Private Capital Markets and Inequality*

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Abstract

This paper studies the relationship between the growth in private capital markets and the rise in economic inequalities in the U.S over the last two decades. First, we document that the share of financing raised by early-stage companies from U.S.-based high-net-worth individuals (HNWIs) tripled from 2004 to 2022. Second, exploiting state-level variation in exposure to the expanded federal capital gains tax exemption on qualified small business stock (QSBS), we find that HNWIs' growing participation in private capital markets increased the income gap between HNWIs and other income earners by 6.0%. Third, we show that this rise in income concentration appears to have been driven by HNWIs' excess returns on their early-stage investments relative to public stock market returns. Finally, using counterfactual simulations, we find that HNWIs' excess returns on these investments accounted for 11% and 5% of the growth in the top 1% share of income and wealth, respectively, from 2010 to 2019.

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1 Introduction

The last four decades have been marked by two important stylized facts in the U.S. On the one hand, there has been a steady rise in income and wealth concentration (Saez and Zucman, 2016; Piketty et al., 2018). On the other hand, private markets have expanded, while public stock market listings have fallen (Stulz, 2020; Ewens and Farre-Mensa, 2022). The aim of this paper is to examine whether high-net-worth individuals (HNWIs) have increased their participation in private capital markets and if so, whether their growing importance in these markets could be behind these two relevant macroeconomic trends.[1]

The rise in economic inequalities and the increasing participation of HNWIs in private capital markets could be strongly linked for two main reasons. First, in general, only the wealthiest individuals are able to invest in private companies (Jensen et al., 2017; Mikhail, 2022), such that private business wealth is highly concentrated at the top of the income and wealth distribution (Kopczuk and Zwick, 2020). Second, if the returns on private assets were larger than the returns on public equity or other assets (Kartashova, 2014; Brown and Kaplan, 2019; Balloch and Richers, 2023), then, all else equal, income and wealth inequality would increase.

We focus on the U.S. for two reasons. First, U.S. companies account for about half of all the financing raised in global private capital markets. Second, after the 2008 financial crisis, the U.S. federal government introduced tax breaks that incentivized HNWIs to invest in certain types of early-stage companies. These reforms represent a quasi-exogenous shock to HNWIs' participation in private capital markets, which we exploit to study how HNWIs' early-stage investments shaped the dynamics of inequality in the U.S.[2] To then rationalize the effects on inequality, we also explore HNWIs' returns on these investments. For our analysis, we use data on private capital market activity from Pitchbook, which includes information on the financing received by private companies, the investors participating in each deal, and the changing valuation of each company across deals.

We provide three sets of results. First, we show that HNWIs participation in private capital markets has grown considerably since 2008 in the U.S. This growth is mainly driven by investments in early stage companies, rather than buyout or other private equity

[1] By "HNWIs", we refer to individuals who satisfy the U.S. Securities and Exchange Commission's (SEC) definition of accredited investors: those whose combined net worth with their spouse (excluding the value of their primary residence) exceeds $1 million, or whose combined (individual) income has exceeded $300,000 ($200,000) for at least two years. The SEC's website provides further details on the nuances of this definition: https://www.sec.gov/resources-small-businesses/capital-raising-building-blocks/accredited-investors.

[2] Throughout this paper, we use "early-stage investments" interchangeably with "investments in startup companies." By these, we refer to investments in companies that Pitchbook categorizes as being in either the pre-seed, seed, early, or late stage of their development.

investments which finance more mature companies. Total private investments in U.S. companies have grown from approximately 200 billion USD to 1,000 billion USD over the period 2004-2022. Importantly, HNWIs' participation in private capital markets has grown not only in absolute terms, but also relative to the overall size of these markets. The share of all private investments in early-stage companies by HNWIs tripled—from approximately 2% to 6%—over the 2004-2022 period, representing 4% of GDP in 2022. Even though less than the share of institutional investors, the large shares of private assets in the portfolio of wealthy relative to the low-income individuals makes this important for economic inequalities. We document that the accumulated value of HNWI's early-stage entrepreneurial investments (directly in companies or via venture capital funds) by 2022 was approximately 450 billion USD, which was more than double the dollar value of counterfactual investments in either the S&P 500, the NASDAQ Composite, or the Russell 2000 public equity indices. HNWIs have thus earned on average, premium dollar returns on early-stage investments relative to the returns that would have been realized had they invested in public stock markets.[3]

Second, we establish a link between the rise in private investments by HNWIs and the rise in income inequality over the last two decades by exploiting the expansion of the tax exemption on capital gains from the sale of qualified small business stock (QSBS). This exemption was originally introduced by the US federal government in 1993 and applies to the purchase of QSBS stocks issued by C corporations that are primarily active in qualified (mainly non-services) trades and businesses, and that never had more than $50 million in gross assets as of the date on which an individual investor purchased the stocks. Initially, if the investor held the stocks for at least five years before selling them, 50% of the first $10 million in capital gains realized from their sale were exempt from the federal long-term capital gains tax. However, in response to the dearth of bank financing available to startup companies in the US in the aftermath of the global financial crisis, the Obama administration expanded the excludable share of the first $10 million of QSBS capital gains from 50% to 75% in 2009 and to 100% in 2010. The expanded tax exemption therefore made it considerably more attractive for HNWIs to participate in venture capital markets, which involved investing small amounts of money across many startup companies.

To study how private investments by HNWIs shape the dynamics of the income distribution, we follow a two-step approach, whereby in the first stage we study the effects of HNWIs on private investments, and in the second stage we estimate the relationship between these investments and income inequality. The QSBS expansion constitutes a common shock to

[3] We estimate private returns based on the valuation history of each company in Pitchbook, given that a company's valuation is updated at the time of each of its financing rounds. The main return measure we use is the annual internal rate of return on the pooled portfolio of all investments in U.S. startups by US HNWIs after accounting for share dilution.

all US states. However, to avoid additional regulatory burdens, startups generally only raise money from accredited investors, who have home bias and invest disproportionately more in companies in the same states where they reside.[4] Hence, the reforms should increase HNWIs investments more in states where the ex-ante number of resident HNWIs is higher. This setting has two main threats for identification. On the one hand, accredited investors may choose to settle in certain states specifically in order to get access to exclusive local investment opportunities (e.g., aspiring venture capitalists moving to California). On the other hand, given that these investors have home bias, if the startups in states with more resident HNWIs are exposed to different economic shocks compared to those in states with fewer resident HNWIs, then startup investments by HNWIs residing in one state may grow faster or slower relative to those by HNWIs residing in another state, and for reasons entirely unrelated to the policy.

In the first stage, we thus compare how the QSBS reform affected the in-state investments in early-stage companies by resident HNWIs versus those by other types of investors—namely, resident institutions, non-resident HNWIs, and non-resident institutions. This comparison allows us to control for interacted state-year fixed effects. We estimate that the expansion of the QSBS tax exemption explains on average 20% of the overall growth in US HNWIs' investments in early stage companies between 2004-2008 and 2009-2022. To ensure that this result is driven by the QSBS policy, we also perform a firm-level analysis where we compare the probability of raising financing by HWNIs between QSBS-eligible and non-QSBS eligible firms before and after the 2009 reform. We find that the probability of raising financing by HNWIs was on average 2.1% higher for QSBS relative to non-QSBS eligible firms in the post-reform period. In the second stage, we use a similar state-level specification to the one we use for investments and compare how the QSBS reform affected the relative income gap between the top 1% and the bottom 99%. We find that the rise in HNWIs' investments in early-stage companies increased the relative income gap between the top 0.5% and top 99.5% by 6.0% in the post-reform period.

Third, we document the excess return on private investments by HNWIs over public markets can be associated with the rise in income concentration over the last two decades. For that, we first decompose our state-level income inequality measure into its three subcomponents (i.e., labor income, realized capital gains and other capital income) and show using a similar state-level design that the rise in the relative income gap between the top 0.5% and bottom 99.5% in the post-reform period was mainly due to a disproportionate rise in capital gains for the top 0.5% income group. To ensure that this result is driven

[4] The US Securities and Exchanges Commission's definition of an accredited investor is an individual whose net worth exceeds $1,000,000 (excluding the value of their primary residence but including the net worth of their spouse), whose own income exceeded $200,000 in each of the previous two years, or whose combined income with their spouse exceeded $300,000.

by the excess returns on investments in early-stage companies, we further show using a similar state-level design that the rise in the capital gains gap between the top 0.5% and the bottom 99.5% is strongly associated with the excess return on private investments by HNWIs over public markets. We show by means of counterfactual simulations that the capital gains from early-stage investing by HNWIs account for 11% and 5% of overall growth in the top 1% shares of taxable income and wealth in the post-reform period, respectively.Finally, we document that the rise in economic inequalities further rises private capital markets activity, suggesting the existence of a feedback loop among the two.

This paper contributes to three main strands of the literature. First, we contribute to the growing theoretical and empirical literature on the dynamics of income and wealth inequality, which—in addition to savings, bequests, interest rates, and labor income—has emphasized asset prices and returns as important determinants of those dynamics (De Nardi, 2004; Jones, 2015; De Nardi and Fella, 2017; Gomez, 2017; Kuhn et al., 2017; Feiveson and Sabelhaus, 2018; Bach et al., 2020; Fagereng et al., 2020; Cioffi, 2021; Greenwald et al., 2021; Hubmer et al., 2021; Mian et al., 2021; Xavier, 2021; Bauluz et al., 2022; Meeuwis, 2022; Andersen et al., 2023; Blanchet and Martínez-Toledano, 2023; Martínez-Toledano, 2023; Nekoei and Seim, 2023; Gomez and Gouin-Bonenfant, 2024). While confirming the importance of return heterogeneity as one such determinant, we also identify a new channel to explain it—namely, the differences across the income and wealth distributions in individuals' access to and participation in private capital markets.

In this way, we further contribute to the separate literature that focuses on measuring the returns to different asset classes and providing explanations for the heterogeneity in those returns across investors. A number of theoretical papers have suggested that such heterogeneity can be driven by differences in entrepreneurial ability (Lucas, 1978), information (Peress, 2004), or sophistication (Kacperczyk et al., 2019). Several recent empirical studies have instead explored the return heterogeneity within a particular asset class, including household wealth (Bach et al., 2020; Fagereng et al., 2020; Xavier, 2021; Balloch and Richers, 2023), bank deposits (Deuflhard et al., 2019), and stocks (Calvet and Fisher, 2007; Campbell et al., 2019). Our paper is most closely related to those that have studied the differences in the returns to public vs. private equity (Moskowitz and Vissing-Jørgensen, 2002; Kartashova, 2014; Brown and Kaplan, 2019; Brown et al., 2021; Balloch and Richers, 2023), most of which have focused on documenting either the under- or outperformance of buyout funds. Our findings that early-stage companies have outperformed public stock markets in the U.S. over the last two decades are in contrast to those of Moskowitz and Vissing-Jørgensen (2002) for the 1990s, but they are consistent with those of Kartashova (2014) and Balloch and Richers (2023) for more recent periods.

Finally, we contribute to the literature on investors in private capital markets. Most of the

studies have focused on institutional investors like pension funds and endowments (Mittal, 2024; Maurin et al., 2022; Robinson and Sensoy, 2013; Lerner et al., 2007; Sørensen, 2007; Lerner and Schoar, 2004). Recently, the literature on angel investors' participation in private capital markets has been growing (Karlsen et al., 2023, Bach et al., 2022, Lindsey and Stein, 2020). We focus on HNWIs' participation in these markets, especially on their investments in early-stage companies. Though other papers have also studied the effects of tax breaks that incentivize investments in early-stage companies (Chen and Farre-Mensa, 2024; Denes et al., 2023; Edwards and Todtenhaupt, 2020), to be best of our knowledge, we are the first to do so with an emphasis on the implications for income and wealth inequality.

The rest of this paper is organized as follows. Section 2 first describes the data that we use, while Section 3 documents key stylized facts. Section 4 then analyzes the effects of the QSBS reforms on HNWIs' early-stage investments, after which Section 5 discusses the implications of these investments for inequality. Section 6 concludes.

2 Data

2.1 Private Capital Market Activity

Pitchbook. The main data source we use for private capital markets activity is Pitchbook. Pitchbook is a commercial data provider that collects data on private financing deals, the investors and funds investing in them, and companies invested in. For the U.S., it contains information on approximately 833,860 financing deals, and 375,339 companies over the period 2004-2022. Pitchbook collects data from various sources, including press releases and regulatory filings by companies, Freedom of Information Act requests to public pension funds, and correspondence with the general and limited partners of private investment funds (Cumming and Monteiro, 2023).[5]

First, we use Pitchbook to identify the type of investors participating in each financing deal, and to measure the private investments made by each investor in a private company. We classify investors into HNWIs (i.e., individuals, angel groups, and family offices), and institutional investors (i.e., pension funds, endowment plans, and other types of institutional investors). We also classify private capital deals into venture capital (equity investments in startup companies), private equity (equity investments in mature companies), private debt (debt investments by non-bank entities in the form of non-bond loans),

[5] Further details on Pitchbook's data collection process are available on its website: https://pitchbook.com/research-process.

and real assets (equity investments in real estate, infrastructure, or natural resources).[6] These four categories include both direct investments in companies and intermediated investments by private investment funds. For intermediated investments, we attribute the investment by the fund to its limited partners, based on the amount committed by the limited partner. Sections B.1.1-B.1.6 of Appendix B contain a detailed description of our data cleaning procedure.[7]

Second, we rely on Pitchbook to calculate the returns on these investments.[8] We use the information on the valuation history of each company, to calculate returns at the deal level. We do so by comparing—between any consecutive pair of rounds—the company's pre-money valuation from the later round (i.e., its valuation before accounting for the new financing that it received as part of this round) to its post-money valuation from the earlier round (i.e., its valuation after accounting for the new financing that it received as part of that round). This comparison between the company's previous post-money valuation to its current pre-money valuation ensures that we account for shareholder dilution, differentiating the growth in the value of the investments by the earlier round's investors from the value of the new investments by the later round's investors. Based on this approach, we can obtain the evolution of the rate of return of each company's equity, and thereby the absolute return on each private investment by each investor in every year. There are some instances where the valuation of a company is missing for a particular financing deal. We discuss the methodology we develop to impute these missing valuations, and other aspects of our procedure to calculate the annual return on each investment in greater detail in Appendix Sections B.1.7 and B.1.8.

Finally, we match our investor-investment level dataset to the companies receiving the financing for our firm-level analyses. In particular, we rely on the type of industry, the assets, and the type of company (C-corporation, partnership, S-corporation, etc.) to distinguish between QSBS qualified and non-QSBS qualified companies. We also use some additional information such as employment, time to IPO, and bankruptcy status to study the additional firm-level outcomes associated with the growing participation of HNWIs in early stage financing.

[6] We follow the categorizations used in the industry: https://www.preqin.com/academy/lesson-2-private-capital/what-is-private-capital.

[7] We have chosen to use data from Pitchbook over data from other competing data providers (e.g., Preqin or Burgiss) because Pitchbook has more extensive data coverage, especially of early-stage investments by HNWIs: https://pitchbook.com/compare/pitchbook-vs-preqin.

[8] Although standard return methodologies are implemented at the fund level, we rely on deals rather than funds given that the vast majority of HNWIs investments are not intermediated through funds, but made directly into the companies.

2.2 High-Net Worth Individuals and Inequality

GEOWEALTH-US. To conduct the state-level regression analyses, we require a measure of the total number of HNWIs residing in each state of the U.S. We rely on the Geographic Wealth Inequality Database (GEOWEALTH-US) built by Suss et al. (2024). This database provides estimates of the number of HNWIs residing in each state every year from 2005 to 2022. To obtain these estimates, the authors first estimate the relationship between wealth and other observable characteristics on the sample of individuals who appear in the Survey of Consumer Finances (SCF). Next, they predict the wealth of individuals sampled in U.S. population surveys, in which those same characteristics, other than wealth, are also observable.

Based on observable income and estimated wealth, Suss et al. (2024) define HNWIs to resemble the U.S. Securities and Exchanges Commission's (SEC) definition of accredited investors. Suss et al. (2024) estimate wealth for individuals who appear in cross-sectional rather than longitudinal population surveys, so they only consider whether an individual's household income exceeds $300,000, or whether his own individuals income exceeds $200,000 in the current year. In the view of the SEC, only accredited investors are sophisticated enough to invest in private, unregistered securities. Private investment funds and companies that raise financing from non-accredited investors are therefore required to register their securities with the SEC.[9]

In Appendix B.2, we validate the number of accredited investors residing in each state as measured in GEOWEALTH-US with alternative estimates from Phoenix Marketing International/MarketCast Wealth and Affluent Monitor, Forbes 400, Credit Suisse, and the SCF. Our baseline measure based on GEOWEALTH-US appears to be consistent with alternative sources, both across states and over time.

IRS Statistics of Income (SOI). To conduct the state-level inequality analyses, we build state-level income inequality series based on the personal income tax statistics from the Statistics of Income (SOI) database provided by the U.S. IRS. Specifically, we use the historical data tables that provide information on a range of personal income tax form items, which are aggregated by state and adjusted gross income (AGI) bracket for each year from 2004 to 2022. AGI refers to income from all sources, including labor income, investment income, business profits, and retirement income, adjusted for tax deductions.

[9] Private funds and private companies can raise financing from up to 35 non-accredited investors before triggering SEC registration: https://www.sec.gov/resources-small-businesses/exempt-offerings/private-placements-rule-506b. In practice, however, this number is so low—and the amount that can be raised from them so limited—that non-accredited investors have generally been excluded from private capital markets; the only exception has been when private companies raise financing via crowdfunding (Jensen et al., 2017).

We apply the method of generalized Pareto interpolation (GPI) developed by Blanchet et al. (2022). GPI is a non-parametric approach that avoids making the assumptions of a Pareto approximation, which are often violated by empirical data. For every state in each year, we construct the state-level income distribution across individuals using data on IRS tax filing units, assuming that the reported household income of couples filing jointly is shared equally between spouses. Our series are consistent with those of Sommeiller and Price (2018), who build state-level income inequality series for the U.S. using personal income tax tabulations from 1917 until 2015.

Using the information available on the composition of income for each tax bracket, we further decompose the aggregate income in that bracket into capital gains, capital income (i.e., dividends, interest income, and other income from investments), and labor income. We also aggregate our state-level income inequality series at the national level to implement the counterfactual simulations of U.S. income inequality in Section 5.2.

Survey of Consumer Finances (SCF). We also build a wealth distribution series to implement the counterfactual simulations of U.S. wealth inequality in Section 5.2. We rely on the SCF which provides a representative picture of the structure of incomes, assets, and debts of U.S. households. It oversamples individuals at the top of the wealth distribution, enabling a more accurate measurement of the wealth of the wealthiest individuals. The survey has been running since 1989 until 2022, and it is updated every three years. We build the wealth distribution series for every wave of the survey using a measure of net wealth, that is, the sum of private business wealth, real estate, public equity, interest-earning assets, and other financial and non-financial assets, minus all liabilities. To complement the return calculations using Pitchbook, we also rely on the SCF to compute the returns on both public and private equity using the methodology used by Moskowitz and Vissing-Jørgensen (2002) and Kartashova (2014).

3 Descriptive Evidence

This section presents descriptive evidence on the evolution of private capital markets activity in the U.S., in particular, on the growing importance of HNWIs in these markets. It also provides evidence on the returns obtained by HNWIs on these investments, benchmarking them with those obtained in public capital markets.

3.1 HNWIs' Increasing Participation in Private Capital Markets

We start by describing the evolution of private capital markets in the U.S. Figure 1, Panel A shows that the total amount of financing raised annually by U.S. private companies grew from about $190 billion in 2004 to about $670 billion in 2007. This growth was mainly driven by private equity, private debt and real assets financing, rather than by early-stage financing.[10] With the onset of the 2008 global financial crisis, private financing collapsed to below its initial level, but it quickly recovered starting in 2010, alongside the broader economic recovery from the crisis. The post-crisis period was marked by faster growth of early-stage financing, relative to private equity, private debt and real assets financing. By the second half of the 2010s, U.S. startups were raising $100-170 billion annually, compared to $20-45 billion during the 2000s. This trend accelerated during the COVID pandemic, with the total amount of financing raised by early-stage companies peaking in 2021, before the tightening of U.S. monetary policy in 2022 and the decline in the demand for risky assets.[11]

The rise in early-stage financing has been partly driven by the increasing participation of HNWIs in these markets. Figure 1, Panel B shows that the total amount invested annually in U.S. startups by U.S.-based HNWIs was very stable between 2004 and 2008, but it grew from about $1 billion to over $20 billion between 2008 and 2021. In line with the patterns shown for the entire market in Figure 1, Panel A, the total amount invested by HNWIs decreased to approximately $10 billion in 2022. HNWIs have, however, barely increased the total amount invested in private equity, private debt or real assets over the period, so that early-stage investments became the most important private asset class in HNWIs portfolios. The increase in HNWIs' participation in early-stage financing was primarily driven by the entry of first-time investors (see Appendix Figure A3, Panel A). Despite the entry of new investors and the sharp increase in the total amount invested by HNWIs in early-stage companies, the sector composition of these investments remained remarkably stable (see Appendix Figure A4).

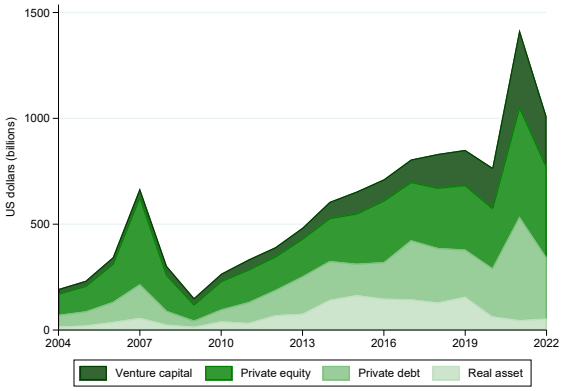
The growth in HNWIs' early-stage investments has outpaced the growth of overall early-stage financing. Figure 1, Panel 3 shows that, while in 2004, U.S.-based HNWIs accounted for 2.0% of the total financing raised annually by early-stage U.S. companies, this share spiked to 8% by the mid-2010s, eventually settling above 6% by the early 2020s. HNWIs

[10] U.S. companies account for about half of the private firm financing globally (see Figure A1, Panel B in Appendix A).

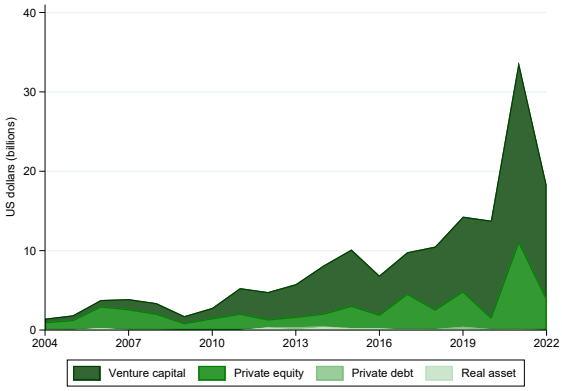
[11] U.S. private capital markets have grown not only in absolute terms but also relative to the overall size of the U.S. economy. Appendix Figure A2 shows that private capital market investments in U.S. companies as a share of U.S. gross domestic product have increased from about 1.5% in 2004 to 4% in 2022.

Figure 1: Private Capital Market Investments in U.S. Companies

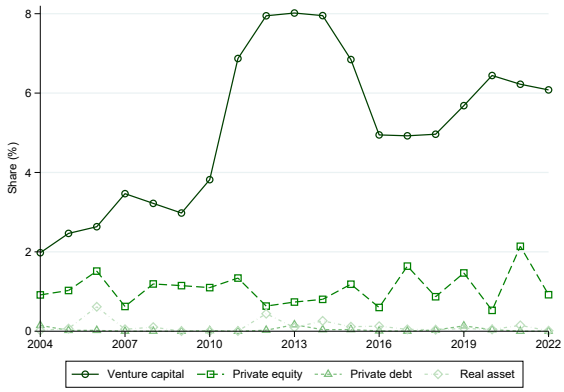
(A) Investments by all investors



(B) Investments by U.S. HNWIs



(C) US HNWIs' Share of Investments



Source: Pitchbook.
Notes: The values in Panels A and B are expressed in nominal terms. High-net-worth individuals (HNWIs) refer to investors categorized by Pitchbook as individuals, angel groups, and family offices. To aid visualization, Panel B excludes 7 private equity investments by HNWIs because the individual amounts invested as part of them are outliers (i.e., in excess of $2 billion).

have thus emerged as a new and important source of financing for U.S. startups. Even though HNWIs provide a relatively small share of early-stage financing compared to institutional investors, private assets are very unequally distributed across households and account for a large share of the portfolio of the wealthy (see Appendix Figure A5). Hence, a drastic increase in the importance of private assets among the wealthy could significantly contribute to the rise in economic inequalities in the U.S. In Section 4, we explore more formally the link between the increasing participation of HNWIs in early-stage financing and the rise in economic inequalities over the 2004-2022 period in the U.S.[12]

3.2 HNWIs' Excess Returns from Early-Stage Investing

We now present descriptive evidence on HNWIs' returns on their early-stage investments and their counterfactual returns had they invested in public capital markets, following the methodology described in Section 2 and Appendix Section B.1.8. Figure 2, Panel A plots the total accumulated value of U.S.-based HNWIs' investments in early-stage U.S. companies from 2004 to 2022—that is, the accumulated value of their initial investments (as plotted in Figure 1, Panel B), plus their accumulated returns on these investments—, as well as the total value of these investments had HNWIs instead invested in either the NASDAQ 100, the S&P 500, or the Russell 2000. The accumulated value of early-stage investments by 2022 was more than double that of the counterfactual investments in any of the public indices. HNWIs thus earned excess returns on their early-state investments relative to the returns that were available to them in public stock markets.

