not, however, impact output per worker, which remains constant in the steady state. In that sense, a falling birth rate that will eventually reduce the size of the workforce (if not compensated with greater immigration) will reduce GDP, but not GDP per worker, according to the Solow model.

A higher level of GDP may be desirable even if GDP per worker is constant, which is achieved through growth in the working-age population. It is beneficial, for instance, in terms of the provision of public goods. A nation can spend more on national defense if its GDP is larger and that provides benefits to all of its citizens. It is not

Figure 4. Size of the US Working-Age (25-54) Population
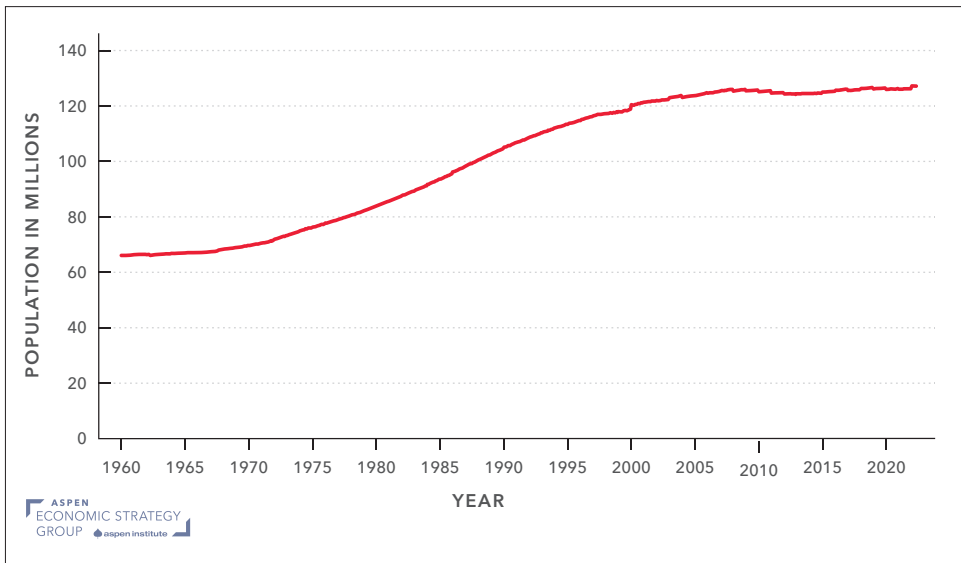
Source: OECD (2022b).

a coincidence that America was a leader in space exploration, not Sweden. Beyond those examples, increasing GDP per person is what improves living standards.

There are also reasons to believe that fertility rates and GDP per capita may be linked. First among those reasons are mechanical explanations related to the population's age distribution. Simple growth models including the Solow model address the relationship between the size of the economy and the size of the workforce, not the overall population. If fewer workers enter the labor force in the wake of falling fertility rates, while more older workers leave the labor force via retirement, the workforce will shrink and GDP per capita will be reduced (Maestas, Mullen, and Powell, forthcoming).

Second, economists have long considered models in which the lack of population growth may slow economic growth on a per capita basis. In fact, some of these ideas predate the Solow model. Hansen (1939) argued that the rock-bottom birth rates of the Great Depression contributed to decreasing incentives for investment at the time, leading to a "secular stagnation." This outcome was not realized going forward, though, as the economy prospered following World War II. In this framework, the baby boom that occurred then may have contributed to that prosperity.[7]   Hansen

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7   Summers (2020) also raised this hypothesis in a contemporary context.

also cited Adam Smith's hypothesis that population growth causes productivity growth: a larger population has more opportunities to efficiently divide labor.

More recently, macroeconomists have focused more intensively on the role that innovation and technological change play in determining economic growth. In the Solow model, technological progress can occur that would increase the steady-state level of GDP, but those developments would be "exogenous" to the model, occurring almost by chance. In newer models of "endogenous growth," innovations occur as the result of economic factors, not by chance.

> *"Low or falling fertility will eventually reduce the size of the US workforce and its overall population, reducing innovation and productivity."*

Romer's seminal work in this area develops these ideas (e.g., Romer, 1990). His model distinguishes objects (like capital and labor) from ideas (like innovation). Societies' resources are directed towards both types of inputs. When those resources are devoted to capital and labor, output increases proportionally as in the Solow growth model. When resources are instead directed toward ideas, however, they can generate even greater increases in output. Unlike capital, innovations are nonrival and can be shared by everyone. An innovation is nonrival if one worker's use of a new technology to become more productive does not inhibit another worker's ability to do the same.

In this framework, growth in the size of the workforce has the potential to produce longer-term economic growth. Consider a society with a constant share of the workforce dedicated to research and development. With a larger workforce, the absolute level of resources devoted to innovation increases. More new ideas arise that can increase all workers' productivity, increasing output per capita. Low or falling fertility will eventually reduce the size of the US workforce and its overall population, reducing innovation and productivity. Jones (2020) expresses this position eloquently, stating:

> *"From a family's standpoint, there is nothing special about "above two" versus "below two" and the demographic transition may lead families to settle on fewer than two children. The macroeconomics of the problem, however, make this distinction one of critical importance: it is the difference between an Expanding Cosmos of exponential growth in both population and living standards and an Empty Planet, in which incomes stagnate and the population vanishes."*

Indeed, some recent research supports the relationship between population growth and economic growth. Karahan, Pugsley, and Sahin (2019) and Hopenhayn, Neira, and Singhania (2018), for instance, suggest that falling labor force growth may explain a substantial part of the decline in firm entry and dynamism in the US economy.

4.b. Lower fertility could also pose fiscal challenges.

Beyond its potential impacts on economic growth, a lower fertility rate also has potential fiscal implications. Of primary concern is the funding of public assistance programs such as Social Security and Medicare (technically, the Old Age, Survivors, Disability and Health Insurance program). Funded by taxes on workers, these programs provide benefits to non-working individuals funded through taxes on workers.

The problems expected to be caused by the aging of the Baby Boom generation have been well-known for quite some time. Figure 4, which demonstrates the size of the US workforce over time, at least partially captures that demographic trend. Baby Boomers, who were born between 1946 and 1964, entered the labor force roughly in the period between 1970 and 1990. They began to retire in meaningful numbers approximately a decade ago, placing downward pressure on the size of the workforce. Based on standard longevity patterns, we can expect the United States to be supporting a large population of retirees in the coming decades.

Forecasting the size of the labor force based on the size of cohorts that have already been born is considerably easier than incorporating cohorts of the yet unborn. But these future cohorts are just as important toward calculating the coming size of the workforce and the country's ability to fund social insurance programs. Projections of the unborn population are necessary to make accurate assessments of these programs' funding needs in the decades ahead.

> *"Existing evidence about likely causes of the US birth rate's sustained decline provide no reason to expect the US total fertility rate to return to near replacement level soon."*

It is not surprising that past fertility forecasts failed to predict the striking decline in birth rates the country has witnessed since 2007. Even in retrospect, we are unable to find data that would have suggested such a sustained drop was imminent. As a result, contemporaneous predictions of public assistance programs' long-run fiscal sustainability were overly optimistic (Office of the Chief Actuary, Social Security Administration, 2007).

We are concerned that current forecasts of future fertility patterns remain overly optimistic. Figure 5 characterizes current long-term demographic projections from the United States Social Security Administration (2022). The report provides alternative forecast values depending on potential costs to the system resulting from varying fertility rates. A low fertility rate, for instance, would require greater additional revenue to fund the Social Security system. It is therefore labeled the "high cost" assumption. The "low cost" assumption stipulates a higher fertility rate, and the "intermediate cost" assumption represents the Administration's best estimate of the future fertility rate.

Each of the Administration's three estimates forecasts a rising fertility rate beginning in 2022. In each of the three estimates, projected fertility rates rise continuously before reaching a steady-state value within approximately a decade. The Administration's best estimate assumes that the country will return to a total fertility rate of 2.0 by 2040. To justify this projection, the report offers the following explanation, with no further elaboration: "a sustained TFR at the low levels experienced by certain other industrialized countries is unlikely due to economic, demographic, and cultural differences between the U.S. and those countries."

Based on our analyses, we view these assumptions as overly optimistic. Existing evidence about likely causes of the US birth rate's sustained decline provide no reason to expect the US total fertility rate to return to near replacement level soon. Indeed, other high-income countries' TFRs fell below that threshold decades ago and have not reapproached it since. Our projections, based on the birth patterns of recent cohorts of US women, imply a TFR that will remain well below 2.0. These more recent cohorts of women are providing no indication that they are merely delaying pregnancy; we project that their lower birth rates at younger ages are likely to translate into lower lifetime completed fertility.

Figure 5. Social Security Administration Fertility Assumptions, 2021
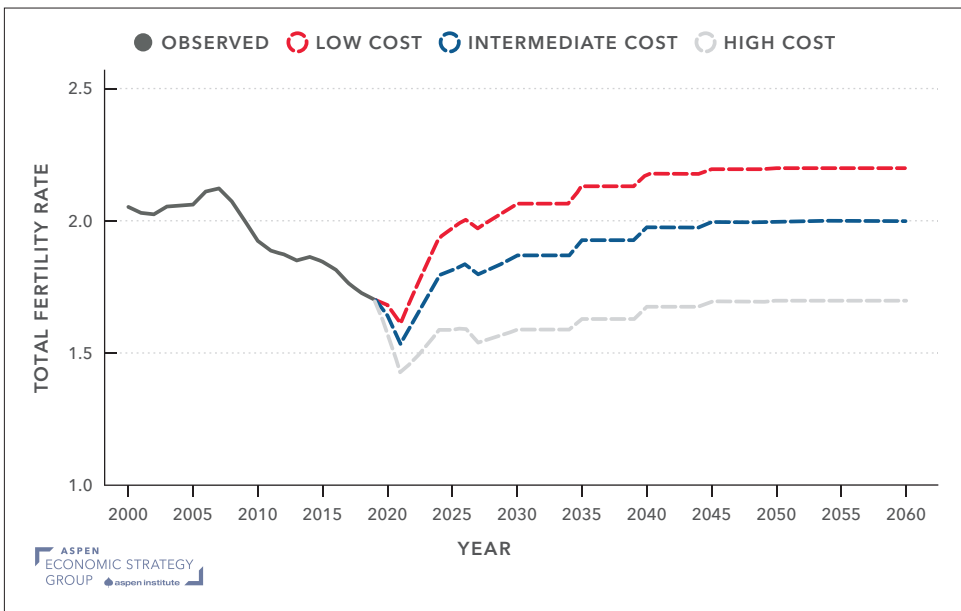
Source: Office of the Chief Actuary, Social Security Administration (2022).

While we cannot assert definitively that younger women today will not substantially increase their rates of childbearing at older ages, nothing exists in the data to suggest this outcome is likely to occur. We therefore suggest that the SSA's high-cost fertility projections are significantly more likely to prove correct than the Administration's "intermediate cost" (best estimate) projections, or especially its "low cost" projections. To better understand the revenue gaps that are likely to make Social Security benefits more difficult to fund, we advise focusing instead on the Administration's more conservative fertility projections.

The 2022 Social Security Trustee Report provides estimates of the "actuarial deficit," which is based on the difference between the present value of the expected outflow of funds (expected benefits and administrative costs) and the expected inflow of funds (expected tax revenue) as a percentage of taxable payroll.[8] The deficit reflects the tax increase that would be necessary to fully fund the system over the next 75 years. The actuarial deficit is 3.42 percent if the TFR is assumed to be 1.99, and 4.13 percent if the TFR is assumed to be 1.69. While the report treats 1.99 as the TFR midpoint estimate, we view a TFR of 1.69 as the more likely outcome. If that prediction proves true, overall taxes would have to be raised another 0.71 percentage points (21 percent) higher than the Social Security Trustees' best estimate in order for the system's finances to be in balance. A TFR below 1.69, which we view as not unlikely, would create an even greater imbalance in the system.

4.c. The decline in US fertility may not have a meaningful effect on climate change.

While lower fertility may reduce economic growth and destabilize elements of our social safety net, it provides potential benefits as well, for instance through its impact on the environment. While we claim no particular expertise in this domain, our review of the relevant evidence suggests that the population decline that would be necessary to meaningfully reduce the impact of human activity on the environment is far greater than what will be achieved by the realized reduction in US birth rates. Reducing human impact on the environment through reduced per capita consumption of energy and materials, in tandem with developing more sustainable production processes, is significantly more likely to produce meaningful impacts.

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8   This calculation also includes the value of the trust fund at the start of the period and a requirement to have one year of benefits on hand at the end of the 75 years.

5. Is There a Role for Pro-Natalist Policies?

A policy is "pro-natalist" if it provides incentives to women or couples to have more children. Broadly, such policies can either raise income for families with children or reduce the costs of having and raising children. For instance, many high-income countries have implemented pro-natalist policies that provide child allowances or subsidies to women who give birth or to families with children. Many countries also provide implicit subsidies in the form of free or subsidized childcare or paid family leave. Such policies reduce the personal cost to parents of having or raising children.

Over the past 30 years, an increasing number of countries have implemented pro-natalist policies. A recent United Nations report (Sobotka et al., 2020) states that the number of national governments reporting that they aim to increase fertility jumped from 19 in 1986 to 52 in 2011. In 2015, the governments of 55 countries and territories surveyed by the World Population Policies Database—including 27 countries in Europe and 18 in Asia—reported that increasing fertility was a national goal.

Sobotka et al. (2020) also reports that pro-natalist policies are often characterized by parity-specific rules that provide benefits based on how many children a family has, even if it is uncommon for governments to set targets for families to bear a specific number of children (China being a notable exception). Since 1993, for instance, Hungarian mothers with three or more children have been eligible to receive a fixed monthly sum to offset the costs of raising a child until the youngest child is eight years old. In the 1990s, the province of Quebec likewise paid families a newborn allowance that ranged from C$3,000 for a first child to C$8,000 for a third child (nominal Canadian dollars).

Many countries provide families with children some type of child allowance or child tax credit or deduction. Even if the explicit goal of such policies is something other than a pro-natalist aim—say, alleviating child poverty or providing income assistance to middle-income families raising children—a cash benefit or tax credit that is conditional on the presence of a child in the family or household can be understood as a financial incentive to have a child. The question is then an empirical one: do child-related cash benefits or tax credits lead to an increase in births?

The empirical evidence on the relationship between cash benefits or child tax credits and fertility is mixed, but in general, it suggests that policies that directly subsidize the birth of a child might lead to a modest increase in fertility. For instance, there is a large literature studying the fertility effects of the former Aid to Families with Dependent Children (AFDC) welfare program in the United States. That literature has consistently produced results showing, at best, small effects of welfare benefits on birth rates (see,

for instance, the review by Moffitt, 1998). More recent evidence comes from studies of the fertility response to child allowances or tax credits in specific locations. For example, Gonzalez (2021) studies the introduction of a new, universal child benefit in Spain in 2007 that awarded parents a one-time payment of about US$3,900. She finds that the policy led to a 6 percent increase in the number of annual births.

Policies that help parents to balance work and family, such as subsidized childcare or paid parental leave, can also be considered pro-natalist and could plausibly lead to an increase in birth rates even if the policies are not implemented with expressly pro-natalist aims. A recent paper by Doepke, Hannusch, Kindermann, and Tertilt (2022) proposes that in modern high-income countries, the ability to combine career and family is a key determinant of fertility rates. The authors also emphasize the practical importance of bargaining between men and women and the role of social norms around shared household and childcare responsibilities in affecting fertility choices. For instance, in couples in which the woman wants fewer children than does the man, fewer children are born.

These authors draw on OECD country-specific data from 1980 and 2000 to relate the percentage of women between ages 25 and 54 who are in the labor force to the total fertility rate.[9] They show that in 1980 there was a negative relationship between a country's rate of female labor force participation and the total fertility rate, but that by 2000, the relationship reversed—in countries where more women work, the birth rate was higher. They argue that as social norms around female work have changed, countries that make it easier for parents to combine work and family have both higher female labor force participation rates and higher fertility rates.

We replicate and extend this analysis in Figure 6. Importantly, we find that data from 2010 and 2019 tell a different story about the relationship between a country's level of female labor force participation and fertility rates. In these more recent years, women in all countries participate in the labor force at about the same rate: approximately 80 to 85 percent. There are, however, sizable differences in total fertility rates across countries, ranging from 1.2 to 1.8. This indicates that differences in policy environments are not highly predictive of female labor force participation rates, but they might have an effect on how many children they have. We note, though, that in no OECD country is the total fertility rate near the replacement level of 2.1, including in those with strong family support programs and more equal gender norms.

Past research focused on estimating the causal effects of various pro-natalist policies designed to facilitate work and childbearing is mixed, but generally does not find evidence of sizable fertility effects. As one example, Dahl et al. (2016) find

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9   The OECD countries used in this analysis represent those with data available throughout the period considered.

that policy reforms in Norway in the late 1980s and early 1990s that substantially expanded paid maternity leave had no discernible effect on fertility rates. In another example, the lengthening of paid parental leave in Sweden led many women to have their subsequent child before the end of the parental leave, fueling a temporary baby boom, that was subsequently offset by a baby bust (Andersson, Hoem, and Duvander, 2006). In other words, that policy led to a transitory timing effect, but not to a sustained increase in the fertility rate. This extensive line of research on the causal effects of pro-natalist policies is reviewed by Brainerd (2014), Lopoo et al. (2018), Sobotka et al. (2019), and Stone (2020).

> *"The evidence suggests that the types of pro-natalist policies that have been implemented and evaluated in the United States and in other high-income countries are unlikely to lead to substantial or sustained increases to the birth rate."*

The evidence suggests that the types of pro-natalist policies that have been implemented and evaluated in the United States and in other high-income countries are unlikely to lead to substantial or sustained increases to the birth rate. It is noteworthy that in Japan, for instance, total government spending on families nearly quadrupled from 0.36 percent of GDP in 1990-1991 to 1.31 percent in 2015, on account of dedicated expansions in childcare provision, paid family leave, and child tax credits, among other pro-natalist policy initiatives. The country's total fertility rate has increased (potentially as a result), but it remains below 1.5 (Sobotka et al., 2019).

Olivetti and Petrongolo (2017) find that spending on early childhood education and childcare produce the strongest evidence for an effect of family policies on fertility. They conclude that "one extra percentage point of GDP spending [on such programs is] associated with 0.2 extra children per woman." With the 2022 US GDP approaching $25 trillion, that represents upwards of $250 billion in additional spending per year. To put this amount in context, let's consider that President Biden's "Build Back Better" proposal called for $100 billion in childcare spending over three years. Olivetti and Petrongolo's estimated fertility effect implies that $100 billion on childcare spending over three years would lead to .03 more children per woman, or an increase in the TFR from 1.66 to 1.69, still far below replacement fertility.

Finally, we would be remiss if we did not acknowledge the recent Supreme Court ruling in *Dobbs v. Jackson Women's Health Organization*, which overturned the ruling of *Roe v. Wade* and increased state discretion over abortion policy. Given the likely state-level response and the results of past research, this ruling will likely lead to an increase in births in the United States. Levine (2004 and 2022) and Myers (2021)

**Figure 6. Relationship Between Female Labor Force Participation Rates
and Total Fertility Rates in OECD Countries**
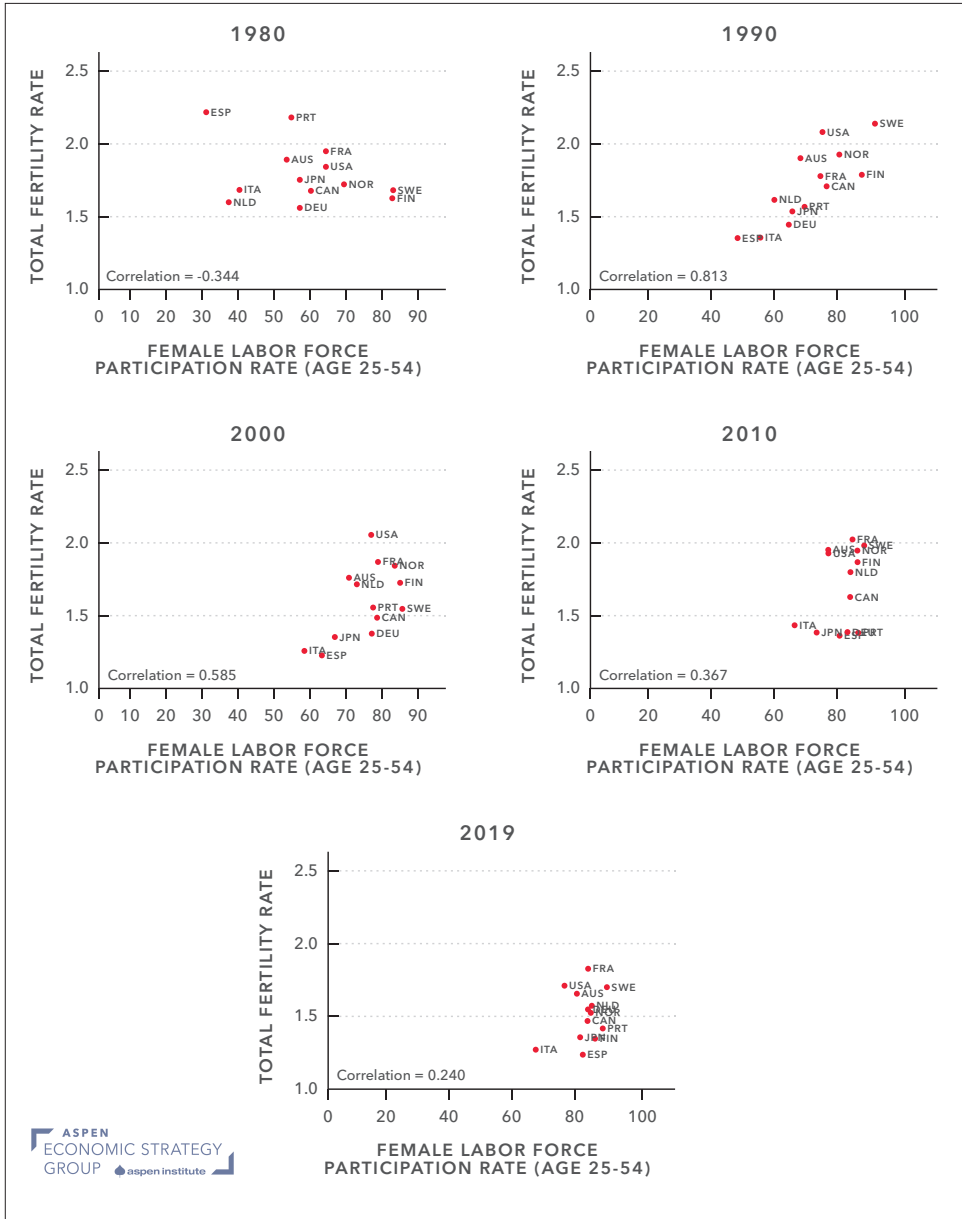
Sources: OECD Employment and Labour Market Statistics (2022), OECD (2022a).

forecast that overturning Roe will result in approximately 100,000 more births per year, representing roughly a 2.5 percent increase in the US birth rate. Even this dramatic change in abortion policy will lead to an increase in births that will not come close to bringing the overall US fertility rate to replacement level.

6. Conclusion

Whatever normative view one takes about declining fertility rates, it is important from an economic policy standpoint to acknowledge that an aging population and shrinking workforce pose challenges for economic growth and the sustainability of social insurance systems. Our read of existing evidence suggests that an incremental pro-natalist policy agenda will have a limited effect on birth rates, although various elements of that agenda may be desirable for other reasons. Reversing the decline in the US fertility rate would likely require dramatic societal changes that alter preferences about having and raising children. Those changes, though, would need to come from outside the bounds of what we can now observe internationally; no environment for women and families among high-income countries currently presents a roadmap for dramatically increasing the domestic TFR.

Barring a reversal in the fertility decline, the United States could instead maintain the working-age population with a sizable increase in immigration. The nation could also adjust to a smaller working-age population with adaptive policies aimed at addressing macroeconomic and fiscal consequences. For instance, greater investments in human capital, productivity-enhancing infrastructure, and research and development could maintain overall productivity in the face of a smaller workforce. Meanwhile, securing the finances of old-age assistance programs including Social Security and Medicare will become increasingly imperative. US policymakers will need to contend with these issues if the recent, sustained decline in birth rates is not reversed.

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Why and How to Expand US Immigration

AUTHORS

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ABSTRACT

Immigration has long been celebrated as an engine of America's economic growth and cultural vibrancy, even as the changes it brings often cause concern among the populace. An estimated 13.7 percent of those living in the United States today were born outside its borders, nearly as high as the peak of 14.8 percent in 1890 (Gibson and Jung, 2006).[1] Annual net inflows of migrants have fallen since 2016, however, and the foreign-born population has stagnated over the past few years. Backlogs in immigration bureaucracy are at record levels (Frey, 2020). There are also more than 10 million people living in the United States without legal status. Political framing of the issue has tended either to highlight humanitarian concerns or to engage in fear-mongering, with surprisingly little attention paid to fact-based economic analysis. However, a robust body of high-quality evidence pertaining to immigration and its economic impacts is available, and that data in tandem with humanitarian and political considerations should inform decision-making. Decades of research demonstrate that there is scope for and value in significantly expanded immigration levels and a reimagined enforcement system. But getting there will require congressional action: harnessing the full potential of those who seek to live and work in the United States requires sensible legislation.

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1   Based on 2019 population estimates.

1. Economic Impacts: What We Know

The economic impacts of immigration have been widely studied. It is hardly surprising that migration provides an economic benefit for immigrants themselves. The average Mexican immigrant doubles their hourly wage upon arrival to the United States, for example, and migrants from the poorest countries triple their earnings on average (Hendricks and Schoellman, 2018). And most economists agree that migration is beneficial to US economic growth. A comprehensive 2017 study by the National Academies of Sciences, for instance, concludes that immigration is good for US-born workers and the economy overall (The National Academies of Sciences, Engineering, Medicine, 2017).

How does immigration generate economic benefits? Consistent with the notion that most immigrants come to the United States to seek work opportunities, the foreign-born tend to participate in the labor force at a higher rate than do native-born Americans (US Bureau of Labor Statistics, 2021). Studies meanwhile tend to show that immigrant inflows produce positive or null impacts on the average US worker's wages, after carefully accounting for confounding factors. Immigrant workers even make many US workers more productive by allowing for more specialization (Peri and Sparber, 2011). However, while overall impacts are positive, research finds more mixed results for workers at the bottom of the US income distribution (The National Academies of Sciences, Engineering, Medicine, 2017). Workers most directly competing with new migrants in the labor market, including some US-born workers of color and previous waves of migrants, are most at risk for negative labor market consequences.

Immigration also impacts the American economy in ways beyond its direct influence on wages. Immigrants are more mobile than US-born workers: they move to areas of relatively high labor demand and exit areas that are struggling. Immigrants therefore serve an important function in smoothing out local shocks across the US economy (Cadena and Kovak, 2016). In addition, immigrant labor helps keep prices low while immigrant demand for goods and services stimulates growth in the economy (Orrenius, 2016).

Immigrants are disproportionately represented in innovation and entrepreneurship. Immigrant inventors represent 23 percent of all granted patents, and these patents are of higher economic value on average than those granted to US-born inventors (Bernstein, Diamond, McQuade and Pousada, 2021). Immigrant inventors are more likely to collaborate with foreign inventors and also appear to increase the level of innovation of US natives. In addition, first-generation immigrants create about a quarter of all new firms in the United States (Pekkala Kerr and Kerr, 2018), and 45 percent of Fortune 500 companies were founded by immigrants or their children (Nowrasteh, 2021).

Immigrants help US society to address its growing demographic challenges. While birth rates have fallen for the US-born and immigrant populations alike, and the overall birth rate lies below the replacement rate, foreign-born women have much higher birth rates than do those born in the country (Livingston, 2019). As a result, the Census Bureau projects that the US population would decline over the next four decades in the absence of immigration (Johnson, 2020). Immigrants will likewise play a key role in maintaining the nation's dependency ratio (the ratio of the working-age population to the population over 65) as its population ages. The National Immigration Forum estimates that to maintain a dependency ratio in 2060 comparable to today's, annual net immigrant inflows must reach nearly 1.4 million, 37 percent higher than the pre-COVID baseline (Noorani and Zak, 2021).

"Immigrants help US society to address its growing demographic challenges. While birth rates have fallen for the US-born and immigrant populations alike, and the overall birth rate lies below the replacement rate, foreign-born women have much higher birth rates than do those born in the country."

Immigration's fiscal impacts are also worth considering. The US population's fiscal impacts are generally negative: in most years the government spends more than it collects. But measuring a particular demographic's direct impacts on government coffers (the difference between taxes paid and benefits received) is complicated by tricky conceptual issues, such as how to treat expenditures like those on national defense that do not directly scale with population. And in the case of immigrants, calculations ought to account for the immigrant population being younger on average than the native-born population. With these considerations in mind, the National Academy of Sciences shows that second-generation immigrants (those whose parents immigrated to the United States) have the most positive fiscal impacts over their lifetime, followed by those whose parents were born in the United States ("third-generation-plus immigrants"), followed by first-generation migrants (The National Academies of Sciences, Engineering, Medicine, 2017). Immigrants commit crimes and use social resources at low rates compared to other demographic groups (Watson, 2017; Light, He, and Robey, 2020).

Immigration's fiscal costs are also geographically concentrated: the national government gains from payroll and income taxes paid by immigrant workers, but state and local governments in immigrant-heavy areas incur high expenditures on education and health programs. A recent study that incorporates both direct and indirect fiscal effects finds that highly educated immigrants confer local fiscal benefits, while less-educated immigrants create local fiscal losses (Mayda, Senses,

and Steingress, forthcoming). Immigration's fiscal impacts vary by context and by place, and these differences are important for understanding the political dynamics that influence immigration policies.

Overall, there are clear economic benefits of expanding the US immigrant population, but sensible policy will consider communities that may be adversely impacted. As noted above, some studies present evidence of adverse impacts at the bottom of the US wage distribution. The empirical findings are mixed and therefore inconclusive, but policy design should take seriously the potential for large increases in immigration to create negative distributional impacts. Similarly, policy proposals must address the fiscal costs borne by some local governments as the result of immigration expansion. By recognizing that the overall gains from immigration are not distributed evenly and designing policy accordingly, it is possible to expand immigration in a way that is both politically palatable and economically sensible.

2. Trends in Immigration

Figure 1 shows the long-run evolution of the foreign-born population in the United States. Immigrants currently represent about 14 percent of US residents, similar to the foreign-born fraction of the population at the turn of the 20th century. The majority of today's immigrant population arrived from Mexico and Central America, and increasingly from Africa and Asia.

Figure 1. Foreign-Born Population, 1850-2020
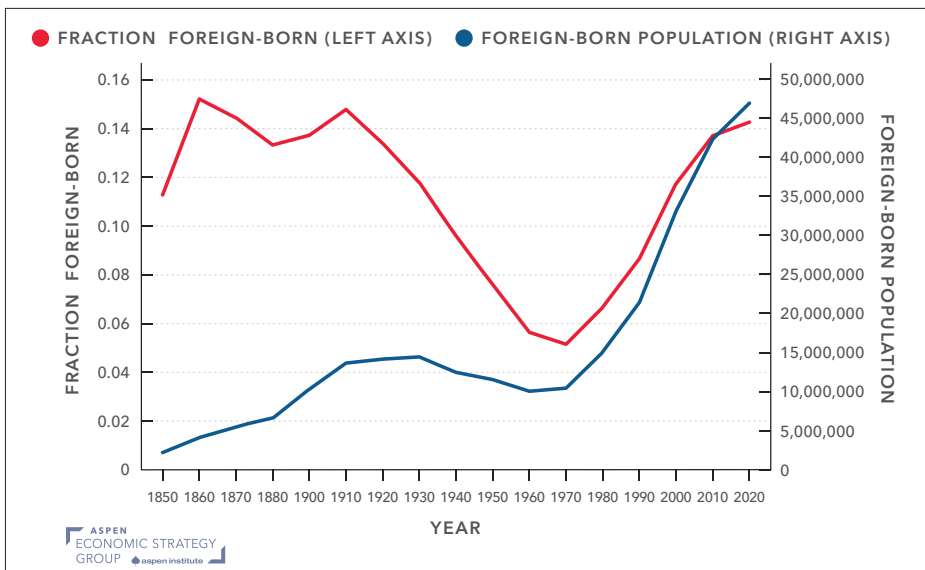
Source: Author's analysis of IPUMS data derived from Census and American Community Survey.
Note: Data not available for 1890.

Of the estimated 45 million foreign-born residents living in the United States today, about 21 million are naturalized US citizens. About half of the remaining, an estimated 12 million, are legal permanent residents, also known as green-card holders, and 2 million are legal temporary residents. Another estimated 10.5 million are undocumented, living in the United States without legal status. The undocumented population peaked at more than 12 million in 2007 and has gradually declined since (Pew Research Center, 2020).[2]

This snapshot of the immigrant population is the product of decisions made over many decades. But net migration flows, which describe how immigration is changing on a year-to-year basis and likely reflect more recent developments, are also instructive to examine. As evidenced in Figure 2, net migration has been declining since 2016. This decline can be attributed to Trump-era policy decisions and rhetoric, bureaucratic backlogs, and COVID restrictions, among other factors. Inflows will presumably rebound to some degree as pandemic restrictions ease, but policy decisions will help to determine how these flows evolve and what forms they will take.

Figure 2. Net International Migration Inflows, 2011-2021
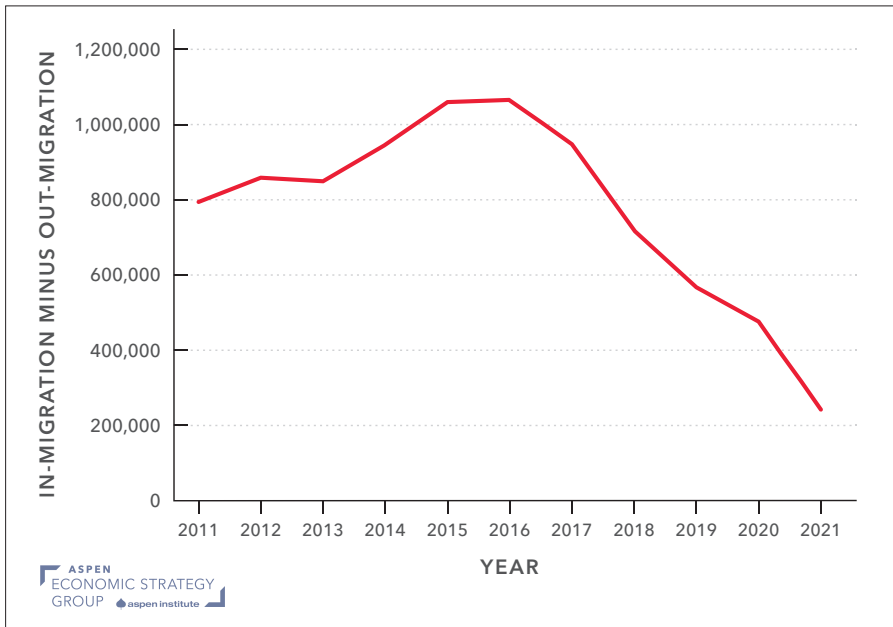
Source: US Census Population Estimates.
Note: Refers to migration over year ending July.

