AMY FINKELSTEIN
Massachusetts Institute of Technology

CASEY McQUILLAN
Princeton University

OWEN ZIDAR
Princeton University

ERIC ZWICK
University of Chicago Booth School of Business

The Health Wedge and Labor Market Inequality

ABSTRACT Over half of the US population receives health insurance through an employer with premium contributions creating a flat "head tax" per worker, independent of their earnings. This paper develops and calibrates a stylized model of the labor market to explore how this uniquely American approach to financing health insurance contributes to labor market inequality. We consider a partial-equilibrium counterfactual in which employer-provided health insurance is instead financed by a statutory payroll tax on firms. We find that, under this counterfactual financing, in 2019 the college wage premium would have been 11 percent lower, noncollege annual earnings would have been $1,700 (3 percent) higher, and noncollege employment would have been nearly 500,000 higher. These calibrated labor market effects of switching from head tax to payroll tax financing are in the same ballpark as estimates of the impact of other leading drivers of labor market inequality, including changes in outsourcing, robot adoption, rising trade, unionization, and the real minimum wage. We also consider a separate partial-equilibrium counterfactual in which the current head tax financing is maintained, but 2019 US health care spending as a share of GDP is reduced to the Canadian share; here, we estimate that the 2019 college wage premium would have been 5 percent lower and noncollege

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annual earnings would have been 5 percent higher. These findings suggest that health care costs and the financing of health insurance warrant greater attention in both public policy and research on US labor market inequality.

The gap in labor market outcomes between college- and noncollege-educated workers has widened in the United States over the last four decades. In 2019, the wages of college-educated workers were nearly twice as high as noncollege-educated workers, and college-educated workers also had much higher employment rates. A large and storied body of literature has explored the causes of this labor market inequality and its spectacular rise. This literature has uncovered a variety of contributing factors, including skill-biased technological change (Autor, Goldin, and Katz 2020; Katz and Murphy 1992; Bound and Johnson 1992; Goldin and Katz 2008; Acemoglu and Autor 2001), institutional changes such as the erosion of unions and worker bargaining power and a declining real minimum wage (Card, Lemieux, and Riddell 2004; Farber and others 2021; DiNardo, Fortin, and Lemieux 1996; Lee 1999), globalization (Feenstra and Hanson 2003; Goldschmidt and Schmieder 2017), and the sorting of workers across firms (Abowd, Kramarz, and Margolis 1999; Card, Heining, and Kline 2013; Song and others 2019). The increase in labor market inequality has not been limited to the United States, and many of these same forces may also drive similar trends in other Organisation for Economic Co-operation and Development (OECD) countries. Yet the level and growth in labor market inequality are particularly pronounced in the American case.

A uniquely American factor that may contribute to labor market inequality is the financing of health insurance through the workplace. About half of the US population—and virtually all of those with private health insurance—receive their health insurance through their employer or a family member's employer.[1] The government heavily subsidizes employer-provided health insurance by excluding any contribution employers make to their employees' health insurance premiums from employees' taxable income. This tax exclusion is the single largest federal tax expenditure. It costs the federal government about $300 billion a year (Congressional Budget Office 2019), or about two-fifths of the amount it spends on Medicare.[2]

1. Kaiser Family Foundation, "Health Insurance Coverage of the Total Population" [data set], www.kff.org/other/state-indicator/total-population/.

2. US Centers for Medicare and Medicaid Services, "National Health Expenditure Accounts: Historical," https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsHistorical.

A lot of literature in public finance has analyzed the impact of this tax subsidy on health insurance coverage, health care spending, and (skill-neutral) labor market distortions brought about by so-called job-lock (Feldstein 1973; Feldstein and Friedman 1977; Gruber 2000, 2002; Garthwaite, Gross, and Notowidigdo 2014; Gruber and Madrian 2004). However, the potential role for firm-based health care financing to contribute to labor market inequality in the United States has received comparatively little attention in either the public finance or the inequality literature.

Crucially, from the perspective of labor market inequality, health care costs for workers do not decrease as their earnings fall. Therefore, unlike other employee benefits that are designed to replace lost earnings, such as life insurance, disability insurance, or unemployment insurance, the cost of providing a worker with a given health insurance plan is a fixed dollar cost per worker, regardless of wage or earnings. This increases the price of lower-skilled labor relative to higher-skilled labor, a phenomenon we refer to as the "health wedge." The health wedge is substantial. Average insurance premiums for employer-provided health insurance were about $12,000 in 2019. This amount is about 25 percent of the average annual earnings for a full-time, full-year worker without a college education (about $50,000), and about 12 percent of the average annual earnings for a full-time, full-year college-educated worker (about $100,000; see table 1, panel A).

Several leading economists have recently and prominently conjectured that the health wedge has influenced US labor market inequality. Emmanuel Saez and Gabriel Zucman advance this hypothesis in *The Triumph of Injustice* (2019a), and summarize it in the popular press:

> Because health insurance premiums are fixed, the wage penalty is the same for a low-wage secretary as it is for a highly paid executive. This severely depresses wages for tens of millions of moderate-income workers. . . . It's the most unfair type of tax: A huge burden for low-wage workers and almost meaningless for the rich. (Saez and Zucman 2019b, pars. 6, 8)

Anne Case and Angus Deaton make a similar argument in *Deaths of Despair and the Future of Capitalism* (2020b), which they summarize in an op-ed:

> Employer-based health insurance is a wrecking ball, destroying the labor market for less-educated workers. . . . At the very least, America must stop financing health care through employer-based insurance, which encourages some people to work but it eliminates jobs for less-skilled workers. (Case and Deaton 2020a, pars. 11, 23)

This qualitative observation follows naturally from textbook models. The data are also suggestive of a potentially important role for the health wedge in contributing to US labor market inequality. Between 1977 and 2019, both the health share of GDP and the college wage premium roughly doubled (figure 1, panel A). Relative to other large OECD countries, the United States today is an outlier both in terms of the size of its health care sector and the college wage premium (figure 1, panel B). However, to our knowledge, we have little evidence of the quantitative importance of the health wedge for labor market inequality.

In this paper, we develop and calibrate a simple model of the labor market and use it to explore quantitatively how the US approach to health insurance financing may contribute to labor market inequality. Specifically, we ask what labor market outcomes would have been for full-time, full-year workers under two types of partial-equilibrium counterfactuals.

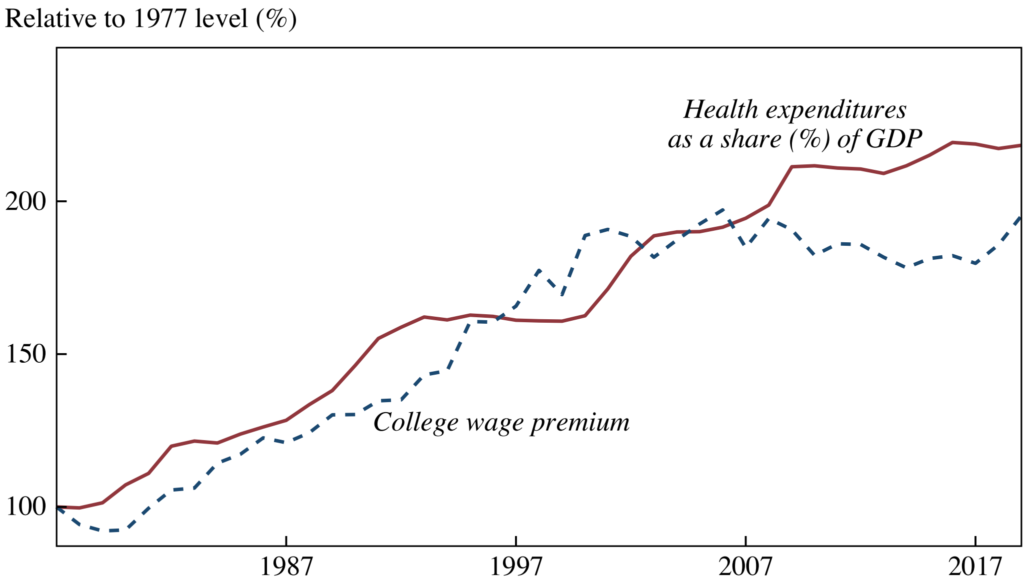
The first set of counterfactuals considers an alternative financing of health insurance through a national payroll tax on firms rather than through the current head tax approach. Specifically, we calculate what labor market outcomes would have been if employees who receive health insurance through employer-provided head tax financing instead received it financed through a national payroll tax proportional to earnings that is levied on firms. This payroll tax financing approach is similar in spirit to how universal health insurance is financed in many countries, such as Canada and Germany. Our purpose is not to propose such a change in financing per se, but rather to use a realistic counterfactual financing approach to quantify the impact of the current head tax financing on labor market inequality. To focus on the impact of a change in financing of a given amount of insurance coverage, we do not give firms the option to stop or start offering health insurance. We also abstract from other potential margins of firm adjustment (such as their decisions around part-time work, outsourcing, or offshoring).

We find that, under this counterfactual payroll tax financing, the college wage premium would have been about 11 percent lower in 2019, noncollege annual earnings would have been approximately $1,700 (about 3 percent) higher, and noncollege employment would have been nearly 500,000 higher. Had this counterfactual financing been in place since 1977, the rise in the college wage premium would have been about 20 percent smaller and the rise in noncollege employment about 4.6 percent larger.[3]

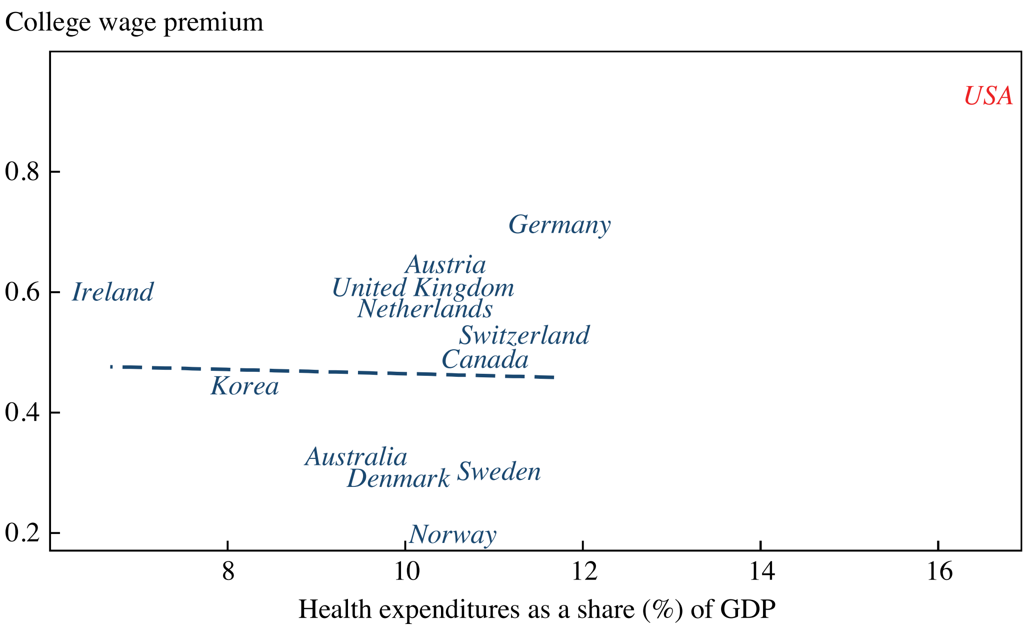
3. Naturally these magnitudes depend on the assumptions we make about empirical objects such as the size of the head tax, the differences in productivity across skill groups, and labor supply functions. We explore the sensitivity of the calibration results to alternative assumptions for these parameters and find the results reassuring. For example, a range of alternative parameters suggests that, under payroll tax financing, the 2019 college premium would have been 10 to 13 percent lower (compared to our baseline estimate of 11 percent), and the rise in the college wage premium between 1977 and 2019 would have been 18 to 23 percent smaller (compared to our baseline estimate of 20 percent).

Figure 1. College Wage Premiums and Health Expenditures

Panel A: US trends over time



Panel B: Cross-country comparisons, 2019



Sources: Authors' calculations using Current Population Survey and OECD data.

Note: Panel A shows health expenditures as a share of GDP and the college wage premium. Both are measured as a percentage relative to their 1977 level. Data on college wage premiums are from the Current Population Survey and are defined as the ratio of full-time, full-year earnings for college workers age 25–64 relative to noncollege workers, minus one. Data describing health care as a share of GDP are from OECD Global Health Expenditure. Panel B plots the relationship between the college wage premium and health expenditures in 2019 for countries with a GDP above 2019 US$ 300 billion. The dashed line shows the best-of-fit for non-US countries, weighted equally. The college wage premium is defined as $W_C/W_N - 1$, or the ratio of college to noncollege wages minus one. Non-US data for twelve countries are from the OECD, further described in online appendix A.1.

These effects are comparable in magnitude to estimates of some of the other leading drivers of labor market inequality, including outsourcing, robot adoption, rising trade, declining unionization, and the decline in the real minimum wage.

Our second set of counterfactuals considers how the spectacular rise in US health care spending and health insurance premiums over the last four decades has affected labor market inequality under the current, head tax regime. Between 1977 and 2019, average health insurance premiums for employer-provided health insurance rose by about $9,000 (in 2019 dollars). This rise was largely in response to the substantial rise in health care spending. We find that if, counterfactually, US health care spending as a share of GDP in 2019 had remained at the 1977 level of 7.7 percent of GDP rather than its 2019 level of 16.8 percent, the college wage premium would be about 11 percent lower and noncollege wages would be about $6,000 (12 percent) higher. In a somewhat more realistic counterfactual, we find that if US health care spending as a share of GDP in 2019 had been the same as the Canadian share—that is, approximately 10.8 percent instead of 16.8 percent of GDP—the college wage premium would have been 5 percent lower and noncollege annual earnings would have been $2,800 (5 percent) higher.

Our analyses rely on several simplifying assumptions. Perhaps most importantly, they occur in partial equilibrium and therefore do not provide a full, general equilibrium assessment of the potential impact of a change in health care financing or spending. Among other things, in all of our analyses we hold constant the share of full-time, full-year workers covered by health insurance as well as the comprehensiveness of employer-provided health insurance coverage. These could be affected by our counterfactuals; indeed, related literature on the labor market impacts of other health insurance reforms endogenizes some of these factors, such as the decision of firms to offer health insurance and the decision of workers to sort into firms with or without health insurance (Dey and Flinn 2005; Aizawa 2019; Aizawa and Fang 2020; Fang and Krueger 2021).[4] Relatedly, we abstract from the ways in which the head tax financing of employer-provided health insurance might also contribute to the "hollowing out" of the workforce (Autor 2018; Autor and Dorn 2013), a shift to part-time workers (Cutler

4. In the most closely related work that we know of, Beemon (2021) uses a labor search model to estimate the impact of switching from employer-provided health insurance to free public insurance on the equilibrium distribution of wages, finding that this would reduce wage inequality.

and Madrian 1998), the rise of alternative work arrangements (Katz and Krueger 2017), and the fissuring of the workforce (Weil 2014; Card, Heining, and Kline 2013; Song and others 2019). Nonetheless, our stylized, partial equilibrium analysis points to the potential importance of this uniquely American form of health care financing in contributing to labor market inequality. Our findings suggest that the financing of US health insurance warrants greater attention in both public policy and research on US labor market inequality.

The rest of the paper proceeds as follows. Section I provides background on employer-provided health insurance and on patterns of labor market inequality. Section II describes a simple model of the effects of health insurance financing on labor market inequality. Section III discusses our calibration. Section IV presents the main results on labor market outcomes under counterfactual payroll tax financing. Section V examines labor market outcomes under counterfactual levels of health care spending and health insurance premiums. Section VI concludes.

I. Background

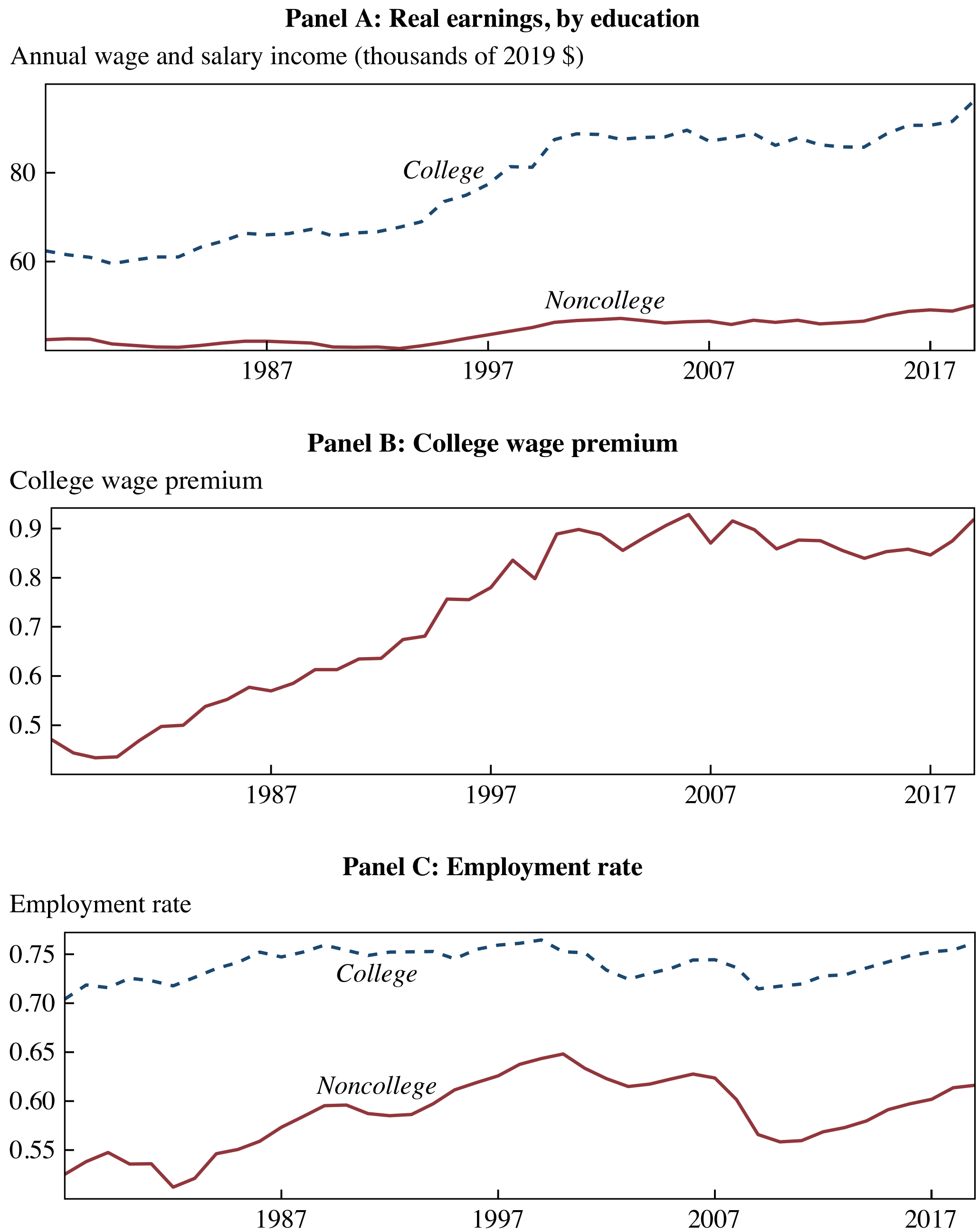
I.A. Trends in Labor Market Inequality and Health Care Spending

Labor market inequality has risen dramatically over the past few decades in the United States. Figure 2 shows trends in labor market outcomes for full-time, full-year workers age 25–64 from the Current Population Survey (Flood and others 2021). Full-time workers are defined as people who worked at least forty weeks in the year and had a usual work week of at least thirty hours. We focus on full-time, full-year workers to simplify the measurement of wages and because employer-provided health insurance is much more common among this group. We report trends separately for those with a college degree—defined as a bachelor's degree or higher—and those without a college degree.

Real annual earnings for college-educated workers (w_C) rose from about \$63,000 (in 2019 dollars) in 1977 to nearly \$100,000 in 2019.[5] At the same time, real annual earnings for noncollege workers (w_N) grew more gradually, from about \$43,000 in 1977 to about \$50,000 in 2019. As a result, the college

5. The rise in wages for college-educated workers was smaller in the 2000s, which could be due in part to the rise of business income of entrepreneurial owner-managers (Smith and others 2019) who face tax incentives to re-characterize wages as profits and whose income is large enough to affect aggregate trends in the corporate sector labor share (Smith and others 2022). Throughout, all dollar values are adjusted to 2019 US dollars using the FRED series Personal Consumption Expenditures (PCE) price index.

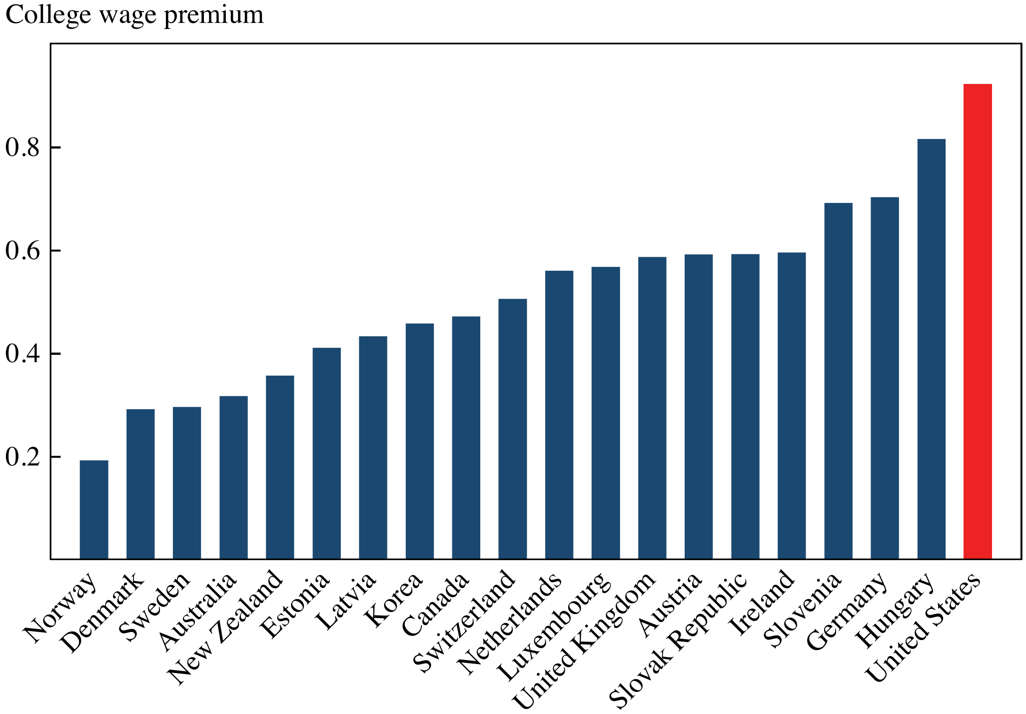
Figure 2. Labor Market Outcomes by Education



Source: Authors' calculations using the Current Population Survey.

Note: Panel A shows the average real wages of college- and noncollege-educated workers. Panel B shows the college wage premium, defined as the ratio of college to noncollege wages minus one. Panel C shows the employment rate, defined as the ratio of workers to the population, for college- and noncollege-educated individuals. The population is restricted to individuals age 25–64. Workers are defined as those employed full-year (at least forty weeks per year) and full-time (at least thirty hours a week). Wages are calculated in 2019 dollars using a PCE price index. Using the CPI price index instead, noncollege workers' wages fall $1,779 instead of increasing by $7,754, and college workers' wages increase $19,880 instead of by $33,903; however, the choice of price index has no effect on the evolution of the college wage premium or the employment rate. Based on guidance from the editors, we use the PCE price index as the baseline.