To explain the divergence between the accumulated values of HNWIs' early-stage and counterfactual investments, Figure 2, Panel B plots average rates of return in every year for both HNWIs' early-stage and counterfactual investments.[13] In 13 of the 19 years from 2004 to 2022, HNWIs' average rate of return on their early-stage investments exceeded the rate that they would have earned on counterfactual investments in any public index. In particular, in every year from 2010 to 2015, during which HNWIs drastically increased their investments in early-stage companies (see Figure 1, Panel B), the average rate of return on early-stage investments always either exceeded or matched the counterfactual return in the highest-yielding public index.[14]

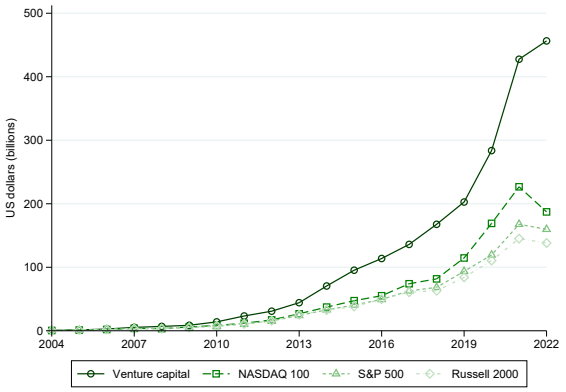
[12] Throughout the rest of the paper we will focus on early-stage financing, as this is the private asset class that has mainly driven the increasing participation of HNWIs in private capital markets.

[13] Following Phalippou (2024), we calculate the internal rate of return (IRR) on the pooled investments at each 1-year horizon, comparing each investment's start-of-year net asset value (NAV) to its end-of-year NAV. This calculation accounts for the fact that HNWIs enter and exit investments at different points during a year, whereas a mere weighted average of investment-specific rates of return would not.

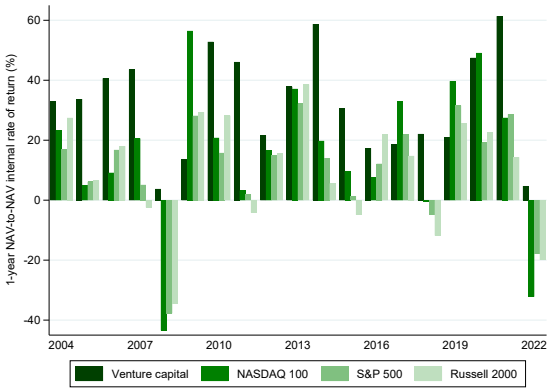
[14] In Section B.1.8, we show that this excess average rate of return on early-stage investments is robust to the exclusion of imputed valuations (see Section B.1.7), as well as to a more pessimistic scenario where

Figure 2: Returns on Venture Capital Investments in U.S. Companies by U.S. HNWIs

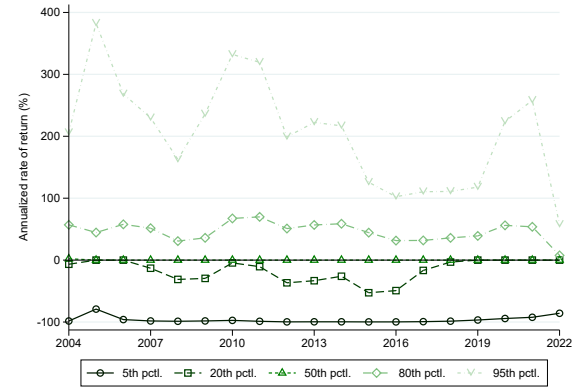
(A) Accumulated Value of Investments



(B) 1-Year NAV-to-NAV IRR



(C) Distribution of Annualized Rates of Return



Source: Pitchbook, S&P Capital IQ.
Notes: The values in Panel A are expressed in nominal terms. The rates in Panel B are based on both observed and imputed valuations, while those in Panel C are based on only observed valuations. The 1-year NAV-to-NAV IRRs in Panel B are calculated following Phalippou (2024). High-net-worth individuals (HNWIs) refer to investors categorized by Pitchbook as individuals, angel groups, and family offices.

The excess average returns on HWNIs' investments in early-stage companies mask substantial heterogeneities across HNWIs' investments. Figure 2, Panel B plots the 5th, 20th, 50th, 80th, and 95th percentiles of the distribution of the annualized rates of return across investments in every year.[15] Whereas the investment at the 5th percentile consistently lost almost all of its value, and the median investment earned zero return, the investment at the 95th percentile more than doubled—if not tripled or even quadrupled—in value.[16] The distribution of early-stage returns was therefore highly right-skewed: though half of these investments did not generate positive returns, the minority of those that did so resulted in outsized capital gains. In the remainder of the paper, we explore more formally whether these excess returns could be behind the recent rise of economic inequalities in the U.S. and quantify its importance.

4 HNWIs Investing in Qualified Small Business Stock

This section quantifies the increasing importance of HNWIs in early-stage financing by exploiting U.S. federal capital gains tax cuts in the aftermath of the 2008 global financial crisis, which incentivized HNWIs to invest in early-stage companies. This is the first-step of the empirical analysis we need to implement before turning to our ultimate goal in Section 5: examining the link between the increasing participation of HNWIs in private capital markets and the rise in economic inequalities. We start the section by providing institutional details about the capital gains tax reforms and then carry both a state-level and a firm-level analysis to quantify the growing importance of HNWIs in private capital markets.

4.1 QSBS Capital Gains Tax Exemption

The qualified small business stock (QSBS) capital gains tax exemption was first introduced by the U.S. federal government in 1993 and it is set forth in Section 1202 of the U.S. Internal Revenue Code. This is a personal income tax exemption on the realized capital

we impute bankruptcies for financially inactive companies.

[15] If we observe an investor eventually exiting an investment (see Section B.1.8), then we assume that neither it nor its corresponding counterfactual investment earns any further returns. Since an investor can exit or enter an investment during the middle of a year, we annualize the rate of return on each investment before taking its distribution. Otherwise, shorter-lived investments that yielded positive returns would incorrectly be ranked lower in the distribution.

[16] Our finding that the median early-stage investment by HNWIs earned zero returns is consistent with existing evidence on the distribution of early-stage returns in general (Karlsen et al., 2023; Stanley and Øvrum, 2023). Reassuringly, Appendix Figure A8 shows that, if we also consider imputed valuations (rather than only observed valuations), then a similar pattern of heterogeneity holds.

gains from the sale of qualified small business stocks. The investor needs to hold the stock for at least five years and the amount of gain eligible for the tax exclusion is limited to $10 million or 10 times the acquisition value of the stock. For companies to be categorized as qualified small businesses, they need to meet the following three requirements: (1) they must be an active business that is incorporated as a U.S. C-corporation[17]; (2) they must have had gross assets of $50 million or less at all times before and immediately after the equity was issued; and (3) at least 80% of a company's assets must be actively used in a qualified trade or business.[18] Companies satisfying these requirements tend to be startups in high-growth sectors (e.g., information technology) that are attractive to early-stage investors. The exemption was thus explicitly designed to incentivize investments in such startups (Polsky and Yale, 2023).[19]

The QSBS capital gains tax exemption has been in place since 1993 until the present, but it is only in the aftermath of the global financial crisis that it became quite attractive from the tax savings standpoint.[20] Figure 3, Panel A shows that, from 2004 to 2008, 50% of the first $10 million in capital gains realized from their sale were *expected* to be exempt from the federal long-term capital gains tax, while the remaining 50% of gains were expected to be taxable at a fixed 28% rate (i.e., the federal long-term capital gains tax rate at the time of the exemption's original introduction in 1993).[21] Nevertheless, since the federal tax rate on capital gains from other long-term investments was itself 15%, the expected federal tax wedge on QSBS capital gains—measured as the difference between the federal long-term capital gains tax rate and the tax rate on QSBS capital

[17] A C-corporation is a legal business structure that separates the business from its owners.

[18] Excluded business types are determined by the IRS and include companies that: (1) perform services related to health, law, engineering, architecture, accounting, actuarial science, performing arts, consulting, athletics, finance, banking, insurance, leasing, investing, or brokerage; (2) rely on an employee or owner's reputation (i.e. if it endorses products or services, uses an individual's image, or has an employee make appearances at events or on media outlets.); (3) produce products, such as fossil fuels, for which percentage depletion (a type of tax deduction) can be claimed; (4) operate a hotel, motel, restaurant, or similar business; or (5) are a farming business.

[19] The QSBS exclusion also varies across states due to differences in state income tax rates or in their decisions whether to apply the federal tax rules about the exemption on QSBS capital gains to their own state tax rules. States either fully conform with federal tax law and apply the same exclusion rate, partially conform and apply a different exclusion rate to the federal rate, or do not conform at all and fully tax QSBS gains at the state level. For example, California does not apply the federal exemption to their own state tax rules.

[20] Figure A9 plots the complete history of the federal tax wedge on QSBS investments, going all the way back to its first introduction in 1993. It shows that successive cuts to the federal long-term capital gains tax rate in 1997 and 2003 eroded any incentives to favor QSBS investments over other investments.

[21] We refer to tax rates as expected rates, as since there is at least a five year gap between the investment date and the selling date to benefit from the exemption, individuals do not have full certainty about the future evolution of the long-term federal capital gains tax rate at the time of the investment. Hence, the tax wedge can either shrink or expand after the investment decision has been made. Since the exemption rate is determined at the time of the investment, there is no uncertainty surrounding

gains—was negligible, as shown in Panel B. Investors therefore had little to no incentive to favor QSBS investments over other investments.[22]

With the onset of the 2008 global financial crisis and the associated credit contraction, the federal U.S. government decided to expand the QSBS exemption in order to help small private businesses raise capital. In particular, the government temporarily expanded in 2009 the exempted share of QSBS capital gains from 50% to 75% until the end of 2010, as part of the American Recovery and Reinvestment Act (ARRA). In 2010, the QSBS exemption rate was temporarily raised from 75% to 100% as of September 27th 2010 until the end of 2011, as part of the Small Business Jobs Act (SBJA)—meaning that, for each investment in each startup, an investor could earn up to $10 million in entirely tax-free capital gains—. The temporary increases repeatedly expired and were retroactively extended until the 100% exemption was made permanent in 2015, as part of the Protecting Americans from Tax Hikes Act (PATH). The 100% exemption rate has thus been in place since 2010 until the present. Given that the long-term federal capital gains tax rate ranged between 15 and 24% over 2008-2022, the QSBS tax exemption made it considerably more attractive for HNWIs to invest in early-stage companies rather on other alternative assets such as public stocks over this period of time.[23]

4.2 Effect on HNWIs' Early-Stage Investments

4.2.1 State-Level Analysis

To assess the increasing importance of HNWIs in early-stage financing as a result of the QSBS reforms, we first carry a state-level analysis. The QSBS expansion constitutes a common shock to all US states. However, to avoid additional regulatory burdens, startups generally only raise money from accredited investors. Hence, the reforms should increase HNWIs investments more in states where the ex-ante number of resident HNWIs is higher.[24]

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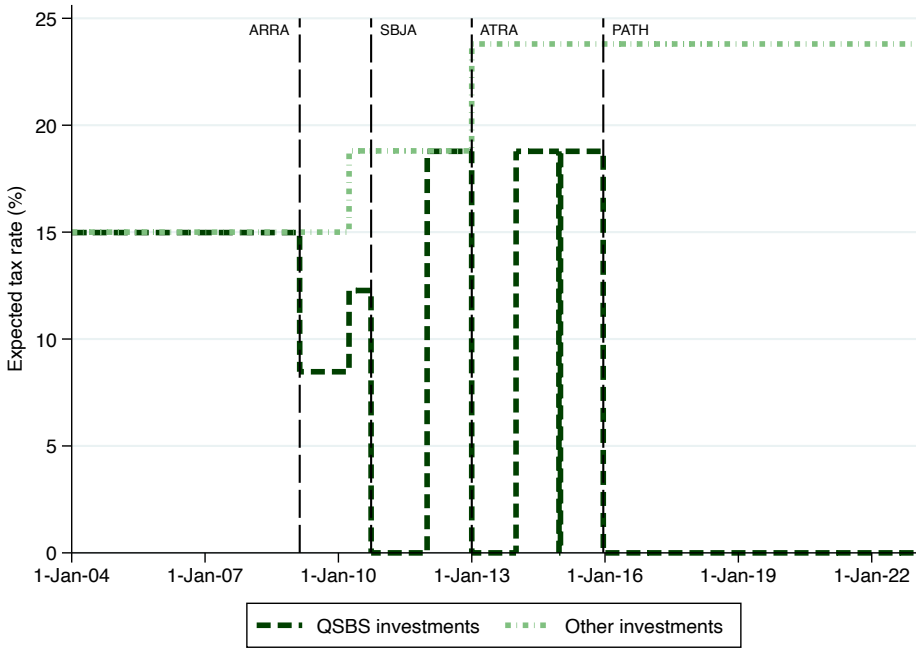
[22] More specifically, 7% of the exempted 50% of the QSBS capital gains were still taxable at a 28% rate as an alternative minimum tax item (Polsky and Yale, 2023). The expected tax rate on QSBS investments was therefore $0.5 \times 28\% + 0.5 \times 0.07 \times 28\% = 14.98\%$, almost identical to the 15% tax rate on other investments.

[23] The full exemption was almost repealed at the end of 2021, but the legislation repealing it never passed the U.S. Senate (Polsky and Yale, 2023). The attempt to repeal it was largely motivated by criticisms that it was effectively a tax cut for wealthy Americans (Viswanathan, 2020).

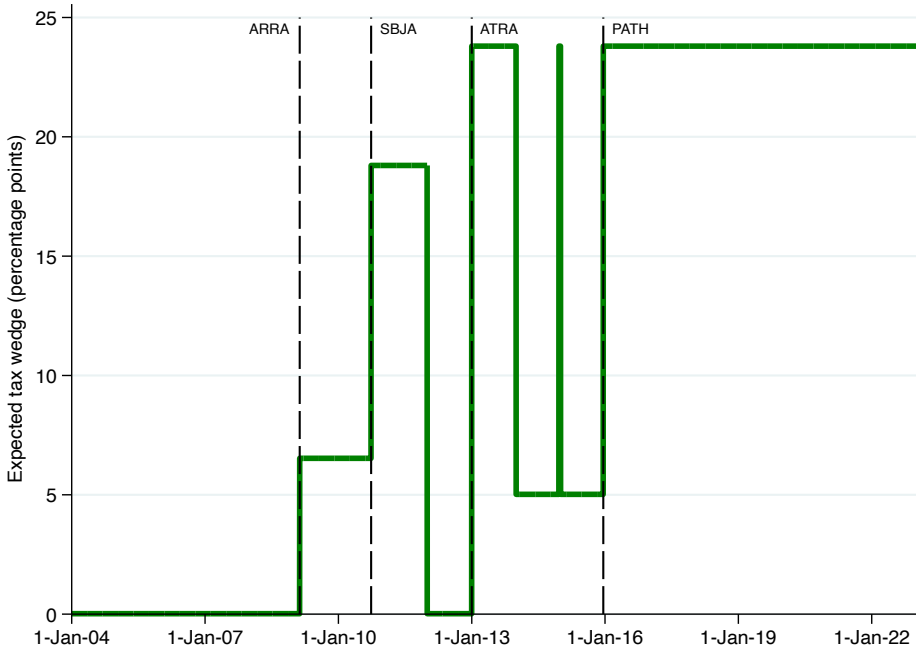
[24] Since only those individuals who are wealthy or high-earning enough to be accredited investors are generally able to invest in private companies (see Section 2.2), the number of resident accredited investors serves as a proxy for the number of resident HNWIS who could potentially invest in early-stage companies, while the amount invested by resident HNWIs measures their actual participation.

Figure 3: Recent History of the Federal Tax Exemption on QSBS Capital Gains

(A) Expected Tax Rates on QSBS vs. Other Investments



(B) Expected Tax Wedge on QSBS Investments



Source: Polsky and Yale (2023).
Notes: Panel B plots the difference between the two lines in Panel A. The highlighted legislation are the American Recovery and Reinvestment Act (ARRA), the Small Business Jobs Act (SBJA), the American Tax Payer Relief Act (ATRA), and the Protecting Americans from Tax Hikes Act (PATH).

Figure 4, Panel A visualizes the latter intuition that we formalize later in our regression analyses. For both the pre-policy (2004-2008) and post-policy (2009-2022) periods, it plots the relationship between the average annual log millions of dollars invested by resident HNWIs in U.S. in-state and out-of-state startups (on the vertical axis) and the log number of resident accredited investors in 2008 (on the horizontal axis), with each pair of points representing a different U.S. state (including the District of Columbia).[25] We find a relatively large and statistically significant increase in the slope of this relationship after the QSBS reforms, suggesting that HNWIs' participation in early-stage financing increased more in states where there were ex-ante more accredited investors who could enter these markets.

There are two main confounding factors other than the reforms which could explain the change in slope. On the one hand, accredited investors may choose to settle in certain states in order to get access to exclusive local investment opportunities (e.g., aspiring venture capitalists moving to California). This would especially be the case if HNWIs had home bias and thus had the tendency to invest locally. Figure 4, Panel B shows that indeed HNWIs' investments were biased towards startups headquartered in the states they resided in. From 2004 to 2022, the in-state investment share of HNWIs residing in that state exceeded in every state the share of companies headquartered within that state receiving early-stage investments by all U.S.investors.[26] On the other hand, given that these investors have home bias, if startups in states with more resident HNWIs are exposed to different economic shocks compared to those in states with fewer resident HNWIs, then startup investments by HNWIs residing in one state may grow faster or slower relative to those by HNWIs residing in another state, and for reasons entirely unrelated to the reforms.

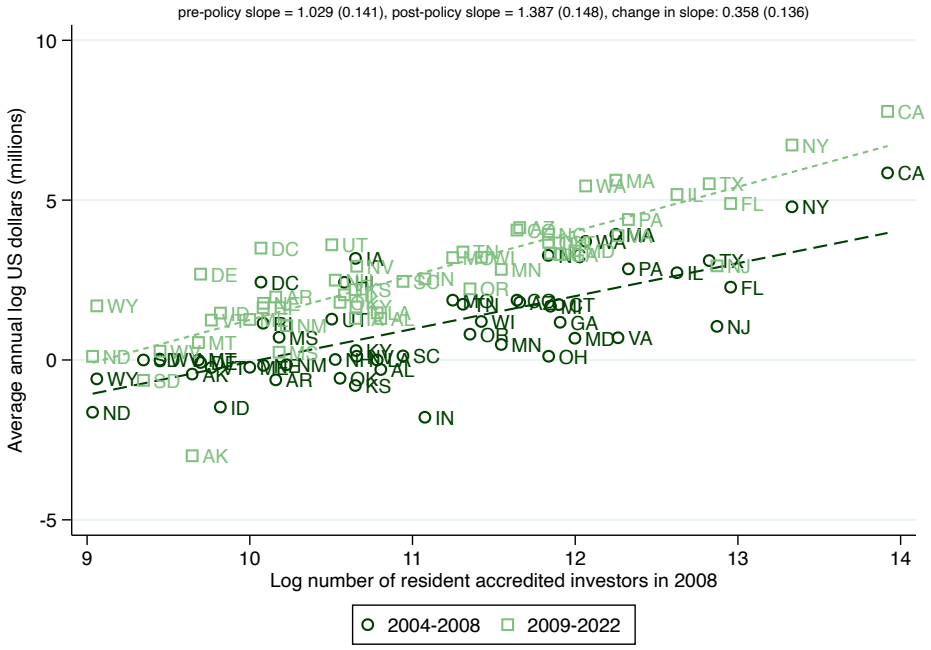
To overcome these threats for identification, we thus compare how the QSBS reform affected the in-state investments in early-stage companies by resident HNWIs versus those by other types of investors—namely, resident institutions, non-resident HNWIs, and non-resident institutions—. This comparison makes it possible to control for interacted state-year fixed effects. Figure 5 Panel A shows that HNWIs' investments in companies headquartered within their own states of residence grew since 2008 more than those of other investors in those same states. Moreover, the amounts invested by resident HNWIs and other investors increasingly diverged as newly enacted legislation ensured the

[25] This figure is depicted by dropping those state-year observations for which the amount is zero. We address the question of how to handle the case of zero investments in our later regression analyses.

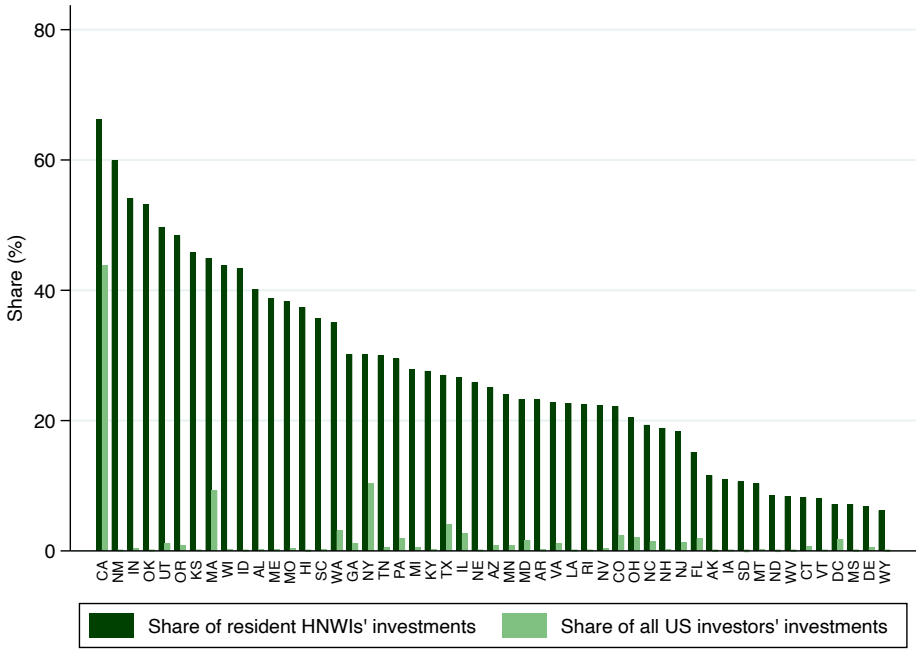
[26] Figure A10 shows that the same investment bias prevails if we focus on only the pre-policy period from 2004 to 2008. Figure A11 further shows that, other than companies headquartered in their own state, HNWIs residing in all states also tend to invest only in companies headquartered in California (where Silicon Valley is located) and, to a lesser extent, Massachusetts.

Figure 4: Motivating How to Evaluate the Effect of the Policy on Venture Capital Investments by HNWIs

(A) Venture Capital Investments by Resident HNWIs vs. Number of Resident Accredited Investors



(B) In-State Bias of Venture Capital Investments by Resident HNWIs: 2004-2022



Source: Pitchbook, GEOWEALTH-US.
Notes: Panel B compares the share of investments by each state's resident HNWIs invested in companies headquartered within that state to the share of investments by all U.S. investors invested in companies headquartered within that same state.

permanence of the 100% QSBS exemption.

To formalize this finding, we estimate the following regression:

$$\ln Y_{i,s,t} = \alpha_{i,s} + \beta_t(\ln X_{s,2008} \times \mathbb{1}_{i=\text{resident HNWIs}}) + \gamma_{i,t} + \delta_{s,t} + \zeta_{i,t} W_{s,t} + \epsilon_{i,s,t}, \quad (1)$$

where $Y_{i,s,t}$ are the log millions of dollars invested by investors of type i in startups headquartered in state s in year t, $X_{s,t}$ stands for the log number of accredited investors residing in s in 2008, and $\mathbb{1}_{i=\text{resident HNWIs}}$ is a dummy variable equal 1 for resident investors and 0 for resident institutions, non-resident HNWIs, and non-resident institutions. We also include investor type-state fixed effects $\alpha_{i,s}$, investor type-year fixed effects $\gamma_{i,t}$, state-year fixed effects $\delta_{s,t}$, and a vector of observable control variables $W_{s,t}$ whose effects $\zeta_{i,t}$ we allow to vary over time and by investor type.[27] We can thus interpret the parameter of interest β_t as the change in the elasticity of resident HNWIs' in-state early-stage investments before and after the reforms relative to the number of resident accredited investors in 2008. In contrast to Figure 4, Panel A, β_t in this case identifies a relative change in slope, netting out the average change in slope across the other types of investors.β_t therefore identifies more cleanly the effect of the QSBS reforms on resident HNWIs' participation in in-state early-stage financing in a way that accounts for potentially confounding shocks to local investment opportunities.