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2   These estimates of the undocumented population are based on 2017 American Community Survey data; more recent evidence suggests that these numbers have likely stayed fairly stable in the years since.

3. Approaches to Immigration Policy

The 1889 Supreme Court decision in *Chae Chan Ping v. United States,* 130 U.S. 581, cemented immigration policy as within the purview of the federal government (Harrington, 2019). Policies surrounding the number and composition of immigrants are primarily determined by Congress; implementation depends to a large degree on the executive branch.

The US immigration system is a complex web consisting of thousands of policy decisions, each with important implications. A simplifying discussion here will focus on three interconnected, big-picture questions: (a) what should be the number and composition of new legal permanent migrants to the United States; (b) how should the temporary visa system operate; and (c) how should the United States address unauthorized migration and support immigrant integration?

3.a. The Permanent Legal Immigration System

The current system of legal immigration into the United States is governed by the Immigration and Nationality Act (INA), which allows for permanent migration—also known as "green cards," named for the historical color of the permanent residency document. Most immigration is allowed through family, employment, or humanitarian channels.

The most common pathway to legally immigrate to the United States is family-based immigration. In a typical (pre-COVID) year, between 450,000 and 500,000 immigrants are admitted as immediate relatives of US citizens. This number is not capped: any spouses, unmarried children under 21, or parents of adult citizens can qualify. About half of these immediate relatives are already living in the United States at the time of their application, either on a temporary status or without status. Those applicants have their status adjusted to permanent.

Non-immediate relatives of citizens, and close relatives of permanent residents, can also be admitted through a family preference system. A formula determines how many non-immediate relatives can be admitted through a series of preference categories—the total usually hews closely to the statutory minimum of 226,000.[3] Combined, family categories account for about two-thirds of new green cards issued in a typical year, as shown in Figure 3.

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3 A "permeable cap" on family admissions of 480,000 can be exceeded for immediate family members. Given the high numbers of immediate relatives seeking admission, the binding constraint is the 226,000 minimum on non-immediate family preference admissions.

Figure 3. Distribution of Green Card Admission Types, Average 2011-2019

ASYLEES &
REFUGEES
14%

OTHER
3%

DIVERSITY
VISA
4%

EMPLOYMENT
PREFERENCE
13%

IMMEDIATE
RELATIVES
45%

FAMILY
PREFERENCE
21%

ASPEN
ECONOMIC STRATEGY
GROUP ♦ aspen institute
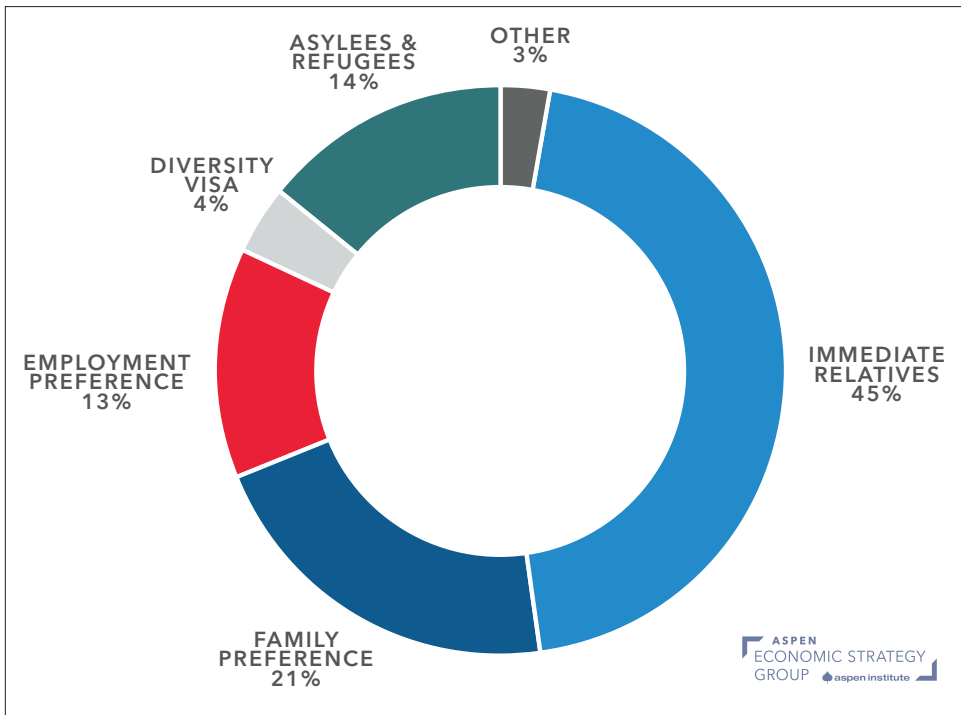
Source: Department of Homeland Security, Yearbook of Immigration Statistics, 2019, Table 6.
Note: Average number of green cards is 1.066 million annually.

The family preference migration limits were set in 1990 and haven't been changed since. These same limits also weigh applicants' countries of origin: a single country may represent no more than 7 percent of the green cards issued to non-immediate family relative in any year. As a result, family members in high-demand countries may face long waits before receiving clearance to immigrate. As of May 2022, the applications currently being processed from most countries for unmarried adult children of US citizens, the highest priority non-immediate relative group, had first been submitted before December 2014 (US Department of State, 2022a). For those applying from Mexico, the date was May 2001. When politicians glibly suggest that would-be immigrants "wait in line," they may not realize that the line is years or decades long for family members from some countries.

A second major category of legal permanent immigration is employment-based admission, set since 1990 at a maximum of 140,000 annual applications accepted. The majority of these slots are reserved for workers of extraordinary ability or with advanced degrees, with another large tranche allocated to college-educated workers

or workers with specific skills in shortage areas. In order for their applications to be accepted, most of these workers are required to show proof of a specific job offer for a permanent position.[4] The same 7 percent limit on admissions from any particular country that applies to family-based immigration also applies in the employment context. For a less-educated worker without specialized skills, entering the United States through the permanent employment pathway is nearly impossible. As a result, for most would-be immigrants without relatives in the United States or a college degree, there is no line; legal immigration to the United States is a functional impossibility.

A number of humanitarian pathways to admission account for about 15 percent of permanent admissions. These include refugees, whose number is decided by the President prior to their arrival at the border, and asylees, whose eligibility for admission is determined after presenting at the border. Many of the immigrants seen in footage of the Southern border are hoping to enter as asylees; there is no numerical cap on admissions and adjudication depends on the strength of the asylum claim, as determined by the US immigration bureaucracy.

A smaller admission category is the diversity lottery, which aims to include representatives from a wider range of countries into the United States. Diversity visas are granted annually to 50,000 applicants (and their dependents) from countries with fewer recent immigrants to the United States, excluding twenty countries from which applicants are not currently allowed. Originally intended to boost Irish and Italian immigration, which had declined in the decades before the system was instituted in late 1980s, the lottery now benefits immigrants from Africa more than those from any other region (Law, 2002; Wilson, 2018). With at least 10 million annual applicants, fewer than 1 percent of applicants are granted admission, and winners make up fewer than 5 percent of the green cards granted in a typical year (US Department of State, 2022b). Though the diversity lottery helps neither to reunite families nor to address specific US employment needs, it broadens the pool of countries from which immigrants arrive. Some scholars argue that this diversity encourages new immigrant communities to develop in the United States, subsequently creating a pipeline for attracting immigrant talent, though evidence on this point is still scant (Kennedy, 2018).

All told, about 1 million immigrants per year (pre-COVID) obtain a US green card. But the country could absorb many more without visiting significant adverse impacts on US natives—this is evident in California, where immigrants make up 27 percent of the population, twice the average US level, and the economy is growing strongly.

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4   A few others enter in special categories including wealthy entrepreneurial investors.

According to Gallup surveys, 160 million people around the world report interest in immigrating to the United States (Esipova, Pugliese, and Ray, 2018). Given the many barriers to immigration, that figure is an imperfect measure of the number that would in fact immigrate if given the legal clearance to do so. But it raises the question: how much of an expansion to the US immigration system would be appropriate?

A sensible approach involves a gradual scaling up of the number of immigrants admitted annually, with numerical limits that respond to national labor market conditions. As noted above, the National Immigration Forum estimates that admitting 37 percent more immigrants than the pre-COVID annual rates would allow the country to return to its 2020 dependency ratio by 2060. Rather than large and static jumps in admission limits, however, a commitment to a smaller default growth rate would future-proof policy against an inertial Congress. For example, policies might target 2 to 3 percent growth in green-card admissions annually, depending formulaically on the unemployment rate. This number incorporates 1 percent for long-run population growth, another 1 percent to mitigate the long-run worsening of the dependency ratio, and a flexible additional amount of up to 1 percent during good economic times. Questions about the optimal composition of that growth would also need to be addressed.

> "A sensible approach involves a gradual scaling up of the number of immigrants admitted annually, with numerical limits that respond to national labor market conditions."

The United States relies more heavily on family-based migration than do many other nations. For example, Canada's point-based admission policies weight more heavily the applicants' potential to contribute to the national economy (Sanders, 2020). There are some economic advantages to prioritizing family-based migration: families can help new migrants to adapt to American society, provide economic support, and offer connections to work opportunities. Family-based migration also aligns with the long-standing cultural value attached to the family as a central social unit. And selecting migrants with family ties may reduce the propensity for some of those immigrants to enter without status.

Family preference migration can sensibly rise on an annual basis by 2 to 3 percent as described above. Because immediate family admissions are already uncapped, this increase would primarily take the form of annual growth in the statutory minimum for non-immediate relative family preference admissions. Immediate relative admissions will then grow gradually as a natural consequence of admissions in other categories. Research suggests that each immigrant regularized as part of the

1986 amnesty program, for instance, sponsored one additional immigrant over the subsequent three decades (Cascio and Lewis, 2020).

Other modifications to the family-based program are also worth considering. For example, because of the 7 percent per-country limit on family preference admissions, would-be immigrants from Mexico, the Philippines, and India currently face longer waiting times than family members from other countries. These caps therefore encourage unauthorized immigration among those with close family residing in the United States but who project to wait years or decades to be granted admission, undermining the integrity of the immigration system. Per-country family preference caps should be raised substantially. A similar tweak is to end the differential treatment of married adult children of US citizens and residents as compared to their unmarried siblings.[5]

Despite some advantages, the family-based approach does not necessarily produce migration patterns that closely align with labor market needs. The employment pathway addresses labor demands more efficiently. Because most green cards granted through this pathway require employer sponsorship, the system filters for immigrants whose skillsets are of particular value to their employers. But the current employment-based system has two important shortcomings.

> *"There is little economic rationale for turning away global talent at this scale. These workers would make significant economic contributions to the national economy, as evidenced by their firms' willingness to sponsor their admissions, and any downward employment pressures on US natives would be felt at the top rungs of the wage distribution, where wage growth has been strong in recent decades."*

The first of these shortcomings is a binding per-country cap on some categories of highly educated or specially skilled workers; applicants from India and China are particularly likely to be deferred because of the same 7 percent quota that governs family-based admission. For example, there are currently more than 700,000 Indian would-be immigrants who have secured employer sponsorship but remain waiting in the queue for admission; under current law, fewer than 10,000 can be granted

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5   Married children of US citizens are currently in a third preference category, whereas unmarried adult children are in the first category. Married children should be moved to the first category, and the cap adjusted accordingly, to avoid disincentivizing marriage. Similarly, married and unmarried adult children of permanent residents should be treated equivalently, either by eliminating both from the preference list or including both as a category.

permanent residence each year (Bier, 2022).[6] There is little economic rationale for turning away global talent at this scale. These workers would make significant economic contributions to the national economy, as evidenced by their firms' willingness to sponsor their admissions, and any downward employment pressures on US natives would be felt at the top rungs of the wage distribution, where wage growth has been strong in recent decades. Immigration opportunities should be expanded for this highly educated group even more aggressively than for those applying through the family-based pathway, in light of the economic and fiscal benefits. Potential avenues for that expansion include increasing overall numeric limits and loosening per-country quotas.

Most employment-based immigration currently requires sponsoring employers to submit to a certification process showing that they cannot find suitable native-born US applicants for the position. And while the Department of Labor maintains a list of occupational shortages, known as Schedule A, which in theory allows for expedited processing for employers in those industries, Schedule A has remained untouched since 1991. Originally designed to be continuously updated, the only occupations listed on the schedule are nursing and physical therapy (Milliken, 2020). An easy fix to the employment-based migration system is for Schedule A to reflect a more fluid, expansive, and updated definition of shortage occupations. For instance, the Job Openings and Labor Turnover Survey, conducted by the US Bureau of Labor Statistics, could be used to identify sustained needs in particular occupations, nationally or within local labor markets. Firms could then recruit internationally to fill positions with less bureaucratic delay.

Strict limits on admission for less-educated workers are a second shortcoming of the employment program. Under current law, only 10,000 employment green cards may be granted annually to workers in positions that require less than two years of experience or training, regardless of labor market needs. But some of these fields are experiencing far more significant shortages than can be closed by adding 10,000 new workers per year. For example, the Bureau of Labor Statistics projects demand for an additional 1.1 million health and personal care aide jobs by 2030, representing a 33 percent increase from pre-pandemic levels (US Bureau of Labor Statistics, 2022). This industry has faced long-standing staffing challenges, and immigrants disproportionately fill its ranks. Not only should these fields be added to Schedule A, but limits on immigrant workers without college degrees should be loosened more generally to ensure that shortages can be filled.

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6   Many are already in the country as H1B visa holders.

The reforms to the permanent legal migration suggested here would incorporate the following guiding principles:

- Legal permanent immigration should gradually increase from its current level, both for family-based and employment-based pathways, with particularly high rates of growth for college-educated employment-based pathways;

- The numeric cap on permanent immigration should grow according to a formula which incorporates a modest baseline level of expansion plus adjustments for economic conditions;

- The employment-based immigration system should be more responsive to labor market conditions, including for occupations not requiring higher education; and

- Per-country caps for both family- and employment-based immigration systems should be substantially raised.

3.b. Temporary Migration and Its Discontents

In addition to the approximately 1 million immigrants issued green cards each year, around 2 million others, including workers and students, legally reside in the United States on a temporary basis. These legal residents tend to be highly educated: many arrive through the NAFTA Professional TN program, which allows college-educated workers from Canada and Mexico to work temporarily in the United States, and another large share arrive through the H1B visa program, which allows companies to hire college graduates in specialty occupations (often STEM fields) for up to three years. These H1B workers are capped annually at 65,000, plus another 20,000 for those with advanced degrees from US institutions. Evidence shows that the H1B program does not drive down wages and may in fact prevent firms from outsourcing technical work, but concerns remain about firms paying below-market wages (Peri, Shih, and Sparber, 2015; Hira and Costa, 2021). In most recent years, the program has been highly oversubscribed (American Immigration Council, 2021).

Immigration programs that admit less-educated workers are aimed at shorter-term employment. The H2A program permits immigrants into temporary agricultural jobs of less than one year. The program is uncapped and has grown to incorporate more than 200,000 workers annually. The H2B program, with is subject to a cap of 66,000 workers, permits entry for seasonal non-agricultural workers or other applicants serving one-time labor needs.

Temporary migration programs are economically beneficial in some ways. Unlike permanent migration pathways, they offer more flexibility to respond to immediate

workforce needs, without producing long-run impacts on the US population. In theory, they can be particularly useful for filling temporary or seasonal gaps in the US labor market. The agricultural industry, for instance, is heavily dependent on seasonal labor (Castillo, Simnitt, Astill, and Minor, 2021).

But these programs have several significant disadvantages. First, workers in temporary immigration programs are bound to their specific employer. Workers looking to switch employers need to restart the visa process with a new sponsor. This bureaucratic barrier inhibits the efficient allocation of workers and reduces worker bargaining power. Admitting permanent residents through an employment-based pathway similarly requires sponsorship through an employer in most cases, but the green-card holder then has much more agency to leave the position if their skills are better utilized elsewhere.

"Workers looking to switch employers need to restart the visa process with a new sponsor. This bureaucratic barrier inhibits the efficient allocation of workers and reduces worker bargaining power."

Second, temporary migration poses a challenge when migrants wish to stay in the United States. The H1B program allows recipients to apply for permanent status in the United States through the permanent employment pathway while they work under their H1B grant—an option known as "dual intent." But three quarters of H1B recipients are from India, where applicants face a decades-long queue due to the per-country caps imposed on employment-based green cards. Meanwhile the H2 temporary visas typically held by less-educated workers don't offer a pathway to permanent residence regardless of the holder's country of origin.

A small fraction of employment-visa holders stay in the United States without documentation after their visas expire. Though only about 1 percent of temporary migrants fail to depart according to the terms of their visas, overstays (including on tourist, business, student, and work visas) are an increasingly common route to undocumented immigration, representing more than half of undocumented immigration in recent years (Warren, 2019). Approximately 70,000 work-based and related visas were over-stayed in 2019, and these populations aggregate over time. The country's over-reliance on temporary visas, and associated problems enforcing their time limits, creates a population of undocumented immigrants that could be avoided by offering more flexibility in the permanent employment-based system.

Finally, the temporary visa program is ill-suited to address longer-term shortages in particular occupations. Health and personal care aide jobs are one example noted

above. No temporary visa program is designed to respond to this type of chronic, sector-specific need. Increased flexibility in the temporary visa program could help to alleviate the issue temporarily, but these long-term challenges are best addressed by expanding permanent migration pathways for less-educated workers in shortage occupations.

Policy takeaways:

- Temporary migration pathways should be used to address seasonal and short-term needs, but longer-term labor-force challenges should be met through expansions in the permanent employment pathways; and

- Over-reliance on temporary visas could reduce worker bargaining power and may lead to unintended consequences.

3.c. Unauthorized Migration and Integration

More than 10 million people are currently living in the United States without legal status. Heightened border control has made temporary or circular undocumented migration less common; as a result, 60 percent of undocumented immigrants have remained in the country for at least a decade (Gelatt and Zong, 2018). And these long-term unauthorized residents often establish roots: 40 percent of undocumented adults are parents of children under 18, and 80 percent of children with an unauthorized parent are US citizens by birth (Gelatt and Zong, 2018). The humanitarian implications of dismantling families through detention or deportation are manifest, but the adverse economic consequences are also serious (Watson and Thompson, 2022). At the same time, large inflows of undocumented immigrants undermine confidence in the rule of law and create a class of workers who are not afforded legal protections. These competing interests require rethinking the country's approach toward immigration more broadly.

The first step should be preventative. A significant expansion of legal immigration caps, a loosening of the per-country limits, and more employment-based pathways to permanent residency for less-educated workers would help to reduce the incentives for unauthorized migration. Currently, migrants who attempt unlawful entry or who are found living in the United States without authorization are subject to re-entry bars that prohibit them from entering lawfully for at least three years and sometimes permanently (US Citizenship and Immigration Services, 2022a). These penalties are of little consequence to the many people who have virtually no chance of entry if they play by the rules, chiefly less-educated immigrants from oversubscribed countries or those without close family ties. But the promise of a significant chance of legal entry could change the calculus. Unauthorized immigration declined only briefly

after the 1986 Immigration Reform and Control Act, suggesting that regularizing existing residents without expanding future opportunities for legal immigration is an inadequate solution (Orrenius and Zavodny, 2003). Therefore, while for political and practical reasons increases in legal limits should be introduced gradually, reductions in unauthorized migration will be realized only when migrants currently excluded from legal pathways obtain a reasonable chance of immigrating through authorized channels. Investment in political stability in key sending regions would also help to reduce inflows (Porzecanski, 2021).

In addition to expanding legal immigration, a preventative approach would address those entering the United States to work without authorization. As the border has become increasingly militarized over the past two decades, it has become increasingly dangerous and costly for immigrants to enter surreptitiously (Capps, Meissner, Soto, Bolter, and Pierce, 2019). Undocumented immigrants are more often arriving legally and overstaying their visas (Warren, 2019). Though only about 1 percent of visa recipients fail to exit the country in a timely manner, in gross total these numbers become significant—an estimated 676,000 visa holders failed to leave on time in 2019, for example (Department of Homeland Security, 2020). Improvements in the dysfunctional visa tracking system would reduce this number (Department of Homeland Security, 2017).

Because the primary motivation for most immigrants to the United States is employment, increasing penalties on unauthorized work is another crucial element of improving the immigration system to prevent overstays. But penalties on workers themselves, the current default, arrive too late and come at great humanitarian cost. Sanctions on employers are rare and usually small, providing minimal incentive for employers to follow the law (American Immigration Council, 2011). A preventative approach would penalize employers who hire unauthorized workers, and penalties could be made substantial enough to encourage compliance. E-verify, a system by which employers can check their workers' immigration status, is an imperfect tool, but one that could play a role in holding employers accountable. At the same time, tools aimed at employers run the risk of promoting discriminatory behavior, a concern that also needs to be addressed (US Department of Justice, 2022).

Enforcement of immigration violations for long-term residents of the United States should also be reimagined. For those who have made their lives in the United States and contributed to society, removal is a disproportionate response to the violation. While only a small fraction of undocumented immigrants face enforcement each year, fear of these harsh consequences drives "chilling effects" in immigrant behavior. For example, the threat of enforcement causes immigrants to avoid enrolling their citizen children in Medicaid and SNAP, to under-report crimes that they are victims

to, and not to share other information with police (Watson, 2014; Alsan and Yang, 2019; Jácome, 2022). About 50 percent of foreign-born Latinos and 80 percent of foreign-born Latinos without a green card say they worry about themselves or someone close to them being deported (Moslimani, 2022). And when deportation does occur, the economic and humanitarian consequences can be devastating (Watson and Thompson, 2022).

While not all those discovered living in the United States without authorization are deported, even those who face less harsh legal consequences can have their lives, and their families' lives, significantly disrupted. Undocumented immigrants seeking relief from removal through an immigration court process often find that the process can take years, during which the immigrant might be detained. And detention is an expensive proposition for taxpayers and immigrant families alike, particularly because those detained are typically their family's primary breadwinner. Increased use of "alternatives to detention," which allow those waiting adjudication to continue living and working in their communities, are a common-sense fix (American Immigration Council, 2022). But even this legal limbo creates significant stress for families who fear that the day of their six-month Immigration and Customs Enforcement check-in will be the last time they are home with their children.

A better alternative is to allow long-term unauthorized residents the opportunity to stay in the United States permanently. This solution could be coupled with levying civil fines against those who arrived as adults, in addition to recovering any back-taxes owed. (Many undocumented immigrants do pay payroll taxes, and about 2 million people, most of whom are unauthorized immigrants, file income taxes using an Individual Tax Identification Number) (Sifre, 2021). Proposed legislation has described various forms of a "pathway to citizenship" for undocumented residents, but the most important components include (a) protection from deportation; and (b) legal work status. Little is to be gained by keeping unauthorized migrants living in the shadows.

The primary argument against a lenient approach toward the current undocumented population is that such an approach would encourage further waves of unauthorized immigration. Indeed, the most recent major amnesty period, in the late 1980s, did not curtail unauthorized inflows. It is therefore essential to couple a more humane approach to enforcement with expansions to the legal immigration system and other measures that will deter undocumented migration. While unauthorized migration will never be fully eliminated, it can be reduced by bolstering opportunities and incentives for legal migration.

Undocumented and documented immigrants alike face barriers to thriving in the United States. Immigrant integration, defined by the Migration Policy Institute as "the process of economic mobility and social inclusion for newcomers and their children," requires not only eliminating policies that break up families but also enacting a broad set of policies promoting economic mobility and racial justice, such as redistributive taxation and support for high-quality and racially integrated public education.

Occupational downgrading is a common feature of immigration to the United States because of language and bureaucratic barriers (Adversario, 2021), but policy initiatives can pave the way for the full use of immigrants' skills and talents. For example, some states have expanded opportunities for immigrants educated abroad to obtain professional licenses; others have allowed professional licenses for undocumented or youth who have received temporary legal status under the 2012 Deferred Action for Childhood Arrivals program (National Conference of State Legislatures, 2017).

The Aspen Institute Community Strategies group has partnered with the Migration Policy Institute and Higher Heights Consulting to understand strategies for culturally competent and inclusive support to immigrant families using a two-generation model (Migration Policy Institute, 2022). Evidence on the long-run impacts of immigrant integration services is lacking, but an extensive literature finds economic payoffs to investments in children and families more broadly. It is also makes clear that economic mobility is not only possible but very common among children in immigrant families. Recent research highlights the remarkable economic success of immigrant children from low-income families, not only in the early 20th century but continuing into today (Abramitzky and Boustan, 2022). While past results are encouraging, the continued success of second-generation immigrants is not guaranteed, and will be determined in part by the social and policy environment in which those children grow up.

Policy takeaways:

- Expanding opportunities for legal immigration, discouraging visa overstays, and strengthening employer-based enforcement would help to discourage unauthorized immigration;

- A more lenient and humanitarian approach would also allow long-term unauthorized residents to permanently stay and work in the United States; and

- Promoting policies that help immigrants to thrive would result in payoffs for the US economy.

4. Backlogs

The current immigration bureaucracy is overwhelmed. While understaffing and inadequate funding were already the norm, these issues were exacerbated during the Trump presidency. The COVID pandemic has only accelerated these gaps into crises.

As shown in Figure 4, the backlog of pending green-card and other permanent adjustment-of-status applications grew from 3 million in 2013 to 8.4 million in 2022. While the backlogs were already ramping up before the 2016 elections, the Trump administration increased scrutiny of green-card applications and newly demanded in-person interviews, further slowing the process. A 2020 pause in processing, and continued pandemic-related issues since then, have worsened the situation. An estimated 250,000 green cards were "wasted" in FY 2021: permanent admissions authorized by law were not processed and cannot be used in future years (Neufeld, 2021). Because the law requires that application processing be self-funded, an increase to green-card application fees will be required to get back on track (Chishti and Gelatt, 2022).

Figure 4. Pending USCIS Petitions, 2013-22
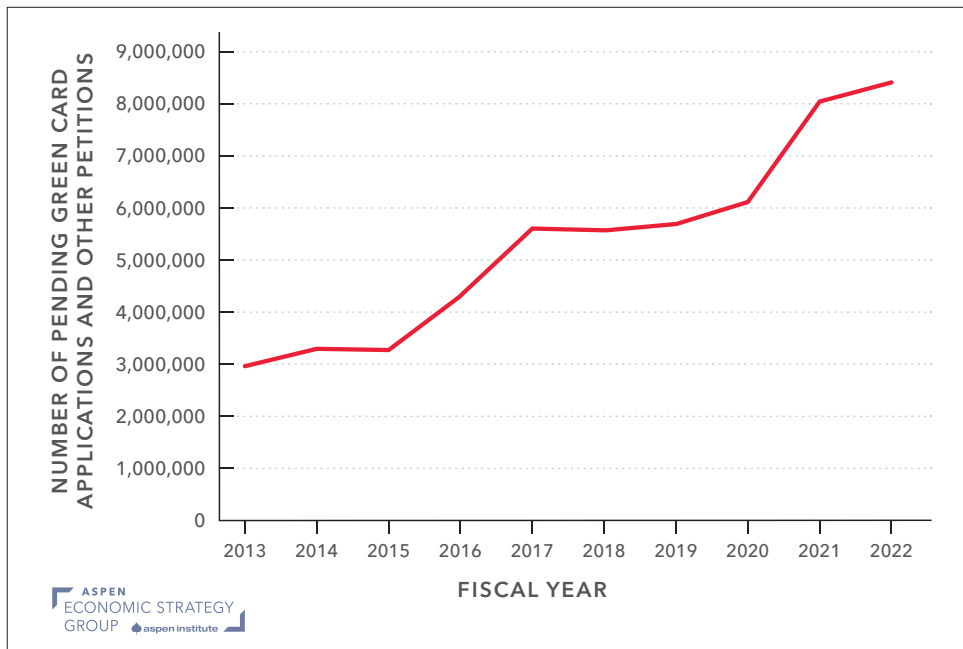
Source: US Citizenship and Immigration Services, "All USCIS Application and Form Types" for various years.

Note: Refers to pending green-card and other adjustment-of-status applications end of Q4 of fiscal year for all years except 2022, which refers to the end of Q1 (December 2021).

Similar backlogs exist in temporary visa processing, with nearly half a million people waiting for a visa appointment (US Department of State, 2022c). Approximately 1.6 million cases also await adjudication in immigration court, triple the 2016 number (TRAC Immigration). Even without passing other reforms, adequate financial support for the immigration bureaucracy is essential. Implementation of a sensible expansion of immigration will require further increases in staffing and similar resources.

5. Congressional Inaction

Congress has primary authority over US immigration law. But despite repeated attempts at legislation, no significant immigration package has been authorized since 1996. Efforts in 2001 were derailed by the September 11th attacks. The House and Senate passed comprehensive immigration reform bills in 2005-2006, but failed to reconcile them into a compromise bill. Additional bills were introduced in 2007, 2009, and 2011, but never voted into law. In 2013, the Senate passed the bipartisan Development, Relief, and Education for Alien Minors Act (DREAM), but House leadership declined to bring it for a vote. It appears that political incentives do not favor the compromise that would be necessary to make progress. As a result, Congress has abdicated its responsibility to legislate on this issue.

The executive branch has stepped into the void. Deferred Action for Childhood Arrivals (DACA) was a 2012 executive action meant to serve as a temporary solution for immigrants who were brought to the United States as children. Roughly 800,000 people enrolled in the program, only to have their status become uncertain when the White House changed hands in 2016 (López and Krogstad, 2017). Enforcement discretion also means wild swings in detention and removal policies.

There is also heterogeneity in enforcement at the local level. The Secure Communities program means that local law enforcement is a key partner in immigration enforcement, with jails submitting arrestee's fingerprints to federal criminal and immigration databases. Local officers can play more or less of a role in immigration enforcement depending on how they operate on the street. In addition, dozens of local law enforcement agencies have agreements with the Department of Homeland Security to play a more active role in immigration enforcement under the 287(g) program, whereas local law enforcement resists cooperation in other cities (US Citizenship and Immigration Services, 2022b). The result is that immigration policy, ostensibly under federal purview, is decentralized and differs substantially across the country, echoing variations across presidential administrations. This lack of uniformity across time and location stems from the policy vacuum left by Congress' failure to enact meaningful immigration legislation.

Bipartisan comprehensive reform is a necessary step toward a functional immigration policy. Historically, proposed bills have offered a combination of increased border and interior enforcement and a pathway toward legal status for the currently unauthorized population. These measures are often coupled with expanded and more sensible legal immigration pathways, which are essential to reducing the long-term undocumented population—the most determined immigrants must have a plausible hope of migrating legally.

Successful reform needs to address two realities that are sometimes ignored. First, though the evidence overwhelmingly suggests that immigration creates economic gains, large-scale expansion of the immigration program presents both a real and perceived risk at the bottom of the income distribution. Some of the gains realized from expanded immigration should be rerouted toward redistributive policies and policies promoting economic mobility.

Second, because the direct fiscal costs of less-educated immigration are typically negative at the local level, and because that cost burden is felt unevenly across the country, communities that receive net inflows of immigrants should receive economic support to offset these higher costs. To some degree these transfers already occur through state educational funding policies, but they should be concretized as an intentional component of immigration reform (Mayda, Senses, and Steingress, forthcoming). For example, federal funding through the existing Impact Aid program could be made available to school districts serving recently arrived immigrant families with low education levels, and support for Federally Qualified Health Centers serving this population could be expanded (Edelberg & Watson, 2022). Recognizing the hardship that some local governments and communities face as the result of federal policy, and responding accordingly, is essential to sharing the benefits of expanded immigration.

In sum, an ideal bill would include provisions to (a) gradually expand legal family immigration each year, expand employment-based migration opportunities, and loosen per-country caps; (b) shift toward permanent rather than temporary migration pathways; (c) discourage visa overstays and penalize employers who hire unauthorized immigrants; (d) offer relief to long-term undocumented residents; (e) redistribute funds to localities and individuals adversely affected by immigration; and (f) fund the bureaucratic infrastructure so that the system functions smoothly.

6. Conclusion

Restricting migration has been described as leaving "trillion-dollar bills lying on the sidewalk" (Clemens, 2011). Economists overwhelmingly agree that immigration is good for growth and prosperity. Reform that allows for the realization of these uncollected benefits would significantly expand legal immigration, reimagine enforcement for undocumented immigrants, and address extreme backlogs in the immigration bureaucracy. It would also recognize that the benefits of immigration are not evenly shared and incorporate support for adversely impacted US natives and local governments.

Over the past two decades, Congress has abdicated its responsibility to address immigration in a responsible way. The result has been a chaotic and often cruel system. But the current labor market and the country's widening demographic challenges may present an opportunity—a nudge to elected officials to enact sensible policy that will broadly benefit current and future Americans.

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Will Population Aging Push Us over a Fiscal Cliff?

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ABSTRACT

The share of the US population age 65 and older is rising dramatically. In the year 2000, 12 percent of the population was over age 65; by 2050 that share will be 22 percent. Much of that aging has already occurred: in 2022, just over 17 percent of Americans are retirement age. Population aging is applying upward pressure on government deficits as a result of increased public spending on programs, including Social Security and Medicare, that are designed to support older Americans. I argue that broader distributional measures assessing who pays for and who benefits from age-related government programs, both across and within generations, are necessary to inform policy decisions. However, in addition to direct aging-related government expenditures, I argue that unfunded spending in other, non-aging parts of the budget along with recent tax policy changes portend significant intergenerational redistribution. These distributional impacts should be measured and taken into account by lawmakers who seek to address looming fiscal challenges in a more equitable way.