Figure 3. College Wage Premiums across Countries in 2019



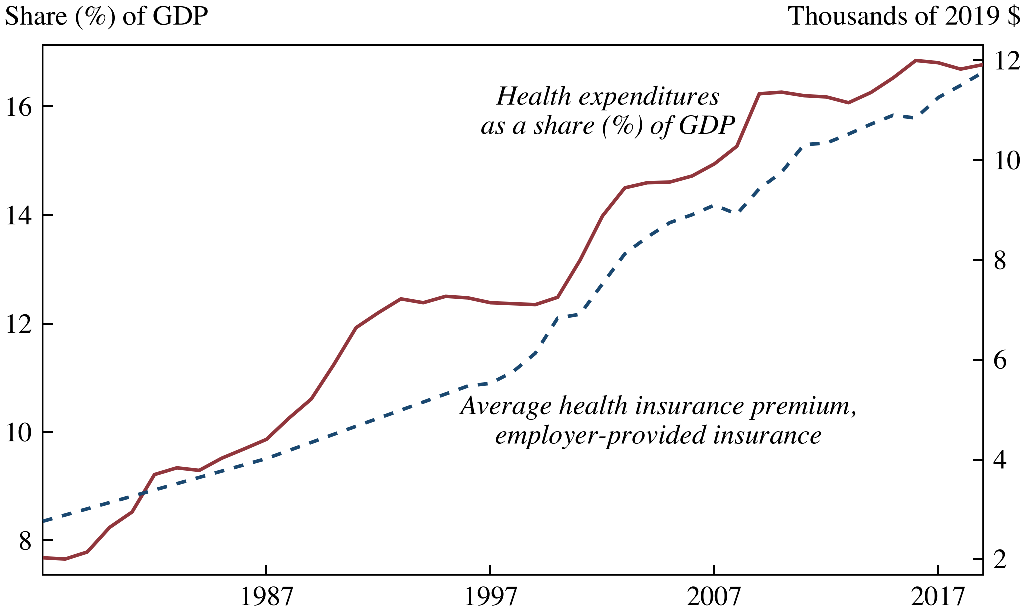
Source: Authors' calculations using data from OECD Education and Earnings, https://stats.oecd.org/Index.aspx?DataSetCode=EAG_EARNINGS.

Note: This figure plots the ratio of college-educated to noncollege-educated worker wages by country. College wage premiums are given for the population of those age 25–64 who were full-year, full-time workers in 2019. The OECD defines full-time workers as those working at least thirty hours per week and full-year according to each country's individual definition.

wage premium $\left(\frac{w_C}{w_N} - 1\right)$ increased from 47 percent in 1977 to 90 percent in 2019. This 90 percent college wage premium exceeds that of other countries for which comparable data are available, including the United Kingdom (figure 3).

Over the same time period, real premiums for employer-provided health insurance in the United States have also risen substantially, fueled by rising health care spending (figure 4). Since 1977, the average health insurance premium has quadrupled in real terms, from about $2,750 (in 2019 dollars) to about $12,000 in 2019. At the same time, health care spending as a share of GDP has risen from 7.7 to 16.8 percent. As a result of these trends in health insurance premiums and in earnings, health insurance premiums as a fraction of labor market earnings increased between 1977 and 2019 from 6 percent of noncollege earnings to almost 25 percent, and from 4 percent of college earnings to 12 percent.

Figure 4. US Health Expenditures and Insurance Premiums



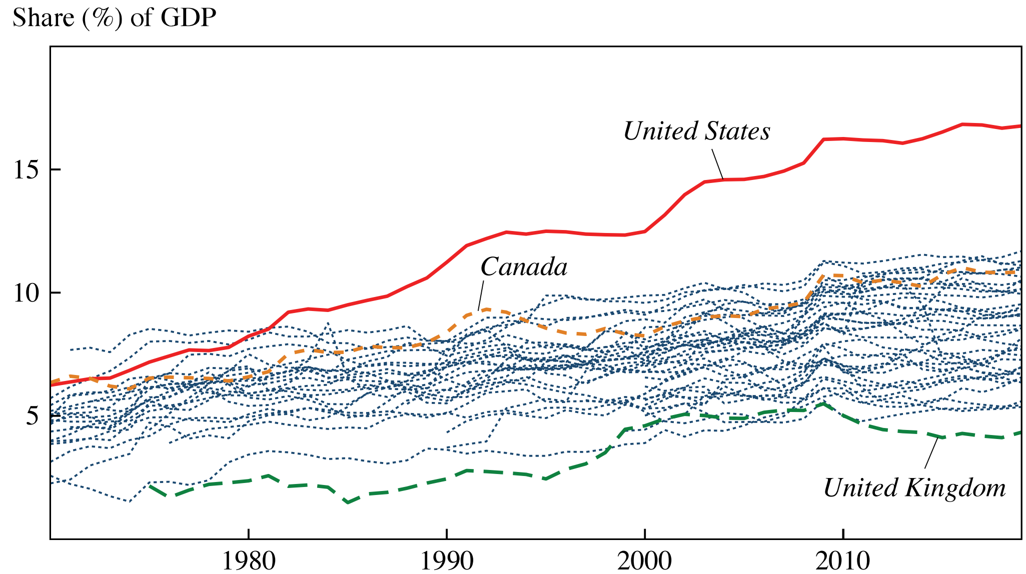
Sources: OECD; National Medical Care Expenditure Survey (1977), https://www.icpsr.umich.edu/web/NACDA/studies/8325; National Medical Expenditure Survey (1987), https://www.icpsr.umich.edu/web/ICPSR/studies/9674; and Medical Expenditure Panel Survey (1996–2019), https://meps.ahrq.gov/data_stats/download_data_files.jsp.

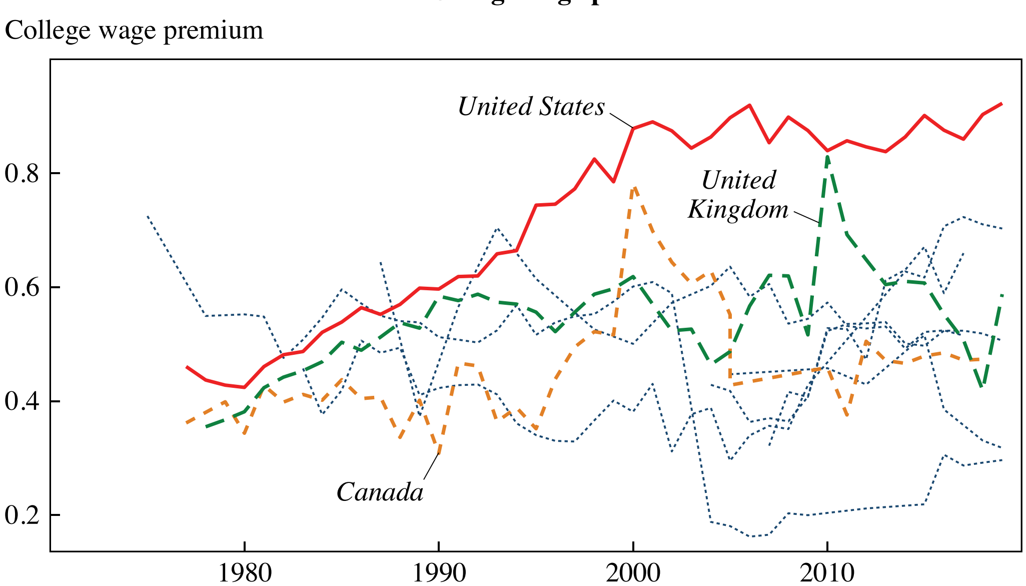
Although many OECD countries experienced both an increase in health care spending as a share of GDP and an increase in labor market inequality, the United States is an outlier in both trends (figure 5). Health care spending as a share of GDP in the United States rose from about 8.2 percent of GDP in 1980 to 16.8 percent in 2019. At the same time, on average across the OECD countries (excluding the United States) it rose from 6 to 9 percent (OECD 2019).[6] Likewise, the college wage premium in the United States increased from 42 percent in 1980 to 91 percent in 2019. Over the same period, in the United Kingdom, Sweden, and Canada, the college premium rose on average from 43 percent in 1980 to only 45 percent in 2019 (Brzozowski and others 2010; Domeij and Flodén 2010; Blundell and Etheridge 2010; Eurostat 2022; OECD 2022).[7]

6. Across the United Kingdom, Sweden, and Canada, where we can also calculate the change in the college wage premium, health care spending as a share of GDP rose on average from 6.5 percent in 1980 to 10.6 percent in 2019.

7. Estimating the college premium for all OECD countries over this period is beyond the scope of this paper. That said, cross-country evidence (e.g., Krueger and others 2010) suggests that most other OECD countries experienced much smaller increases in the college premium over the past few decades. Despite having college premiums closer to the United States in 1980, most OECD countries have lower college premiums than the United States does today (figure 3).

Figure 5. Health Expenditures and College Wage Premiums across Countries





Sources: Brzozowski and others (2010); Eurostat (2022); Fuchs-Schuendeln, Krueger, and Sommer (2010); and Jappelli and Pistaferri (2010).

Note: The college wage premium is defined as $W_C/W_N - 1$. In both panels, the United States, the United Kingdom, and Canada are labeled. Panel A includes all other OECD countries. Additional countries in panel B are Australia, France, Germany, Italy, Sweden, and Switzerland. A version of panel B with a full set of OECD countries can be found in figure A.2 in the online appendix; data sources and construction are described in online appendix A.1.

These patterns over time and across countries lend some credence to the hypothesis that US health care—and in particular the financing of health insurance through employers—may be contributing to rising labor market inequality in the United States.

I.B. Employer-Provided Health Insurance

INSTITUTIONAL BACKGROUND The workplace is the primary source of private health insurance in the United States. About half of the US population—and virtually all of those with private insurance—receive that insurance through an employer.[8] This development is generally viewed as an accident of history. During World War II, the federal government imposed wage and price controls on American firms as part of its effort to prevent a surge in inflation in the face of competition for scarce labor and goods. But employer contributions to health insurance didn't "count" as part of workers' wages, and employers soon realized that this created a loophole: faced with binding wage controls, they started offering—and paying for—workers' health insurance as a way to attract and retain employees. What had been initially viewed as a wartime stopgap measure became codified and entrenched into the tax code after the war, with the 1954 codification of the exclusion of employer contributions to health insurance from taxable income. It remains in place to this day (Starr 1982; Thomasson 2002). Thomasson (2003) argues that this 1954 codification contributed to the rise of employer-provided health insurance in the United States.

While employer compensation paid in the form of wages and salary is subject to personal income taxes and to payroll taxes on both the employee and employer, compensation paid in the form of contributions to health insurance premiums is not. This treatment creates a tax subsidy to employer-financed health insurance s that is given by:

$$s = 1 - \left(\frac{1 - \tau_{inc} - \tau_{ss}}{1 + \tau_{inc}} \right),$$

where τ_{inc} is the employee's marginal tax rate on earnings and τ_{ss} is the statutory payroll tax rate paid by the employee and separately by the employer. To see where this formula comes from, first note that the employer is indifferent between contributing a dollar to the employee's health insurance

8. Kaiser Family Foundation, "Health Insurance Coverage of the Total Population" [data set], www.kff.org/other/state-indicator/total-population/.

premiums and contributing $1/(1 + \tau_{ss})$ to wages, since the employer must pay payroll tax on any wage contributions but not on health insurance contributions; we assume the incidence of payroll taxes is fully on the worker. If employees are paid $1/(1 + \tau_{ss})$ in wages, they must in turn pay both income tax and payroll tax on that wage. Thus, workers face a choice of receiving $1 in employer contributions to their health insurance premiums or $\left(\frac{1 - \tau_{inc} - \tau_{ss}}{1 + \tau_{ss}}\right)$ in take-home pay.

The resulting tax subsidy is substantial. For example, in 2019 the combined employer and employee payroll tax rate—including both Social Security and Medicare—was 15.3 percent, split evenly between employer and employee ($\tau_{ss} = 7.65$).[9] An employee earning $50,000 in 2019 faced a federal income tax rate of 22 percent while one earning $100,000 faced a 24 percent tax rate (El-Sibaie 2018). Thus, the tax subsidy to employer-financed health insurance *s* was about 35 percent; if the employee faced state income taxes, it would be even higher. In other words, at the same cost to the employer, the employee could receive either $1 in contributions to health insurance premiums or $0.65 in take-home pay.

The tax subsidy to employer-provided health insurance is uniformly reviled by economists of both parties (Mankiw and Summers 2015).[10] A large body of empirical literature reviewed by Gruber (2002) has documented that the tax subsidy distorts compensation from wages to health insurance; this in turn distorts the demand for medical care (Feldstein 1973; Feldstein and Friedman 1977; Pauly 1986). The tax subsidy is also highly regressive, since both rates of employer provision of health insurance and tax rates rise with employee income (Pauly 1986; Gruber 2011). There have been policy attempts to reduce the tax subsidy, most notably the so-called Cadillac tax under the 2010 Affordable Care Act, which would have reduced the tax subsidy to employer-provided health insurance premiums above a specified dollar amount. It was passed into law but never put into effect.[11]

9. The Social Security component of the tax rate was not applied to income above $132,900; Social Security, "Contribution and Benefit Base," https://www.ssa.gov/oact/cola/cbb.html.

10. See also Chicago Booth Kent A. Clark Center for Global Markets, "U.S. Poll: Cadillac Tax," https://www.kentclarkcenter.org/surveys/cadillac-tax/.

11. There have been many related policy proposals. For example, concerned about the tax subsidy's regressivity and its encouragement of low-value health care innovation, Bagley, Chandra, and Frakt (2015, 11) suggest that Congress should "replace the tax exclusion for health insurance with a tax credit for employer-sponsored insurance—a fixed amount that each taxpayer could subtract from her overall tax liability—that phases out as income increases. Less radically, the tax exclusion could itself phase out with income."

As to the provision of health insurance through employers more broadly, the prevailing wisdom is that it is hard to rationalize on efficiency grounds. "If we had to do it over again," the health economist Uwe Reinhardt observed, "no policy analyst would recommend this model" (Blumenthal 2006, 82). A large body of empirical literature has documented that the linking of insurance to the workplace distorts labor market decisions, including retirement and labor supply, and limits job-to-job mobility (Gruber 2000; Gruber and Madrian 2004; Garthwaite, Gross, and Notowidigdo 2014). More closely related to our head tax analysis, Cutler and Madrian (1998) observe that because health insurance contributions represent a fixed cost per employee, rising health care costs should encourage a reduction in the number of employees and an increase in hours per worker. Consistent with this prediction, they find that hours per worker increased more over time for workers with employer-provided health insurance compared to those without.

The head tax feature of financing employer-provided health insurance also raises the question of whether firms can voluntarily use a financing approach that charges highly compensated employees a larger amount for health insurance than lower-paid employees. Our understanding is that firms can do so under current law but rarely do. Nondiscrimination rules under IRS Code section 105(h) prohibit discrimination in favor of highly compensated individuals, however no regulations forbid the opposite. Nevertheless, it appears that in practice market forces largely prevent firms from pursuing this approach.[12] Charging highly compensated workers more for health benefits effectively lowers their wage, making this approach less attractive for firms that compete to retain and attract college workers. Offsetting a higher charge for benefits with more pay would be a disadvantage tax-wise relative to the status quo arrangement.

In the context of cost sharing, Robertson (2014) argues that agency frictions and the locus of benefit decisions within the firm can also explain why firms are reluctant to implement progressive financing arrangements in their health plans. Specifically, the managers who make such decisions tend to be the higher-income workers most likely to be hurt by a proportional-to-income scheme. Customizing plans to depend on worker income at the firm level also introduces administrative burden in designing health benefit

12. Recent surveys suggest that a number of large employers do vary contributions by coarse salary classes, but this is a far cry from the proportional financing we will analyze below (Gregware 2017; Sammer 2017). Such arrangements are likely driven by the affordability limit under the Affordable Care Act, which requires the lowest-cost single coverage plan offered by large employers to be below 9.5 percent of household income.

Table 1. Summary Statistics for Full-Time, Full-Year Workers Age 25–64 (2019)

	Total	*College*	*Noncollege*
Panel A: Labor market outcomes			
FTFY employment rate (P_g)	0.672	0.762	0.616
Average annual earnings (w_g)	\$70,333	\$96,304	\$50,179
Panel B: Health insurance coverage			
Employer-sponsored	0.802	0.895	0.729
Policyholder	0.659	0.732	0.603
Dependent	0.140	0.162	0.123
Other private	0.062	0.055	0.067
Public	0.072	0.032	0.103
None	0.084	0.031	0.125
Panel C: Offering and take-up			
Offered employer-sponsored health insurance	0.830	0.895	0.780
Take-up | Offered	0.794	0.818	0.773

Source: Current Population Survey.

Note: College-educated workers are defined as those who have obtained a bachelor's degree or above; noncollege-educated workers do not have a bachelor's degree. The full-time, full-year (FTFY) employment rate is the share of the population who worked at least forty weeks in the year and had a usual work week of at least thirty hours. Offering is defined as individuals who either enroll in employer-provided health insurance as a policyholder or report being offered this insurance at their workplace; take-up is defined as enrolling in employer-provided health insurance as a policyholder. The results are similar when looking at self-reported eligibility for employer-provided health insurance instead of offering. Dollar amounts are in 2019 US dollars.

menus relative to the status quo. Consistent with these barriers to private implementation, conversations with employment law experts suggest that firms typically approach health benefits from the perspective of how much they will cost to provide and then offer a simple fixed price per worker in each coverage class.

DESCRIPTIVE STATISTICS Table 1 provides an overview of the health insurance of the approximately 100 million full-time, full-year workers age 25–64, based on the 2019 Current Population Survey. Panel A summarizes the key labor market outcomes in 2019 that will be the focus of our analysis: the employment rate and average annual earnings. The first row indicates that two-thirds of those age 25–64 were working full-time, full-year in 2019, with the rest either working less than full-time, full-year or not working. The full-time, full-year employment rate for college-educated workers is 0.76 and for noncollege-educated workers it is 0.62. Average annual earnings are \$96,304 for full-time, full-year college-educated workers (w_C) and \$50,179 for full-time, full-year noncollege-educated workers (w_N). Figure 2, panel C, shows that the full-time, full-year employment rate for college-educated workers (P_C) has risen since 1977 from about 0.70 to 0.76, while that for noncollege-educated workers (P_N) has risen from about 0.52 to 0.62.

We focus on the extensive margin of labor force participation; rates of labor force nonparticipation are high among noncollege-educated prime-age adults, even for men, and have generated substantial interest in their causes and consequences (Binder and Bound 2019).

Table 1, panel B, describes the health insurance coverage of these full-time, full-year workers. Just over 80 percent are covered by employer-provided health insurance, 13 percent have another form of health insurance (e.g., non-group private health insurance or public insurance such as Medicaid), and 8 percent are uninsured. About two-thirds of full-time workers are policyholders of employer-provided health insurance—meaning that any employer contributions to those premiums are part of the cost of hiring such workers—while another 14 percent have coverage as a dependent on a spouse's employer-provided health insurance. The share of workers who are policyholders for employer-provided health insurance is higher for college-educated workers (73 percent) than noncollege-educated workers (60 percent) while rates of uninsurance are lower (3 percent versus 12.5 percent).[13]

The one-third of workers who are not policyholders reflects a combination of working for a firm that doesn't offer health insurance and not taking up offered insurance, in roughly equal measure (table 1, panel C). About 83 percent of full-time, full-year workers are offered insurance by their employer, and, conditional on being offered this insurance, about 79 percent take up this insurance (i.e., enroll as the policyholder). Offering and conditional take-up are higher for college-educated workers (at 90 percent and 82 percent, respectively) than for noncollege-educated workers (78 percent and 77 percent, respectively). One reason that workers may not take up employer-provided health insurance is that they typically have to pay a portion of the premiums; many who do not take up the offered insurance through their employer are insured through another source, such as another family member's employer-provided health insurance or public insurance (Gruber 2008; Gruber and Simon 2008).

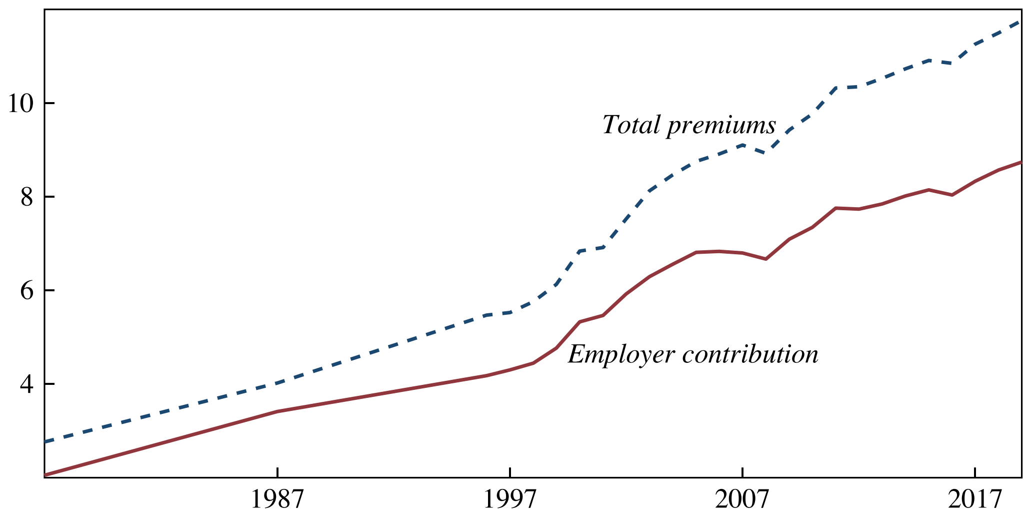
Average annual premiums for employer-provided health insurance have been rising over time (figure 6, panel A). The data on premiums are provided directly by employers and include average employer and employee

13. Another 14 percent of those age 25–64 are part-time workers, defined as anyone who reports working (not counting self-employment) during the year but does not meet the definition of a full-time, full-year worker. Only 53.5 percent of them are covered by employer-provided health insurance, and only 31 percent are policyholders; 15 percent have no health insurance.

Figure 6. Premiums for Employer-Provided Health Insurance

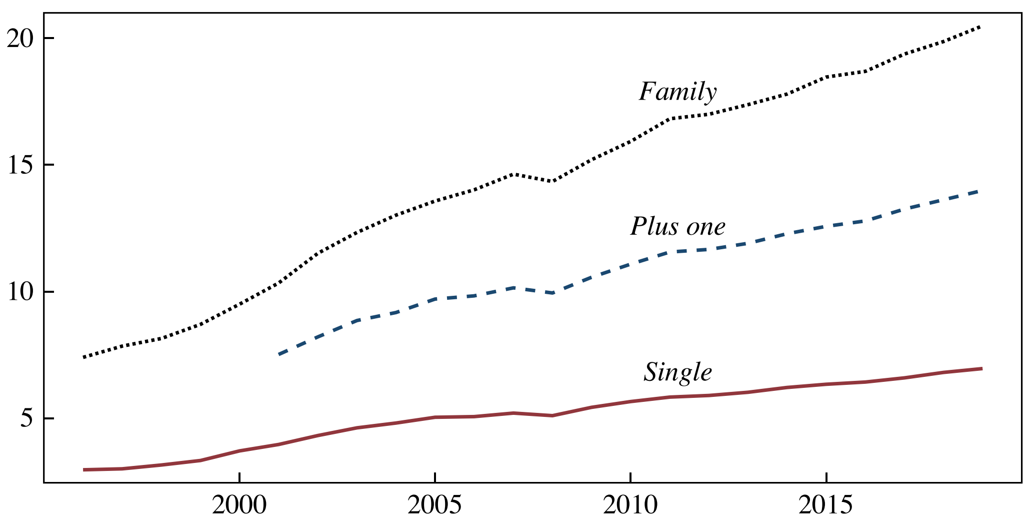
Panel A: Average premiums

Average premium (thousands of 2019 $)



Panel B: Premiums by coverage type

Average premium (thousands of 2019 $)



Sources: Medical Expenditure Panel Survey (1996–2019); National Medical Expenditure Survey (1987); and National Medical Care Expenditure Survey (1977).

