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Perspective

Best of times, worst of times: record fossil-fuel profits, inflation and inequality

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A B S T R A C T

The 2022 oil and gas crisis resulted in record fossil-fuel profits globally that rehabilitated the oil and gas industry, obstructed the energy transition and contributed to inflation, but their magnitude and beneficiaries have been insufficiently understood. Here we show the size of profits across countries and their distribution across socio-economic groups within the United States, using company income statements, comprehensive ownership data and a network model for propagating profits via shareholdings. We estimate that globally, net income in publicly listed oil and gas companies alone reached US$916 billion in 2022, with the United States the biggest beneficiary with claims on US$301 billion, more than U.S. investments of US$267 billion in the low carbon economy that year. In a network of U.S. shareholdings with 252,433 nodes including privately held U.S. companies, 50 % of profits went to the wealthiest 1 % of individuals, predominantly through direct shareholdings and private company ownership. In contrast the bottom 50 % only received 1 %. The incremental U.S. fossil-fuel profits in 2022 relative to 2021 were enough to increase the disposable income of the wealthiest Americans by several percent and compensate a substantial part of their purchasing power loss from inflation that year, thereby exacerbating inflation inequality. These profits also reinforced existing racial and ethnic inequalities and inequalities between groups with different educational attainments. We discuss how an excess profit tax could be used to both lower inequality and accelerate the energy transition as increasing geopolitical tensions and climate impacts threaten continued volatility in oil and gas markets.

1. Introduction

The spike in oil and gas prices in 2021 and especially 2022 brought record profits for the industry. An increase in profitability in an industry is a signal for additional capital allocation and expansion. This is counterproductive for climate change mitigation in the case of the fossil fuel industry, which urgently needs to contract for climate change mitigation but was instead rehabilitated by recent record profits [1–3]. Stock market valuations soared, and capital expenditure in the sector went up, including in new oil and gas fields [4]. Simultaneously, high fossil fuel profits hurt the renewable energy industry. The biggest oil companies cut back their transition plans, and the more attractive short-term profit opportunities in oil and gas made renewables, with comparatively poorer margins, a less desirable investment for short-term-oriented financial institutions [5]. More investment in oil and gas supply also leads to more assets at risk of stranding in a subsequent transition [6], and potentially increased political lobbying to protect the investments' profitability by ensuring future demand for fossil fuel-intensive products [7,8]. But while the consequences for the energy transition have been discussed, the sheer magnitude of these profits is not well understood, nor is who receives them and how they affect not just inflation but also nominal incomes of the recipients.

A substantial proportion of global inflation in 2021 and 2022 was driven by oil and gas prices, both directly through higher prices 'at the pump' and for home heating and electricity, and indirectly as higher input costs pushed up prices – from fertilizers to plastics and industrial products [9–11]. The deterioration of purchasing power caused a cost-of-living crisis and output curtailments, leading to widespread and

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fiscally costly energy price caps across Europe, while affluent governments bought gas at expensive spot prices. These European purchases priced out gas import-reliant developing countries, causing energy shortages, poverty increases and economic slowdown [12]. The impacts on the income distribution due to 'inflation inequality', i.e. that lower income households spend a larger share of their income on energy and were therefore disproportionately hit, have been documented [13–15]. Yet relatively little attention has been paid to the fact that the substantial profits caused by these price spikes do not simply disappear but instead are someone's income.

A better understanding of the volume and distribution of these oil and gas profits helps shed light on the net impact of energy price inflation, including the question of whether it reduced or exacerbated inflation inequality. It can also inform policies to mitigate socioeconomic repercussions when prices spike, including excess profit taxes, which can be designed to accelerate the energy transition [16]. The fossil fuel industry defended itself against such policies (successfully in the United States) by claiming their profits ultimately benefit the population in the form of dividends [17]. This raises two questions: How big were fossil fuel profits during the recent price shocks? And who received those profits and to what extent did this profit income offset the increased costs of living? In the next section, we provide a brief response to the first question; in Section 3 we introduce our data and methods to answer the second question; in Section 4 we show how profits were

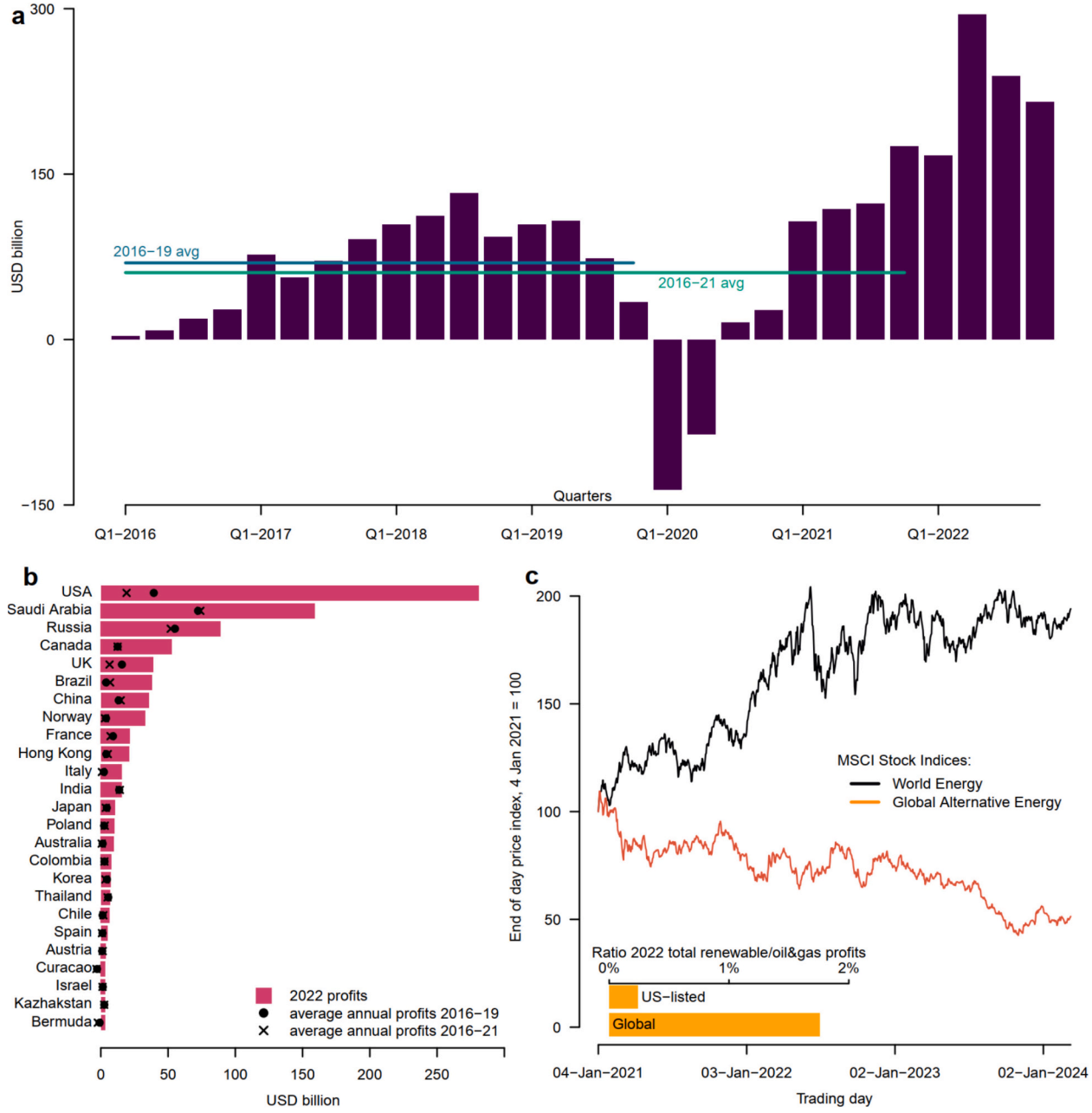

Fig. 1. Record after-tax profits in 2022 concentrated in the United States. **a**, Quarterly profits in stock market-listed oil and gas companies were at a record globally in 2022, with a peak in quarter 2. **b**, Companies headquartered in the United States saw the largest increase in 2022 relative to recent averages, making the United States the country where the largest amount of profits were earned, overtaking Saudi Arabia and Russia. **c**, The stock market valuation of fossil-fuel companies tracked by the MSCI World Energy Index diverged sharply from that of renewable energy companies since 2021, while in the inset the total global volume of profits earned by renewable energy companies was <2 (0.3) percent of those earned by oil and gas companies globally (in US-listed companies only).
(Data sources: Company income statements, and MSCI stock indices accessed via Refinitiv.)

distributed; in Section 5 we analyze how increased nominal income through profits increased different groups incomes; and in Section 6 we discuss the policy implications of our results.

2. Context: record profits in the United States

Globally, annual profits after interest payments, depreciation, and taxes, or net income (henceforth profits) in stock market-listed oil and gas companies in 2022 were at a record high (Fig. 1a) reaching $916 billion (US dollars). In the second quarter of 2022, profits reached an all-time high. In the second, third and fourth quarters, profits were more than three times recent quarterly averages over 2016–19. This is the case despite the write-downs of Russian assets following the Russian invasion of Ukraine, which lowered fossil fuel profits in the first quarter.

The country experiencing the largest fossil-fuel profit increase was the United States: in 2022, the profits of companies headquartered in the United States exceeded their 2016–2019 annual average by $241 billion to reach $281 billion (Fig. 1b). US-headquartered stock market-listed oil and gas companies thus earned the largest share of profits of any country in the world, a distinction that had during recent years belonged to Saudi Arabia with its listed national oil company, Saudi Aramco. In relative terms, the 7-fold increase above 2016–19 average profits in the United States was matched only by Brazil (10-fold) and Norway (9-fold), but with these two countries experiencing much smaller absolute increases of $34 billion and $29 billion, respectively. As we show below, the financial ownership of foreign oil and gas companies resulted in an additional net transfer of $20 billion to U.S. owners ($44 billion in claims were transferred abroad but $64 billion were transferred into the United States). This transfer increased overall fossil-fuel profit claims in the United States by a further 5 % to $301 billion.

The uptick in oil and gas profits coincided with a divergence of stock market valuations between fossil and renewable energy companies, reflecting investors' expectations about the profits and shareholder distributions these two industries will generate (Fig. 1c). The renewables industry faced several challenges during this period, one being the higher interest rates, which came in response to inflation. This surge in borrowing costs increased the financial burden of upfront investments, which constitute the largest expenses for wind and solar projects [18]. These changes in expectations moreover occurred in the context of vastly different scales of profit volumes across fossil fuels and renewables. Global profits in stock-market listed renewables companies in 2022 – while at all-time highs – were <2 % those in oil and gas. For US-listed companies the ratio was a quarter of 1 % (Fig. 1c).

3. Data and methods

3.1. Data collection

For the foregoing analysis, we collected recent quarterly oil, gas and renewable energy profit data for all stock market-listed companies from Refinitiv (now LSEG), which covers 99 % of the world's market capitalization. Profits are measured using the variable "net income including extraordinary items before distributions", also called after-tax income, and defined as sales minus costs of goods sold, expenses (including royalties), interest payments, depreciation, taxes on corporate income, and other taxes on production. We selected all companies in the sectors "Oil and Gas" and "Oil and Gas Related Equipment and Services"—the combined set of which we refer to as "oil and gas firms"—and "Renewable Energy", according to The Refinitiv Business Classification (TRBC), and grouped them by company headquarter country and by year. This leaves us with 1437 distinct publicly listed oil and gas firms in the period 2016–2022, including such majority state-owned companies as Saudi Aramco and Sinopec, and 317 distinct renewable energy firms. The respective U.S. numbers are 228 and 62. For the ownership analysis for the United States that is to follow, we further collected 20,910 privately held oil and gas firms in the sector with headquarters in the United States from oil and gas extraction all the way to retail via gas stations according to the NACE industry classification from Orbis to get total U.S. profits in oil and gas, not just from listed companies (see Appendix A for more detail on the oil and gas firm data selection and later in this section a discussion of summary statistics).