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1. Introduction

The share of the US population age 65 and older was just 12.5 percent in 1990. By 2010, with older members of the Baby Boomer generation (defined here as those born between 1945 and 1965) nearing retirement, this number had increased slightly, to 13.1 percent. But by 2030, when the last of the Baby Boomers will turn 65, the share of the population age 65 and older is expected to balloon to 20.6 percent. Rather than crest and fall, however, this large shift in the age distribution will create a new American normal. A steady though less dramatic trend toward an increasingly older population, attributable to longer-term shifts in longevity, fertility, and immigration, is likely to cause the share of the population 65 and older to reach 22 percent by 2050.[1]

Forecasters have long anticipated population aging. Because these trends are key inputs for projecting outlays and revenues, government agencies including the Congressional Budget Office (CBO) and the Social Security Administration continuously monitor and adjust projected demographic shifts, including age distributions (Congressional Budget Office, 2021b, 2021c; Social Security Administration, 2021). New information suggests that these forecasts could be underestimating the country's shift toward an older population: recent data on fertility trends might be indicating a slowing birth rate, further increasing the share of the older population in the coming generations (Kearney, Levine, and Pardue, 2022). Absent dramatic increases in fertility or immigration, the demographic cards have largely been dealt for the next few decades.

Population aging is often cited in budgetary discussions as a harbinger of unsustainable fiscal policy and a call to action. At face value, the budgetary math is straightforward: government programs in which taxes are levied on workers and payments or services are then furnished to retirees will be pushed toward deficit as the ratio of retirees to workers increases; the outflows become imbalanced from the inflows. Two easy examples of such programs are Social Security and Medicare, but revenue sources such as income taxes and estate taxes, as well as other government programs including Medicaid, are also significantly impacted by the population's age distribution. An aging population is generally associated with slower growth in real output and incomes, and therefore lower income tax revenues per capita. If spending per capita remains unchanged, the budget is pushed further into deficit.

Nor is population aging a concern limited to the future; rather, it is already upon us. As of 2022, the share of the population age 65 and older, just over 17 percent, is already well on its way to its projected 22 percent share in 2050. Whether the

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1   See Statista (2021).

remaining increase will represent the difference between sustainable levels of government debt and a fiscal cliff remains to be seen. How important to the overall budget picture are age-related programs such as Social Security and Medicare, particularly as they risk slipping into deficit? How should policymakers think about maintaining these programs' essential benefits, while modifying them to avoid dire fiscal consequences? Or do we face an even broader policy challenge, the solution to which requires that we reconsider all forms of revenues and expenditures?

This paper aims to move the policy debate on population aging and resulting deficits and debt beyond macroeconomic phenomena and instead consider them in terms of their distributional consequences, with solutions grounded in the principle of fairness. Most economists would agree that government debt—in addition to the possibility that debt crowds out investment and slows economic growth—imposes a burden on future generations. And transfers across generations are indeed key to the distributional framework discussed here. But transfers within generations must also be considered.[2]

I begin by separating age-related social insurance programs from all other revenues and spending in the federal budget. That division provides a preliminary sense of how various budgetary components have contributed to deficits past, present, and into the future. Although programs such as Social Security and Medicare have grown as a share of GDP, due to both population aging and the increasing overall share of health spending, recent trends in deficit spending are also being driven by other patterns in spending and revenues. For example, the government responded to the COVID-19 pandemic with a spike in outlays, while changes to income tax policy have slowed the growth of revenues.

Second, I explore the redistributive impacts of Social Security and Medicare, focusing on how program design affects who pays and who benefits. These social insurance programs exist to improve economic welfare, requiring that their overall net benefits exceed their costs. Even when that balance is correctly struck, however, social insurance can lead to redistribution across and within generations. For example, Social Security redistributes from lifetime high-earners to lifetime low-earners within each generation. Both Social Security and Medicare generate redistribution across generations as well; for example, a generation of retirees may be receiving more in Social Security and Medicare benefits than they paid in taxes while they were working, and that redistribution is being paid for by current and future workers. The extent of this redistribution is largely determined by policy changes and by factors such as the pace of health cost growth.

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2   A much older "generational accounting" literature (Auerbach et al., 1994) seeks to measure how government policy transfers resources across generations, but that approach ignores transfers within generations, which are key to the arguments here. Criticisms of the generational accounting approach (Ruffing e. al., 2014) are also important to heed.

Third, I review the evidence on redistribution within Social Security (CBO, 2021c). One insight that emerges is that the determinants of redistribution across and within generations are resolved only ex post. For example, the projected exhaustion of the Social Security trust fund will ultimately be resolved by determining redistribution across (and possibly within) generations. If benefits are reduced when the Social Security trust fund exhausts, the generations then receiving benefits will bear the burden. If instead taxes are raised to cover the shortfall, the burden will fall on those in the workforce at the time. Medicare coffers face the same issues, and redistribution within Medicare is also dependent on how health costs grow over the ensuing generations and how policymakers choose to fund those cost increases.

Fourth, I argue that more government spending programs can and should be evaluated based not only on their efficiency but also their distributional impacts, characterized here through the lens of fiscal winners and losers. Fairness suggests that the subset of the population that benefits most from an efficient social insurance program, or from public investment in, for instance, roads, defense technology, or education, should be responsible for the costs when the investment returns are realized. As a result, policy responses in some cases will involve borrowing on behalf of future generations and having them share in repaying the costs in future years.

Lastly, I discuss how the distributional perspective on government deficits and debt should affect our thinking about fiscal policy in response to the population aging. The public economics literature provides the tools for determining whether a government program's benefits exceed its costs. Those tools are best used not only to help inform our decisions about a program's desirability and ideal scale, but also to frame discussion about how the program should be funded across and within generations. If we ignore the other drivers of government deficits and debt and focus only on changes to aging-related programs including Social Security and Medicare, we greatly risk undoing or foregoing otherwise desirable government policies.

2. Population Aging and Government Budgets: Past, Present, and Future

The oldest members of the Baby Boomer generation began turning 65 in 2010, and the youngest will be 65 by 2030. During that 20-year period, the fraction of the US population age 65 and older will increase from 13.1 to 20.6 percent (Figure 1). This paper begins by examining how population aging has affected government outlays and revenues as of 2022, and the outlook for future budgets.

Figure 1. Share of the US Population 65 and Older
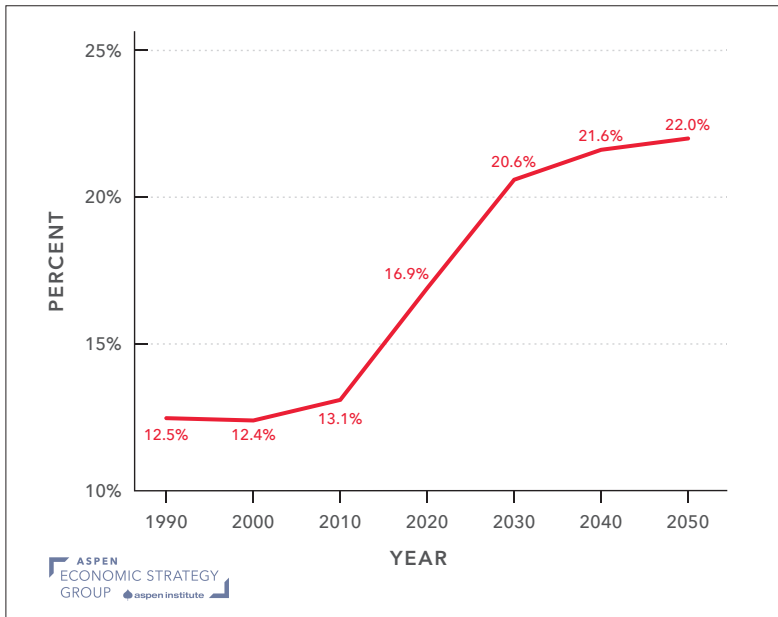
Source: Statista (2021).

Understanding the relationship between population aging and budgets first requires examining the population's aging curve. Figure 1 covers the years between 1990 and 2050, which includes 20 years on either side of the Baby Boomer retirement period. Next, aging-related components of the federal budget—including Social Security, Medicare, and other health-related expenditures— should be separated from other budget components. Third, large movements in other budget components not directly affected by population aging, such as countercyclical spending and the impact of tax policy changes on long-run revenues, are also instructive and must be understood.

2.a. Federal Outlays, Revenues, and Deficits

The outlook for federal government outlays and revenues and the resulting deficits may appear alarming in historical context, as demonstrated in Figure 2 below.[3] In 1990, outlays represented 20.2 percent of GDP, and revenues were 17.5 percent, resulting in a budget deficit of 3.7 percent of GDP. At the time, such budget deficits motivated concerted action on the budget that contributed to budget surpluses by the turn of the century. Both spending restraint and the dot-com stock market boom pushed the budget into surplus, as outlays declined and revenues increased.

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3   Charts in this section are created by splicing together time series from the supporting data files associated with the CBO 10-Year and Long-Term Budget Outlooks (CBO, 2021a, 2021b).

Figure 2. Federal Revenues and Outlays as a Share of GDP
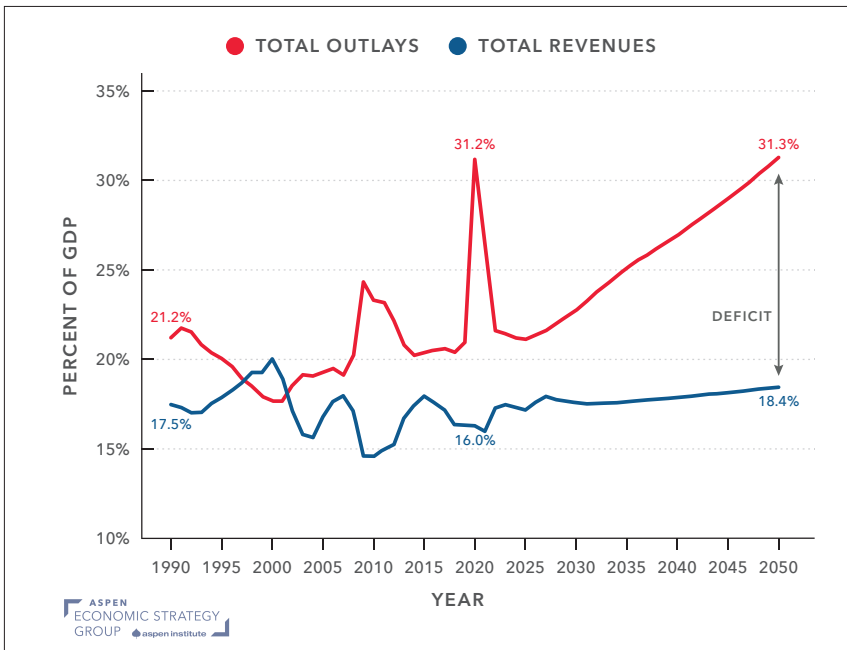
Source: Congressional Budget Office.

These budget surpluses were short-lived. Changes in tax law in 1998 and 2001 led to lower revenues, though the housing and stock market bubbles in the early 2000s offset some of the decrease. Revenues declined dramatically as a result of the 2008 Financial Crisis and associated Great Recession, even outpacing the dramatic decline in GDP. Automatic stabilizers and deliberate policy responses to the economic downturn also increased outlays relative to GDP, and the resulting deficit reached 10 percent of GDP in 2010, nearly tripling its previous peak two decades earlier.

Large deficits associated with the Great Recession led to renewed fiscal discipline between 2010 and 2016. Deficits shrank relative to GDP, but the decrease in federal government outlays also likely contributed to the economy's slow recovery. Although the unemployment rate fell consistently during this period, labor force participation remained stubbornly low, and lower aggregate demand contributed to slower overall growth. Such fiscal discipline, motivated by the textbook macroeconomic idea that government deficits slow growth by crowding out private investment, was likely misplaced. Crowd-out is only a concern in an economy operating at full capacity, which was not the case between 2010 and 2016. Between 2017 and 2019, increased spending and tax cuts resulted in improved GDP growth, even though the economy had appeared to be at full employment.

The COVID-19 pandemic and the associated recession wrote a new chapter in federal budget history. As in all recessions, the spike we observed in outlays relative to GDP could be attributed in part to the decrease in GDP itself. However, the pandemic led to a much more aggressive spending response, with the usual increases in unemployment insurance and other support programs supplemented by direct cash transfers to individuals, businesses, and states. As a result, federal outlays surged to 31.2 percent of GDP. One indicator of the federal response's success was the rapid return to a more normal budgetary situation, with both outlays and revenues approaching pre-pandemic levels by 2022.

Revenues are expected to return to pre-pandemic levels (relative to GDP) as the economy recovers and as some provisions of the 2017 tax changes expire. Forecasters then expect bracket creep to lead to a slight upward trajectory in revenues as a share of output, but the ratio is not expected to recover to its 2000 level. An important story unfolds meanwhile on the other side of the ledger. Outlays are expected to surge relative to GDP in the coming decades, and the spike in outlays during the COVID-19 pandemic provides an interesting reference point: the one-time spike in spending relative to GDP in 2020 is the CBO's expected norm in 2050.

If the upcoming surge in outlays were primarily driven by population aging, then the trends in Figure 1 suggest we should expect those outlays eventually to level off. However, as Figure 2 illustrates, the increase in outlays is expected to persist well beyond Baby Boomers' retirement, warranting a deeper dive into the components of federal outlays.

2.b. Components of Federal Outlays

While population aging will continue to contribute to rising federal outlays, there are other important contributors. Figure 3 compares projected spending on aging-related programs (Social Security and major health programs) to other drivers of government outlays, net interest, and non-aging components of health spending. Major health programs include Medicare parts A, B, C, and D, Medicaid, Affordable Care Act (ACA) exchange subsidies, and veterans' health, each of which are subject (to varying degrees) to aging- and non-aging-related spending drivers.

Figure 3. Components of Federal Outlays as a Share of GDP
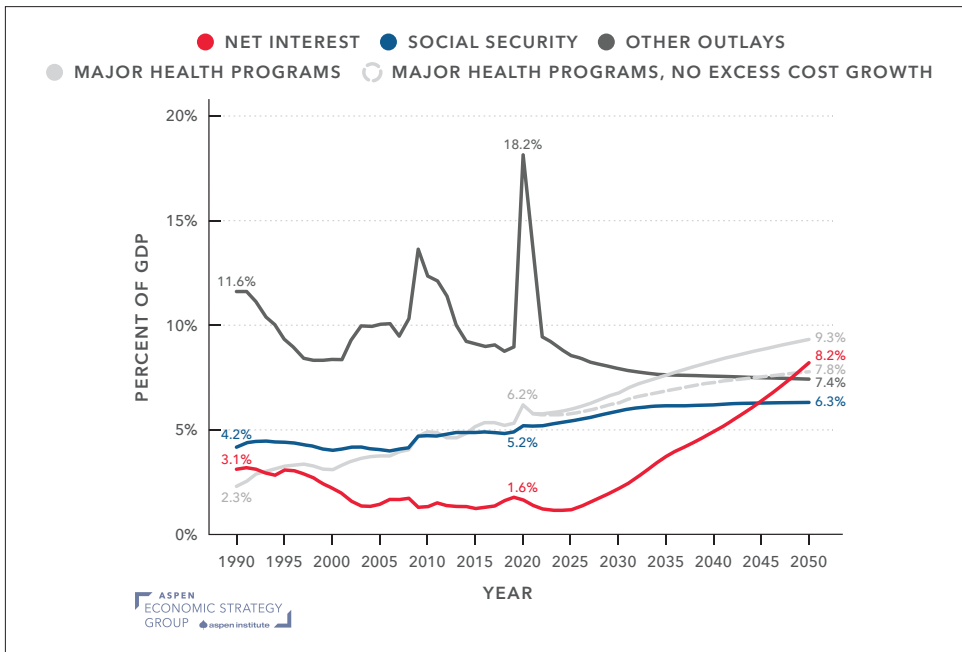
Source: Congressional Budget Office.

Figure 3 separates the projected growth in health spending into two components: the first is "excess" health cost growth, which captures expectations of how health spending will evolve beyond the effects of population aging or policy changes. The historical rate of excess cost growth is computed as a residual by subtracting the effects of population aging and policy changes from actual health spending relative to GDP. That historical average then informs analysts' expectations for future health cost growth. The second component is health spending absent excess cost growth, which reflects the impact of age-related demographic change.

Separating population aging, policy changes, and excess health cost growth helps to explain and to interpret the country's budget history between 1990 and 2020, as detailed in Figure 3. Both Social Security and health spending have increased alongside population aging since 1990, but the increase in Social Security spending (1 percentage point) is well below the increase in health spending (3.9 percentage points). The growth of Social Security can be entirely attributed to population aging, while the growth in health spending reflects aging-related increases along with excess cost growth and policy changes such as the introduction and subsequent modification of Medicare Part D and ACA-related spending.

Projections for the two spending categories that relate directly to an aging population—Social Security and health spending absent excess cost growth—show the expected jump in outlays relative to GDP as Baby Boomers become eligible for benefits. But neither is the dominant factor driving exploding total outlays relative to GDP. Social Security is expected to add only 1.1 percentage point to spending relative to GDP between now and 2050, while the aging-related component of health spending is expected to add another 1.6 percentage points of GDP; other factors are far more significant.

> *"Projections for the two spending categories that relate directly to an aging population—Social Security and health spending absent excess cost growth—show the expected jump in outlays relative to GDP as Baby Boomers become eligible for benefits. But neither is the dominant factor driving exploding total outlays relative to GDP."*

The largest single driver of future outlays relative to GDP is net interest, as shown in Figure 3, which is projected to increase from 1.6 percent of GDP today to 8.2 percent by 2050. That 6.6 percentage-point increase alone represents more than double the 2.7 percentage-point increase attributable to aging among Social Security and health program recipients. The expected growth in net interest reflects deficits accumulated to date and the incremental effect of continued primary deficits going forward. While some of that growth is aging-related, more generally it reflects the government's failure to pay for current spending.

Roughly half of future health spending growth (1.5 percentage points of GDP) is attributed to excess health cost growth between now and 2050. Forecasters often combine excess cost growth with aging-related spending growth when characterizing budgetary problems that result from population aging. But excess cost growth is by construction not driven by population aging, and it should be analyzed from a distributional perspective that examines effects not only across but also within generations, which I address in Section 3.

The final component of federal outlays shown in Figure 3 is a residual, accounting for all "other" spending. Absent the COVID-19 spike, other spending is expected to decline from around 9 percent of GDP to 7.4 percent by 2050. Although other spending relative to GDP declined during two periods of fiscal restraint in the 1990s and 2010s, the 7.4 percent that forecasters expect by 2050 would represent an even lower share of GDP than was observed in any year during those periods. CBO projections suggest that population aging is not adding to upward spending pressures in the category that captures "other" outlays, and indeed, reduced relative spending in these other

parts of the budget may in fact provide an offset to the upward effects of aging on spending in Social Security and health programs.

Examining both the history of budget components and their future projections provide key perspective for understanding how population aging affects the federal budget. Prior to the COVID-19 spike, total federal outlays were about 20 percent of GDP. The CBO projects spending to increase to 31.3 percent of GDP by 2050, an increase of more than 11 percentage points. Social Security and other aging-related health programs are together expected to account for 2.7 percentage points of this outlay growth. Thus, about one-fourth of the expected increase in federal spending relative to GDP will be directly attributable to population aging.

2.c. Components of Federal Revenues

Changes in government outlays relative to GDP is only the first part of an overall fiscal equation that also considers how revenues relative to GDP relate to population aging.

In general, the direct effects of population aging on revenues relative to GDP are more modest compared to the spending side of the ledger. Population aging exerts direct downward pressure on GDP itself as workers age out of the workforce, which forms the basis for tax collection. Though the government collects less in gross income taxes from an aging population, the relationship between revenues and GDP remains stable. Nevertheless, as spending increases relative to GDP, population aging expands the gap between revenues and spending.

Two key determinants of long-term growth demonstrate the effect of population aging on GDP: the size and productivity of the labor force. The CBO estimates that labor force growth contributed 1.4 percent annually to potential GDP growth between 1950 and 2020,[4] while labor productivity grew at 1.7 percent per year. Altogether, potential GDP grew 3.1 percent per year. But over the next decade, potential GDP growth is expected to slow to only 1.8 percent per year. Productivity growth is expected to decrease to 1.4 percent per year, lagging the annual rate of growth from 1950 to 2020 by .3 percent. More notably, labor force growth is expected to decrease to only 0.4 percent per year, nearly a full percentage point below the historic annual average. This decline can largely be attributed to the Baby Boomer generation exiting the workforce without adequate replacement by younger workers; population aging is slowing the growth of GDP, and its associated revenue streams, by 1 percent per year.

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4   See Table 2-3 in CBO's economic outlook, https://www.cbo.gov/system/files/2021-02/56970-Outlook.pdf.

Figure 4 shows revenues disaggregated into four broad categories: personal income taxes, payroll taxes, corporate income taxes, and other taxes. Recall how Figure 2 shows that revenues have historically been much more stable relative to GDP than have outlays and are projected to remain that way. Figure 4 demonstrates how offsetting trends and cyclical variability in the various components explain this difference. Personal income taxes are the largest source of federal revenue, with payroll taxes a close second. Corporate income and other taxes (including excise, estate and gift, customs, and miscellaneous) each account for between 1 and 2 percent of GDP, with a downward trend.

Figure 4. Components of Federal Revenues as a Share of GDP
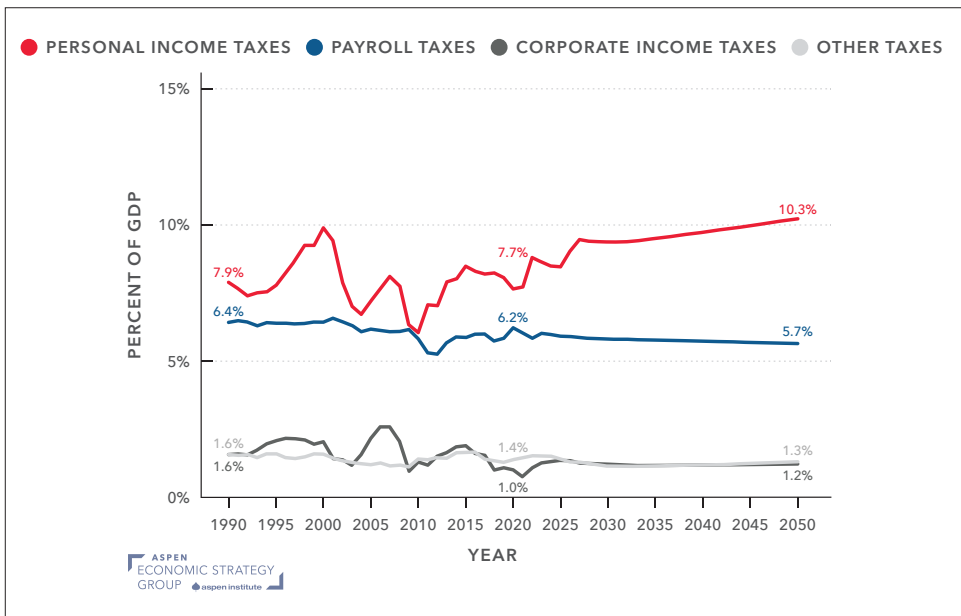
Note that Figure 4 does not demonstrate the most direct implication of population aging on revenues—slowing the growth of GDP via downward pressures on labor force growth and earnings—because each of the four revenue sources are measured relative to GDP. Rather, in its generally more stable revenue projections, Figure 4 reflects the direct connection between GDP growth and tax revenues, especially personal income taxes, payroll taxes, and corporate income taxes.

Payroll taxes provide a good example of how revenue streams should be unaffected by population aging and remain stable over time relative to GDP, but Figure 4 reflects how other factors lead to declining payroll tax revenues over time. Most

payroll taxes are designated for Social Security spending and are levied at a rate of 12.4 percent on earnings up to a taxable maximum that grows with average wages. Medicare payroll taxes are meanwhile levied at a rate of 2.9 percent on all earnings. If earnings as a share of GDP are stable, and the share of earnings below the taxable maximum is stable, payroll taxes will be constant relative to GDP. Moreover, payroll tax policy has not changed since 1990 except for a temporary cut in payroll taxes in response to the Great Recession, which shows up as a downward notch in the series. The downward trend in payroll taxes relative to GDP from 6.4 percent in 1990 to 5.7 percent by 2050 therefore reflects that earnings are forecasted to represent a declining share of GDP, while earnings inequality is forecasted to increase.

Income taxes are also fundamentally correlated with GDP, though again factors unrelated to population aging lead to changes in the relationship between the two. In 1990, personal income taxes represented 7.9 percent of GDP. The ratio surged to 10 percent by 2000, due in large part to the surge in asset values and incomes borne from rapid economic growth during the dot-com bubble. Asset values bear directly on personal incomes through capital gains realizations. But increases in GDP itself do not necessarily increase revenue from personal income taxes relative to GDP; the relationship between personal income taxes and GDP depends on where in the income distribution rises occur. During the 1990s, for example, revenues increased relative to GDP because rising income inequality led to more rapid growth at the top of the income distribution, where taxpayers face higher marginal tax rates. Rising incomes toward the bottom portions of the distribution, where marginal tax rates are lower, would decrease personal income taxes relative to GDP.

A series of tax policy changes between 1998 and 2017 led to much of the downward movement in personal income taxes relative to GDP, while variability during those two decades was largely due to business-cycle and asset-value effects. While tax policy to some extent impacted marginal tax rates throughout the income distribution, business and financial incomes saw more notable policy changes (Gale, Joshi, Pulliam, and Sabelhaus, 2022). Policies such as lower rates on long-term capital gains, the Qualified Dividend exclusion, and the Qualified Business Income deduction combined to dramatically decrease the already low effective tax rates on business and capital incomes.

The projected increase in personal income taxes relative to GDP shown in Figure 4 is expected to contribute positively to the country's long-run fiscal position. This increase is attributable mostly to two factors.[5] First, the 2017 tax cuts—like other tax policies enacted in the past two decades—were "paid for" by rescinding some

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5 Tax preferences for retirement saving are an additional factor expected to increase future revenues, because Baby Boomers who enjoyed tax breaks when they made contributions will owe tax on the withdrawals under current law (Sabelhaus, 2000).

provisions toward the end of the 10-year budget window. Whether those cuts remain rescinded is a budgetary wild card. "Bracket creep" is the second driver of the projected increase: static income cutoffs for marginal tax rate brackets coupled with growth in real incomes over time pushes more taxpayers into higher tax brackets, which raises revenues relative to GDP. Finally, estate tax revenues should increase as a result of population aging, though recent policy changes have all but eliminated estate taxation.

Taken together, the history of federal spending (Figure 3) and federal revenues (Figure 4) relative to GDP shows that while population aging had the expected impact on federal outlays in the three decades between 1990 and 2020, recent deficits and debt reflect a failure to match increases in other (non-aging) spending with increased revenues. The accumulation of both aging and non-aging related federal debt is unlikely to be repaid by its current consumers, and thus has important distributional consequences, which I turn to next.

3. Fiscal Winners and Losers

Social Security and the major health programs such as Medicare have accounted for roughly half of all federal outlays in recent (non-pandemic) years and are expected to contribute to increased government spending in the coming decades. Because total spending over time must equal total revenues, fiscal imbalances today will be resolved by some combination of higher taxes or diminished benefits. The most important question facing policymakers is whose taxes to increase or whose benefits to cut. Answering those questions will require identifying the fiscal winners and losers across and within generations.

> *"Because total spending over time must equal total revenues, fiscal imbalances today will be resolved by some combination of higher taxes or diminished benefits. The most important question facing policymakers is whose taxes to increase or whose benefits to cut."*

3.a. Redistribution Defined

Redistribution—the process by which government takes economic resources from one group and gives those resources to another—is theoretically a simple concept. For example, each year the government redistributes resources from the current workforce (via payroll taxes) to current retirees (via benefits such as Social Security and Medicare Part A).[6]

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6   The Social Security and Medicare Trust Funds add a subtlety because, for example, in years when benefits paid out exceed taxes, Trust Fund balances are drawn down, and those balances were paid for by taxes levied on workers in some earlier period.

Government insurance programs such as Social Security and Medicare insure recipients against above-average longevity and large, negative health shocks. Those within the insured group who experience the insured outcomes—living longer or suffering a health shock—will receive more in government benefits, but everyone in the group enjoys the insurance value of understanding that they are covered. A similar framework describes every group for whom we measure taxes paid and benefits received.

I argue that the method developed by CBO to measure redistribution in the Social Security program, which compares *average* lifetime costs and benefits among and across age cohorts and income quintiles, should be applied more broadly across tax and spending programs. Average outcomes are a necessary measure because lifetime taxes and benefits will vary enormously among a given sample of individuals, depending on actual mortality and health experiences. The average taxes and benefits for groups of similar individuals, however, both across and within generations, provides more information about a program's redistributive effects. While the measure does not capture the insurance value of the program, it does tell us how the program's costs and benefits are distributed across and within generations.

In the case of Social Security, a taxpayer's benefits received in retirement are dependent on the payroll taxes they incurred while working. When the sum of an individual's lifetime payroll taxes are equal to their lifetime Social Security benefits (after adjusting for the time value of money), then the program's main accomplishment is to shift resources within that taxpayer's lifetime; no redistribution has occurred to or from that taxpayer. As this paper will show, that is often the case. Although Social Security produces some net redistribution within 10-year birth cohorts from lifetime high-earners to lifetime low-earners, and some net across-cohort redistribution as a result of policy changes, most taxpayers who live to an average age receive in Social Security benefits close to what they paid into the system through payroll taxes. And everyone covered by the program enjoys the insurance value.

3.b. Estimated Redistribution in Social Security

The CBO regularly produces and publishes a lifetime redistribution framework for Social Security, which compares the average lifetime earnings, taxes paid, and benefits received across population cohorts (CBO, 2021c).[7] The data are available for the 10-year birth cohorts born between the 1940s and 2000s, for a total of seven

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7   The modeling framework used to generate the long-term budget projections described in Section 2 has an integrated dynamic microsimulation that tracks and projects lifetime earnings, taxes paid, and benefits for a representative sample of the population. Those person-by-person lifecycle outcomes are then aggregated to measure and characterize redistribution across and within birth cohorts. See CBO (2021c) for a description of the modeling framework and details about how the statistics presented here are constructed from the individual life histories in the representative sample.

cohorts, and within each cohort by lifetime income quintile. The lifetime benefit and taxes measures allow for measuring within-cohort redistribution.[8] Because the two measures are capturing individual inflows and outflows on a conceptually equivalent basis, the ratio of lifetime benefits to lifetime taxes provides what Social Security analysts often refer to as a "money's worth" statistic. When the ratio of lifetime benefits received to lifetime taxes paid is exactly one, the individual can be said to have received back everything they paid in, with interest.

As demonstrated in Figure 5, lifetime benefit-to-tax ratios vary across and within birth cohorts, but for much of the population they are close to one, indicating little or no net redistribution. The solid (scheduled) lines indicate lifetime benefits and taxes are near to one another for the middle quintile by lifetime earnings in all birth cohorts. Lifetime benefits received exceed lifetime taxes paid by a factor of two or more for the lowest quintile of earners across birth cohorts; progressivity is built into the benefit formula and amplified by the higher incidence of disability benefits in that group. Meanwhile, the highest quintile of earners on average receives less than what they paid into the system, indicated by lifetime benefit-to-tax ratios below one. The differences between the lowest and highest lifetime earnings quintiles demonstrate net redistribution within birth cohorts, though that redistribution is likely more modest than many observers would have expected (Meyerson and Sabelhaus, 2006).

Why do lifetime benefit-to-tax ratios vary across birth cohorts after controlling for lifetime income quintile? Focusing again on just the solid (scheduled) lines in Figure 5, we see for example that the CBO benefit-to-tax ratios for the 1950s and 1960s cohorts are slightly higher than those for the 1940s cohort, the 1970s cohorts are slightly above those for all but the highest earners, and that the ratios decline for those born in the 1980s and later. Benefit-to-tax ratios vary across cohorts because of changes in demographics, economics, and policy. Life expectancy is generally increasing over time, which increases lifetime benefits. Rising earnings inequality meanwhile disadvantages those in lower earnings quintiles to a greater degree than had been the case in earlier decades, and Social Security's built-in progressivity counteracts this trend by increasing the benefit-to-tax ratio. The timing of average real wage growth over an individual's life also impacts on their ratio, since benefits are indexed for wages and prices. And finally, policy changes such as the two-step increase in the Full Retirement Age (FRA) changes benefits across birth cohorts.

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8   Lifetime taxes is the sum of annual taxes paid by an individual, inflation- and time-adjusted forward to age 65. Similarly, lifetime benefits is the sum of annual benefits received by the individual, inflation- and time-adjusted back to age 65. The construction of lifetime taxes and benefits underscores the need for a representative sample approach, because it is important to capture the heterogeneity in realized earnings, demographics, disability, retirement, and lifespan.

Figure 5. Social Security Lifetime Benefit-to-Tax Ratios
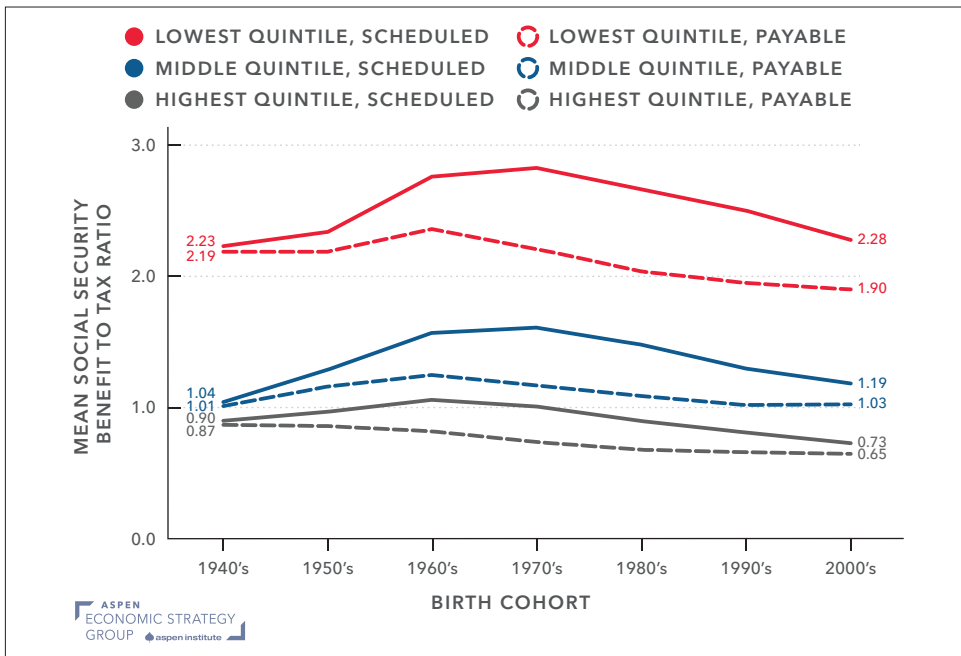
Lifetime benefits and tax data for later birth cohorts, including the 2000s birth cohort who mostly consist of teenagers and college-age adults, are estimated by using historical data to inform future expectations. Fewer inferences—though still some—are needed to complete the lifetime data for the 1940s cohort, for example, who are currently of retirement age. Uncertainty about the random sample's lifetime outcomes corresponds one-to-one with uncertainty about the Social Security system's finances, since total benefits and taxes are summed across the representative sample in the model.[9]

Social Security's redistributive effects are uncertain not only because of shifting demographics and economics, but also because of the inherent uncertainty regarding future policy changes. The dashed (payable) benefit-to-tax ratios in Figure 5 represent this policy uncertainty: they show the average benefit-to-tax ratio for each birth cohort and lifetime income group if benefits are reduced proportionally

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9   The connection between individual and macroeconomic outcomes in the CBO model also makes it possible to study uncertainty about Social Security outcomes under alternative polices in situations where demographic and macroeconomic inputs are unknown (Harris, Sabelhaus, and Simpson, 2005; Sabelhaus and Topoleski, 2007).

when the Social Security Trust Fund is exhausted in the mid-2030s, as the CBO projects. At that inflection point, current taxes will pay for only about 75 percent of Social Security benefits, and beneficiaries from that point forward will receive a proportional reduction. The gradual widening between the solid and dashed lines captures the growing certainty that younger birth cohorts will spend more of their retirement years in the post-exhaustion period.