Note: The average total premium is the sum of employer and employee contributions across types of plans.

premiums for each type of coverage (single, employee-plus-one, or family coverage; see figure 6, panel B), as well as the share of employees who are policyholders in each type of coverage (Blewett and others 2019). We report average premiums across employees by weighting each coverage type by its employee share. Average health insurance premiums in 2019 were about \$12,000. The average premium varied from about \$7,000 for a single coverage plan, to \$14,000 for plus-one coverage, to \$20,000 for family coverage.[14]

On average, employers paid about three-quarters of these premiums (or \$9,000 relative to the total average premium of \$12,000). Gruber and McKnight (2003) discuss possible incentives for an employer to require some employee contributions to premiums, including encouraging those with outside insurance options to avail themselves of those instead or allowing firms to offer a range of low-cost plan options with employees contributing on the margin if they want more comprehensive coverage.[15]

II. Conceptual Framework

We sketch a simple, stylized model of a competitive labor market and use it to analyze qualitatively the equilibrium labor market impact of (1) counterfactually financing health insurance premiums through a proportional payroll tax rather than a fixed, per worker head tax and (2) counterfactually lower levels of health care spending. In the next sections, we calibrate a generalized version of this model for our quantitative analyses.

II.A. Setup

There are two types $g \in \{N, C\}$ of workers, where N and C denote noncollege and college workers, respectively. We assume that the productivity of college workers (A_C) exceeds that of noncollege workers ($A_C > A_N$). For the qualitative analysis, we assume a linear production technology for

14. The Medical Expenditure Panel Survey data used in figure 6 are not the only source of information on the cost to employers of providing health insurance. The Bureau of Labor Statistics provides an alternative estimate each quarter in the Employer Cost for Employee Compensation (ECEC), which includes the cost per employee hour of health benefits to the employer. In figure A.1 in the online appendix we adjust both estimates to make them comparable and compare their implications for the employer cost of providing health insurance. They line up quite closely.

15. Most employees are able to make their contributions out of pretax dollars. Gruber (2011) estimates that roughly 80 percent of employees with employer-provided coverage have access to a section 125 or cafeteria plan that allows them to make their health insurance contributions pretax.

output Y such that $Y = A_N L_N + A_C L_C$, where L_g is the employment of group g. The assumption that college and noncollege workers are perfect substitutes with a constant relative wage determined by their relative productivity irrespective of labor supply simplifies some of our comparative statics without affecting the qualitative insights that we emphasize. We also assume that everyone in the workforce holds employer-provided health insurance. We relax both assumptions in our quantitative calibration in the next sections.

LABOR DEMAND We consider a representative firm in a competitive labor market.[16] The firm chooses labor inputs to solve:

$$(1) \qquad max_{L_N, L_C} Y - \omega_N L_N - \omega_C L_C,$$

where w_g denotes the total cost to the employer of hiring a worker from group g. Under head tax financing of health insurance, $\omega_g = w_g + \tau$, where w_g is the salary paid to group g and τ is the health insurance premium per worker.[17] Under payroll tax financing, the cost of hiring a worker from group g is given by $\omega_g = (1 + t)\, w_g$, where t is the payroll tax on earnings. Given the assumption of a linear production technology, equilibrium costs per worker are determined by worker productivity. Thus, $\omega_g = A_g$.[18]

LABOR SUPPLY Each worker i in group $g \in \{N, C\}$ faces a discrete choice of whether or not to work. We model the indirect utility from employment (U^e_{gi}) as consisting of a systematic component V_g shared by all individuals in the group and an idiosyncratic component ε_i. The systematic component V_g depends on wages and health insurance provision. The idiosyncratic component $\varepsilon_i \geq 0$ captures the individual-specific disutility from working. This construction allows us to represent the indirect utility from working by $U^e_{gi} = V_g - \varepsilon_i = w_g + \alpha_g h - \varepsilon_i$, where $\alpha_g \geq 0$ is the group-specific amenity value of health insurance expenditures h relative to wages.

16. Focusing on a representative firm abstracts away from important ways in which firms influence labor market inequality (Card 2022).

17. Another important simplifying assumption is that there is an equal health insurance premium per worker at a representative firm. In reality, different firms may offer different benefit packages. In recent work, Ouimet and Tate (2023) and Lurie and Miller (2023) show that higher-income employees tend to select more-expensive plans. Indeed, they find that those in the top decile of the income distribution collectively account for 20 percent of total employer-sponsored health insurance premiums. That said, they find that inequality in premiums is much smaller than inequality in income.

18. The assumption that workers' compensation is equal to the value of their marginal product of labor is common but not innocuous. There are many reasons (e.g., imperfect competition and rent sharing) why worker compensation might not equal worker productivity.

A priori, α_g may be larger than or less than one. If health insurance is only available through the employer, employee risk aversion could produce a value of health insurance that is more than wages ($\alpha_g > 1$). In the presence of moral hazard, the privately and socially optimal amount of insurance would be to provide health insurance until $\alpha_g = 1$ (Baily 1978; Chetty 2006). However, as emphasized by Feldstein (1973), the preferential tax treatment of employer-provided health insurance can result in an equilibrium value of health insurance that is less than wages ($\alpha_g < 1$). When we keep constant the provision of employer-provided health insurance and focus solely on the impact of how it is financed, we can remain agnostic on the potentially group-specific utility to workers from health insurance relative to earnings, α_g.

We normalize the indirect utility from not working to zero. An individual will therefore work if and only if $U_{gi}^e > 0$. If we consider the idiosyncratic component of utility from work ε_i to be a random variable, the share of individuals in group g who will work is therefore given by:

$$P_g = Pr\left(V_g > \varepsilon_i\right) = Pr\left(w_g + \alpha_g h > \varepsilon_i\right).$$

For simplicity, we assume that the idiosyncratic components ε_i are independently and identically distributed according to a uniform distribution over the interval from $\underline{\kappa}$ to $\bar{\kappa}$ (i.e., $\varepsilon_i \sim U[\underline{\kappa}, \bar{\kappa}]$). The resulting aggregate labor supply function is therefore linear between $\underline{\kappa}$ and $\bar{\kappa}$:

$$P_g = Pr\left[V_g > \varepsilon_i\right] = \begin{cases} \dfrac{V_g - \underline{\kappa}}{\bar{\kappa} - \underline{\kappa}} & \text{if } V_g \in \left[\underline{\kappa}, \bar{\kappa}\right] \\ 0 & \text{if } V_g < \underline{\kappa} \\ 1 & \text{if } V_g > \bar{\kappa} \end{cases} . \quad (2)$$

We denote by $L_g = P_g N_g$ the total employees in group g, where N_g is the number of workers in group g.

II.B. Comparative Statistics: Head Tax vs. Payroll Tax Financing

Under the status quo head tax financing, the cost of hiring a worker is given by $\omega_g = w_g^H + \tau$, where we use the superscript H to denote the head tax scenario. Equilibrium wages are therefore $w_g^H = A_g - \tau$, and the college wage premium is:

$$\frac{w_C^H}{w_N^H} - 1 = \frac{A_C - \tau}{A_N - \tau} - 1. \tag{3}$$

The greater the health insurance premiums (τ) and the greater the relative productivity of college workers $\left(\frac{A_C}{A_N}\right)$, the greater the college wage premium. Substituting equilibrium wages into the labor supply function gives us relative equilibrium employment under the head tax (where $h = \tau$):

$$\frac{L_C^H}{L_N^H} = \frac{A_C + (\alpha_C - 1)\tau - \underline{\kappa}}{A_N + (\alpha_N - 1)\tau - \underline{\kappa}}. \tag{4}$$

We now consider the impact of financing employer-provided health insurance with a proportional, nationwide payroll tax instead of the current head tax. In this comparison we hold constant at τ the average employer contribution to each employee's health insurance. Thus, the per employee cost of health insurance remains unchanged at the national level; the only thing that changes is how that contribution is financed. As noted at the beginning of the paper, we also hold fixed the share of full-time, full-year workers receiving health insurance in this manner. This assumption allows us to focus exclusively on the impact of changing how a fixed amount of coverage is financed. This counterfactual also allows us to abstract from difficult-to-measure parameters such as the amenity value of health insurance premiums relative to wages (α_g), which affects equilibrium employment and (once we relax the assumption of a linear production technology) equilibrium wages as well.[19] More generally, the amenity value of employer-provided benefits is an important parameter for a range of policy counterfactuals (Gruber 1994; Summers 1989).

Because we assume that the health insurance provided remains constant under the counterfactual payroll tax financing, the labor supply function, equation (2), is unaffected. Labor demand, however, is affected. Under payroll tax financing (which is levied statutorily on firms), the employer now contributes a fixed proportion t of each worker's earnings to their health insurance, so that the cost per worker in group g is now $\omega = (1 + t)w_g^P$ where we use the superscript P to denote the payroll tax scenario. Equilibrium wages are now $w_g^P = \frac{A_g}{1+t}$.

19. See equation (4) and online appendix A.2.

Since, by construction, the average per employee cost of health insurance is held constant, the payroll tax t is determined in equilibrium by the following budget constraint:

$$\tau \cdot \left(L_N + L_C\right) = t \cdot \left[w_N \cdot L_N + w_C \cdot L_C\right].$$

Given equilibrium wages under the payroll tax we can rewrite this relationship as:[20]

$$\tau = \left(\frac{t}{1+t}\right)\tilde{A}, \tag{5}$$

where $\tilde{A} \equiv \left(A_N \cdot \frac{L_N}{L_N + L_C} + A_C \cdot \frac{L_C}{L_N + L_C}\right)$ is the average productivity of college and noncollege workers weighted by their relative shares. Since $A_N < \tilde{A} < A_C$, it follows that the equilibrium wage for college workers is lower under payroll tax financing than head tax financing:

$$w_C^P = \frac{A_C}{1+t} < A_C - \tau = w_C^H. \tag{6}$$

By the same token, the equilibrium wage for noncollege workers is higher under payroll tax financing than under head tax financing:

$$w_N^P = \frac{A_N}{1+t} > A_N - \tau = w_N^H. \tag{7}$$

Because labor supply is the same under these two alternative financings, equilibrium employment under payroll tax financing is higher for noncollege workers ($L_N^P > L_N^H$) and lower for college workers ($L_C^P < L_C^H$).

Thus, the switch from head tax financing to payroll tax financing unambiguously reduces labor market inequality. The size of the health insurance premium τ compared to the gap in productivity between groups is key for determining the quantitative impact of the change in financing on labor market inequality. Note, however, that the effect on total employment

20. We assume that for determining labor demand, each firm takes the payroll tax t as fixed and ignores the impact of its hiring of noncollege and college workers on the equilibrium payroll tax. This seems reasonable given that any given firm's hiring has a negligible effect on the nationwide employment rates for these two types of workers.

is ambiguous since employment is increasing for noncollege workers and decreasing for college workers.

Figure 7 illustrates the impact of moving from head tax to payroll tax financing graphically. We plot the supply and demand for noncollege and college labor services separately in panels A and B, respectively. In panel C, we plot supply and demand of college relative to noncollege labor services in log terms to show directly how the college premium changes.[21] Because relative labor supply is unaffected by the form of financing, the shift from head tax to payroll tax financing lowers the college wage premium and lowers the college wage share, thereby reducing labor market inequality.

II.C. Comparative Statics: Counterfactual Levels of Health Care Spending

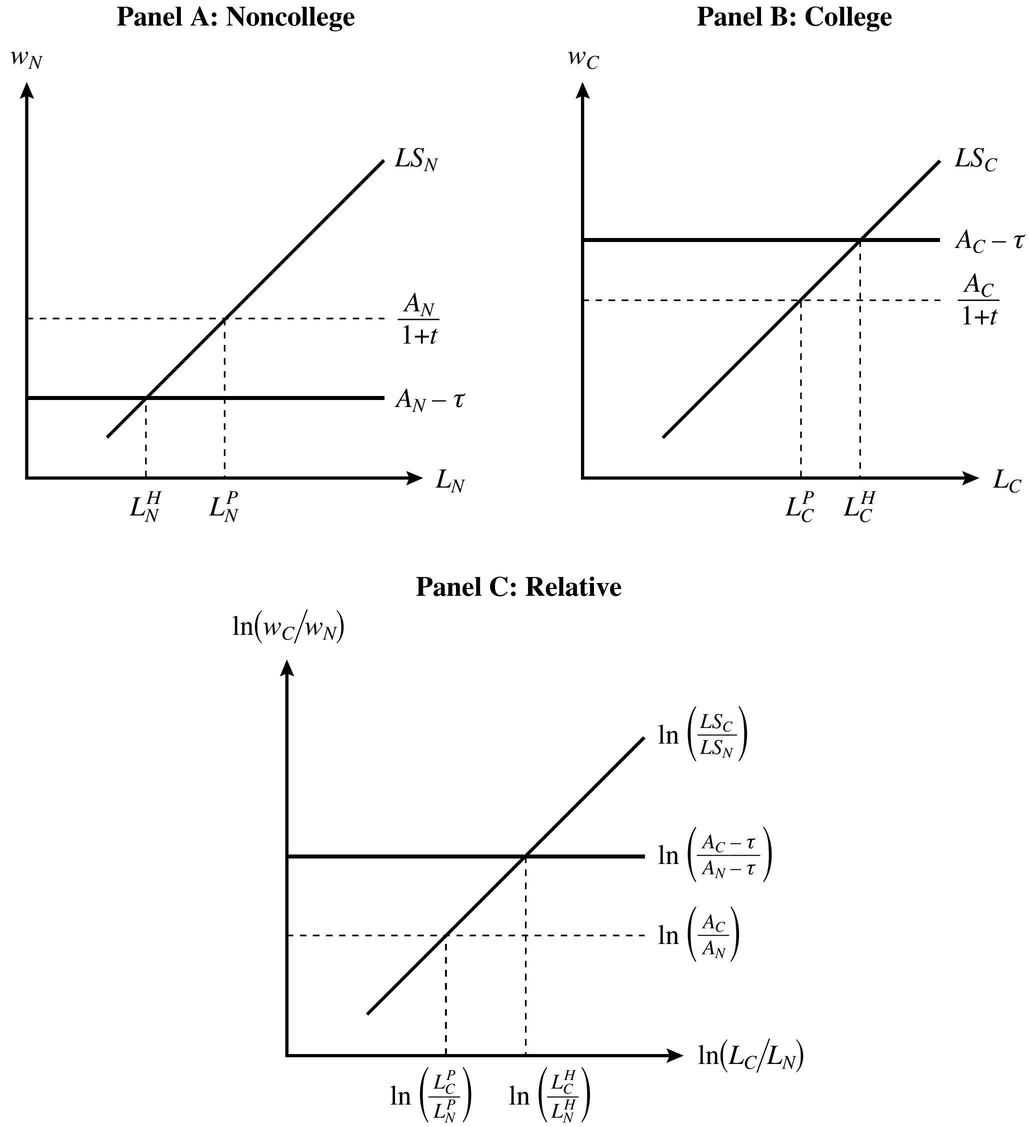
We can also use this framework to consider labor market outcomes under the current head tax regime but with counterfactual levels of health care spending and hence counterfactual levels for the head tax τ. A decline in τ shifts out labor demand (since the total cost for hiring an employee is smaller) and also shifts in labor supply (since less health coverage is provided at a given wage).[22] As can be seen from equation (3), these shifts would reduce the college wage premium. To determine how equilibrium employment outcomes would change, however, we must make additional assumptions regarding the workers' amenity value α_g of employer-provided health insurance relative to cash. These assumptions were not required for our analysis of counterfactual financing of employer-provided health insurance since the amount of health insurance provided was held constant under the counterfactual.[23] They are required for this counterfactual since

21. To obtain the log linear relative labor supply expression depicted in panel C, we log linearize our expressions for relative labor supply $\left(\frac{L_C}{L_N} = \frac{w_C + \alpha_C \tau - \underline{\kappa}}{w_N + \alpha_N \tau - \underline{\kappa}} \cdot \frac{N_C}{N_N}\right)$.

22. This counterfactual lowering of t can also be loosely viewed as a way of analyzing the impact of the Cadillac tax that was enacted but never implemented, as discussed at the beginning. In particular, one way of interpreting a goal of the Cadillac tax is that it was designed to reduce the generosity of health insurance provision. However, the effects on disposable income and labor supply of different groups, whose marginal tax rates vary, would need to be incorporated into our model to characterize the effects of a Cadillac tax more realistically. In addition, there are several other important aspects of this policy that are beyond the scope of our paper, such as the prevalence of Cadillac health plans across different groups.

23. Specifically, as discussed in online appendix A.2, the amenity value α_g is relevant only for pinning down the intercept of the labor supply function. In our payroll tax analysis, we assume this amenity value is the same across groups ($\alpha_C = \alpha_N$); in our sensitivity analysis, where we make a direct assumption about the shape of the labor supply function, we also do not have to make any additional assumptions about α_g.

Figure 7. Moving from a Head Tax to a Payroll Tax Equilibrium



Source: Authors' calculations.

Note: This figure shows the impact on equilibrium wages and employment from switching from a head tax (τ) to a payroll tax (t). Panel A shows the results for noncollege educated workers (with productivity A_N), panel B shows the results for college-educated workers (with productivity A_C), and panel C shows relative outcomes for college workers relative to noncollege workers. We use superscript H to denote outcomes under the head tax and superscript P to denote outcomes under the payroll tax. As shown in panel C, the change from head tax to payroll tax financing unambiguously lowers the college wage premium and college employment relative to noncollege employment.

they determine the magnitude of labor supply shifts for both groups. If the amenity value of rising health care spending were zero, rising health care spending would function in the same way as a standard tax increase, with impacts on wages and employment that depend on relative supply and demand elasticities. If the amenity value were one for both groups, labor supply would shift out by the same amount as the cost increase and effects would be entirely on wages, with no impact on employment (Summers 1989; Gruber 1994).

Figure 8 illustrates the impact of a reduction in the cost of employer-provided health insurance from τ to τ' when assuming the amenity value of this insurance is equal to one for both groups (i.e., assuming $\alpha_N = \alpha_C = 1$). Once again, panels A and B plot the demand for and supply of labor for noncollege and college workers, respectively, while panel C shows the relative supply and demand of college versus noncollege labor services in log terms. For both groups of workers, the reduction in the cost of employer-provided health insurance leads to an increase in labor demand at any given wage and so wages unambiguously increase for both groups. Since wages increase by a similar amount for both groups, wage inequality decreases as shown in panel C. However, the effect on labor supply depends on the amenity value of employer-provided health insurance. Since we assumed $\alpha = 1$ for both groups, the shift in labor demand is matched exactly by a shift in labor supply so that the quantity of labor supplied is unaffected. For $\alpha < 1$, the shift in labor supply would be less than the shift in labor demand and labor supply would increase for both groups; conversely for $\alpha > 1$, the shift in labor supply would be greater than the shift in labor demand and labor supply would decrease for both groups.

III. Calibration and Implied Parameter Values

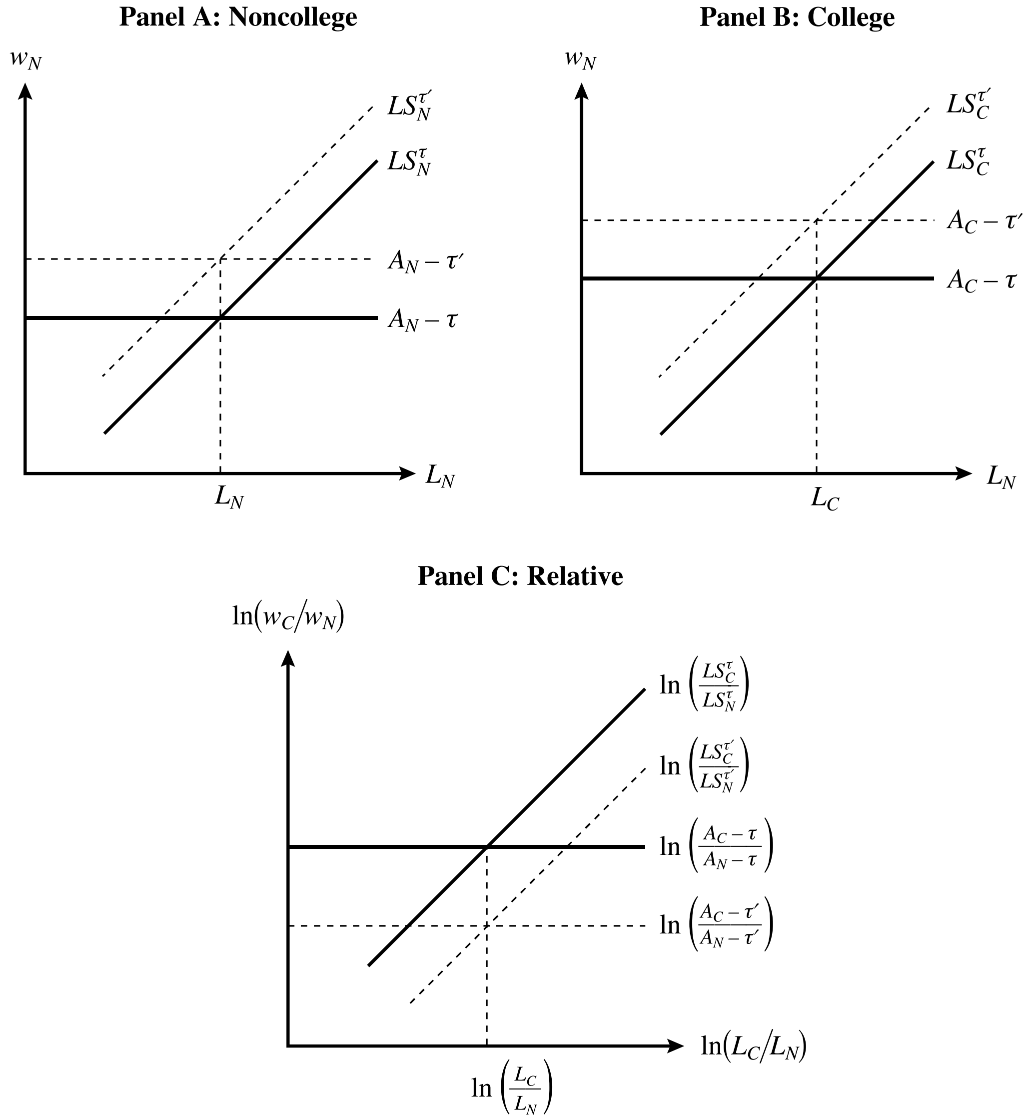
III.A. Calibration

For our calibration exercise, we generalize the linear technology used in our qualitative analysis to a CES production function:

$$Y = \left(\lambda_N L_N^{\rho} + \lambda_C L_C^{\rho}\right)^{1/\rho},$$

where λ_g is a group-specific productivity shifter, and the parameter $\rho < 1$ dictates the relative substitutability or complementarity of noncollege and college workers. When $\rho = 1$, this gives us the linear production function discussed before and implies that the two types of workers are perfect

Figure 8. Reducing the Cost of Health Insurance



Source: Authors' calculations.

Note: This figure shows the impact on equilibrium wages and employment from reducing τ to τ' under the assumption of $a_g = 1$. Panel A shows the results for noncollege-educated workers (with productivity A_N), panel B shows the results for college-educated workers (with productivity A_C), and panel C shows relative outcomes for college workers relative to noncollege workers. As shown in panel C, the reduction in τ unambiguously lowers the college wage premium.

substitutes. For our baseline analysis, we assume $\rho = .038$ based on Autor, Goldin, and Katz (2020), and explore sensitivity to other assumptions below.