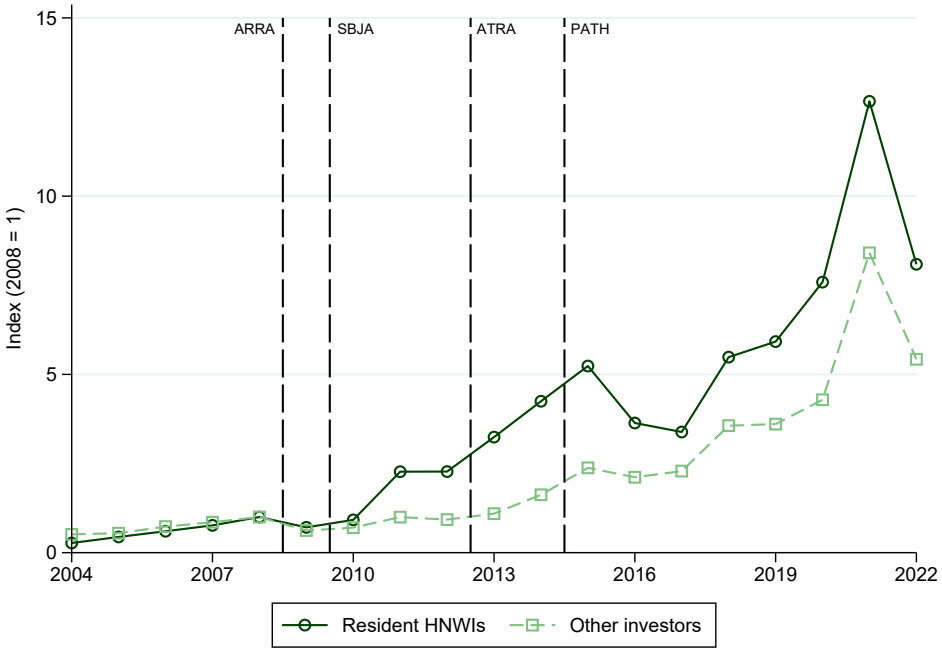
Figure 5, Panel B plots our baseline annual estimates of β_t from Equation (1) for 2004-2022, replacing $\ln Y_{i,s,t}$ with $\ln(1 + Y_{i,s,t})$ as the outcome variable to ensure a balanced panel. The estimated coefficients for the pre-reforms period are never statistically significant and exhibit no pre-trends. We find an immediate increase in resident HNWIs' in-state venture capital investments with the initial temporary expansions of the QSBS tax exemption in 2009-2010. We find even further increases during 2013-2014, when the 100% exemption was repeatedly—but still only temporarily—renewed. Finally, when the full exemption was made permanent in 2015, our estimated effect reaches its peak, remaining around this elevated level until 2022. The dynamic effects that we estimate are therefore consistent with the actual timing of the policy's introduction.[28]

[27] The only control variable that we include for the moment in this vector is the state long-term capital gains tax wedge on QSBS investments for individuals residing in state s. The purpose of this control variable is therefore to account for likely differences between resident HNWIs and other investors in the responsiveness of their investment activity to any state-specific policy changes related to QSBS.

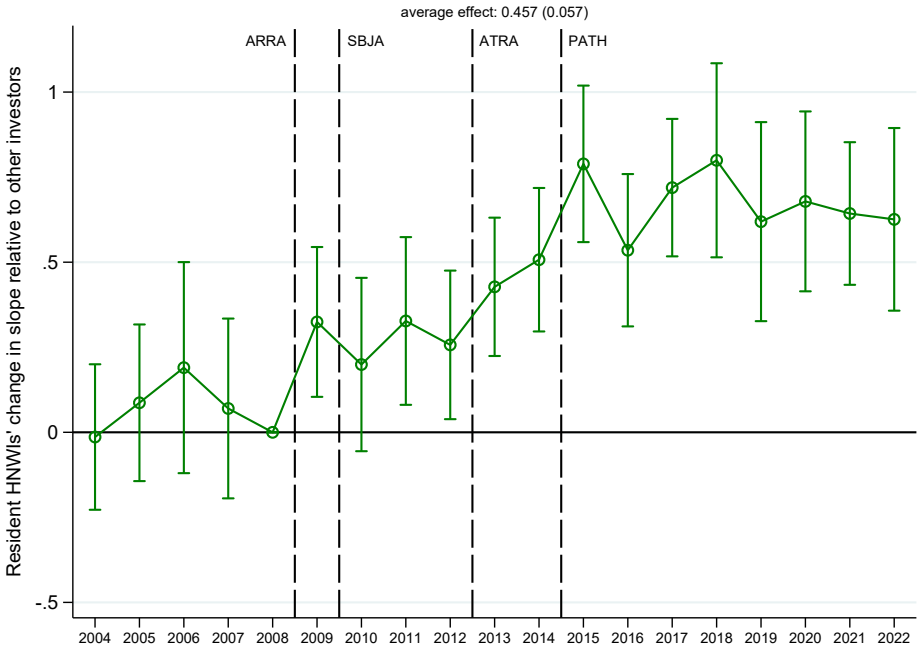
[28] Our baseline estimates are robust to the use of different specifications. First, we find similar results shows when estimating Equation (1) on unbalanced panels with $\ln Y_{i,s,t}$ as the outcome (i.e., dropping observations for which $Y_{i,s,t} = 0$) or with $Y_{i,s,t}$, but using a Poisson pseudo-maximum likelihood (PPML) estimator as in Chen and Roth, 2024 (see Appendix Figure A12). The average effect estimated used the PPML estimator is only 0.264 if we compare the post-reforms period to the whole pre-reforms period. However, this average effect becomes 0.396—close to our baseline estimate of 0.457—if we compare the post-reform period only to 2008. Second, Appendix Figure A13 further shows that the inclusion of the

Figure 5: Effect of the Introduction of the Policy on Resident HNWIs' In-State Venture Capital Investments

(A) In-State Investments by Resident HNWIs vs. Other Investors



(B) Estimates of Equation (1)



Source: Pitchbook, GEOWEALTH-US.
Notes: The regression is based on 3,876 state-year observations. The average effect reported in Panel B is based on a modified version of Equation (1) where β_t is replaced with $\beta_{t:t>2008}$.

Finally, we quantify the importance of the QSBS reforms for the overall rise early-stage investments. For that, we start by replacing the dynamic coefficient β_t from Equation (1) with the static coefficient $\beta_{t:t>2008}$ and obtain an average effect of 0.457. With approximately 6.4 million accredited investors residing in the U.S. in 2008, this estimate implies that the QSBS reforms explain $(6.4 \times 10^6)^{0.457} \approx \$1{,}300$ million $= \$1.3$ billion of the increase in annual early-stage investments by HNWIs between the average pre-reform year and the average post-reform year. Since the overall increase was \$6.4 billion (from \$0.9 billion to \$7.3 billion per yer on average), the QSBS reforms account for $1.3/6.4 \approx 20\%$ of the increase in HNWIs' participation in early-stage financing after 2008.

4.2.2 Firm-Level Analysis

We next study the extent to which the expanded tax exemption on QSBS capital gains increased HNWIs' investments in QSBS-eligible firms. For that, we restrict our analyses from the universe of deals in Pitchbook to the sample of U.S. firms which have non-missing deal dates and completed deals. We require the firms to exist, and not to be bankrupt, public, or acquired prior to 2009 (i.e., the pre-reforms period). We define the group of treated and control firms, respectively, as those who were QSBS-eligible versus those who were not. In particular, the treated firms are those which satisfy the four necessary conditions to qualify for the QSBS capital gains tax exemption: (1) they are based in the U.S.; (2) they are classified as C-corporations; (3) they operate in a QSBS-eligible industry; and (4) they have raised no more than \$50 million as of or before 2008.[29] The control firms are U.S. companies that exist in the pre-reforms period, but that do not satisfy all three of the other conditions. The regression below summarizes the estimation:

$$Y_{i,t} = \beta_t(\text{Treated}_i \times \text{Post}_t) + \alpha_i + \alpha_t + \gamma_{\text{corp},t} + \gamma_{\text{ind},t} + \gamma_{\text{size},t} + u_{it}, \tag{2}$$

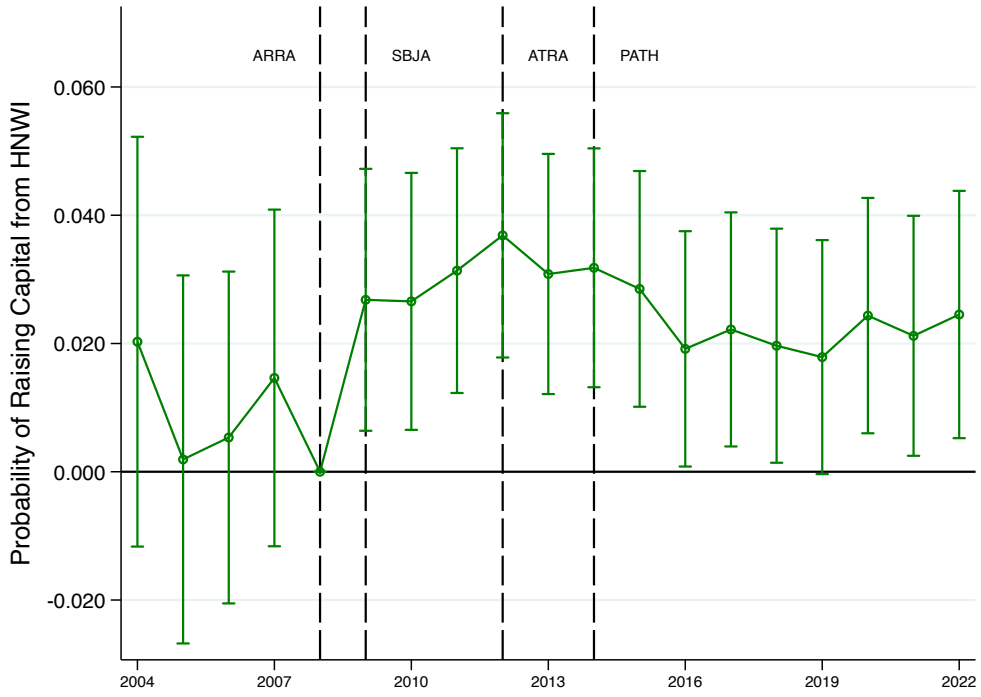
local long-term capital gains tax wedge on QSBS investments as a control variable meaningfully alters only the PPML estimates (Panel C) but not the ordinary-least-squared estimates with either $\ln(1+Y_{i,s,t})$ (Panel A) or $\ln Y_{i,s,t}$ (Panel B) as the outcome. This suggests that state-specific policies related to QSBS may affect the extensive margin of resident HNWIs' participation in local venture capital markets (i.e., do any resident HNWIs participate in the market?), but not its intensive margin (i.e., how much do participating HNWIs actually participate?). Third, we also show that the increase in the triple-difference parameters identified in Equation (1) is driven by an increase in in-state early-stage investments by resident HNWIs, rather than by a decrease in the investments by other investors—exactly as we would have expected, given the policy's design (see Appendix Figure A14). Finally, we show that our baseline estimates are entirely robust to dropping California and the few other states that contain major U.S. technology hubs (see Appendix Figure A15).

[29] We use capital raised as a proxy for gross assets—which is the measure with which the tax code determines QSBS-eligible firms—since Pitchbook only has information on gross assets for a very small sample of companies.

where $Y_{i,t}$ is the probability of firm i raising capital in year t from U.S. HNWIs; Treated_i is an indicator equal 1 for treated and 0 for control firms, and Post_t is an indicator equal 1 for the post-reform 2009-2022 period and 0 for the pre-reform period 2004-2008. We include firm and year fixed effects. We also include industry $\times$ year fixed effects to control for differences in firms' growth in certain industries over time. We similarly control for corporation type $\times$ year fixed effects to control for the differential growth over time in the popularity of certain corporate legal structures. We could similarly control for firm size $\times$ year fixed effects to control for differential growth over time in startup versus mature firms.

Figure 6 plots our estimates for Equation (2)—the effect of the QSBS tax exemption on the probability of receiving HNWI's investments. The estimates for the years 2004-2007 are relatively stable and always statistically insignificant, suggesting the absence of pre-trends. Immediately after the reform was introduced in 2009, the probability of HNWIs' investing in QSBS-qualified companies jumped to approximately 3% and declined steadily to 2% throughout the post-reform period. The average effect in the entire post-period is 2.1%, and statistically significant at 1%. The rise in capital from HNWIs at the firm level is consistent with the state-level results documented in the prior section. Table A1 shows additional firm level outcomes. We show that firms benefiting from the policy stay private for longer, and have a lower probability of going bankrupt.

Figure 6: U.S. HNWI Investment Activity at Firm Level



Notes: The figure shows coefficients estimated in specification (2), along with 95% confidence intervals. Standard errors are clustered at the company level.

5 Excess Returns and Inequality

5.1 QSBS Reforms and Income Inequality

This section studies the implications of the QSBS reforms on state-level income inequality. We rely on the taxable income distribution that we construct for every state in every year using the Statistics of Income from the IRS. In particular, we decompose the distribution into 103 income groups, with each of the first ninety-nine groups covering a percentile, while the top percentile is further split into four groups covering the 99th to 99.5th, 99.5th to 99.9th, 99.9th to 99.99th, and 99.99th to 100th percentiles.[30] We then calculate the average taxable income $Y_{g,s,t}$ (in thousands of dollars) of the individuals belonging to each income group $g \in \{1, \ldots, 99, 99.5, 99.9, 99.99, 100\}$ of the distribution in state s in year t. Ultimately, we run the following regression:[31]

$$\ln Y_{g,s,t} = \alpha_{g,s} + \beta_t(\ln X_{s,2008} \times \mathbb{1}_{g>99.5}) + \gamma_{g,t} + \delta_{s,t} + \zeta_{G(g),t} W_{s,t} + \epsilon_{g,s,t}, \tag{3}$$

where $X_{s,t}$ is the number of accredited investors residing in state s in 2008; $\mathbb{1}_{g>99.5}$ is a dummy variable equal to 1 for income groups $g > 99.5$ in the top 0.5% of the state-level income distribution, and 0 otherwise; $W_{s,t}$ is a vector of time-varying state-level controls whose dynamic effects $\zeta_{G(g),t}$ are the same for all income groups g within decile G of the distribution, except for the top income groups $g > 99.5$ that are assigned to their own G; and $\alpha_{g,s}$, $\gamma_{g,t}$, $\delta_{g,t}$ are interacted group-state, group-year and state-year fixed effects, respectively. We can therefore interpret the parameter of interest β_t as the effect of the reforms on the average (log) income gap between the top 0.5% and bottom 99.5% of the state-level income distribution, which we choose to further interpret as the income gap between HNWIs and other income earners.[32]

Figure 7, Panel A plots our baseline estimates of Equation (3), replacing $\ln Y_{g,s,t}$ with the $\text{asinh} Y_{g,s,t}$ transformation to ensure a balanced panel, given that average income is negative

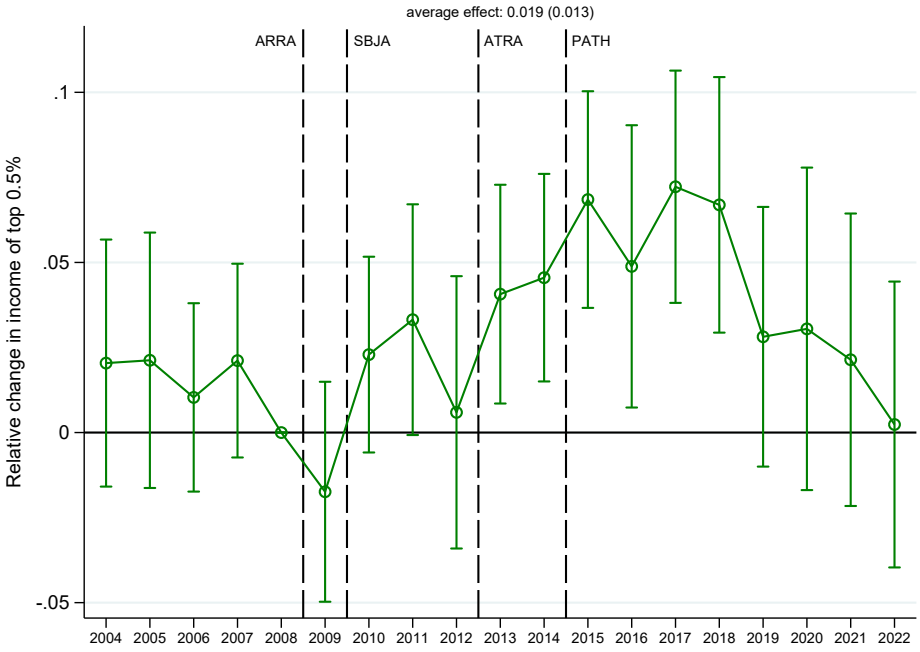
[30] We split the top percentile because average income differs drastically across these four income groups.

[31] As we discuss in Section 4.1, only the first $10 million of the long-term capital gains from each QSBS investment are exempted from the personal income tax. However, as we discuss in section 5.2, QSBS investments that yield at least $10 million in capital gains tend to yield much more than just $10 million. We therefore expect the majority of QSBS capital gains to be included in the measures of taxable income that we consider.

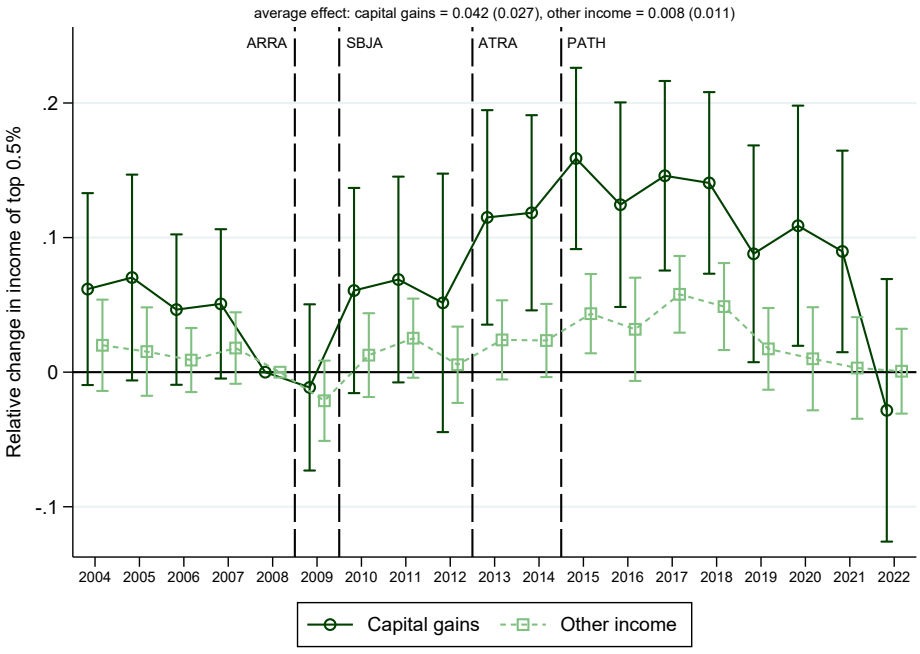
[32] Our decision to split the state-level income distribution at the 99.5th percentile is not arbitrary. It is motivated by the fact that this is the largest top income group for which in every state and year the average income of individuals exceeded $200,000—the individual income threshold for qualifying as an accredited investor (see Section 2.2). Hence, we are certain that accredited investors belong to that income group across all states and years.

Figure 7: Income Gap between the Top 0.5% and Bottom 99.5% of the State-Level Income Distribution after the QSBS Reforms

(A) Estimates of Equation (3) for Total Income



(B) Estimates of Equation (3) for Capital Gains vs. Other Income



Source: SOI Tax Stats, GEOWEALTH-US.
Notes: Other income includes labor income and capital income. The regression is based on 99,807 state-year observations. The average effect reported is based on a modified version of Equation (3) where β_t is replaced with $\beta_{t:t>2008}$.

for 1% of the observations.[33] We find that the average income gap between HNWIs and other income earners grew more after the reforms in those states with more ex-ante resident accredited investors than in those with fewer accredited investors.[34] This rise in income inequality is consistent with the findings that we presented previously—namely, that resident HNWIs' investments in local startups increased disproportionately more in those same states (Section 4.2.1), and that these investments yielded excess returns relative to the returns that were available in public stock markets (Section 3.2).

The increase in income inequality peaked five years after the QSBS reforms were introduced. This is consistent with the fact that investors needed to hold their QSBS investments for at least five years before selling them in order to benefit from the capital gains tax exemption (Section 4.1). To corroborate that this increase in income inequality was driven by an increase in HNWIs' capital gains, we decompose the average taxable income for each income group into capital gains and all other types of income—namely, labor and capital income. Figure 7, Panel B shows that the gap between the capital gains of the top 0.5% and the bottom 99.5% increased much faster after the reforms than the gap for the other income component.[35] This increase in the inequality of capital gains was driven by an increase in the gains of the top 0.5%, rather than by a decrease in those of the bottom 99.5% (see Appendix Figure A19, Panel B).[36]

For further reassurance, we also compare this increase in the inequality of capital gains to the growth in residents HNWIs' returns on their early-stage investments. Specifically, we replace the term $\beta_t(\ln X_{s,2008} \times \mathbb{1}_{g>99.5})$ in Equation (3) with $\beta \ln R_{s,t}$, where $R_{s,t}$ is the average returns earned in year t by HNWIs residing in state s from their accumulated investments in local startups.[37] Using the transformations asinh $Y_{g,s,t}$ and asinh $R_{s,t}$ to

[33] Appendix Figure A18 shows that our baseline estimates using the asinh $Y_{g,s,t}$ transformation are robust to the alternative transformation $\ln Y_{r,s,t}$ based on unbalanced panels, as well as to asinh$(1000 \times Y_{r,s,t})$.

[34] We further show that this increase in income inequality was driven by an increase in the income of the top 0.5%, rather than by a decrease in that of the bottom 99.5% (see Appendix Figure A19, Panel A).

[35] We distinguish between the estimated effects on labor and capital income in Appendix Figure A20.

[36] In Appendix Figures A21 and A22, we show that our baseline estimates of the effect of the policy on the capital gains of the top 0.5% are sensitive to the specific transformation of the outcome—namely, asinh $Y_{r,s,t}$, $\ln Y_{r,s,t}$, or asinh$(1000 \times Y_{r,s,t})$—that we choose to use. This is because a higher share of observations were negative for capital gains (4.9%) than for overall taxable income (1.0%), especially in the first years after the QSBS reforms. These years coincide with the immediate aftermath of the 2008 financial crisis, explaining why a higher share of the observations for capital gains were negative.

We prefer the transformation asinh $Y_{r,s,t}$ for three reasons. First, the high share of negative observations makes the $\ln Y_{r,s,t}$ transformation inappropriate. Second, when we use the asinh$(1000 \times Y_{r,s,t})$ transformation, the difference-in-difference estimates for the bottom 99.5% are implausibly negative, with these estimates driving the implausibly positive estimates of the triple-difference coefficients. Finally, the IRS Statistics of Income report the aggregate income in each range of the state-level income distribution in thousands of dollars, making it more appropriate to measure the outcome variable in this unit.

[37] We calculate these average returns as the thousands of dollars of returns earned by resident HNWIs on their accumulated investments in local startups (as measured from Pitchbook), divided by the number

ensure a balanced panel, we estimate $\beta = 0.059$ (significant at the 1% level). This suggests that, for every 10% increase in HNWIs' early-stage returns, the gap between the capital gains of HNWIs and other income earners increased by about 0.6%.

Finally, we quantify by how much the QSBS reforms increased the average income gap between HNWIs and other income earners. For that, we compare our estimate of the reforms' average effect on resident HNWIs' investments in local startups (Figure 5, Panel B) to our estimate of its effect on state-level income inequality (Figure 7, Panel A). We find that the income gap between the top 0.5% and bottom 99.5% increased by $0.019/0.457 \approx 4.2\%$ for every 100% increase in HNWIs' early-stage investments. Since the reforms increased these investments by about \$1.3 billion per year relative to the pre-reform average of \$0.9 billion (see Section 4.2.1), they also increased this income gap by $1.3/0.9 \times 4.2\% \approx 6.0\%$.

5.2 Counterfactual Simulations of Income and Wealth Inequality

The reduced-form analyses in the previous subsection make it possible to assess the implications of the growing participation of HNWIs in private capital markets on state-level income inequality, but they do not help us understand the overall effect on U.S. income nor wealth inequality. This is the reason why in this section we run counterfactual simulations to quantify how the rise in the partipation of HNWIs in private capital markets has shaped overall U.S. income and wealth inequality between 2004 and 2019.

To carry the counterfactual simulations for income inequality, we rely on the taxable income inequality series estimated based on the Statistics of Income published by the U.S. IRS. The methodology used to build the series is based on Blanchet et al. (2022), and is explained in Section 2.2. We focus the counterfactual analysis on the top 1% income group, as this is the usual indicator used to examine the dynamics of income concentration. We run three different counterfactual simulations for the post-reform 2010-2019 period using the private and counterfactual public gains derived from Pitchbook and described in Section 3.2.[38] First, we re-estimate the taxable income inequality series excluding taxable private capital gains. We distribute the private capital gains proportionally on an annual basis so as to match the total capital gains distribution of accredited investors who are full or partial owners of a C-corporation or a partnership in the SCF. This group of investors is highly concentrated at the very top, since only the top 1% income group

of residents in the top 0.5% of the state-level income distribution (as measured from the Statistics of Income).

[38] We start the simulations in 2010, since it is the first available post-reform year for which there is a wave of the SCF available.

accounts for approximately 98% of their capital gains over the 2001-2022 period. Second, we re-estimate the taxable income inequality series replacing taxable private capital gains by the counterfactual gains had these money been invested in the S&P500. Note that because there is no exemption in the tax code for investing in public stocks, these capital gains are 100% taxable. Finally, we re-estimate the taxable income inequality series replacing the taxable private capital gains by total private capital gains, that is, the sum of taxable and non-taxable capital gains.

Table 1 compares the differences in growth rates of the top 1% taxable income share under the baseline and the different counterfactual scenarios. We have three main takeaways. First, private capital gains from early-stage investing account for 15% of overall growth in the top 1% taxable income share over 2010-2019. Second, had U.S. HNWIs instead invested in the S&P500, the top 1% taxable share would have grown by 11% less than it actually did. These two results are consistent with the fact that private capital gains are highly concentrated at the top of the income distribution and the return premium over public markets we document in Section 3.2. Third, if all QSBS capital gains had been taxable, the top 1% taxable income share would have grown by 4% more than it actually did, as top income holders would have obtained even higher realized gains..[39]

Table 1: Growth rate in taxable income share of top 1% under various scenarios

Period	Baseline	W/o taxed priv	W/o taxed priv, W/ pub	W/o taxed priv, W/ priv
2001-2019	15.27%	14.20%	14.51%	15.58%
Baseline (=100)		93	95	102
2010-2019	6.60%	5.63%	5.90%	6.85%
Baseline (=100)		85	89	104

Source: SOI Tax Stats, Pitchbook.
Notes: This table summarizes the growth rates in the top 1% taxable income share between 2001-2019 and between 2010-2022 for the baseline series.