The lifetime benefit-to-tax ratios shown in Figure 5 provide support for the argument that Social Security is much less redistributive than most budget observers would expect. Even the top quintile of lifetime earners in all birth cohorts on average receive most of what they pay in taxes. Before discussing this result's policy implications, we first examine another set of findings from the CBO model that illustrates the importance of Social Security across and within cohorts.

The replacement rate estimates the share of an individual's earnings that are replaced after retirement by Social Security payments. The average initial replacement rate is measured by dividing initial benefits at age 65 by a measure of the individual's peak average earnings. As Figure 6 demonstrates, for instance, Social Security benefits replaced 56 percent of peak earnings for the lowest quintile of lifetime earners in the 1940s cohort, the middle quintile had 42 percent of earnings replaced, and the top quintile had 26 percent of earnings replaced.

While a 26 percent replacement rate may strike some readers as low, recall that the denominator used here is gross earnings measured at peak earnings age. Because top-quintile earners generally have steep earnings profiles, their average earnings over their lifetime relative to their earnings at peak age are lower than that for other groups. Meanwhile, top earners' net income at their peak earnings age is well below their gross income, since these earners are clustered in higher tax brackets and are more likely to prioritize saving. The same adjustments apply to the other income groups as well, but less dramatically. Thus, adjusting Figure 6 to reflect net rather than gross incomes would implicitly shift up the resulting replacement rates and equalize them across quintiles. The main takeaway from Figure 6 is that Social Security—although most important for lifetime low-earners—plays an important role in retirement income security across the entire lifetime income distribution.

Figure 6 shows that cutting benefits when the Social Security Trust Fund exhausts would dramatically lower replacement rates and thus change the nature of Social Security for future generations of retirees across the entire lifetime earnings distribution.

Figure 6. Social Security Benefit to Earnings Replacement Rates at Age 65
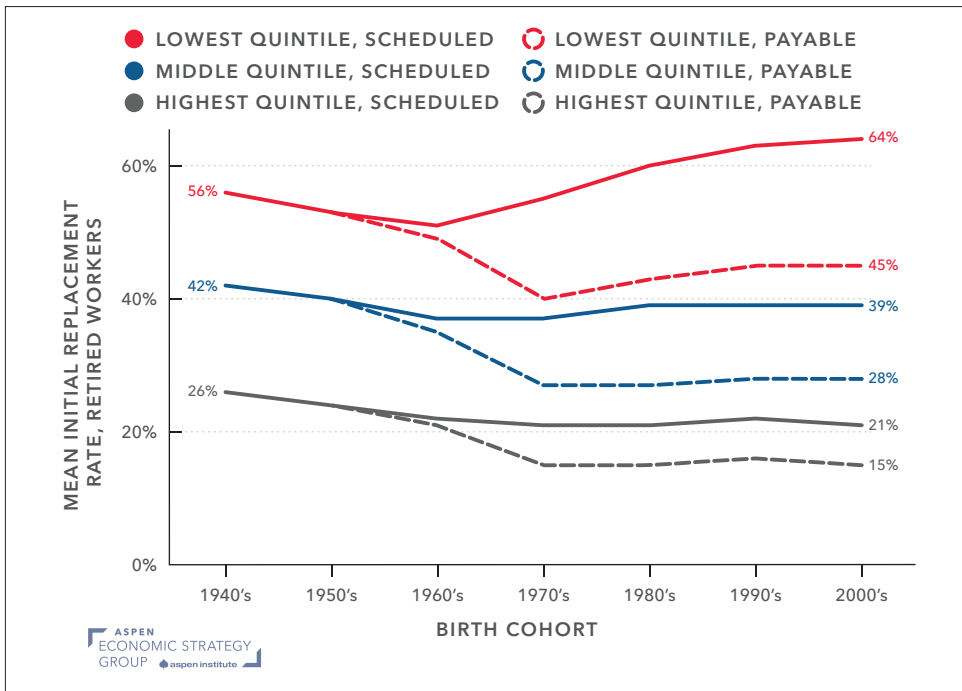
Source: Gale, Joshi, Pulliam, and Sabelhaus (2022).

Figure 5 meanwhile shows that the scheduled lifetime benefit-to-tax ratios for the birth cohorts now entering or approaching retirement (the 1950s, 1960s, and 1970s cohorts) are greater than the scheduled lifetime benefit-to-tax ratios for both the preceding birth cohorts and those that follow. If Social Security's twin goals are to replace income and to mitigate redistribution across generations, the appropriate policy response should shift more of the net burden of system solvency onto those high benefit-to-tax-ratio birth cohorts. Whether that change is reflected in lowering benefits or increasing taxes is a policy decision, and arguably one that the affected birth cohorts should be involved with resolving.

3.c. Measuring Redistribution in Major Health Programs

Because of its built-in individualized connection between taxes and benefits, Social Security provides a useful example of how to measure a policy's net redistributive effects, but the same approach, measuring lifetime costs against lifetime benefits, can and should be extended to other government programs, beginning with those that provide Americans healthcare.

Medicare is the primary aging-related health program, covering individuals 65 and older and the disabled beneficiary population. Other health programs like Medicaid have an aging-related component, through the provision of long-term care and other "dual" benefits for some elderly. Although major health programs have some similarities with Social Security, a key difference is that Social Security shifts resources across a taxpayer's lifetime based solely on age, while health programs shift resources based on other factors including health status. Most people contribute to these programs while young and healthy, and the unlucky few receive large returns on those contributions when they become very ill. In theory, constructing redistribution measures for these health programs, just like the lifetime benefit-to-tax ratios calculated for Social Security in Figures 5 and 6, should be feasible.

Medicare Part A, which is funded by payroll taxes, is a good candidate for measuring average taxes paid and benefits received across and within birth cohorts, to produce a measure of net redistribution. Unlike Social Security it imposes no taxable maximum. Those with higher taxable earnings therefore pay a higher share of Medicare Part A program costs than they do for Social Security. The remaining components of Medicare and Medicaid are funded out of general revenues, as are the other major federal health programs that CBO includes in this spending category, such as CHIP and the ACA marketplace exchange subsidies. Funding health programs through general revenues again suggests that higher lifetime earners within cohorts will pay a larger share of program costs, because income taxes are progressive.

Health program benefits are paid in the form of in-kind medical care, and therefore an individual's net lifetime benefits depend on both their need and willingness to seek medical treatment, and their longevity. These factors can interact in complicated ways with the income distribution. Low earners on average are in poorer health, but higher earners are generally more willing to seek medical attention, especially expensive treatments, because they can better afford program copays.[10] Higher earners also in general have longer life expectancies—an important factor for Social Security captured by the CBO dynamic microsimulation model—but longevity's impact on health spending is less obvious. Although end-of-life medical spending is disproportionately high relative to medical spending at other ages, it happens only once regardless whether a program recipient dies at 75 or 85.

Although specific empirical estimates of these health programs' redistributive effects within or across generations comparable to those for Social Security are not yet available, we can easily observe that the across-generation transfer is quite

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10   For an excellent discussion of the type of simulation modeling required to construct such estimates, see Jones, De Nardi, French, McGee, and Kirschner (2018).

substantial. This conclusion is particularly certain in light of the "excess" cost growth factor that has recently caused health spending to grow disproportionately and that is expected to continue impacting health costs over the CBO's long-term budget window. Excess cost growth is calculated by subtracting the overall rate of economic growth from health spending per person, adjusted for fixed differences in health spending by age. That is, the recent trend in excess cost growth indicates that overall health spending has represented an increasing share of GDP *after controlling for age,* and that share is expected to continue increasing.

Advances in healthcare technology are at the heart of excess cost growth. Medical advances make more procedures possible, but also require more doctors and nurses to implement those procedures. Relative changes in prescription drug prices and doctors' salaries also likely contribute to excess health cost growth. These rapid changes in technology and how healthcare is priced sever the link between lifetime taxes paid and lifetime benefits received. No generation adequately prepays for the modernized healthcare they receive in retirement, nor is it clear how that prescience and foresight would even be feasible.

Health cost growth from technological advancements requires using different parameters for measuring cross-generation redistribution than those used for Social Security. Social Security benefits are direct cash payments, which makes them easy to quantify for the purposes of measuring transfer ratios, and the CBO's time-adjusting (that is, discounting) of future benefits is appropriately based on a risk-free interest rate. But healthcare benefits should be discounted at the risk-free rate of interest plus the assumed rate of excess health cost growth, since the technology pressuring costs upward is only available in the future. In that formulation, time-adjusted lifetime benefits would be lower and more in line with lifetime taxes paid, and the implied redistribution across generations would be significantly more modest.

3.d. Measuring Redistribution in Other Parts of the Budget

The unemployment insurance program —like Social Security and Medicare—is funded by taxes on the same workers who will eventually receive the program's benefits. Thus, UI could also be analyzed through a distributional framework that uses data from tax schedules and benefit distribution across and within generations, which are readily available.

Matching benefits and costs across and within generations is easier in programs that provide direct benefits, such as unemployment insurance. Other programs such as investments in infrastructure and technology provide tangible benefits to the general public, though some subgroups benefit more than others. While still

other programs, such as education and medical research, confer both individual and public benefits.

Measuring redistribution in programs that provide only public benefits is more challenging, because the benefits vary over time and across lifetime income groups. A key task for budget analysts is to identify who benefits most from these more generalized government programs. Benefits from programs such as infrastructure and technology development likely skew toward the wealthiest; these groups see their incomes increase disproportionately when productivity rises.

3.d.1. Intergenerational Redistribution in Tax Policy

Recent changes to capital income tax policy have created clear fiscal winners and losers: an ever-shrinking share of capital income is subject to the personal income tax, corporate tax rates have been reduced, and the estate tax has been all but eviscerated. These changes have shifted the burden of paying for government programs disproportionally onto the less wealthy or been deferred onto future generations.

The implications of these changes for population aging, and the prospects of a looming fiscal cliff, are first order. Gale, Joshi, Pulliam, and Sabelhaus (2022) show that effectively taxing all capital incomes could increase personal income tax revenues by more than 16 percent, or slightly better than 1 percent of GDP. Gale, Pulliam, Sabelhaus, and Sawhill (2020) show that simply reinstating the 1982 estate tax system adjusted for inflation would bring the total increase in revenues to over 2 percent of GDP. Recall from Section 2 that the entire increase in aging-related spending between 2020 and 2050 is expected to represent 2.7 percent of GDP.

Most discussion of how to address the impact of population aging on looming fiscal deficits is rightly focused on programs like Social Security and Medicare. However, disproportionate attention on these programs contributes to a false sense of fiscal crisis and unnecessarily narrows the set of tools available to work with. The solution is to broaden the discussion about fiscal winners and losers to taxing and spending policies more generally.

4. Policy Implications

Distributional analysis of government programs provides a useful framework for understanding the budgetary implications of population aging. The potential for net redistribution is limited in programs including Social Security and Medicare, where recipients generally bear their own costs through past taxation. Addressing aging-

related fiscal imbalances in those programs begins with devising better distributional measures that can help elucidate how changes in taxes and benefits will impact individuals across and within birth cohorts. A threshold question is to measure a program's overall net costs and benefits, which is key to understanding whether the program should exist and at what scale. Finally, the distributional perspective casts light on government programs' implications on equity, particularly as pertains to tax policy.

4.a. Measuring Redistribution

The CBO redistribution measures provide a tool for policymakers to frame Social Security proposals in ways that voters can understand. Does the current Social Security system cause too much or too little redistribution within age cohorts, or is the balance (as argued here) about right? Is the current generation of retirees receiving a larger net lifetime benefit than are future retirees? How will answers to these questions be affected by the tax or benefit changes that will likely be required to resolve expected Social Security shortfalls? Support for Social Security is widespread, in large part because of the program's limited potential for redistribution across and within generations. Changing the redistribution calculus could threaten that widespread support.

> *"CBO should be resourced to regularly measure the distributional impacts of other government programs, existing or proposed, beginning with healthcare programs."*

CBO should be resourced to regularly measure the distributional impacts of other government programs, existing or proposed, beginning with healthcare programs. Public discourse over health spending is distorted by a disconnect between the taxes people perceive they are contributing into the programs relative to the benefits they are receiving. For example, the costs for employer-sponsored health plans are paid in part through deductions on federal income taxes. And people who do not require medical care are unlikely to calculate the insurance value they nevertheless receive—only the unlucky few receive substantial, tangible benefits. Despite these challenges, better measures of redistribution in health programs should become a primary focus of budget analysis.

Next, analysts should measure whether those groups benefitting from costly programs with high rates of return, such as infrastructure and technology investment, are paying a fair share of those programs' costs. These evaluations should be based on comprehensive measures of group incomes, and not on the biased income measures currently used in the personal, corporate, and estate tax systems. Our current tax

system allows a substantial fraction of non-wage income to escape taxation, fueling the justifiable impression that the wealthy are not paying a fair share. Developing more comprehensive income measures should therefore be another focal point for budget analysts.

4.b. Measuring the Net Benefits of Government Programs

Modern-day debates over population aging and the trajectory of government spending would be greatly improved not only by measuring redistribution but also by measuring existing and proposed programs' net benefits—that is, their rate of return. The field of public finance has long focused on measuring the net costs and benefits of government programs, and work in that area has recently accelerated.[11] When an existing or proposed government program has a demonstrably high rate of return, that is generally indicative of some form of market failure—otherwise private industry would have already moved to take advantage of the potential investment opportunity. How government chooses to fund the program in the absence of private investment becomes the key question.

Social Security is a prime example of why policymakers ought to consider overall net benefits when making program decisions related to population aging. Distributional analysis tells part of that story. Rising life expectancies for future retirees may for example justify reducing future benefits: future generations expected to live longer should perhaps begin receiving benefits at a later age to keep their lifetime taxes and benefits aligned. But if that generation is willing to increase their working-age taxes to keep their benefits unchanged, that option should not be dismissed either. A benefit reduction justified simply by what the government can continue to afford—especially benefit cuts that would greatly reduce middle-class benefits while establishing a minimum benefit—ignores the primary reason for Social Security's existence.

Social Security is not a welfare program; it is a government-run pension program that voters continually express a desire to maintain because it provides them with value they cannot obtain from private markets. Social Security is famously referred to as a "Ponzi scheme that works" because the program inflows can always be matched to program outflows by adjusting tax and benefit parameters. Population aging has shifted the balance between inflows and outflows, with Baby Boomers currently on track to receive more benefits than they put into the system, on average, and thus redistribute resources away from future generations. A declining worker-to-beneficiary ratio will require some beneficiaries to be taxed more or receive less, on average, across and within generations. But policymakers should heed that Social

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11 One exciting ongoing development in this area is a concerted effort within public economics to standardize how we measure the costs and benefits of government programs. See www.policyimpacts.org/.

Security also confers an important insurance value that is unavailable without government intervention.

Other examples of positive net benefits from government intervention abound, and distributional analysis helps to quantify those benefits. Investment in early childhood education changes the lifetime income trajectory for program participants, and the overall benefits, which spring largely from increased lifetime incomes, exceed the program's costs. Distributional analysis shows that those higher lifetime earnings can also lead to higher tax revenues (depending on the tax system), which both pay for the program and match costs and benefits for the program participants over their lifetimes. Similar examples are found in government health programs, where lower-cost early intervention helps avoid more costly care down the road.

4.c. From "What We Can Afford" to Matching Costs and Benefits

Many politicians argue that the government can't afford to expand or even to continue some types of age-related social programs, and that further increasing government debt risks doing irreparable harm to long-term economic growth, diminishing our ability to afford even basic government programs in the future.

The redistributive approach provides an alternative to the macroeconomic affordability criteria. The criteria for whether a program is sustainable is whether that program improves welfare by correcting a market failure (such as by providing insurance value in the case of Social Security or health programs) or has a high return on investment (such as in technology or infrastructure investments). In both cases there are analogs back to the most basic building blocks of economic theory: households and businesses routinely make decisions about borrowing and investing, and the criteria they use—analyzing costs and benefits--are similar to those proposed here for evaluating government programs.

Household and businesses make decisions based on whether an option's benefits are expected to exceed its costs. When making such private decisions, individual actors rightly focus on their own costs and benefits, calculated over the entire period during which the decision will continue to bear consequences. These are present-value calculations that are comparable to the money's worth measures CBO produces for Social Security, and likewise comparable as this paper argues to the calculations that should be produced for government programs more generally. But even when an existing or proposed government program produces a positive net benefit as viewed through the lens of traditional public economics, an important follow-up question is whether the costs and benefits are matched across and within generations. Failure to match costs and benefits threatens political support for

desirable government interventions; leery of paying for programs from which they expect little or no value, voters are unlikely to support such programs.

Will our aging population push us over a fiscal cliff? The macroeconomic perspective tells us little. Analysts can project the extent to which spending on aging-related programs like Social Security and Medicare will contribute to overall increased government spending. But the same analysts can also measure those programs' lifetime costs and benefits and address the question of fiscal winners and losers across and within generations under any proposed set of policy parameters. By measuring redistribution, we can focus on more than merely the overall debt picture and begin to think about who is responsible for that debt, and how that debt should be repaid.

Avoiding exploding deficits and debt will almost certainly involve some changes to aging-related programs, but the size and nature of those changes will depend on our budget policies more broadly. Continuing to shrink the income tax base by eliminating taxes on capital income calls into question more than just fiscal fairness; it also increases the pressure to resolve expected budget shortfalls through changes to programs like Social Security and Medicare. If we ignore fiscal winners and losers in other parts of the budget, we risk undoing or foregoing otherwise desirable government policies.

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CHALLENGES CONFRONTING US WORKERS AND FIRMS

Local Labor Market Impacts of the Energy Transition: Prospects and Policies
Gordon Hanson

Lessons from COVID-19 Aid to State and Local Governments for the Design of Federal Automatic Stabilizers
Jeffrey Clemens and Stan Veuger

Local Labor Market Impacts of the Energy Transition: Prospects and Policies

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ABSTRACT

Society's transition toward more sustainable energy sources is well underway. But substantially reducing the use of fossil fuels to generate electricity, to power vehicles, and to manufacture the stuff of everyday life will profoundly disrupt the communities that currently dedicate themselves to carbon-intensive industries. In this paper, I consider the potential for adverse labor market consequences from the energy transition and the suitability of existing policies to counteract them. Top of mind in this discussion is to avoid repeating the painful adjustment to globalization and automation, which in recent decades brought concentrated job loss and long-lasting economic distress to local labor markets that had been specialized in manufacturing. I begin by mapping the spatial distribution of employment in fossil-fuel-intensive activities across US commuting zones from 2000 forward. Then, using the labor market consequences of the post-1980 decline of coal as a backdrop, I discuss policy options for easing adjustment to the energy transition, including letting market forces work, reinforcing the social safety net, and expanding place-based policies.

1. Introduction

Curtailing greenhouse gas emissions is likely to require far-reaching changes in countries' production and consumption patterns. Efforts are well underway to reduce reliance on fossil fuels in generating electricity, heating buildings, powering vehicles, and manufacturing the stuff of everyday life. Alongside the long-run costs and benefits of these adjustments are the immediate impacts of decarbonization on communities that continue to depend on fossil fuels for their livelihoods.[1] For these places, a rapid societal reduction in carbon intensity could prove profoundly disruptive.

> *"Top of mind in this discussion is how the recent decline of manufacturing employment has affected labor markets in the United States and other high-income economies. Manufacturing—like the oil, gas, and coal industries—pays relatively high wages to workers without college degrees."*

In this paper, I consider how the energy transition will affect regions that are specialized in fossil-fuel-intensive industries and explore options to mitigate its negative labor market consequences. Top of mind in this discussion is how the recent decline of manufacturing employment has affected labor markets in the United States and other high-income economies. Manufacturing—like the oil, gas, and coal industries—pays relatively high wages to workers without college degrees. Job loss in manufacturing over the last several decades has consequently hit traditional industrial regions especially hard (Charles et al., 2019). After import competition from China caused extensive closures of US factories, for instance, many displaced workers neither found new jobs in other sectors nor migrated elsewhere (Autor et al., 2013, 2014; Acemoglu et al., 2016). Local employment rates, earnings for less-educated workers, and average incomes all declined upon shock impact and stayed depressed for decades after (Autor et al., 2022). Affected communities saw fewer families form, more children raised in poverty, and higher mortality from drug and alcohol abuse (Autor et al., 2019; Pierce and Schott, 2020). Because the energy transition is still in its early stages, many options remain available to help exposed regions to avoid the hardship that has accompanied local labor market adjustment to automation and globalization (Autor et al., 2016; Acemoglu and Restrepo, 2020; Dorn and Levell, 2021). Without improving how local economies respond to job loss, we risk miring more communities in distress.

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1   For prior research on regional exposure to the energy transition in the United States, see Beckfield et al. (2020), Gallagher and Glasmeier (2020), Raimi (2021), Greenspon (2022), and Krause (2022).

I begin by mapping the spatial distribution of employment in fossil-fuel-intensive activities across US regions from 2000 forward. Perhaps the most immediate impacts of the energy transition will be to displace workers who currently extract and refine coal, natural gas, and petroleum. Employment in these activities is concentrated regionally and among non-college-educated workers (Black et al., 2005; Jacobsen and Parker, 2016; Raimi, 2021). Many workers at legacy suppliers of electricity, such as the coal-fired power plants that are now being retired (Davis et al., 2021), are also likely to be affected. Also at risk are those employed in energy-intensive manufacturing industries—such as basic chemicals, nonmetallic minerals, paper, and primary metals—which are often located where access to electricity was cheapest at the historical moment when those industries developed (Kahn and Mansur, 2013; Glaeser et al., 2015). In response, energy-intensive industries may relocate to where green energy sources are available, which could displace workers in current manufacturing centers. Whatever the cause of job loss, successful adjustment to the energy transition requires that displaced workers find new positions. Candidate sectors include those tied to wind, solar, hydro, and other renewable energy sources (Curtis and Marinescu, 2022; Popp et al., 2022). But because much of the job growth in these sectors is likely to occur far from where today's fossil fuel industries are located, the shift to green technology may not absorb many workers displaced by the energy transition.

In the second part of the analysis, I turn to policy options for addressing the energy transition's adverse labor market consequences. One is simply to let market forces work. Basic economic logic suggests that if decarbonization causes unemployment to spike in some regions, local wages would fall, new or existing firms would expand their operations, and these new investments would help to absorb displaced workers. In practice, however, we rarely see regional unemployment gaps close via capital chasing labor (Blanchard and Katz, 1992). As an alternative, geographically mobile workers could equilibrate labor markets across space, but recent evidence has overturned confidence that distressed regional labor markets are able to recover quickly via labor chasing capital. We now appreciate that the local net supply of non-college-educated workers responds only modestly to negative labor demand shocks (Bound and Holzer, 2000; Autor et al., 2013; Diamond, 2016; Notowidigdo, 2020). In labor markets beset by large downturns, joblessness can therefore become entrenched (Austin et al., 2016). Without outside action of some kind, the energy

transition could depress employment rates and living standards in exposed communities for an extended period of time (Bartik, 2020).[2]

A second approach to labor market adjustment to the energy transition is to *target exposed individuals*, such as those who have lost their jobs, low-wage workers whose earnings have dropped, and households that have fallen into poverty. The existing US social safety net is built around such assistance. In theory, the safety net should help low-income households to smooth consumption over time and to make productive investments in job search and training, while also redistributing resources to those for whom extra income would bring a relatively large improvement in well-being. Unemployment insurance (UI) provides benefits to laid-off workers for up to six months after the loss of their jobs. Payments are calculated as a percentage of the recipient's most recent wage, up to a cap. Following spikes in unemployment, such as during the Great Recession and the COVID-19 pandemic, Congress often temporarily expands the duration and generosity of UI benefits.[3]

Among the employed, low-wage workers are eligible for the Earned Income Tax Credit, which supplements earnings by a percentage that declines to zero as wages rise; these percentages are set much higher for workers who have dependent children at home (Hoynes, 2019). And low-income households may be eligible for benefits from means-tested entitlement programs, including Medicaid, the Supplemental Nutrition Assistance Program (food stamps), Temporary Assistance to Needy Families, and energy or housing assistance, regardless the employment status of those in the household. Because the generosity of these programs varies widely across US states, as well as among families and over the national business cycle, job or earnings losses caused by the energy transition may trigger transfer payments that end up being highly conditional on location, time, and household structure.

To see how the safety net might address job loss from the energy transition, consider the consequences of the post-1980 decline of coal. During the past 40 years, coal mining has had two major contractions. The first occurred in the 1980s, when oil prices

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2   Declines in nominal earnings do not necessarily imply a decline in real earnings. Glaeser and Gyourko (2005) and Notowidigdo (2020) suggest that the durability of housing causes housing prices to adjust asymmetrically, falling more sharply in response to a negative shock than they rise in response to a positive shock. Housing price adjustments can thus help incomes equilibrate across locations, even with limited labor mobility. Moretti (2013) and Diamond and Moretti (2021) find that real wage differences across US metropolitan areas are smaller than nominal wage differences. An alternative (and readily available) indicator of real labor earnings is the employment rate. As the return to working declines, so too does the willingness to work. Abraham and Kearney (2020) suggest that falling wage rates for less-educated US men was a major force behind the decline in their employment rates in recent decades. Because differences in employment rates across US regions are large and growing (Austin et al., 2016; Charles et al., 2019), it stands to reason that differences in the return to working are widening across regions, too.

3   Although in theory unemployment insurance may cause unemployment rates to rise artificially, evidence suggests that in practice such impacts are small (Chodorow-Reich et al., 2019; Boone et al., 2021).

fell from their 1970s highs and caused a major reduction in coal demand (Black et al., 2005); the second came in the 2010s, as natural gas and renewable energy increasingly supplanted coal in generating electricity (Fell and Kaffine, 2018). Following the first shock, employment and earnings fell precipitously in coal counties, which then saw sharp increases in uptake of government transfers across a wide set of programs (Jacobsen and Parker, 2016; Black et al., 2002; Black et al., 2003). At the time, some

> *"Regions exposed to the four-decade coal bust have seen long-run reductions in earnings and employment rates, temporary increases in government income assistance, ballooning Medicare and Medicaid usage, and delayed but substantial net decreases in population, especially among younger workers. The picture that emerges is one of collapsing local labor markets in which gradual net outmigration ultimately leaves behind a population that is disproportionately old, sick, and poor."*

analysts worried that monetary support for coal communities was insufficient, while others raised concerns that government assistance would create a culture of welfare dependence. To evaluate these possibilities, I examine the regional impacts of the decline of coal over the period spanning 1980 to 2019. Regions exposed to the four-decade coal bust have seen long-run reductions in earnings and employment rates, temporary increases in government income assistance, ballooning Medicare and Medicaid usage, and delayed but substantial net decreases in population, especially among younger workers. The picture that emerges is one of collapsing local labor markets in which gradual net outmigration ultimately leaves behind a population that is disproportionately old, sick, and poor. I discuss options for modifying the social safety net to help communities affected by the coming energy transition avoid the hardship that has afflicted coal country.

An alternative to addressing job loss by targeting individuals is to *target exposed regions* through placed-based policies, which condition assistance on the state of the local economy.[4] These policies include tax incentives to recruit or to retain companies, subsidies for worker training, subsidized lending for real estate development, and technical assistance to local business (Bartik, 2020). Because the energy transition is likely to reduce the export capabilities of regions currently specialized in fossil fuels, the role of place-based policies would be to help communities to develop a new export base and to replace the well-paying jobs that

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4   These policies include broader efforts to help entire distressed towns and cities and narrower efforts to help distressed neighborhoods within larger metropolitan areas. Because the energy transition represents a shock to the comparative advantage of regions as a whole, I focus on the former over the latter set of initiatives. See Neumark and Simpson (2015) for a complete discussion of place-based policies.

have been lost.[5] Such efforts, though clearly ambitious, are justified if they reduce distortions caused by localized spillovers, which if left unaddressed may cause the most skilled workers and innovative firms to further concentrate in superstar cities (Kline and Moretti, 2014b; Fajgelbaum and Gaubert, 2020; Bilal, 2021) and contribute to destructive cycles of industry deagglomeration in distressed regions (Dix-Carneiro and Kovak, 2017). Place-based policies may also be justified if they achieve large gains in equity at small costs to efficiency, such as by transferring resources to communities in which needy households are clustered (Gaubert et al., 2021).

Economists tend to be skeptical of place-based policies (e.g., Glaeser and Gottlieb, 2008; Duranton and Venables, 2018), in part because of their many drawbacks. They may intensify zero-sum tax competition among regions to attract firms (Kim, 2021), be manipulated by elected officials for political gain (Jensen et al., 2015; Slattery, 2020; Slattery and Zidar, 2020), or have their benefits captured by landowners (Ehrlich and Seidel, 2018). These concerns notwithstanding, place-based policies often have long-lived effects on regional specialization (Kline and Moretti, 2014a; Freedman, 2017; Garin and Rothbaum, 2020; Bianchi and Giorcelli, 2022), which suggests that they have the potential to catalyze local investments in human and physical capital.

I discuss options for tailoring place-based policies to address the energy transition. Examples from past policy successes and failures reveal several challenges to applying them successfully. First, most resources are absorbed by tax incentives offered to recruit large companies from outside the targeted region (Bartik, 2020). These incentives appear to have small effects on overall regional economic activity and may divert resources from more effective policy alternatives (Slattery and Zidar, 2020; Bartik, 2022). Second, policy implementation tends to be badly fragmented across state and federal government agencies, which often fail to coordinate their efforts and instead frequently design incentive structures that cause them to work at cross purposes. Third, although worker training is intended to supply workers with skills that potential employers would find attractive, employers are often only weakly involved in these training programs. I close by considering strategies to address these challenges.

2. Regional Employment in Fossil-Fuel-Intensive Industries

The energy transition's potential to disrupt local labor markets draws from the spatial agglomeration of fossil-fuel-intensive industries. Agglomeration arises in part from the concentration of energy reserves in relatively few places, and their absence in

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5   In this context, exporting means selling goods and services to buyers outside of a local labor market, be they elsewhere in the same state, elsewhere in the same country, or in foreign countries.

most others (Moreno-Cruz and Taylor, 2017). These places often specialize in a narrow set of activities and are thus highly exposed to industry-specific shocks. Upstream energy supplies also attract downstream industries that refine and distribute fossil fuels, build equipment for extraction and refining, generate electricity from fossil fuels, or make intensive use of this electricity. By changing how society generates electricity, the energy transition may dent the export capabilities of the regions that specialize in the upstream extraction and refining of fossil fuels, while also dampening downstream consumption.

Forecasters do not know how many fossil fuel jobs will be lost or over what time horizon. But to avoid major contractions, places specialized in extraction and refining may have to find a new export base; places specialized in using fossil fuels in production, either directly as inputs or indirectly via electricity, may have to find new energy sources and methods of production. These challenges are likely to be most acute in the smaller regional labor markets in which industry specialization is greatest. In this section, I review where in the United States employment in fossil-fuel-intensive industries is located and which regions may therefore be most exposed to the adverse effects of the energy transition.

2.a. Fossil-Fuel-Intensive Industries

To characterize regional exposure to decarbonization, I trace the spatial distribution of employment along the energy supply chain. For ease of exposition, I focus on the narrower set of industries that make direct and substantial use of fossil fuels, and not the larger set of industries that use fossil fuels in modest quantities or that indirectly consume inputs that are intensive in fossil fuels. Although this approach may paint an incomplete picture of regional dependence on fossil-fuel-related activities, it is likely to identify the places that would be subject to the first-order impacts of reducing carbon intensity. For national employment totals in energy-related jobs, I use data from the U.S. Energy Employment Jobs Report for 2022.[6] For employment by region, I aggregate local employment by major energy sector up to US commuting zones using data from Ipums.org based on the 2000 US Decennial Census and the 2019 American Communities Survey.[7]

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6   See Keyser et al. (2022).

7   For 2019, I combine ACS annual surveys from 2017, 2018, and 2019, which expands sample sizes in small localities. County-level employment is available for more recent years from the Quarterly Census on Employment and Wages. However, the suppression of data for small cells in this source leaves many counties with missing data in key industries.

2.a.1. *Fossil Fuel Extraction and Refining*

At the beginning of the energy supply chain is fossil fuel extraction and refining, which in 2021 employed 729,000 workers (Figure 1A). Extraction is the largest source of jobs in the sector, accounting for 45 percent of the 2021 total. Most extraction jobs (89 percent) are in gas and oil, as opposed to mining coal, which in previous decades was subject to widespread job loss. Relative to other jobs tied to fossil fuels, employment in extraction is volatile, fluctuating elastically in response to energy prices. The refining of renewable fuels (corn ethanol, woody biomass, and other biofuels) is a small industry by comparison to that for nonrenewables (Figure 1B). In 2021, renewable fuels employed 108,000 workers. Most jobs in the sector are primarily agricultural (for instance, growing corn or tending other biomass). Among prime-age workers (ages 25 to 54) employed in fossil fuel extraction and refining, 69 percent did not have a bachelor's degree in 2019, as compared to 60 percent of all prime-age workers.