Given per worker costs ω_g, the firm chooses group-specific labor inputs to maximize profits:

$$max_{L_N, L_C}\left(\lambda_N L_N^{\rho} + \lambda_C L_C^{\rho}\right)^{1/\rho} - \omega_N L_N - \omega_C L_C. \tag{8}$$

We assume that under the head tax regime, equilibrium wages and employment for each group are given by their observed 2019 values (table 1).

A key calibration choice concerns the value of the head tax τ. Average premiums for employer-provided health insurance were \$11,764 in 2019 (figure 6). However, as seen in table 1, not all full-time, full-year workers are enrolled in employer-provided health insurance. In online appendix A.3, we show that in a model of incomplete take-up, the effective τ is simply the average premium scaled by the share of employees who are policyholders.[24] Since only 66 percent of full-time, full-year workers are policyholders, for our baseline analysis we therefore scale down average premiums by 0.66. This gives us a baseline value of $\tau = \$7{,}758$ in 2019.

III.B. Implied Parameter Values

With values for L_g, w_g, ρ, and τ, this setup allows us to solve for the remaining model parameters: the productivity shifters λ_C and λ_N and the value of $(\bar{\kappa} - \underline{\kappa})$, which governs the slope of the labor supply function. Specifically, we can solve the firm's maximization problem in equation (8) for the productivity shifters λ_C and λ_N, and we use the labor supply function in equation (2) to solve for $(\bar{\kappa} - \underline{\kappa})$. Intuitively, the productivity shifters λ_C and λ_N are revealed by the firm's first-order conditions for labor demand, and the labor supply slope $(\bar{\kappa} - \underline{\kappa})$ is identified from our assumption that the observed equilibrium wage and employment allocations for each group are produced by a linear labor supply function with a common slope. Online appendix A.2 provides the derivation.

Having identified the baseline parameters of the CES production function and the slope of the labor supply function, we can then solve for

24. In practice, table 1 showed that the lack of coverage reflects—in roughly equal measure—the fact that some firms do not offer health insurance and that some workers who are offered do not take up the insurance. Modeling incomplete offering of health insurance is more complicated, as we must then solve for equilibrium sorting of workers across firms that do and do not offer insurance. We discuss some of the implications of this possible extension in the last section.

the equilibrium under the payroll tax, where the cost per worker is now $\omega_g^P = (1 + t) \cdot w_g^P$. To do so, we use the solution to the firm's maximization problem in equation (8), together with the labor supply function in equation (2), and the equilibrium condition for the payroll tax.[25]

The equilibrium condition for the payroll tax that generalizes equation (5) for the CES production function is given by:

$$t = \frac{\tau}{\tilde{w} - \tau},$$

where $\tilde{w}$ is the average wage, which equals $\frac{L_N}{L_N + L_C} \cdot w_N^P + \frac{L_C}{L_N + L_C} \cdot w_C^P$. Together, this equilibrium condition gives us five equations—first-order conditions for each group's employment, labor supply functions for each group, and the equilibrium payroll tax—for the five unknowns. This system of equations allows us to solve for wages and employment of each group, as well as the payroll tax using a nonlinear equation solver.

Table 2 provides the baseline implied values for key model parameters under the baseline assumed value of τ = \$7,758 and the assumed substitution parameter $\rho = 0.38$. The college productivity shifter λ_C is roughly 50 percent higher than that of noncollege workers λ_N.[26] Our estimate of $(\bar{\kappa} - \underline{\kappa}) = 316{,}743$ can be translated into an implied labor supply elasticity

25. Specifically, since we know the slope of the labor supply function, we use a modified version of this equation that uses the head tax equilibrium as an intercept and calculates the labor supply given the slope of labor supply and the change in wages. Full details provided in online appendix A.2.

26. To provide some intuition for these productivity shifters, recall that when $\rho = 1$, the firm problem simplifies to equation (1) and then $\lambda_g = A_g$. Given the value of college and noncollege earnings in table 1, together with the assumed value of $\tau = 7{,}883$, this implies that $A_C = 104{,}062$ and $A_N = 57{,}937$. Thus, in the case of perfect substitutes, we get that $\frac{\lambda_C}{\lambda_N} = 1.80$. Our baseline calibration of $\rho = 0.38$ has a production technology with less substitutability. The effect of this substitutability on the value of λ_C and λ_N can be seen from investigating the first-order conditions for labor. The ratio of first-order conditions for noncollege and college workers gives the following expression: $\lambda_N = \left(\frac{w_N + \tau}{w_C + \tau}\right) \cdot \left(\frac{L_N}{L_C}\right)^{1-\rho} \cdot \lambda_C$. Rearranging and taking logs gives an expression $ln\left(\frac{w_C + \tau}{w_C + \tau}\right) = ln\frac{\lambda_C}{\lambda_N} - (1 - \rho) ln\frac{L_C}{L_N}$ for the log college wage premium, which is determined by a race between education and technology (Goldin and Katz 2008). The $ln\frac{\lambda_C}{\lambda_N}$ term is the intercept or technology term of the relative inverse demand for college workers.

Table 2. Baseline Implied Parameter Values

College productivity shifter	λ_C	59.584
Noncollege productivity shifter	λ_N	38.794
Difference in reservation wages	$(\bar{\kappa} - \underline{\kappa})$	\$316,743

Source: Authors' calculations.

Note: Our baseline analysis assumes, following Autor, Goldin, and Katz (2020), a substitution parameter (ρ) of 0.38 and that the cost of employer-provided health insurance (τ) is \$7,758. Dollar amounts are in 2019 US dollars.

of $\frac{1}{(\bar{\kappa} - \underline{\kappa})} \cdot \frac{w_g}{P_g} = \frac{1}{316{,}743} \cdot \frac{w_g}{P_G}$ for group g. Given the observed equilibrium values of w_g and P_g in table 1, the implied elasticities are 0.40 and 0.26 for college and noncollege groups, respectively. These estimates are within the range of estimates in the literature. For example, Chetty (2012) reports that estimates of extensive margin elasticities range from 0.15 to 0.45. Chetty and others (2013) provide a meta-analysis that points to an extensive margin labor supply elasticity of around 0.25, though estimates based on macroeconomic data tend to be larger (Keane and Rogerson 2012; Mui and Schoefer 2021).

IV. Labor Market Outcomes under Counterfactual Payroll Tax Financing

IV.A. Effects of Payroll Tax Financing on 2019 Labor Market Outcomes

Table 3 shows how labor market outcomes would differ in 2019 if, counterfactually, employer-provided health insurance were financed by a proportional payroll tax rather than a fixed, per worker head tax. The first column shows our baseline analysis, which assumes τ = \$7,758. This approach scales down the average \$11,764 health insurance premium to account for the fact that only about two-thirds of workers are policyholders.[27] With this τ, we calculate that the counterfactual, equilibrium payroll tax t would be 11 percent. That is, switching to payroll tax financing would add an additional 11 percentage points to existing payroll and income tax rates.

27. Because the cost of hiring a worker depends on the total health insurance premium, regardless of its statutory incidence, our calculation of τ does not adjust for the fact that only about three-quarters of premiums are paid by the employer (figure 6). This calculation follows the standard approach in public finance to disregard statutory incidence in calculating the economic incidence of taxes; in our setting, as discussed above, the split into employer and employee contributions is likely an equilibrium response.

Table 3. 2019 Labor Market Effects of Counterfactual Payroll Tax Financing

	(1) Baseline	(2) Full coverage
Fixed per worker cost, τ	\$7,758	\$11,764
Payroll tax rate, t	11.06%	16.80%
Wages		
Change in college wage, $\Delta(w_C)$	−\$2,181	−\$3,158
Change in noncollege wage, $\Delta(w_N)$	\$1,660	\$2,383
Change in college wage premium (%)	−11.26	−16.00
Employment		
Change in college employment rate, $\Delta(P_C)$	−0.69 pp	−1.00 pp
Change in noncollege employment rate, $\Delta(P_N)$	0.52 pp	0.75 pp
Change in total employment, $\Delta(L)$	86,833	119,495
Change in college employment, $\Delta(L_C)$	−408,588	−591,747 pp
Change in noncollege employment, $\Delta(L_N)$	495,420	711,242
Change in college share of wage bill, $\Delta\left(\frac{w_C L_C}{w_N L_N + w_C L_C}\right)$	−1.77 pp	−2.55 pp

Source: Authors' calculations.

Note: This table presents the change in 2019 outcomes from moving to counterfactual payroll tax financing relative to the current head tax financing. Each column shows results under a different measure of the cost of employer-sponsored health insurance (τ). The first column shows results of our baseline estimate: total premium accounting for the fact that only 66 percent of workers are policyholders. The second column shows results for the total premium cost with the assumption that all workers eligible for employer-provided health insurance are policyholders. The college wage premium (CWP) is defined by $CWP = w_C/w_N - 1$ and often referred to as a percentage, that is, a value of 0.90 implies college workers make 90 percent more than noncollege workers. In this table, the percentage change in the college wage premium is calculated as the percentage change in this value when moving from the head tax to the payroll tax, which would be equal to $(CWP^P - CWP^H)/CWP^H$. All dollars are in 2019 US dollars.

We estimate that if employer-provided health insurance were financed by this payroll tax, the wages of college graduates would fall by \$2,181, the wages of noncollege graduates would rise by \$1,660, and the college wage premium would fall by 11.1 percent. Employment would increase by 86,833 jobs, with an increase of 495,420 jobs for noncollege workers that is offset by 408,588 fewer college jobs. These wage and employment changes would result in a 1.8 percentage point lower college share of the wage bill.

For comparison, the second column shows results under the assumption that the head tax τ is equal to the average \$11,764 health insurance premium for employer-provided health insurance (which naturally changes the implied parameter values in table 2). This value for τ corresponds in a sense to the raw policy instrument: it is the cost of providing all full-time, full-year workers with employer-provided health insurance financed through a head tax. The counterfactual analysis thus tells us the impact of instead providing all of these workers, rather than only the 66 percent who are policyholders, with the same health insurance financed through a payroll tax. In this case, we estimate that the counterfactual equilibrium payroll tax rate would be 16.8 percent, rather than 11 percent in our baseline, and the college wage premium would fall by 16 percent, rather than 11.1 percent. Likewise, our baseline estimate of the approximately 500,000 increase in noncollege employment would increase to 710,000 under this alternative assumption.

SENSITIVITY ANALYSIS Table 4 holds the value of t constant at our baseline of \$7,758 and shows the sensitivity of our results to other assumptions. As shown in the last column, these alternative assumptions have virtually no impact on the equilibrium payroll tax rate, which ranges from 11.05 percent to 11.07 percent. They cause only slight adjustments to the other equilibrium outcomes.

Panel A shows results under different labor supply elasticities. Recall that for our baseline we derived group-specific elasticities based on the observed equilibrium allocations for each group and the assumption of a common labor supply slope across groups (i.e., κs are not group-specific). Here, we provide results based on directly calibrating a common labor supply elasticity. Since Chetty (2012) reports estimates of extensive margin elasticities ranging from 0.15 to 0.45, we show results for 0.15, 0.3, and 0.45. When we assume a common labor supply elasticity across groups, we now allow the κ parameters to be group-specific. In other words, to implement counterfactuals that calibrate labor supply elasticities directly, we set the slope of the labor supply functions for both groups to be consistent with the desired labor supply elasticities.[28] When labor supply elasticities are lower, the wage premium effects are bigger in absolute value, and changes in the college wage bill share and noncollege employment are smaller in absolute value. Intuitively, more of the equilibrium adjustment to the financing change happens via prices rather than quantities when labor supply is less elastic. Depending on this assumption, the decrease in the college wage premium ranges from 10.5 to 12.2 percent.

Panel B shows results using higher and lower assumptions about substitutability across worker types relative to our baseline level of substitutability $\rho = 0.38$ from Autor, Goldin, and Katz (2020). Alternative assumptions about substitutability change the slope of the relative labor demand curve

28. Specifically, given the assumed elasticity ε_g, we use the expression for the elasticity $\varepsilon_g = \frac{1}{\left(\overline{\kappa_g} - \underline{\kappa_g}\right)} \cdot \frac{w_g}{P_g}$ to identify the group-specific slope of the labor supply function $\left(\overline{\kappa_g} - \underline{\kappa_g}\right) = \frac{1}{\varepsilon_g} \cdot \frac{w_g}{P_g}$. Other than this detail, calibration is the same as in the baseline analysis.

Table 4. Sensitivity Analysis: 2019 Labor Market Effects of Counterfactual Payroll Tax Financing

	Change in college wage premium (%)	*Change in noncollege wages* $\Delta(w_N)$	*Change in college employment rate* $\Delta(P_C)$	*Change in noncollege employment rate* $\Delta(P_C)$	*Change in noncollege employment (thousands)* $\Delta(L_N)$	*Payroll tax rate t (%)*
Baseline	−11.26	$1,660	−0.69 pp	0.52 pp	495.42	11.06
Panel A: Labor supply elasticities						
Derived group-specific elasticities						
$\varepsilon_C = 0.42$ and $\varepsilon_N = 0.28$ (baseline)	−11.26	$1,660	−0.69 pp	0.52 pp	495.42	11.06
Assumed common elasticities						
$\varepsilon_C = \varepsilon_N = 0.15$	−12.28	$1,824	−0.28 pp	0.34 pp	317.53	11.05
$\varepsilon_C = \varepsilon_N = 0.30$	−11.35	$1,674	−0.52 pp	0.62 pp	582.94	11.06
$\varepsilon_C = \varepsilon_N = 0.45$	−10.55	$1,547	−0.73 pp	0.85 pp	807.90	11.07
Panel B: Substitutability (ρ)						
Perfect substitutes ($\rho = 1$)	−13.39	$1,985	−0.82 pp	0.63 pp	592.36	11.07
Gross substitutes ($\rho = 0.38$, baseline)	−11.26	$1,660	−0.69 pp	0.52 pp	495.42	11.06
Cobb-Douglas ($\rho = 0.01$)	−10.28	$1,511	−0.63 pp	0.48 pp	450.92	11.06

Source: Authors' calculations.

Note: This table shows the sensitivity of our baseline analysis (table 3, column 1; τ = $7,758) of the impact of moving to counterfactual payroll tax financing on 2019 outcomes. The college wage premium is defined as $CWP = w_C/w_N - 1$. In this table, the percentage change in the college wage premium is calculated as the percentage change in this value when moving from the head tax to the payroll tax, which would be equal to $(CWP^P - CWP^H)/CWP^H$.

for college workers compared to noncollege workers. Intuitively, as that substitutability increases, the impact of a given health financing tax on employment also increases. However, in practice, because our assumed value of ρ affects the calibration of the productivity shifters, our exercise is not one of pure comparative statics. Nonetheless, we find that this qualitative intuition holds. Thus, if college and noncollege workers were perfect substitutes, as in section II, with an assumed linear production function (i.e., $\rho = 1$), the changes in outcomes would be larger in absolute value: the college premium would decline by 13 percent, and the noncollege employment rate would increase by 592,000 instead of 495,000. If the production technology combining college and noncollege workers were nearly Cobb-Douglas (i.e., $\rho = 0.01$), changes in outcomes would be smaller in absolute value, with a 10 percent increase in the college wage premium and an increase in noncollege employment of 451,000.

In online appendix B we also show results when we expand our definition of college-educated workers to include those with some college education, even if they do not have a bachelor's degree.

IV.B. Effects of Payroll Tax Financing on Changes in Labor Market Outcomes, 1977–2019

Table 5 considers what changes in labor market inequality from 1977 to 2019 would have looked like if payroll tax financing had been in place throughout. We use the observed values of τ (figure 6) in 1977 and 2019 in the baseline calculations and assume throughout that 66 percent of full-time, full-year workers are policyholders of employer-provided health insurance.[29] The first column shows changes over time that have occurred under the head tax regime. Column 2 shows counterfactual changes under our baseline assumption of τ, which scales average premiums by 0.66 to reflect the share of workers that are policyholders. Column 3 shows results without that scaling. We focus our discussion on the baseline results.

The results show that labor market outcomes would have evolved quite differently under payroll tax financing. Under the head tax regime, real college wages (in 2019 dollars) increased by $33,903, while real noncollege wages grew by $7,754. As a result, the college premium increased by 44.8 percentage points over this period. Employment rates also increased for both groups; the employment rate increased by 5.8 percentage points for college workers and by 9.1 percentage points for noncollege workers.

29. In practice, this number ranges from 0.73 to 0.66 from 1996 to 2019, but since it is not available for every year, we use the statistic for 2019 throughout.

Table 5. Changes over Time: Labor Market Effects of Counterfactual Payroll Tax Financing, 1977–2019

		Payroll tax equilibrium	
	(1) Head tax equilibrium	*(2) Baseline*	*(3) Full coverage*
Employer-sponsored health insurance			
Change in cost ($\tau_{2019} - \tau_{1977}$)	—	\$5,937	\$9,003
Payroll tax ($t_{2019} - t_{1977}$)	—	7.16 pp	10.88 pp
Wages			
Change in college wages ($w_{C,2019} - w_{C,1977}$)	\$33,903	\$32,121	\$31,339
Change in noncollege wages ($w_{N,2019} - w_{N,1977}$)	\$7,754	\$9,305	\$9,976
Change in college wage premium (percentage points)	44.83	35.80	32.08
Employment rate			
Change in college employment rate ($P_{C,2019} - P_{C,1977}$)	5.77 pp	5.44 pp	5.31 pp
Change in noncollege employment rate ($P_{N,2019} - P_{N,1977}$)	9.13 pp	9.55 pp	9.73 pp
Change in college share of wage bill $\left(\frac{w_C L_C}{w_N L_N + w_C L_C}\right)_{2019} - \left(\frac{w_C L_C}{w_N L_N + w_C L_C}\right)_{1977}$	31.06 pp	29.62 pp	29.00 pp

Source: Authors' calculations.

Note: This table presents the change of each outcome between 1977 and 2019 for the head tax equilibrium and for the payroll tax counterfactual. Columns 2 and 3 show results for different measures of the cost of employer-sponsored health insurance (τ). The college wage premium is defined as $CWP = w_C/w_N - 1$ and often referred to as a percentage, that is, a value of 0.90 implies college workers make 90 percent more than noncollege workers. In this table, the percentage point change in the college wage premium is calculated as the percentage point change in this value from 1977 to 2019, which would be equal to $CWP_{2019} - CWP_{1977}$.

The payroll tax rate necessary to finance health insurance at the same per capita cost as under the head tax would have increased steadily from around 4 percent in 1977 to 11 percent in 2019. Under this alternative financing, the increase in the college wage premium would have been about 20 percent smaller: a 35.8 percentage point increase instead of the observed 44.8 percentage point increase. The employment rate of noncollege workers would have increased by about 4.5 percent more; specifically, the noncollege employment rate would have increased by 9.6 percentage points under the payroll tax, instead of the observed 9.1 percentage points.

SENSITIVITY ANALYSIS Table 6 once again shows the sensitivity of these results to alternative assumptions about the substitutability of workers and labor supply elasticities. Our baseline estimate (table 5, column 2) that the college wage premium would have risen about 20 percent less varies

Table 6. Sensitivity Analysis: Changes over Time: Labor Market Effects of Counterfactual Payroll Tax Financing, 1977–2019

	Change in college wage premium	*Change in noncollege wages* $(w_{N,2019} - w_{N,1977})$	*Change in college employment rate* $(P_{C,2019} - P_{C,1977})$	*Change in noncollege employment rate* $(P_{N,2019} - P_{N,1977})$	*Change in payroll tax rate* $(t_{2019} - t_{1977})$
Head tax equilibrium	44.83 pp	$7,754	5.77 pp	9.13 pp	—
Payroll tax equilibrium					
Labor supply elasticities					
Derived group-specific elasticities					
$\varepsilon_C = 0.42$ and $\varepsilon_N = 0.28$ (baseline)	35.80 pp	$9,305	5.44 pp	9.55 pp	7.16 pp
Assumed common elasticities					
$\varepsilon_C = \varepsilon_N = 0.15$	35.32 pp	$9,430	5.58 pp	9.43 pp	7.15 pp
$\varepsilon_C = \varepsilon_N = 0.30$	36.04 pp	$9,292	5.42 pp	9.69 pp	7.16 pp
$\varepsilon_C = \varepsilon_N = 0.45$	36.66 pp	$9,175	5.28 pp	9.91 pp	7.17 pp
Substitutability (ρ)					
Perfect substitutes ($\rho = 1$)	34.46 pp	$9,578	5.47 pp	9.61 pp	7.17 pp
Gross substitutes ($\rho = 0.38$, baseline)	35.80 pp	$9,305	5.44 pp	9.55 pp	7.16 pp
Cobb-Douglas ($\rho = 0.01$)	36.49 pp	$9,174	5.44 pp	9.52 pp	7.16 pp

Source: Authors' calculations.

Note: This table shows the sensitivity of our baseline analysis (table 5, column 2) of the impact of moving to counterfactual payroll tax financing on the change in outcomes between 1977 and 2019. The college wage premium is defined as $CWP = w_C/w_N - 1$ and often referred to as a percentage; therefore, in this table, the percentage point change in the college wage premium is calculated as the percentage point change in this value from 1977 to 2019, which would be equal to $CWP_{2019} - CWP_{1977}$.

modestly from 18 to 23 percent less. Online appendix B shows results when workers with some college education are included in the definition of college-educated workers.

DISAGGREGATING EFFECTS BY SEX The employment rate for noncollege males declined by 4.3 percentage points from 1977 to 2019 (online appendix table A.5). To consider how this group would have fared under a payroll tax, we extend the baseline model to account for different trends in employment and wages by sex. To do so, we assume that male and female workers of the same group are perfect substitutes. Total labor input from group $g \in \{N, C\}$ is therefore equal to $L_g = X_{g,M} L_{g,M} + X_{g,F} L_{g,F}$, where we normalize the male-specific productivity shifter $X_{g,M}$ to one. We also assume that the parameters determining labor supply $\overline{\kappa}_s$ and $\underline{\kappa}_s$ are sex-specific. By disaggregating wage and employment rate data by sex, the rest of the calibration follows the same logic as our main analysis.

Online appendix table A.4 shows the effects of moving from a head tax to a payroll tax in 2019 in aggregate and for each sex. In aggregate, the results largely match those from our main analysis, yet differences emerge when disaggregated by sex. The payroll tax has a redistributive effect such that the wage loss is biggest for the subgroup with the highest wages, college males, and the wage gain is biggest for the subgroup with the lowest wages, noncollege females. Meanwhile, the effects for college females and noncollege males are relatively smaller. Changes in employment rates and employment follow a similar pattern.

Online appendix tables A.5 and A.6 show the changes over time under a head tax versus a payroll tax for males and females, respectively. As before, the payroll tax is redistributive such that the wage loss is biggest for college males and the wage gain is biggest for noncollege females, while college females and noncollege males experience more modest effects. Since the effect is more modest for noncollege males, their wage increase would only be \$1,300 greater and their employment rate decline would be only 0.4 percentage points smaller from 1977 to 2019 under the payroll tax than the head tax. Therefore, the results suggest the health wedge is unlikely to account for much of the excess decline in employment rates for noncollege males.

IV.C. Benchmarking the Results

To benchmark these calibration results, we compare the impacts of counterfactual payroll tax financing to existing estimates from the literature of the impact of other factors on US labor market inequality. Although there is vast literature to draw on, direct comparisons are often hampered by differences across papers in the outcomes analyzed, the measures of inequality used, and the time periods studied. Still, we are able to provide some benchmarks for our estimated impacts on the college wage premium, noncollege employment, and noncollege wages. Where we are able to make reasonable comparisons, they suggest that the magnitude of the health wedge effect rivals other leading causes of labor market inequality, including outsourcing, union density, trade, the relative supply of college graduates, and automation.