The listed companies around the world and the unlisted U.S.-based companies together comprise the set of companies for which we identify the U.S. beneficiaries to whom the profits ultimately accrue. To do so, we collect data on shareholders and shareholdings using data from Orbis, Preqin, Pitchbook, the Securities and Exchange Commission, the Federal Reserve, Thinking Ahead Institute/P&I, Sovereign Wealth Fund Institute, and from manual searches. Our method is a snowball system: we first collect data on the shareholders of oil and gas companies, then on the shareholders of these shareholders, and so forth until we arrive at a set of nodes that have no further shareholders. Nodes without shareholders—which can be individual persons, households, or groups of persons represented by employee associations, pension funds or governments—are called ultimate beneficiaries. We filter for ultimate beneficiaries that are U.S-based to depict the global portfolio of oil and gas shareholdings by U.S. ultimate beneficiaries. For unlisted companies, when there is no ownership information, we assume that all U.S. headquartered companies are owned by U.S. Americans. The data can be represented as a network with 252,433 nodes. Each node represents an oil company or shareholder, not necessarily in the United States but on the path to a U.S. ultimate beneficiary, e.g. a non-U.S. financial firm which intermediates the funds of U.S. persons. Each edge represents a shareholding relationship where one node is a shareholder of another that is quantified and lies in the interval of zero to one. The network thus represents all oil and gas firms in which U.S. investors own stakes, and all identifiable chains of shareholders that ultimately lead to U.S. beneficiaries.

We focus on U.S. ownership because as Section 2 showed, the United States was the biggest beneficiary of the 2022 profit spike and has the largest global ownership share; moreover, data availability allows for a fine-grained analysis of the ownership distribution. Using data from the Federal Reserve's Distributional Financial Accounts, which estimate how wealth is distributed across various socioeconomic groups by category such as via shareholdings or pensions, we also assign ultimate beneficiaries and their profits to socio-economic groups classified according to their wealth, race and ethnicity, and education. To do so using the aggregate statistics, we assume that the distribution of fossil-fuel shareholdings across socio-economic groups resembles the distribution of total shareholdings. This data adds another layer of nodes to the network as each ultimate beneficiary is connected by an edge to a socio-economic group (see Appendix A for more detail on the construction of all aspects of the network of shareholders). Finally, we use data from the Bureau of Economic Analysis, Bureau of Labor Statistics and Census for data on various sectoral and aggregate data. Table 1 gives an overview over all data sources used.

3.2. Summary statistics

For listed firms, 2022 profit totals, as well as the mean, median and standard deviation far exceed previous years, both in the United States and globally (Table 2). The number of firms instead declined slightly driven by acquisitions in the United States. Oil and gas profits are heavily concentrated among a small number of top firms—a trend which was slightly mitigated during the bumper year 2022. The top 10 % of US (global) firms generated 136.6 % (109.4 %) of U.S. (global) oil and gas profits between 2016 and 2019—exceeding 100 % due to the preponderance of losses in the remaining 90 % of firms—and the top 1 % generated 67.6 % (64 %). These numbers decline to 82 % (93.8 %) for the top 10 % and 39.1 % (52.4 %) for the top 1 % in 2022. High energy prices thus translated into broad-based growth in oil and gas profits.

Adding up Refinitiv and Orbis-derived profits, for public and private firms respectively, yields $372.1 billion in 2022 for U.S. firms. This

Table 1
Data sources and their usage.

Data source	Oil and gas companies & their profits	Individual shareholders	Private equity shareholders	Clients of fund managers	Reclassifying shareholders	Socio-economic group wealth
Refinitiv	X					
Orbis	X	X	X			
Preqin			X		X	
Pitchbook			X		X	
Fed				X		
SEC				X		
TAI/P&					X	
SWFI					X	
Fed DFA						X
BEA	Sectoral and economywide profits, disposable income, personal consumer expenditure price index					
BLS	Consumer price index (CPI), CPI by equivalized income quintiles (R-CPI-I)					
Census	Sectoral profits from Quarterly Financial Report (QFR), firm count from Statistics of U.S. Businesses (SUSB)					

Notes: Fed = Federal Reserve, SEC = Security and Exchange Commission, Fed DFA = Fed Distributional Financial Accounts, TAI = Thinking Ahead Institute, SWFI = Sovereign Wealth Fund Institute, BEA = Bureau of Economic Analysis, BLS = Bureau of Labor Statistics. Manual searches were used throughout to verify information. The first four rows contain data sources accessed under license. Fig. 1c uses additional stock index data from Refinitiv which we detail in Appendix C.

Table 2
Refinitiv summary statistics for profits.

Scope	Year	Number of Firms	Total	Mean	Median	SD	Share (%) of Total by Top 10 % of Firms	Share (%) of Total by Top 1 % of Firms
U.S. Firms	2016	223	−32.5	−0.1	−0.01	1	−77.1	−38.8
	2017	224	56.4	0.3	0.004	1.7	115.4	60.3
	2018	225	94.2	0.4	0.014	1.9	92.7	44.5
	2019	227	36.4	0.2	0.001	1.3	161.2	71.8
	2020	222	−148.1	−0.7	−0.035	2.3	−8	−4.5
	2021	222	104.1	0.5	0.003	2.2	99.9	46.5
	2022	215	280.8	1.3	0.058	5	82	39.1
All Firms	2016	1193	57.4	0	0	0.9	260.6	129.8
	2017	1209	294.6	0.2	0.002	2.4	107.2	60.9
	2018	1226	441.2	0.4	0.002	3.5	101.7	61.1
	2019	1233	318.2	0.3	0.002	2.8	114.6	70.3
	2020	1225	−179.8	−0.1	−0.001	2.1	−78	−53.2
	2021	1203	522.5	0.4	0.004	3.6	99.7	56.9
	2022	1195	915.7	0.8	0.01	5.6	93.8	52.4

Notes: the share of profits earned by the top firms can exceed 100% of the total if the rest of the firms make losses while total profits for the industry remain positive. If total profits are less than zero while the top firms generate positive profits, then the share earned by the top firms can be negative.

figure amounts to 13.6 % of the total 2022 U.S. after-tax corporate profits including net transfers abroad ($2738 billion) as presented by the BEA. The figure exceeds the $157.5 billion reported by the BEA as 2022 U.S. domestic after-tax corporate profits in oil and gas sectors ("oil and gas extraction", "support activities for mining", and "petroleum and coal products manufacturing") by 73 %. The reason is that a substantial portion of the profits we capture via Refinitiv and Orbis are generated abroad (corporate profits including net transfers abroad are not available at the sectoral level within the U.S. national income accounts). Our profit total is also 33 % higher than the estimate from the Census Quarterly Financial Reports for the same sectors as for the BEA, but including foreign income. Besides the imputations needed to calculate sectoral QFR profits (see Table 3 notes), the most important explanation for the lower QFR figure may be the exclusion of gas manufacturing, transport and wholesale and retail of oil and gas, for which no separate data are available either in the BEA or Census data. A second explanation may be different sectoral classifications between Refinitiv, with its own classification, Orbis, which uses NACE, and NAICS used by both BEA and QFR. Lastly, our sample of small firms in Orbis differs from that used by the Census. The firm count in our dataset is 21,125, and 8,713 when restricting Orbis to the closest approximation of the three NAICS sectors covered by all BEA and Census, 1.64 and 0.68 times the 12,814 firms according to the Census SUSB. This divergence in the number of firms likely results from our Orbis search missing some small firms that the Census records.

Moving on to the characteristics of the shareholding network, Table 4 reveals its skewed nature. The low median highlights how dense the distribution is at very small values across all these metrics, and the much higher mean highlights how long the tail is out to very large values. For shareholdings values are capped at 100 %, yet it is discernible that most ownership is far below 1 % of any company. Institutional investors (managed share) that generally pool capital from many sources and invest it, are less likely to hold very small shares in companies. At the same time, direct shareholders (which can be companies or individuals) have larger investments at the third quartile of the distribution, reflecting outright ownership of private companies. Equity owned and profits received again illustrate a very skewed distribution with the mean profits received being three orders of magnitude larger than the median.

3.3. Methods

We use a novel model of network propagation to assign the profits from oil and gas companies to ultimate beneficiaries in the United States. The profits are treated as a shock to oil and gas companies and are then propagated through the network we described in the data section through to ultimate beneficiaries and socioeconomic groups. Each step of the propagation algorithm is detailed in Appendix B.

It is useful to think of the propagation as a flow through 4 broad stages as depicted in Fig. 2. Stage 1 shocks oil and gas firms with profits. Stage 2a allocates profits to direct ultimate beneficiaries (who own shares in their own names) and stage 2b to fund managers (who own shares on behalf of their clients), for which we make special provisions as detailed below. Stage 3 allocates profits from direct ultimate beneficiaries and funds to broad categories of ultimate beneficiaries, such as pension funds, business owners and mutual fund holders. Finally, Stage

Table 3
Firm profits (in USD billion) and firm count from various sources.

Data Source	Measurement	Industry	2021	2022
BEA	BEA Corporate Profits After Tax	Oil and Gas Extraction*	27.4	77.6
BEA	BEA Corporate Profits After Tax	Support Activities for Mining*	−0.9	9.6
BEA	BEA Corporate Profits After Tax	Petroleum and Coal Products Manufacturing*	11.6	70.3
BEA	BEA Corporate Profits After Tax	Total (Sum of above 3)*	38.1	157.5
BEA	BEA Corporate Profits After Tax	Whole Economy	2613.4	2737.5
Census QFR	Income After Income Taxes	Oil and Gas Extraction**	32.2	110.1
Census QFR	Income After Income Taxes	Support Activities for Mining**	3.9	13.6
Census QFR	Income After Income Taxes	Petroleum and Coal Products Manufacturing	72.2	166.1
Census QFR	Income After Income Taxes	Total (Sum of above 3)**	108.3	289.8
Refinitiv	Profits	Oil and Gas	104.1	280.8
Orbis	Profits	Oil and Gas	45.8	91.3
Refinitiv+Orbis	Profits	Oil and Gas	149.9	372.1
Census SUSB	Number of Firms	Oil and Gas Extraction (NAICS 211)	4,337	4,213
Census SUSB	Number of Firms	Support Activities for Oil and Gas Operations (NAICS 213112)	7,659	7731
Census SUSB	Number of Firms	Petroleum and Coal Products Manufacturing (NAICS 324)	872	870
Census SUSB	Number of Firms	Total (Sum of above 3)	12,868	12,814
Census SUSB	Number of Firms	Total for all US industries		6,395,635
Refinitiv	Number of firms	Oil and Gas	222	215
Orbis	Number of firms	Oil and Gas***	8,017	8,498
Refinitiv+Orbis	Number of firms	Oil and Gas***	8,239	8,713

Notes: *Sectoral detail of BEA after tax corporate profits are not available on a level of disaggregation below the categories of "Mining" and "Nondurable goods manufacturing". Hence, 2022 sectoral profits are imputed by assigning them the share of mining/manufacturing corporate profits after tax that they have in 2022 gross operating surplus for which this detail is available. BEA corporate profits at the sectoral level only include profits from domestic operations.
**The Census QFR only reports figures for all "Mining". Hence income for "Oil and Gas Extraction" and "Support Activities for Mining" takes profits for all "mining" multiplied by the BEA's 2022 gross operating surplus of either sectors as a fraction of gross operating surplus of all "mining". QFR statistics capture all firms with revenue above $250 million, and a sample of smaller firms.
***Orbis firm count is restricted to NACE codes below 2000 to better approximate the Census SUSB coverage.

4 allocates profits from ultimate beneficiary categories to socio-economic distributions, such as the wealth size distribution.

To illustrate, if an oil company makes $1 million in profits, and is owned 60 % by a holding company investing its own equity, then we propagate 60 % of $1 million, or $600,000, to this company. If this holding company is itself owned by 4 persons in equal proportions, then we propagate 25 % of the $600,000 or $150,000 to each person. The 4 persons are ultimate beneficiaries.

Table 4
Network summary statistics.

	1st quartile	median	3rd quartile	mean
Direct share %	0.0075	0.02	2.7	8.5
Managed share %	0.16	0.43	2.3	10
Equity owned $	13 k	51 k	0.33 M	100 M
Profits received $	2	62 k	0.2 M	7 M
Profits managed $	0.0006	21	18 k	24 M

Notes: Direct share refers to investors investing their own money, as retail investors, managed share refers to investments by asset managers, investing on behalf of others.