Figure 1. Employment in Energy Extraction, Refining, and Electricity Generation, 2021
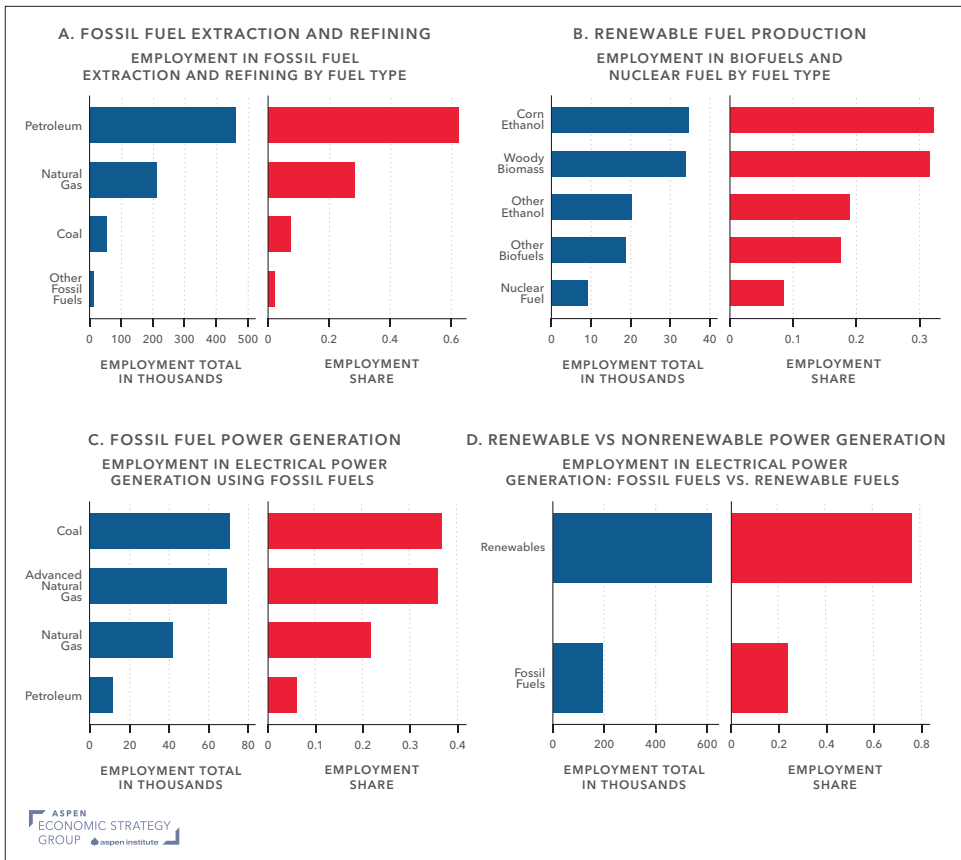
Note: Calculations are based on data from the U.S. Energy Employment Jobs Report for 2022.

Figure 2 shows the share of employment of prime-age workers in fossil fuel extraction and refining across commuting zones in the continental United States for 2000 and 2019.[8] Specialization in extraction and refining is concentrated in four regions: Appalachia, East Texas-Louisiana, West Texas-Eastern New Mexico-Oklahoma Panhandle, and the Mountain West-northwestern Plains.[9] Excepting Houston and Salt Lake City, few extraction and refining commuting zones overlap with major metropolitan areas. Many are remote from major population centers. Although some production centers, such as the Permian Basin in Texas and the North Dakota oil fields, developed only recently during the fracking boom of the 2000s and 2010s (Bartik et al., 2019), others including Appalachia, East Texas-Louisiana, and western Kentucky have long specialized in fossil fuels. Because of this history, adjusting to worker displacement in these locations may be painful. In 2019, Perkins County, North Dakota, with 7.3 percent of its prime-age employment devoted to extraction and refining, was the commuting zone at the 95th percentile of specialization in the sector. The commuting zones with the highest shares of employment in fossil fuel extraction and refining in that year were Odessa, Texas (20.1 percent); Hobbs, New Mexico (17.4 percent); and Brewster County, Texas (16.5 percent).

2.a.2. Electric Power Generation

In 2021, electric power generation using fossil fuels employed 194,000 workers (Figure 1C). Newer power plants, which use advanced technologies to burn natural gas cleanly, comprised 36 percent of industry employment, while older power plants, which use legacy technologies to burn coal, gas, and oil, accounted for the remaining 64 percent. This latter group of 125,000 workers are those who are most likely to be exposed to job loss during the energy transition. In 2019, 61 percent of prime-age workers in electric power generation and distribution had a bachelor's degree.

Figure 3 shows regional shares of prime-age employment in power generation and distribution for all energy sources, including renewables.[10] In the large majority of commuting zones, employment shares in power generation and distribution are small. In 2019, less than 5 percent of commuting zones had employment shares in the sector of greater than 2.5 percent. Notable in the figure is the decline in employment shares over time—most commuting zones are seeing a net shift in jobs

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8   In Figure 2, which is based on Census/ACS data, extraction and refining includes oil and gas extraction (NAICS 211), coal mining (NAICS 2121), and petroleum and coal products (NAICS 3241). This definition of extraction and refining is somewhat narrower than in Figure 1, which is based on data from the US Department of Energy.

9   Smaller clusters include the inland empire of Los Angeles, southern Illinois-western Kentucky, and (sparsely populated) northern Nevada.

10   Because Census/ACS data on employment in power generation combine renewable and nonrenewable energy, they differ from the USEER data reported in Figure 1, which exclude power distribution, separate employment according to the energy source used, and add in estimates of construction-related employment that supports the sector.

Figure 2. Employment in Fossil Fuel Extraction and Refining, 2000 and 2019
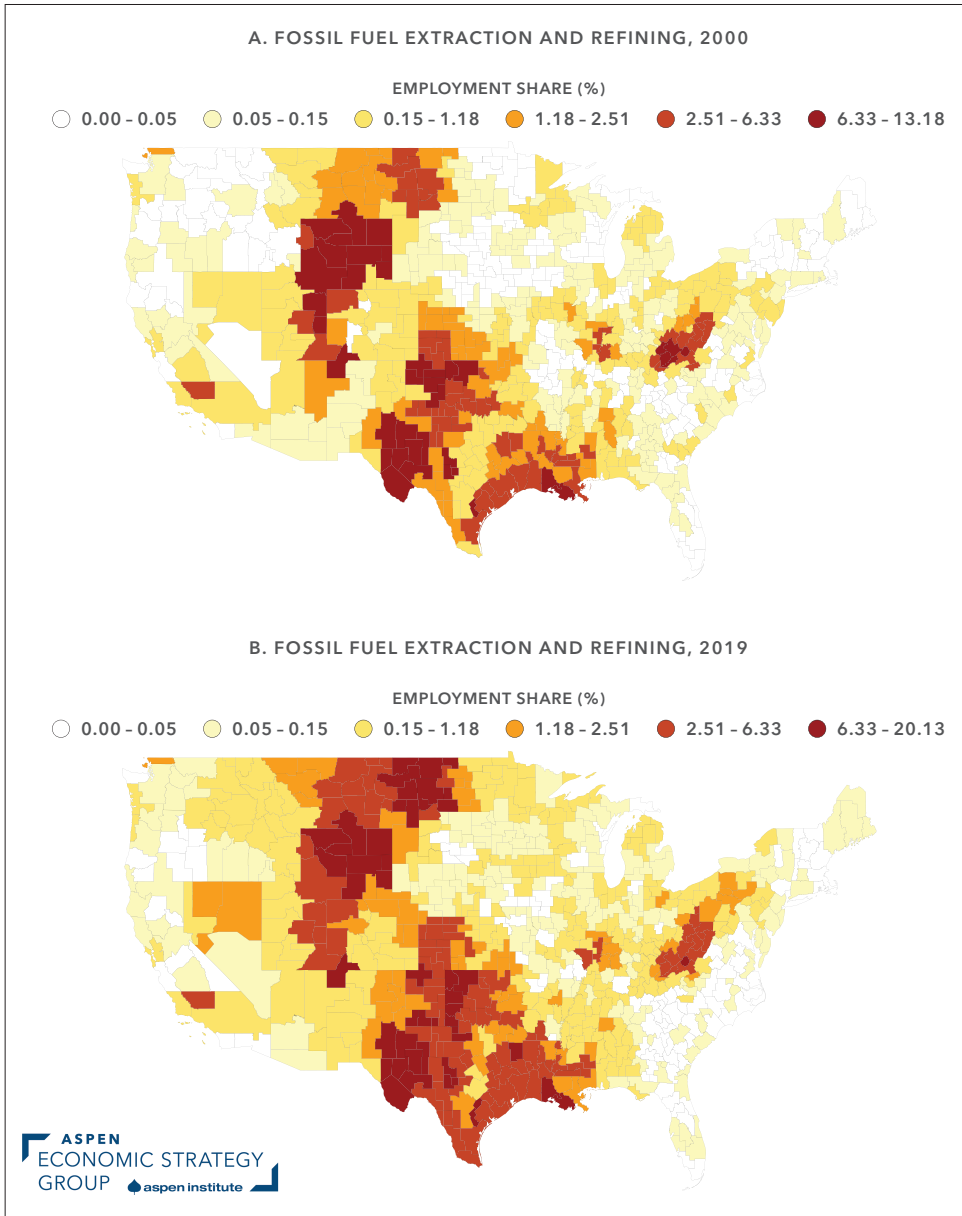
A. FOSSIL FUEL EXTRACTION AND REFINING, 2000

EMPLOYMENT SHARE (%)

○ 0.00 – 0.05   ○ 0.05 – 0.15   ○ 0.15 – 1.18   ● 1.18 – 2.51   ● 2.51 – 6.33   ● 6.33 – 13.18

B. FOSSIL FUEL EXTRACTION AND REFINING, 2019

EMPLOYMENT SHARE (%)

○ 0.00 – 0.05   ○ 0.05 – 0.15   ○ 0.15 – 1.18   ● 1.18 – 2.51   ● 2.51 – 6.33   ● 6.33 – 20.13

Note: The figures show share of employment of prime-age workers (ages 25-54) by commuting zone in fossil fuel extraction and refining using the 2000 Census (5 percent sample) and 2017-2019 ACS (combined 1 percent samples) from Ipums.org. The INDNAICS industries are: oil and gas extraction (211), coal mining (2121), support industries for mining (213), petroleum refining (32411), and petroleum and coal products (3241M). Support services for mining include a small amount of employment in activities unrelated to fossil fuels. The six categories in the legend are for shares in the bottom three quartiles, the 75th-84th percentiles, the 85th-94th percentiles, and the 95th–99th percentiles. See Figure A2A for the change in employment shares over 2000 to 2019.

away from power generation and distribution. This shift appears clearly in Appendix Figure A2B, which shows the change in the share of prime-age employment in power generation and distribution between 2000 and 2019. The retirement of coal-fired power plants may be contributing to these losses (Davis et al., 2021). Meanwhile, the comparatively few commuting zones with employment gains appear to be in areas in which power generation using renewable energy is most prevalent (Raimi, 2021).

Employment in power generation using renewable energy was a sizable 595,000 workers in 2021, as shown in Figure 1. But the sector may have limited potential to absorb workers released from fossil-fuel-intensive industries, for two reasons. First, construction jobs account for 43 percent of this employment figure (and may not be included in the totals shown in Figure 3, which do not count employment that is indirectly linked to power generation). These jobs are likely to remain abundant while renewable power generating capacity is rapidly expanding, but may later decline as the sector matures. Second, power generation in solar, wind, and hydro—the three main sources of renewable energy—is primarily located in places that are sunny, have consistently high winds, or have hydrodynamic potential, many of which are far from where fossil-fuel-based power generation occurs today.

2.a.3. Energy-Intensive Manufacturing

Manufacturing industries vary widely in their consumption of electricity and fuels. In 2018, energy costs per dollar of shipments in the most energy-intensive sectors—basic chemicals, iron and steel, nonmetallic minerals, and paper—were seven to 28 times higher than those in the least energy-intensive sectors, including beverages, computers and electronics, furniture, and motor vehicle parts.[11] Historically, manufacturing plants in highly energy-intensive industries saved on energy expenses by locating near power-generating facilities, many of which in turn were proximate to coal or other fossil fuel reserves (Kahn and Mansur, 2013; Glaeser et al., 2015). If power generation continues to shift from fossil fuels to renewables, energy-intensive industries may face cost pressures to relocate closer to these new fuel sources. Such pressures are likely to be felt more strongly by firms that produce tradable goods such as manufactures, which can be produced in many locations, than by firms in nontradable services, whose location is limited by where their customers live.

To gauge the potential for such disruption, I examine where employment in highly energy-intensive industries is located. For three-digit NAICS industries within

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11 These figures are based on averages for the 2014-2018 period using data on three-digit NAICS industries from the NBER-CES Manufacturing Industry Database.

**Figure 3. Employment in Electric Power Generation and
Natural Gas Distribution, 2000 and 2019**
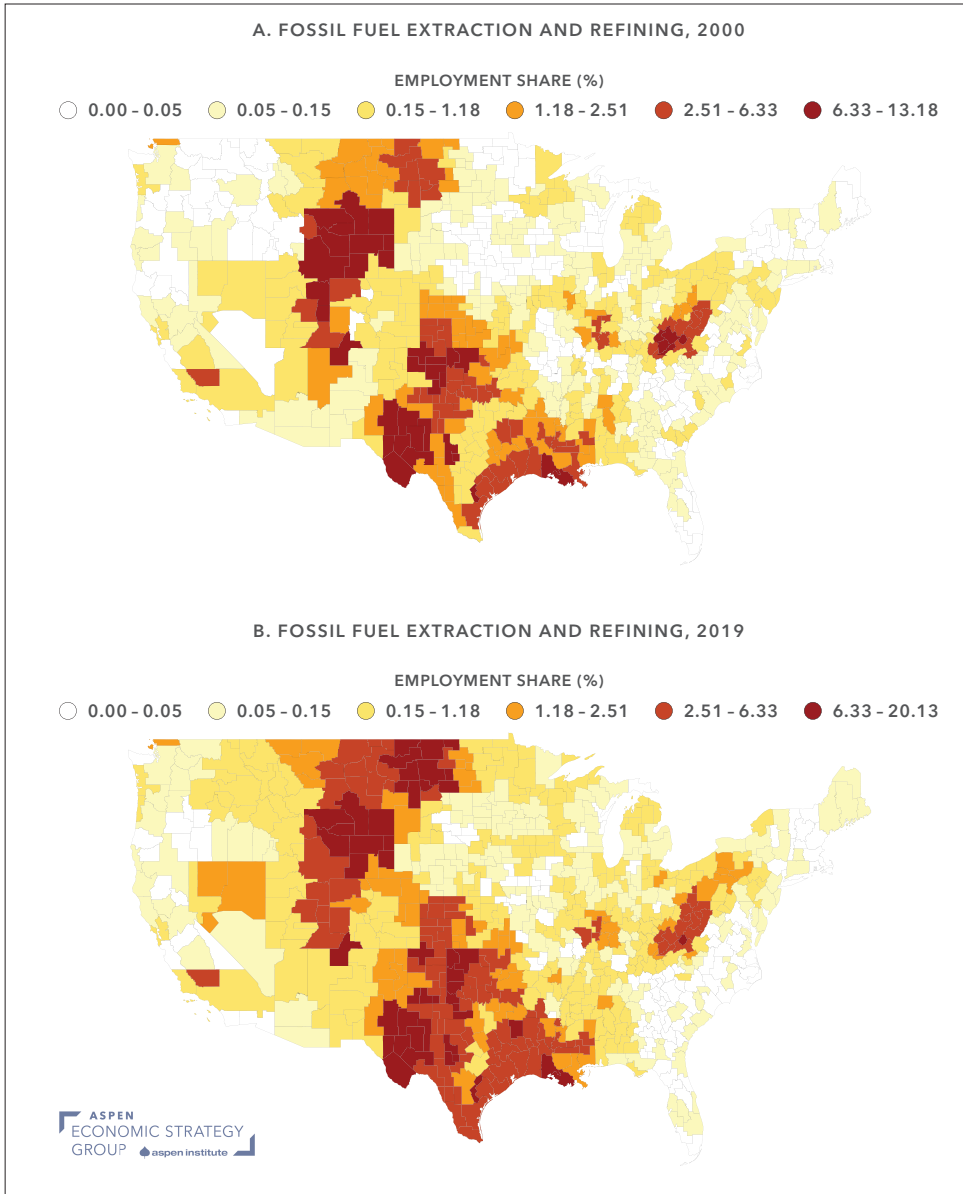
Note: The figures show share of employment of prime-age workers (ages 25-54) by commuting zone in electric power generation and natural gas distribution using the 2000 Census (5 percent sample) and 2017-2019 ACS (combined 1 percent samples) from Ipums.org. The INDNAICS industries are: electric power generation, transmission, and distribution (211P), natural gas distribution (2212P), and electric and gas and other combinations (221MP). The six categories in the legend are for shares in the bottom three quartiles, the 75th–84thpercentiles, the 85th–94thpercentiles, and the 95th–99thpercentiles. See Figure A2B for the change in employment shares over 2000 to 2019.

manufacturing, I define as energy-intensive those above the 90th percentile based on average energy used per dollar of shipments for the 2014-2018 period using the NBER-CES Manufacturing Industry Database, which is motivated by the approach in Kahn and Mansur (2013).[12] The electricity and fuel use of these industries were 3.5 to 10.2 times that of the (shipments-weighted) median manufacturing industry over the time period. In decreasing order, the most energy-intensive industries are lime and gypsum, pulp and paper, glass products, industrial chemicals, iron and steel mills, aluminum, clay products, fiber and thread mills, and cement and concrete. In 2018, these nine industries employed a total 731,000 workers, of which 74 percent did not have a bachelor's degree.

Figure 4 shows regional shares of prime-age employment in energy-intensive manufacturing. As of 2019, Mobile, Alabama was the commuting zone at the 95th percentile of specialization in the sector, with 3.1 percent of its prime-age workers employed in energy-intensive production. The commuting zones with the highest employment shares in the sector were Escambia County, Alabama (7.9 percent); Sugar Land, Texas (6.1 percent); and Ashley County, Arkansas (6.1 percent). Declines in employment shares across many commuting zones are readily apparent in the Figure, and are further highlighted in Appendix Figure A2C. The commuting zones where energy-intensive manufacturing employment declined to the greatest extent from 2000 to 2019 were Steubenville, Ohio (-10.1 percentage points); Wheeling, West Virginia (-9.7 percentage points); and Gary, Indiana (-4.8 percentage points). But the data alone leaves unclear whether these employment losses were due to local changes in energy infrastructure or other industry shocks.

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12   This definition of energy intensity is based on the direct consumption of energy and not the indirect consumption via the purchase of inputs that are themselves energy-intensive.

Figure 4. Employment in Energy Intensive Manufacturing, 2000 and 2019
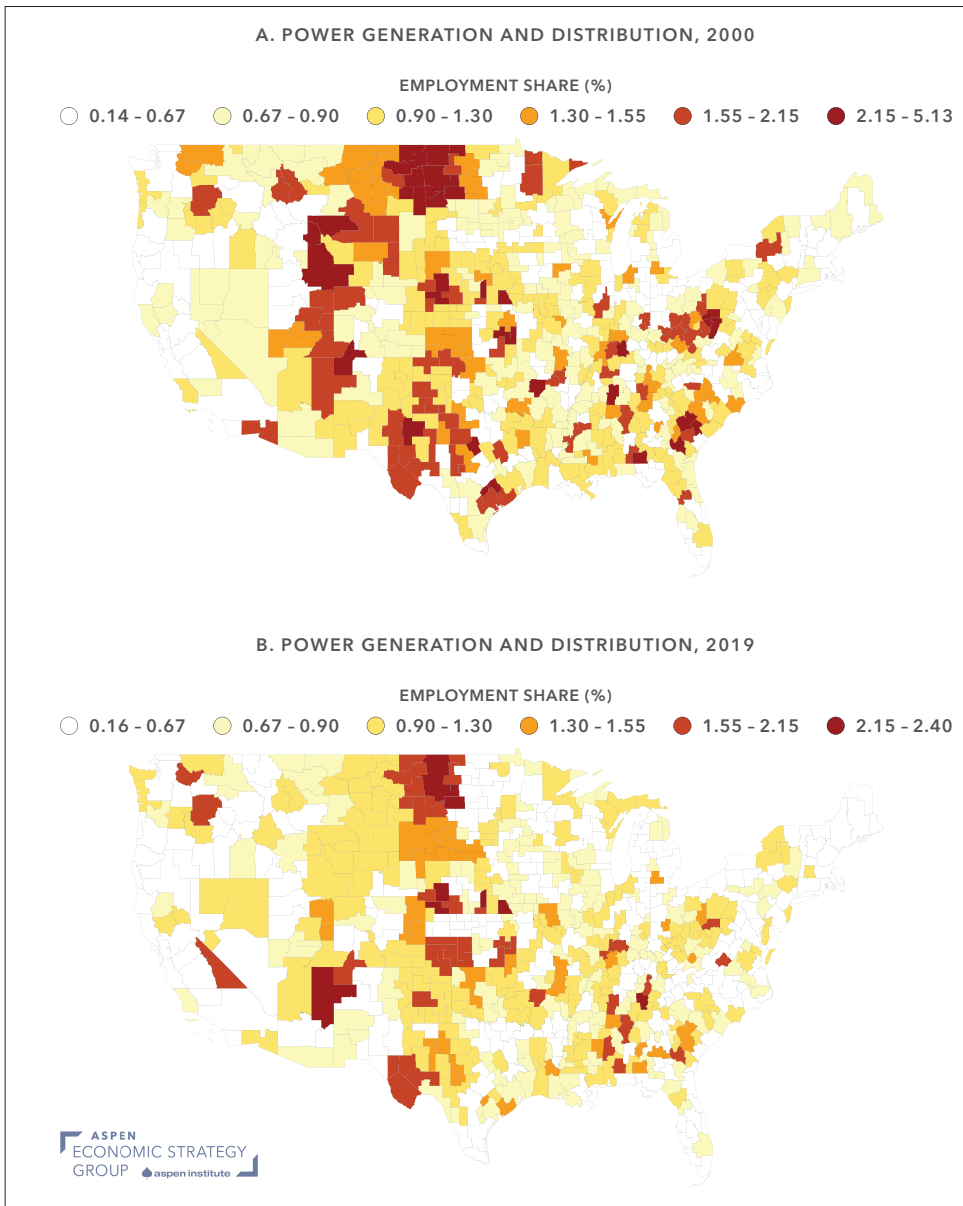
Note: The figures show share of employment of prime-age workers (ages 25-54) by commuting zone in energy intensive manufacturing using the 2000 Census (5 percent sample) and 2017-2019 ACS (combined 1 percent samples) from Ipums.org. The INDNAICS industries are: fiber, yard, and thread mills (3131); pulp, paper, and paperboard (3221); industrial chemicals (325M); clay products (3271); glass products (3272); cement and concrete (3273); lime and gypsum (3274); iron and steel mills (3311); and aluminum (3313). The six categories in the legend are for shares in the bottom three quartiles, the 75th–84th percentiles, the 85th–94th percentiles, and the 95th–99th percentiles.

2.a.4. Other Sectors

Other significant sectors related to the fossil fuel industry include retail gas and motor vehicle manufacturing. Retail gas stations employed 938,000 workers in 2021. Because they provide a nontradable service, gas stations tend to be distributed across the country in proportion to the size of local populations. Replacing traditional cars and trucks powered by internal combustion engines with electric vehicles would reallocate employment from gas stations to vehicle charging stations. Although this shift may require a nationwide response from a large population of workers, it is unlikely to be much more disruptive in some regions than in others. As manufacturers expand production of electric vehicles, they will reduce the demand for labor producing traditional power trains and increase the demand for labor producing batteries and related parts. In 2021, 54,000 workers produced motor vehicle gasoline engine and parts (NAICS 33631), out of total employment in motor vehicle parts of 539,000 (NAICS 3363); an additional 73,000 workers produced motor vehicle power train components (NAICS 33635). Over three-quarters of employees in these jobs are production workers, and there is little way to predict how the move to electric vehicles will affect where these jobs are located or how many employees will remain necessary.

2.b. Prospects for the Energy Transition

Reducing the carbon intensity of US power generation and manufacturing output would have sweeping effects on the jobs that workers perform and where they perform them. Dealing with job loss is a familiar challenge for regions engaged with fossil fuels. The volatility of energy prices has subjected these regions to repeated cycles of boom and bust.[13] In the past, local economies have expanded when energy prices have risen and stayed high, with employment and wage rates rising in concert; to the contrary, local economies have contracted when energy prices have fallen and stayed depressed, with many workers losing their jobs. But the energy transition is not likely to subject these economies to short-lived fluctuations; rather, it will herald a permanent reduction in the demand for fossil fuels. Regions that have weathered past booms and busts would now face the stiffer challenge of helping many local residents to find entirely new careers and perhaps to move elsewhere.

A substantial body of research demonstrates that job loss is scarring (Topel, 1990; Ruhm, 1991). Six years after their displacement, workers who were laid off because their employer either shut down or dramatically downsized earn 13 to 25 percent below their pre-displacement salaries, relative to otherwise similar workers who were

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13   On regional booms and busts in energy production, see Michaels (2011), Jacobsen and Parker (2016), Allcott and Keniston (2017), Feyrer et al. (2017), Bartik et al. (2019), Clay and Portnykh (2018) and Kearney and Wilson (2018).

not let go (Jacobson et al., 1993; Couch and Placzek, 2010). These losses are more severe when they recur during a recession (Davis and von Wachter, 2011; Huckfeldt, 2022).

But worker displacement that is more concentrated in place and time entails even greater repercussions. Import competition from China, for instance, produced greater job losses in commuting zones that were initially more specialized in their core manufacturing industries (Autor et al., 2022). And regions that undergo more severe recessions see larger drops in employment rates not just initially but in the medium and longer run (Yagan, 2019).

Appendix Figure A3 shows regional employment shares of prime-age workers in fossil-fuel-intensive industries when combining fossil fuel extraction and refining, natural gas distribution, and energy-intensive manufacturing. In 2019, the top 5 percent most specialized commuting zones in these sectors had between 8.9 percent (Bismark, South Dakota) and 21.1 percent (Odessa, Texas) of their prime-age workers employed in industries closely tied to fossil fuels. None of these exposed communities is a major metropolitan area. The largest commuting zone in this group—Lafayette, Louisiana—had a 2019 population of 409,000 inhabitants. Others are smaller towns spread across eastern New Mexico, North Dakota, eastern Oklahoma, East and West Texas, West Virginia, and Wyoming. If the energy transition were to cause a rapid decline in these communities' core export industries, the local consequences could be devastating.

3. Dealing with Job Loss

In this section, I discuss policy options for addressing the consequences of job loss. The familiar approach in federal US policy is to provide targeted income assistance and training to individuals that depends on their employment and disability status, income, and family structure. Social assistance programs (partially) insure individuals against the consequences of being laid off or suffering a large drop in earnings while remaining employed. Such programs may help people to manage the immediate consequences of displacement and provide the financial cushion they need to search for a new position or to retrain for a new line of work. A perhaps less familiar approach targets places by tuning assistance to local economic conditions. These "place-based" policies are enacted through overlapping efforts by federal, state, and local governments; they are meant to encourage firms to invest in promising ventures and workers to invest in skills that employers find desirable—which local economic conditions may otherwise prevent them from doing—thereby helping a region out of depressed earnings and employment rates. I discuss policy frameworks for achieving these objectives and the drawbacks that may limit their effectiveness. To connect the policy discussion directly to the energy transition, I consider how local labor markets have adjusted to employment declines in coal mining since 1980.

3.a. Targeting Individuals: The Social Safety Net

The social safety net exists to help people adjust to negative shocks to their employment status, income, and health. Because adverse selection and moral hazard impede private markets from supplying adequate wage insurance, such insurance tends to be provided by the government. The demand on social insurance most likely to be occasioned by the transition to renewable energy is helping individuals to manage the consequences of permanent job loss. In the shorter run, the jobless need to replace lost income; in the longer run, they need to find a new line of work at a desirable wage. I discuss the adequacy of the US social safety net to meet these challenges in the context of the energy transition.

3.a.1. Programs

The programs that comprise the safety net include social insurance programs, which people pay into, partially covering the programs' costs, and transfer programs, which are financed out of general tax revenues.

Unemployment Insurance. The front-line policy to address job loss is unemployment insurance. Those who lose their jobs through no fault of their own and who meet work history and minimum earnings requirements are eligible to receive 26 weeks of UI benefits. Benefits are typically set at somewhere below half of the recipient's pre-displacement wage, up to a cap, but vary substantially by state. In January 2020, just prior to the COVID-19 pandemic, maximum weekly benefits ranged from a low of $235 in Mississippi to a high of $823 in Massachusetts. Receipt of UI benefits can affect eligibility for other social assistance programs.

Public Assistance Programs. These programs tend to be oriented more toward alleviating poverty than toward returning previously gainfully employed people to work. Medicaid provides access to subsidized healthcare for those with low incomes. The Supplemental Nutrition Action Program (SNAP) provides a debit card for food purchases to households that have incomes less than 130 percent of the federal poverty line and that meet other eligibility requirements.[14] For those who qualify, there is no time limit for benefit receipt. Temporary Assistance for Needy Families (TANF) provides direct cash assistance to low-income families with children. Benefits are calculated as a decreasing function of income and are modest, maxing out at 27 percent of the federal poverty line; most states impose a five-year limit on benefit receipt over a recipient's lifetime. Supplemental Security Income (SSI) is available to adults who are over age 65, blind, or disabled, and are in lower income brackets. In 2021, monthly benefits were limited to $841 for a qualifying

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14   In 2021, the federal poverty line was $12,880 for a one-person household and $26,500 for a four-person household.

adult and $1,261 for a qualifying couple. Other income assistance programs, which are small in the aggregate, include the Free and Reduced Price Lunch program, the Special Supplemental Nutrition Program for Women, Infants, and Children, energy assistance, and housing assistance (East and Simon, 2020).

Social Security Programs. The Social Security Administration provides retirement benefits to qualifying people of retirement age (age 62 or older), disability insurance benefits to those who are deemed to be permanently disabled, and payments to the surviving spouses and children of previously qualifying recipients. Prior research finds that uptake of Social Security Disability Insurance (SSDI) increases during economic downturns, and that those who take up SSDI during downturns tend to exit the labor force permanently and to remain benefit recipients until retirement or death (Autor and Duggan, 2003; Maestas et al., 2018; Kearney et al., 2021). Although not the program's original intent, SSDI appears to be used predominantly by people whose labor market prospects have deteriorated.

Earned Income Tax Credit. The Earned Income Tax Credit (EITC) transfers money to low-income households with positive earned income (Hoynes, 2019). The subsidy depends heavily on having dependent children in the household. In 2019, for a single head of household with no children, the income limit for benefit eligibility was $15,570 and the maximum benefit was $529; for a single head of household with two children, these values rose to $46,703 and $5,828. Most benefits are received by poor single mothers who work. Research indicates that the EITC reduces poverty and improves long-run outcomes for children in poor households, but given that it is conditioned on positive earnings, it is by design not a reliable source of income assistance for people who are out of work for a year or longer.

3.b. The Safety Net and Job Loss

How well do safety net programs perform in helping workers to deal with the consequences of job loss? East and Simon (2020) use longitudinal data from the Survey of Income and Program Participation over 1996 to 2018 to evaluate how social assistance helps workers who have been displaced.[15] Unemployment insurance is by far the most important program in helping the jobless to replace lost income, at least in the months immediately following displacement. UI payments are mildly regressive by design. In the months following displacement, workers with household incomes below the poverty line had 21 percent of their lost earnings replaced, while workers in households whose income was one to five times the poverty line saw 26 to 28 percent of their income replaced. And although participation in means-tested

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15   Their analysis does not include the contribution of the EITC to income replacement for displaced workers.

entitlement programs increases substantially in the aftermath of job loss—at least for workers in households with incomes less than 200 percent of the federal poverty line—these programs replace small amounts of income relative to UI payments. Whereas UI benefits provided an average of $560 in extra monthly income just after job loss, SNAP—the entitlement program most responsive to displacement—provided just an extra $10 in monthly income.

Despite its promise, unemployment insurance also features potential drawbacks in dealing with job loss. One is that its benefits may be too generous, encouraging workers to stay out of work for longer and potentially reducing economic efficiency and aggregate income (see, e.g., Barnichon and Zylberberg, 2021). But in practice, extra UI benefits do not appear to reduce aggregate employment. During the Great Recession, Congress increased the potential duration of UI receipt from 26 to as many as 99 weeks. States with higher unemployment rates were allowed to provide benefits for longer, and because many local labor markets straddle state boundaries, UI benefits often differed substantially between adjoining counties that shared a local labor market. Between 2009 and 2013, differences in UI benefit duration between these adjoining counties were commonly greater than five weeks and occasionally greater than 10 weeks. Comparing adjoining counties located in different states, Boone et al. (2021) find no evidence that counties offering more substantial UI benefits witnessed lower employment as a result. Other approaches find similar evidence of the limited macroeconomic consequences of increased UI benefits during the Great Recession (Chodorow-Reich et al., 2019). Governments that expand UI benefits during periods when local labor markets are in severe recession appear not to significantly risk adverse consequences.

A second potential pitfall of unemployment insurance as a response to job loss is that benefits may not be generous enough. At the exhaustion of UI benefits, individual spending drops sharply (Ganong and Noel, 2019), which is consistent with binding liquidity constraints. Such constraints may impede recipients from investing in training, job search, or moving to a new location, and these constraints may be more binding in local labor markets that are more depressed. There may therefore be cause to tune benefits to local economic conditions. The federal program implicitly recognizes the need for increased benefits in times of distress: since 1970, states have been allowed to provide 13 to 20 weeks of additional UI benefits if their unemployment rate exceeds a trigger. Yet these triggers are so stringent that they are rarely enacted, and even when they are enacted the extra benefits may be too small to improve long-run worker outcomes (Chodorow-Reich et al., 2022). A further problem is that when dealing with highly localized shocks, tuning benefits to state-level economic conditions may be too coarse to be effective. Figure A3 speaks to variation in economic conditions within states. Both employment shares

in fossil-fuel-intensive industries (panel B) and changes in these shares between 2000 and 2019 (panel C) vary widely within states, suggesting that using state-level unemployment triggers to tune UI benefits to local economic conditions may be insufficient for addressing job loss from the energy transition. A better trigger may be the unemployment rate in the local labor market.