COLLEGE WAGE PREMIUM Our baseline estimate is that switching from head tax to payroll tax financing of employer-provided health insurance would decrease the 2019 college wage premium by 11 percent. Our sensitivity analyses suggest a range for this estimate of 10 to 13 percent. This decline in the college wage premium is comparable to the effect of outsourcing that Goldschmidt and Schmieder (2017) estimate. Specifically, they find that domestic outsourcing in Germany causes wages at the outsourcing establishment to fall about 10 percent for non-outsourced noncollege-educated workers, while there is no effect on wages of non-outsourced college-educated workers; this suggests that outsourcing raises the college premium at the parent establishment by about 10 percent.

Another way to benchmark our estimate is to consider the equivalent shock to the relative supply of college workers needed to cause the college premium to decline by the same magnitude as the impact of switching to payroll tax financing. Autor, Goldin, and Katz (2020), who update Katz and Murphy (1992), estimate that a 10 percent increase in the relative supply of college equivalents reduces the college premium by about 6 percent.[30] From 1979 to 2017, the log relative supply of college equivalents fell 0.213 per decade or 2.13 log points per year. A decade of decline in the relative supply of college equivalents would therefore increase the log college wage premium by 0.131 $\left(=\frac{0.213}{1.62}\right)$. Thus, our estimate that the college wage premium would be around 11 percent lower under payroll tax financing is roughly the same magnitude (albeit opposite in sign) as the estimated impact of a decade of decline in the relative supply of college workers.

We can also compare our estimate of the decline in the college wage premium from payroll tax financing to estimates of the impact of the minimum wage on the college wage premium. In particular, Vogel (2022) generalizes the canonical model in which the college wage premium is

30. Note that college equivalents are college plus half those with some college, and noncollege workers are those with twelve years or fewer of schooling and half of those with some college.

determined by the relative supply and demand of labor to incorporate labor market institutions—such as monopsony power, minimum wages, and unemployment—and uses this framework to estimate the elasticity of the college wage premium with respect to the real minimum wage. These results suggest that the real minimum wage would need to increase by around 30 percent to achieve an equivalent of the 11 percent decrease in the college wage premium that we estimate would occur from switching from head tax to payroll tax financing.[31]

Much of the literature has focused on the role of various factors in contributing to changes in labor market inequality over time. We estimate that under counterfactual payroll tax financing, the college wage premium would have increased by 20 percent less from 1977 through 2019. In our sensitivity analyses, alternative calibrations suggest a range of 18 to 23 percent for how much less the college wage premium would have increased. This estimate is roughly comparable to the estimated impact of rising trade and declining unionization (albeit over slightly different time periods). Binder and Bound (2019) provide a useful summary of the literature on the contribution of rising trade and declining unionization to the change in the college premium between 1980 and 2006. They cite Katz's (2008) comment on Krugman (2008), suggesting that "rising trade accounted for less than 20 percent of the increase in the college wage premium" over this period (Binder and Bound 2019, 167). This assessment preceded the findings of Autor, Dorn, and Hanson (2013), which have shed further light on the effect of trade on inequality. Binder and Bound (2019) also note that DiNardo, Fortin, and Lemieux (1996) find the decline in unionization led to around 20 percent of the rise in the college wage premium over the 1980s. Using a related measure of inequality, Farber and others (2021) find declines in union density explain about 12 to 21 percent of the increase in the Gini coefficient from 1968 to 2014.[32]

NONCOLLEGE WAGES Our baseline estimate is that switching from head tax to payroll tax financing would increase the annual earnings of noncollege

31. Vogel (2022) measures the college wage premium as the ratio of wages instead of the percentage difference, but this benchmark calculation accounts for this difference. Additionally, note that the results in Vogel (2022) are based on the average minimum wage across states instead of the federal minimum wage.

32. Farber and others (2021) find that a 10 percentage point decline in union density—which is roughly the observed decline since 1980—reduced the college premium by about 12–15 percent when using time series variation, but they found somewhat smaller effects when using micro-level and state-year panel designs. Their state-year panel estimates, for example, were about half the magnitude of the time series estimates, and the micro estimates were in between those of the two designs.

full-time, full-year workers by about $1,700 (about 3 percent). Two useful benchmarks are the estimate of an average 10 percent union wage premium over the last two decades (Farber and others 2021) and the estimate that domestic outsourcing of workers in Germany causes wages to fall about 10 percent for noncollege-educated non-outsourced workers (Goldschmidt and Schmieder 2017).

Other useful comparisons are to the impact of increased exposure to imports or to robots. Chetverikov, Larsen, and Palmer (2016) estimate that for every $1,000 increase in import exposure per worker—roughly the interquartile range in CZ-level import exposure growth from 2000 through 2007 in Autor, Dorn, and Hanson (2013)—weekly wages decrease by about 0.7 percent on average, with workers in the bottom quartile of the wage distribution experiencing declines about twice as large in percentage terms and those at the top experiencing smaller declines. Acemoglu and Restrepo (2020) estimate that one more robot per thousand workers (the observed increase from 1993 to 2007) decreased wages by 0.4 percent, with effects again concentrated on those toward the lower end of the wage distribution. Our estimate of the impact on noncollege wages of switching to payroll tax financing is thus larger than the estimated impact of a $1,000 increase in import exposure per worker or of the increase in robots per thousand workers from 1992 to 2007.

NONCOLLEGE EMPLOYMENT Our baseline estimate is that switching from head tax to payroll tax financing of employer-provided health insurance would increase the 2019 employment rate for noncollege workers by 0.52 percentage points. In our sensitivity analyses, alternative calibrations suggest a range for the increase in the noncollege employment rate from 0.3 to 0.8. This effect is roughly comparable in magnitude to what others have estimated would be the decline in noncollege employment from a $500 increase in import exposure per worker, or a doubling of the growth in the number of robots per one thousand workers between 1993 and 2007.

To gauge the impact of the spread of robots, we look to Acemoglu and Restrepo (2020). They estimate that an additional robot per thousand workers between 1993 and 2007 reduced the employment-to-population ratio in a local area by 0.4 percentage points, with negative employment effects for all but the most highly educated workers.[33] They also document

33. Using a model of how local economies interact, Acemoglu and Restrepo (2020) then use their regional estimate to calculate that the overall effect on employment-to-population is about 0.2 percentage points or about 400,000 jobs, which are the estimates that they discuss in their conclusion.

that the number of robots in the United States increased by about one per thousand workers from 1993 to 2007. Thus, our baseline estimate of the impact of switching to payroll tax financing on increasing the employment rate of noncollege workers is similar in magnitude to the estimated effect of the increase in robots from 1993 to 2007 on decreasing that employment rate.

To gauge the impact of import exposure, we draw on Autor, Dorn, and Hanson (2013). They estimate that a \$1,000 greater import exposure shock (roughly the interquartile range in CZ-level import exposure growth from 2000 through 2007) decreased the noncollege employment rate by 1.11 percentage points. Thus our baseline estimate of the impact of switching to payroll tax financing on increasing the employment rate of noncollege workers is around half the size of the decrease in this employment rate caused by a \$1,000 import exposure shock.

V. Labor Market Effects of Rising Health Care Spending

We can also use our framework to consider how the rapidly increasing cost of health insurance in the United States affected labor market outcomes under the current head tax regime. Health expenditures increased in the United States from 6.25 to 16.77 percent of GDP between 1977 and 2019. During this time, the United States "advanced" from being on the higher end of health care spending across countries to being an extreme outlier (panel A of figure 5).

We consider two alternative counterfactual paths for the growth in health care spending: a "no-growth" counterfactual in which US health care spending (and hence the cost of employer-provided health insurance) remains fixed at the 1977 level in real terms and a "Canada" counterfactual in which health care spending in the United States in 2019 was the same share of GDP as it was in Canada (i.e., 10.84 percent of GDP instead of 16.77 percent). In 1977, average employer-provided premiums were \$2,760 in 2019 dollars. Under our baseline assumption that only 66 percent of full-time, full-year workers are policyholders, the implied head tax $\tau_{1977} = \$1,820 = 0.66 \cdot \$2,760$. Thus, compared to our baseline 2019 head tax $\tau_{2019} = \$7,758$, under the no-growth counterfactual the head tax would be \$5,938 lower than under the observed baseline. Under the Canada counterfactual, we scale our baseline 2019 head tax by the ratio of the Canadian share to the US share of the economy in terms of health care spending. As a result, the counterfactual 2019 head tax is 65 percent (= 10.84/16.77) of our baseline value, or \$5,017. Thus, under the Canada counterfactual, the head tax would be \$2,741 lower than under the observed baseline.

As discussed in section II, employment outcomes under counterfactual levels of US health care spending and health insurance premiums depend on the workers' amenity value α_g of employer-provided health insurance relative to cash. Conceptually, as discussed in section II, α may range from zero to a value above one and may also vary by group.[34] In practice, there is considerable disagreement about the amenity value of health care spending and further ambiguity about the amenity value of the portion of health care spending that rose over the last four decades. Some researchers emphasize the valuable and health-increasing technological improvements in medicine behind the rise in health spending (Cutler 2022), and others emphasize the large amounts of waste in US health spending (Garber and Skinner 2008). Naturally, these views are not mutually exclusive, and their relative importance likely varies over time and across locations. Absent much guidance from the empirical literature, we present results for four different amenity values: 0, 0.75, 1, and 1.25. In each case, we assume that the amenity value is the same for both groups of workers so that the marginal rate of substitution between health insurance and wages is equal across groups at the margin.

Table 7 presents the results. We estimate that college and noncollege wages would both be about \$6,000 higher under the no-growth counterfactual and about \$2,750 higher under the Canada counterfactual. These effects are largely insensitive to our assumption about the amenity value. Both groups experience a similar absolute increase in wages when health care spending grows less rapidly.[35] However, this increase is larger proportionally for noncollege workers (12 percent and 5.4 percent, respectively) than for college workers (6 percent and 3 percent, respectively; see table 1, panel A). As a result, the college wage premium is about 10.5 percent lower in the no-growth counterfactual and about 5 percent lower in the Canada counterfactual.

By contrast, the impacts of alternative levels of health care costs on employment vary greatly depending on the assumed amenity value. If workers are indifferent between wages and spending on employer-provided

34. For example, many people might not value medical spending focused on rare conditions.

35. In all cases, we can see that the cost reduction leads to a nearly equal increase in wages for both groups of workers. With linear production (as in our stylized model in section II and $\alpha = 1$) it is straightforward to see that the increase in wages would be the same for both groups (and equal to the decrease in health care costs τ). This is also the case with CES production (see columns 3 and 7), but with CES production and other values of α equilibrium changes in employment that affect marginal productivity of labor have a second-order effect on equilibrium wages that can differ across groups.

Table 7. 2019 Labor Market Effects of Health Care Spending Counterfactuals

	No-growth counterfactual				*Canada counterfactual*			
	$\alpha = 0$	$\alpha = 0.75$	$\alpha = 1$	$\alpha = 1.25$	$\alpha = 0$	$\alpha = 0.75$	$\alpha = 1$	$\alpha = 1.25$
Change in cost, τ	–$5,937	–$5,937	–$5,937	–$5,937	–$2,740	–$2,740	–$2,740	–$2,740
Wages								
Change in college wage, $\Delta(w_C)$	$6,062	$5,969	$5,937	$5,905	$2,799	$2,755	$2,740	$2,726
Change in noncollege wage, $\Delta(w_N)$	$5,840	$5,912	$5,937	$5,962	$2,695	$2,729	$2,740	$2,752
Change in college wage premium (%)	–9.99	–10.43	–10.58	–10.73	–4.88	–5.10	–5.18	–5.25
Employment rate								
Change in college employment rate, $\Delta(P_C)$	1.91 pp	0.48 pp	0.00 pp	–0.48 pp	0.88 pp	0.22 pp	0.00 pp	–0.22 pp
Change in noncollege employment rate, $\Delta(P_N)$	1.84 pp	0.46 pp	–0.00 pp	–0.46 pp	0.85 pp	0.21 pp	–0.00 pp	–0.21 pp
Change in college share of wage bill, $\Delta\left(\frac{w_C L_C}{w_N L_N + w_C L_C}\right)$	–1.30 pp	–1.27 pp	–1.26 pp	–1.25 pp	–0.62 pp	–0.61 pp	–0.61 pp	–0.60 pp

Source: Authors' calculations.

Note: The college wage premium is defined as $CWP = w_C/w_N - 1$. In this table, the percentage change in the college wage premium is calculated as the percentage change in this value when moving from the head tax to the payroll tax, which would be equal to $(CWP^P - CWP^H)/CWP^H$.

health insurance, as represented by a value of α equal to one, then lower spending increases have no employment effects (Summers 1989; Gruber 1994). For α less than one, workers value an increase in wages more than an increase in spending on employer-provided health insurance. As a result, an increase in health care spending is partially a tax on workers, and the incidence of this tax is split between wages and employment. Thus, under counterfactuals of lower spending increases, employment increases. Conversely, for α greater than one, workers value increased spending on employer-provided health insurance more than the increase in wages and so employment increases as health care spending rises. Thus, under counterfactuals of lower spending increases, employment falls.

VI. Discussion

This paper calibrates the effect of the US health care head tax on labor market inequality. We find that if employer-provided health insurance were instead financed by a proportional payroll tax, the college premium would be 11 percent lower, and noncollege employment would be nearly 500,000 higher. Over the last four decades, the rise in the college premium would have been about 20 percent lower and the rise in the employment rate of noncollege adults would have been 4.6 percent higher. These effects are comparable in magnitude to previous estimates of the impact of other leading sources of labor market inequality, including outsourcing, robot adoption, rising trade, and declining unionization. Some of these forces might be driven in part by firms' responses to rising health costs for domestic workers, so they are not mutually exclusive from the health care financing mechanism we focus on here.

Our analyses rely on several important simplifying assumptions. We briefly discuss them here, in the hopes that they may offer fruitful directions for future research.

Perhaps most importantly, our analysis occurs in partial equilibrium. In particular, we have not considered potential effects on employer behavior. In practice, health insurance financing reforms may change whether employers offer health insurance as well as the generosity of plan offerings. There may also be important labor market margins of response, such as the share of workers in part-time versus full-time employment, the propensity of employers to use contract workers, domestic outsourcing, and offshoring. These potential responses are ignored in our counterfactual analysis of the impact of rising US health care spending under current head tax financing, and they are explicitly assumed away in our analysis of a counterfactual, nationwide payroll tax to finance the health insurance of workers. Naturally, a policy that applies based on workers' current form of health insurance is not practically feasible. As noted at the beginning of the paper, in practice a nationwide payroll tax would need to also finance health insurance for currently uninsured individuals.

Within this partial-equilibrium framework, there are other, potentially important simplifying assumptions. First, like much of the existing literature on labor market inequality, we focus on outcomes such as the college wage premium and noncollege employment and wages. Other measures of inequality such as inequality in total compensation warrant greater attention, especially in light of work on the role of health benefits in affecting a broad measure of compensation inequality (Pierce 2001, 2010; Gittleman and Pierce 2015; Piketty, Saez, and Zucman 2018; Ouimet and Tate 2023). In particular, this work has highlighted that considering health benefits materially reduces measured inequality between high- and low-income workers, while adding incentive compensation and retirement benefits has an opposite effect.

Second, our model of the labor market involves a number of potentially important simplifying assumptions. We consider a textbook, competitive model of the labor market; imperfect competition and other labor market frictions are attracting increasing attention among labor economists (Card 2022), and their quantitative impact on our calibrations is an important and open question. We also abstract from the fact that some full-time, full-year workers are not offered employer-provided health insurance; we instead model the incomplete coverage as happening only through the take-up margin. In practice, firms choose whether or not to offer health insurance in equilibrium (Dey and Flinn 2005), and noncollege workers are disproportionately located in firms that do not offer health insurance (table 1). This sorting—which is itself an equilibrium outcome (Aizawa 2019)—may be partly a reaction to the head tax financing of insurance and likely cushions its impact on labor market inequality. How quantitatively important such worker sorting across firms is for our analysis, however, remains unclear, especially because high-wage workers tend to disproportionately sort into high-wage firms (Song and others 2019).

Expanding our model to allow workers to choose between firms that do and do not offer health insurance would also allow analysis of additional impacts of the financing of employer-provided health insurance on the distribution of employment and earnings. In particular, our analysis follows Case and Deaton (2020b) in focusing on college workers compared to noncollege workers. Others have focused on the decline in the share of workers in the middle of the wage distribution (Autor 2018; Autor and Dorn 2013). It is conceivable that this "hollowing out" phenomenon may also be affected by the head tax financing of employer-provided health insurance. The lowest wage group may be predominantly covered by Medicaid and in jobs that do not offer health insurance. Accordingly, the middle group would be the one squeezed out by head tax financing, which makes them less attractive relative to both higher-wage workers for whom the head tax is a smaller share of labor costs and lower-wage workers who do not require the head tax to be paid by their employers. Relatedly, it is also conceivable that financing health insurance through the firm contributes to the rise of alternative work arrangements that don't provide insurance and to the fissuring of the workforce (Weil 2014; Katz and Krueger 2017; Card, Heining, and Kline 2013; Song and others 2019).

One important way to make progress on these issues would be through empirical work that identifies exogenous variation in the costs of employer-provided health insurance that can be used to study its impact on labor market outcomes. Importantly, the ideal variation would occur at the labor market rather than firm level, so that it might be possible to estimate impacts on the labor market equilibrium.

Despite all these important directions for further work, our calibrated analysis suggests that the uniquely American approach to financing health insurance could have a quantitatively important impact on labor market inequality. Our analysis suggests that if the cost of health care in the United States continues its rapid rise over the coming years, labor market inequality will also continue to grow in the absence of substantial reforms to how we finance health insurance in America.

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Comments and Discussion

COMMENT BY

DAVID CUTLER Among high-income countries, the United States is unusual in relying so heavily on employer-based financing of health insurance. Most countries finance health insurance through an income or payroll tax, as part of a national health insurance system. Such a system assesses a fee more than actuarial cost of insurance on higher-income people and less than actuarial cost of insurance on low-income people. In contrast, a premium-based system charges the same dollar amount to everyone—the classic head tax.

Because health insurance is so expensive, the implicit cost of health insurance for each employee differs greatly between a head tax and a payroll tax. An average family health insurance policy costs around $20,000 per year. If one considers an employer paying for that entire amount, that is 40 percent of the wage for a $50,000 per year employee, but only 10 percent of the wage for a $200,000 per year employee. If the employer instead paid a fixed share of payroll for insurance, the required tax rate would be 16 percent (in this example), and the cost of health insurance would fall to $8,000 annually for the low-wage employee and rise to $32,000 annually for the high-wage worker.

A key question is what impact such a change, $12,000 per employee per year in this example, would have on earnings and employment of different workers. Finkelstein, McQuillan, Zidar, and Zwick explore that issue in this paper. They use a model of the labor market to simulate the impact of moving from a head tax to payroll tax on earnings and employment of workers with more and less education. The theoretical effect is clear. With the lower cost for workers with less education, labor demand for such

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workers will rise. This will lead to some combination of increased earnings and greater employment, with the relative split between the two determined by the labor supply elasticity. The same is true in the opposite direction for workers with more education.

The authors' results suggest that the impact will be largely on wages, though employment will be somewhat affected as well. If health insurance were financed by a payroll tax instead of a head tax, wages for noncollege-educated workers would rise by roughly $1,700 per year, and the college wage premium would fall by 11 percent. Employment of noncollege-educated workers would increase by nearly 500,000 people. There would be a similar-sized reduction in employment of college-educated workers, of roughly 400,000 workers. The net impact would be a modest increase in employment, roughly 87,000 workers, and a tilting of earnings toward workers with less education. The relatively greater impact of the change on wages relative to employment is a reflection of the fact that the labor supply elasticities the authors use are not particularly large.

The authors do a similar calculation about the impact of the increase in health insurance costs over time. Here, the analysis is more complex, because the additional spending on health insurance is buying additional services (in part), which may themselves influence labor supply. Using an assumption of no benefit from additional spending, so that the increase in premiums is entirely a tax, they find that workers with both more and less education would earn more and work more hours had health insurance cost not increased. This is understandable since insurance costs for both groups of workers would fall. The overall income gains would be greater for the noncollege-educated group, as one expects given the higher cost burden for that population.

It is important to note that payroll tax financing cannot be administered in the same fashion as head tax financing. A head tax can be implemented in private markets. Insurers can, and some do, charge firms a fixed amount per insured individual, equal to expected medical costs plus overhead. At such a premium, the insurer will break even for each firm. In contrast, the payroll tax has to be administered through the public sector. In the example above, if the firm hired an additional low-wage worker, a constant payroll tax rate would not cover expected health insurance costs for the firm. Thus, the privately set tax rate would have to increase or decline with the wage composition of employment. This adjustment would have to be sufficient to raise the total amount paid by the firm by $20,000 for each new worker hired, independent of the worker's wage. A savvy firm would know that the cost of each worker was the full cost of insurance for an additional person, independent of how the premium was quoted. For this reason, a private payroll tax financing system would not be feasible, and the change that the authors consider, from a head tax to a payroll tax, is not a trivial one.

One implication of the authors' analysis is that wage inequality is not the best measure of labor market differences across groups. Rather, the right measure of inequality is compensation inequality. Wages are one part of total compensation, but there are other parts as well.

The authors do not analyze trends in total compensation in the United States over time or across countries. However, others have. Most notable is research by Pierce (2010). Pierce compares changes in compensation in different parts of the compensation distribution to changes in wages in different parts of the wage distribution. Overall, the growth of compensation inequality between 1987 and 2007 is roughly the same as the growth of wage inequality. This seems unusual given the very rapid growth of health insurance over this time, which raises compensation the most for low- and middle-income employees. The reason is that there is an offsetting effect: at the same time that health insurance costs were rising, other benefits increased more for high-wage workers, such as pensions and bonuses or incentive pay. On net, the two roughly cancel out.

The importance of differential changes in benefits other than health insurance suggests a key issue with the incidence analysis in the paper. It may be that the impact of rising health insurance premiums is not on wages but rather on other benefits. For example, firms may respond to rising health insurance costs by moving money out of wages and salaries and into pensions or bonus arrangements, especially those targeted to high-income workers. If this were the impact, changing the financing of health insurance in the United States would not necessarily change wages but might instead change other benefits.

The net impact of an offset to benefits rather than wages depends on the marginal valuation of benefits and wages. If all benefits are valued dollar for dollar at the margin, employees would not care where the offset occurred. Of course, there are different tax implications of benefits and wages or salaries, which the government would need to consider. And the impact on well-being would be very different if not all employees value benefits dollar for dollar at the margin. For all these reasons, understanding whether health insurance costs have led to reduced wages and salaries or other benefits is a very important issue.

This discussion raises a broader point about the incidence of the current health insurance financing system, as well as proposed alternatives. To do their analysis, the authors need to make assumptions about incidence—How does a firm respond when faced with health insurance costs that vary in how they are assessed? The authors are upfront about the need to do this and are also clear in the assumptions they make. They treat the current financing system as a head tax, and the alternative as a tax per dollar of earnings. Viewing the payroll tax this way is reasonably standard. Since the payroll tax rate is specified in advance, and it is not complicated for firms to understand, it makes sense to assume that firms treat the payroll tax as a tax per dollar of wage and salary payment.

In contrast, treating the current financing system as leading to a reduction in the wage per hour worked is a more complicated assumption. There is not a great deal of evidence about the incidence of current health insurance payments. Some studies suggest a dollar for dollar trade-off between health insurance costs and wages (Gruber 1994; Sheiner 1999), though not all do so (Levy and Feldman 2001). However, full impact on wage rates is not the only theoretical prediction. Provided firms can adjust hours as well as wages, one would not expect health insurance costs to affect only wages (Gruber 2000). Rather, firms should have employees work more hours and hire fewer workers in total. The additional hours may come at a greater marginal cost, but the reduction in employment it leads to would reduce the overall compensation bill. Along these lines, some studies have found impacts of health insurance costs on hours of work (Cutler and Madrian 1998), though work on this topic is not fully complete.