We take special provisions for nodes in the ownership network that are fund managers, such as BlackRock or Vanguard. Since fund managers maintain share ownership on behalf of their clients—rather than on behalf of their shareholders—profits are not propagated from fund managers to their shareholders. Instead, we group fund managers into special categories of fund managers (such as mutual funds and private equity funds) and further propagate profits from these categories of fund managers to categories of ultimate beneficiaries based on aggregate statistics of the clients of fund manager categories (see Table 1 for data sources).

To propagate on to socio-economic distributions in terms of wealth quantiles, race and ethnicity, and education respectively, we use data from the Federal Reserve Distributional Financial Accounts (DFA) on what share of each asset category belongs to what part of a distribution. For instance, the 4 persons from the previous example own equity in a non-financial firm and thus fall into the DFA category "Corporate equities and mutual fund shares". According to the DFA, 53 % of Corporate equities and mutual fund shares belong to the top 1 % of the wealth size distribution, so 53 % of the $600,000 is propagated to the top 1 % wealth quantile. The remaining 47 % of the $600,000 is similarly propagated to the rest of the wealth size distribution based on the aggregate percentages of shareholders of non-financial corporations belonging to wealth size quantiles. Similarly, 89 % of Corporate equities and mutual fund shares belong to white households and 83.6 % to college educated households, with the rest distributed among other racial and ethnic groups, and among less educated households respectively. In general, this procedure allocates all profits reported by oil and gas companies to their ultimate beneficiaries and on to socio-economic distributions.

Once we have allocated the profits to socioeconomic groups, we calculate how these profits compensate each group for inflation, for the case of wealth quantiles. To do so, we compare how the increment in profits in 2022 over 2021, i.e. an increase in nominal income, compensates for the quantile-specific inflation. We use the joint income wealth distribution from ref. [19] and aggregate data on disposable income and inflation (see Table 1) to calculate by what percent the oil and gas incremental profits compensate for inflation.

There are three caveats to using profits as a measure of income for the compensation calculation. First, besides their shareholders firms also pay creditors for interest expenses, which are subtracted from the firm result before profits. This means that another group of wealth owners – the shareholders of credit institutions – benefits indirectly from oil and gas operations. However, for U.S. listed firms for which this information was reported, interest expenses were only 19 % and 7 % of profits in 2021 and 2022 respectively, for all quarterly observations that report both profits and interest expense. This suggests that interest expenses are not large enough to substantially increase what ultimate beneficiaries receive or alter the distribution qualitatively. The declining proportion moreover underscores that oil and gas shareholders benefitted disproportionately from the high 2022 oil and gas prices compared with creditors.

Conversely, not all profits are distributed to shareholders, some are retained. In 2021, for U.S. firms for which shareholder distribution data are reported (Refinitiv reports these data for only 24 % of observations

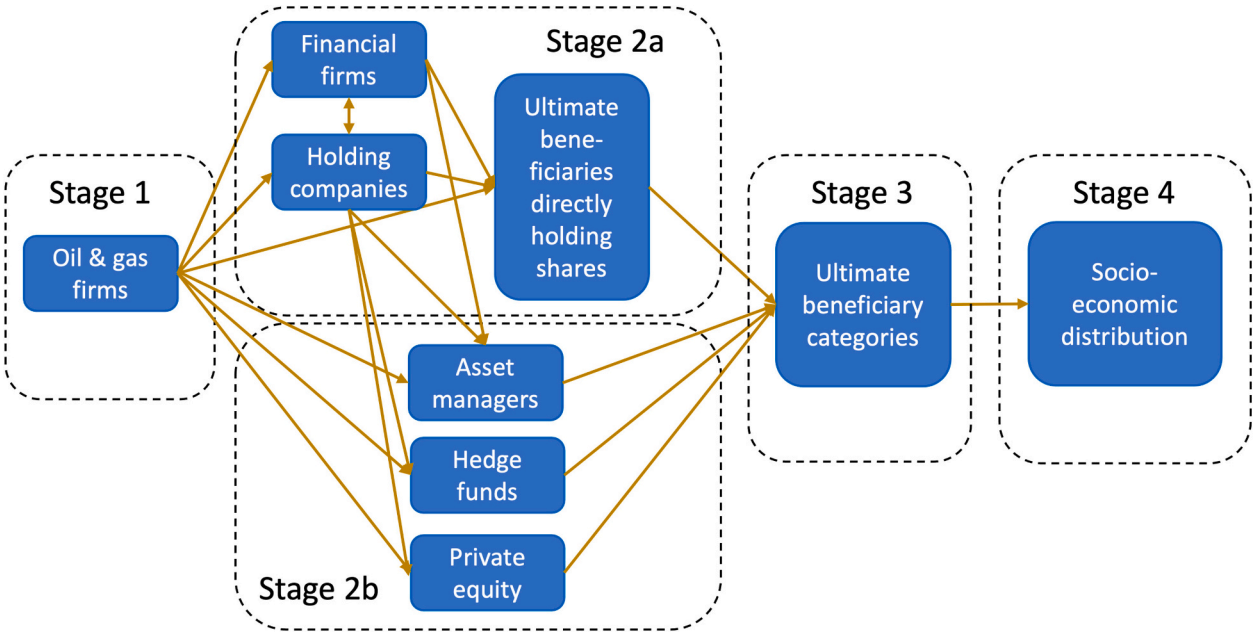

Fig. 2. Propagation network schema. Nodes (boxes) are connected by links (arrows), see Table A3 for a list of all ultimate owner categories at stage 3. Arrows from 'financial firms' to 'hedge funds' and 'private equity' are omitted for clarity.

in 2021), 70 % of profits were paid out. In 2022 this share dropped to 60 % (reported for 28 % of observations), with the rest retained for capital expenditures, debt paydown or future distributions via share buybacks. For instance, ExxonMobil distributed $30 billion of its $56 billion profits to shareholders in 2022, a pay-out ratio of 54 %. As a result, assigning all profits to shareholders can overstate the income accruing to shareholders. However, it can also be misleading to attribute only profits distributed in 2022 to shareholders' income. The high profits prompted several oil and gas companies to announce major share buyback programs spread out over several years. For instance, Chevron, with 2022 net income of $35 billion, announced a $75bn share buyback program in January 2023 spread over the next years, three times its previous buyback programme from 2019. So at least part of the retained income would be used for future shareholder distributions. Therefore, studying only the instantaneous shareholder distributions of 2022 can understate the benefit from the extraordinary 2022 profits accruing to shareholders. In our analysis of inflation inequality below, we report income changes both for all profits and for distributions only.

Finally, capital gains are not currently counted as part of income in national accounts, however, in recent years there have been arguments for why they should be, given their quantitative importance [20,21]. Notwithstanding the fact that many affluent people also earn high wages [22], an important part of their income comes from borrowing against their investment portfolio, and capital gains grow the size of that portfolio [23,24]. Since we are interested in how income offsets inflation, including shareholder distributions under income makes sense. In fact, share price appreciation may have increased over and above the increase mechanically resulting from share repurchases. Regressing the rate of share price increases from December 2021 to 2022 on the rate of change in profits for U.S. listed companies shows that for every percent increase in profits, share prices rose by 0.18 %, on top of a 0.14 % intercept, both of which are highly statistically significant. On the other hand, a 1 % increase in share repurchases is associated only with a 0.1 % increase in share prices (see Table E1 for the full regression results). Thus, the data suggests that share prices increased in response to share repurchases and rising profits more generally. This added to income at least indirectly, which we proxy by studying profits, rather than dividends or some other subset of profits, as income.

4. Extremely unequal benefits

Our analysis reveals that the 2022 U.S. fossil fuel profits almost exclusively benefit the top wealth owners: 50 % of all profit claims by U.S. beneficiaries are held by the top 1 % of wealth owners, and 84 % by the top 10 % (Fig. 3). In contrast the bottom half of the population (66 million households) receive hardly any profits at all: only 1 %. The top 0.1 %—a mere 131 thousand households—receive 26 times as much as half of all Americans. The middle 40 % (the 51st to 90th wealth percentile) only receive 15 % of all profits.

Record fossil fuel profits reinforce existing racial and ethnic inequalities. Whites (64 % of households) benefit disproportionately with a claim on 87 % of all profits. Blacks (14 % of households) have a claim on only 3 % of all profits, and Hispanics (10 % of households) a mere 1 %. Blacks and Hispanics hold their entitlements to fossil fuel profits predominantly in the form of pensions. Other ethnic groups (12 % of households), which includes Asian Americans, claim the remaining 9 %.

Households with high educational attainment are prime beneficiaries of fossil fuel profits. 91 % of all profits go to households with at least some college education even though this group only includes 66 % of households. College degree holders alone (38 % of households) claim 79 % of profits.

Fig. E1 displays the final leg of the Sankey diagram for distributions by race and ethnicity, and education. Since each component of these distributions includes people from all wealth quantiles, both distributions allow substantial within-group inequality, e.g. most of the 3 % of profits claimed by Black households likely belongs to a small portion of those households.

The channels through which profits reach beneficiaries differ by wealth group. Those groups who claim a disproportionate share of the profits relative to their share in the population receive profits predominantly via private company ownership and direct shareholdings. That includes the family offices of ultra-high-net-worth individuals as well as the stocks held by companies' executives as part of their compensation packages. For instance, the top 1 % wealth owners receive less than a quarter of their profits through mutual funds and pension funds, and college-educated Americans less than half. On the other hand, pension funds alone make up almost half of the profit channel to the 50th–90th percentile of wealth owners (labelled the 'next 40 %'), and more than

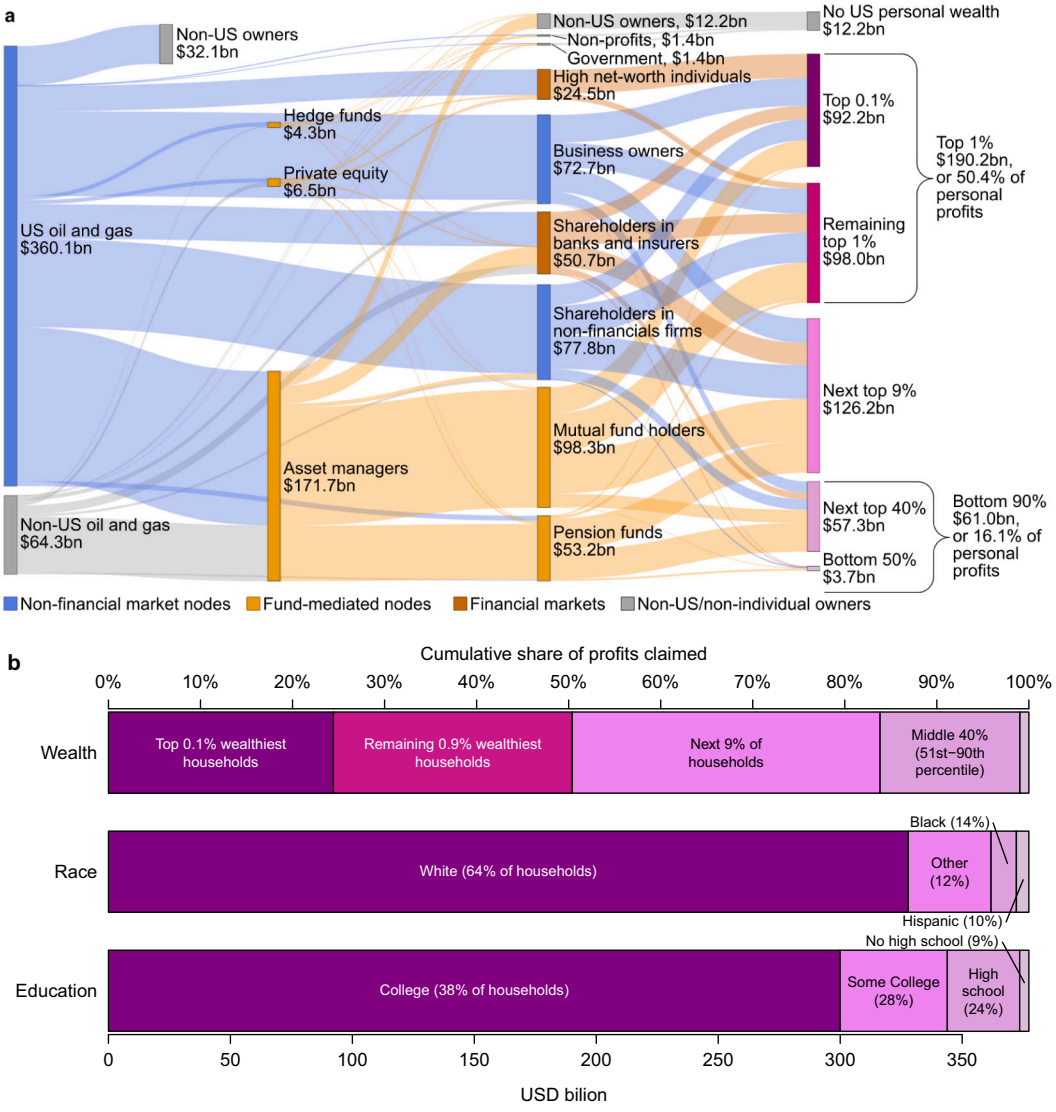

Fig. 3. Profits flow disproportionately to the most affluent, white, and highly educated Americans. The Sankey diagram in **a,** shows how profits made by oil and gas companies in 2022 both in the United States and elsewhere are intermediated by fund managers and reach U.S. ultimate beneficiaries that belong to quantiles of the wealth distribution. **b,** results for ultimate beneficiaries also according to race and ethnicity, and education.
(Data sources: Authors' calculations based on data listed in Table 1.)

half for Blacks and Hispanics.