In a 2021 paper written for the AESG, VonWachter (2021) argues that income support and workforce programs run through the UI program are underutilized by the most vulnerable workers who are most likely to benefit from them. He makes specific suggestions for improving the delivery of assistance through UI, including the use of targeting income support and workforce services to workers at risk of poverty or of adverse consequences from job loss and long-term unemployment, expanding Short-Time Compensation programs, instituting automatic triggers to benefit and eligibility expansions, and reforming the UI data infrastructure systems to improve real-time decision-making.

3.c. Local Labor Market Adjustment to the Decline of Coal

The repercussions of the coal industry's decline since 1980 may presage the coming energy transition's consequences on the labor market. Because coal production is so spatially agglomerated, the shock that resulted from its decline was highly localized. How measures including earnings, employment, and the uptake of government transfers responded to the coal bust provides a glimpse of how well past policies performed in addressing concentrated job losses. In this section, I extend the analysis on labor market adjustment to the 1980s coal bust in Autor et al. (2022) to cover the decline of coal over the entire time period between 1980 and 2019. Both analyses build on Black et al. (2005), who find that during the 1983-1993 coal bust, counties more specialized in coal in Kentucky, Ohio, Pennsylvania, and West Virginia incurred larger decreases in employment rates, total earnings, and earnings per worker, and larger increases in the uptake of government transfers.

Figure 5 plots US employment in coal mining from 1969 to 2021. It demonstrates a boom in coal production during the 1970s—employment in coal rose from 140,000 workers in 1969 to 234,000 workers in 1979—caused by surging energy prices during the decade's two major oil price shocks. After 1980, coal prices and then jobs began an extended decline. Employment fell to 136,000 workers in 1990 and to 72,000 workers in 2000. After a brief rebound in the 2000s, coal employment plummeted again in the ensuing decade, dropping to 51,000 workers in 2019, just before the COVID-19 pandemic. The industry then shed another 13,000 jobs during the first two years of the pandemic.

Figure 5. The Decline of Employment in Coal Mining
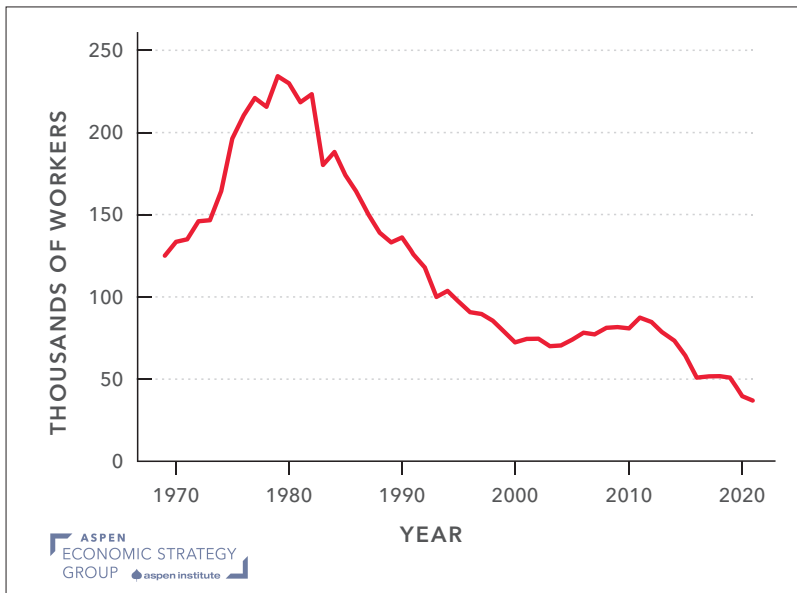
Note: Data are from the BEA National Industry Product Accounts.

To consider how the loss of coal jobs affected local labor markets specialized in coal, I rank commuting zones based on their exposure to the national decline in coal mining that took place between 1980 and 2019 and then compare the outcomes of zones at the median with those at the 95th percentile of exposure.[16] Because zones near the median had virtually no employment in coal to begin with, the comparison describes how the most highly exposed regions fared relative to regions that were not directly affected by coal's decline. Figure 6 shows the average differential changes (i.e., for commuting zones at the 95th versus 50th percentiles of exposure) in employment among working-age (18-64) adults (panel A), compensation per worker (panel B), and the size of the working-age population (panel C) over various time horizons (x-axis).

Employment, Earnings, and Net Migration. Relative to the median commuting zone, local labor markets that were most exposed to the coal shock had larger

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16 I undertake regression analysis in which I project changes in commuting zone outcomes over varying time horizons on a commuting zone's exposure to the national decline in coal mining that occurred from 1980 to 2019. The Appendix gives complete details. The graphs below show, for a given labor market outcome, regression-based estimates of how the nationwide decline in coal affected a commuting zone at the 95th percentile of exposure to the coal shock relative to a commuting zone at the median of exposure to the coal shock, for time horizons that extend from 1980, when the coal bust began, to one year later (i.e., 1981) out to 39 years later (i.e., 2019). In the analysis, I control for many other factors that could have affected local labor market outcomes over the time period, including access to college-educated workers, exposure to immigration, exposure to the decline of manufacturing (including the China trade shock), and other potential confounds. Because of the distorting effects of the COVID-19 pandemic, I conclude the analysis in 2019.

declines in employment rates, average compensation per worker, and the size of the working-age population. These results are highly statistically significant over most time horizons. The negative impact of the coal shock on employment rates persisted from the 1980s through the 2000s, and then attenuated in the 2010s, despite the intensification of the coal shock in that decade. Population declines (panel C) might possibly indicate why employment rates recovered. Commuting zones more exposed to the coal shock ultimately saw larger declines in head counts of the working-age population, which is consistent with positive net outmigration. Krause (2022) finds that younger and more-educated workers were those most likely to leave exposed Appalachian counties, and the results of this analysis support these conclusions.[17] Negative population impacts were much stronger for the cohort from age 18 to 39 than for the cohort from age 40 to 64 (see Figure A1). Even though the coal decline began in the 1980s, substantial relative population declines do not begin to register until the 2000s and especially the 2010s. Although net outmigration ultimately may have helped to reduce gaps in employment rates between coal country and other regions, the process took decades to initiate and to play out. A push factor for departures was the decline in average labor compensation in coal-impacted regions, which is evident in Figure 6B.[18]

Government Transfers. How did government transfers respond to falling wage and employment rates in coal country? Prior research shows that during the 1990s counties with larger declines in coal employment registered sharp increases in UI payments (Jacobsen and Parker, 2016), uptake of transfers from Aid to Families with Dependent Children (the precursor to TANF) (Black et al., 2003), and participation in disability programs (Black et al., 2002). Using data from the BEA Regional Economic Information System (REIS), I consider the full range of government transfers to which locals would have had access and the long-run impact of coal's decline on benefit uptake. Figure 7 shows the impact of the decline of coal on the change in total government transfers (panel A), Social Security retirement and disability benefits (panel B), transfers associated with Medicare (panel C), and transfers associated with Medicaid (panel D), each expressed as a percentage of total personal income.[19] For total government transfers, Figure 7A demonstrates that relative to

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17   See Appendix.

18   Because these are average wages, they are subject to composition bias. Average wages likely fell in part because those who left in larger numbers were more-educated workers (Krause, 2022). Declines in the local cost of housing caused by the coal shock may have softened the impact of falling nominal earnings on real incomes.

19   BEA estimates of county personal income include labor compensation (wages, salaries, bonuses, employer contributions to health and pension plans), proprietor income (income of sole proprietorships, partnerships, tax-exempt cooperatives), financial returns (rent, interest, dividends, realized capital gains), government transfers (both cash and in-kind), and adjustments to capture income by place of residence. BEA personal income thus approximates aggregate local income. I aggregate county personal income up to the level of the commuting zone.

Figure 6. Impact of the Decline of Coal on Employment, Earnings, and Population
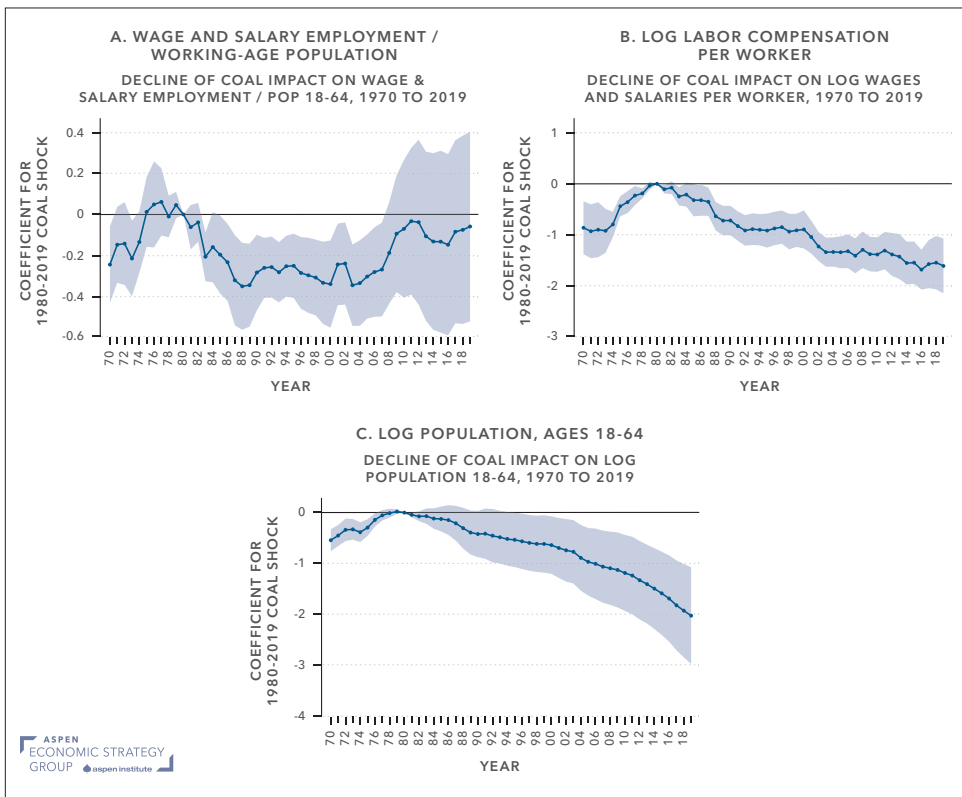
Note: The panels report OLS coefficient estimates for the coefficient β_{1h} in equation (1) (see Appendix) and 95 percent confidence intervals for these estimates. The dependent variable is the change in the indicated measure between 1980 and the year on the horizontal axis; the coal shock is defined in equation (2); and the control variables are described in the Appendix. Regressions are weighted by the commuting zone working-age population in 1980; standard errors are clustered by state.

the commuting zone at the median of shock exposure, a commuting zone at the 95th percentile of shock intensity experienced a stunning 40 percentage-point larger increase in government transfers as a share of personal income. Figures 7C and 7D reveal that nearly all of this increase was due to differentially greater uptake of Medicare and Medicaid benefits in local labor markets that were more exposed to the coal bust. By contrast, the long-run impact of the coal shock on increased uptake of Social Security benefits, which includes retirement and disability payments, was essentially null.

Figure 7. Impact of the Decline of Coal on Government Transfers
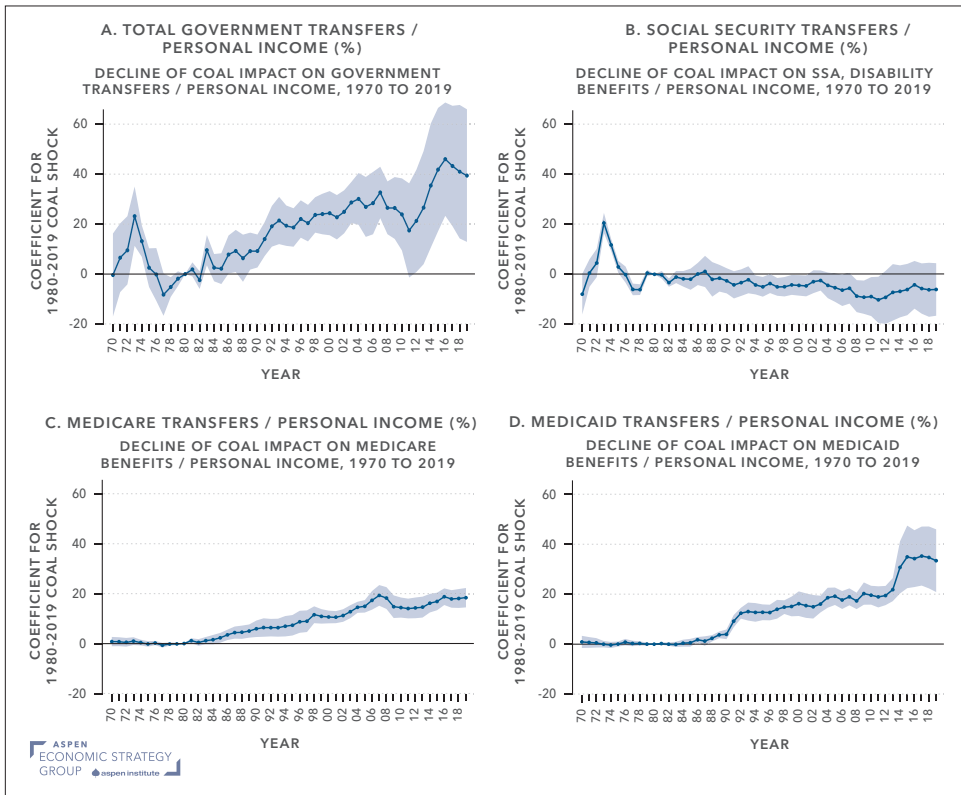
Note: The panels report OLS coefficient estimates for β_{1h} in (1) and 95 percent confidence intervals for these estimates (see Appendix). The dependent variable is the change in the indicated measure between 1980 and the year on the horizontal axis; the coal shock is defined in (2); and the control variables are described in the Appendix. Regressions are weighted by the commuting zone working-age population in 1980; standard errors are clustered by state.

Finally, I consider the impact of the decline of coal on uptake of government income assistance programs, which is shown in Figure 8. Commuting zones more exposed to the decline of coal saw larger long-run increases in total government income maintenance as a share of personal income (panel A).[20]   However, the impacts were modest relative to those for Medicaid and Medicare. Highly exposed commuting zones saw increases in income assistance as a share of total personal income only five percentage points higher than the median commuting zone, a minor difference in comparison to the near 40 percentage-point differential for Medicaid and Medicare

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20   Income maintenance includes Supplemental Security Income, the Earned Income Tax Credit, Supplemental Nutrition Assistance, and other benefits including foster care and adoption assistance, child tax credits, energy assistance, and vouchers under the Special Supplemental Nutrition for Women, Infants and Children (WIC) program.

combined. Likewise, in the short- to medium-run, commuting zones more exposed to the coal shock had greater uptake of food stamps (panel B), but these impacts shrank to zero by later in the shock period. Panel C indicates that nearly all of the long-run increase in uptake of government income maintenance in commuting zones more exposed to the coal shock was in the form of Supplemental Security Income, which is primarily distributed to the elderly poor and the disabled poor. Important for the discussion of placed-based policies, the coal shock had close to zero impact on the uptake of education and training assistance (panel D), including programs intended to help displaced workers retrain for new careers. Although individuals in communities exposed to the decline of coal may have received more income maintenance benefits in the short run, in the longer run such differences were small.

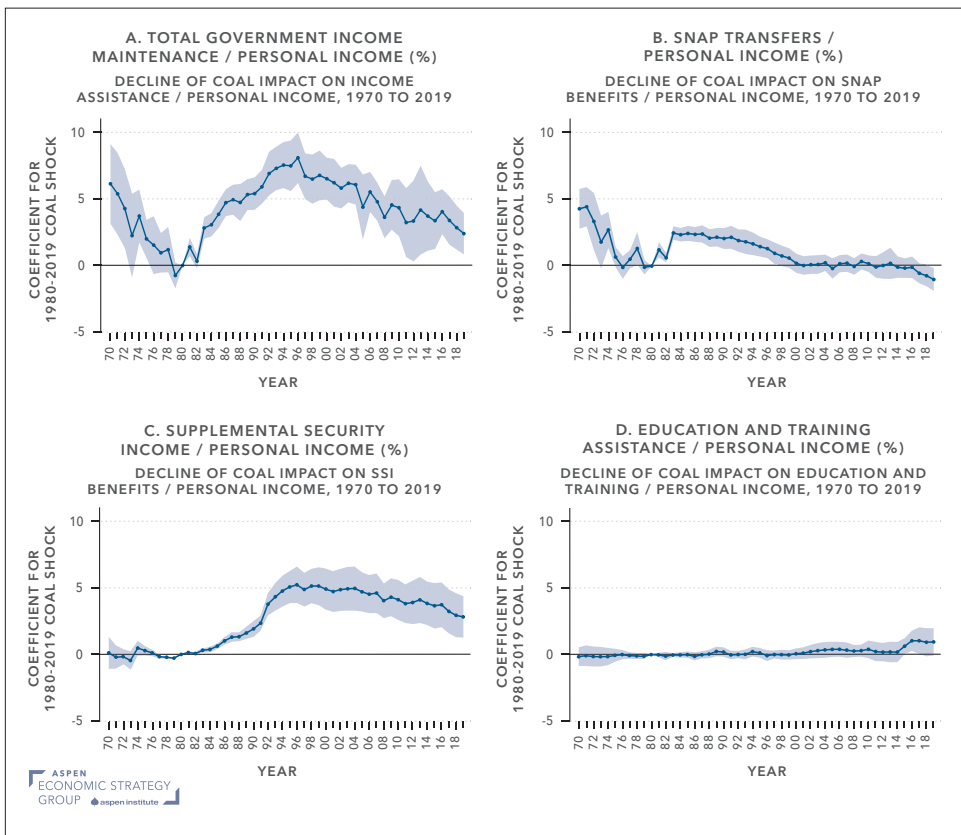### Figure 8. Impact of the Decline of Coal on Government Transfers

Note: The panels report OLS coefficient estimates for β_{1h} in (1) and 95 percent confidence intervals for these estimates (see Appendix). The dependent variable is the change in the indicated measure between 1980 and the year on the horizontal axis; the coal shock is defined in (2); and the control variables are described in the Appendix. Regressions are weighted by the commuting zone working-age population in 1980; standard errors are clustered by state.

Summary. The picture that emerges of regional adjustment to the decline of coal is bleak. Places highly specialized in coal saw declines in employment and wage rates that persisted for 20 years or longer. On net, younger job-seekers ultimately left the areas in large numbers to pursue opportunities elsewhere, but their outflows took decades to fully materialize. The population that remained, which tended to have considerably less education than the groups that left, became substantially more dependent on government transfers, primarily in the form of subsidized healthcare. The decline of coal appears to have left behind communities that are smaller, older, sicker, and with sharply lower average earnings power.

3.d. Targeting Regions: Place-Based Policies

Even the best-designed social safety net may be only partially effective in a local labor market that is severely depressed. More substantial and longer-lasting UI benefits may not help laid-off employees to avoid the scarring effects of joblessness in a market in which few return to work. The consequences of the decline of coal and the China trade shock are sobering reminders that regional economies that fall into distress can remain distressed for decades. Because the mobility choices of less-educated workers tend to be unresponsive to negative local labor demand shocks in the medium and even long run, policies that target individuals may only go so far in helping regional economies to escape the hardship that has accompanied recent episodes of widespread worker displacement. Region-level challenges call to mind region-level solutions, such as place-based policies.

3.d.1. Promises and Drawbacks of Place-Based Policies

Designing effective place-based policies requires understanding the imperfections that complicate how markets work. One is the combination of immobile labor (e.g., less-educated workers not leaving when the local economy hits hard times), mobile capital (e.g., firms responding to downturns by shutting down their operations to relocate elsewhere in the United States or abroad), and the myriad economic benefits that come from clustering firms and workers together in larger cities (see, e.g., Fajgelbaum and Gaubert, 2020; Bilal, 2021). In such a context, industry disruptions—be they from globalization, technological change, or new environmental regulations—can trigger localized processes of industry growth or decline that are self-reinforcing (Diamond, 2016; Dix-Carneiro and Kovak, 2017). In places beset by negative shocks, firms exit, wages decline, and workers who are tied to the region suffer losses in real income, though falling housing prices can offset some of these impacts.[21] More-educated workers become less likely to stay in the region, and their absence further hinders

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21 Falling housing prices can have negative consequences, too. A decline in home equity reduces the collateral that potential entrepreneurs can put forward to obtain loans to start new businesses. Housing-market declines are commonly followed by reduced job creation in new enterprises (Davis and Haltiwanger, 2019).

the attractiveness of a location to firms looking for a place to invest. Interventions that induce either more productive workers or firms to relocate to distressed regions can raise well-being nationally. In practice, these outcomes may also be achieved by helping high-potential firms and workers located in distressed regions to improve their capabilities (for instance if lower-income workers and newer, smaller firms face disadvantages in obtaining loans). More generally, localized employment creation can improve well-being if it targets places in which joblessness is relatively damaging (Wilson, 2011), and in which the non-employed eagerly take up jobs when offered the opportunity to work (Austin et al., 2016; Bartik, 2022).

Perhaps the most notable application of place-based policies in the United States was the Tennessee Valley Authority (TVA), which began in 1933 and used federal money to build bridges, canals, highways, power plants, and schools throughout the impoverished Appalachian region over several decades.[22] Kline and Moretti (2014a) find that in treated counties the TVA temporarily expanded employment in agriculture and permanently expanded employment in manufacturing. But their results highlight a central weakness of placed-based policies: they may reallocate activity across space without raising national income; in the case of the TVA, the region's manufacturing gains were offset by manufacturing losses elsewhere in the United States. [23] As discussed in the 2020 AESG paper by Timothy Bartik, recent evidence suggests that place-based policies may be zero-sum even within regions, expanding employment in targeted sectors but leaving aggregate employment unchanged (Ehrlich and Seidel, 2018; Slattery and Zidar, 2020). Zero-sum competition seemed egregiously evident in the Kansas City border war, for instance, in which over the 2011 to 2019 period municipal authorities in Kansas and Missouri spent large sums of money to induce companies to relocate across state lines within the same metropolitan area.[24] Such behavior is suggestive of elected officials using placed-based policies purely for political gain (Kim, 2021; Slattery, 2020). In analyzing place-based policies, economists have devoted most of their attention to whether tax incentives are successful in attracting investment to a region. This focus is understandable. These subsidies appear to account for the majority of spending on place-based initiatives (Bartik, 2020). Yet, place-based policies consist of much more than business tax incentives. Local economic development has evolved into a sophisticated if underappreciated area of practice, in which policymakers deploy a wide range of tools. However the energy transition plays out, it will be these tools that policymakers will likely apply first, especially at the state and local levels.

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22 The Appalachian Regional Commission later continued this work on a smaller scale.

23 Even in the absence of positive impacts on aggregate output, the TVA may have been justified on welfare grounds: it improved very low-income communities' well-being (Gaubert et al., 2021).

24 See Shayndi Raice, "Tired of Fighting for Business, Missouri and Kansas Near Cease-Fire Over Incentives," *The Wall Street Journal*, June 25, 2019.

3.d.2. Place-Based Policies in Practice

A reasonable goal of place-based policy is to increase employment and earnings in distressed regions, especially among low-wage workers, and to improve both regional and national well-being in a manner that would not happen in the absence of the intervention (see, e.g., Bartik, 2022; Austin et al., 2016). The elected officials, policy professionals, and non-government actors who are responsible for local economic development typically handle the policies' design and implementation. In the United States, the practice of local economic development—not to be confused with the scholarly economics subfield of development economics—tends to be organized around five major areas: business retention and recruitment, workforce development, financial and technical assistance to small business, infrastructure development, and financial incentives to invest in low-income areas (Bartik, 2020). I will discuss the first three areas of practice.[25] These areas tend to be managed by different bureaucracies, funded from different sources, and guided by different and often conflicting incentives. The result is a decentralized process in which decision-making is divided across a complex set of jurisdictional boundaries. I discuss how these areas of practice might be deployed to address job loss from the energy transition.

Business Recruitment (building capital). The goal of business recruitment is to catalyze investments in physical capital in a geographic region. A common approach is to provide tax incentives to a large company in return for promised investments in new productive capacity, the expansion of existing operations, or the creation of R&D facilities (Slattery, 2020). If the company breaks ground, the logic goes, it will attract upstream industry suppliers and downstream industry buyers, thereby realizing external economies of scale and raising regional productivity and wages. For regions hurt by the energy transition, the idea would be to use tax incentives to develop new export industries unrelated to fossil fuels. There is considerable evidence that policies that target specific industries in specific regions succeed in expanding regional capacity in the target area well beyond the duration of the policies, in a manner consistent with agglomeration economies (Greenstone et al., 2010; Freedman, 2017; Garin and Rothbaum, 2020; Bianchi and Giorcelli, 2022). Whether these policies do more than reallocate employment within or across regions is less clear, but the rough consensus of the literature seems to be that they do not. That is, business tax incentives likely move targets but not aggregates.

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25   Scope for action on the fourth area, new infrastructure, may be limited by the federal government's authorization of a major infrastructure spending bill in 2022. The fifth area includes government support for investments in federally recognized Empowerment Zones and Opportunity Zones and state-designated Enterprise Zones. Because these programs appear to allocate most of their resources to real estate projects in low-income neighborhoods within larger metropolitan areas (see, e.g., Lambie-Hanson, 2008), they may be unlikely sources of major support for the smaller towns and cities on the front lines of disruption by the energy transition. For recent work on such initiatives, see Neumark and Simpson (2015), Chen et al. (2019), and Neumark and Young (2020).

Business tax incentives may yield disappointing aggregate results because they are inherently flawed. Alternatively, the flaw may not be in their design but in their implementation. Business recruitment is typically the purview of a local or state entity, staffed by professionals (as opposed to elected officials) and funded from a combination of public and private sources. These quasi- government entities are often (confusingly) called "economic development agencies," even though they are not responsible for all aspects of development practice. Economic development agencies help states and localities find companies to recruit, and then assist these companies in locating a production site, obtaining the statutory tax incentives for which they are eligible, managing the permitting and regulatory process, and expanding into new markets. The agencies' performance is typically measured in terms of the gross number of companies that they recruit or retain and the associated *gross* number of jobs that are created or saved (Bartik, 2022). The emphasis on gross versus net job creation may contribute to why business tax incentives frequently disappoint.

The two possible conclusions that bear policy lessons for the energy transition are difficult to separate. One is that business tax incentives are a valuable tool for helping distressed regions, but that the incentives governing their implementation need to be realigned to match social objectives. A second is that tax incentives represent a large pool of poorly used resources that could be redeployed for more productive ends through alternative place-based policies. Either way, the resources that states and localities devote to business tax incentives may feature prominently in responses to worker displacement induced by the energy transition.

Workforce Development (improving labor). Many workers displaced by the energy transition will need to retool their skills for new occupations. In the presence of localized human capital externalities, public investments in retraining may bring gains to society at large. A better equipped local workforce may help a region to rebound more quickly from the loss of key export industries. In most regions, workforce development agencies oversee the provision of vocational and technical training to local workers.[26] Their role includes helping displaced workers acquire new skills—in part by relaxing constraints on obtaining funding for education and training that may impede those workers from making worthwhile investments—and assisting low-income youth in successfully entering into the labor force, possibly by compensating for disadvantages they have accumulated in the past (Holzer, 2008).

Research shows that specific types of training known as "active labor market programs" yield high returns: raising wages for low-wage workers and sometimes paying for themselves within five years (Katz et al., 2022). These programs, after

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26 Here, I ignore the (plausibly modest) role of K-12 education and public universities in regional labor market adjustment to the energy transition.

screening candidates for their suitability for employment, provide training in sector-specific skills demanded by local employers—who themselves often help to define the training—and offer wrap-around services regarding career readiness, career counseling, job placement, and post-placement job advancement. International evidence supports the effectiveness of well-designed sectoral training programs in improving individual employment outcomes (Card et al., 2018). Although successful training models have been identified, there appear to be challenges in replicating and scaling them. While the effectiveness of certain approaches developed by specific nonprofit organizations has been established in randomized controlled trials, the success of these approaches does not always replicate when applied by other organizations and in other contexts (Kanengiser and Schaberg, 2022). Employers' wariness to participate in these programs—for instance by guaranteeing to hire certain numbers of qualified graduates—is a common problem.

Part of the challenge in scaling successful training programs may be the bureaucracy that governs them. Central to this bureaucracy are Workforce Development Boards, which are the product of federal legislation on worker training in recent decades (Holzer, 2008). These Boards oversee the provision of employment services to displaced workers, disadvantaged youth, and other constituents. Their services include help in obtaining UI benefits, vouchers for worker training, career counseling, and other employment related assistance, which are often provided at job centers located in community colleges. The Boards are typically run by local leaders selected by the mayor or governor. Whereas some states have a single Board, others have 20 or more. In total, the United States has over 600 such boards, which appear to vary enormously in their administrative capacity. Their jurisdictional boundaries bear little relation to the geographic structure of local labor markets, and often do not align with the regional structure of local economic development agencies.

Workforce Development Boards help workers to obtain training but do not conduct that training themselves. This responsibility usually falls on community colleges and private or nonprofit technical institutes. In community colleges, job-specific training typically takes the form of certificate programs. These are practical courses of study of less than two years in length, which target specific occupations such as construction, manufacturing, repair, transportation, and other vocational trades. In panel data, certificates yield significantly improved earnings and employment outcomes for attendees (Jepsen et al., 2014). Prior research finds that when local economic conditions deteriorate, enrollment in certificate programs tends to rise—in particular for programs that provide certification in industries where employment is expanding—which suggests that workers are using the programs to move between occupations in response to changing economic conditions (Foote and Grosz, 2020; Acton, 2021). Yet most community colleges allocate substantially fewer resources

to certificate programs than to two-year associate degree programs, many of which are geared to prepare students for entry into four-year colleges and universities (Schanzenbach and Turner, 2022). Goolsbee et al. (2019) develop a detailed proposal for expanding the training capacity of community colleges, as part of a broader agenda to fortify the accumulation of human capital in the United States.

Despite several decades of job loss among non-college-educated workers in manufacturing, energy extraction, and other well-paying industries, workers continue to have difficulty in retraining for new lines of work. Although research and practice have identified training approaches that work in some settings, and although the ubiquity of community colleges provides ready infrastructure for such training, these programs have yet to be scaled regionally or nationally. There would appear to be substantial scope for improving workforce development in advance of the energy transition.

Business Technical Assistance (raising productivity). In economically distressed regions, local entrepreneurs may have difficulty in securing loans to launch a new business while owners of existing firms may face challenges in financing business improvements or expansions. By reducing housing values and potential collateral, the decline of a region's existing export industries may initiate a financial accelerator mechanism that stifles business formation (Davis and Haltiwanger, 2019), possibly impeding economic recovery. In the aftermath of localized economic downturns, there may be cause to subsidize services to businesses that have a demonstrated interest in expanding local employment. Intriguingly, several public sector programs, which are neither well known nor well studied, are doing just that.

The US government provides a wide range of support to small- and medium-sized businesses. The Small Business Administration, in addition to guaranteeing loans to qualifying small businesses, runs over 900 Small Business Development Centers, which are often housed in community colleges or universities and which provide technical assistance and consulting services to local firms. The Economic Development Administration, through its grants to colleges and universities, funds similar business services. Specific to industrial production, the Manufacturing Extension Program run by the National Institute of Standards and Technology helps companies to upgrade their technology through a national network of centers. Could these programs help regions that will be adversely affected by the energy transition? In truth, we do not know. Rigorous evaluation of such programs in the United States is limited. We know a great deal, however, about the efficacy of related types of interventions in developing countries. In randomized controlled trials, supplying consulting services to medium-sized businesses in developing countries leads to long-lasting improvements in economic performance (Bloom et al., 2013, 2020; Iacovone et al., 2022). The absence of evidence in the US context is

particularly concerning considering that many such programs received enormous funding increases —often many times their annual budgets—as part of COVID-19 relief packages. Opportunities to evaluate their effectiveness would seem to abound.

Looking ahead to the energy transition, economists anticipate that local economic downturns may complicate business formation. Given that new, small firms are the primary source of net, new job growth, forces that block business growth may dim prospects for successful adjustment to job loss in fossil-fuel-related industries. Although the US government funds a wide range of services to promote business expansion, researchers and policy makers have a poor sense of which would be best-suited for the coming challenge of mitigating worker displacement in fossil-fuel-intensive industries.

Summary. The practice of place-based policy in the United States is highly decentralized, confusingly fragmented, and poorly understood outside of the regions in which it occurs. State and local governments are likely to play a large role in helping local economies hurt by the energy transition to chart a path toward economic recovery. In advance of this adjustment process, it behooves us to understand place-based policies more soundly.

4. Final Discussion

Economists have long known that people are scarred by job loss. Displaced workers earn significantly less than otherwise similar workers who have not been displaced, even years after the separation occurred. Over the last several decades, import competition from China, the automation of manufacturing production, and the shift in electricity generation away from coal have caused locally concentrated job loss in the United States, which has led to lasting declines in employment rates, earnings, and social conditions in the local labor markets that were exposed to these shocks. Because less-educated workers were slow to migrate away from these regions, localized distress has persisted for decades beyond the actual displacement events. Despite now well-documented instances of painful adjustment to large contractions in labor demand, there is no consensus about how to remediate such injuries. If we continue with business as usual, the energy transition seems likely to add new chapters to the already unfortunate story of industry decline and regional hardship. Adjustment experiences to date suggest three areas in which revising existing approaches may produce gains.

Tuning unemployment insurance to local economic conditions. During the Great Recession, the government sharply increased the generosity and duration of unemployment insurance benefits. The long-standing concern about such

interventions is that they induce workers to delay seeking new jobs and thereby elevate unemployment rates and prolong economic recovery. Yet, the literature provides compelling evidence that greater UI benefits in response to the Great Recession had little impact on aggregate employment, while helping recipients replace lost income and smooth their spending over time. There appears be scope to further tune UI benefits to local economic conditions, beyond the existing and infrequently used state-level trigger mechanisms. Because job loss caused by the energy transition is likely to be highly concentrated in specific local labor markets, state-level triggers may be too crude to help the regions that will suffer high levels of worker displacement. Labor market adjustments during the Great Recession and the COVID-19 pandemic may be instructive for how to tune UI benefits with greater precision.