To carry the counterfactual simulations for wealth inequality, we rely on the wealth inequality series estimated based on the U.S. SCF provided by the Federal Reserve Board. We also focus the counterfactual analysis on the top 1% wealth group, and run two different counterfactual simulations for the post-reform 2010-2019 period using the private and counterfactual public gains derived from Pitchbook and described in Section 3.2.[40] First, we re-estimate the wealth inequality series excluding cumulated private capital gains. We distribute the cumulated private capital gains proportionally on an annual basis so as to match the total distribution of business wealth among top 1% wealth holders who are full or partial owners of a C-corporation or a partnership in the SCF. Second, we

[39] Figure A23 compares the evolution of the three different counterfactual income inequality series to the baseline scenario over the period 2010-2019.

[40] We start the simulations in 2010, since it is the first available post-reform year for which there is a wave of the SCF available.

re-estimate the wealth inequality series replacing the cumulated private capital gains by the counterfactual cumulated gains had these money been invested in the S&P500.

Table 2 compares the differences in growth rates of the top 1% wealth share under the baseline and the different counterfactual scenarios. We have two main takeaways. First, private capital gains from early-stage investing account for 6% of overall growth in the top 1% wealth share over 2010-2019. Second, had U.S. HNWIs instead invested in the S&P500, the top 1% wealth share would have grown by 5% less than it actually did. These findings are consistent with the fact that private business wealth is highly concentrated at the top of the wealth distribution and the return premium over public markets we document in Section 3.2.[41]

Table 2: Growth rate in wealth share of top 1% under various scenarios

Period	**Baseline**	**W/o private**	**W/o private, W/ public**
2001-2019	15.61%	14.92%	15.08%
Baseline (=100)		96	97
2010-2019	9.27%	8.69%	8.81%
Baseline (=100)		94	95

Source: Survey of Consumer Finances, Pitchbook.
Notes: This table summarizes the growth rates in the top 1% wealth share between 2001-2019 and between 2010-2022 for the baseline series.

5.3 A Self-Reinforcing Relationship

To what extent is the relationship between HNWIs' increasing participation in private capital markets and rising inequality self-reinforcing? We briefly consider this question in this last section, where we evaluate the effect of previous entrepreneurial success on a HNWI's later activity as an investor in other early-stage companies.

Specifically, we first identify investments by HWNIs to capitalize the companies of which they were founders themselves. We then calculate the distribution of these founders' lifetime rates of return on their capitalization investments, grouping the investments into three categories: those that yielded returns in the bottom 75% of this distribution, those ranked between the 75th and 90th percentiles, and those in the top 10%. Lastly, we estimate the effect of ranking in the top 10% of this distribution (relative to ranking either in the bottom 75% or in between the 75th and 90th percentiles) on the log amount invested by these former founders as part of their later early-stage investments, controlling for year fixed effects. We find that former founders who are in the top 10% of successful

[41] Figure A24 compares the evolution of the two different counterfactual wealth inequality series to the baseline scenario over the period 2010-2019.

entrepreneurs invest almost 60% more as part of their later early-stage investments in comparison to those ranked in the bottom 75%. Even compared to those ranked in between the 75th and 90th percentiles, the most successful former founders invest 35% more. These results suggest the existence of a feedback loop between rising private capital market activity and rising economic inequalities.[42]

6 Conclusion

This paper studies the interplay between the growth in private capital markets, the shrinking in public markets, and the rise in income and wealth concentration over the last two decades in the U.S. For that, we rely on novel data sources, and exploit an exemption from capital gains tax for investments in early-stage companies introduced during the financial crisis as a quasi-experimental shock increasing the participation of HNWIs in private capital markets.

We obtain three main findings. First, we document that the share of financing raised by early-stage companies from U.S.-based high-net-worth individuals (HNWIs) tripled from 2004 to 2022. Second, exploiting state-level variation in exposure to the expanded federal capital gains tax exemption on qualified small business stock (QSBS), we find that HNWIs' growing participation in private capital markets increased the income gap between HNWIs and other income earners by 6.0%. Finally, using counterfactual simulations, we find that HNWIs' excess returns on these investments accounted for 11% and 5% of the growth in the top 1% share of income and wealth, respectively, from 2010 to 2019. The rise in economic inequalities further rises private capital markets activity, suggesting the existence of a feedback loop among the two.

Taken together, our paper reveals that private capital market dynamics may have non-negligible distributional implications due to the differences in portfolio composition and in returns across asset classes across the income and wealth distribution. Our analyses are based on reduced-form approaches and partial equilibrium counterfactual simulations. Further research is needed to quantify the distributional implications of changing private capital markets taking a general equilibrium approach.

[42] We will further develop this section in a future version of this paper.

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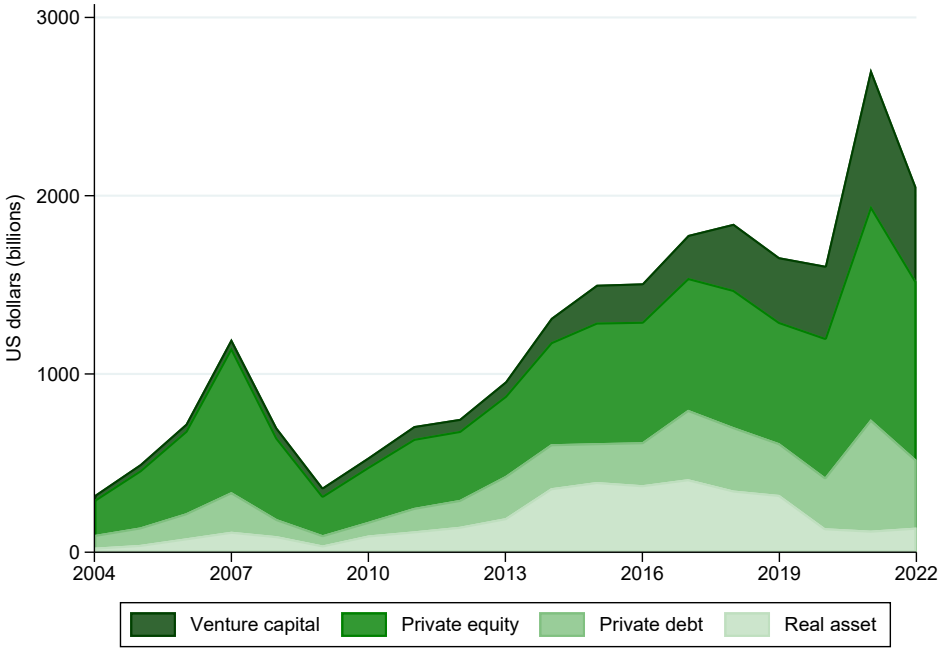
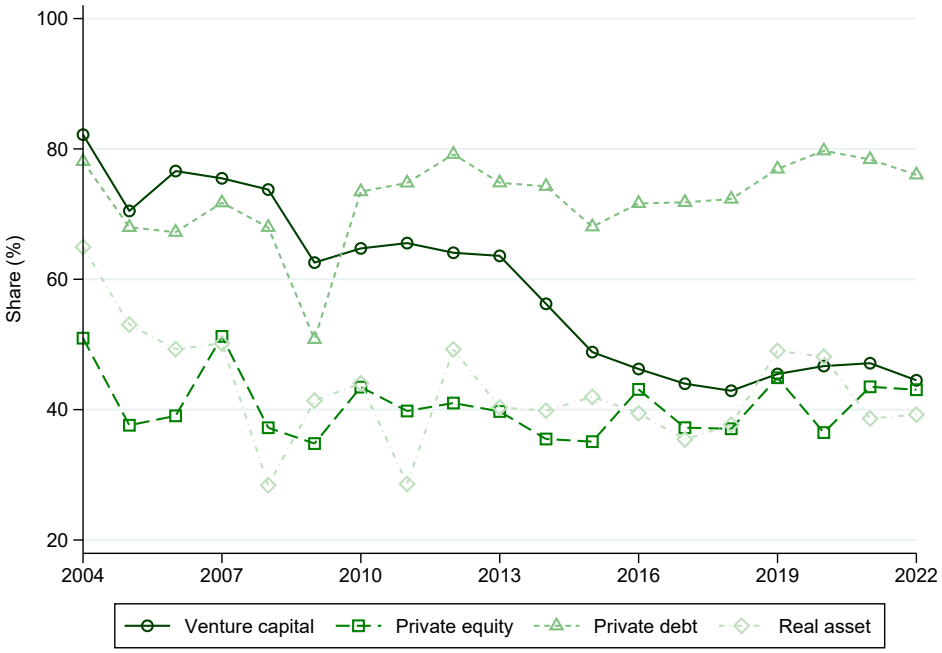
Appendix A: Additional Figures and Tables

Figure A1: Private Capital Market Investments Globally

(A) Investments in All Companies

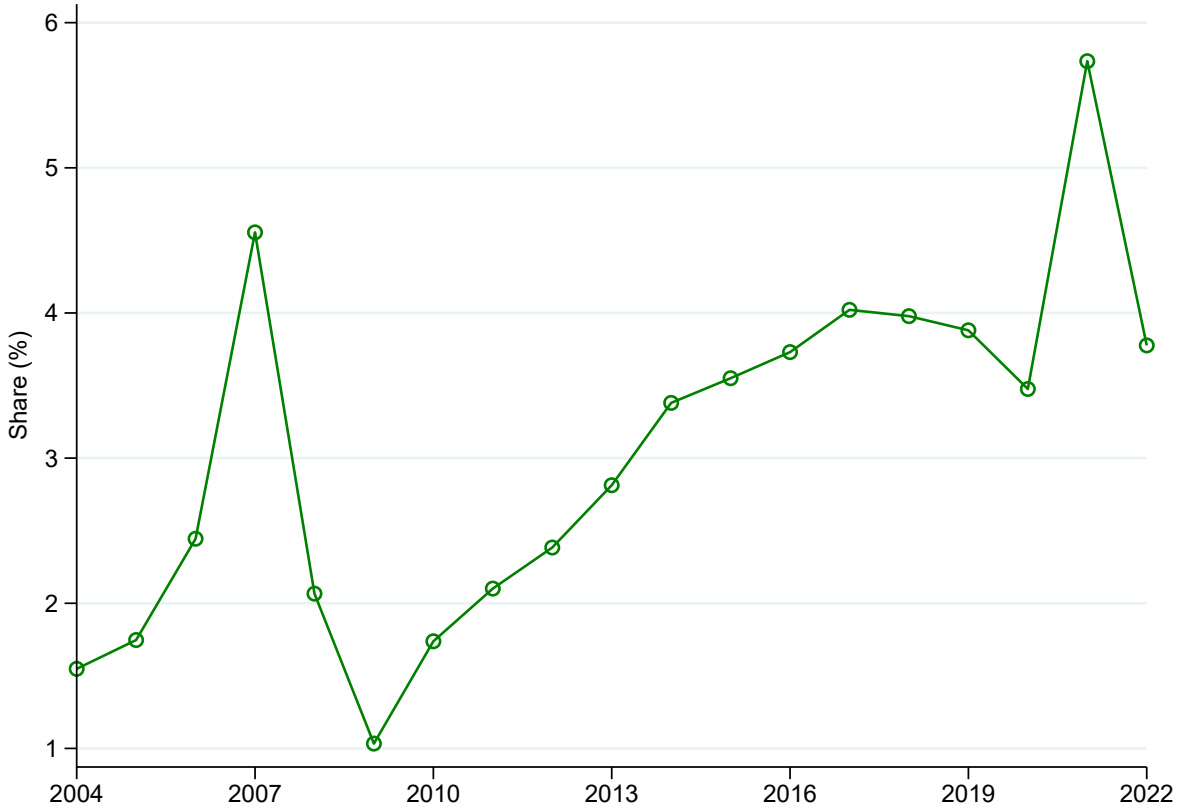


(B) US Companies' Share of Investments



Source: Pitchbook.
Notes: The values in Panel A are expressed in nominal terms.

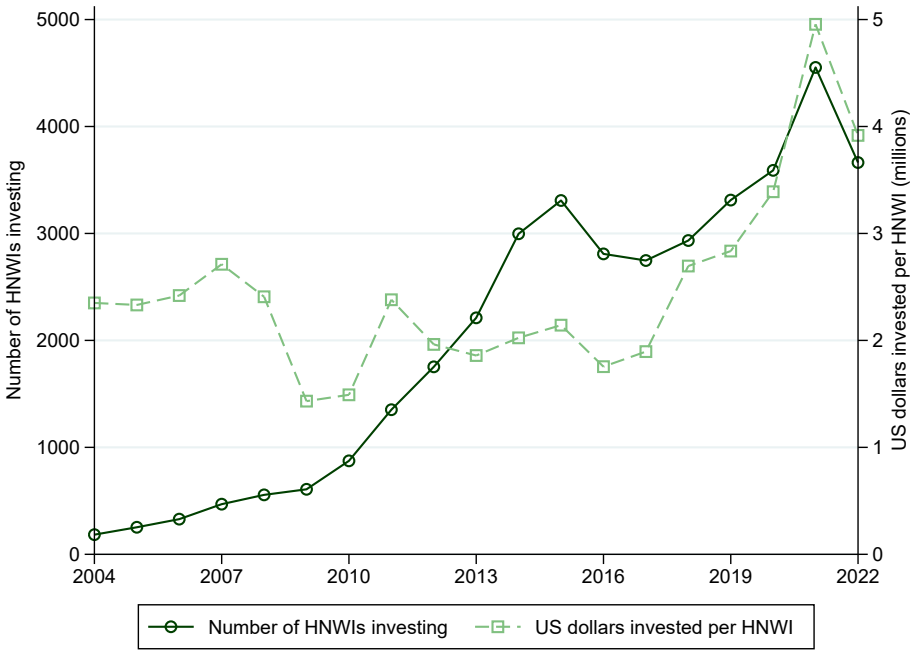
Figure A2: Private Capital Market Investments in U.S. Companies as a Share of U.S. GDP



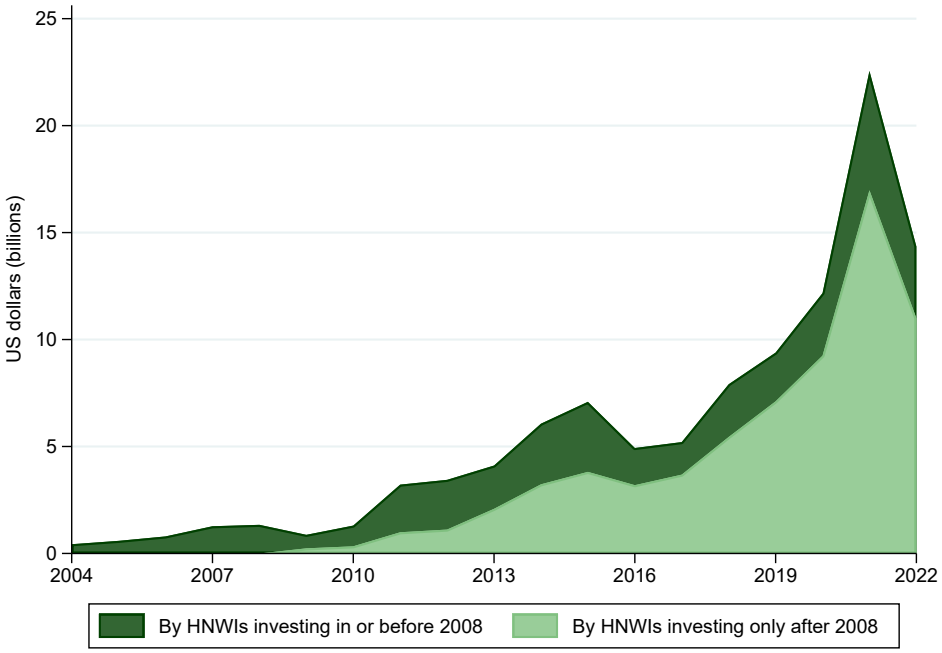
Source: Pitchbook, Bureau of Economic Analysis.
Notes: When calculating the share, private capital market investments in U.S. companies and U.S. gross domestic product (GDP) are both measured in nominal terms.

Figure A3: US HNWIs' Participation in U.S. Venture Capital Markets

(A) US HNWIs with Venture Capital Investments in U.S. Companies

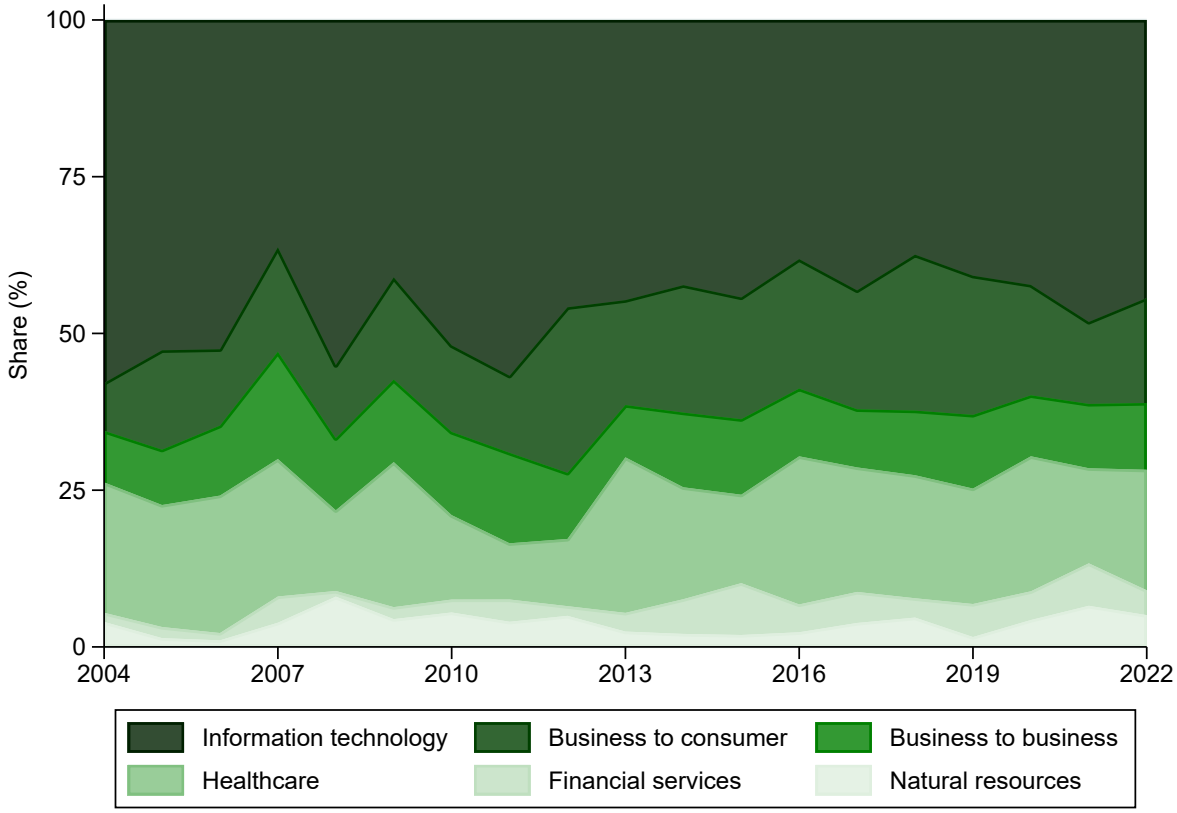


(B) Venture Capital Investments in U.S. Companies by U.S. HNWIs



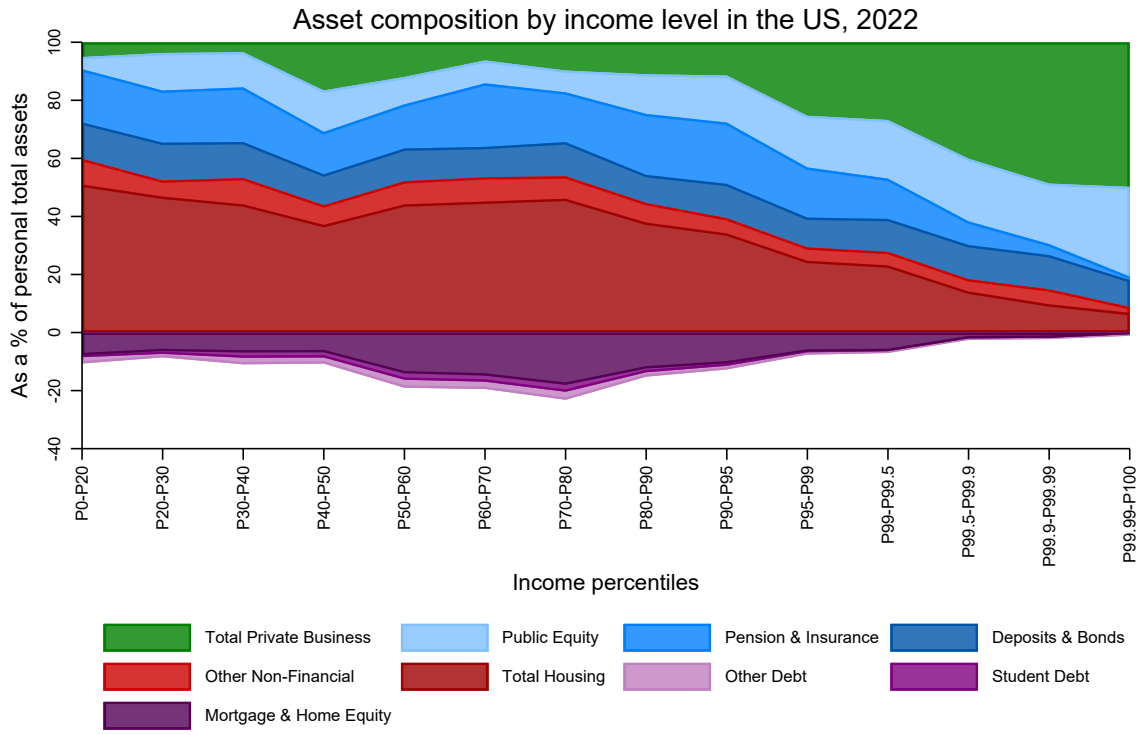
Source: Pitchbook.
Notes: The values in Panel B are expressed in nominal terms. High-net-worth individuals (HNWIs) refer to investors categorized by Pitchbook as individuals, angel groups, and family offices.

Figure A4: Sector Composition of VC Investments in U.S. Companies by U.S. HNWIs



Source: Pitchbook.
Notes: Only venture capital (VC) investments are considered. High-net-worth individuals (HNWIs) refer to investors categorized by Pitchbook as individuals, angel groups, and family offices. The natural resources sector encompasses Pitchbook's own distinct sector categories for energy and for materials and resources.

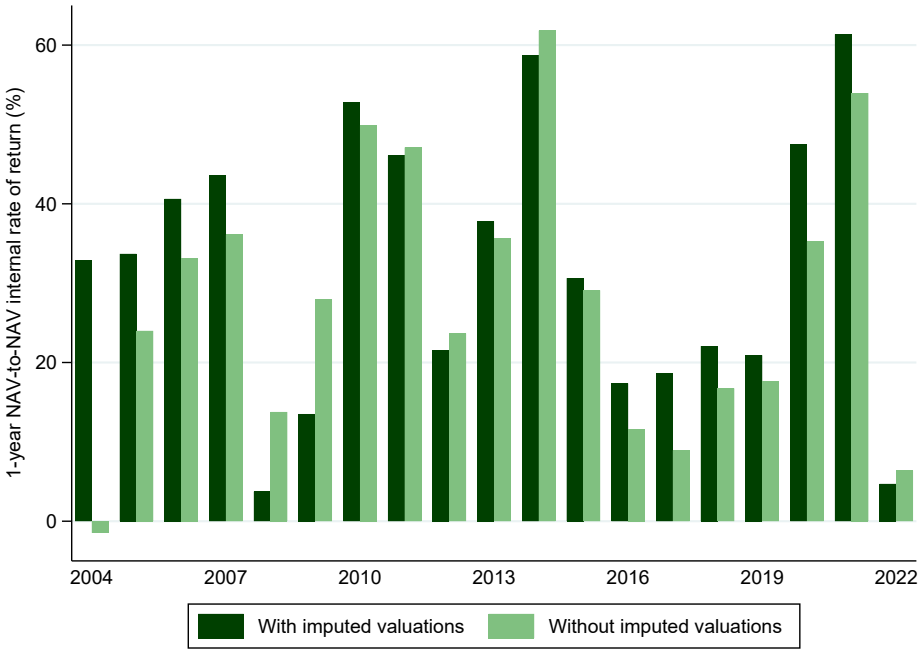
Figure A5: Asset composition by income level in the U.S. in 2022



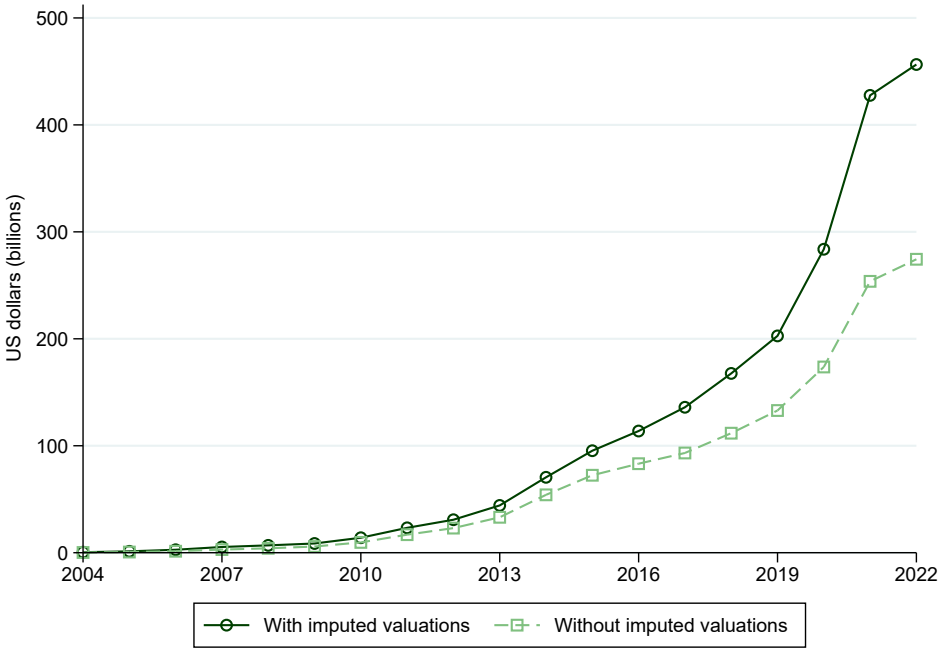
Source: SCF.
Notes: This figure shows the asset composition by income level in the U.S. using the household-level information from the 2022 wave of the Survey of Consumer Finances (SCF).