Shareholder distributions are often justified with their contribution to pension funds, on which many people depend for their retirement savings. However, our results show that only a small share of overall profits benefits institutions that serve the wider public. In the case of fossil fuel profits, pension funds only account for a share of 14 %. Asset managers intermediate more than half of all profit claims of listed companies but do so predominantly for individual holders of mutual funds, not pension funds [25]. Unlike the more equally distributed retirement assets, 90 % of individually held mutual fund shares belong to the top 10 % wealth owners. The importance of fossil fuel stocks and dividends for asset managers' business also helps explain why major asset managers recently walked back some of their Environmental, Social, and Governance (ESG) and climate pledges.

Despite the large share of profits flowing to top wealth owners we document, our analysis is likely to understate the importance of financial intermediation on their behalf: Due to limitations of our ownership data, we are probably understating the involvement of private equity funds, which, like hedge funds, cater disproportionately to the very affluent (see Appendix A).

5. Impacts on inflation inequality

Given the record profits are the flipside of high energy prices, which drove a substantial part of 2022 inflation, it is important to understand how these profits compensated for that inflation. Given the above results, our hypothesis is that the impact of price inflation is skewed towards the poorer and more disadvantaged groups while profits are skewed in the opposite direction, so that the net effect is an increase in inequality. This section quantifies this contribution.

Inflation inequality describes a variation of inflation across groups in the income distribution [13]. It occurs because different income groups purchase different consumption baskets whose prices may rise at different rates [26,27]. For instance, the bottom 20 % of U.S. Americans spent 3.3 % of their budget on gasoline in 2021, while the top 20 % spent only 2.1 % [28]. If gasoline prices rise faster than other prices, this causes inflation inequality, and indeed, the bottom 20 % experienced 0.5 percentage points higher inflation than the top 20 % in 2022 [29]. To understand how profits affected inequality by compensating higher prices with higher incomes, we study how profits accruing to different groups in the wealth distribution altered the purchasing power and

inflation burden of those groups of households.

As a first approximation, we calculate income changes for each group by assuming all incremental profits in 2022 over those in 2021 accruing to U.S. persons, which total $225 billion, flow to the ultimate beneficiaries as income. The US Consumer Price Index (CPI) rose 6.5 % in 2022. That is, a basket of goods demanded by the average person cost 6.5 % more at the end of 2022 than at the end of 2021. Counting incremental fossil-fuel profits in 2022 as disposable income of beneficiaries would increase the disposable income of the average U.S. American by 1.2 %, thereby compensating them for part of the inflation and leaving them with a 5.3 % residual inflation burden (Fig. 4). This additional capital income would constitute a substantial reduction in the inflation burden that is left out when tracking how income from wages alone compares with inflation. But this compensating capital income effect is highly unequal across the wealth distribution. For the top 0.1 %, the additional profits claimed from their fossil-fuel holdings would increase their disposable income by nearly as much as inflation reduced it, thus compensating for most of their inflation burden. For the top 1 % as a whole, the capital income effect would increase disposable income by 4.1 %, compensating for all but 2.2 %age points of inflation. In contrast, the disposable income of the 50th to 90th percentile of the population would increase by only 0.5 %. For the bottom 50 %, the compensation from fossil fuel capital income would be hardly noticeable, amounting to 0.05 % of disposable income and leaving them at a quantile-specific residual inflation of 6.8 % (full calculations in Appendix D).

This compensation on the income side compounds an already existing inflation inequality on the expenditure side. In the United States in 2022, this inflation inequality has been estimated to create differences in quantile-specific CPI rates of up to 0.5 annual percentage points [29]. Our results show that this inflation inequality derived from heterogenous consumption baskets is dwarfed by the unequal compensation from oil and gas profits that leaves wealth groups with several percentage points difference in residual inflation after oil and gas capital income compensation.

As we discuss in the methods section, not all profits flow directly to shareholders. To account for the fact that not all incremental profits may be available to ultimate beneficiaries as disposable income in 2022, Fig. 4 (squares) also calculates how disposable income increases with a pay-out ratio of 60 %, reduced by a further 20 % by taxes on dividends. Even with this reduction, disposable income still increases by 2.7 % for the top 0.1 % wealth owners due to the increase in fossil fuel profits, and by 2.0 % for the wealthiest 1 % of households, substantially reducing the impact of inflation. Under these assumptions, the least affluent 90 % of households see their inflation burden essentially unchanged from any fossil-fuel profits accruing to them. Regardless of the measure of the fraction of profits adding to disposable income, residual inflation was highly heterogenous across wealth quantiles. In conclusion, record fossil-fuel profits undoubtedly exacerbated U.S. inflation inequality with most U.S. citizens receiving no significant benefit and a small number reaping sizable gains.

An important potential caveat to this inflation compensation analysis is that fossil fuel profits rose but profits in other industries may have fallen, so as to offset the fossil-fuel profit rise. The inflation inequality specifically from fossil fuels would remain, but be offset by declining inflation inequality in other sectors because affluent households would take the bulk of income losses there, too. Then, shareholders would not be better off in the aggregate than others. This would be so in particular if corporations using energy as an input would absorb rather than pass on the increase in their energy input cost. On the contrary, economy-wide cost shocks have functioned in the recent inflation episode as an implicit coordination mechanism that enabled firms across the economy to hike prices rather than absorb costs. As a result, upstream price spikes such as importantly in fossil fuels have induced sellers' inflation [30,31]. The profit share in national income and that of domestic non-financial industries remains elevated compared to pre-pandemic levels [32]. To have a one-for-one comparison of how profits evolvd in other industries would require analysing net income for all corporations in which U.S. Americans have stakes using the same methodology. As an approximation, corporate profits after tax in the United States increased by about half as much as our estimate of fossil fuel profits in 2022 according to the BEA (Table 3). According to this estimate, inflation inequality considering economy-wide profits is about half as high as that depicted in Fig. 4 which considers only fossil fuel profits, but still very substantial compared with inflation inequality from differences in expenditure. The upshot of the extra large increase in fossil fuel profits is that the signal to invest in the fossil fuel sector, as it performs better than the rest of the economy, was even larger and the larger the share of fossil fuel assets in a portfolio the bigger the gain.

6. Distributional and climate arguments for excess fossil fuel profit taxes

The oil and gas industry claims that it keeps energy affordable for all while the shift to renewables threatens higher energy costs [33]. Our analysis has instead shown that the spike in oil and gas prices, which resulted in record profits, primarily benefitted the wealthiest. Inflation inequality increased in consequence, because the higher profits deriving from higher energy prices inflicted on the entire population are channelled as additional income mainly to an already affluent minority of owners of oil and gas shares. Whereas the richest 1 % of households received a nominal income several percent higher than the prior year because of windfall oil and gas profits, we found no discernible increase in income from such profits for the least wealthy half of households. Since the correlation between wealth and income is high, most of these findings also translate to the top 1 % and bottom 50 % income earners [19].

Moreover, these profits also exacerbated income inequality between white and Black, Hispanic, Asian, Native and other U.S. Americans, and college-educated and non-college-educated U.S. Americans. This inflation inequality arising from high profits and leading to unequal income increases was much more marked than the inflation inequality from an unequal rise in expenditure whereby lower income households spend a larger share of income on essentials like energy and food and therefore experience a higher rate of inflation for their consumption baskets.

The year 2022 set a record for fossil fuel profits, but profits have remained elevated since. As the energy transition deepens, oil and gas prices could remain volatile in a declining market where demand and supply can be hard to balance [35,36]. Geopolitical turmoil, worsening climate impacts and future pandemics could further increase the risks of a disorderly transition and help recreate the kinds of fossil energy supply shocks that triggered the 2022 price rise [37,38]. Future rounds of cost-of-living increases for all would again be accompanied by compensation for wealthy households benefiting from high profits and shareholder distributions without proportional compensation for poorer households. This pattern might eventually be continued with profits from negative emissions technologies [39].

Recent studies by researchers at the International Monetary Fund have shown that excess profit taxes are efficient compared to other forms of profit taxation and beneficial for fiscal revenue without inducing inflation or distorting the scale or allocation of investment [40,41]. Our results suggest that taxing excess oil and gas profits could reduce income inequality in times of high energy-induced inflation. Excess profit taxes are rent-targeting taxes. In other words, excess profits are defined as rents. Rents can be the outcome of market power or of location-specific advantages such as in the case of resource extraction. Beyond such permanent characteristics, exceptional events such as wars, pandemics or climate shocks can lead to temporary increases in excess profits, often referred to as windfall profits. In the context of the 2022 energy crisis windfall profit taxes were introduced in several constituencies, e.g. in the United Kingdom and the European Union. In the United States the policy was discussed but not enacted. Temporary windfall profit taxes are a good second-best policy in a crisis. But the first best solution,

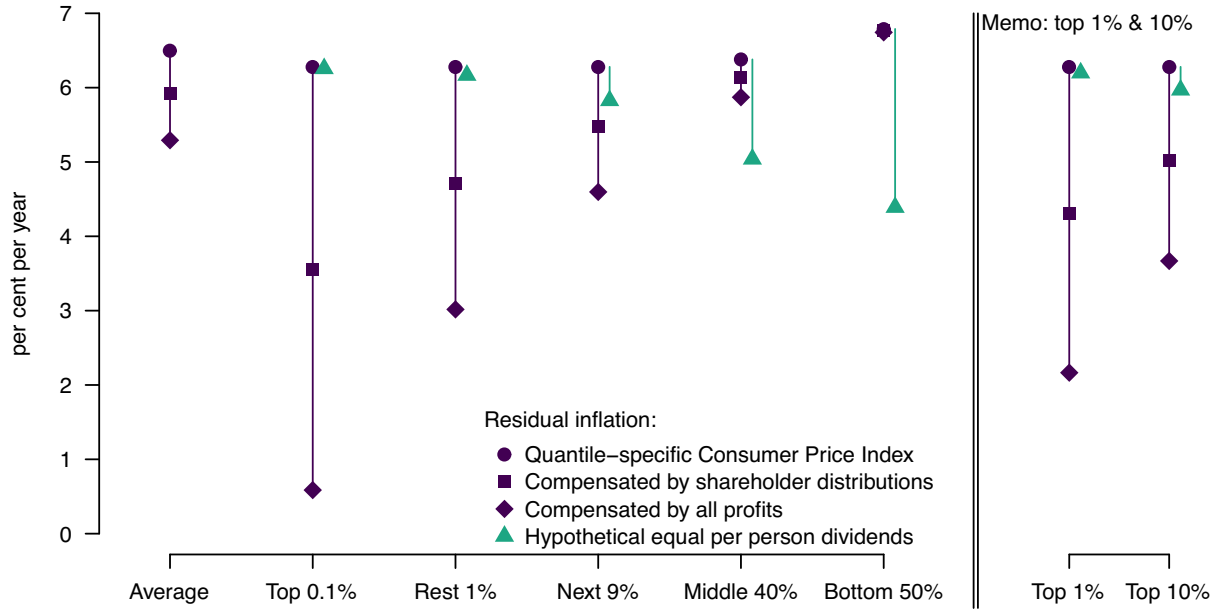

Fig. 4. Residual inflation after accounting for incremental 2022 fossil fuel profits as additions to disposable income by wealth quantile. If oil and gas profits flow to the ultimate beneficiaries in the form of disposable income, they compensate for inflation in 2022 measured by the consumer price index (disks) to different extents. Diamonds show the reduction in the inflation burden assuming the entirety of the profits accrue to ultimate beneficiaries, while squares show the reduction assuming only 60 % of these profits are distributed to shareholders and taxed a further 20 %. CPI differs for different quantiles. Green triangles show the residual inflation if incremental 2022 profits had been paid out as equal per capita dividends.
(Data sources: Authors' calculations based on data listed in Table 1.)

according to the above cited studies, is a permanent excess profit tax based on a clear measure of excess profits such as profits above a specified return on capital and allowing for carryforward of losses to ensure symmetry with profits. Such a permanent, rules-based excess profit tax creates predictability for investors.