The issue of how high insurance costs affect the full employment contract is very important because understanding how firms treat the current financing system will directly affect the implications of moving to a new financing system. In particular, if firms respond to a health insurance bill presented by an insurer by reducing the wages of all employees by the same percentage (not the same dollar amount), this will be the same incidence as the payroll tax alternative that the authors consider.

Three features of the world suggest to me that the incidence of current health insurance financing is more complex than what the authors assume. The first fact is that there are large firm effects in compensation. The same worker, with the same occupation, earns different amounts depending on which firm they work for (Card and others 2018). In essence, the administrative staff at a fancy software engineering firm earns more than the same administrative staff at a low-wage retail establishment. It may be that this is irrelevant with respect to the incidence of health insurance—the high-wage firm may still offset higher insurance costs by reducing the wage rate dollar for dollar—but it may also be relevant. The same firms that offer above-average wages for similar workers may not offset the higher costs of health insurance to those workers in the same fashion.

The second observation is that firms seem to care a lot about health insurance costs, even when medical spending trends are affecting all firms roughly equally. Costs that affect one firm and not others will necessarily affect that firm's decision-making. If one firm has less healthy employees than another and thus higher medical spending than its competitor, the firm with higher medical costs will have to decide how to adjust—reduce wages, earn lower profits, or some other method. However, if all firms are affected by rising costs, the equilibrium would be for all wages to fall dollar for dollar. In this equilibrium, firms would not care about the cost of health care. They would simply take the total cost of health insurance as given and set wages based on them.

In reality, firms seem to care greatly about how much they are paying for health insurance, even when they pay more because of general cost increases. In a recent survey, roughly one-third of firms expressed dissatisfaction with the overall cost of medical care (Claxton and others 2022). The vast majority of the remainder are "satisfied" but not "very satisfied." Such a situation would not be apparent if firms took health costs as given and costs were rising uniformly for all firms.

Third, firms seem to respond to high health costs not just by reducing wages but by changing the structure of their health insurance in a way that reduces the costs they face. Perhaps the biggest change in health insurance in recent years has been the shift to high deductible plans. In the 1990s, less than 10 percent of workers with employer-sponsored insurance were enrolled in high deductible health plans. Today, it is one-third of workers (Claxton and others 2022). There are many reasons for this change; the rising cost of medical care is one of them (Chernew, Cutler, and Keenan 2005). As medical costs have increased, firms have responded by reducing the generosity of what they offer.

For many reasons, this is not what theory would suggest. One major reason is the tax exclusion of employer-provided health insurance. Employer payments for health insurance are not taxed as income, where wages and salaries are. Thus, from an employee's standpoint, it is best to run any medical spending which is sure to occur through health insurance. In addition, rising cost sharing exposes employees to more risk. This risk bearing is a welfare reduction, and employees might be willing to pay for (i.e., in lower wages) a more generous package than is the norm in a high deductible policy. Thus, something seems off with the basic theory.

In thinking about alternative models of wage setting in the presence of high and rising health insurance costs, there are several directions one can go. One traditional way is by building in nominal wage stickiness. Offsetting rising health insurance costs with lower wages may not be feasible if it involves reductions in nominal wages, as opposed to lower wage increases. In the presence of nominal wage stickiness, the offset to health insurance costs may occur more in employment and less than wages.

A second type of model considers separation of benefits costs and wages. Imagine a model of the following form. First, firms pay for health and other pre-committed benefits out of revenues. Second, employees outside of senior executives are paid a wage based on opportunity cost. Third, residual revenues are distributed to owners, either as bonuses, performance pay, or in some other nonwage form. In the classic version of wage setting, employees recognize the value of health benefits at the firm and are willing to take a wage discount for better benefits. However, it is possible that employees have difficulty comparing health benefits at their current firm with other potential employers. They may assume health benefits are "good" everywhere, or at minimum very difficult to compare, and thus only consider the wage on the job relative to the wage on other potential jobs. In this case, wages could not be fully adjusted for increasing health costs or workers would leave the firm.

In such a setting, high benefits costs will primarily come out of executive compensation—the residual after wages or salaries and benefits for nonexecutives are paid. Employment may or may not be affected, depending on the elasticity of demand for nonexecutive labor. This model would have a very different application for incidence than the one that the authors consider.

A third type of model involves differential valuation of health insurance by different types of people. It is easiest to introduce the model starting with the pattern of wage inequality that we observe in the data. Song and others (2019) analyze changes in the wage distribution over time.[1] They highlight three aspects contributing to wage inequality. The first is that high-wage people are more likely to work in high-wage firms over time—superstar computer programmers increasingly work at superstar software engineering companies. My guess is that this has relatively little to do with health insurance and much more to do with geographic mobility by income.

The second component is that there is more segregation of high-wage workers into high-wage firms than used to be the case. An example of this

1. See also Haltiwanger, Hyatt, and Spletzer (2022).

would be a software engineering firm that used to have its own cleaning staff but now contracts for those services from outside companies. The result is that high wages are more concentrated among high-income earners than used to be the case. This may absolutely be a result of rising health costs, which I return to. The third part of rising wage inequality is absolute reductions in wages in what researchers call "mega firms"—firms that employ 10,000 or more workers. There are roughly 750 such firms, including many well-known companies: Walmart, Coca-Cola, the major airlines, and so on (Song and others 2019). Within these firms, low-wage workers have traditionally been paid more than the wage workers in their comparable smaller competitors, as noted above. Over time, wage differentials for low-wage workers in these firms have been eroding. Indeed, wages have been falling in nominal terms in many of these firms. This also might be a direct result of rising health insurance costs.

The theory that I have in mind is easiest to consider in the context of rising medical care costs. In such a setting, it is important to understand why health insurance costs are increasing. The evidence suggests several reasons. The first is the rising cost of new medical technologies. Historically, this is the most common explanation for rising health costs (Newhouse 1992; Cutler, Rosen, and Vijan 2006; Cutler and others 2022).

That explanation remains true, but with a twist that is particularly important. A lot of recent new technologies have been in pharmaceuticals and other treatments that apply to a relatively small group of people, who are ex ante easy to identify. For example, a few decades ago, there was little effective treatment for people with rheumatoid arthritis. Now, there are a number of different possibilities, each with a very high price tag. Treating rheumatoid arthritis can cost upward of $20,000 per year (Cardarelli 2016). This type of technological change has led to a large increase in spending at the high end of the spending distribution. We see this in pharmaceutical data. The Massachusetts Health Policy Commission (2023) found that between 2017 and 2021, the median price of a prescription was essentially unchanged, while the 95th percentile price increased by over 50 percent.

A hallmark of rheumatoid arthritis, and many similar conditions, is that it is extremely persistent: people who have the condition in one year are almost certain to have it the next year, and people who do not have the condition are very unlikely to acquire it. For example, about 1 percent of the US population has rheumatoid arthritis (Xu and Wu 2021), and since there is no cure, people who are treated for it in one year will almost certainly be treated for it in the future. At the same time, the annual onset of new cases is much smaller (Abhishek and others 2017).

Now consider what happens when a new drug is developed to manage rheumatoid arthritis. If a firm that is providing insurance charges everyone more to pay for the cost of the new drug (for example, by reducing wages across the board), a lot of people will be paying more for something they have very little expectation of using. To be sure, they would like actuarially fair insurance to cover rheumatoid arthritis medications, but for someone without rheumatoid arthritis, the actuarially fair policy costs very little. Any policy that covers people with preexisting cases reasonably well will be actuarially unfair for those without the condition. Of course, some people buy insurance even for risks that are low. But given the very low likelihood of developing rheumatoid arthritis for those who do not have it, and the amount it adds to premiums, it is entirely possible that people without rheumatoid arthritis would choose not to purchase coverage for the new medication.

Targeted new treatments are one source of cost increase. There are others that are important as well. A second source of cost increases is higher prices charged by providers, especially providers with market power. A large body of literature shows the providers with market power charge more than those without. For example, nationally ranked hospitals with a reputation for high quality receive extremely high prices relative to those without such a reputation (Cooper and others 2019). Over time, the medical system has consolidated (Cutler and Scott Morton 2013). What used to be many independent hospitals is now a smaller number of health systems, including hospitals and other care providers (Beaulieu and others 2023). These health systems often have the market power necessary to charge higher prices. Indeed, in the past few decades, research shows an important role for rising prices in higher medical care spending (Tollen and Keating 2023).

Paying more for better providers may be worth it, but raising prices may be particularly pernicious for low-income workers. The reason is that the providers charging more are often ones used disproportionately by the highest-wage workers. For example, in Boston, the highest prices are charged by the academic medical centers—the integrated system of Massachusetts General Hospital and Brigham and Women's Hospital (Massachusetts Health Policy Commission 2023). Those hospitals are difficult to access for people who have low and middle incomes, who do not live nearby, and who have difficulty following through on the various steps required to schedule appointments at these institutions. My guess is that the bulk of those with private insurance who use Mass General Brigham tend to be higher than average income. Thus, even if one thought the higher prices at prestigious institutions were justified by higher quality, a typical insurance policy charges everyone more to pay for care used disproportionately by the best off.

A third explanation for rising medical spending is higher administrative costs. Both insurers and providers incur administrative costs as they haggle over what services can be provided and how much will be paid for them. These administrative costs have increased over time as underlying medical costs have risen. Indeed, high prices are likely causing high administrative spending. To return to the example of rheumatoid arthritis, in order to minimize the cost of new rheumatoid arthritis drugs, insurers may require documentation before approving each use of the medication. Managing such documentation adds to cost, without providing any direct patient benefits.

The effect of these three components—new medications, provider rents, and increased administrative costs—is that a good deal of health insurance cost increases is likely not associated with measurable quality gains. That is particularly true at the margin, where a typical, generally healthy employee may experience relatively little new technology to help improve their condition. If that is the case, the α term in the paper may be far below one, again at the margin (that is, for the rise in medical spending).

In response to a low marginal value of medical spending, firms will find it difficult to offset the cost of health insurance in lower wages. This will lead them to cut back on the generosity of the benefits package. In many instances, this is done by raising the cost sharing that individuals need to make for coverage. For example, medications for rheumatoid arthritis can be put on a higher tier of the formulary where much greater out-of-pocket payments are required, along with the value of prior approval noted above. One limit of this is the high deductible health insurance plan, for which the employee has to pay several thousand dollars before insurance contributes anything. The consequence of these actions is that health insurance premiums stay low, but health insurance becomes a less desirable product.

As the health insurance policy becomes less generous, the overall value of the policy declines, especially for those with low and middle incomes. Think again about a high deductible health insurance plan. Only one-third of American families have money they consider savings (Pew Charitable Trusts 2015), and total financial assets for the median family with $40,000–$60,000 in annual earnings is only $4,000.[2] Effectively, for many families, having a high deductible insurance policy is close to being uninsured. If the

2. Board of Governors of the Federal Reserve System, "Survey of Consumer Finances, 1989–2019," https://www.federalreserve.gov/econres/scf/dataviz/scf/table/#series:Transaction_Accounts;demographic:inccat;population:all;units:median.

family has to pay the first $2,500 before any insurance reimbursement, they may act as if they are uninsured—they may avoid all care to limit the possibility of facing medical bills they cannot afford. That translates into a still lower value of insurance. Employees will be less willing to give up wages for benefits when the benefits realized are not very helpful.

The impacts of such changes are likely to be felt in many ways. As the overall value of health insurance falls, firms will face incentives to break into high- and low-wage subcomponents, outsourcing low-wage workers to companies that do not provide health benefits (the second of the three explanations for increasing wage inequality noted above). Some literature suggests that high health insurance costs may be one of the explanations for outsourcing (Weil 2014). For this reason, I do not view outsourcing of workers as a separate explanation for the impact of health insurance on wage inequality, the way that the authors sometimes set it up. Similarly, the push to replace human labor with machines may also be a consequence of rising health insurance costs. Machines do not need health insurance, and thus wage trade-offs are not necessary.

In the end, I think the authors have identified an important issue associated with wages for low-income workers. However, I suspect the true model of the world runs even deeper than what they propose. The fact that a good deal of health care costs are not associated with technologies or care settings that benefit typical workers, especially generally healthy low- and middle-income workers, means that rising medical costs may have far-reaching implications for the structure of employment and wages. The economic importance of bringing rationality to medical care may be even bigger than is generally discussed.

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COMMENT BY

ANGUS DEATON[1] I welcome this paper and congratulate its authors. It is an important contribution to the policy debates about the American health care system and how it is financed. I also have a personal reason to welcome it because it takes seriously and extends an argument that Anne Case and I made in our book *Deaths of Despair and the Future of Capitalism* (Case and Deaton 2020).

I begin with an account of the origins of our argument about the health wedge, that the financing of health care lowers both wages and the demand for labor and does so by more for less-skilled workers. In our book, we focused on workers without a four-year college degree, but the argument is more general.

Our work began with a paper (Case and Deaton 2015) in which we identified an unprecedented increase in mortality among midlife white non-Hispanic men and women in the twenty-first century. An analysis of the death certificates showed that the increase was almost entirely confined to men and women without a four-year college degree. An important factor in the increase was an epidemic of suicides, drug overdoses, and deaths from alcoholic liver disease, deaths that Case (2015) subsequently labeled "deaths of despair." In later work (Case and Deaton 2020, 2022), we documented that after 2013 deaths of despair had spread beyond white Americans into the Black and Hispanic communities. Here too, those with a four-year college degree were largely immune.

From the beginning, we suspected that the underlying causes lay in an increasingly difficult labor market for less-skilled workers and the cascading

1. I am grateful for helpful comments and discussions to Bettina Aten, Anne Case, Jason Furman, and Marshall Leinsdorf. They did their best and remaining errors are the responsibility of the author. I acknowledge support from the National Institute of Aging through a grant to the NBER, award number R01AG060104.

effects of the loss of good jobs on community destruction, on morbidity as well as on mortality, on marriages, and on social and institutional attachment. An immediate challenge for such accounts was the fact that deaths of despair were not showing up in other countries, at least not in anything like the same rate as in the United States. Similar, but much smaller, epidemics existed in England and in other English-speaking countries but, with the notable exception of Scotland, the United States stood out among rich countries. Given this, stories of globalization and automation, despite the evidence from the China shock literature, did not seem fully satisfactory; there are robots and Chinese imports in Britain, France, and Germany, too.

A more promising account lies in the fact that America's safety net is so much weaker than the value-added tax–supported welfare systems in Europe. The United States has long been less dependent on trade than smaller European countries and so has had less need to develop a safety net to shield its citizens against trade-related shocks (Rodrik 1998). The baleful effects of racial animus have also undermined attempts to construct a welfare state, so that the United States is left uniquely unprotected in the age of hyper-globalization. We suspect that this is part of the story.

The other thing that differentiates the United States from other rich countries is its health care system, both in terms of its exceptional cost—according to the Organisation for Economic Co-operation and Development (OECD), its share of GDP is about half again as much than the second-most expensive country, Switzerland—and by the way in which it is financed, with most working people covered by insurance provided by their employer.[2]

Case and I know a retired corporate executive who read a draft of our book. His politics are very different from ours, so he brought a perspective that we would not get from most academic audiences; he also knows a great deal about labor practices within large firms. He told us that at one annual meeting with the human resources staff in his firm the executives were told that their health insurance premiums for the next year would increase by 40 percent. Spending that amount was infeasible, so they sent for a well-known firm of management consultants who told them to cut their head count by shedding employees with the highest ratio of health insurance premium to contribution to the firm. Because health insurance premiums do not vary much across employees, that meant getting rid of

2. OECD, "Health Expenditure and Financing," https://stats.oecd.org/Index.aspx?DataSetCode=SHA.

the lowest-paid workers and outsourcing their jobs either domestically or internationally. This is the health wedge in action. It was our friend's belief that the corporation's ex-employees were replaced by illegal immigrants, but his only evidence for this was that they spoke Spanish. Right or not, he was angry, and we suspect that the health wedge has political as well as economic consequences.

The outsourcing is clearly widespread, and few large corporations in the United States employ their own security, transport workers, food service workers, cleaners, or building maintenance staff (Dorn, Schmieder, and Spletzer 2018). These workers, now employed by contract service firms, may be doing work that is close to identical to the work that had been done by employees within the company, but they are paid less, they are less likely to have benefits, and what had been "good jobs" became "not so good jobs." The institutional affiliation, which was important to at least some, has been lost. The new workers may be doing exactly the same work as the original workers, and working alongside the same company employees, but they are not part of the company, and, to use Nick Bloom's words, are not invited to the holiday party (Bloom 2017). This outsourcing of less-skilled workers is one consequence of the health wedge. Another is switching less-skilled workers from full-time to part-time, for whom health insurance need not be offered. To take a local example, the public library in Princeton, New Jersey, not exactly a poor town, complains that many of its (once full-time) staff are now part-timers, and health premiums are cutting into its budget for books.

Finkelstein, McQuillan, Zidar, and Zwick provide a much fuller analysis than we did. We did not think of the effects on the college wage premium, nor did we calculate the differential employment effects. I am delighted that they have done so, but mostly I am pleased and relieved that work on the health wedge exists and is ongoing. Before our book was published, and immediately afterward, we tried hard to sell the idea to friendly labor economists. We pressed hard on the contrast between the vast literature on the minimum wage and the absence of literature on the health wedge. The magnitudes are similar, as is confirmed by the authors. The average annual health insurance premium for a single person cost $7,911 in 2022 and varies little across different employees (Claxton and others 2022). That is $4.00 an hour for a 2,000-hour year; for a worker on the federal minimum wage, health insurance adds 55 percent to labor costs. For the remuneration of executives in the C-suite, the cost is negligible. Yet we were met by blank stares and incomprehension. It was only when Saez and Zucman (2019) published *The Triumph of Injustice*, after our book had gone to press, that we discovered we were not alone in the health wedge universe. Finkelstein, McQuillan, Zidar, and Zwick take that process several important steps further.

Among the most important findings of their calibration study is that the health wedge is quantitatively important. Compared with a tax proportional to the wage bill, and with plausible functional forms and parameter settings, it reduces employment of people without a college degree by 500,000. It also reduces their earnings by 3 percent so that the college wage premium is increased by 11 percent. Somewhat larger but similar effects come from reducing the cost of the system to Canadian levels. Also important is their finding that the likely size of these effects is comparable to those of other forces that have been arguably harming the well-being of the American working class, including globalization, robots, outsourcing, the decline of unions, and the fall in the real value of the minimum wage. Notably, their estimated magnitudes are not very sensitive to variations in their assumptions. Of course, less-educated workers themselves are less concerned about which of these catastrophes is more or less important; they must suffer all of them. I will return to this point below.

The authors do not consider it, but we might go further and look at a financing scheme based on value-added, including profits as well as earnings, which we can think of as income tax financing. A payroll tax exempts capital from contributing to the cost of health care, so that, following along the same analysis as in the paper, there is also a wedge that favors capital over both kinds of labor. Compared with an income tax, current flat-tax financing creates inequality, not just between more- and less-skilled workers, but also between workers and the owners of capital.

Employer-provided health insurance raises another inequality-related issue, this time on measurement. Because the employer-provided insurance is valuable to employees, what the authors refer to as its amenity value, there is a case for including that amenity value in earnings. Standard measures of wage inequality do not do so, but the Congressional Budget Office (CBO), in its reports on income inequality, adds employer-provided health benefits to household income.[3] Those of us who consider the cost of health care to be much larger than necessary regard part of these payments as extortion by the industry and would argue for their inclusion in industry profits, not in household income. The CBO's accounting thus understates the degree of household inequality. The excessive size of these payments is hurting workers so that to add them to household income is adding statistical insult to actual injury.

3. For the 2019 version, see Congressional Budget Office (2022).

That employer-financed health care works like a head tax, and that this fact is essentially unrecognized by policymakers and economists alike, points again to the long-recognized lack of transparency in the way American health care is financed. Many employees do not recognize that they are paying anything for their insurance and regard it as a gift from their employers. This shrouding makes it very difficult to have rational discussions of reform, something that is very much in the interests of those who are benefiting from health care's extraordinarily high costs. It is surely inconceivable in an open, well-informed, and democratic discussion of health care that a head tax on labor would ever be put in place. It is not the least of the contributions of this paper that it penetrates some of the fog.

It would be much easier to reform health care financing if the system were useless, but it is not. Many years ago, Cutler (2008) documented what happened after President Nixon's 1971 declaration of war on cancer. Mortality from cancer increased by 8 percent over the next two decades, twice the rate of increase over the previous two decades. But since 1990, cancer mortality has fallen across most types of cancer, and although reductions in cigarette smoking have been important, there is also no doubt that the medical system has been important too, with new and effective drugs and with increasingly prevalent screening. Mortality from cancer has fallen since 1992 for both men and women, for those both with and without a college degree, though by more for the former than for the latter (Case and Deaton 2023).

We do not want to threaten this continuing progress, and there is likely more to come, for example, through treatments for Alzheimer's disease or for obesity. Apart from guaranteeing access to treatment, health insurance is important for peace of mind and to protect our pockets against the costs of expensive episodes of sickness. Calculations such as those by Dzau and others (2017) or by Shrank, Rogstad, and Parekh (2019) suggest that America's unnecessary expenditures on health care are on the order of a trillion dollars. Similar numbers come from imagining what would be the case if the United States were to spend not the 19 percent of GDP it spent in 2020 but the 12 percent of GDP that was spent in Switzerland, whose mortality outcomes are much better than ours. These savings would be enough to finance either America's military or America's education system, in either case with change left over. The prices of health care goods and services in the United States are multiples of those in other countries, and the American system is a heavy provider of low-value but highly profitable procedures. As always, resources lost to waste and abuse are not simply shot into space but show up as someone's salary (or stock portfolio). The system is effective at redistributing wealth upward from firms and their employees, especially less-skilled employees, to doctors, device manufacturers, and pharmaceutical company and hospital executives.

The burden of health care falls on us all, if not equally. It is not costless to waste a trillion dollars a year. Not only are wages lower than they need to be but so are profits. In 2013, long before COVID-19 added to the deficit, Blinder (2013, 405) wrote that "if we can somehow solve the health care cost problem, we will also solve the long-run deficit problem. But if we can't control health care costs, the long-run deficit problem is insoluble." All of this has dire effects on politics, not just on the economy.

I want to direct the remainder of my remarks to measures of the well-being of Americans without a college degree. As the authors show, the health wedge means that the burden of health care financing differentially affects the noncollege-educated, but this is not the only force that is working against them. They note that the effects of the wedge are comparable in size to those from the decline in private-sector unions, from trade, from automation, and from declines in the federal minimum wage. We cannot simply add up these effects, but I do not need to sort out the ways they overlap to know that the cumulative effect will be much larger than the effects of the wedge that are discussed in the paper. Figure 2 in the paper addresses outcomes for college-educated and noncollege-educated workers, and I want to focus on two of the measures shown, real earnings, in panel A, and the employment rate, in panel C.

Starting with panel C, on employment, this shows men and women together, and because women's participation in the labor force was rising until around 2000 and falling thereafter, we get a different picture if we look at men and women separately.[4] For noncollege-educated men, attachment to the labor force shows a long-term downward trend punctuated by upturns when the economy is doing well, but the peak to which each upturn leads is always lower than the previous one. Even in the best of times, participation of less-educated men is lower than it was in the previous best of times. (It is possible that this pattern has been broken post-COVID-19, but it is too early to tell.) I believe that this long-term decline comes not from any decline in supply associated with a loss of virtue (Murray 2012) but from the cumulative loss of good jobs for working-class men, a loss that is

4. Figure 11.2 in Case and Deaton (2020) shows the employment rates for 25- to 54-year-olds by college degree status and gender; the profile for women without a college degree follows an inverted *U*-shape, rising until 2000, so that when women and men are taken together, the rise in women's participation annihilates the fall for men up to 2000.

exacerbated by the rising cost of health care worsened by the health wedge. This is part of the general loss of institutional attachment among working-class men documented by Edin and others (2019).