Figure A6: Returns on Venture Capital Investments in U.S. Companies by U.S. HWNIs: with and without Imputed Valuations

(A) 1-Year NAV-to-NAV Internal Rate of Return on Pooled Investments



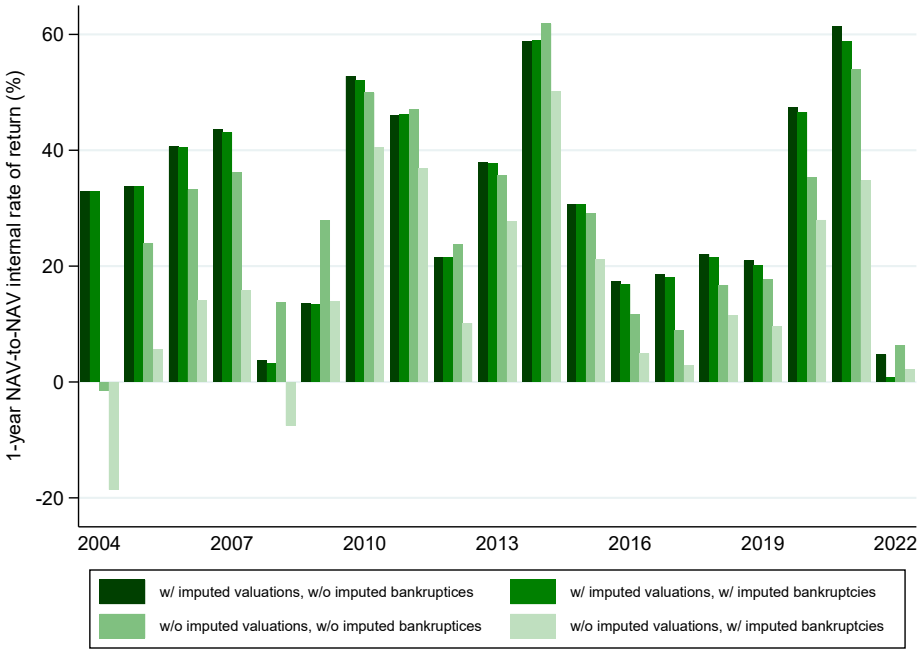
(B) Accumulated Value of Investments



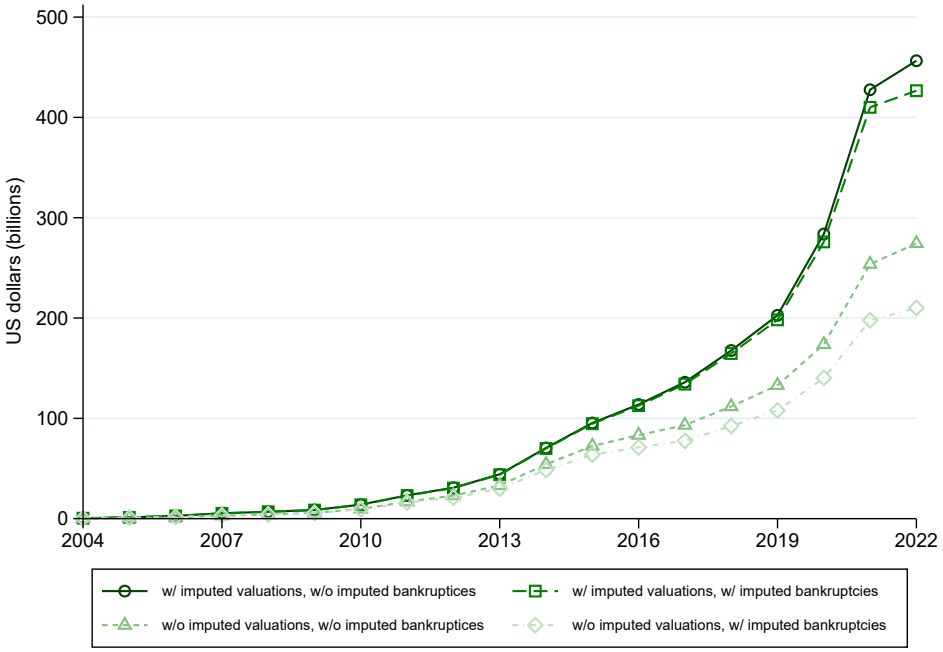
Source: Pitchbook.
Notes: The rate in Panel A is calculated as in Phalippou (2024). The values in Panel B are expressed in nominal terms. High-net-worth individuals (HNWIs) refer to investors categorized by Pitchbook as individuals, angel groups, and family offices.

Figure A7: Returns on Venture Capital Investments in U.S. Companies by U.S. HWNIs: with and without Imputed Valuations or Bankruptcies

(A) 1-Year NAV-to-NAV Internal Rate of Return on Pooled Investments

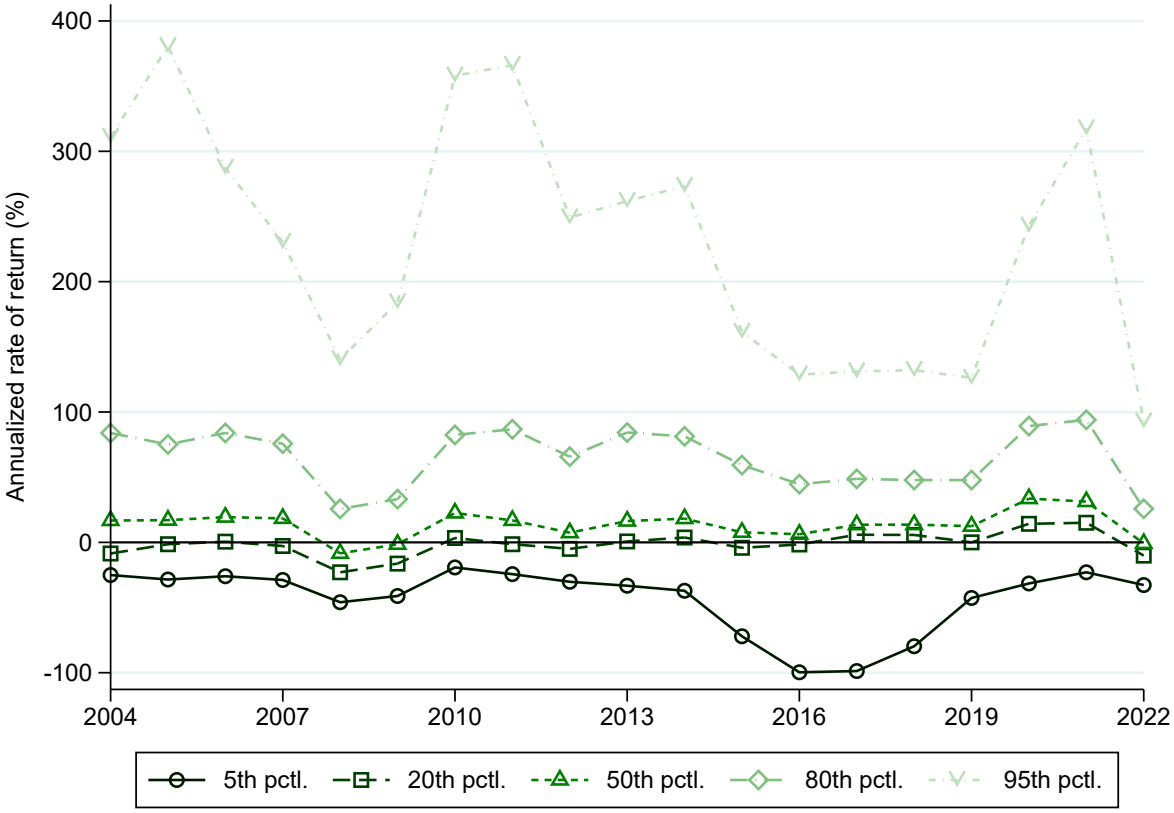


(B) Accumulated Value of Investments



Source: Pitchbook.
Notes: The rate in Panel A is calculated as in Phalippou (2024). The values in Panel B are expressed in nominal terms. High-net-worth individuals (HNWIs) refer to investors categorized by Pitchbook as individuals, angel groups, and family offices.

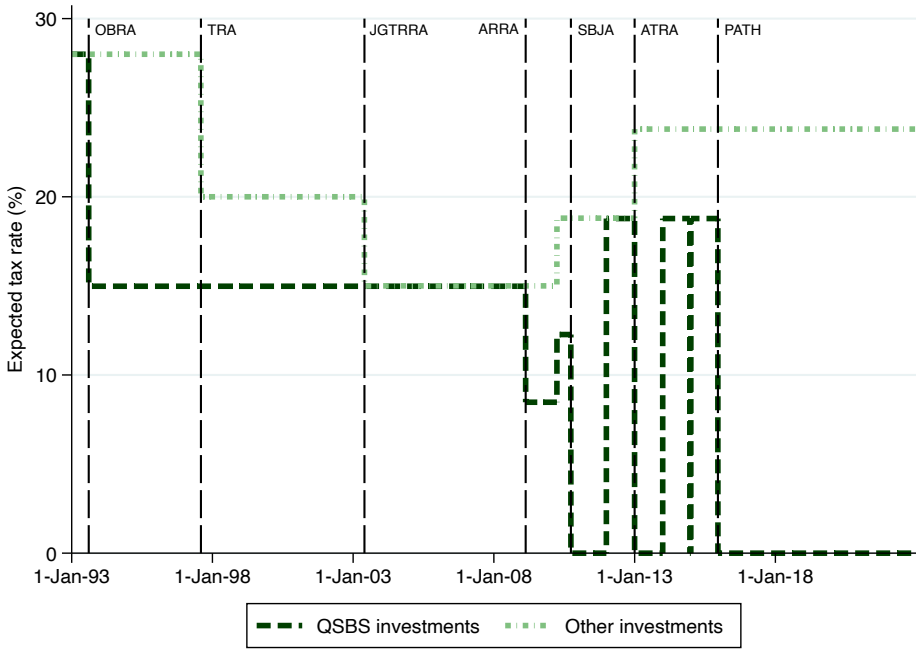
Figure A8: Distribution of Annualized Rates of Return: with Imputed Valuations



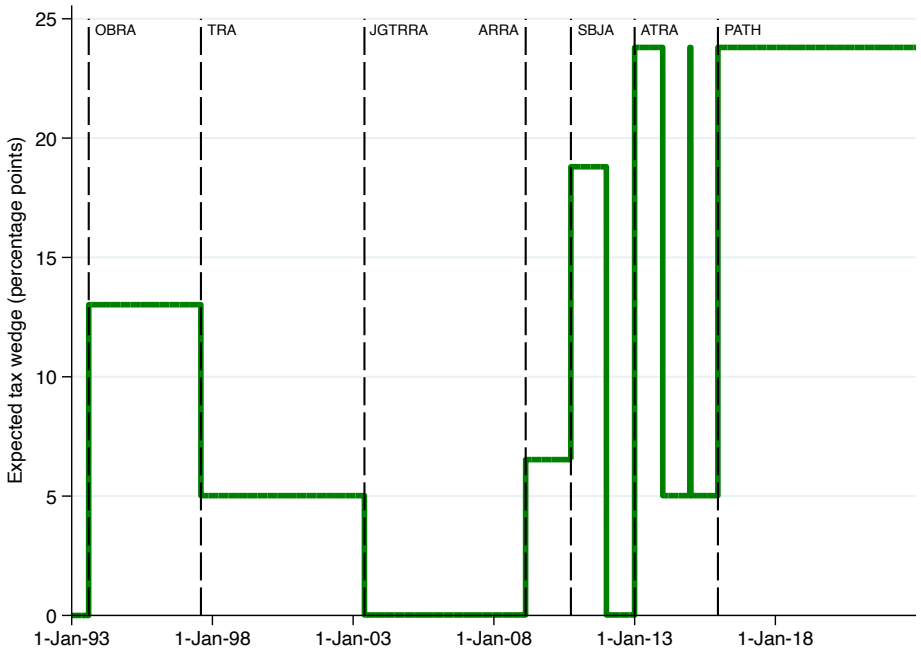
Source: Pitchbook.
Notes: The rates are based on both observed and imputed valuations. High-net-worth individuals (HNWIs) refer to investors categorized by Pitchbook as individuals, angel groups, and family offices.

Figure A9: History of the Federal Tax Exemption on QSBS Capital Gains

(A) Expected Tax Rates on QSBS vs. Other Investments

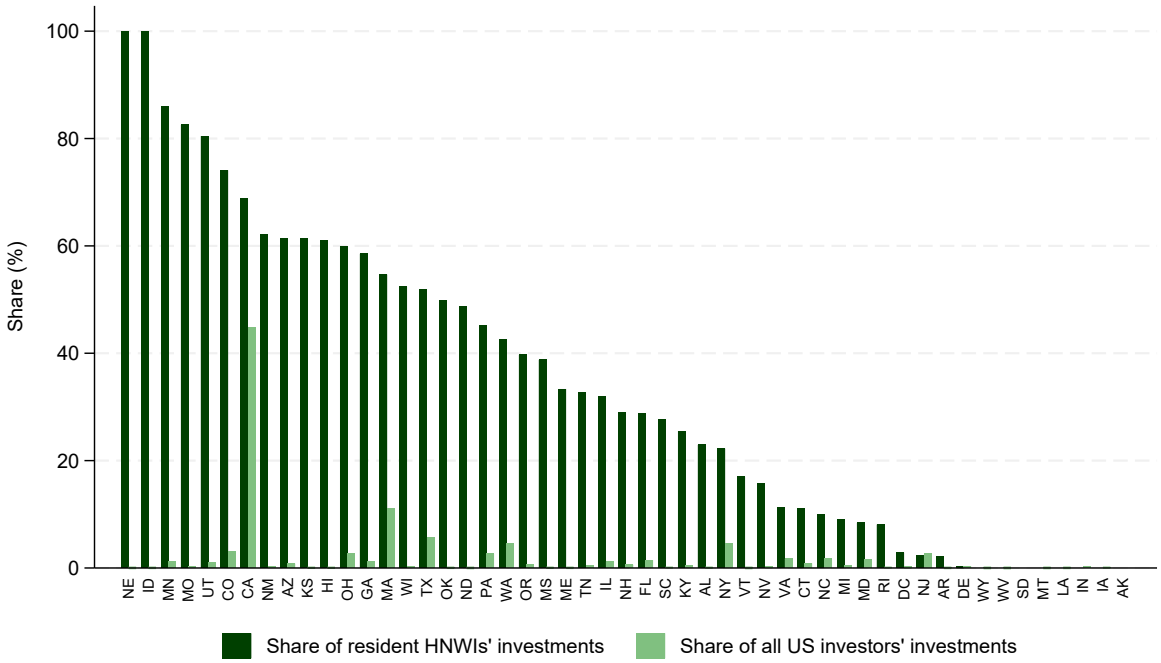


(B) Expected Tax Wedge on QSBS Investments



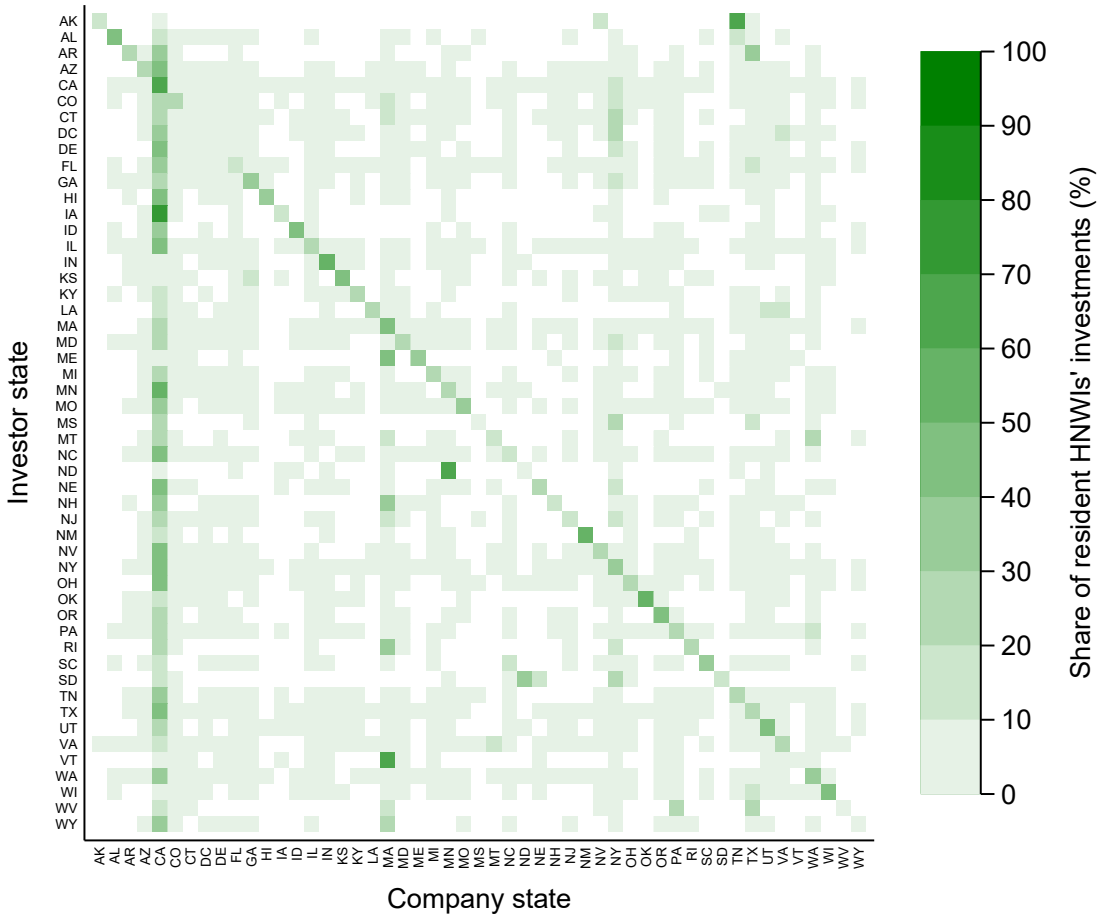
Source: Polsky and Yale (2023)).
Notes: Panel B plots the difference between the two lines in Panel A. The highlighted legislation include the Omnibus Budget Reconciliation Act (OBRA), the Taxpayer Relief Act (TRA), the Jobs and Growth Tax Relief Reconciliation Act (JBGTRRA), the American Recovery and Reinvestment Act (ARRA), the Small Business Jobs Act (SBJA), the American Tax Payer Relief Act (ATRA), and the Protecting Americans from Tax Hikes Act (PATH).

Figure A10: In-State Bias of Venture Capital Investments
by Resident HNWIs: 2004-2008



Source: Pitchbook.
Notes: The plot compares the share of investments by each state's resident HNWIs invested in companies headquartered within that state to the share of investments by all U.S. investors invested in companies headquartered within that same state.

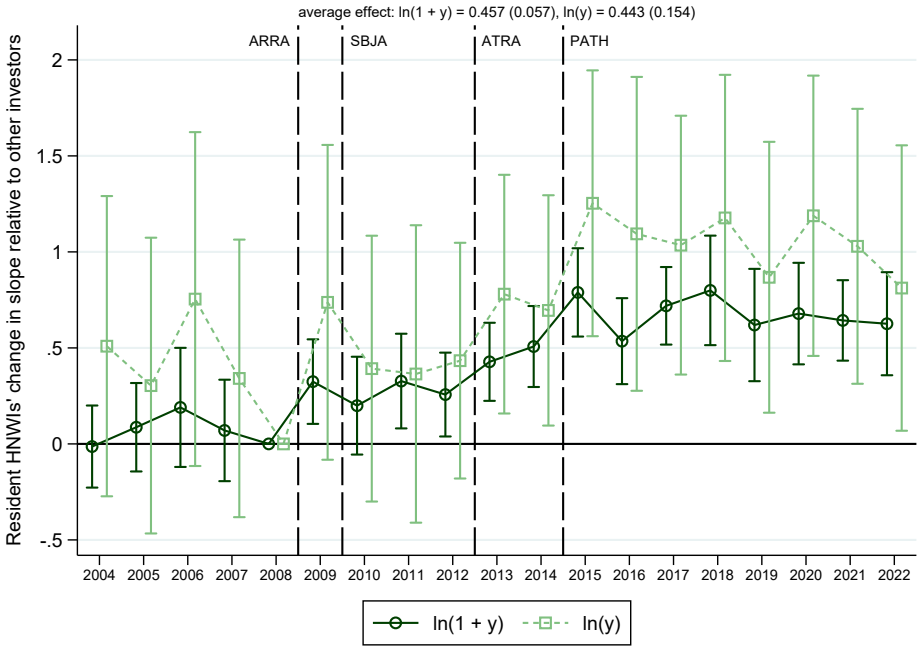
Figure A11: Distribution of Venture Capital Investments by Resident HNWIS across States: 2004-2022



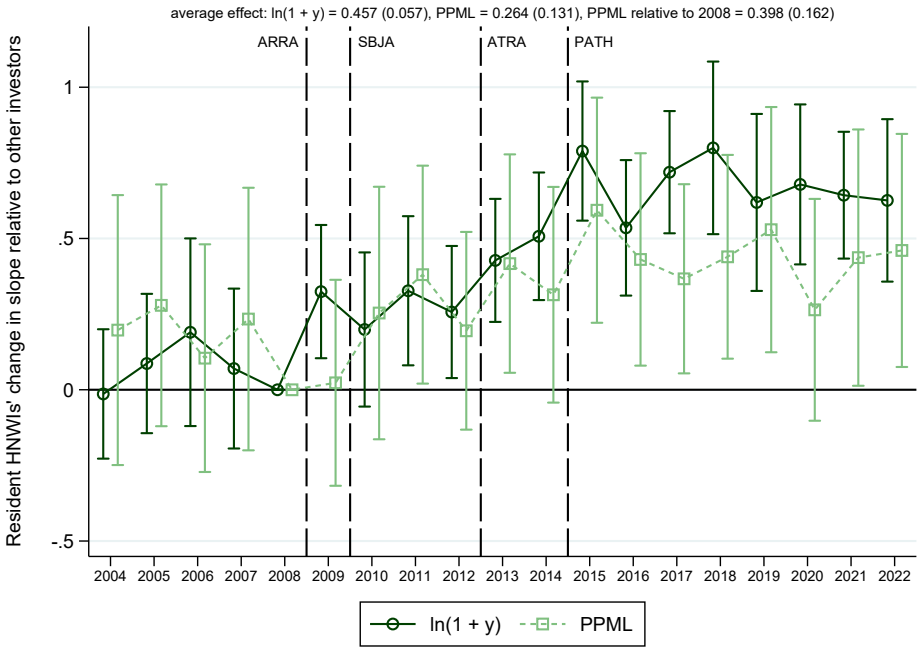
Source: Pitchbook.
Notes: The plot reports the share of investments by each (investor) state's resident HNWIs invested in companies headquartered each (company) state.