Expanding technical and vocational training. Because the energy transition may require affected regions to develop new export bases, local workers may need to acquire skills suitable for new and unfamiliar industries. There is now abundant evidence that active labor market programs can be successful in helping displaced and disadvantaged workers to find employment in new occupations and at wage rates that are higher than they otherwise would have commanded. Community colleges, through the certificate programs that they already offer, represent a training infrastructure that is seemingly ready to be deployed (Goolsbee et al., 2019). Existing approaches to workforce development, however, appear to be deficient in many respects. Challenges include how to scale up active labor market programs and to expand them into new regions, and how to fortify and to expand the technical and vocational training missions of community colleges that vary widely in their capacities and that tend to favor preparing students for entry into four-year universities. Possibly working against experimentation and expansion is an existing system in which Workforce Development Boards' jurisdictions, mandates, and administrative structures may be poorly aligned with other actors and thereby impeding innovation. The task at hand thus seems less a matter of identifying viable training programs or building training infrastructure than of harnessing a decentralized and fragmented system to accomplish new and more ambitious objectives.

Coordinating place-based policies. If a development economist were to tour towns and cities in the United States, she would find the local interventions in lending to small businesses and expanding their managerial capacities entirely familiar. Although mainstream economics has become comfortable with such policies when implemented in Colombia or India, skepticism over place-based policies in high-income countries, which involve many of the same features, remains strong. Yet, local-level industrial policies favored by the World Bank and by states including Michigan, Minnesota, and Virginia have a lot in common. The challenge is not to

convince states and localities to undertake place-based policies—they are already doing so and have been for close to a century (Cobb, 1993). Rather, the challenge is that we know relatively little about which place-based policies are effective and in which contexts. Although there seems to be a building consensus that offering generous tax breaks to recruit large companies yields low social returns, there is less consensus about how these funds could be better deployed. There is no accepted formula for how to combine business recruitment, worker training, technical assistance to business, and infrastructure development in a manner that would raise employment rates and wage levels in a distressed local labor market. Spending by the federal government in response to the COVID-19 pandemic, which has temporarily and dramatically expanded the budgets of the federal agencies that support place-based policies, including the Economic Development Administration, the Employment and Training Administration, and the Small Business Administration, presents an immediate opportunity to experiment with alternative policy formulas. We have an opportunity to evaluate which place-based policies work, just at the moment when the demands of preparing for the energy transition are becoming pressing.

Just as in 1980, when economists did not see the decline of coal coming, in 1990 economists did not see the China trade shock on the horizon. Although in retrospect it seems obvious that these events would have large, concentrated, and negative impacts on exposed local labor markets, few economists foresaw them (an exception is Wood, 1995). The energy transition, however, is a shock foretold. We have a keen sense of which industries will see reduced employment, which local labor markets will be most exposed to the resulting job loss, and which existing policies have worked poorly in addressing past disruptions. This time, we have the opportunity to get things right.

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Appendix

A1. Econometric Framework

In this section, I describe the econometric framework I apply to produce the estimation results shown in Section 3.3. To evaluate adjustment to the decline of coal across US commuting zones, I use the following specification, which adapts that in Autor et al. (2022) and which is inspired by the local projections approach in Jordà (2005):

$$\Delta Y_{it+h} = \alpha_t + \beta_{1h}\Delta SS_i^{coal} + \mathbf{X}'_{it}\beta_2 + \varepsilon_{it+h}. \tag{1}$$

The variable ΔY_{it+h} is the change in an outcome for commuting zone (CZ) i between the base year $t = 1980$, when the coal decline began in earnest, and year $t + h$ for $h = -5, \ldots, 39$; ΔSS_i^{coal} is a shift-share variable that projects the US national shock to coal employment onto CZ i; and $\mathbf{X}_{it}$ is a vector of controls. I include time changes before 1980 to evaluate the presence of pretrends in the data.

I specify the decadalized shift-share coal shock as,

$$\Delta SS_i^{coal} = -\left(\frac{100}{39}\right) \times \frac{L_{ic1980}}{L_{i1980}} \left[\ln L_{coal,2019}^{-i} - \ln L_{coal,1980}^{-i}\right], \tag{2}$$

where L_{ic1980}/L_{i1980} is the share of coal production in the employment of CZ i in the initial year of 1980, and the term in brackets is the log change in national employment in coal production over 1980 to 2019, outside of the state in which CZ i is located. The shock period spans both the 1980s and 2010s coal busts. To ease interpretation of the regression analysis, I multiply the shock in (2) by –1, such that a higher value of the shift-share variable indicates a larger negative change. The population-weighted mean of this projected employment change is 0.121 ($\sigma = 0.670$) percentage points, where the shock at the 95th percentile of exposure is 0.453 percentage points and at the 50th percentile of exposure is 0.002 percentage points. Thus, while commuting zones at the median of shock intensity and below feel effectively zero impact of the decline of coal, CZs near the peak of shock intensity are highly exposed. I divide the value in (2) by the quantity (0.453 – 0.002), such that the coefficient β_{1h} is the differential impact of the shock between a commuting zone at the 95th of shock exposure and a commuting zone at the 50th percentile of shock exposure.

Control variables in the regression include a dummy for the CZ having positive coal employment in 1980, the corresponding shift-share variable to that in (2) defined for manufacturing,[1] time trends for Census region divisions, and values in 1980 for the

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[1]   The coal shift-share variable in (2) is very weakly correlated either with the corresponding shift-share variable for the change CZ manufacturing employment ($\rho = 0.02$) or the China shock shift-share variable studied in Autor et al. (2022) ($\rho = -0.08$).

share of CZ employment in manufacturing, the share of women in CZ employment, the share of the college-educated in the CZ adult population, and the share of the foreign-born in the CZ population.

A.2. Figures

Figure A1. Impact of the Decline of Coal on Population Headcounts by Age Cohort
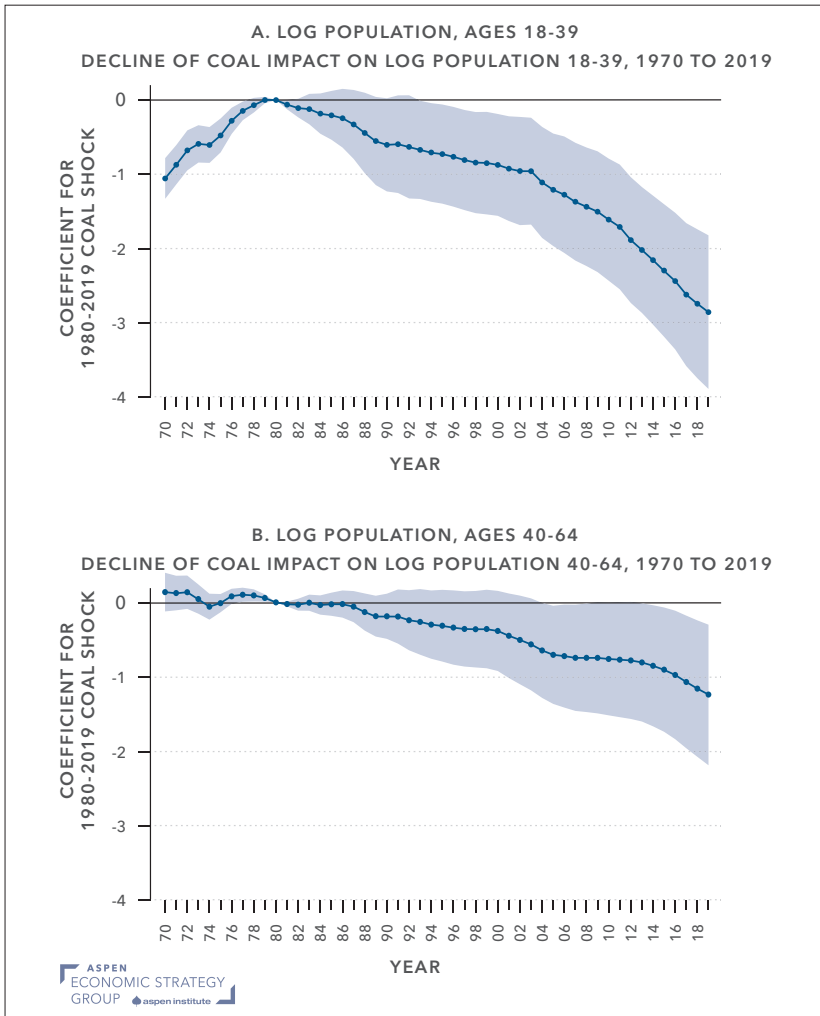
Note: The panels report OLS coefficient estimates for β_{1h} in (1) and 95 percent confidence intervals for these estimates. The dependent variable is the change in the indicated measure between 1980 and the year on the horizontal axis; the coal shock is defined in (2); and the control variables are described in the Appendix. Regressions are weighted by the commuting zone working-age population in 1980; standard errors are clustered by state.

Figure A2. Change in Employment in Energy Industries, 2000 to 2019

A. FOSSIL FUEL EXTRACTION AND REFINING

CHANGE IN EMPLOYMENT SHARE (PP.)

● -7.06 – -0.35 ● -0.35 – -0.07 ● -0.07 – -0.02 ● -0.02 – 0.08 ○ 0.08 – 0.62 ○ 0.62 – 8.03

B. POWER GENERATION AND DISTRIBUTION

CHANGE IN EMPLOYMENT SHARE (PP.)

● -3.75 – -0.95 ● -0.95 – -0.53 ● -0.53 – -0.35 ● -0.35 – -0.15 ○ -0.15 – 0.05 ○ 0.5 – 1.35

C. ENERGY INTENSIVE MANUFACTURING

CHANGE IN EMPLOYMENT SHARE (PP.)

● -10.11 – -2.10 ● -2.10 – -1.30 ● -1.30 – -0.87 ● -0.87 – -0.28 ○ -0.28 – 0.06 ○ 0.06 – 1.59

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Note: The figures show changes in the share of employment of prime-age workers (ages 25-54) by commuting zone in energy related industries. The six categories in the legend are for shares in the bottom three quartiles, the 75th–84th percentiles, the 85th–94th percentiles, and the 95th–99th percentiles.

Figure A3. Fossil Fuel Extraction, Refining, and Distribution plus Energy Intensive Manufacturing
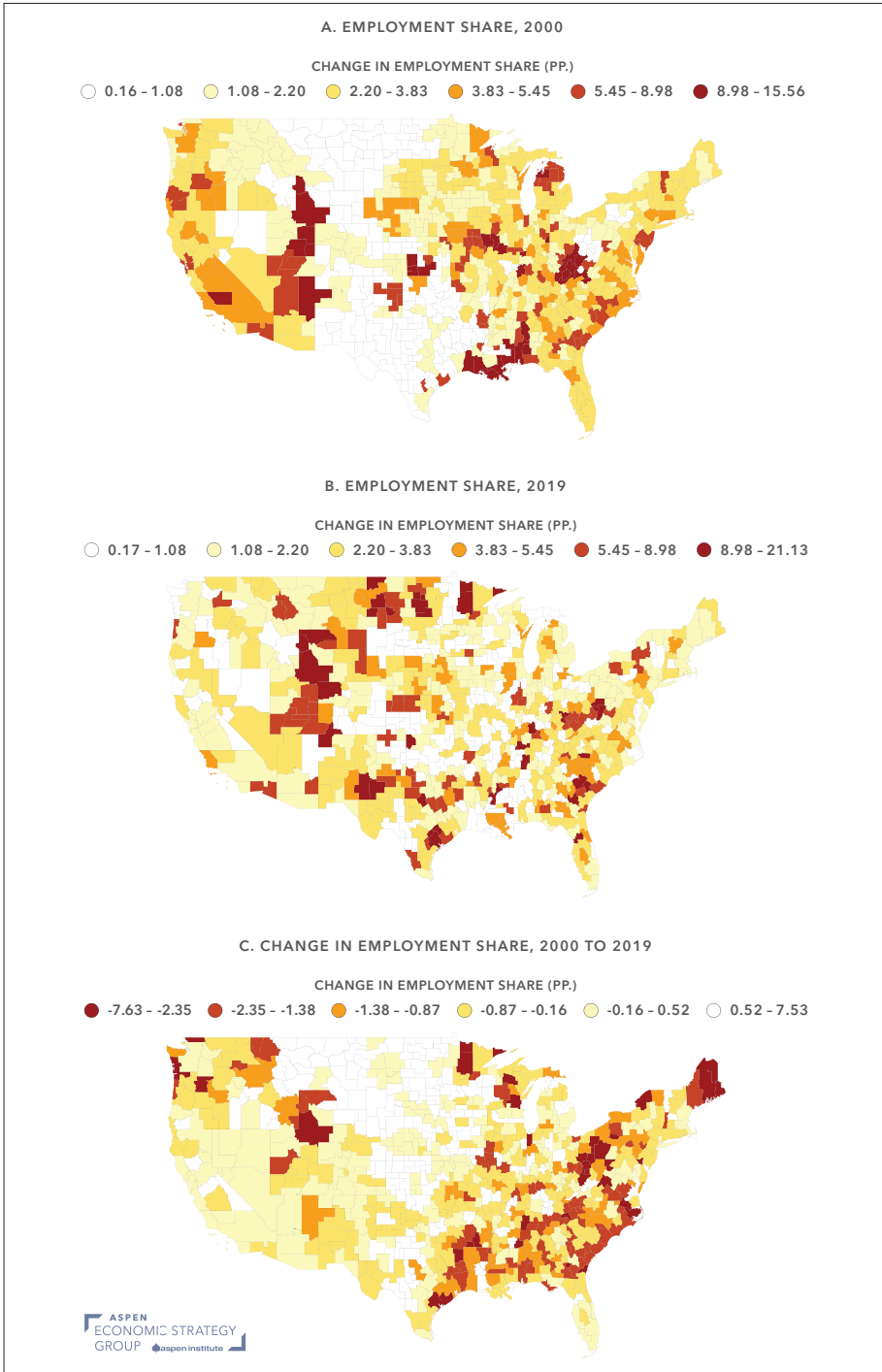
Note: The figures show the combined share of employment of prime-age workers (ages 25-54) by commuting zone in the INDNAICS industries oil and gas extraction (211), coal mining (2121), support industries for mining (213); natural gas distribution (2212P); petroleum refining (32411), petroleum and coal products (3241M); and fiber, yard, and thread mills (3131); pulp, paper, and paperboard (3221); basic chemicals (325M); clay products (3271); glass products (3272); cement and concrete (3273); lime and gypsum (3274); iron and steel mills (3311); and aluminum (3313). The six categories in the legend are for shares in the bottom three quartiles, the 75th–84th percentiles, the 85th–94th percentiles, and the 95th–99th percentiles.

Lessons from COVID-19 Aid to State and Local Governments for the Design of Federal Automatic Stabilizers

AUTHORS

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ABSTRACT

In this paper we analyze pandemic-era federal fiscal assistance to state and local governments and draw lessons for the design of stabilization policy. We start by explaining why the federal government plays a key role in stabilizing state and local government budgets across the business cycle, before describing the shape this role currently takes. We then provide an overview of how the COVID-19 crisis was expected to affect state and local budgets, and how those expectations affected the amount of fiscal relief the federal government provided. We next assess the design of the federal response and evaluate its effectiveness. We conclude by drawing lessons for the design of future countercyclical federal aid to state and local governments. We argue for tying the quantity of aid provided to national measures of tax bases and propose three delivery mechanisms: rule-based grants, loans, and an insurance program.

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1. Introduction

As the economic crisis triggered by the COVID-19 pandemic unfolded, federal policymakers in the United States repeatedly allocated large amounts of funding to state and local governments. Particularly large amounts of such funding were included in the March 2020 Coronavirus Aid, Relief, and Economic Security Act (CARES) and the March 2021 American Rescue Plan Act (ARPA). Total federal relief for state and local governments over the course of the pandemic has amounted to about $900 billion.

We analyze these relief efforts and draw specific lessons for the design of fiscal stabilization policy. We start by explaining why and how the federal government plays a key role in stabilizing state and local government budgets across the business cycle. We then turn to an overview of how the COVID-19 crisis was expected to affect state and local budgets, and describe how those projections led to the approval of more federal assistance than was necessary to close revenue shortfalls. We next assess the impact of this federal assistance, arguing that it was less cost-effective in achieving its economic aims than were comparable past programs. We conclude by drawing specific lessons from the fiscal assistance provided to state and local governments during the COVID-19 pandemic for the design of similar future aid packages. We emphasize the need for rules-based assistance determinations premised on measures that more reliably predict revenues than does the unemployment rate. Our final section proposes three reform options for federal fiscal aid to state and local governments: rule-based grants, loans, and an insurance mechanism.

2. Fiscal Federalism and Stabilization Policy

State and local governments in the United States, which play major roles in taxation, providing services, and administering federal safety net programs, are generally bound by a mix of statutory and constitutional balanced-budget requirements to avoid operating-budget deficits (National Association of State Budget Officers, 2021a). Among the fifty states, only Vermont does not face an explicit requirement of this sort, though historically even the Green Mountain State behaves as if it too were bound to balance its budget. The federal government has therefore assumed responsibility for ensuring that fiscal policy does not become (overly) countercyclical, and that revenue shortfalls at the subnational level do not trigger sudden cutbacks in the services provided by states, cities, counties, school districts, and similar government entities.

In theory, rainy-day funds and creative accounting (such as flexibility in the funding of public-sector employee pensions) could allow states to smooth operating expenditures and service provision without resorting to federal assistance. In

practice, however, rainy-day funds have played little role in helping states to achieve balanced budgets.[1] This ineffectiveness reflects both political and institutional factors. When governments experience budget surpluses, politicians are incentivized either to spend the surplus on public projects or to cut residents' taxes. Likewise, institutional constraints on states' ability to draw rapidly on rainy-day fund balances during recessions—or to invest considerably in building those balances during expansions—impede the funds' utility. Of course, some of these constraints may also reflect expectations of countercyclical federal aid.

These design features leave the federal government to play a primary role in macroeconomic stabilization through a wide range of policies, including monetary policy, direct payments to households and firms, and aid to state and local governments. In this paper, we focus our attention on the last of these. Federal aid to subnational governments comes in two forms: through so-called automatic stabilizers—programs legislated in advance of potential downturns—and through discretionary spending, which are typically one-off, temporary programs legislated in response to specific downturns.

Assessing how stabilization efforts might best be designed requires a framework for understanding what these programs are meant to accomplish. Generally, apportioning the responsibility for both raising revenues and providing services among federal, state, and local governments is meant to achieve a mix of distributional and efficiency-oriented goals. Several classic considerations enter the picture (Oates, 1999, 2008). For instance, the government's redistributive functions tend to work best when centralized at the federal level, to avoid creating incentives for corporations or high-income individuals to flock to low-tax destinations. And while local and state governments may be best suited to tailor services to the needs of local populations, the federal government may likewise be best suited to provide services that entail substantial border-crossing externalities or that exhibit substantial economies of scale.

Three aspects of efficient service delivery are particularly salient in the context of downturns or other economic emergencies. First, essential services including policing, fire safety, and public transit will tend to provide greater benefits if they are delivered consistently than if they fluctuate between lean years and years of plenty. Second, downturns and other crises might create context-specific needs, such as

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1   Nationwide, states' rainy-day fund balances rose by nearly $36 billion from Fiscal Year 2020 to Fiscal Year 2021 and declined by just under $13 billion from Fiscal Year 2021 to Fiscal Year 2022 (National Association of State Budget Officers, 2021a, Table 26A). During the Great Recession, states spent down roughly half of their rainy-day fund balances, or $37 billion, between Fiscal Year 2006 and Fiscal Year 2009, at which time balances began to recover (National Association of State Budget Officers, 2009, Table 9).

when a pandemic necessitates the public provision and administration of disease-testing and vaccination. Third, the demands on various income-support programs inevitably rise during economic downturns.

While keeping state and local government budgets balanced has been a repeated source of concern during economic downturns, multiple automatic stabilizers are built into the US system of fiscal federalism. The most prominent of these stabilizers relate directly to state-administered programs associated with the social safety net. First, not all state expenditures are subject to balanced-budget requirements; unemployment insurance trust funds, for example, are separately accounted for, enabling states to dip into the revenues collected from payroll taxes during more robust times to pay out the escalated claims that occur during recessions. Second, the Medicaid program's matching grant structure shields states against a large fraction of the costs associated with increases in the number of beneficiaries that tend to occur during recessions.

Beyond these built-in stabilizers, a number of ad hoc policy measures have become regular features of the federal government's response to recessions. Interestingly, two of these measures are straightforward augmentations of existing mechanisms. During every recession since 1958,[2] Congress has enacted a temporary extension on unemployment benefits (Whittaker and Isaacs, 2014). During recent downturns, Congress has also enhanced the funding it channels through the Medicaid program by increasing each state's Federal Medical Assistance Percentage (FMAP), which determines the share of states' Medicaid expenditures that are reimbursed by the federal government.

In addition to augmenting built-in stabilizers, Congress has acted during the last two recessions to send states a more general form of fiscal assistance. During the Great Recession, Congress authorized roughly $225 billion in fiscal relief for state and local governments through the 2009 American Recovery and Reinvestment Act (ARRA) (Inman, 2010). And during the COVID-19 pandemic, federal fiscal assistance to state and local governments through ad hoc measures has reached roughly $900 billion. These relief programs have included not only general funds but also assistance earmarked for education, healthcare, transportation, and various other state and local government functions.

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2   Except the 1980 recession, if we consider that to be a separate episode from the 1981-82 recession.

3. Projected State and Local Revenue Losses during the COVID-19 Pandemic and Federal Aid to States and Localities

At the beginning of the pandemic, analysts drew on the experience of the Great Recession in worrying that strains on state budgets would inhibit states' responses to the pandemic along several dimensions, including their provision of standard public services, their administration of the safety net, and their administration of pandemic-related health services. Some analysts forecasted that the pandemic would result in massive revenue shortfalls. For instance, W. E. Upjohn Institute for Employment Research labor economist Timothy J. Bartik's 2020 report forecasted combined state and local government budget shortfalls summing to $959 billion over the 2020 and 2021 calendar years. McNichol, Leachmen, and Marshall (2020) similarly estimated a shortfall of $500 billion for state governments alone.

> *"Pandemic relief packages would ultimately buoy household incomes and firms' balance sheets such that aggregate income exceeded pre-pandemic forecasts."*

Bartik's analysis, which drew on historical estimates of the relationship between budget outcomes and unemployment rates (Furman, Fielder, and Powell, 2019), attributed more than 90 percent of these budgetary gaps to revenue shortfalls. We now know that state government tax revenues ultimately exceeded pre-pandemic forecasts for the 2020 and 2021 fiscal years by 2.2 percent (National Association of State Budget Officers, 2021b). Nonetheless, Bartik's early projection is quite close to what Congress would ultimately deliver across four major pieces of legislation: approximately $900 billion in federal support for state and local governments.

The disparity between analysts' initial projections and the pandemic's realized impacts on state and local tax revenues provides important lessons for the design of future state and local fiscal assistance. A first lesson is that formula-driven aid, which adjusts automatically in response to economic conditions, has a crucial advantage over ad hoc fiscal assistance packages. For example, the Congressional Budget Office's dire economic forecasts from the pandemic's early months need not have served as the principal basis for the design of fiscal assistance packages. Had the forecasts of need been updated to reflect conditions on the ground, for example, Bartik's unemployment-based estimates would ultimately have called for around $400 billion in aid rather than $959 billion.

Economic forecasts from the pandemic's initial months were wrong in no small part because they did not (and were not meant to) incorporate the economic effects of the pandemic relief packages that Congress had not yet authorized. Pandemic relief

packages would ultimately buoy household incomes and firms' balance sheets such that aggregate income *exceeded* pre-pandemic forecasts. By buoying both incomes and spending, these relief packages bolstered state and local governments' tax bases. It was therefore a mistake for forecasters to view the "shortfalls" facing households, businesses, and governments as separate gaps in need of being filled independently, when in fact they were closely intertwined. A benefit of formula-driven automatic stabilizers that incorporate new information as it becomes available is that they take these interactions into account.

A second lesson for the design of automatic stabilizers is that the unemployment rate is not the most suitable macroeconomic aggregate for forecasting revenue shortfalls. Fiscal assistance formulas commonly call for aid to depend on local unemployment rates. However, these unemployment rates connect only indirectly to state and local tax bases. COVID-era analyses that forecasted revenue shortfalls based on variables that proxy more directly for tax bases tended to produce smaller and more accurate forecasts of revenue shortfalls (Auerbach et al., 2020; Clemens and Veuger, 2020a, 2020b; Chernick et al., 2020; Whitaker, 2020a, 2020b). These analyses used more detailed information than the analyses based primarily on unemployment-rate predictions. Clemens and Veuger (2020a, 2020b), for example, used aggregate income to proxy for the income tax base, and consumption to proxy for the sales tax base. Likewise, by accounting for industry variations in job losses in their analysis of the income tax base, Auerbach et al. (2020) captured the pandemic's disparate impact on relatively low-paying industries, which would prove to moderate the decrease in individual income tax revenues. And Whitaker (2020a, 2020b) improved sales tax receipts forecasts by accounting for variations in spending across consumption categories. Disaggregated spending data proved essential for tracking the performance of typical sales tax bases during the pandemic. Consumers' shift away from services and toward goods tended to enhance sales tax collections, since states' sales tax bases exempt most services and rely disproportionately on goods (Kaeding, 2017).

Figures 1 and 2, which present time series for the unemployment rate, aggregate income, services consumption, and goods consumption during the COVID-19 pandemic (Figure 1) and during the Great Recession (Figure 2), illustrate the relevance of benchmarking fiscal assistance to proxies for tax bases. During the Great Recession, these macroeconomic time series moved in unison: unemployment rose substantially while income, services consumption, and goods consumption all declined relative to trend. Consequently, the particular mix of macroeconomic data used in a fiscal-assistance formula would not have made an appreciable difference, as unemployment, income, and consumption all indicated a similar need for assistance. During the COVID-19 pandemic, by contrast, the implications of unemployment, income, and consumption data diverged. While unemployment remained elevated (though less

than initially expected), pandemic relief packages caused incomes to rise relative to trend. Services consumption declined relative to trend, and goods consumption rose relative to trend after a short-lived decline. State governments' heavy reliance on both income taxes and the taxation of goods played an important role in state tax revenues exceeding pre-pandemic forecasts (National Association of State Budget Officers, 2021b).

Figure 1. Income and Expenditures over the Pandemic
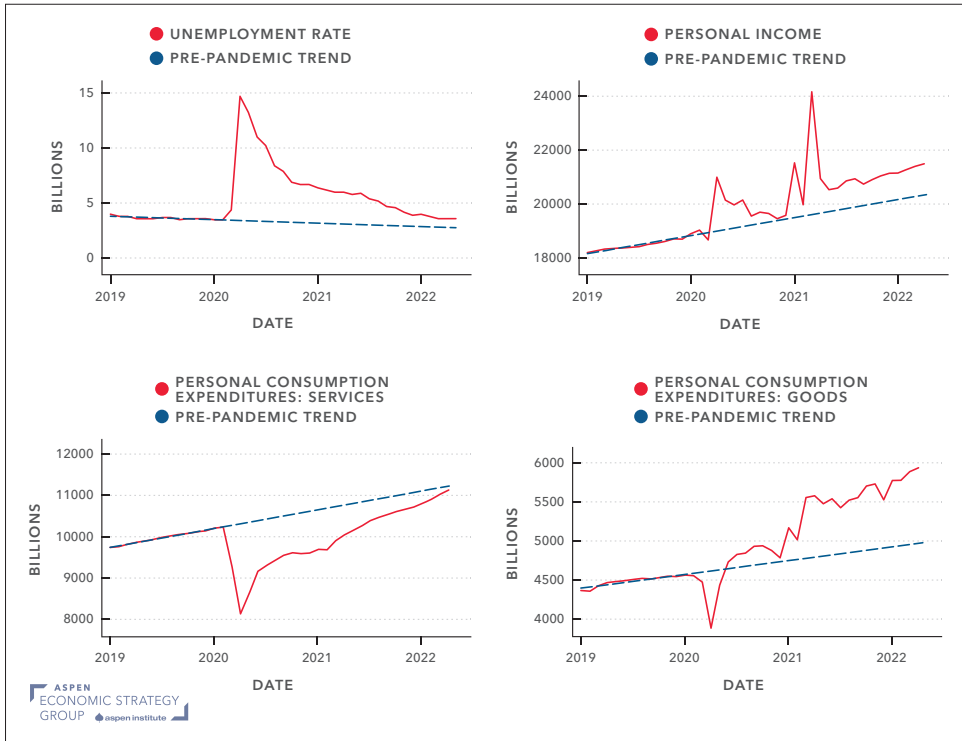
Note: The figure presents national time series on the unemployment rate (top left), personal income (top right), personal consumption expenditures on services (bottom left), and personal consumption expenditures on goods (bottom right). Underlying data are from the US Bureau of Labor Statistics and the Bureau of Economic Analysis. The dashed blue lines in each panel, labeled Pre-Pandemic Trend, are simple linear time trends estimated using monthly data from January 2019 through February 2020.

Figure 2. Income and Expenditures over the Great Recession
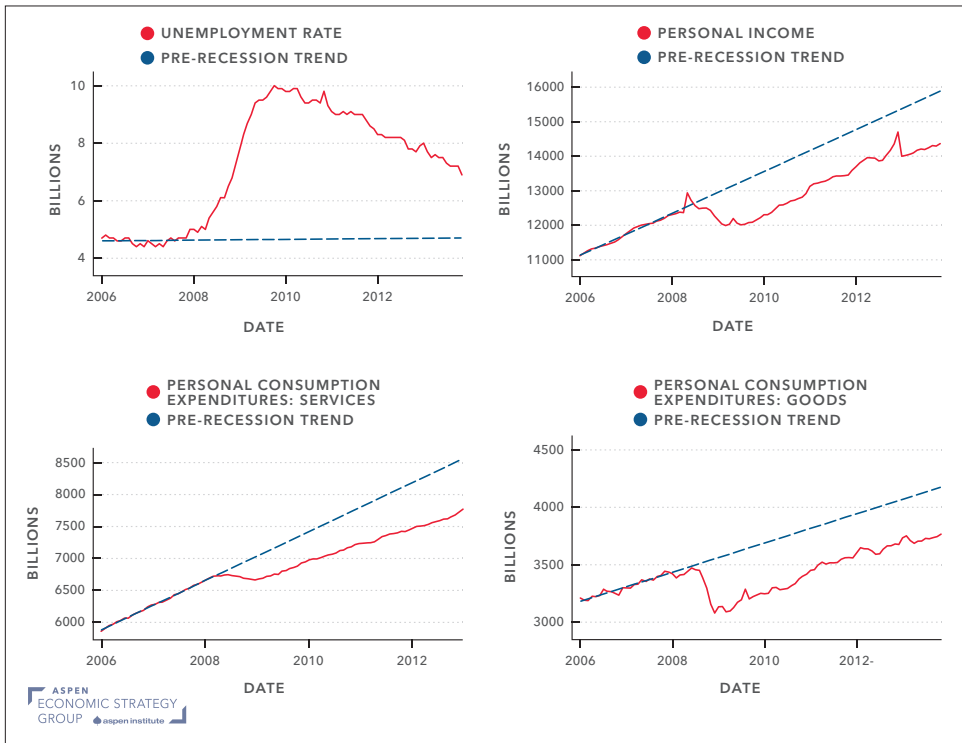
Note: The figure presents national time series on the unemployment rate (top left), personal income (top right), personal consumption expenditures on services (bottom left), and personal consumption expenditures on goods (bottom right). Underlying data is derived from the US Bureau of Labor Statistics and the Bureau of Economic Analysis. The dashed blue lines in each panel, labeled Pre-Recession Trend, are simple linear time trends estimated using monthly data from January 2006 through December 2007.

Ultimately the congressional response delivered far more fiscal assistance than state and local governments needed to balance their budgets, by several hundred billion dollars. This error is particularly frustrating when considered in tandem with Congress' other legislative responses to the pandemic. Through mid-2022, for example, Congress has struggled to pass legislation that would dedicate appropriate funds to COVID-19 therapeutics and vaccines, which would cost less than the fiscal assistance packages by an order of magnitude (Ruoff and Wilkins, 2022).

4. Undesirable Features of the Federal COVID-19 Aid to States and Localities

In addition to its overall size, two key features of federal fiscal relief to state and local governments were less than ideal from an economic perspective: (1) the delay and uncertainty around its eventual design and size and (2) the role of politics in shaping how funds were allocated across states. This section describes those features.

The $900 billion in total federal funds for state and local governments were contained in four distinct pieces of legislation. The CARES Act of March 2020, the Families First Coronavirus Response Act (FFCRA) of March 2020, the Response and Relief Act (RRA) of December 2020, and the ARPA of March 2021 were enacted during an approximately one-year period that spanned two different presidential administrations.

These four pieces of legislation provided fiscal assistance on a scale that reflected the most pessimistic budgetary assessments from the early months of the pandemic. At the same time, by delaying approval of more than half of the fiscal assistance until March 2021, a year after the start of the pandemic, Congress failed to provide clarity to state and local policymakers as they drew up their budgetary responses to the downturn (cf. Sheiner, 2022). Because both the RRA and the ARPA were enacted well into the pandemic's second fiscal year, state and local revenue forecasts and spending plans could not take these funds into account when they were needed most. Furthermore, the fiscal support promised in the March 2021 American Rescue Plan Act in particular seemed unlikely to take effect until the Democratic Party secured control of the Senate with wins in the January runoff elections in Georgia.

> *"The disproportionate representation in Congress of states with fewer residents led to greater per capita fiscal support directed toward those states."*

Politically-driven small-state bias, arising from the underlying political processes that determine Congress' composition, also affected the shape and scope of the fiscal assistance directed to states during the pandemic. As illustrated in Panel A of Figure 3, the disproportionate representation in Congress of states with fewer residents led to greater per capita fiscal support directed toward those states. In Clemens and Veuger (2021) and Clemens, Hoxie, and Veuger (2022), we show that this small-state bias was substantial. Across the four bills, an additional Senator or Representative per million residents translated to an additional $530 to $1,450 in aid per capita. The smallest and hence most over-represented states enjoyed allocations in excess of $3,000 per capita larger than the largest and least represented states.

The transition from divided government to a Democratic trifecta in late January 2021 changed the relative power held by Democrats and Republicans, and shifted the allocation of resources as well. Panel B of Figure 3 demonstrates this shift. As we show in Clemens and Veuger (2021), states with congressional delegations more aligned with the Democratic Party benefited from the swing in political momentum. In the ARPA, states with unanimously Democratic delegations received approximately $300 more per resident than did states with entirely Republican delegations, as compared against the distributions in previous bills. This change reflected two factors. First, the modest skew towards Democratic-leaning states that pervaded all four relief packages was amplified by ARPA's sheer size. Second, the distribution of transportation funds and, to a lesser extent, general relief funds, skewed more strongly toward Democratic-leaning states in the ARPA than in the earlier relief bills.