Measuring employment is relatively straightforward compared with measuring real wages. Incomes, expenditures, and wages are more complicated to assess than a binary indicator of whether someone is employed. Beyond the estimation of money amounts, which is often difficult in itself, we need price indexes to correct for inflation.

Panel A of figure 2 in the paper shows estimates of real earnings for those with and without a college degree. There is a substantial divergence with more rapid growth for the more-educated, which is what drives the expansion of the college wage premium in panel B. As the accompanying notes point out, the increase of real wages of $7,754 from 1977 to 2017 becomes a decrease in real wages of $1,779 if, instead of using the Personal Consumption Expenditures (PCE) price index to convert nominal to real, we use the Consumer Price Index (CPI). Over the forty years from 1980 to 2020, the CPI rose at 2.9 percent a year and the PCE index by 2.41 percent per year; over forty years, there was 16 percent more inflation in the CPI. Over four decades, we might argue that a difference of 16 percent is not of great importance. But that depends on the purpose to which it is being put. It is certainly of rhetorical significance. The statement "real wages of workers without a bachelor's degree are lower now than forty years ago" is true when the CPI is used to deflate and false if the PCE price index is used to deflate. Another important measure that depends on the CPI is the poverty rate, and its behavior over time is markedly different using the PCE price index (Jencks 2015). Social Security payments would also grow less rapidly if the PCE price index were to substitute for the CPI.

There is no straightforward answer to which index is right and, as I shall argue, even if the choice were settled, more difficult issues lurk beyond. The Bureau of Economic Analysis publishes a table that shows step-by-step reconciliation between the two indexes, and I draw on that and on other work here.[5]

The PCE price index is a Fisher index while the CPI is a Laspeyres index, and many economists prefer the former to the latter. If the two indexes used identical prices and quantities—which they do not—the Fisher would respond to the negative correlation between changes in prices

5. Bureau of Economic Analysis, "National Income and Product Accounts," table 9.1U: Reconciliation of Percent Change in the CPI with Percent Change in the PCE Price Index, https://apps.bea.gov/iTable/?reqid=19&step=3&isuri=1&1921=underlying&1903=2075.

and changes in quantities by rising less rapidly than the Laspeyres. Arguably, this makes the Fisher a better approximation of a true cost-of-living index, but that welfare result is not readily established, not least because it would apply to a representative agent, not to any specific group of consumers, and because there are multiple cost-of-living indexes.[6] But the main reason that the indexes diverge is not to do with formula differences but comes from using different weights (weighting) and from covering different bundles of goods (scope). In effect, the two indexes are measuring different things, the underlying bundles that are being priced are not the same.

The PCE price index, which is a byproduct of the National Accounts, uses expenditures supplied by business. The CPI is produced by the Bureau of Labor Statistics and uses (mainly) household survey data to construct weights, data that come from the Consumer Expenditure Survey. In most countries around the world, and the United States is no exception, expenditures from household surveys are far from a perfect match to expenditures in the National Accounts, and although progress has been made to reconcile them, differences remain (Passero, Garner, and McCully 2015). Even were the surveys to match the National Accounts, differences in scope remain. Perhaps the most important of these is that the CPI weight for health care covers only expenditures made by consumers and excludes expenditures made on behalf of consumers by nonprofits, by employers, and by government. In consequence, the PCE price index weight for health care is larger than the CPI weight for health care, which implies that the next most important item, housing, has a larger weight in the CPI. An important source of difference between the two indexes is thus the extent to which the two prices are rising at different rates. Johnson (2017) shows that between 2014 and 2016, the PCE price index increased at 1.25 percent annually, compared with only 1.06 percent for the CPI, largely because of the more rapid increase in the price of health care. He notes that indexing Social Security on the PCE price index instead of the CPI would have led to $10 billion additional government expenditure over the period. For an earlier period, from 2002 to 2007, McCully, Moyer, and Stewart (2007) show that the weight and scope effects approximately cancel, with most of the faster inflation in the CPI accounted for by the formula effect.

Clearly, the hunt for the right price index is fraught with difficulty, which raises the specter of unprincipled political interference in what many might hope would be a technical matter. Politicians stand ready to step into the gaps left by statisticians.

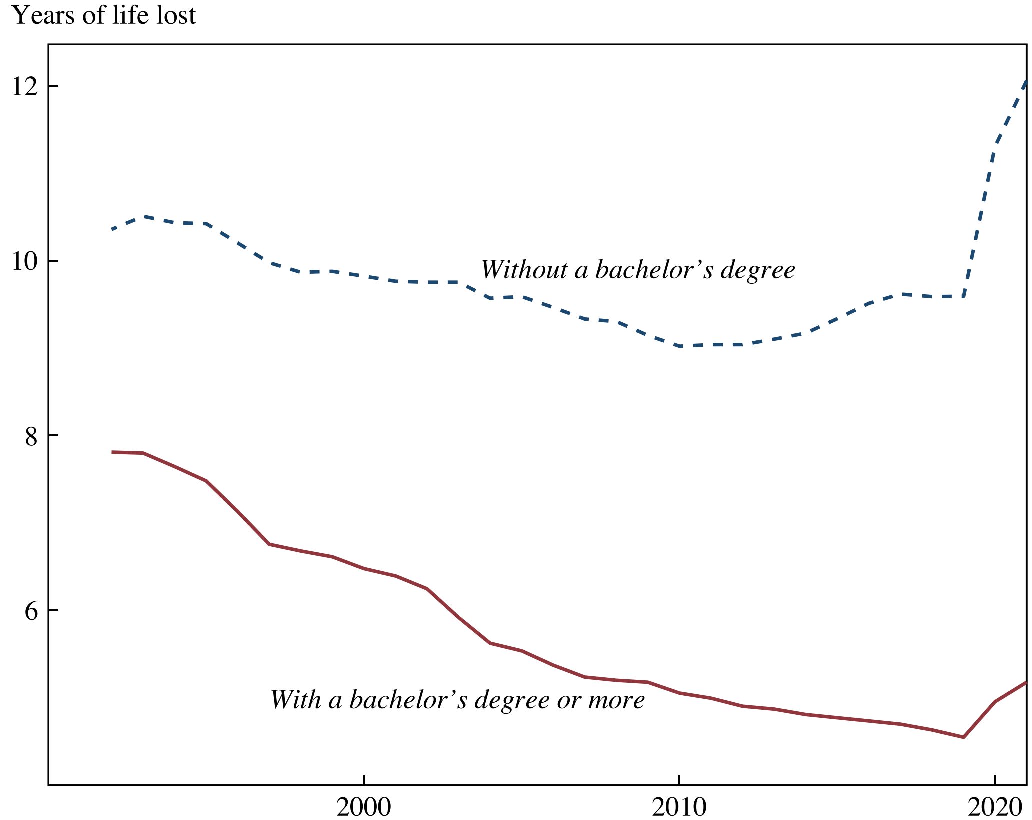
6. See, for example, Schultze and Mackie (2002).

I have not yet mentioned perhaps the most difficult issue besetting price indexes, which is how to treat quality change. In some cases, quality changes are isomorphic to quantity changes. If an improved gasoline were to deliver twice as many miles per gallon as the original, it effectively costs half as much, and the obvious (and obviously correct) procedure is to enter into the index not its price but half of its price. This quantity-augmenting analogy serves as the basis for quality correction in both the PCE price index and the CPI, even though its validity is not always clear. The original good is not always available, so consumers may be forced to buy a more expensive good or service than they need, so that for them quality correction understates the true increase in price. Cass (2023) has calculated what he calls a "cost-of-thriving index" by calculating how many hours of median-wage work is needed to buy a list of important goods for middle-class Americans, including a house, a car, and health care; his index rises much more rapidly than either the CPI or the PCE price index. He refers to "the catastrophic erosion of middle-class life in America" (Cass 2023, 6). Cass's index is unlikely to replace standard indexes, if only because it covers only some items in the budget, but his work is thought-provoking—it highlights the conceptual difficulties of statistical agencies' current hedonic correction procedures and illustrates (if likely overstating) the dangers of quality correction.

The argument that both the PCE price index and the CPI overstate the true increases in prices was made in an influential Advisory Commission report, commissioned by the Senate Finance Committee and commonly referred to, after its chairman, as the Boskin Report (Advisory Committee to Study the Consumer Price Index 1996). The report argued that the CPI was overstating the rate of inflation by 1.5 percentage points a year, of which 1.0 percent came from unmeasured quality change, and recommended that, going forward, CPI inflation be reduced by this amount each year. The report makes a brave (or perhaps foolhardy, depending on the reader) attempt to estimate quality change for each category of consumer expenditure, often when there was no underlying research to support the estimate. The Bureau of Labor Statistics responded effectively, noting that they make adjustments when there is good evidence but that national statistical offices cannot rely on guesswork. A National Academy report (Schultze and Mackie 2002) came to a similar conclusion, but a number of writers continue to make the correction called for in the Boskin Report, particularly in nonofficial measures of poverty.[7]

7. See Deaton (2023, chapters 3 and 4) for an informal account.

Figure 1. Expected Years of Life Lost between Age 25 and 85



Source: Data from Case and Deaton (2023).

Perhaps it is impossible to estimate fully credible estimates of inflation, or at least to do so in a way that commands close to universal assent, let alone assent across the political divide. Which is why, in our own work, Case and I have turned to measures of well-being that are not subject to these kinds of problems. In particular, whether someone is alive or dead is typically clear and (mostly) unchallengeable. Even if there is wide disagreement on whether the American working-class is prospering or suffering, evidence that they are dying is hard to explain away, especially when they are dying by suicide or by drug or alcohol overdose. Clearly, something is badly wrong.

I therefore conclude with some of the evidence on mortality. Figure 1 shows one of many possible measures: the expected number of years of life lost (YLL) between an individual's twenty-fifth and eighty-fifth birthdays. The measure is calculated following standard life table principles. In each year, we have a set of age-specific mortality rates for people with and without a college degree, and we collapse those into a single number, the expected years of life from age 25 to 85 at that year's mortality rates. Expected YLL is 60, the maximum, minus the expected years of life lived. Note that this does not assume that the mortality rates hold constant going forward; it is simply a way of aggregating the sixty age-specific mortality rates from each year into a single number. A similar procedure, with similar results, would be to calculate age-adjusted mortality, though this requires a set of population weights, which is not required to calculate YLL. The underlying data are those used in Case and Deaton (2023), which explains our procedures in more detail. The figure covers men and women together, and all racial and ethnic groups.

The bottom line, for those with a four-year college degree, shows continuous decline from 1992 to 2019, with the rate of decline slowing somewhat after 2010, followed by a marked upturn during the pandemic. The top line, for those without a bachelor's degree, shows mortality decline up to 2010, albeit at a slower rate than for those with a bachelor's degree, but the mortality decline reverses after 2010 so that, even before the pandemic, the mortality experiences of those with and without a degree were going in opposite directions. During the pandemic, the less-educated lost two and a half years of expected life, compared with 0.2 years for those with a degree. The YLL gap between the more- and less-educated group doubled between 1992 and 2019, from 2.5 years to 5 years, and then jumped to 6.9 years in 2021.

Figure 1 here echoes figure 2 in the paper, though it matches most closely a version of panel C in which real wages of the noncollege-educated are falling; of course, we are not claiming that mortality is an alternative measure of real wages or that real wages are indeed falling.

The many details and a few caveats to figure 1 are covered in Case and Deaton (2023), though that paper does not work with YLL. And since it is often asked, it is true that the fraction of Americans with a bachelor's degree rose between 1992 and 2021, so that there was likely some health-based selection from the less- to the more-educated group over time. Such selection increases mortality for both groups and can either widen or narrow the gap. The evidence suggests that the gap is little affected by health selection into education.

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GENERAL DISCUSSION Matthew Fiedler offered a critique of the model structure. Fiedler noted that the authors provide a representative firm that offers health care coverage, which contrasts with reality. In the real world, outside of the model, Fiedler claims, there are many firms that do not offer coverage and these firms disproportionately employ noncollege workers. As a result, Fiedler expected the wages of the noncollege-educated workers to be pinned down by the non-offering firms, which may seriously constrain the ability of the offering firms to pass through the costs to their noncollege-educated workers. Thus, Fiedler suspected the real world may not be well represented by the head tax financing modeled by the authors.

Adam Looney further expressed skepticism of the characterization of the health care wedge as a fixed per worker cost whose rising cost thereby consumed a larger share of lower-paid workers' compensation for three reasons. First, he noted Brooks Pierce's paper "Compensation Inequality" and subsequent work suggests that compensation inequality is increasing at the same pace as wage inequality, which suggests that the health care cost wedge is rising faster for higher-paid workers.[1] Second, health insurance is in reality quite progressive rather than being a flat tax. The Affordable Care Act (ACA), for example, requires all employers to provide the values of the premiums that they pay to their W-2 employees. Analysis of these data shows that the top 10 percent of employees account for 21 percent of health insurance premiums.[2] Thus, while the existing "tax" of insurance premiums may not be as progressive as a payroll tax would be, it is closer to a payroll tax than a poll tax. Lastly, looking over time, one important consequence of rising health insurance costs was that it encouraged employers to drop coverage, particularly among lower-paid workers. While that may have reduced their total compensation, it also meant it was less of a "wedge" reducing their potential wages or employment prospects.

Eswar Prasad suggested broadening the study to include other fixed or quasi-fixed costs in the benefit package, such as Social Security contributions. Prasad pointed out that including these other fixed or quasi-fixed costs would amplify the findings of this study. Further, he agreed with the point made by Looney that compensation and wage inequality have tracked together in overall trend. Unlike Looney, however, Prasad suggested that the nonwage benefits may alter the dynamics of the model presented by the authors. John Haltiwanger, in a later remark, agreed that there are potentially multiple levers at work that are not necessarily mutually exclusive and suggested that the authors consider interactions between the various levers.

Haltiwanger expressed simultaneous skepticism and interest in whether the authors account for empirical patterns. He primarily focused on advocating for using Bureau of the Census data rather than Social Security Administration (SSA) data, in part because the SSA data used by Song and others experience a high degree of missingness for key variables.[3] Haltiwanger, in a paper with Henry Hyatt and James Spletzer, used the industry codes and found that most of the rising inequality between firms was actually rising inequality between industries.[4] But even more striking,

1. Brooks Pierce, "Compensation Inequality," *Quarterly Journal of Economics* 116, no. 4 (2001): 1493–525; and Brooks Pierce, "Recent Trends in Compensation Inequality," in *Labor in the New Economy*, Katharine G. Abraham, James R. Spletzer, and Michael J. Harper, eds. (Chicago: University of Chicago Press, 2010).

2. Ithai Z. Lurie and Corbin L. Miller, "Employer-Sponsored Health Insurance Premiums and Income in U.S. Tax Data," *Journal of Public Economics* 224 (2023): 104942.

3. Jae Song, David J. Price, Fatih Guvenen, Nicholas Bloom, and Till von Wachter, "Firming Up Inequality," *Quarterly Journal of Economics* 134, no. 1 (2019): 1–50.

4. John C. Haltiwanger, Henry R. Hyatt, and James R. Spletzer, "Industries, Mega Firms, and Increasing Inequality," working paper 29920 (Cambridge, Mass.: National Bureau of Economic Research, 2022).

only 10 percent of the approximately three hundred four-digit industries were responsible for the bulk of this trend. Of the thirty industries that might be considered "household name" industries, there are nineteen at the top that are high-tech industries, finance, and physicians. At the bottom, there are eleven industries, including general merchandise stores, grocery stores, and restaurants. Regarding David Cutler's comment on the decline in earnings at megafirms, that decline is observed at the eleven bottom industries. So it's plausible that the rising cost of health care and the authors' hypothesis is limited to a very distinct pattern in a very small number of industries.

Neil Mehrotra and Melissa Kearney both discussed the college wage premium. Mehrotra asked a specific mechanical question regarding the dynamics of the college wage premium: To the extent that the authors see US health care expenditures relative to other countries as a subsidy to providers, would that mechanically increase the college wage premium, to the extent that most providers are college-educated? Kearney presented comments suggesting that the authors supplement their theoretical calibration with an empirical study. Kearney anticipated that post-2010, after changes implemented by the ACA and the expansion of Medicaid, in equilibrium we should have seen fewer low-wage, noncollege-educated workers getting health insurance through their employers, which would have led to a shrinking of the college wage premium.

Adele Morris made positive comments placing the authors' work in the broader context of inefficient and negative outcomes in other policy arenas. These include climate change policy's unpopularity due to the lack of a well-designed safety net that would mitigate the impacts of contractionary pro-climate legislation. In this respect, Morris called the United States a political outlier.

The authors provided responses in conclusion. Owen Zidar first addressed Angus Deaton's comments on the value of insurance. He noted that the authors do not need the value of insurance for the payroll tax counterfactual, rather only for the Canada counterfactual. Zidar further addressed Kearney's comment, noting that the original idea for the paper involved more estimation and empirical components. The authors initially planned to use regional variation in health prices to examine places that, due to consolidation or innovation, had higher health care costs and to investigate the amenity value of these higher costs. Zidar further noted that comparing technological improvements driving cost versus increasing administrative costs would be a challenge beyond the scope of the paper. Zidar further noted, as Cutler and Deaton suggested, that if the value of health insurance is low, then there is less amenity effect, and it is mostly observed as a tax increase and the distortion grows with the square of the tax rate. Thus, as health care costs go up, the distortion will increase. Finally, Zidar agreed with Deaton's critique of the correct inflation metric to use for the study, and the authors will make corrections regarding the CPI.

Amy Finkelstein noted that the general theme of the comments was "this can't be all that is going on" because the phenomenon described by the authors doesn't match an exact time series or the between-industry facts. The authors agree with this criticism, as the goal of this exercise was to evaluate whether the health care wedge was quantitatively important and to determine whether it should be studied more. Finkelstein cited books by Case and Deaton and by Saez and Zucman from the introduction of the paper as ample sources of qualitative evidence that this project was a good line of inquiry.[5] Finkelstein further referenced the provisional results in the form of supply-demand graphs Zidar presented to provide evidence that the question may be quantitatively important. Provisionally, the authors' answer is that the health care wedge could indeed be quantitatively important, and thus invites further study. Additionally, Finkelstein emphasized the importance of health care costs in labor inequality in general and provided a counterargument to Kearney's question. She noted the authors attempted empirical work on this question, and they did attempt to investigate the Medicaid expansion. However, they found that the Medicaid expansion primarily took people out of the ranks of the previously uninsured, surprisingly to some, rather than those already insured by their employer. In terms of other types of benefits, as mentioned by Prasad, Finkelstein acknowledged their importance but noted that Social Security is already financed as a payroll tax.[6] Thus, there is not the same lump sum per worker phenomenon for Social Security as Prasad suggested.

Eric Zwick concluded the authors' remarks, noting that the ACA, when introduced, had provisions attempting to prevent firms from outsourcing but this did not reach to international outsourcing.[7] Thus, as referenced

5. Anne Case and Angus Deaton, *Deaths of Despair and the Future of Capitalism* (Princeton, N.J.: Princeton University Press, 2020); and Emmanuel Saez and Gabriel Zucman, *The Triumph of Injustice: How the Rich Dodge Taxes and How to Make Them Pay* (New York: W. W. Norton, 2019).

6. Social Security Administration, "How Is Social Security Financed?," https://www.ssa.gov/news/press/factsheets/HowAreSocialSecurity.htm#:~:text=Social%20Security%20is%20financed%20through,self%2Demployed%20pay%2012.4%20percent.&text=The%20payroll%20tax%20rates%20are,up%20to%20a%20certain%20amount.

7. Christopher G. Guldberg and Michael J. Poland, "The Affordable Care Act: International Implications," *Lexology*, March 18, 2013, https://www.lexology.com/library/detail.aspx?g=c87ac028-18d8-4f78-984f-930a1f03770a.

by Haltiwanger, some of the industry-specific trends and types of workers exposed to outsourcing over a twenty-to-thirty-year period will be middle income, older workers in higher health cost industries such as heavy manufacturing. Zwick noted that this is more representative of the quantities rather than earnings piece. For some of the other response margins, however, quantities of employment were more relevant. Thus, Zwick noted, the earnings data are partially incomplete, and thus, regarding compensation, there may be an overstating of welfare inequality. Zwick further addressed Looney's point, noting there are two offsets to take into account and referring back to Pierce's paper.[8] Zwick noted that if the authors had focused on health care alone, compensation inequality would have gone up less than pay inequality because the health piece is much larger in the middle of the distribution, with the offsets being pensions and 401(k)s in the top portion of the earning distribution, which Zwick determined was beyond the scope of the paper.

8. Brooks Pierce, "Recent Trends in Compensation Inequality," in *Labor in the New Economy*, Katharine G. Abraham, James R. Spletzer, and Michael J. Harper, eds. (Chicago: University of Chicago Press, 2010).

Online Appendix to

"The Health Wedge and Labor Market Inequality"

A Data and Calibration

A.1 Data on international health spending and educational outcomes

Data for Figure 5 is constructed as follows: Panel A data from OECD Global Health Expenditure "Health expenditures and statistics." Panel B data 2010-2019 for all countries from OECD Education Statistics "Education at a Glance 2019" for the population of full-year, full-time workers aged 25-64 . Panel B data for EU member countries 2003-2009 from EU-SILC . Panel B data for United States 1977-2010 from the Current Population Survey (Flood et al. (2021)). Panel B data for Canada 1977-2005 from Brzozowski et al. (2010). Panel B data for Italy 1987-2002 from Jappelli and Pistaferri (2010). Panel B data for Sweden 1975-2002 from Domeij and Floden (2010). Panel B data for Germany 1983-2004 from Fuchs-Schuendeln et al. (2010). Panel B data for the United Kingdom 1978-2004 from Blundell and Etheridge (2010). United Kingdom college wage premium data pre-2005 are for men only. For all countries and years, we use wages of "some college" workers in the college wage premium when the wages of "B.A. or more" workers are unavailable.

A.2 Calibrating Key Parameters

We can use the observed health insurance premium and wages and participation rates for each group in what we assume to be the head tax equilibrium to solve for the key model parameters: the productivity shifters λ_C and λ_N and the parameters $\overline{\kappa}$ and $\underline{\kappa}$, which govern the distribution of reservation wages and thus the shape of the labor supply function.