Figure A12: Robustness of Estimates of Equation (1) to Alternative Estimators

(A) $\ln(1 + Y_{i,s,t})$ vs. $\ln Y_{i,s,t}$



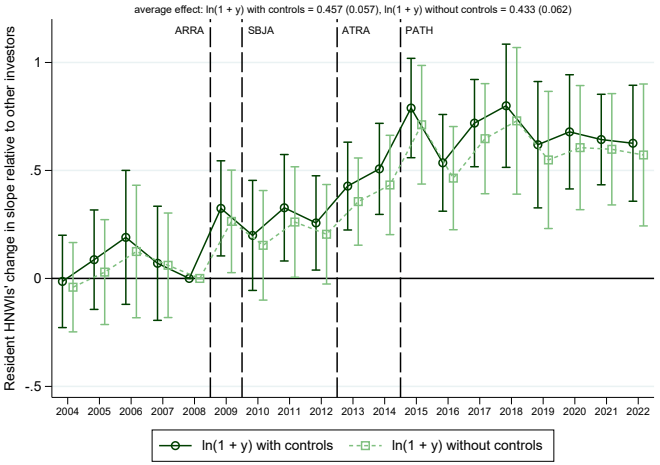
(B) $\ln(1 + Y_{i,s,t})$ vs. PPML



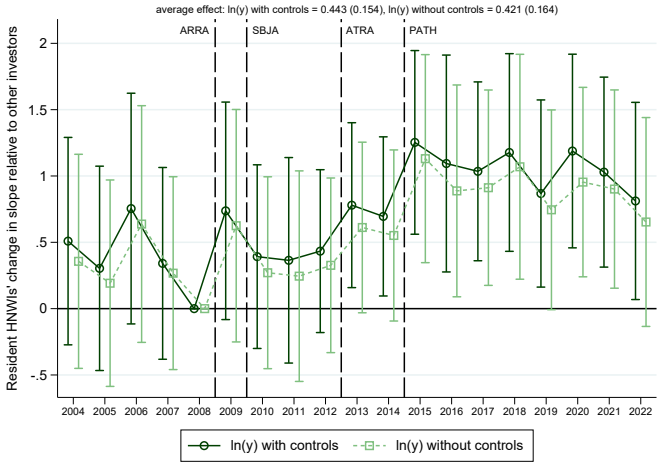
Source: Pitchbook, GEOWEALTH-US.
Notes: The average effects reported are based on a modified version of Equation (1) where β_t is replaced with $\beta_{t:t>2008}$ (or with both $\beta_{t:t<2008}$ and $\beta_{t:t>2008}$). The regression with $\ln(1+Y_{i,s,t})$ as the outcome is based on 3,876 state-year observations. In Panel A, the regression with $\ln(Y_{i,s,t})$ as the outcome is based on 3,296 observations. In Panel B, the regression is estimated using a Poisson pseudo-maximum likelihood (PPML) estimator with $Y_{i,s,t}$ as the outcome and is based on 3,812 observations.

Figure A13: Robustness of Estimates of Equation (1) to Inclusion of Controls

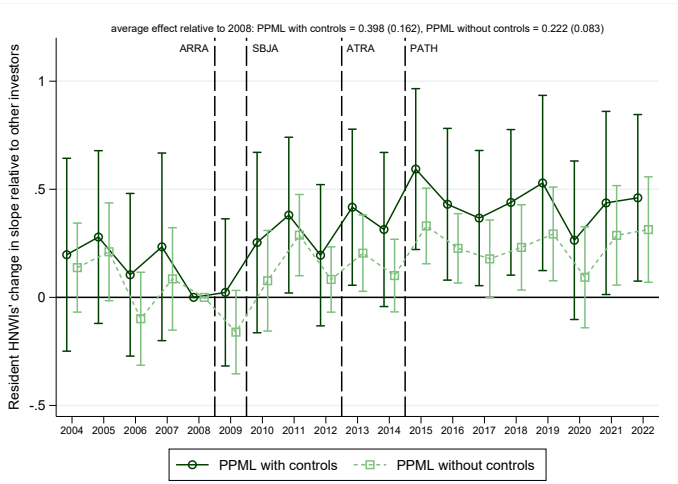
(A) $\ln(1 + Y_{i,s,t})$



(B) $\ln Y_{i,s,t}$



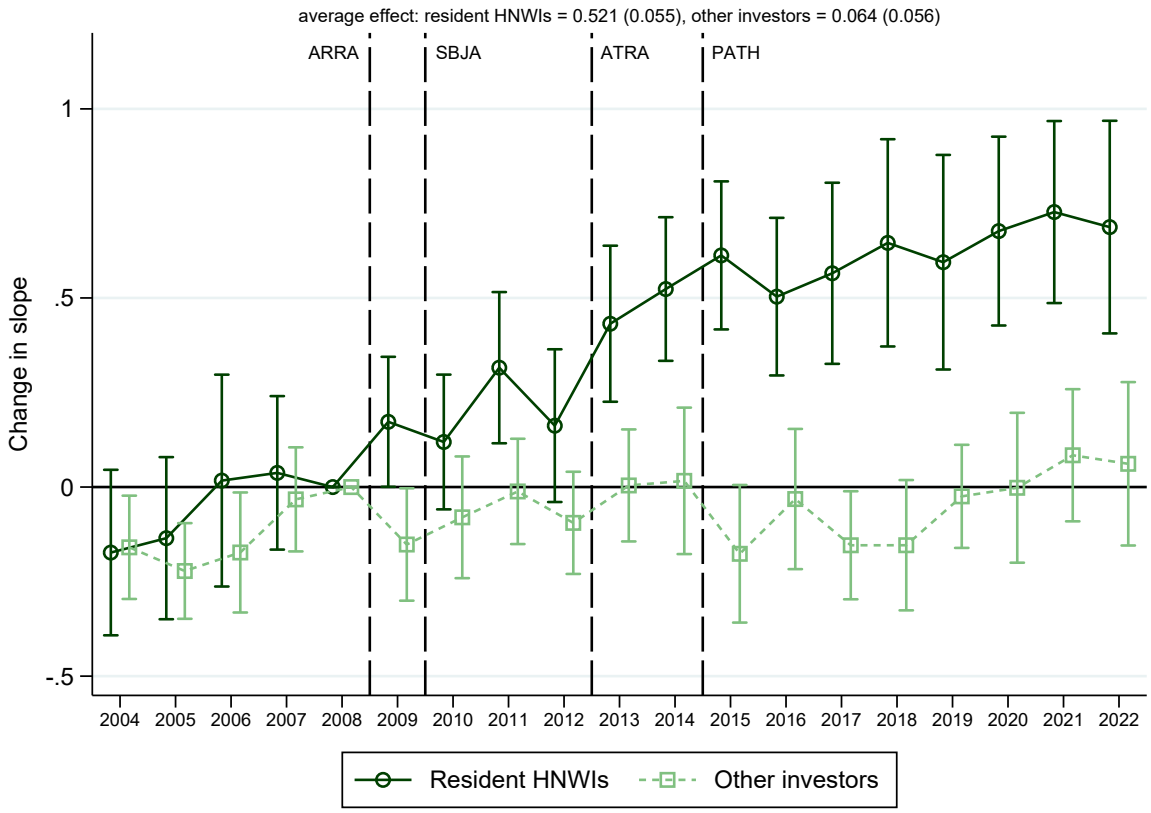
(C) PPML



Source: Pitchbook, GEOWEALTH-US.

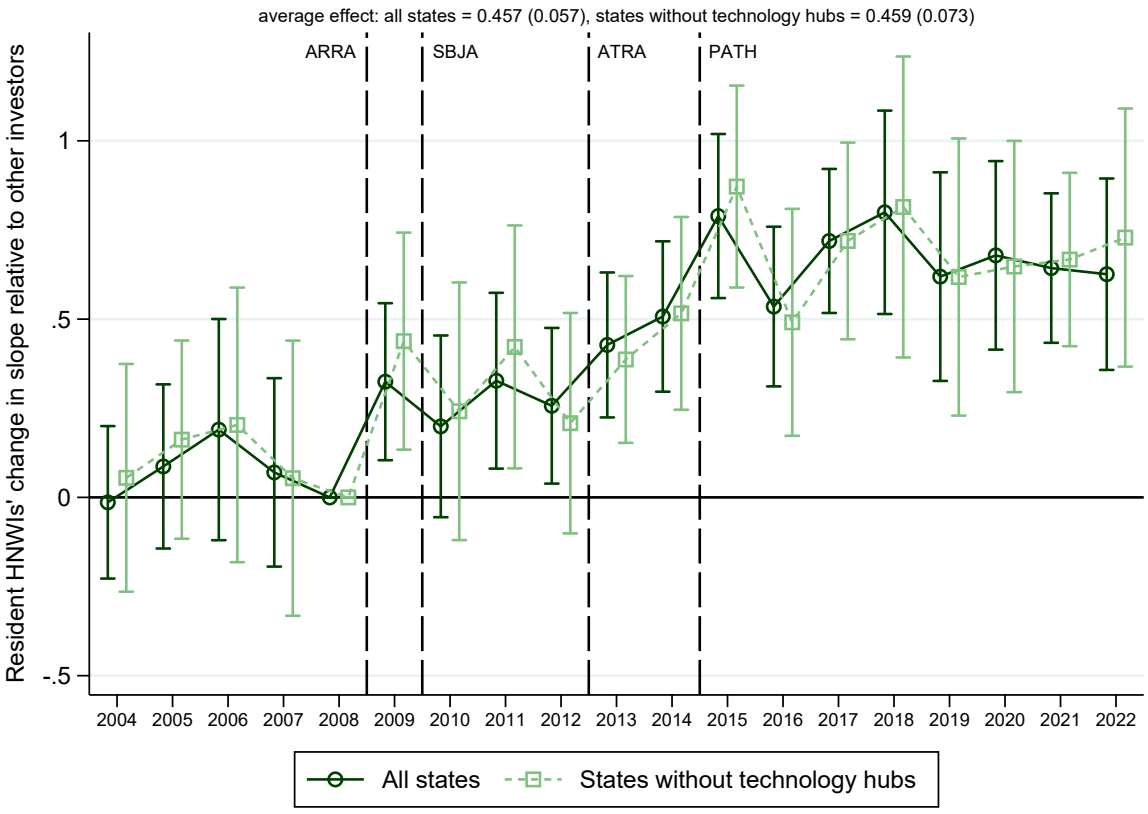
Notes: The average effects reported are based on a modified version of Equation (1) where β_t is replaced with $\beta_{t:t>2008}$ (or with both $\beta_{t:t<2008}$ and $\beta_{t:t>2008}$). In Panel A, the regression with $\ln(1 + Y_{i,s,t})$ as the outcome is based on 3,876 observations. In Panel B, the regression with $\ln(Y_{i,s,t})$ as the outcome is based on 3,296 observations. In Panel C, the regression is estimated using a Poisson pseudo-maximum likelihood (PPML) estimator with $Y_{i,s,t}$ as the outcome and is based on 3,812 observations. The controls include only the local long-term capital gains tax wedge on QSBS investments for individuals residing in state s.

Figure A14: Difference-in-Difference Estimates Underlying Estimates of Equation (1)



Source: Pitchbook, GEOWEALTH-US.
Notes: The difference-in-difference estimates are based on a modified version of Equation (1) where $\mathbb{1}_{i=\text{resident HNWIs}}$ and $\delta_{s,t}$ are dropped. The average effects reported are then based on a further modification that replaces β_t with $\beta_{t:t>2008}$.

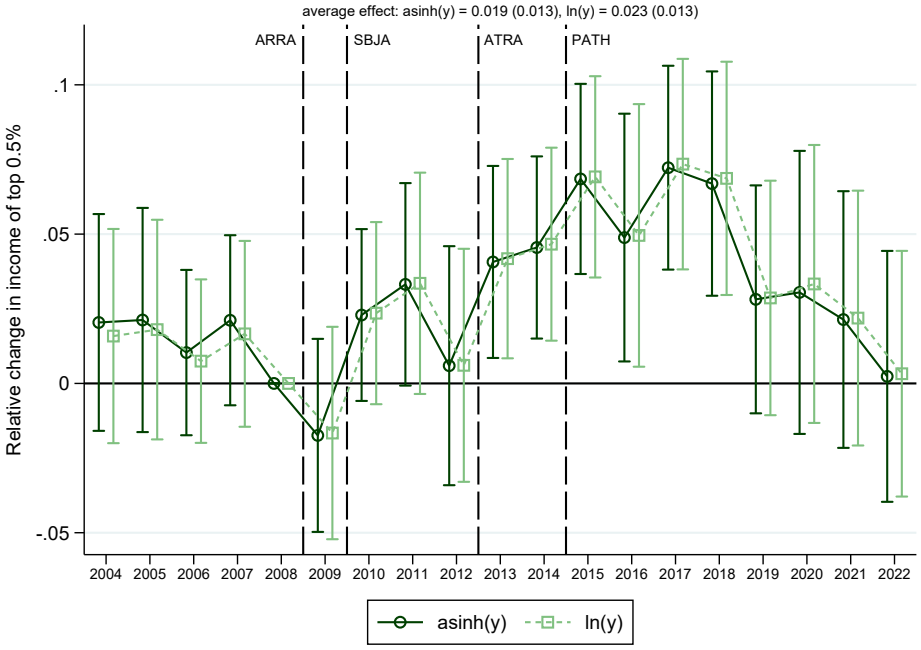
Figure A15: Robustness of Estimates of Equation (1) to Subsamples of States



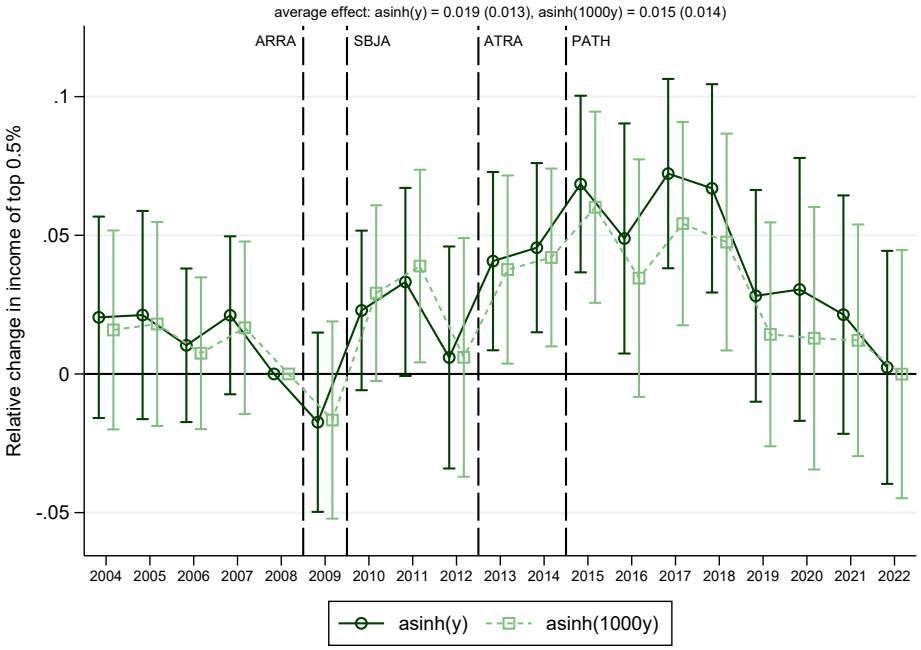
Source: Pitchbook, GEOWEALTH-US.
Notes: The regression is based on 3,192 state-year observations. The average effects reported are based on a modified version of Equation (1) where β_t is replaced with $\beta_{t:t>2008}$. The states without technology hubs exclude only those 9 states (California, Colorado, District of Columbia, Georgia, Illinois, Massachusetts, New York, Texas, and Washington) that contain a city listed as a technology hub on the website of the U.S. technology networking company Built In: https://builtin.com/tech-hubs.

Figure A18: Robustness of Estimates of Equation (3) to Alternative Estimators

(A) asinh $Y_{r,s,t}$ vs. $\ln Y_{r,s,t}$



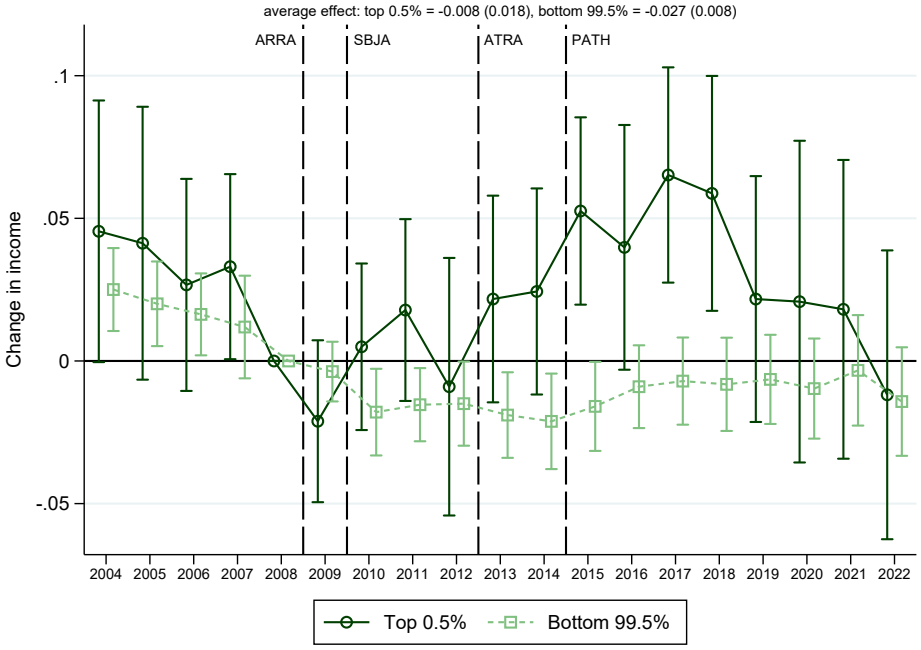
(B) asinh $Y_{r,s,t}$ vs. asinh$(1000 \times Y_{r,s,t})$



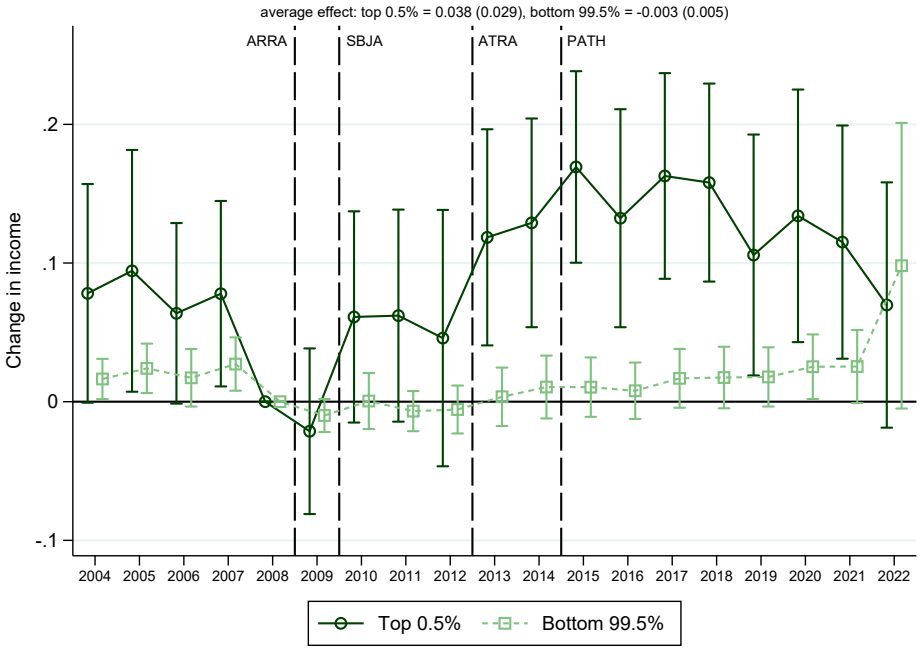
Source: SOI Tax Stats, GEOWEALTH-US.
Notes: Other income includes labor income and capital income. The regression is based on 99,807 state-year observations. The average effect reported is based on a modified version of Equation (3) where β_t is replaced with $\beta_{t:t>2008}$.

Figure A19: Robustness of Estimates of Equation (3) to Alternative Estimators

(A) asinh $Y_{r,s,t}$ vs. $\ln Y_{r,s,t}$

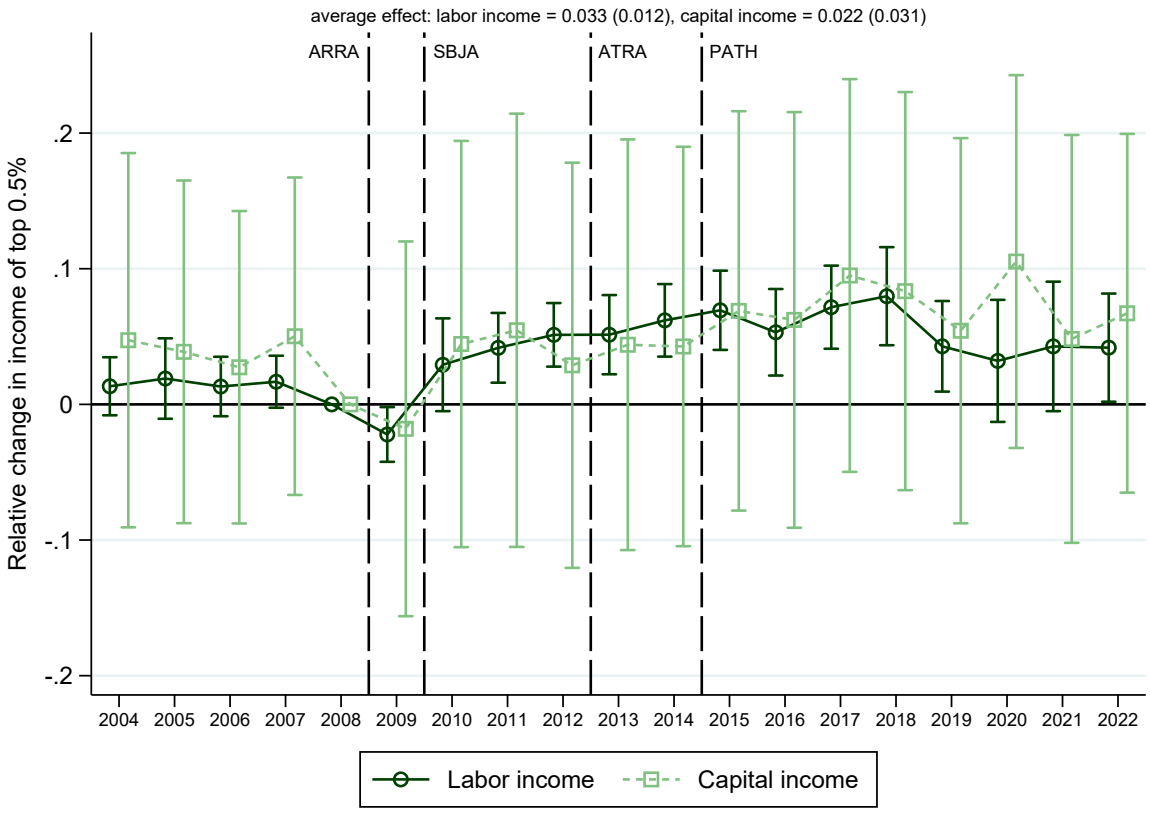


(B) asinh $Y_{r,s,t}$ vs. asinh$(1000 \times Y_{r,s,t})$



Source: SOI Tax Stats, GEOWEALTH-US.
Notes: Other income includes labor income and capital income. The regression is based on 99,807 state-year observations. The average effect reported is based on a modified version of Equation (3) where β_t is replaced with $\beta_{t:t>2008}$.

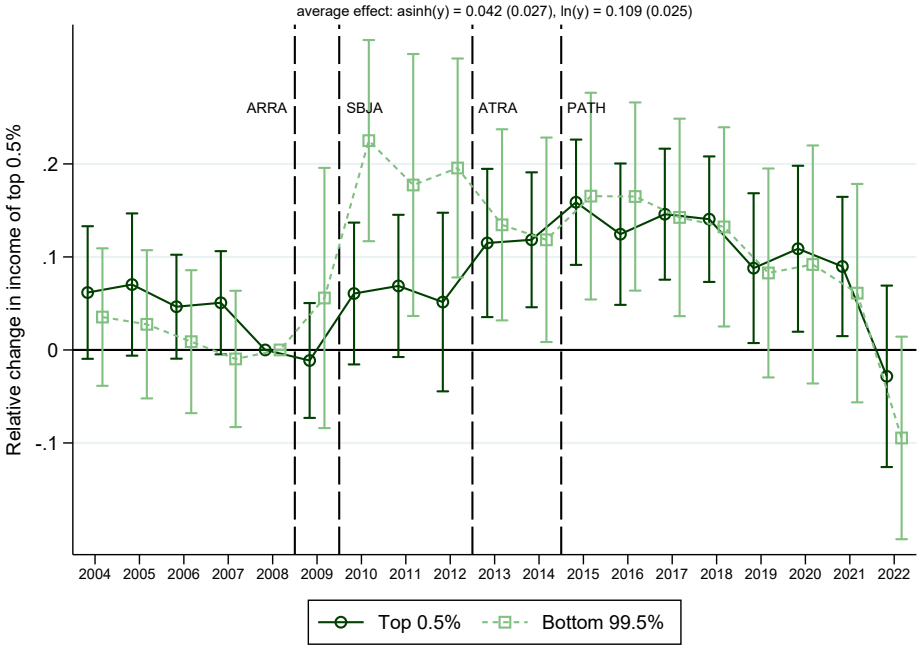
Figure A20: Robustness of Estimates of Equation (1) to Subsamples of States



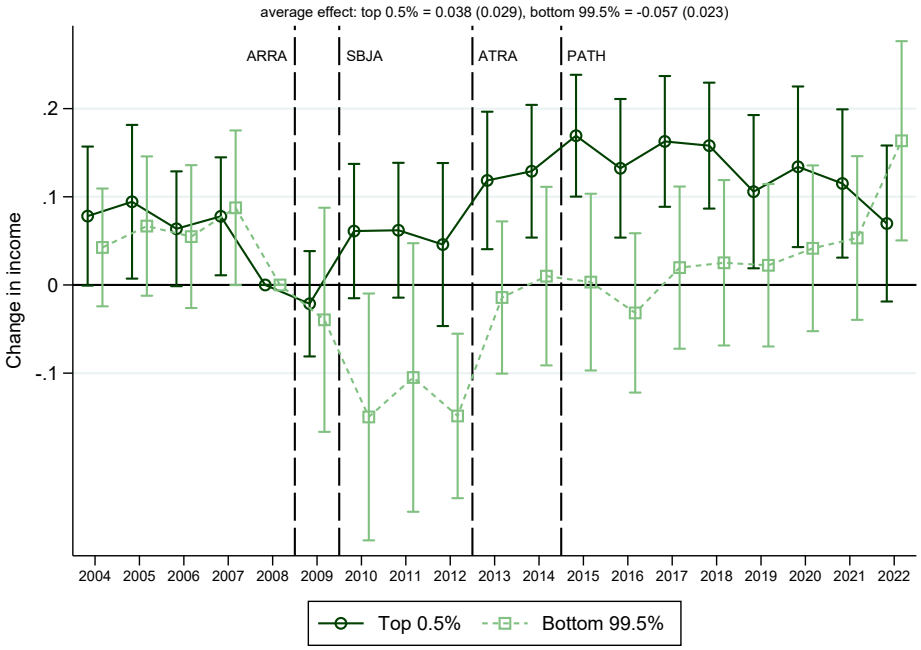
Source: Pitchbook, GEOWEALTH-US.
Notes: The regression is based on 3,192 state-year observations. The average effects reported are based on a modified version of Equation (1) where β_t is replaced with $\beta_{t:t>2008}$. The states without technology hubs exclude only those 9 states (California, Colorado, District of Columbia, Georgia, Illinois, Massachusetts, New York, Texas, and Washington) that contain a city listed as a technology hub on the website of the U.S. technology networking company Built In: https://builtin.com/tech-hubs.