Revenues from an excess profit tax could be used to correct the regressive redistribution from windfall profits. To illustrate this point, let us assume the total incremental US fossil fuel profits in 2022 over those in 2021 going to US persons to be excess profits. In this case, a 100 % excess profit tax rate would provide $225bn, a number similar to that arrived at with another method for calculating windfall taxes [16]. If these taxes had instead been distributed as equal 'dividends' to all households, each would have received $1715 (dividing the total through the 131 million U.S. households). In this scenario, reminiscent of dividends paid with the revenue from carbon pricing [42–45], the excess profits would have led to lower relative income inequality by boosting the incomes of the bottom 50 % by 2.4 % and those of the next 40 % by 1.3 %, more than untaxed fossil fuel profits would have, while leaving the incomes of the top 10 % wealth owners nearly unchanged (Fig. 4 triangles). A dividend system of this kind has been in operation for royalties from Alaskan oil production since the 1970s [46]. Another example of a progressive redistribution was the $1200 per person COVID-19 cheques under the CARES Act which were only sent to households jointly earning less than $150,000. More sophisticated redistribution measures could be implemented, and part of the revenue could also be directed towards ends other than compensation, such as towards the low-carbon energy transition. Clean energy investments (including renewables, transmission and end-uses such as efficiency and electric vehicles) totalled $267 billion in the United States in 2022 [4]. If the 2022 incremental profits had been taxed and invested in the U.S. low-carbon energy sector, total sector investments that year would have nearly doubled to $492 billion. They would also have nearly doubled investments in all emerging markets and developing economies without China –from $244 to $469 billion, if alternatively invested there.

The opportunity that a fossil fuel excess profit tax presents to reduce income and wealth inequality should be considered before the next price and profit shock occurs. An important added benefit of a fossil fuel excess profits tax is that it corrects the misallocation of capital away from renewables and into oil and gas, which undervalues present physical climate impact and transition risks as well as inevitable and irreversible impacts on future generations.

CRediT authorship contribution statement

Gregor Semieniuk: Writing – original draft, Visualization, Validation, Supervision, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Isabella M. Weber:** Writing – original draft, Supervision, Methodology, Investigation, Funding acquisition, Conceptualization. **Iain S. Weaver:** Writing – original draft, Visualization, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Evan Wasner:** Writing – original draft, Software, Methodology, Investigation, Formal analysis, Data curation. **Benjamin Braun:** Writing – original draft, Methodology, Investigation, Data curation. **Philip B. Holden:** Writing – review & editing, Validation, Software. **Pablo Salas:** Data curation. **Jean-Francois Mercure:** Validation. **Neil R. Edwards:** Writing – review & editing, Funding acquisition.

Declaration of competing interest

The authors have nothing to declare.

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Appendix A. Network database construction

Network construction part I: input profit data

Our input profit data at stage 1 comes from Refinitiv and Orbis. We selected the US generally accepted accounting principles (GAAP) measure of net income as the preferred measure of profits, which is also the main indicator of profits reported in the financial press. This measure of profits is sales minus costs of goods sold, expenses (including royalties), interest payments, depreciation, taxes on corporate income, and other taxes on production, where the latter include various state and local taxes on both upstream and downstream parts of oil and gas production [47]. In Refinitiv, we collected quarterly net income from all companies (1437 companies) categorized under the industry groups "Oil and Gas" and "Oil and Gas Related Equipment and Services" according to The Refinitiv Business Classification (TRBC), which includes all stages of oil and gas mining, transport, refining and retail as well as oil field service companies. Since each firm defines its own fiscal calendar, we mapped fiscal quarters to calendar quarters based on the end of period date of each firm's fiscal quarter.

We primarily rely on quarterly profit data from Refinitiv where available. Quarterly profit data for all four quarters of 2022 was available in Refinitiv for the majority of firms (903 out of 1382), accounting for 86.4 percent of our final 2022 profits figure. However, not all companies report quarterly data to Refinitiv; some only report semi-annual data, while others report only annual data. Furthermore, some firms are missing random quarters of data in Refinitiv, while others did not yet report 2022 results by the time we collected data from Refinitiv. We therefore imputed quarterly 2022 profits for firms missing this data in Refinitiv from semi-annual and annual data as follows.[1]

We first took the subset of firms that reported all eight quarters of profits and revenues from the first quarter of 2021 to the fourth quarter of 2022 in order to deduce aggregate trends in profits over time. For what follows, the term 'aggregate' refers to the sum of profits or revenues across this set of firms. Quarterly profits for 2022 were then assigned for those firms missing them in Refinitiv by the following logic: [1] For firms which reported one quarter of profits as well as corresponding semi-annual profits (2022-H1 or 2022-H2), profits for the missing quarter were calculated as its profits for the semi-annual period minus its profits for quarter that was available (e.g. if a firm reported 2022-Q1 and 2022-H1 profits but were missing 2022-Q2 data, profits for 2022-Q2 would be imputed by subtracting 2022-Q1 profits from 2022-H1 profits). [2] If a firm was missing just one quarter of profits, did not report semi-annual profits, but did report annual profits, the missing quarter of profits was deduced by subtracting the annual profits by the other three quarters of profits. [3] For firms missing all quarterly data but which reported semi-annual data, the profits for each quarter were calculated as one half of its profits for the semi-annual period plus the nominal difference between the quarter's aggregate profits and one half of aggregate semi-annual profits weighted by the fraction of the firm's revenue out of aggregate revenue for the semi-annual period (e.g. a firm's 2022-Q2 profits would be calculated as one half of its 2022-H1 profits plus the nominal difference between aggregate 2022-Q2 profits and one half of aggregate 2022-H1 profits ($38.7 billion) weighted by the fraction of the firm's revenue out of aggregate revenue for 2022-H1). [4] For the remainder of firms which reported annual profits for the full year 2022, quarterly profits were calculated as one fourth of its profits for the full year 2022 plus the nominal difference between the quarter's aggregate profits and one fourth of aggregate 2022 profits ($35.8 billion) weighted by the fraction of the firm's revenue out of aggregate revenue for 2022. [5] For the remainder of firms which reported annual profits for the full year 2021, profits for the full year 2022 were extrapolated by multiplying its profits for the full year 2021 by the percentage by which aggregate profits changed between 2021 and 2022 (an increase of 81.1 %). This annual 2022 profits figure was then split into quarterly profits as in [4].

In other words, if there was a missing quarter of data, we first attempted to directly deduce the firm's quarterly profits when it was possible to do so from the available data (i.e. subtract its semi-annual profits by its first quarter profits), and when not possible, used trends in aggregate profits to predict what portion of a firm's semi-annual or annual profits would likely have been generated in each quarter. In instances of the latter, the steps described above ensure that the imputed quarterly profits for each firm sum to the semi-annual or annual data taken from Refinitiv. If 2022 data was not available and the firm was still listed as active by Refinitiv at the time of data collection, we used trends in aggregate profits to predict how a firm's 2021 annual profits would have changed in 2022 and which portion of those profits would have accrued each quarter, with profits from this category accounting for 7.5 % of our total 2022 profits figure. Table A1 summarizes the total 2022 profits derived for three categories: quarterly profit data taken directly from Refinitiv, quarterly profits imputed from semi-annual and/or annual data (i.e. profits imputed from any of the steps [1] to [4] above), and profits extrapolated from 2021 data (step [5] above).

Table A1
2022 profits by calculation method for publicly listed firms.

Profit data source	Total profits in $ billion
Quarterly Refinitiv data	804.7
Quarterly profits imputed from semi-annual and annual data	41.9
Profits extrapolated from 2021 using aggregate trends	68.9
Total	915.5

Refinitiv focuses on stock market-listed companies. To capture profits from non-listed companies (e.g. Koch Industries), we additionally included all non-stock market-listed, US-based companies in Orbis that are classified under NACE sectors 06, 09.10, 19.2, 35.2, 46.71, 47.3, 49.5, and which fall under the climate policy relevant sector classification [49]. This includes private equity-owned and family-owned companies and partnerships.[2] In

[1] As noted by Müftüoglu et al. [48] studying energy companies poses methodological challenges. While the ethnographic approach they propose can provide detailed insights into operations at the company level, we instead opt for a quantitative method that aggregates firm-level financial data to analyze sector-level developments, using imputations where data is missing.

[2] The selected sectors comprise all fossil fuel-related sectors minus coal. They are: extraction of crude petroleum and natural gas (06), support activities for petroleum and natural gas extraction (09.10), manufacture of refined petroleum products (19.2), manufacture of gas and distribution of gaseous fuels through mains (35.2), wholesale of solid, liquid, and gaseous fuels and related products (46.71), retail sale of automotive fuel in specialised stores (47.3), and transport via pipeline (49.5). We use NACE codes rather than TRBC for non-listed companies in Orbis because TRBC classifications are not available in Orbis.

order to exclude subsidiaries, we only include non-listed companies in which no single shareholder has a shareholding of >50 %. Thus, for instance, we exclude XTO Energy, which is a subsidiary of ExxonMobil.[3] Since XTO's profits already show up on the ExxonMobil income statement, we do not include them again. The precise Orbis queries are in Tables E1 and E2 below. One query finds global ulimate owners (GUO), the other finds companies that are subsidiaries of a GUO that is not an oil or gas company (oil companies are filtered out from GUO type after the search). This filters for companies where the GUO is a person or financial company.

We track US-based beneficiaries of profits, but for non-listed companies shareholder information is frequently not provided. However, non-listed companies registered in the US are most likely owned by US persons, whereas non-listed companies registered elsewhere that are not subsidiaries are most likely owned by non-US persons. Therefore, we approximate profits accruing to US-based beneficiaries of private companies by limiting our view to private companies registered in the US. This may capture some foreign-owned companies, but where this information is recorded we capture it via our shareholding network. However, even where such data may be unavailable, we do not believe that this leads to substantial bias in our results, since U.S. person would in turn own oil and gas companies abroad that we do not capture. Inward and outward cross-border equity investments for the United States are roughly balanced. In 2022, U.S. FDI equity assets stood at $7.9 trillion, versus $10.5 trillion of FDI equity liabilities. Portfolio equity assets and liabilities stood at $10.3 trillion and $12.2 trillion, respectively. Overall, foreign equity assets stood at 80 % of foreign equity liabilities. Moreover, due to the strong oil and gas sector in the United States, compared with other countries (the US being the largest oil and gas producer in the world), it means that there is substantial knowledge, expertise and existing firms, that may well lead to higher outward FDI investment in this sector compared with foreign inflows. One indication for this is that there is a net outward asset position for listed companies. We found that ownership by foreign investors of US oil profits was only 50 % of the ownership by US investors of foreign profits which stood at USD 64.3bn (see the 3 leftmost grey nodes in Fig. 2 in the main text). As such, we are confident that our assumption of no net transfers of profits to the US for unlisted companies is a conservative estimate, meaning we likely understate profits flowing to U.S. Americans.