The conceptual considerations discussed in this and the previous section suggest that federal fiscal relief to states and localities during the COVID-19 pandemic was too generous, ill-timed, and targeted, at least in part, in accord with political pressures. The next section provides evidence from a results-based perspective: how did fiscal assistance impact macroeconomic and public-health outcomes?

Figure 3. Average Funds Per Capita Versus Congressional Representation and Congressional Democratic Party Share

A. STATES DIVIDED INTO TERCILES ACCORDING TO
SENATE AND HOUSE REPRESENTATION PER CAPITA

● EDUCATION   ● RELIEF   ● TRANSIT

AVERAGE FUNDS PER CAPITA

B. STATES DIVIDED INTO TERCILES ACCORDING TO THE DEMOCRATIC
PARTY'S SHARE OF THE CONGRESSIONAL DELEGATION

● EDUCATION   ● RELIEF   ● TRANSIT

AVERAGE FUNDS PER CAPITA

ASPEN
ECONOMIC STRATEGY
GROUP ◆ aspen institute
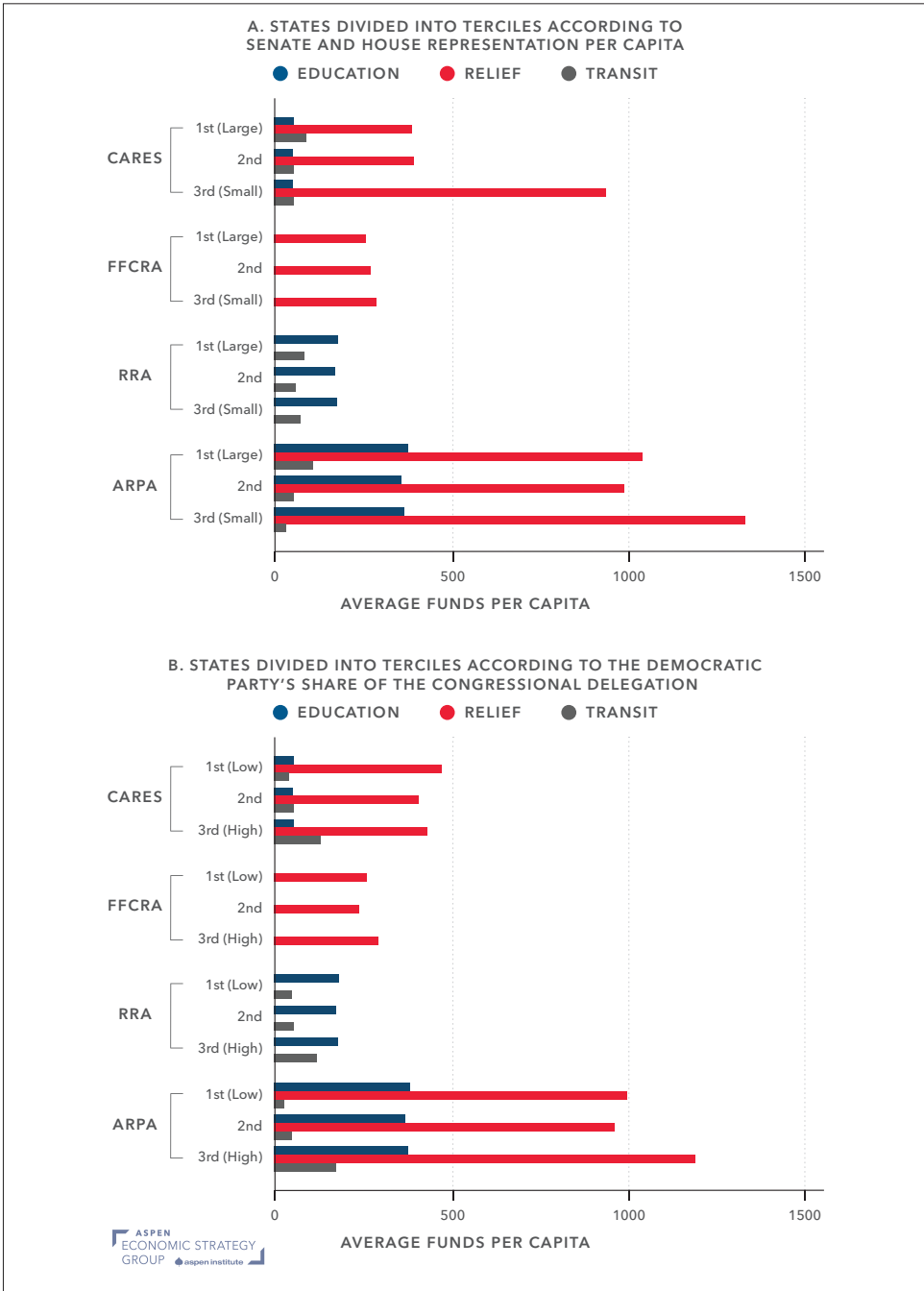
Note: This figure replicates Figure 1 from Clemens and Veuger (2021) and presents data on the distribution of COVID relief funds per capita across the four major pieces of COVID relief legislation. Panel A groups states into terciles by the number of Senators and Representatives per million residents, with the first tercile containing the most underrepresented states and the third tercile containing the most overrepresented states. Panel B groups states into terciles by the share of their congressional delegation that are Democrats, with the first tercile containing states with less Democratic congressional delegations and the third tercile containing states with more Democratic congressional delegations.

5. Economic Impact of Federal COVID-19 Aid to States and Localities

In early 2022, Deputy Secretary of the Treasury Wally Adeyemo argued that the aid to state and local governments in the American Rescue Plan Act would "ensure that governments across the country have the flexibility they need to vaccinate their communities, keep schools open, support small businesses, prevent layoffs, and ensure a long-term recovery" (US Department of the Treasury, 2022). Preserving state and local government employment, macroeconomic recovery, and the delivery of vital health and educational services were the primary stated goals of the federal government's fiscal assistance to state and local governments during the pandemic.[3]

To what extent were these goals accomplished? In Clemens, Hoxie, and Veuger (2022), we investigate that question empirically and offer a decidedly mixed assessment. Using the overallocation of funds to states over-represented in Congress as a source of quasi-experimental variation, we estimate that the federal government allocated $855,000 for each state or local government job-year preserved, with plausible estimates ranging from $400,000 to $1.3 million. We find little evidence for spillovers to either the broader labor market or to macroeconomic metrics including output and income.

These effects are modest when compared to the estimated effects of similar support programs during previous periods. For instance, research on the effects of the American Recovery and Reinvestment Act of 2009 suggest an employment multiplier ranging between $50,000 and $112,000 per job-year (Ramey, 2019), approximately an eighth of the cost per job-year compared to pandemic-related state and local aid. Our estimated cost per job-year also exceeds that of the Paycheck Protection Program (PPP), which Autor et al. (2022a and 2022b) describe as costly. Furthermore, we find null effects on aggregate income and output multipliers, while estimates from previous periods dating back to the 1930s range from 0.5 to 2 (Ramey, 2019; Chodorow-Reich, 2020).

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3   As the Biden administration (The White House, 2021) stated elsewhere, the Act would: "Distribute more than $360 billion in emergency funding for state, local, territorial, and Tribal governments to ensure that they are in a position to keep front line public workers on the job and paid, while also effectively distributing the vaccine, scaling testing, reopening schools, and maintaining other vital services. State and local employment has fallen by around 1.4 million jobs since the pandemic began including layoffs of 1 million educators, compared to around 750,000 job losses during the Great Recession."

Explanations for the different impacts of federal fiscal assistance during the COVID era as compared to the Great Recession plausibly include the volume of fiscal assistance provided, the ongoing measures taken by public and private actors alike to mitigate the spread of the novel coronavirus, and the pandemic's macroeconomic context, which features substantial inflationary pressures, whereas the Great Recession featured shortfalls in aggregate demand.

Additional goals for state and local aid during the pandemic included the maintenance of education services and the provision of public-health services. The latter includes the distribution of tests and vaccines and the collection of data describing the pandemic's advance. The evidence of effectiveness here is also somewhat mixed. In Clemens, Hoxie, Kearns, and Veuger (2022) we analyze whether states that received more generous allocations of fiscal assistance established more robust testing and vaccination campaigns. Relying once more on small-state bias as our instrument, we find that fiscal assistance had at most a modest impact on the pace of vaccine rollouts. However, we also find that federal dollars may have improved the equitability of vaccine administration and had a substantial impact on the volume of tests administered.

> *"Federal dollars may have improved the equitability of vaccine administration and had a substantial impact on the volume of tests administered."*

While improvements in vaccine equity and testing rollouts have the potential to be valuable, such gains surely fall far short of justifying the expenditure of hundreds of billions of dollars. A full cost-benefit analysis would include additional outcomes, such as the delivery of in-person education, learning outcomes, graduation rates, and rates of college matriculation, particularly given the strains the pandemic placed on education. These outcomes will be important topics for future research.

Various financing mechanisms are available to federal policymakers looking to advance specific goals. The advantage of general fiscal assistance is that states retain maximum flexibility to deploy that money toward the uses they deem best, limited only by the amount of funding delivered. But because federal and state governments may not share the same goals or policy preferences, federal policymakers might prefer to constrain states' spending, allocating the money only for particular uses or toward particular objectives. And during times of crisis, when the required emergency services might vary in substantial and unpredictable ways, efforts to design a single automatic stabilizer to meet all needs simultaneously may be complicated.

In light of these tradeoffs, an attractive approach is to separate the goal of revenue stabilization from the goal of financing emergency spending needs. Emergency

spending needs might best be met through funds set aside to deliver on federal commitments that arise in the wake of a formal declaration of a Natural Disaster, as through the Stafford Act, or through a Public Health Emergency.

The federal government's treatment of the Medicaid program during the COVID-19 pandemic provides an interesting case study of the links between fiscal instruments and program-specific goals. The federal government made available an important funding stream—a 6.2 percentage point increase in states' Federal Medical Assistance Percentages (FMAPs)—contingent on their compliance with a requirement to maintain continuous coverage of Medicaid beneficiaries. As analyzed by Clemens, Ippolito, and Veuger (2021), this FFCRA requirement generated a remarkable expansion of the Medicaid program. The continuous coverage provision required, for example, that beneficiaries not be disenrolled from the Medicaid program for exceeding the program's usual maximum income limit. By making the FMAP increase contingent on continuous coverage, the federal government blurred the line between general and targeted fiscal assistance. We make two observations about the federal government's use of the FMAP and continuous coverage provisions in this context.

First, linking each state's fiscal assistance allocation to their pre-pandemic Medicaid spending does not serve clear revenue stabilization goals. Notably, this approach neither targets assistance based on increases in program enrollment nor does it employ estimates of fiscal need. In fact, as we discuss in our work with Ippolito (2021), transfers triggered by the FMAP increase had been, as of late 2020, less correlated with increases in Medicaid spending than was the funding included in the American Rescue Plan.

Second, the continuous coverage provision has created an as-of-yet unresolved enrollment cliff. Because the determination of a Public Health Emergency, first declared by Secretary Azar on January 31, 2020, has now been renewed for over two years, the continuous coverage provision has also remained in effect. Between February 2020 and May 2022, national Medicaid and CHIP enrollments rose by 18 million beneficiaries, of whom 12 million were adults (Centers for Medicare and Medicaid Services, 2022). The timing of this rise, which included 11 million net new beneficiaries after September 2020, suggests that the continuous coverage provision was a primary driver of increased enrollment, rather than insurance losses connected to the pandemic's impact on the labor market. Indeed, rates of employer coverage were surprisingly stable over the first year of the pandemic and declined by only 1-3 percent during the recession (Ruhter et al., 2021). As many as 18 million Medicaid and CHIP beneficiaries may thus be poised to lose coverage when the continuous coverage provision lapses and eligibility is re-examined. This ad hoc measure has unintentionally created a scramble for guidance and transition assistance among state-level policymakers and program administrators (Gould, 2021).

6.   Three Specific Lessons from the COVID Era for Setting the Amount of Federal Assistance to State and Local Governments

Our observations result in three clear implications for the policy question of how to determine the amount of federal aid state and local governments need:

### 1. Rule-based determinations are likely more desirable than discretionary practices.

Formulaic approaches—as opposed to discretionary allocations—hold the promise of producing fiscal assistance packages that are more proportionate to the magnitude of state and local budget shortfalls. The two most recent downturns saw allocations of relief to state and local governments that were perceived as off the mark (Gordon, 2012; Oliff et al., 2012). After the Great Recession, observers argued that this led to persistent employment losses and contributed to the nation's slow recovery. In the current pandemic cycle, wrong-sized allocations have added inflationary pressure in a context of excess demand and increased the federal debt in an environment of surging interest rates.

2. Rule-based determinations should be based on indicators that are closely tied to revenue.

The most pessimistic estimates of likely state and local revenue shortfalls were based on poor proxies for revenue, such as the expected unemployment rate. A robust research literature demonstrates that tax bases, and forecasts thereof, are superior proxies for estimating revenue shortfalls (Auerbach et al., 2020; Clemens and Veuger, 2020a, 2020b; Chernick et al., 2020; Whitaker, 2020a, 2020b).

Tax bases have also recovered faster than expected in the COVID era, in part due to other policy interventions targeting households and firms. This context contrasts with the lasting demand shortfalls that followed the global financial crisis of the late 2000s (Eichengreen, 2015; Summers, 2015; Eggertsson et al., 2019). And while CBO forecasts, central to many of the analyses discussed, do not account for policy changes that have not yet been approved, policymakers must update their estimates of state and local needs as information becomes available, including regarding legislative relief packages that are likely to pass. As Figure 4 illustrates, updating would have dramatically reduced overshooting. The revenue shortfalls implied by May 2020 forecasts for unemployment, income and consumption far exceeded those implied by subsequent forecasts and the realized performance of the economy.

Figure 4. Estimated Shortfall from 2020 (Q2) – 2022 (Q2)
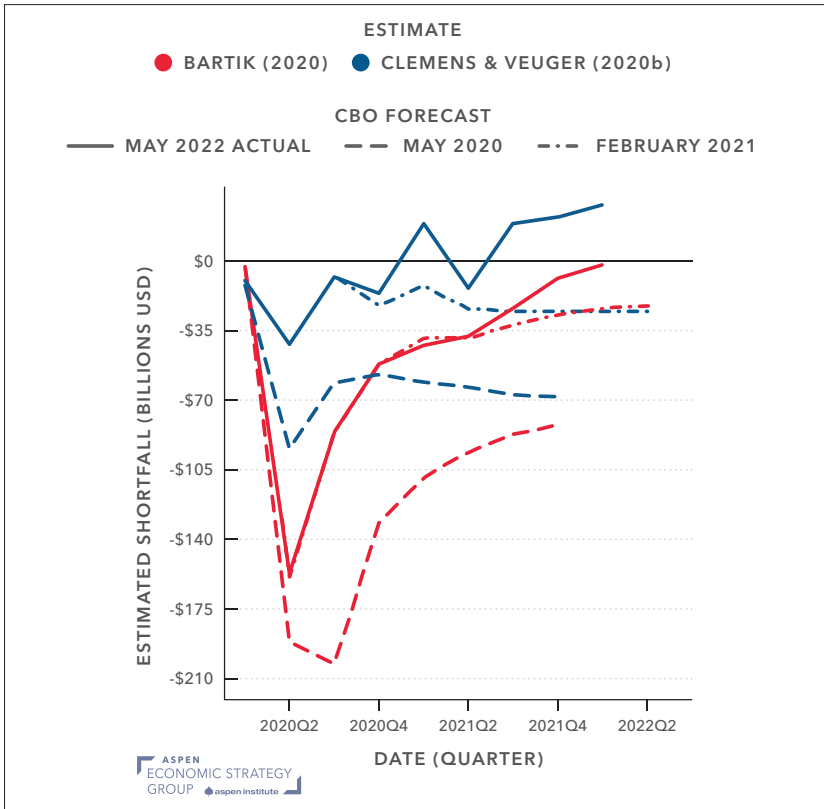
Note: This figure presents estimates of revenue shortfalls based on the approaches in Bartik (2020), in red, and in Clemens and Veuger (2020b), in blue. The solid lines are estimated using realized GDP, employment, and consumption as of May 2022, from the Bureau of Economic Analysis and the US Bureau of Labor Statistics. The long-dashed and short-dashed lines rely on macro forecasts from the Congressional Budget Office from May 2020 and February 2021, respectively.

Fiscal assistance based on a formulaic approach incorporating the most up-to-date information delivers the best of both worlds: support of the right size and predictability for state and local policymakers. If macroeconomic forecasts are too pessimistic, for example, a state's own-source revenue will be greater than expected while the support it receives from a formula-driven assistance model will simultaneously be decreased. Similarly, if forecasts are overly optimistic, own-source revenues will be lower than expected while federal aid will be higher. The key outcome for state and local policymakers is that combined aid and own-source revenues will, in both instances, hew closely to their forecast for total revenue. Indeed, offsetting unexpected revenue shocks is precisely the purpose an effective stabilization program is meant to serve.

3. The goals of revenue stabilization and funding for crisis-specific spending needs can most effectively be achieved if they are decoupled from one another.

Federal policymakers may also want to provide targeted relief or to guide state and local policymakers toward specific spending priorities, such as vaccine distribution during the COVID pandemic. For these purposes, discretionary legislation is more appropriate. Targeted relief can be tied to emergency declarations, while federal paternalism can be embodied in specific, narrowly defined new spending programs that accompany the automatic stabilizers proposed here. These measures should, in our view, be decoupled from revenue stabilization. Blurring the line between revenue stabilization and other goals (such as public health) can, as discussed above in the context of Medicaid, result in unintended consequences and dilute the efficacy with which either outcome is targeted. Policymakers instead should heed the Tinbergen (1952) rule by targeting distinct policy goals with distinct policy tools. Independent policy objectives are best met with independent policy instruments.

> *Fiscal assistance based on a formulaic approach incorporating the most up-to-date information delivers the best of both worlds: support of the right size and predictability for state and local policymakers.*

7. Reforming the Design of Federal Aid to States and Localities in Light of the Above

There has long been support for more automatic stabilizers in the US system of fiscal federalism. A leading proposal advanced by Fiedler, Furman, and Powell (2019) would automatically increase federal shares of spending on Medicaid and the Children's Health Insurance Program when a state's unemployment rate exceeds a pre-specified level determined by the state's average historical unemployment rate. We evaluate this proposal against the three criteria described above.

By incorporating economic data into a formula that automatically adjusts FMAPs, the federal government's fiscal relief packages would better reflect changes in economic circumstances. But the leading proposal's reliance on unemployment rates can result in aid that is poorly correlated with revenue shocks, as described above. Nor do frequent updates fully address this problem. These FMAP adjustments would also be oddly targeted in that both the upside and downside will be exaggerated in states with relatively high baseline levels of Medicaid spending compared to their peer states.[4]

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4   Because the Fiedler, Furman, and Powell (2019) proposal is designed to be budgetarily neutral at the state level, this

Instead, federal assistance should be tied to proxies for the principal state and local tax bases, such as state or nationwide measures of consumption and income. These tax bases are closely tied to revenue, in many cases proportionately so.

An ostensible objection to relying on consumption and income data—the two most important tax bases for our purposes—is that they do not become available at the same speed as estimates of the unemployment rate. However, for macroeconomic stabilization purposes it is reasonable to rely on nationwide measures of income and of the components of consumption that correspond closely to states' tax bases. These data become available within a month of national unemployment data, a rather modest data lag that would have little impact on the timing with which assistance is delivered.

> *"Instead, federal assistance should be tied to proxies for the principal state and local tax bases, such as state or nationwide measures of consumption and income. These tax bases are closely tied to revenue, in many cases proportionately so."*

Moreover, the timing of aid to state and local governments is less urgent than the timing of aid to households. A program of automatic stabilizers would enable subnational officials to conduct their usual budgetary processes without the threat that revenue shortfalls will require an unwelcome search for sudden spending cuts and tax increases. The certainty that aid is forthcoming will suffice in all but the most extreme cases, for which more targeted discretionary support would presumably be better suited. Basing such aid on consumption and income data would not be worth waiting years but is well worth waiting a month.

Relying on statewide, rather than national, macroeconomic data would entail tradeoffs, including an additional delay as the data is gathered. Further, the use of statewide data increases the risk that state and local governments might distort their tax policies to "game" the metrics on which federal assistance is calculated. Using statewide measures to calculate federal assistance also disincentivizes states from relying on broad tax bases that can help to insulate states and localities from idiosyncratic shocks. It does this by reducing the cost of narrowly targeting taxation on particular income or consumption types.

Relying on nationwide measures, however, reduces states' insurance against state-specific disturbances. Hawaii, for example, is more exposed to the tourism industry than are other states, and would have been underserved during the pandemic by

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would not be expected to result in a redistribution of dollars across states over the long run. The odd targeting property is that the amount of revenue stabilization, on both the upside and downside, would be arbitrarily greater in states that happen to spend more generously on Medicaid than their stingier counterparts.

a revenue stability program based on national metrics. A second-order downside of relying on nationwide measures is therefore that aid would not be tailored to specific states' tax bases, which may well have been carefully chosen to fit a state's circumstances.

Setting aside these issues, we now consider how the generosity of revenue stabilization transfers should be calibrated. We propose a simple approach that would achieve several goals, including long-run budget neutrality, timely injections of aid during recessions, an expectation of aid when forecasters anticipate revenue shortfalls, and ease of implementation. We illustrate the general approach by providing a detailed look at two examples: income tax revenue shortfalls and sales tax revenue shortfalls.

We propose the straightforward use of aggregate income as a proxy for the income tax base, and consumption expenditures on goods as a proxy for the sales tax base. During the Great Recession, each of these variables dropped substantially below their pre-recession trends.

We propose benchmarking aid allocations using a simple algorithm for assessing the performance of major tax bases relative to trend. The basic idea is to forecast the growth of each tax base based on its recent history. A key parameter is therefore how many years' worth of recent historical data to include in the forecasting formulae. Here we illustrate how such forecasts would have performed during the Great Recession had forecasts been based on a seven-year history of monthly data on income or goods consumption.

The technical details are as follows: We begin by indexing the income and goods consumption series such that each takes a value of one in December 2007. Consider by way of illustration the forecast for income in January 2009. The forecast for income in January 2009 is constructed by estimating the trend growth in income from January 2002 through December 2008 and using the estimated trend to forecast one month ahead. The estimated shortfall of the income tax base is equal to the forecasted value of the indexed series minus the realized value of the indexed series. A positive value, as we observe in January 2009, indicates that income came in below trend. Our algorithm would therefore call for positive allocations of federal fiscal assistance.

Figure 5 illustrates the resulting "indexed shortfalls" for each month from January 2003 through December 2019. Both series would have called for net payments from states into the stabilization program during the mid-2000s expansion, comparatively large payments to states during the Great Recession, and modest but sustained net payments from subnational governments into the stabilization program during the subsequent economic expansion.

The precise magnitude of revenue stabilization payments would depend on the program's additional details. The income shortfall series, for example, takes an average value of 4.2 percent across the period extending from July 2008 through December 2010. The series on goods consumption takes an average value of 6.2 percent over that same time period. Benchmarked to 2008 state and local sales- and income tax revenues, which totaled $755 billion nationwide, the implied revenue shortfall would be around $79 billion over this two-and-a-half-year period if revenues move proportionally with both revenue bases.

Two additional questions need to be answered to arrive at a comprehensive revenue stabilization program. First, federal policymakers may want to account for the extent to which a revenue base moves disproportionately relative to its tax base. A progressive income tax, for example, will typically move more than proportionately with the income tax base. A second question relates to revenue from income and sales taxes accounting for a moderate fraction of state and local governments' total own-source revenues. In 2008, for example, these tax revenues accounted for only 39 percent of total own-source revenues. Scaling the $79 billion estimate from above by this fraction, for example, would yield an estimated revenue shortfall of $204 billion. Interestingly, this estimate is roughly in line with the amount of aid distributed through the ARRA. As a result, analysts who perceived the ARRA's fiscal assistance to be insufficient might prefer a more amplified scaling from indexed shortfalls and windfalls into the stabilization program's outflows and inflows. This scaling factor is a key choice on which policymakers would need to decide. An alternative to scaling up from estimated income- and sales tax shortfalls would be to expand the set of matches between revenue sources and macroeconomic data. This approach follows the work of Whitaker (2020a and 2020b), which enables a more detailed accounting for likely revenue shortfalls. The tradeoff here is between precision and simplicity.

Once these questions are settled, the next step is to secure budget neutrality over the business cycle. The algorithm we sketched above provides one pathway for achieving that goal. That is, the indexed shortfalls for both income and goods consumption average close to zero, both over the time period shown in Figure 5 and when estimated over longer time horizons. One key consideration when fine-tuning such an algorithm is how quickly the algorithm transitions from periods of payouts to periods of pay-ins. The transitions displayed in Figure 5 strike us as reasonable. Alternative paths can be obtained either by tweaking our algorithm or by adopting an alternative pay-in structure such as a premium structure, as would be included in the revenue insurance option we discuss below.

Figure 5. Indexed Tax-Base Shortfalls and Surpluses Based on Simple Linear Forecasts
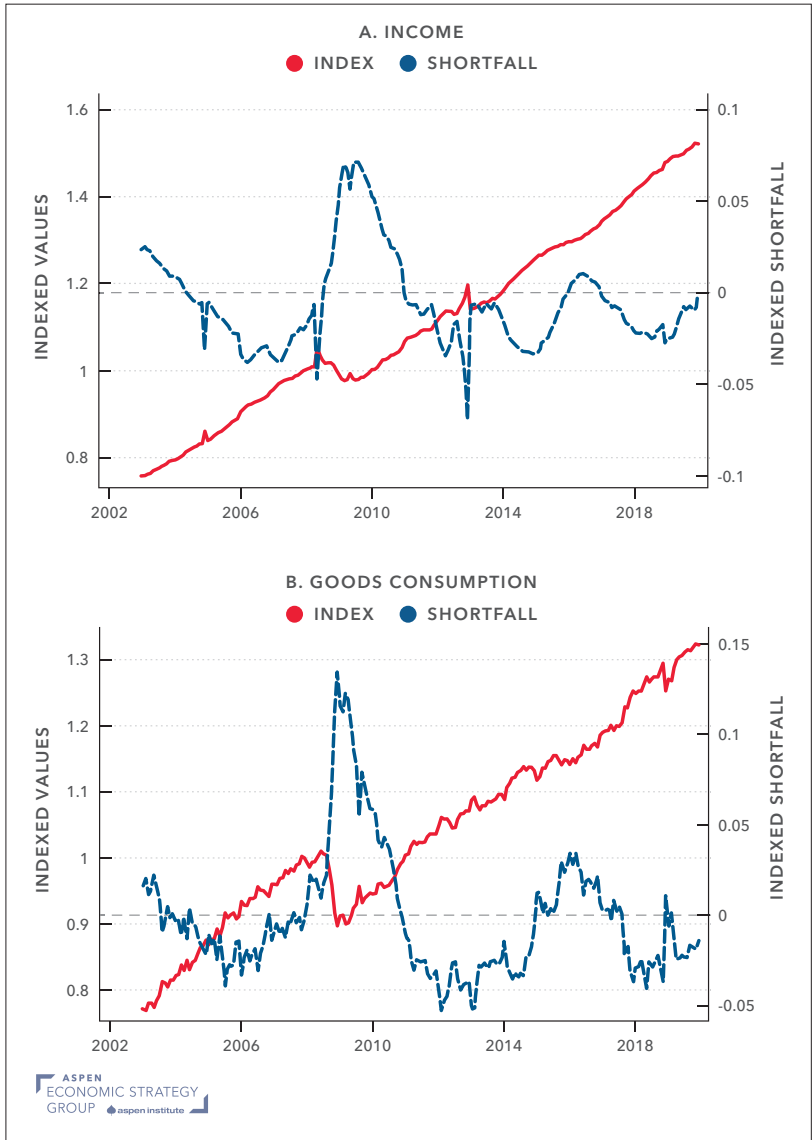
Note: This figure presents data on personal income and personal consumption expenditures on goods. The underlying data is derived from the Bureau of Economic Analysis. The "Indexed PI" and "Indexed PCEG" series are obtained by straightforwardly normalizing the income (PI) and goods consumption (PCEG) series relative to their values in December 2007. Shortfalls are calculated as described in the text.

What would our algorithm have implied for payouts and pay-ins during the COVID-19 pandemic? Because both income and goods consumption were above trend for most of the pandemic, our algorithm would have called in large part for net pay-ins, with the exception of a substantial early-pandemic payout associated with a brief period during which the consumption of goods collapsed alongside the consumption of services. While this outcome may be surprising in light of early-pandemic forecasts, it corresponds appropriately with the path of subnational tax revenues. As the National Association of State Budget Officers has reported, revenues were ultimately 2.2 percent higher than pre-pandemic forecasts for the 2020 and 2021 fiscal years (National Association of State Budget Officers, 2021b).

The absence of large payouts during the pandemic might initially strike many as a bug rather than a feature. A common intuition suggests that pandemic-driven uncertainty justified substantial payouts. This intuition, however, misses a central benefit of a well-designed revenue stabilization program: revenue stabilization programs stabilize both revenues *and* revenue forecasts. Under a revenue stabilization regime, a revenue agency that forecasts contracting tax bases would also forecast an inflow of federal assistance. And as the pandemic unfolded, resilient revenue bases would have resulted in higher-than-expected tax revenues and lower-than-expected assistance payments. Whether the macroeconomic forecast turns out to be right or wrong, the forecast for tax revenues and federal transfers combined can remain on target.

8. Reforming the Delivery of Federal Aid to States and Localities

We propose three options for how fiscal assistance, calculated on the basis of shocks to tax bases and neutral over the business cycle, can be delivered.

1. *Grants-in-aid*

The first option is the most straightforward: the federal government could continue its current practice of relying on grants-in-aid—federal money granted to fund projects or programs. Grants-in-aid tend to have long-run budgetary implications, since debates over fiscal assistance arise only when there is a reason to send aid and not when funds are left over after the economy recovers. The algorithm described above has the benefit of achieving revenue neutrality so long as growth *rates* are neither persistently rising nor persistently declining. Achieving budgetary neutrality is a key reason why automatic adjustments to an existing stream of funding, such as federal Medicaid spending (as in the 2019 proposal of Fiedler, Furman, and Powell), can be an attractive mechanism for delivering the aid called for by the stabilization formula.

2. A Federal Lending Program

The second option, a lending program, has the benefit of providing a straightforward means to overcome concerns related to budgetary neutrality. A further benefit of operating through a lending program is that states would be encouraged to request only those funds that suit their needs, making federal efforts to measure the magnitude of shocks less necessary. Nevertheless, capping the size of loans that can be requested through such a program may be helpful to avoid the temptation of after-the-fact bailouts and to avoid political lending cycles at the state and local level.

One major concern with a lending program is that it sits uneasily with the spirit of balanced-budget requirements that create the need for a federal role in stabilizing state and local government revenues. Whether a lending program can be structured to sidestep this concern, either by lending to state rainy-day funds or by varying FMAPs in a countercyclical, state-specific fashion, remains an open question. An objection to such an approach is that withholding future Medicaid matching funds may not be politically palatable or credible.

3. A Revenue Insurance Scheme

A final option is for the federal government to sponsor a revenue insurance scheme.[5] Such a scheme would require state and local governments to pay in premiums, and would enable them to collect payouts when negative shocks materialize. As with grants-in-aid, it would be necessary for federal policymakers to specify formulae that determine when payouts are appropriate and how large those payouts should be in response to particular economic shocks. The formula we propose above strikes us as sensible for calculating the payouts to be made through a program of revenue insurance, just as it could be used to calculate grants-in-aid.

The core difference between the insurance and grants-in-aid models involves their funding. When implemented through grants-in-aid, our formula would imply both payments out and payments in. Under the insurance model, by contrast, the necessary premiums must be inferred based on estimates of the expected stream of payouts. A benefit of the insurance program as compared to other options is that premiums can be spread evenly across the business cycle. Calculating the needed premiums, however, would pose both political and conceptual challenges to federal administrators. And a question policymakers must answer is whether premiums and payouts ought to be determined based on nationwide factors or state-specific factors.

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5   In the spirit of Shiller (2004), who argued for widespread adoption of ideas from financial risk management throughout the economy.

Under the insurance model, a key question is how the federal government might incentivize the participation of states and other localities. An effective program would require sufficient incentives to ensure widespread if not universal participation by the states. It would be essential, however, for these incentives not to run afoul of the prohibition against federal "commandeering" exemplified for instance in *National Federation of Independent Business v. Sebelius*, 567 U.S. 519 (2012), a constitutional limitation on the federal government's ability to influence state budgetary choices. Negative incentives, such as FMAP or highway fund reductions for non-participants, could also play a role in inducing participation.

The three options sketched above—grants-in-aid, a loan program, and a revenue insurance program–-are each imbued with potential strengths and weaknesses. And there is reason to worry that budgetary neutrality may prove elusive. Formulas like those we propose above would deliver on budgetary neutrality only so long as Congress does not succumb to the temptation to postpone, reduce, or waive states' contributions during economic expansions. Grants-in-aid, as noted above, have arisen as ad hoc sources of assistance, and political pressures may similarly convert loans into grants. Such pressures may also make a revenue insurance model prone to underfunding, with top-ups arriving at future taxpayers' expense.[6] Additionally, while automatic stabilizers may make Congressional action less necessary during economic downturns, the allure of "saving the day" through ad hoc interventions will surely persist.

These issues notwithstanding, a well-designed program for stabilizing state and local government revenues has substantial advantages over current approaches. Under the status quo, booms and busts carry state and local governments through alternating cycles of bloat and beeeching the federal government for aid. A formula-based revenue stabilization program would relieve these pressures. States and other subnational governments would see their spending restrained toward responsible levels during booms, while assistance would flow formulaically during busts. During downturns, this flow would enable subnational budgeting agencies and federal policymakers to focus their attentions on the myriad other concerns facing their constituents.

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6   The insurance model of the Pension Benefit Guaranty Corporation (PBGC) provides an illustrative example. The PBGC's multi-employer program was projected in its 2020 report to become insolvent in 2026 (Pension Benefit Guarantee Corporation, 2020). This impending insolvency was pushed back through the Special Financial Assistance program legislated through the American Rescue Plan Act (Pension Benefit Guarantee Corporation, 2021).

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