Figure A21: Robustness of Estimates of Equation (3) to Alternative Estimators

(A) asinh $Y_{r,s,t}$ vs. $\ln Y_{r,s,t}$



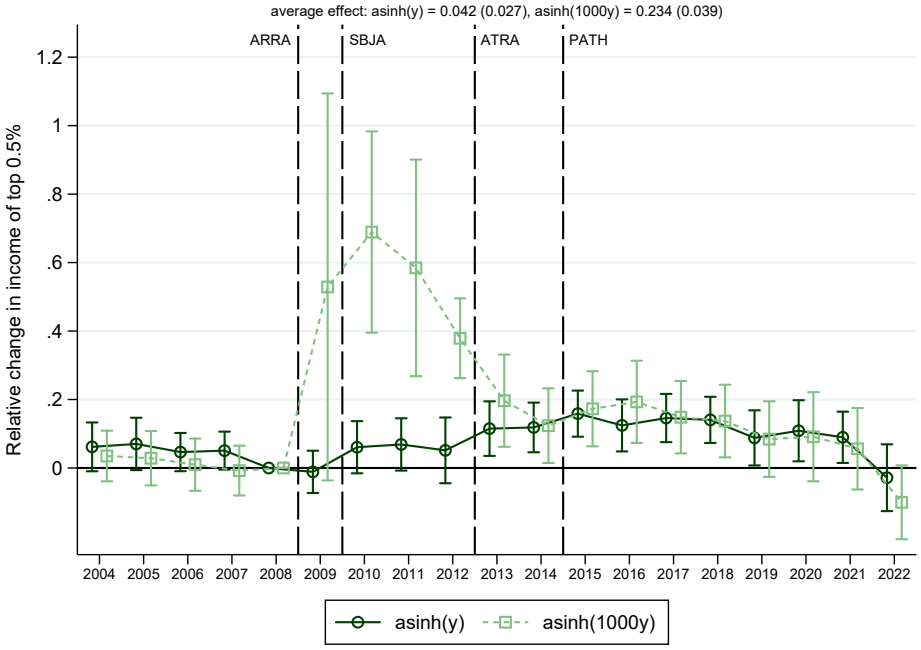
(B) asinh $Y_{r,s,t}$ vs. asinh$(1000 \times Y_{r,s,t})$



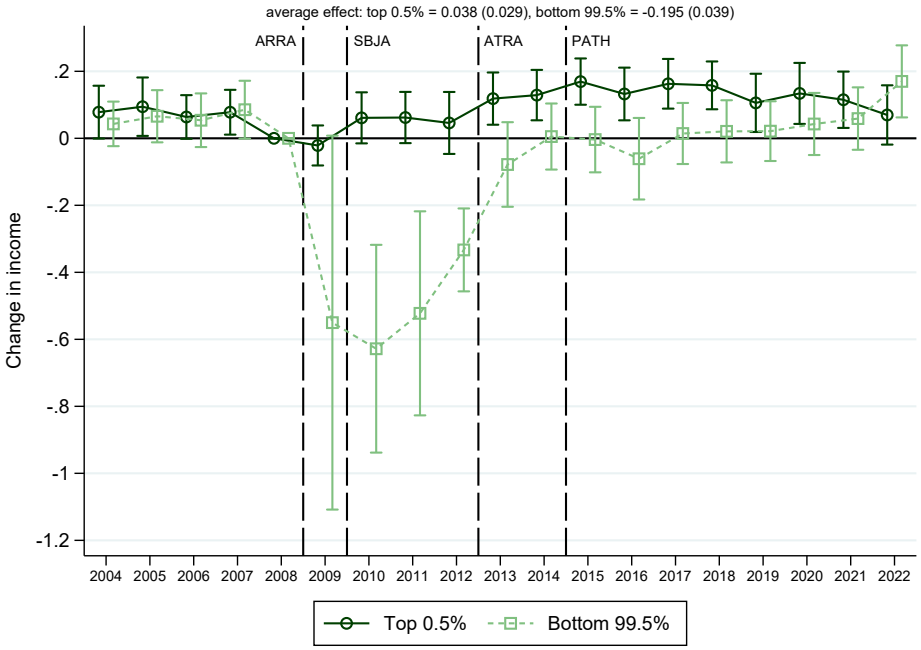
Source: SOI Tax Stats, GEOWEALTH-US.
Notes: Other income includes labor income and capital income. The regression is based on 99,807 state-year observations. The average effect reported is based on a modified version of Equation (3) where β_t is replaced with $\beta_{t:t>2008}$.

Figure A22: Robustness of Estimates of Equation (3) to Alternative Estimators

(A) asinh $Y_{r,s,t}$ vs. $\ln Y_{r,s,t}$

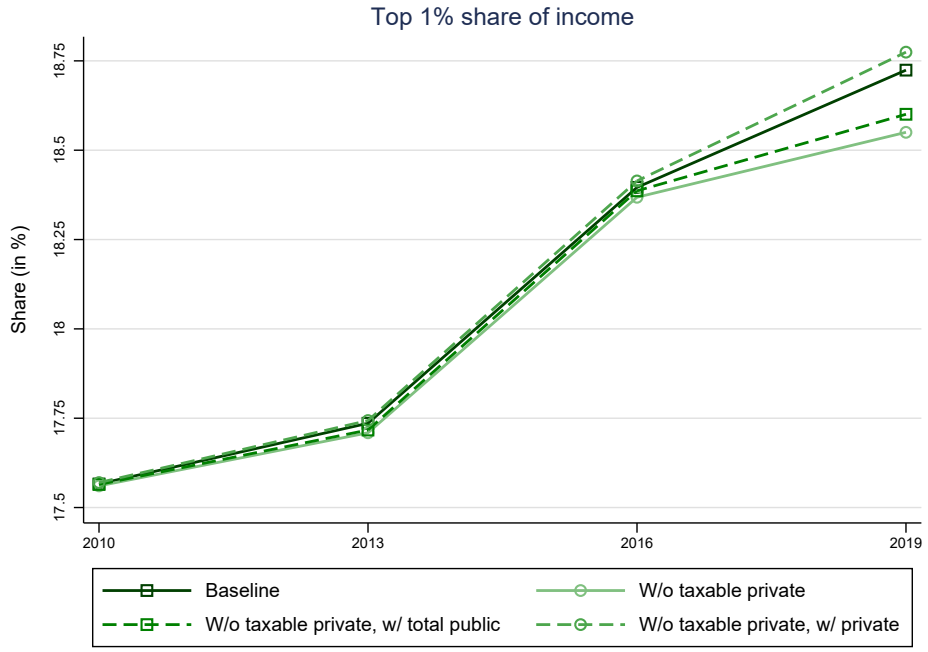


(B) asinh $Y_{r,s,t}$ vs. asinh$(1000 \times Y_{r,s,t})$



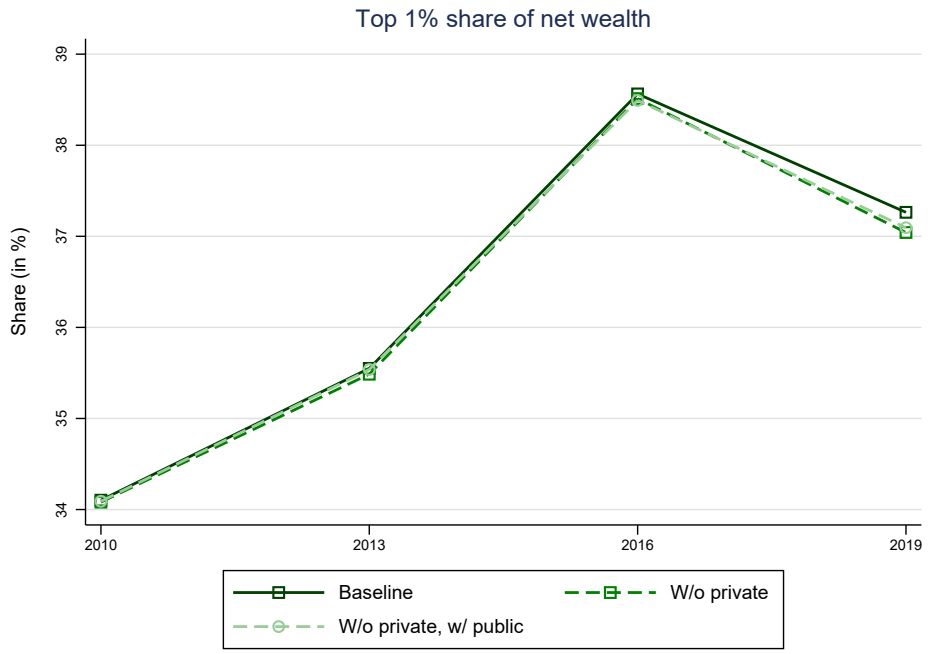
Source: SOI Tax Stats, GEOWEALTH-US.
Notes: Other income includes labor income and capital income. The regression is based on 99,807 state-year observations. The average effect reported is based on a modified version of Equation (3) where β_t is replaced with $\beta_{t:t>2008}$.

Figure A23: VC investments by resident HNWIs vs. number of resident accredited investors



Source: SOI Tax Stats, Pitchbook.
Notes: This figure compares the baseline top 1% taxable income share to the counterfactual top 1% taxable income share over the period 2010-2019 under three different scenarios: no taxable private capital gains; no taxable private capital gains but with counterfactual public capital gains; and no taxable private capital gains, but with total (taxable and non-taxable) private capital gains.

Figure A24: VC investments by resident HNWIs vs. number of resident accredited investors



Source: Survey of Consumer Finances, Pitchbook.
Notes: This figure compares the baseline top 1% wealth share to the counterfactual top 1% wealth share over the period 2010-2019 under two different scenarios: no taxable private capital gains; and no taxable private capital gains but with counterfactual public capital gains.

Table A1: Firm level outcomes

	Probability of HNWI investment	Log of HNWI investments	Probability of staying private	Probability of bankruptcy
Treated x Post	0.021***	0.013*	0.030***	0.001
	(0.006)	(0.007)	(0.009)	(0.006)
Company FE	×	×	×	×
Year FE	×	×	×	×
CCorp x Year FE	×	×	×	×
Industry x Year FE	×	×	×	×
Size x Year FE	×	×	×	×
Observations	336228	336228	336228	336228
R squared	0.223	0.190	0.781	0.434

Notes: Standard errors clustered at the company level. *** p<0.01, ** p<0.05, * p<0.1.

Appendix B: Further Details about Data

B.1 Pitchbook

B.1.1 Data versions

The data to which we purchased access from Pitchbook include datasets on companies that have ever received certain types of financing from capital markets; the specific deals as part of which they received those and other types of financing; and the specific investors who participated in those deals, whether directly or via funds.

We merge together two versions of the data. One version (updated as of 9 August 2024) contains information on companies that have ever received either private equity, venture capital, or pre-venture financing or that are less than two years old. The other version (updated as of 23 November 2023) also contains information on companies that have only ever either received debt financing, been acquired by another company, or been publicly traded.[43] When a company appears in both versions of the data, we consider their information only from the first, more recently updated version.[44]

B.1.2 Companies

We observe a total of 937,903 companies, 62.9% of which appear in the more recently updated version of the data. For 85.4% of companies, we observe the year in which they were founded; for the remaining companies, we will need to impute their missing year founded based on their deal history (see Section B.1.3). We also observe that 40.0% of companies are headquartered in the United States, further observing the state (including the District of Columbia) in which they are headquartered for all but 1.1% of these U.S. companies.

To identify those U.S. companies that are C corporations, we parse their legal name; we observe this for 78.7% of these companies, using their trade name whenever their legal name is missing. We can identify limited partnerships ("LP"), limited liability partnerships ("LLP"), and limited liability limited partnerships ("LLLP"), none of which can be taxed

[43] Pitchbook also tracks companies that are two years old or older but that have never received any of these types of financing. However, these companies are missing from our versions of the data.

[44] Our access to each version of the data is based on a separate license. The first license allows us to update the data at regular intervals but contains information on only a subset of the companies that have ever received financing from private capital markets. In contrast, the second license does not allow for updates but contains information on the whole universe of such companies.

as C corporations. Though we can also identify limited companies ("LC" or "Ltd"), limited liability companies ("LLC"), professional limited liability companies ("PLLC"), and professional corporations ("PC"), these can be—but are not necessarily—taxed as C corporations. We therefore classify only—and all—of the remaining corporations ("Corp" or "Inc") as C corporations.[45] By this classification, 49.7% of the U.S. companies in the data are C corporations.

To next identify those U.S. companies that are active primarily in qualified trades or businesses, we consider each company's primary industry code.[46] We classify a company as active primarily in a disqualified trade or business if its primary industry code is related to either healthcare services, legal services, engineering services, accounting services, consulting services, financial services, performing arts, athletics, hospitality, agriculture, or natural resources.[47] By this classification, 68.7% of the U.S. companies in the data are active primarily in qualified trades or businesses.

Finally, as an initial attempt to identify when—if at all—the aggregate gross assets of each U.S. company first exceeded $50 million, we consider its financial history. In total, we observe 970,345 quarterly financial statements for 82,443 U.S. companies, which represent 22.0% of all the U.S. companies in the data. We calculate gross assets as the sum of "cash and cash equivalents" and "net property, plant, and equipment," observing both in 36.0% of these financial statements.[48]

For only 4,348 U.S. companies do we either observe their gross assets in 2008 or observe their gross assets exceeding $50 million before 2008; for 29.3% of these companies, gross assets never exceeded $50 million in or before 2008. Given this small number of U.S. companies whose gross assets history we observe before the expansions of the QSBS tax exemption in 2009-2010, we will need to consider a proxy for gross assets that can be constructed for a larger number of companies (see Section B.1.3).

Given our classifications of C corporations and of qualified trades or businesses, as well as

[45] Companies seeking financing in capital markets are unlikely to be taxed as S corporations, since these can have at most 100 shareholders (Polsky and Yale 2023).

[46] This is missing for only 0.1% of U.S. companies. In this rare case, we assume that a company missing its primary industry code is active primarily in a disqualified trade or business.

[47] Section 1202 of the Internal Revenue Code requires that at least 80% of the company's assets be used in the active conduct of one or more qualified trades or businesses (Polsky and Yale 2023). However, since we cannot observe how much of its assets a company actually uses in each trade or business in which it is active, we consider only its primary industry code.

[48] In addition to cash, gross assets include "the fair market value of property contributed to the corporation measured at the time of the contribution" and "the adjusted basis of property other than contributed property" (Polsky and Yale 2023). While we expect the "adjusted basis" component to be captured in the "net property, plant, and equipment" measure that we use when calculating gross assets, it is unlikely that this measure accurately captures the "fair market value" component.

our calculation of gross assets, we can classify 18.9% of U.S. companies as eligible issuers of QSBS as of the end of 2008, just before the first expansion of the QSBS tax exemption in February 2009. Once again, however, the companies that we can classify as either QSBS-eligible or -ineligible are limited to only those same 4,348 whose pre-2009 gross assets history we observe.

B.1.3 Deals

We now consider each company's deal history. For all but 1.0% of the 937,903 companies in the data, we observe at least one deal as part of which they received financing from capital markets. Among those companies for which we observe at least one deal, the median company (in terms of the number of deals) received financing twice.

In total, we observe 2,116,217 deals. Of these deals, we drop the 2.2% that were never (or have not yet been) completed.[49] Of the remaining deals, we drop a further 8.5% whose completion date we do not observe, since our analysis of investments and returns will require knowledge of the timing of deals.

We distinguish between different categories of deals. First, using Pitchbook's description of each company as well as its primary industry code, we identify real asset deals that involve purchases of real estate, infrastructure, and natural resources. Then, using the deal types maintained by Pitchbook, we classify each of the remaining deals as either a debt, private equity, venture capital, or other deal. In the private equity category, we include all buyouts, growth/expansion investments, and private investments in public equity ("PIPEs"). In the ventury capital category, we instead include all capitalization, crowdfunding, grant, angel, seed, accelerator/incubator, early-stage, and late-stage investments. Of the 1,894,673 completed deals whose completion date we observe, 2.3% are real asset deals, 8.1% are debt deals, 14.8% are private equity deals, and 40.7% are venture capital deals.

For 50.2% of these deals, we observe their size—that is, the amount of financing that a company received as part of a deal. Since this may have included both equity and debt financing, we can further decompose the deal into its separate equity and debt components. To that end, we observe the amount of equity and debt financing that the company received for 28.2% and 8.4% of these deals, respectively.

Of the 21,436 deals for which we observe the overall size of a deal as well as both its equity and debt components, 93.9% satisfy (to the nearest thousand U.S. dollars) the identity that the size of the deal equals the sum of these two components. Thus, we can use this

[49] These deals could have failed or been canceled after being announced initially. Alternatively, despite already being announced, they could still be in the process of being completed.

identity to impute either the equity or debt component of a deal whenever only one of them is missing but the overall size of the deal is not missing. We can likewise impute the size of a deal whenever it is missing but neither the equity nor debt component of the deal is missing. In this way, we impute the equity component for 15.8% of deals, the debt component for 0.9%, and the overall size for 2.2%.[50]

For the 14.6% of companies whose year founded is missing (see Section B.1.2), we can similarly impute it as the earliest year in which a company ever completed a deal.[51] In this way, we impute the year founded for 93.5% of the companies missing it.

To next calculate a proxy for each company's gross assets (see Section B.1.2), we calculate the total amount of capital raised by the company up to the completion date of each deal. When calculating capital raised, we consider only those deals in which we expect the financing received by the company to have increased the amount of gross assets on its balance sheet.[52] We can calculate capital raised as of the end of 2008 for 28,600 U.S. companies, 80.1% of which had not raised capital in excess of $50 million in total. The number of companies whose pre-2009 capital raised history we observe is therefore more than six times as large as the number of companies whose pre-2009 gross assets history we observe.

Given our calculation of capital raised as a proxy for gross assets, as well as our classifications of C corporations and of qualified trades or businesses, we can classify 46.9% of U.S. companies as eligible issuers of QSBS as of the end of 2008. To verify the accuracy of this proxy-based classification of QSBS-eligible companies, we can compare it to our initial classification of those companies whose gross assets we observe in the data (see Section B.1.2). Of the 3,424 companies classifiable according to both classifications, the proxy-based one correctly classifies 76.9% of the QSBS-eligible companies and 81.2% of the QSBS-ineligible ones. If we restrict this comparison to only the 338 companies founded between 2001 and 2008, the proxy-based classification becomes even more accurate, correctly classifying 82.9% of the QSBS-eligible companies and 93.4% of the QSBS-ineligible ones. Given its accuracy and broader applicability, we will focus on this proxy-based classification for the rest of our analysis.

Finally, we can also use the deal history of each company to identify when it first went

[50] Whenever Pitchbook records the one non-missing component of a deal as exceeding its overall size, or whenever both components of the deal are missing, we impute the deal's missing component(s) by instead considering the equity or debt investments by specific investors as part it (see Section B.1.5). For example, whenever we observe neither any debt component of a non-debt deal nor any debt investments by specific investors as part of it, we set the deal's missing equity component equal to its overall size.

[51] Among companies whose year founded we do observe, this imputed year founded precedes the observed one in less than 0.1% of cases.

[52] For example, this excludes buyouts and debt refinancings.

bankrupt, was traded publicly, or was acquired by another company. This is because Pitchbook tracks bankruptcies, public offerings, and acquisitions as deals. Of the 375,339 U.S. companies in the data, 10.5% eventually go bankrupt, 4.4% are eventually traded publicly, and 50.7% are eventually acquired. We can use the earliest date of each of these different types of events to identify which companies were still active, private, and independent as of the end of 2008. We can also use these dates to observe exactly how long each of these companies remained active, private, or independent after the expansions of the QSBS tax exemption in 2009-2010.

B.1.4 Participants in capitalization deals

We now identify the participants in a particular type of venture capital deals: the capitalization deals as part of which a company's founders, their family and friends, and other investors provide the company with its initial capital. Pitchbook's data model for deals of this type differs from its data models for other deals, for which it directly lists the investments made by specific investors (see Section B.1.5). For capitalization deals, we will instead need to extract the names of the participating investors from Pitchbook's description of each deal, which is missing for only 0.3% of these deals. We will then further need to map each named investor to a unique one of the investor IDs maintained by Pitchbook.

Of the 2,116,217 deals in the data (including the ones that we drop; see Section B.1.3), only 0.2% are capitalization deals. Nevertheless, since the investors participating in these deals at the very start of a company's life will experience outsized increases in the value of their investments if the company succeeds and grows, it will be important to our analysis of returns that we correctly identify these initial investors.

From the string containing the description of each capitalization deal, we extract each substring of consecutively capitalized words, interpreting it as the name of a distinct investor.[53] We then extract further information about whether the company's "founder(s)" or their "family" and "friend(s)" participated in the deal, treating both the group of unnamed founders and the group of unnamed family and friends as additional investors. The result of this text analysis procedure is a list of 7,105 investments by specific investors across 3,797 capitalization deals.

We next identify each company's founders and other board members. For 47.5% of the 937,903 companies in the data, we can identify at least one founder. Furthermore, of

[53] To the best of our abilities, we first clean the text to ensure that only the names of investors (whether individual or institutional ones) are capitalized.

the 7,105 capitalization investments that we observe, we can attribute 52.1% to board members who share their name with an investor and 49.7% specifically to founders.

For those investors that we cannot match to board members, we attempt to match each of them by name to one of the 397,735 investors for which Pitchbook maintains an investor ID.[54] We can successfully match 236 additional investors to unique IDs, but we are left with no information about any of the 376 investors remaining unmatched.

Finally, we consider the investments by unnamed investors. We first drop the 1,250 investments by unnamed founders in deals for which we have already matched at least one named investor to a named founder. We then translate the remaining 402 investments by unnamed founders into 994 investments by the named founders of those companies.[55] We are left with 6,447 investments in capitalization deals, 71.1% of which are by founders, while 16.8% are by their unnamed family and friends.

B.1.5 Investments

We now consider investments by specific investors as part of deals of all types. Pitchbook's data model for equity investments differs from its data model for debt investments, so will we have to consider each data model separately. Moreover, a single deal can involve both equity and debt investments; in such a case, we will have to consolidate these two different types of investments, assigning the investments of each type to the corresponding equity or debt component of the deal (see Section B.1.3).

Of the 2,116,217 deals in the data (including the ones that we drop; see Section B.1.3), 68.1% involve at least one equity investment. In total, we observe 2,705,601 equity investments. 21.7% of these are intermediated by funds, while the majority are made directly by investors without the use of intermediaries.[56] Furthermore, for 17.0% of equity investments, we observe the exact amount invested by a specific investor.

For the remaining equity investments, we must impute the amount invested by each

[54] If there is no investor ID associated with an investor's name, we instead attempt to match it to one of the 3,173,982 people for which Pitchbook maintains a person ID.

[55] We retain only the 58 investments by unnamed founders as part of the capitalization deals for those companies with no named founders.

[56] This is based on whether Pitchbooks names a fund (or multiple funds) through which an investment is made, such that we can ultimately attribute the investment to the fund's limited partners (see Section B.1.6). There may be cases when the named investor is a fund manager but the fund through which it may have invested (on behalf of the fund's limited partners) is unnamed. In this case, we can attribute the investment only to the fund manager, but not to any of the limited partners of the unnamed fund. This attribution is not necessarily inaccurate, since the fund manager is the true investor in cases when it invests on its own behalf as a general partner.

investor. To do this, we first sum the observed amounts invested across the equity investments in the deal. We then subtract this sum from the observed amount invested in total as part of the deal's equity component, distributing the remainder equally across all of the equity investments whose exact amount invested we do not observe.[57]

7.7% of deals also involve at least one debt investment. In total, across 228,321 credit facilities, we observe 554,155 debt investments. 7.6% of these are intermediated by funds.[58] Moreover, we observe the exact amount lent by a specific lender for 20.5% of debt investments, and the exact amount lent in total as part of a specific credit facility for 76.7% of facilities. Whenever either of these amounts is missing, we impute it in the same way that we do the missing amount invested by a specific equity investor.

We next reconcile these equity and debt investments by specific investors with the lists of participants in capitalization deals that we previously identified (see Section B.1.4). This is necessary because, in rare cases, Pitchbook actually records participation in these capitalization deals as such investments. To avoid double-counting, we drop 2.0% of the 6,447 investments in capitalization deals for which we observe either an equity or debt investment by the same investor in the same deal. We then recategorize all the remaining investments in capitalization deals as equity investments, imputing each investment's share of the corresponding deal's equity component. We are left with a total of 3,266,077 investments by specific investors, 83.0% of which are equity investments. For an additional 547,030 deals, we observe no specific investors.