Since Orbis only reports annual data, we collected annual 2021 and 2022 profits and revenues. For the set of private companies, 2022 profit data were only available in Orbis for a small fraction of firms. When profit data was missing, we instead rely on revenue data, which were available for a much larger portion of firms. At the time of data collection 2022 data were still unavailable in Orbis for a large portion of firms, thus we also collected 2021 profits and revenue data. For each firm, we first attempt to take 2022 profits directly; if missing, we use 2022 revenue data; if 2022 revenue data is missing, we use 2021 profit data; and finally if 2021 profit data is missing we use 2021 revenue data. Our 2022 profit figures for the set of private companies are thus divided into four groups: those [1] taken directly from Orbis, [2] imputed from 2022 revenues, [3] extrapolated from 2021 profits, and [4] extrapolated from 2022 revenues. The extrapolations and imputations were done with the use of aggregate trends among publicly listed firms who reported all 8 quarters of data between 2021-Q1 and 2022-Q4, thus we rely on the assumption that changes in profits among private firms mirrored the changes in profits that occurred among publicly listed firms. For group [2], 2022 profits were imputed from 2022 revenues for each firm by multiplying the firm's 2022 revenue by the aggregate profit rate in 2022 (i.e. aggregate 2022 profits divided by aggregate 2022 revenues, where "aggregate" refers to the set of publicly listed firms who reported all 8 quarters of profit data in 2021 and 2022). For group [3], each firm's 2022 profits were extrapolated from its 2021 profits by multiply its 2021 profits by the percentage by which aggregate profits changed between 2021 and 2022. For group [4], 2022 profits were extrapolated by multiplying each firm's 2021 revenues by the percentage by which aggregate revenues changed between 2021 and 2022 and then multiplying again by the aggregate profit rate in 2022. Table A2 summarizes the profits derived for the four groups described above.

Table A2
2022 profits by calculation method for private firms.

Profit data source	Total profits in $ billion
Group 1 (2022 profits taken directly from Orbis)	0.4
Group 2 (scaled imputation from 2022 revenue)	3.4
Group 3 (extrapolation from 2021 profits)	5.0
Group 4 (extrapolation from 2021 revenue)	82.5
Total	91.3

Network construction part II: shareholder

The main data source for identifying stages 2a and 2b nodes in Fig. 2 in the main text and the transmission to them is Orbis' shareholder database. First we matched companies in Refinitiv's database with those in Orbis, achieving a match for 1382 companies. Then for these listed companies as well as all non-listed oil and gas companies collected from Orbis, we collected information on each company's shareholders in Orbis and the size of the share (the link) it holds in the company. For every collected shareholder, we in turn collected their own shareholders from ORBIS. We did this until no new shareholders were collected. This process resulted in a network of 252,433 companies and shareholders as nodes with shareholdings linking them. Of these, 72,817 are companies, and 179,616 are persons, i.e. ultimate beneficiaries. Our shareholding data is current as of October 2022.

The network of shareholding relations from oil and gas companies through intermediate shareholders (e.g. financial institutions or holding companies) to ultimate beneficiaries allows propagating a unit of profit from an oil company to its ultimate beneficiaries. An ultimate beneficiary is a shareholder that doesn't in turn have shareholders. Persons, groups of persons (e.g. families or the directors or employees of a company), and governments are ultimate beneficiaries. Companies cannot be ultimate beneficiaries: by definition a company is owned by persons or a government. For many companies only part of the shareholdings are disclosed, due to data limitations, as Orbis only records large shareholders (owning >0.05 % of the company). In such cases where the shareholders sum to <100 % ownership, we assumed that the rest is owned by small, private shareholders: i.e. no funds or governments. Again, we assumed that for US-incorporated companies, these ultimate beneficiaries are US persons, and for non-US incorporated companies these are non-US persons. In principle, there could also be US government or fund ownership among these unknown shareholders. But since government typically holds a substantial share of any company in which it has any position at all (see e.g. Table 3 in ref. [50])

[3] https://corporate.exxonmobil.com/who-we-are/our-global-organization/brands#Mobil.

and the United States government has stakes in comparatively few companies, we assumed that all government holdings would be above 0.05 % of the company's ownership and recorded by Orbis [51]. For funds, we similarly assume that any fund ownership is above 0.05 % as it pools investments by several persons. The next section details our treatment of fund ownership in general.

On some occasions, the total listed shareholdings of a company according to Orbis exceed 100 %. This issue could arise from asynchrony in Orbis' own sources. In the absence of any additional information to determine which shareholding values are in error, we rescale each reported shareholding percentage by a common factor to ensure the total shareholding is exactly 100 %. Shareholdings sum to >100 % in 1005 companies in the network. The mean excess is +5.7 %, the maximum excess is +96 %. These 1005 companies have assets totaling 10.5 % of the reported assets for the entire network, and the 289 above the mean excess have 6.7 % of the reported assets.

Network construction part III: fund managers

To map profits from oil and gas companies to ultimate beneficiaries, we must account for the cases where shareholding is controlled by fund managers, rather than directly by the ultimate beneficiaries. A substantial part of equity on capital markets is held via funds rather than directly. In the US, only 40 % of corporate equity is held directly by households, and the figure is even lower elsewhere [52]. The rest is held by institutions. This can either be direct holdings by institutional asset owners, such as pension funds; or – and that is the predominant configuration – holdings of fund managers. Here, the fund manager invests in a company's shares on behalf of clients, e.g. pension funds or individuals, who are the ultimate beneficiaries and invest in the shares of the fund. Funds are set up and maintained by fund managers, such as BlackRock and Vanguard. In Orbis, shareholding links via funds are flagged, and the fund manager is shown as the shareholder. But fund managers do not have a claim on the profits of the shares they manage because they are not the ultimate beneficiaries of the shares. Instead, the clients are the ultimate beneficiaries of the shares, while the fund managers merely receive fees for managing the funds.[4] As such, whenever a shareholding link is mediated through funds, we break the link from the fund manager to its shareholders and instead pass it to the fund manager's clients.

Inspection of the data shows that Orbis underreports shareholding via funds, i.e. not all links that are clearly mediated through funds are flagged as such. In particular, some asset managers – the most common type of fund managers – are shown to have large direct shareholdings (i.e. not via funds). That is implausible for an entity that has little of its own equity to invest. For instance, BlackRock had more than $10 trillion in assets under management at the end of 2021, but its own assets were valued at $152 billion, of which only $32 billion were equity [53]. Thus, BlackRock could in principle financially invest only on the order of 1 % of its assets under management on account of its own shareholders, but Orbis lists many of BlackRock's assets as direct shareholding links.[5] To improve our estimate of shareholding via funds we assume that *all* shareholdings of fund managers are mediated through funds.

We identify fund managers by type of organization. We leverage a variable within Orbis called 'shareholder type' that assigns one of fifteen categories to each shareholding node. The relevant classifications of shareholders from this typology are "Mutual and pension fund/Nominee/Trust/Trustee", "Hedge fund" and "Private equity firm", all of which tend to manage funds for their clients as their primary business function. We supplement this 'type' classification from Orbis with a list of 6916 major financial institutions with our own classification. For these institutions, our list overrides the classification provided by Orbis, which is wrong or misleading in many cases. For instance, Orbis classifies BlackRock, the world's largest asset manager, as a bank. Vanguard, the second largest asset manager, is classified as a non-financial corporation. We use the following categories:

- Asset managers
- Banks
- Endowments
- Family offices
- Foundations
- Hedge funds
- Insurers
- Other government
- Private equity
- Private pension funds
- Public pension funds
- Sovereign wealth funds
- Wealth managers

We assigned financial institutions to these categories based on a mix of manual searches and publicly available lists, notably the Thinking Ahead Institute/P&I's list of the 500 largest asset managers, and the Sovereign Wealth Fund institute's public lists of various types of institutional asset owners. We then assume that any shareholdings by companies categorized as asset managers, hedge funds, private equity, private pension funds, public pension funds and wealth managers in our list are 'mediated through funds'. For companies classified by Orbis as one of the three relevant shareholder types mentioned above but which are not on our constructed list of 6916 financial institutions, we rely on Orbis's classification to assign these firms as fund managers. For other firms classified by the remaining shareholder types by Orbis, such as banks, we follow Orbis' flag as to whether a firm has a direct or via funds shareholding linkage.

Measuring the importance of the fund manager category of private equity as owners of non-listed oil and gas companies poses a particular challenge. This is because the quality of ownership data in Orbis is significantly worse for non-listed firms than for listed firms. However, in light of recent studies documenting private equity's targeted push into the oil and gas sector, measuring the size of its equity holdings is crucial [54–56]. In order to meet this challenge, we use two additional data sources. First we use Preqin, the leading provider of data on private equity transactions. We

[4] Since these fees are paid by clients, we do not add them here. To the extent that fees are paid out of oil and gas shareholder distributions, their addition would constitute a double counting of profits.

[5] Moreover, the assets on BlackRock's balance sheet are of course not all in the form of investible cash and instead reflect the book value of the physical capital (plant and equipment), such as office buildings and computers, that allows the company to carry out its asset management operations.

sequentially apply the following filters:

- Primary industry: 'Oil & Gas' or 'Power & Utilities'
- Sub-industry: Contains the strings 'Oil|Gas|Petroleum|Petrochemicals'
- Investment type: 'Buyout' or 'Public to private'
- Investment status: 'Active'
- Investment stake: any except 'Minority'

This leaves us with 671 oil and gas firms. Based on the finding that the average holding period for private equity buyouts has increased to six years, we exclude all firms with a purchase date prior to 2016, which leaves 262 oil and gas firms that in 2022 are likely owned by private equity funds [57]. Second, we use Pitchbook, another provider of data on private equity to collect all oil and gas firms held by ten of the largest private equity companies. These companies and the oil and gas firms they hold are identified in a 2021 report by the Private Equity Stakeholder Project (PESP), using Pitchbook, too [58]. We updated the list of current holdings to spring 2023, after dropping one of the ten private equity companies, because it isn't based in the US. We apply the following filters:

- Private equity firm: one of the nine largest companies from PESP
- Ownership status: 'Privately held (backing)'
- Backing status: 'PE-backed'
- Industries: 'Oil and Gas Equipment' or 'Energy Exploration' or 'Energy Refining' or Verticals: 'Oil & Gas'

This yielded 101 oil and gas backed by private equity as of early 2023.

Searching for the union of the 262 and 101 companies in Orbis produced 275 matches, including a small number of firms that were not found with the search filter described in network construction part I section above. These firms were added to the other 'input profit' firms and are part of the totals in Table A2. These 275 firms received a flag signifying 'fully owned by private equity firm'. For these firms, all other ownership information from Orbis is disregarded. For all remaining firms in the network, whether listed or unlisted, ownerships stakes are assigned to private equity whenever a shareholder is classified as a private equity firm in our shareholder list, or else by Orbis' own classification variable.

To create links from fund managers to their clients (which are not reported in Orbis), we use data on the clients of asset managers, hedge funds and private equity as groups. To link asset managers to clients, we use information from the Financial Accounts of the Federal Reserve (table L.224), which provides aggregate data on the clients of asset managers. The Financial Accounts allow us to create links between asset managers and the following groups beneficiaries: public and private pension funds, insurance companies, households, non-financial companies, the US government and the rest of the world [59]. For hedge funds and private equity funds, we use the Securities and Exchange Commission's private fund statistics to create links to these same recipients and, in addition, to non-profits (endowments and foundations) and to high-net-worth individuals [60].[6] By not accounting for the common 20 % performance fee charged by these alternative asset management firms—money that goes to the owners/general partners of these firms—we offer a conservative estimate of the share of hedge-fund and private-equity-held profits flowing directly to the top 1 % of the wealth distribution. Generally, our allocation of fund holdings to ultimate beneficiary groups rests on the assumption that the structure of beneficial ownership for fund holdings in the oil and gas sectors mirrors that for fund holdings in the economy as a whole.