Specifically, given per-worker costs ω_g, the firm chooses group-specific labor inputs to maximize:

$$max_{L_N,L_C} \left(\lambda_N L_N^{\rho} + \lambda_C L_C^{\rho}\right)^{1/\rho} - \omega_N L_N - \omega_C L_C. \tag{A.1}$$

Under the head tax, the cost per worker is $\omega_g = w_g + \tau$. Plugging this into the first order conditions for the firm's maximization problem yields:

$$\omega_g^H = w_g^H + \tau = \lambda_g L_g^{\rho-1} \left(\lambda_N L_N^{\rho} + \lambda_C L_C^{\rho}\right)^{\frac{1-\rho}{\rho}}$$

Given we observe employment and wages for both groups in (what we assume to be) the head tax equilibrium as well as τ, we can solve the firm's maximization problem for the the productivity shifters λ_C and λ_N. Specifically, by combining the equations for ω_C^H and ω_N^H, we can express λ_N as a function of λ_C. Plugging this back in and and re-arranging yields a solution for λ_C:

$$\lambda_N = \left(\frac{w_N+\tau}{w_C+\tau}\right) \cdot \left(\frac{L_N}{L_C}\right)^{1-\rho} \cdot \lambda_C$$

$$\lambda_C = \left[(w_c + \tau) \cdot (L_C)^{1-\rho} \cdot \left(\left(\frac{w_N + \tau}{w_C + \tau} \right) \cdot \left(\frac{L_N}{L_C} \right)^{1-\rho} \cdot (L_N)^\rho + (L_C)^\rho \right)^{1/\rho} \right]^\rho .$$

Next, we can solve for the slope of the labor supply function in equation (2), which gives the share of agents that choose to work as:

$$P_g^H = \frac{(w_g^H + \alpha_g \tau) - \underline{\kappa}}{\overline{\kappa} - \underline{\kappa}}$$

We identify the the slope of the labor supply $\frac{1}{(\overline{\kappa} - \underline{\kappa})}$ by using labor force participation rates for both groups P_g and the assumption that both groups have the same distribution of reservation wages. Specifically, the difference in participation rates between college and non-college groups is proportional to the difference in wages plus the difference in amenity value of health insurance in our model. We can solve for $(\overline{\kappa} - \underline{\kappa})$:

$$(P_C^H - P_N^H) \cdot (\overline{\kappa} - \underline{\kappa}) = (w_C^H - w_N^H) + (\alpha_C - \alpha_N) \cdot \tau$$

$$(\overline{\kappa} - \underline{\kappa}) = \frac{(w_C^H - w_N^H) + (\alpha_C - \alpha_N)\tau}{P_C^H - P_N^H}.$$

Intuitively, for a given college wage premium, a bigger gap in labor force participation rates between college and non-college individuals reveals that the inverse extensive margin labor supply curve is flatter, i.e., that $(\overline{\kappa} - \underline{\kappa})$ is smaller, and therefore, that the labor supply slope $\frac{1}{(\overline{\kappa} - \underline{\kappa})}$ is bigger.[1] Note that the slope of the labor supply function can be identified by making an assumption about the difference in the amenity-value of health insurance relative to cash $(\alpha_C - \alpha_N)$ without making assumptions about the exact values of α_C or α_N. The group-specific amenity value α_g matters only for pinning down the intercept in the labor supply function. In the payroll counterfactual, we assume that this amenity value is the same for college and non-college workers $(\alpha_C = \alpha_N)$ and this is suffiicient to solve for the equilibrium. In the cost counterfactuals, it is necessary to make an assumption about the group-specific amenity values since the value of τ varies. This allows us to identify $\overline{\kappa}$ by subtracting the lower bound $\underline{\kappa}$ of reservation wages from the dispersion in reservation wage parameters $(\overline{\kappa} - \underline{\kappa})$. Next, plugging the expression for $(\overline{\kappa} - \underline{\kappa})$ back in to the expression for P_g^H allows us to separately identify $\underline{\kappa}$ and then $\overline{\kappa}$:

$$\underline{\kappa} = (w_g^H + \alpha_g \tau) - P_g^H \cdot (\overline{\kappa} - \underline{\kappa})$$

$$\overline{\kappa} = (\overline{\kappa} - \underline{\kappa}) + \underline{\kappa}.$$

Lastly, to estimate equilibrium values under a payroll tax in the cases where we make an assumption about the difference in the amenity value for college and non-college workers $(\alpha_C - \alpha_N)$ but do not make assumptions about the exact values of α_C or α_N, we use a modified version of the labor supply function that uses

[1] Note that identifying the slope of the labor supply curve from quantity differences relies on our simple model of inverse labor demand. If labor demand were downward sloping and not just pinned down by technology A_g less the cost of providing employee-provided-health insurance, then identifying these parameters would require different steps that relate equilibrium prices and quantities to policy shocks (Zoutman et al. (2018)).

the equilibrium values P_g^H and w_g^H under the head tax, the change in wages $(w_g^H - w_g^H)$, and the slope of the supply curve $(\overline{\kappa} - \underline{\kappa})$:

$$P_g^P = \frac{(w_g^P + \alpha_g \tau) - \underline{\kappa}}{\overline{\kappa} - \underline{\kappa}} = P_g^H + \frac{(w_g^P - w_g^H)}{\overline{\kappa} - \underline{\kappa}}$$

A.3 Estimating tax rate under each tax regime

A.3.1 Head Tax τ

Our benchmark model in Section 3 assumes that all full-time, full-year workers have covered by employer-provided health insurance. When we calibrate the model in Section 4, we use as the effective head tax rate (τ) the observed average health insurance premium (τ^{obs}) scaled down by the share θ of full-time, full-year workers who are policyholders. We show here that this scaling can be derived from a simple model in which all firms offer employer-provided health insurance but only a fraction θ of them take it up.[2] To see this, let

$$\tau = \tau^{obs} \cdot \theta.$$

To simplify the exposition, we continue with the assumption of a linear production technology (see equation (1)). Therefore, once again we have equilibrium wages in the head tax regime $w_g^H = A_g - \tau$ and in the payroll tax regime $w_g^P = \frac{A_g}{1+t}$. Recall that on average workers pay about one-quarter of their health insurance premiums, and that—presumably as a result—take-up is incomplete. To account for this incomplete take-up, we allow for heterogeneity in the amenity value of health insurance. Specifically, for a worker in group a worker in group $g \in \{N, C\}$, we assume their amenity-value α_{gi} is $\overline{\alpha}_g$ with probability p_g and $\underline{\alpha}_g$ with probability $(1 - p_g)$. We assume that $\overline{\alpha}_g$ and $\underline{\alpha}_g$ are such that $\alpha_{gi} = \overline{\alpha}_g$ implies the worker will take up the insurance, and $\alpha_{gi} = \underline{\alpha}_g$ implies they will not. In practice, the lower amenity value could reflect that workers have access to another source of health insurance, or have lower expected medical costs or are less risk averse.

Once again, we normalize the utility from not working to zero; utility from working in the Head Tax regime is now $U_{gi}^e = w_g + \alpha_{gi}\tau - \varepsilon_i$. An individual will work if and only if her utility from working exceeds her utility from not working. The probability that an individual in group $g \in \{N, C\}$ chooses to work in the Head Tax Equilibrium can then be expressed as:

$$P_g^H = p_g \cdot \frac{A_g + (\overline{\alpha}_g - 1)\tau - \underline{\kappa}}{\overline{\kappa} - \underline{\kappa}} + (1 - p_g) \cdot \frac{A_g + (\underline{\alpha}_g - 1)\tau - \underline{\kappa}}{\overline{\kappa} - \underline{\kappa}},$$

where the first term represents the employment rate of the share of workers with $\alpha_{gi} = \overline{\alpha}_g$ and the second term represents the employment rate of the share of workers with $\alpha_{gi} = \underline{\alpha}_g$. Note that the participation rates of the two groups differ by $\frac{(\overline{\alpha}_g - \underline{\alpha}_g) \cdot \tau}{\overline{\kappa} - \underline{\kappa}}$. Intuitively, workers who place less value on the health insurance that is part of their compensation are less likely to work. We define $\alpha_g = \left[p_g \cdot \overline{\alpha}_g + (1 - p_g) \cdot \underline{\alpha}_g\right]$ to represent the average amenity value of health insurance in the entire population for type $g \in \{N, C\}$, which allows us

[2] We abstract from the fact that, in practice, θ is higher for college educated workers than non-college educated workers (Table 1). This would introduce a potential further source of inequality (redistribution from non-college educated workers to college educated workers) from financing health insurance through the employer.

to rewrite group-specific labor supply in the head tax equilibrium as a function that does not depend on the parameter p_g,

$$P_g^H = \frac{A_g + (\alpha_g - 1)\tau - \underline{\kappa}}{\overline{\kappa} - \underline{\kappa}},$$

and is the same expression as in our benchmark model with full take-up. It immediately follows that the comparison to outcomes in the payroll tax equilibrium therefore also remains the same

A.3.2 Payroll Tax t

Given the the parameters of the CES production function and labor supply equation, as well as an estimate of the head tax τ, we can now solve for the equilibrium tax rate t under the payroll tax. Under the payroll tax, a portion of a worker's wage goes to the payroll tax so that the cost per worker is $\omega_g = (1+t) \cdot w_g$. Plugging this into the first order conditions for the firm's maximization problem in (A.1) yields:

$$\omega_g^P = (1+t) \cdot w_g^P = \lambda_g L_g^\rho \left(\lambda_N L_N^\rho + \lambda_C L_C^\rho\right)^{\frac{1-\rho}{\rho}}$$

We can also use the labor supply function in equation (2) to write equilibrium employment as a function of wages:

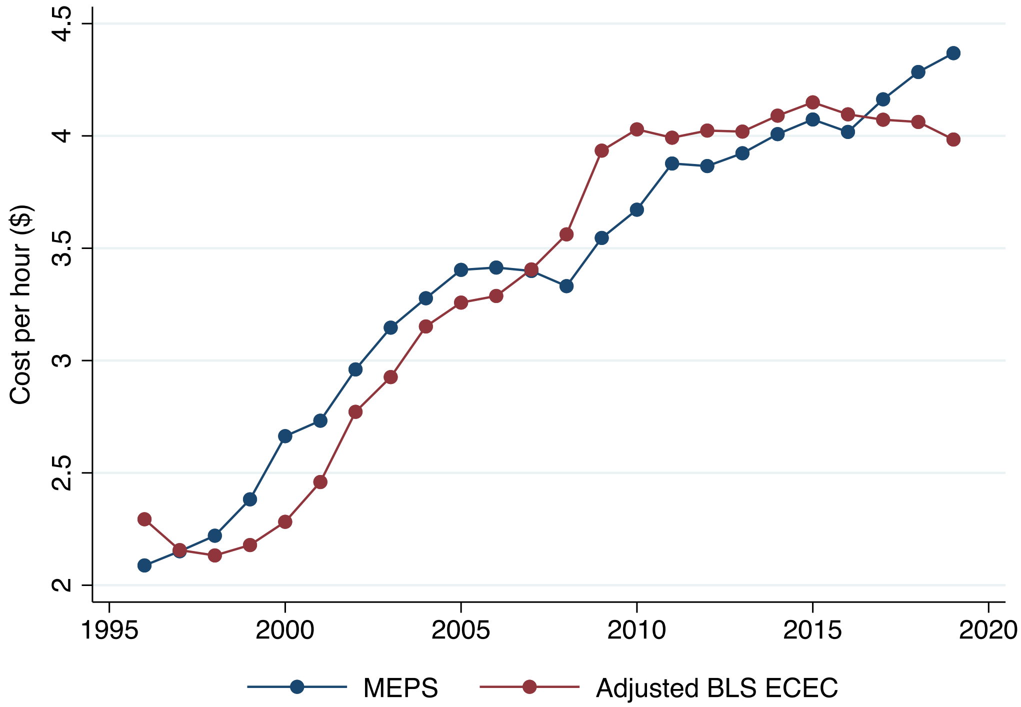
$$P_g^P = P_g^H + \frac{w_g^P - \underline{w_g^H}}{\overline{\kappa} - \underline{\kappa}}$$

Lastly, equilibrium also requires solving for the payroll tax t, which can be expressed (see equation (5)):

$$t = \frac{\tau}{\tilde{w} - \tau}$$

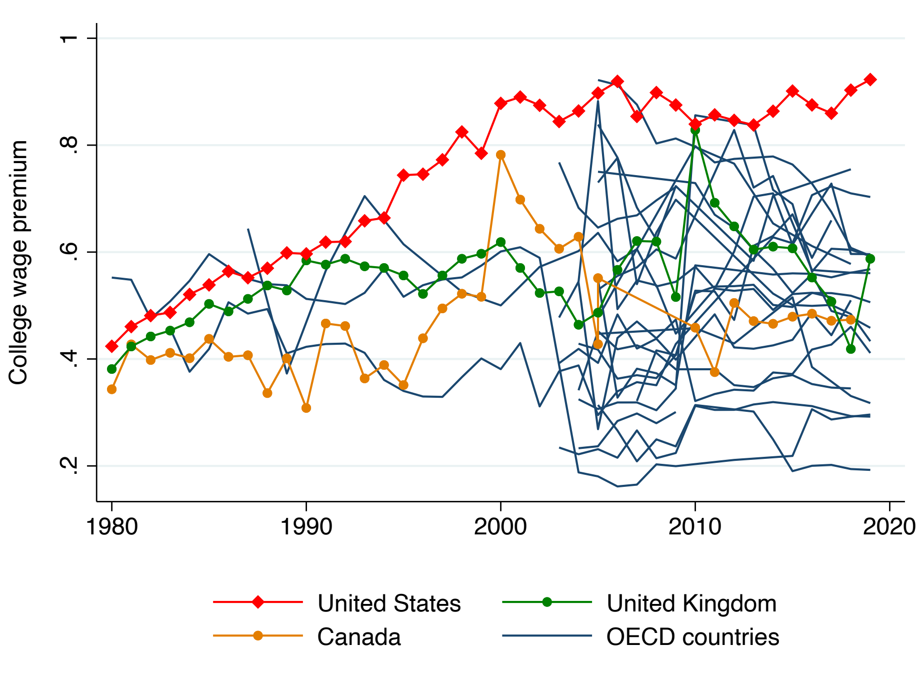
where $\tilde{w}$ is the average wage under the payroll tax, and thus equal to $\tilde{w} = \frac{L_N}{L_N+L_C} \cdot w_N + \frac{L_C}{L_N+L_C} \cdot w_C$, where employment and wages are determined in the payroll tax equilibrium. Together, this gives us five equations for the five unknowns, allowing us to solve for wages and labor supply of each group as well as the payroll tax using a nonlinear equation solver.

Figure A.1: Alternative Measures of Employer Costs (per hour) of Health Insurance



Notes: This figure compares two estimates of the hourly employer cost of health insurance per full-time, full-year employee. Red series shows an adjusted estimate from the BLS' hourly Employer Cost for Employee Compensation (ECEC) series. The ECEC reports the estimated hourly employer cost ofr employee compensation each quarter, including the cost of health benefits to the employer. Private industry ECEC estimates are a weighted average of the cost of health insurance for all workers, including part-time workers and those who do not take up insurance despite eligibility. These estimates are weighted by current employment, so year-to-year changes reflect differences in employment and industry composition as well as changes in the cost of health insurance itself. To more directly compare the ECEC estimates to the MEPS estimates, we divide the ECEC estimates each year by the share of the population who are full-time, full-year workers in that year. Blue series shows an adjusted estimate from the MEPS series used in the main text. Specifically, to more easily compare the MEPS data to the BLS's ECEC estimates, we use the annual MEPS employer contribution series divided by 2,000 (assuming a full-time, full-year employee works 40 hours per week for 50 weeks a year). This provides an estimate of the hourly cost of the MEPS employer contribution. Like the ECEC series, the MEPS series is based on private sector employee compensation.

Figure A.2: College Wage Premia



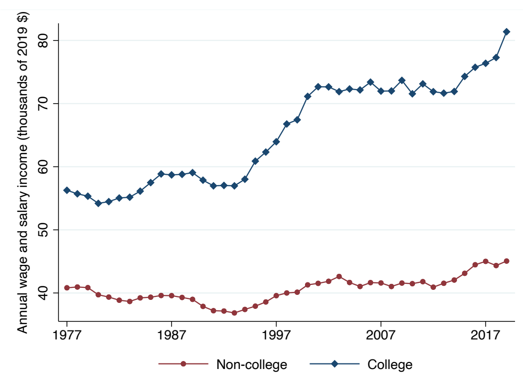
NOTES: This figure shows college wage premia for the full set of of OECD countries. A version with fewer countries is found in Figure 5.

B Broaden Definition of College-educated Workers To Include Those With Some College

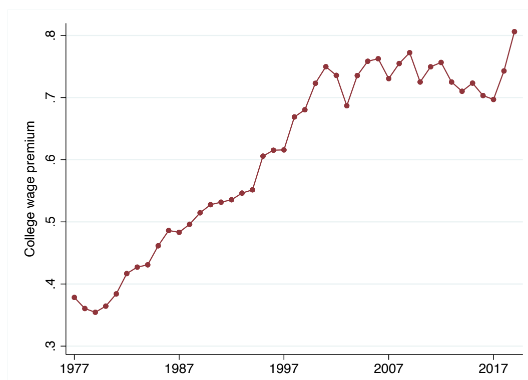
We reproduce our main analyses using an alternative definition of college-educated worked which includes workers with some college in the definition of college-educated; by contrast, in our baseline definition these workers are included in the group without a college degree, while the college-educated category requires a bachelor's degree or higher. Figure A.3 shows trends in labor market outcomes (the analog of Figure 2) for this alternative definition, and Table A.1 shows summary statistics (the analog of Table 1) for this alternative definition. Tables A.2 and A.3 show, under this alternative definition of college educated workers, counterfactual labor market outcomes in 2019 and counterfactual changes over time in labor market outcomes under a payroll tax.

Figure A.3: Labor Market Outcomes, By Education

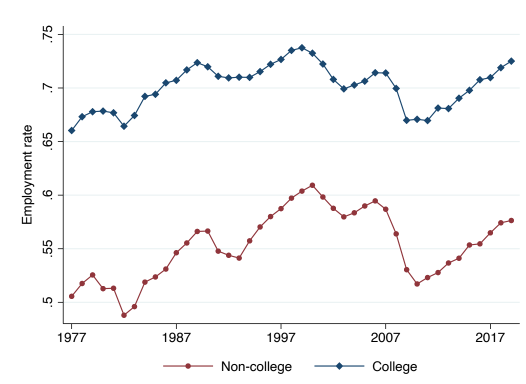
(a) Real Earnings, by Education



(b) College Wage Premium



(c) Employment Rate



NOTES: This figure replicates Figure 2, but defines college-educated such that the individual has attended at least some college.

Table A.1: Summary Statistics for FTFY Workers Ages 25-64 with Some College or More (2019)

Panel A: Labor Market Outcomes

	Total	College	Non-College
Employment Rate (P_g)	0.672	0.725	0.576
Avg. Annual Earnings (w_g)	\$70,333	\$81,381	\$45,057
Panel B: Health Insurance Coverage			
Employer-Sponsored	0.802	0.859	0.670
Policyholder	0.659	0.706	0.554
Dependent	0.140	0.153	0.112
Other Private	0.062	0.059	0.067
Public	0.072	0.051	0.122
None	0.084	0.048	0.166
Panel C: Offering and Take-up			
Offered Employer-Sponsored Health Insurance	0.830	0.872	0.733
Take-up | Offered	0.794	0.809	0.755

Notes: This table replicates the results in Table 1, but defines college such that the individual attended at least some college.

Table A.2: 2019 Labor Market Effects of Counterfactual Payroll Tax Financing (Some College or More)

	(1) Baseline	**(2)** Full Coverage
Fixed Per Worker Cost, τ:	\$7,758	\$11,764
Payroll Tax Rate, t:	11.05%	16.78%
Wages:		
Change in College Wage, $\Delta(w_C)$	-\$914	-\$1,325
Change in Non-college Wage, $\Delta(w_N)$	\$2,046	\$2,937
Pct. Change in College Wage Premium	-12.14%	-17.14%
Employment:		
Change in College Employment Rate, $\Delta(P_C)$	-0.37 pp	-0.54 pp
Change in Non-college Employment Rate, $\Delta(P_N)$	0.84 pp	1.20 pp
Change in Total Employment, $\Delta(L)$	85,696	117,755
Change in College Employment, $\Delta(L_C)$	-371,593	-538,730
Change in Non-college Employment, $\Delta(L_N)$	457,288	656,486
Wage Bill:		
Change in College Share of Wage Bill, $\Delta(\frac{w_C L_C}{w_N L_N + w_C L_C})$:	-1.21 pp	-1.75 pp

Notes: This table replicates the results in Table 3, but defines college such that the individual attended at least some college.

Table A.3: Changes over Time: Labor Market Effects of Counterfactual Payroll Tax Financing, 1977-2019 (Some College or More)

	Head Tax Equilibrium	Payroll Tax Equilibrium: Baseline	Payroll Tax Equilibrium: Full Coverage
Employer-Sponsored Health Insurance:			
Change in Cost $(\tau_{2019} - \tau_{1977})$	-	\$5,937	\$9,003
Payroll Tax $(t_{2019} - t_{1977})$	-	7.16 pp	10.87 pp
Wages:			
Change in College Wages $w_{C,2019} - w_{C,1977}$	\$25,111	\$24,434	\$24,139
Change in Non-college Wages $w_{N,2019} - w_{N,1977}$	\$4,233	\$6,134	\$6,955
PP Change in College Wage Premium	42.78 pp	34.06 pp	30.55 pp
Employment Rate:			
Change in College Employment Rate $P_{C,2019} - P_{C,1977}$	6.47 pp	6.34 pp	6.28 pp
Change in Non-college Employment Rate $P_{N,2019} - P_{N,1977}$	7.08 pp	7.77 pp	8.06 pp
Wage Bill:			
College Share of the Wage Bill $\left(\frac{w_C L_C}{w_N L_N + w_C L_C}\right)_{2019} - \left(\frac{w_C L_C}{w_N L_N + w_C L_C}\right)_{1977}$	34.49 pp	33.63 pp	33.27 pp

Notes: This table replicates the results in Table 5, but defines college such that the individual attended at least some college.

Table A.4: 2019 Labor Market Effects of Counterfactual Payroll Tax Financing, by Sex

	Baseline	Aggregate	Male	Female
Fixed Per Worker Cost, τ:	\$7,758	\$7,758	-	-
Payroll Tax Rate, t:	11.06%	11.07%	-	-
Wages:				
Change in College Wage, $\Delta(w_C)$	-\$2,181	-\$2,227	-\$3,731	-\$632
Change in Non-college Wage, $\Delta(w_N)$	\$1,660	\$1,601	\$1,085	\$2,412
Pct. Change in College Wage Premium, $\%\Delta(w_C/w_N - 1)$	-11.26%	-11.14%	-	-
Employment Rate:				
Change in College Employment Rate, $\Delta(P_C)$	-0.69 pp	-0.56 pp	-0.90 pp	-0.29 pp
Change in Non-college Employment Rate, $\Delta(P_N)$	0.52 pp	0.68 pp	0.26 pp	1.10 pp
Change in Total Employment, $\Delta(L)$	86,833	305,099	-116,362	421,461
Change in College Employment, $\Delta(L_C)$	-408,588	-334,349	-240,678	-93,671
Change in Non-college Employment, $\Delta(L_N)$	495,420	639,448	124,316	515,132
Wage Bill:				
Change in College Share of Wage Bill, $\Delta(\frac{w_C L_C}{w_N L_N + w_C L_C})$:	-1.77 pp	-1.77 pp	-	-

Table A.5: Changes over Time: Labor Market Effects of Counterfactual Payroll Tax Financing, 1977-2019, for Males

	Head Tax Equilibrium	Payroll Tax Equilibrium	
		Baseline	Full Coverage
Employer-Sponsored Health Insurance:			
Change in Cost $(\tau_{2019} - \tau_{1977})$	-	\$5,937	\$9,003
Payroll Tax $(t_{2019} - t_{1977})$	-	7.16 pp	10.88 pp
Wages:			
Change in College Wages $w_{C,2019} - w_{C,1977}$	\$41,406	\$38,398	\$37,083
Change in Non-college Wages $w_{N,2019} - w_{N,1977}$	\$5,184	\$6,466	\$7,032
Employment Rate:			
Change in College Employment Rate $P_{C,2019} - P_{C,1977}$	-1.14 pp	-1.67 pp	-1.89 pp
Change in Non-college Employment Rate $P_{N,2019} - P_{N,1977}$	-4.28 pp	-3.92 pp	-3.76 pp

Table A.6: Changes over Time: Labor Market Effects of Counterfactual Payroll Tax Financing, 1977-2019, for Females

	Head Tax Equilibrium	Payroll Tax Equilibrium	
		Baseline	Full Coverage
Employer-Sponsored Health Insurance:			
Change in Cost $(\tau_{2019} - \tau_{1977})$	-	\$5,937	\$9,003
Payroll Tax $(t_{2019} - t_{1977})$	-	7.16 pp	10.88 pp
Wages:			
Change in College Wages $w_{C,2019} - w_{C,1977}$	\$37,551	\$36,645	\$36,223
Change in Non-college Wages $w_{N,2019} - w_{N,1977}$	\$13,911	\$15,695	\$16,442
Employment Rate:			
Change in College Employment Rate $P_{C,2019} - P_{C,1977}$	19.16 pp	18.56 pp	18.27 pp
Change in Non-college Employment Rate $P_{N,2019} - P_{N,1977}$	17.80 pp	18.18 pp	18.31 pp