Whenever a deal has both equity and debt components (see Section B.1.3), we separate them. For 38,512 deals, we observe at least one equity investment and at least one debt investment by specific investors. Additionally, we observe 2,342 debt deals with an equity component but no equity investments; 30,585 non-debt deals with a debt component but no debt investments; 1,535 debt deals with only equity investments; and 3,392 non-debt deals with only debt investments. Splitting each of these deals into two, we observe a total of 3,850,961 investments across 2,192,583 deals.[59]

Finally, we distinguish private from traditional debt. The latter includes bank loans and

[57] Whenever the summed amount exceeds the size of the deal's equity component, we first calculate the share of the equity investments whose exact amount invested we do not observe, distributing it equally across this first set of investments. We then distribute the remaining share across the other equity investments whose exact amount invested we do observe, distributing it according to each investment's share of the summed amount invested across this second set of investments.

[58] Only 20.4% of these intermediated debt investments are made through funds for which the fund ID maintained by Pitchbook appears in our versions of the data. For the remaining intermediated debt investments, we are left with no information about the limited partners of the intermediating funds. Thus, we can attribute them only to the fund managers of these funds.

[59] We reassign all equity investments in debt deals to duplicated deals that we recategorize as private equity, and all debt investments in non-debt deals to duplicated deals that we recategorize as debt.

bonds, and the former, all other debt investments by non-bank lenders.[60] Splitting each deal involving both types of debt into two, we are left with 2,213,522 deals.

Of the 1,988,903 completed deals whose completion date we observe, we drop 40.7% that are not private capital market deals.[61] Of the 1,178,794 remaining, 65.4% are venture capital deals, 24.4% are private equity deals, 6.6% are private debt deals, and 3.7% are real asset deals. Across them, we observe a total of 2,468,987 investments.

B.1.6 Investors

We now consider information about the specific investors who have made these private capital market investments. We will first identify the limited partners of funds, attributing any investments intermediated by these funds entirely to their limited partners. We will then identify all investments (whether intermediated or direct) that we can ultimately attribute to high-net-worth individuals (HNWIs).

We observe 44,198 funds in total, 47.7% of which are headquartered in the US. For 48.1% of all funds, we observe at least one limited partner who has committed capital to it. Furthermore, among the 158,248 relationships that we observe between funds and limited partners, the limited partners are HNWIs in 3.4% of the cases.[62]

We next determine how much of each fund's investments can be attributed to each of its limited partners. We observe the exact amount committed by a limited partner for 47.5% of the 165,646 commitments in the data.[63] Whenever this amount is missing, we impute it in the same way that we do the missing amount invested by a specific investor as part of a deal (see Section B.1.5).[64]

We then attribute the 356,076 private capital market investments intermediated by funds for which we observe at least one limited partner to their limited partners. Specifically, we replace these investments by the funds' fund managers with the corresponding 4,446,362 investments by their limited partners. Given the 2,112,911 direct investments that we

[60] We categorize all debt investments by lenders of an unknown type as traditional debt.

[61] These include traditional debt deals, mergers/acquisitions, and IPOs, among other deal types.

[62] In 21.7% of these cases, the limited partners are family offices or wealth management firms that have invested on the behalf of HNWIs.

[63] This exceeds the number of relationships that we observe between funds and limited partners, since the same limited partner can commit to the same fund multiple times.

[64] To do this, we compare the sum of the observed amounts committed across the fund's limited partners to the observed size of the fund overall. In the rare cases when we do not observe the size of the fund, we impute it based on its target size as set by its fund manager(s) at its inception.

also observe, we are left with a total of 6,559,273 investments.[65]

Finally, we consider similar information about the specific investors who have invested directly in companies. After doing so, we find that, across all direct and intermediated investments, 63.1% are made by investors headquartered or residing in the US.[66] Furthermore, 6.7% of all these investments are attributable to HNWIs, 78.7% of whose investments are made as part of venture capital deals.[67] We lastly identify investments by companies' founders, including but beyond those that they have made as part of capitalization deals (see Section B.1.4); overall, 1.5% of all venture capital investments made by HNWIs are by founders who are financing their own companies.

B.1.7 Valuations

We now consider how the valuation of each company changes over time. Whenever a company receives financing as part of a new deal, its investors and its management must agree on its new valuation. By comparing its new pre-money valuation (*before* accounting for the financing that it receives as part of the new deal) to its previous post-money valuation (*after* accounting for the financing that it received as part of its previous deal), we will be able to calculate the returns that its existing investors earned on their investments (see Section B.1.8) in a way that accounts for any dilution of their shares between deals.

Since our analysis of returns will start from 2001, we consider the 1,819,835 deals that were completed after 2000. Of these, we have complete information about the valuation of the company receiving financing—that is, about both its pre- and post-money valuations as part of a deal, as well as the size of the equity component of that deal (see Section B.1.3)—for only 11.8%.

96.7% of these deals with complete valuation information satisfy (to the nearest thousands U.S. dollars) the identity that the equity component of a deal equals the difference between the company's post- and pre-money valuations. However, for 14.6% of these, Pitchbook only estimates the company's valuation (rather than observing it). When constructing each company's valuation history, we will consider only the 177,738 deals whose valuation

[65] In terms of the size of each investment, the intermediated investments tend be smaller than the direct ones. For example, the size of the median intermediated venture capital investment is about $0.115 million, while that of the median direct venture capital investment is about $0.583 million.

[66] For all the founders of a company and their family and friends who participated in a capitalization deal for it (see section B.1.4) but for which we have no additional information, we assume that they reside in the same location as the company's headquarters.

[67] In addition to HNWIs themselves, their family offices, and their wealth managers, we also include angel groups in this classification. These refer to groups of HNWIs who meet together to coordinate their angel investments in startup companies.

neither violates this identity nor is estimated by Pitchbook.

For the remaining deals, we will need to impute the missing valuations of the company receiving financing. For our baseline analysis of returns (see Section B.1.8), the only imputation that we apply is to the 89,965 deals that identify when a company went permanently bankrupt, in which case we impute the company's valuation as \$0.01.[68]

Of the 267,703 deals (in our baseline analysis) for which we either observe or impute the valuation of the company receiving financing, we drop 123 that were completed on a date on which multiple deals were completed for that same company.[69] We also drop 60,817 for those companies for which we observe only one such deal, since we need to observe the valuation of a company at least twice (and on two different dates) in order to even be able to consider how its valuation has changed over time.[70]

For the 206,763 remaining deals that we observe across 110,191 companies, we first calculate the number of days between consecutive deals for each company as well as the percent change between its previous post-money valuation and new pre-money valuation. We then convert this percent change into a daily compounded rate.[71] We lastly use this rate to construct the daily history of valuation changes for each company from 2001 to 2024, applying a rate of zero to all dates preceding the completion date of the company's first deal and following the completion date of its last deal.

We next construct an alternative, pessimistic valuation history for each company. We first assume that, in addition to the bankruptcies that we actually observe, every company that has received no new financing since the end of 2021 went bankrupt three years after the date of its last deal. We also assume that, for the remaining companies whose valuation we observe less than twice, their valuation has never changed.[72]

Finally, in order to be able to compare the returns earned by investors on all of their venture capital investments to counterfactual returns that they would have earned had they instead invested in publicly listed stocks (see Section B.1.8), we consider a complete and

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[68] In rare cases (where we do not apply this imputation), a company went bankrupt only temporarily before later receiving financing and being attributed a positive valuation as part of a new deal.

[69] We keep only the last deal (in terms of its deal number) completed on that date for that company.

[70] To ensure that we capture the losses of investors on their investments in companies that eventually go bankrupt but whose valuation we never observe, we first impute the valuation of each such company (as part of every one of its deals) as a fixed \$1 million.

[71] If D is the number of days between deals for the company and R is the percent change between its previous post-money valuation and new pre-money valuation, then the daily compounded rate is $r = \exp\left(\frac{\ln(1+R)}{D}\right) - 1$. This follows from $(1+r)^D = 1+R \implies D \times \ln(1+r) = \ln(1+R) \implies \ln(1+r) = \frac{\ln(1+R)}{D} \implies 1 + r = \exp\left(\frac{\ln(1+R)}{D}\right) \implies r = \exp\left(\frac{\ln(1+R)}{D}\right) - 1$.

[72] This is in contrast to our choice to drop these companies from our baseline analysis.

more sophisticated imputation of the valuation of each company in every year since their founding (and until their eventual bankruptcy, if it ever occurs).[73] Using the valuations of those companies whose valuation we observe at least twice (which thereby allows us to control for company fixed effects), we estimate a regression of their log valuation on observable company-level characteristics, interacted with year fixed effects.[74] We then use the estimated parameters from this regression to predict the change in each company's valuation over time.[75]

B.1.8 Investment returns

We now consider the returns earned by investors on their venture capital investments, using the valuation history that we constructed for each company (see Section B.1.7). After calculating these actual returns, we will also calculate the counterfactual returns that they would have earned had they instead invested in publicly listed stocks.

We first consider the returns earned by U.S. HNWIs on their 92,829 venture capital investments in U.S. companies from 2001 to 2022.[76] For each investment, we calculate the change in its value since the date on which the HNWI to which it is attributable initially made the investment; we do this until the date on which the HNWI eventually exited the investment, which we observe for 35.7% of these investments.[77] We then calculate the return (in U.S. dollars) earned by the HNWI in each year in which they held the investment, also calculating the corresponding rate of return.[78]

[73] If we observe multiple deals for a company during a given year, we impute the company's valuation as part of every deal for which its valuation is otherwise missing during that year.

[74] Specifically, we estimate triple-interacted sector-by-stage-by-year fixed effects in the regression. We classify companies into four aggregated sectors (with each company's sector classification fixed over time): business-to-business products/services; business-to-consumer products/services; information technology; and all other industries (including energy, financial services, healthcare, and materials/resources). We also classify companies into eight stages of maturity based on the number of times that they have receiving financing (with each company's stage classification changing over time): one, two, three, four, five, six, seven, and eight times or more.

[75] For each deal as part of which we observe a company's valuation, we first calculate the difference between its valuation and the value predicted by the regression. We then add this difference to the predicted value for each year in which we do not observe the company's valuation, taking the difference from the most recent deal for which we observe its valuation and therefore can calculate the difference between the valuation and the predicted value.

[76] 81.5% of these investments are direct, while only 18.5% are intermediated by funds (see Section B.1.6). It is for this reason that we focus on HNWIs' returns on their direct and intermediated investments in companies, rather than on their commitments to funds.

[77] After the HNWI exits the investment, we assume that they hold their proceeds from the sale in the form of cash, such that there is no further accumulation of value. Since we make the same assumption for the exited counterfactual investments in publicly listed stocks, this assumption does not affect our analysis of the differences between HNWIs' actual and counterfactual returns.

[78] In a given year, the annual rate of return of an investment will differ from its annualized rate of return

We can calculate these returns using each of the three distinct methodologies that we used to construct the valuation history for each company: our baseline methodology that considers only those valuations and bankruptcies that we can actually observe, a pessimistic alternative that assumes additional bankruptcies, and complete imputation of every company's valuation in every year (see Section B.1.7). While we can calculate returns for all 92,829 investments using the latter two methodologies, we can calculate returns for only 64.2% of them in our baseline analysis.[79]

We next consider how to aggregate returns across investments. Most transparently, we simply aggregate the value of all investments as of the end of each year.[80] However, we can also calculate the rate of return that all HNWIs earned across all their investments pooled together; specifically, we calculate the pooled internal rate of return (rather than an average rate of return across investments) to accurately account for the timing of their entries into new investments and their exits from existing ones.[81]

We also calculate the counterfactual returns that investors would have earned on their venture capital investments had they instead invested in publicly listed stocks. To do this, rather than let the value of each investment in a company evolve according to the valuation history that we construct for that company (see Section B.1.7), we let it evolve according to the history of one of three major stock indices: the S&P 500, the NASDAQ 100, or the Russell 2000.[82] We then compare these counterfactual returns to the actual returns that investors earned on their venture capital investments.

In Section 3.2, we find that early-stage investments yielded excess returns relative to public stock markets. To evaluate the robustness of this stylized fact, Figure A6, Panel A shows that our imputation of valuations (for companies whose valuation we do not observe

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if the HNWI held the investment for less than the whole year—that is, if they either entered or exited the investment during the middle of the year. Specifically, if the annual rate of return on an investment is R, the number of days that the investment was held during the year is D, and the number of days during that year is $d \in \{365, 366\}$, then the annualized rate of return is $r = \left[\exp\left(\frac{\ln(1+R)}{D}\right)\right]^{d} - 1$, such that $r = R$ only if $d = D$. This formula follows directly from the one that we already derived to convert the annual rate R into a daily one (see footnote 29).

[79] This is because, for each of the companies that received the remaining investments, we observe less than two valuations across time (see Section B.1.7).

[80] This includes not only investments that HNWIs had entered during previous years but that they had not yet exited as of the start of that year, but also investments that they newly entered.

[81] We treat each investment's initial value during each year as a negative cash flow and its final value as a positive one. We then aggregate the cash flows for each date of that year, apply the formula to calculate the daily internal rate of return, and convert that rate into an annualized rate.

[82] We consider the Total Return versions of these indices, since a publicly listed company may pay investors dividends, which, we assume, they would immediately reinvest in the company's stock. In contrast, we assume that the startup companies in which they actually invest pay no dividends.

in certain years) does not meaningfully alter the rate of return that we calculate; the only exception is in 2004—the first year of our analysis—when there were few early-stage investments by HNWIs. Since we cannot construct the history of the rate of return on the equity of companies whose valuation we do not observe at least twice (see Section B.1.7), the total accumulated value of investments is necessarily lower when we do not impute valuations, as shown in Panel B. This imputation is therefore essential for accurately quantifying the scale of HNWIs' returns on all of their early-stage investments, quantities which we use in our analysis in Section 5.2.

As a last robustness check, we further consider the following pessimistic scenario. We assume that, if a company (whose bankruptcy we do not otherwise observe) has raised no new financing since 2021, then it went bankrupt three years after its latest deal. We also assume that, for each of the remaining companies whose valuation we do not observe (and cannot impute) at least twice, its valuation has never changed. Figure A7 shows that the implications of Figure A6 do not change much under this pessimistic scenario—that is, HNWIs' average rate of return on their early-stage investments remains elevated.

Finally, we calculate the realized returns that U.S. HNWIs have earned from their venture capital investments in U.S. companies that they have already exited. Of the 33,161 such investments that we observe, the average number of years that an HNWI held an investment before exiting it was 4.7 years. Thus, when comparing HNWIs' realized returns on these investments to the counterfactual in which they had instead invested in publicly listed stocks, we impute the missing exit date of each investment (which we do not otherwise observe as exited) as the end of the year five years after the date on which the deal (as part of which the investment was made) was completed.

B.2 GEOWEALTH-US

This section validates the baseline state-level measure of HNWIs we use in the regression analyses of Sections 4.2.1 and 5.1. As described in Section 2.2, we rely on the measure provided by Suss et al. (2024), who define HNWIs so as to resemble as closely as possible the SEC's legal definition of accredited investors, that is, those whose net worth exceeds $1m (excluding their primary residence) or whose household income exceeds $300,000. We validate this measure by comparing it with with alternative estimates for the number of high-net worth individuals in the U.S. provided by Phoenix/MarketCast Wealth and Affluent Monitor, Forbes 400, Credit Suisse/UBS, and the Survey of Consumer Finances.

Figure B1, Panel A depicts the correlation between the state-level average measure of Suss et al. (2024) and the one provided by Phoenix/MarketCast in its Wealth and Affluent

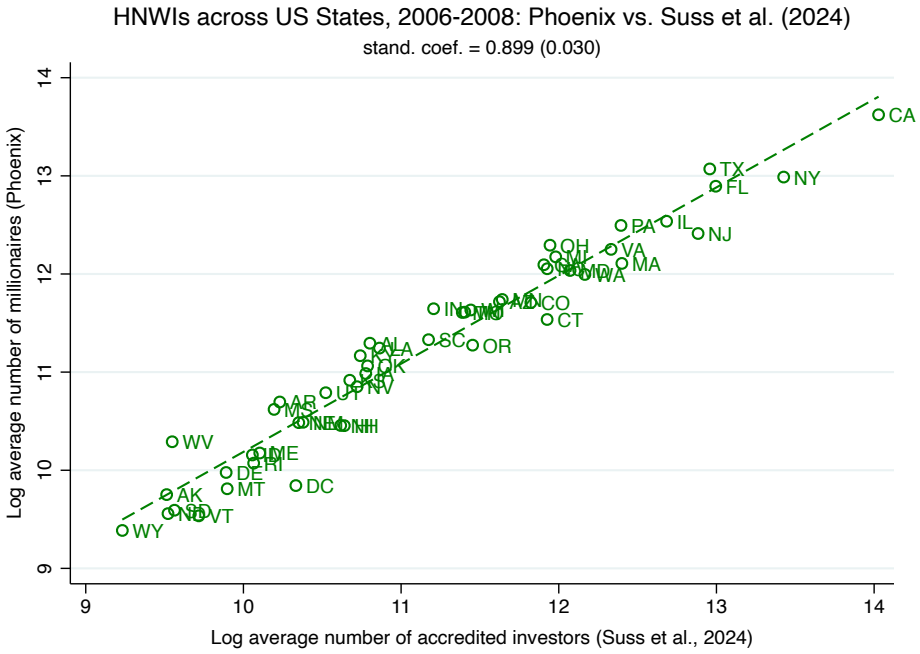
Monitor over the period 2006-2019. The latter measure is an estimation of the number of resident HNWIs across U.S. states with $1 million or more in investable assets. They arrive to these estimates by combining information from the Survey of Consumer Finances with data from Nielsen-Claritas. The correlation between the two measures is quite high and it amounts to approximately 0.9. The differences between the two measures are likely driven by the fact that Suss et al. (2024) estimates are for accredited investors (i.e., those whose net worth exceeds $1m (excluding their primary residence) or whose household income exceeds $300,000), while Phoenix/MarketCast are for millionaires in investable assets.

Figure B1, Panel B shows the correlation between the state-level average measure of Suss et al. (2024) and the one based on the Forbes 400 list of richest Americans over the period 2006-2019. This list has been published each year since 1982 and we use the digitized and harmonized series from Saez and Zucman (2022). The correlation between the two measures is quite high and it amounts to approximately 0.8. The differences between the two measures are likely driven by the fact that Suss et al. (2024) estimates are for accredited investors (i.e., those whose net worth exceeds $1m (excluding their primary residence) or whose household income exceeds $300,000), while the Forbes 400 list only includes billionaires.

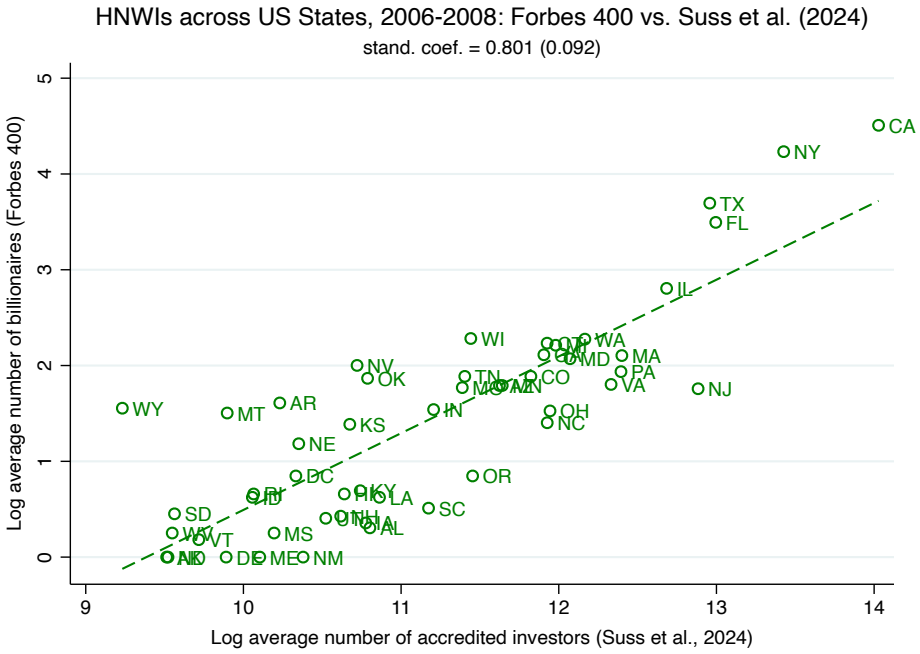
Figure B2, Panel A compares the evolution of the total number of accredited investors residing in the U.S. from Suss et al. (2024) with the total number of millionaires estimated by Credit Suisse over the period 2006-2019. The time series correlation between the two measures is quite high and it amounts to approximately 0.5. The differences across the two measures are likely driven by the fact that Suss et al. (2024) provide estimates for the number of accredited investors, while Credit Suisse estimates are for the total number of millionaires. Furthermore, the estimates for Suss et al. (2024) are based on household units, while Credit Suisse provides estimates based on individual units.

Finally, Figure B2, Panel B contrasts the evolution of the total number of accredited investors residing in the U.S. from Suss et al. (2024) with that obtained using by the Survey of Consumer Finances (SCF) over the period 2006-2019. The differences in levels across the two measures are likely driven by the fact that Suss et al. (2024) do only use the SCF to predict wealth and not directly to count the number of HNWIs.

Figure B1: HNWIs across U.S. States, 2006-2019

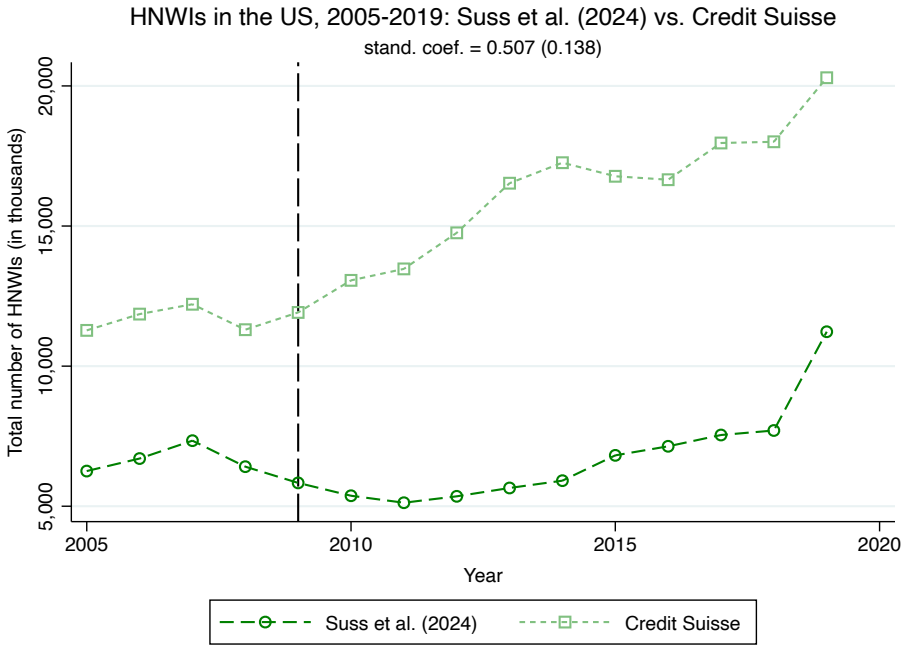


(A) Suss et al. (2024) vs. Phoenix

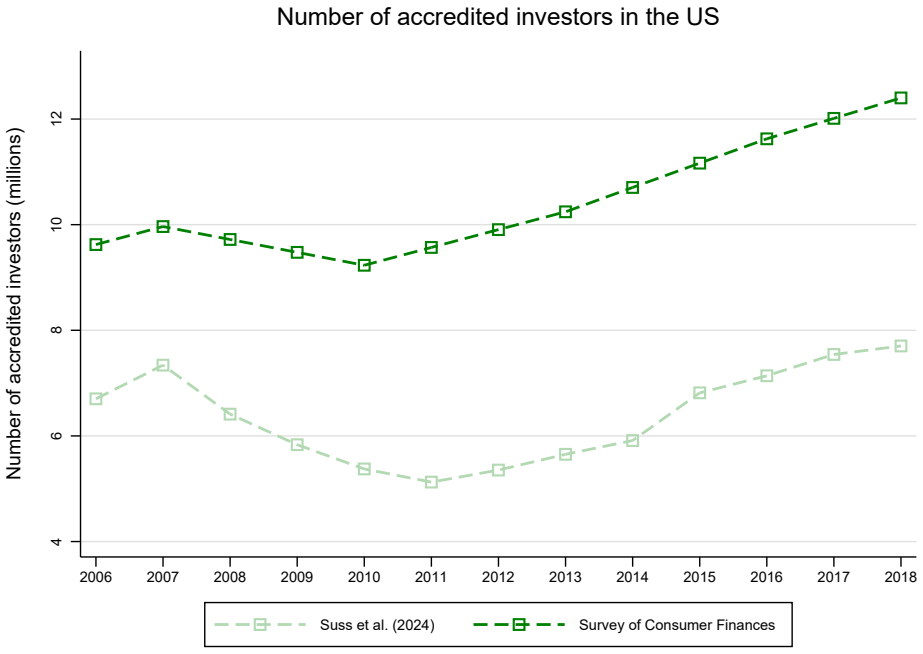


(B) Suss et al. (2024) vs. Forbes 400

Figure B2: HNWIs in the US, 2006-2019



(A) Suss et al. (2024) vs. Credit Suisse



(B) Suss et al. (2024) vs. SCF