Network construction part IV: socio-economic distribution

In the last step, we group ultimate beneficiaries into broad categories (Table A3) and then link these categories to the wealth size distribution and distributions by race and ethnicity, and by education. For this we use the Distributional Financial Accounts (DFA) from the Federal Reserve [61]. We match components of household financial assets in the DFA with our ultimate beneficiary categories. For instance, we match individual shareholders of a non-financial corporation with the DFA financial asset category "corporate equities and mutual funds". We match a pension fund with the DFA category "pension entitlements". Table A3 has a complete list of matches of our ultimate beneficiary categories with DFA categories. The DFA breaks down (partitions) the ownership of these asset categories according to the wealth size distribution. As a first approximation we assume that the ownership of fossil fuel financial assets reflects that of the overall economy (we are not aware of any studies that examine biases of particular wealth groups in the ownership of assets across industrial sectors). Thus, we can allocate shares summing to 100 % of each ultimate beneficiary group to the quantiles in the wealth distribution. Similarly, the DFA reports the ownership of each financial asset category broken down by race and ethnicity and by educational attainment. Once again, we assume that the distribution of fossil-fuel ownership by racial and ethnic or educational groups resembles that of the whole economy. For more detail on the race and ethnicity, and education definitions, see ref. [62].[7] An interesting additional dimension of distribution would be geographical within the U.S., as the regional distribution of overall wealth is unequal [63], and the distribution of oil and gas profits may be skewed – at least for private businesses – to oil and gas producing regions. Unfortunately, our data does not allow identifying the location of shareholders.

[6] We assume that all clients of hedge funds and private equity funds designated as "U.S. persons" (roughly 14 % and 6 % of beneficiaries, respectively, in the SEC's private fund statistics) are high net worth individuals, who own enough wealth to put them entirely into the top 1 % of the wealth distribution. We split them evenly across top 0.1 % and the rest of the 1 % quantiles, which are detailed in the section on socio-economic distributions.

[7] Note in particular that the racial and ethnic categories come from self-identification in the Survey of Consumer Finance, and are listed as White non-Hispanic, Black non-Hispanic, Hispanic or Latino, and other or multiple race, and abbreviated as White, Black, Hispanic and Other in the DFA and our figures. The question of whether respondents consider themselves as "Hispanic or Latino in culture or origin", included in the survey since 2004, is ignored in the DFA for consistency with pre-2004 surveys.

Table A3
Match of ultimate owner categories with DFA financial asset categories.

Ultimate beneficiary category (Stage 3)	Financial asset category
Business owners	Private businesses
Pension funds	Weighted average of defined contribution and defined benefit pension entitlements
Mutual fund holders	Corporate equities and mutual fund shares
Shareholders in non-financial firms	Corporate equities and mutual fund shares
Shareholders in banks and insurers	Corporate equities and mutual fund shares
High net worth individuals	Bespoke: 50 % top 0.1 % and 50 % rest of top 1 %
Government, nonprofits, rest of the world	No match as not US-based household wealth

This completes the network of shareholding where claims on profits flow from oil and gas companies all the way to quantiles in a socio-economic distribution. We identify 4 stages in this process. Where profits enter the network via oil and gas companies is stage 1. Stage 2a propagates profits from oil companies which are owned directly (i.e. not via funds) to ultimate beneficiaries, stage 2b propagates profits to fund managers. Stage 3 propagates both directly and fund-held profits to broad ultimate beneficiary categories. Stage 4 propagates these into socio-economic distributions. All that remains to develop is an algorithm to propagate these profit claims.

Appendix B. Profit propagation algorithm

We construct an algorithm to propagate profits from where they originate with oil and gas companies all the way to the socio-economic distributions. It builds on and is completely reworked, improved and expanded from the algorithm in ref. [6]. The propagation is simplified within the financial network by considering accounting profit. Accounting profit is not a conserved quantity, but it accumulates at every level of the ownership chain. We recover conserved profit by isolating the fraction of the accounting profit that is not held by shareholders. We map the accounting profits reported by 80,017 fossil-fuel companies to their shareholders, company by company and shareholder by shareholder, and then isolate the (unowned) share of the economic profits in each shareholder. This ultimately leads to an allocation of economic profits to two types: to direct ultimate beneficiaries (who hold shares in their own names) and to fund managers (who hold shares on behalf of their clients).

Direct shareholding links in the network propagate a fraction of profits from a company to its shareholders. Therefore, for direct shareholder i – which can be a firm, individual, or group – the profits propagated to i, p_i, consist of the sum:

$$p_i = g_i + \sum_{j=1}^{N} p_j \, s_{i,j} \text{ for } i \text{ in } 1, \ldots, N. \tag{1}$$

where g_i is any profit deriving from shareholder i's own oil and gas operations, and $s_{i,j}$ is the fraction that shareholder i *directly* holds of company j's shares, with $s_{i,i} = 0$ by definition.[8] In our network of $N = 252{,}433$ firms and shareholders, g is nonzero for the 22,105 firms that we identified as earning oil and gas profits, and zero for all others.

In the case of managed ownership, profits m_i are propagated to fund manager i as follows:

$$m_i = \sum_{j=1}^{N} p_j \, f_{i,j} \text{ for i in } 1, \ldots, N. \tag{2}$$

where $f_{i,j}$ is the shareholding of i in j mediated through funds. Notably, these managed profits do not appear in Eq. (1) because they accrue to the fund manager's managed assets, not to its own balance sheet, and therefore do not propagate through other share ownership.

The total propagated profits in the network are equal to the total profits originating from the oil and gas firms:

$$\sum_i g_i = \sum_i ((1 - S_i) p_i + m_i) \tag{3}$$

where

$$S_i = \sum_{i=1}^{N} s_{i,j} + f_{i,j} \leq 1 \text{ for } j \text{ in } 1, \ldots, N. \tag{4}$$

that is, direct shareholders and shareholdings mediated through funds cannot together own >100 % of a company's equity. Where shareholdings sum to <1, we assume that the rest is owned by direct shareholders, as explained in the network construction section above.

The solution to these equations is straightforward. Eq. (1) defines profits implicitly, as the right-hand side involves p_i, so the solution must be obtained by inverting the matrix of shareholdings s_{ij}. Fortunately, Eq. (1) can be solved simply by iteration; the profits of each oil and gas company are propagated to the direct shareholders during each iteration, until there is no further change in the distribution of profits across the network. Fig. B1 illustrates the propagation from a particular company to a sequence of shareholders.

[8] When firm i reports self-shareholding in Orbis (e.g. because of how Orbis records a share buyback), this just increases the effective shareholding by all other shareholders proportionally. Thus, for reported self-shareholding $z_{i,i}$ and other reported shareholdings $z_{i,j}$, we calculate $s_{i,j} = z_{i,j}/(1 - z_{i,i}) \forall j \neq i$ and set $s_{i,i} = 0$.

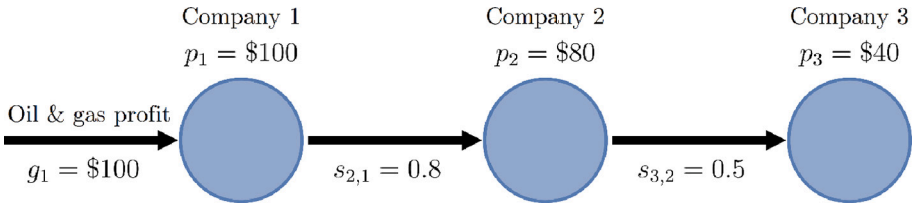

Fig. B1. Illustration of direct shareholding propagation. Profits are propagated to shareholders by the fractional shares of the profiting company they hold.

A single propagation step can be expressed in matrix form as

$$\boldsymbol{p}_{k+1} = \mathbf{S}\boldsymbol{p}_k \tag{5}$$

where $\boldsymbol{p}_0 = \boldsymbol{g}_0$ *and* $\boldsymbol{p}$ and $\boldsymbol{g}$ are vectors of length N, $\mathbf{S}$ is a square matrix of direct shareholding links, and k is the step of propagation. At $k = 0$ all profits reside in oil and gas companies only.

In order to propagate profits through to ultimate owners, we treat Eq. (5) as a system of first order linear difference equations, equivalent to solving via the Jacobi method. Intuitively, this system, with all entries in $\boldsymbol{S}$ in the interval [0,1), propagates smaller and smaller portions of the initial profits in vector $\boldsymbol{g}_0$, until vector $\mathbf{p}$ becomes an unchanging vector of profits after enough iterations. Formally, the system is asymptotically stable because its largest eigenvalue modulus is <1 (for a proof see e.g. ref. [64]). We therefore repeat iterations of propagation until $\boldsymbol{p}_{k+1} = \boldsymbol{p}_k$ within machine precision.

For the previous paragraph to hold, any closed shareholding loops must be removed. Conceptually, such loops cannot occur: corporations are (ultimately) owned by persons or groups of persons. But in practice, in some cases, asynchrony in ownership information within Orbis can introduce closed loops to the network, causing the iterative propagation of profits to cycle indefinitely without convergence. This phenomenon is resolved by identifying subsets of companies in which convergence fails, identifying closed ownership loops within each subset, and subjectively identifying and removing the least credible link in the cycle. We identify this link as one for which a smaller company (in terms of equity) owns 100 % of a larger company, rather than vice versa. Twelve links are removed in this way to resolve the issue of convergence in the entire network.

Now that the directly held shares have been resolved, shares held mediated through funds are accounted for in a single matrix $\mathbf{F}$ and illustrated by Fig. B2.

$$\boldsymbol{m} = \mathbf{F}\boldsymbol{p}. \tag{6}$$

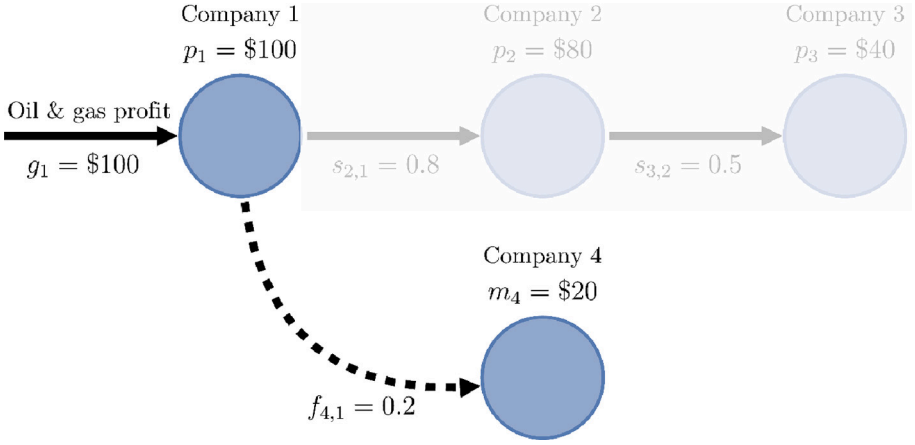

Fig. B2. Illustration of fund holding propagation. Once the shareholder network has been iterated, thus finding the solution to Eqn. [1], ownership mediated through funds is resolved in a single step. These managed funds do not propagate further.

After allocating profits to ultimate owners via direct shareholdings and fund managers, three steps remain. First, we aggregate direct shareholdings into categories of ultimate owners shown in Table A3. Second, we use information on the average holdings of these different categories of ultimate owners in funds as described in the network construction above to propagate the profits mediated through funds to ultimate owner categories, and add them to the profits claimed via direct shareholdings. Finally, we use our match of ultimate owner categories with the DFA asset categories (also Table A3), as well as the DFA's data on the ownership of asset categories by components of our three socio-economic distributions, for our final propagation of profits to socio-economic groups.

Appendix C. Additional data for Fig. 1c

Parts A and B of Fig. 1 in the main manuscript use profit data for all listed firms available in Refinitiv from the first quarter of 2016 to the fourth quarter of 2022, with the set of firms as described above. Part B partitions the data by the country of each firm's headquarters. Part C uses additional data all from Refinitiv. Renewable energy profits are calculated exactly as oil and gas profits, but on the set of companies that are in 'renewable energy'

according to TRBC. The MSCI index end of day time series was downloaded for MSCI World Energy Sector Price Index USD, and for the MSCI Global Alternative Energy Net Index USD, approximations of fossil fuel and renewable energy sector equities. At the time of writing, the top 10 constituents of the former are Exxon Mobil, Chevron, Shell, ConocoPillips, TotalEnergies, BP, Canadian Natural Resources, Schlumberger, Enbridge, and Marathon Petroleum.[9] Of the latter the top 10 constituents are Vestas, First Solar, Enphase Energy, Orsted, Adani Green Energy, Nextracker, Verbund, EDP Renovaveis, Northland Power, Solaredge Technologies.[10]

Appendix D. Inflation compensation with fossil fuel profits

Table D1 presents a simple calculation of the extent to which the incremental profits in 2022 compensated each quantile of the wealth distribution, on average, for inflation over the same period. Column (1) estimates the disposable income of each wealth group in 2021, relying on the income earned by wealth shares from ref. [19] and adjusting to Fed-reported wealth shares. Columns (2) and (3) report oil and gas profits in 2021 and 2022. Column (4) calculates the proportional increase in nominal income from incremental 2022 profits accruing to each quantile. Taking the estimated 60 % shareholder distributions for 2022 and assuming the same in 202, and subtracting an upper limit of 20 % tax on both dividends and realized capital gains yields an income increase of 0.6*0.8 = 0.48 of all profits. Column (5) calculates the proportional increase in nominal income this more restrictive increase in capital income.

Table D1
Profit increase impact on effective inflation by wealth quantile in USD billion.

Wealth quantile	Disposable personal income, 2021	Oil and gas profits		Nominal income increase; all profits, no tax (%)	Nominal income increase; distributions net of tax (%)
		2021	2022		
	(1)	(2)	(3)	(4) = [(3)– (2)] ÷ (1)	(5) = (4)*0.48
Top 0.1 %	966.4	37.2	92.2	5.7%	2.7%
Rest top 1 %	1792.2	39.5	98.0	3.3%	1.6%
Next 9 %	4467.2	50.8	126.0	1.7%	0.8%
Middle 40 %	6717.1	23.1	57.3	0.5%	0.2%
Bottom 50 %	4690.3	1.5	3.7	0.0%	0.0%
All households	18,633.1	152.1	377.16	1.2%	0.6%
Memo: top 1 %	2763.2	76.7	190.2	4.1%	2.0%
Memo: top 10 %	7237.9	127.5	316.2	2.6%	1.3%

Note: Disposable income is from the Bureau of Economic Analysis, National Income and Product Accounts, Table 2.1, release 21 Dec, 2023.

Comparing columns (4) or (5) to inflation figures shows what part of inflation was compensated as discussed in the main text. The CPI inflation for the top 20 % of income earners was 0.4 percentage points lower than the average in 2022, and possibly even lower for the top 10 % and 1 % by one estimate [14]. To account for this inflation disparity, Fig. 4 in the main text modifies the inflation for each wealth quantile using the Bureau of Labor Statistics estimates of inflation disparity by income quintile [14,29]. This lowers top 20 % inflation by 0.2 percentage points and raises bottom 20 % inflation by 0.3 percentage points. Deviations in between are lower and change monotonically. For lack of information on how wealth quantiles were affected differently by inflation, we use these broad categories on income quantile inflation for our wealth quantiles, leading to a conservative modification: the top 0.1 % wealth owners are experiencing the same reduction of inflation as the top 20 % income earners, and no more. The result is that for the top 0.1 % column (5) should be compared to a CPI of 6.3 %, not 6.5 %, which is what Fig. 4 does.

Appendix E. Additional tables and figure

Table E1
Regressing share price on profits and share buybacks.

Dependent variable:	Proportional change in share prices		
Model:	(1)	(2)	(3)
Intercept	0.13774*	0.18037**	357.20
	(0.05554)	(0.05142)	(355.41)
Proportional change in profits 2021 to 2022	0.17893**		
	(0.03147)		
Proportional change in share buybacks 2021 to 2022		0.10169*	
		(0.04006)	
2022 share buybacks divided by 2022 profits			−67.24
			(393.07)
Adj. R-squared	0.1654	0.06153	−0.01128
N	159	84	88

Notes: Linear regression using lm() command in R. Restricted sample to rates of change of <500 % to avoid results being driven by 2021 values near zero. * signifies statistical significance in the 95 % confidence interval, ** in the 99.9 % interval. Model 1 has fewer observations than firms in Table 2 because of missing share price observations, models 2 and 3 have even fewer observations because of missing share buyback observations.

[9] https://www.msci.com/documents/10199/4436b773-ee19-4bac-8fbf-307d28408ca8.
[10] https://www.msci.com/documents/10199/40bd4fec-eaf0-4a1b-bfc3-8ed5c154fe3c.

Table E2
Query to select companies in Orbis that are global ultimate owners.
Search on July 15, 2023.

Search Step		Step result
1. Status	Active, Unknown situation	295,000,237
2. Listed/Unlisted companies	Formerly publicly listed companies, Unlisted companies	439,518,570
3. NACE Rev. 2 (Primary codes only)	06 - Extraction of crude petroleum and natural gas, 061 - Extraction of crude petroleum, 0610 - Extraction of crude petroleum, 062 - Extraction of natural gas, 0620 - Extraction of natural gas, 0899 - Other mining and quarrying nec, 091 - Support activities for petroleum and natural gas extraction, 0910 - Support activities for petroleum and natural gas extraction, 192 - Manufacture of refined petroleum products, 1920 - Manufacture of refined petroleum products, 352 - Manufacture of gas; distribution of gaseous fuels through mains, 3521 - Manufacture of gas, 3522 - Distribution of gaseous fuels through mains, 3523 - Trade of gas through mains, 4671 - Wholesale of solid, liquid and gaseous fuels and related products, 473 - Retail sale of automotive fuel in specialised stores, 4730 - Retail sale of automotive fuel in specialised stores, 495 - Transport via pipeline	1,853,852
4. World region/Country/Region in country	United States of America	68,719,118
5. Ultimate Owners	Global; Def. of the UO: min. path of 50.01 %, known or unknown shareholder	5,303,133
6. Latest year of accounts	2021, 2022, 2023	109,292,047
7. Standardised legal form	Branch	45,528,999
8. Consolidation code	NF (No financial variables at all)	220,544,708
Boolean search	1 and 2 and 3 and 4 and 5 and 6 and not 7 and not 8	
TOTAL		19,547

Table E3
Query to select companies in Orbis that are subsidiaries of non-oil and gas companies.
Search on July 15, 2023.

Search Step		Step result
1. Status	Active, Unknown situation	295,000,237
2. Listed/Unlisted companies	Formerly publicly listed companies, Unlisted companies	439,518,570
3. NACE Rev. 2 (Primary codes only)	06 - Extraction of crude petroleum and natural gas, 061 - Extraction of crude petroleum, 0610 - Extraction of crude petroleum, 062 - Extraction of natural gas, 0620 - Extraction of natural gas, 0899 - Other mining and quarrying nec, 091 - Support activities for petroleum and natural gas extraction, 0910 - Support activities for petroleum and natural gas extraction, 192 - Manufacture of refined petroleum products, 1920 - Manufacture of refined petroleum products, 352 - Manufacture of gas; distribution of gaseous fuels through mains, 3521 - Manufacture of gas, 3522 - Distribution of gaseous fuels through mains, 3523 - Trade of gas through mains, 4671 - Wholesale of solid, liquid and gaseous fuels and related products, 473 - Retail sale of automotive fuel in specialised stores, 4730 - Retail sale of automotive fuel in specialised stores, 495 - Transport via pipeline	1,853,852
4. World region/Country/Region in country	United States of America	68,719,118
5. Latest year of accounts	2021, 2022, 2023	109,292,047
6. Standardised legal form	Branch	45,528,999
7. Consolidation code	NF (No financial variables at all)	220,544,708
8. Subsidiaries with Ultimate Owners by profile	UO; GUO only; Def. of the UO: min. path of 50.01 %, known or unknown shareholder	60,904,189
Boolean search	1 and 2 and 3 and 4 and 5 and not 6 and not 7 and 8	
TOTAL		3,212

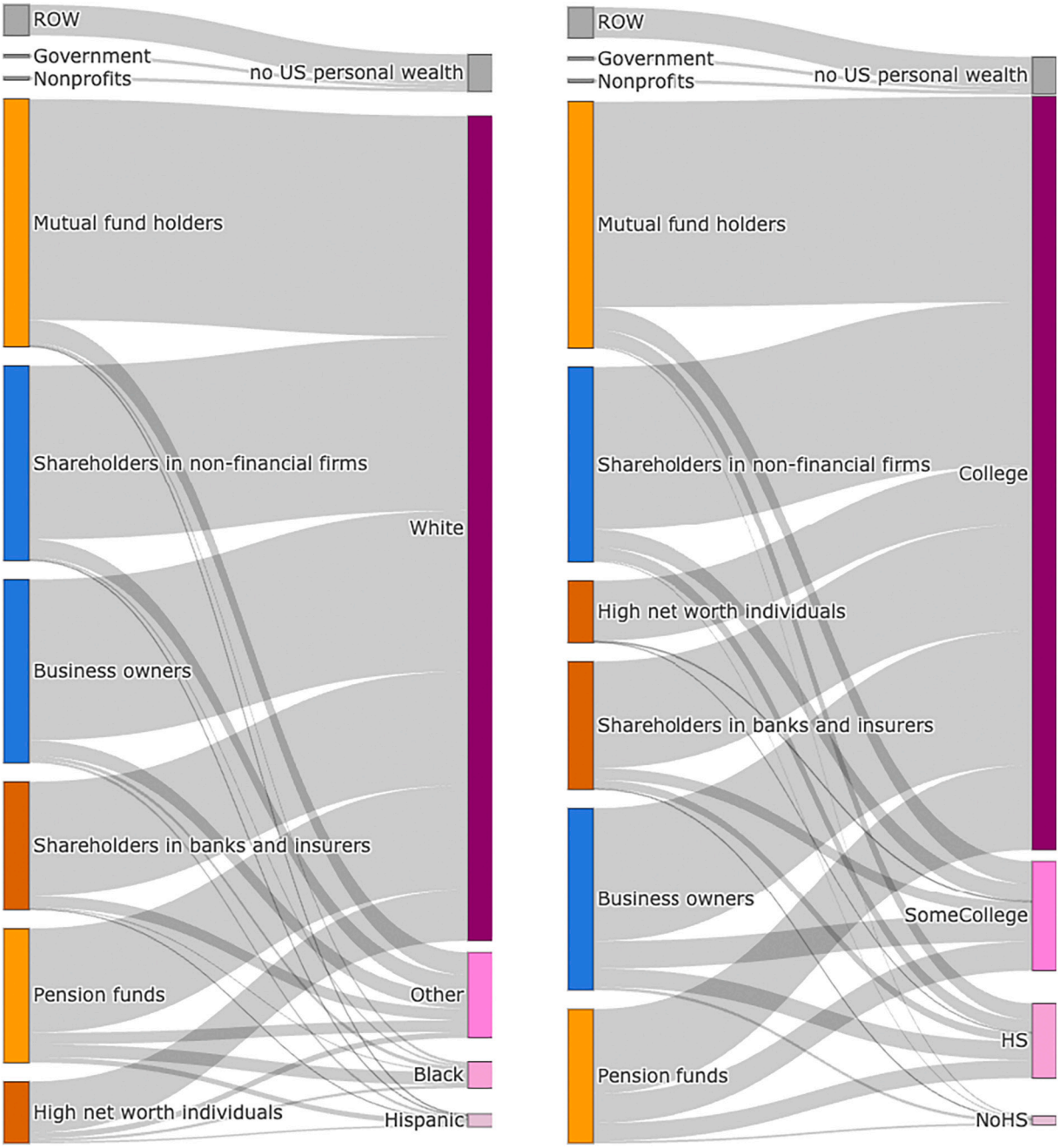

Fig. E1. Sankey flow of profits to households grouped by race and ethnicity or education.
The Sankey diagrams shows how claims on profits reaching ultimate beneficiary groups are allocated to households based on a) race and ethnicity and b) education.

Data availability

Data was accessed under license and cannot be shared. Figure data points are shared at https://doi.org/10.5281/zenodo.15893489.

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