RICH PICKINGS? RISK, RETURN, AND SKILL IN HOUSEHOLD WEALTH

Laurent Bach, Laurent E. Calvet, and Paolo Sodini*

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We investigate wealth returns on an administrative panel containing the disaggregated balance sheets of Swedish residents. The expected return on household net wealth increases with net worth, exceeding the risk-free rate by 9% for households in the top 0.01%. The expected wealth return is driven by systematic risk-taking and exhibits strong persistence. Idiosyncratic risk is transitory but sufficiently large among business owners to generate substantial long-term dispersion in returns in top brackets. We estimate the distribution of the geometric average return on gross wealth over a generation. Heterogeneity in returns explains most of the historical increase in top wealth shares.

*ESSEC Business School, 3 Avenue Bernard Hirsch, 95021 Cergy-Pontoise, France; bach@essec.edu. Calvet: Department of Finance, EDHEC Business School, 393 Promenade des Anglais, BP 3116, 06202 Nice Cedex 3, France, and CEPR; Laurent.Calvet@edhec.edu. Sodini: Department of Finance, Stockholm School of Economics, Sveavägen 65, Box 6501, SE-113 83 Stockholm, Sweden, and CEPR; Paolo.Sodini@hhs.se. We are grateful to the editor and three anonymous referees for many insightful comments. The paper also benefited from helpful feedback from Luc Bauwens, Jan Bena, Jess Benhabib, Alberto Bisin, John Y. Campbell, Jack Favilukis, Adlai Fisher, René Garcia, Luigi Guiso, Tullio Jappelli, Alexander Kempf, Kai Li, Florencio Lopez de Silanes, Marco Pagano, Kim Peijnenburg, Pierre Picard, Thomas Piketty, Patrice Poncet, Joshua Rauh, Per Strömberg, Pietro Veronesi, Daniel Waldenström, Fabrizio Zilibotti, and seminar participants at the Bank of Italy, Ecole Normale Supérieure de Cachan, Ecole Polytechnique, EDHEC Business School, ENSAE, ESCP Europe, ESSEC Business School, the European Central Bank, HEC Paris, the National University of Singapore, Paris Dauphine University, the Paris School of Economics, Piraeus University, the Shanghai Forum 2016, the Stockholm School of Economics, Stockholm University, the Sveriges Riskbank, the Swedish Ministry of Finance, Université Catholique de Louvain, the University of British Columbia, the University of Melbourne, the University of Naples, the University of New South Wales, the University of Technology Sydney, the 2016 Cologne Colloquium on Financial Markets, the 2016 CEPR European Conference on Household Finance, the 2016 NBER Summer Institute, and the 2017 Meeting of the Western Finance Association. We are especially grateful to Statistics Sweden for providing the data. Nikolay Antonov provided excellent research assistance.

The concentration of wealth far exceeds the concentration of labor income and exhibits rapid growth in the United States and around the world (Piketty 2014, Saez and Zucman, 2016). Economic theory implies that wealth returns, which allow household savings to accumulate multiplicatively over time, should play a fundamental role in explaining these empirical regularities (Benhabib Bisin and Zhu 2011, De Nardi and Fella 2017). The impact of wealth returns on capital concentration should be considerably amplified if returns are heterogeneous across households (Piketty 2014), and multiple sources of heterogeneity have been considered in the literature (Gabaix Lasry Lions and Moll 2016). Some households may earn high average returns due to high investment skill or risk tolerance, a channel often referred to as *type dependence*. A complementary mechanism, called *scale dependence*, considers that households with high net worth earn high average returns, for instance because they have access to better information or investment opportunities than others or they exhibit decreasing relative risk aversion. Recent calibrations show that differences in long-term average returns should be prime drivers of the level and dynamics of top wealth shares, and the dispersion in household returns has emerged as a key variable in the macroeconomic literature (Benhabib Bisin and Luo 2018, Hubmer Krusell and Smith 2018).

Despite these theoretical advances, the empirical analysis of wealth returns has hitherto been hampered by the lack of comprehensive data on household balance sheets. The investigation of household wealth traditionally relies on sources that do not permit the proper measurement of wealth returns. Tax records contain only realized capital gains and flow payments, while estate records provide no information on capital income. The few existing studies on average rates of return across the wealth distribution are restricted to U.S. foundations or university endowments (Piketty 2014, Saez and Zucman 2016). The distribution and determinants of household wealth returns therefore remain open empirical questions.

In recent years, the growing availability of high-quality administrative datasets has made it possible to investigate in greater detail the returns on specific components of household balance sheets. Calvet Campbell and Sodini (2007) focus on liquid financial assets, excluding pension wealth and debt from consideration. They show that households with large portfolios of financial assets tend to tilt the portfolio allocation toward risky financial securities and also bear high exposures to systematic and idiosyncratic risks. These properties may have important implications for the distribution of household total net wealth and its dynamics, which remain to be explored.

Making progress in this direction requires detailed information on other components of household balance sheets, such as real estate, private equity, pension wealth, and debt. These components are critically important because they largely dominate financial assets in value terms in the balance sheets of most households and also have markedly different return properties (Knoll Schularick and Steger 2017, Moskowitz and Vissing-Jørgensen 2002). The analysis of wealth inequality also makes it necessary to have access to a sizable and representative sample of households from top wealth brackets, who control a large share of national assets. Traditional surveys do not meet these requirements. For instance, the U.S. Survey of Consumer Finances (SCF) contains only about 700 households from the top 1% of the wealth distribution and the response rate in the top percentile is only 12% (Kennickell 2009).

In this paper, we overcome the data challenge by relying on an administrative panel containing the full balance sheet of every Swedish resident between 2000 and 2007. The panel is based on the Swedish Income and Wealth Registry, one of the most comprehensive sources on household finances available in the world. We complement it for the first time with information on funded pension wealth and household holdings of private equity. Overall, our panel contains the debt level, funded pension wealth, and disaggregated non-retirement holdings of every household on December 31st of each year, reported at the level of each bank account, financial security, private firm, and real estate property.[1]

The paper makes several contributions to the literature. First, we develop a comprehensive methodology for estimating the historical total return on household wealth. The measurement

[1]The panel is a substantially expanded version of the dataset used in earlier work (Betermier Calvet and Sodini 2017, Calvet Campbell and Sodini 2007, 2009, Calvet and Sodini 2014), which is primarily based on the Swedish Income and Wealth Registry. Furthermore, while earlier work focuses for computational convenience on a small random subsample of 2% of the population, the present paper uses the entire population of Swedish households, including the very richest.

of wealth returns is challenging because it requires the measurement of *realized* and *unrealized* capital gains as well as flow payments (interest, dividends, non-pecuniary services). The Swedish panel allows us to measure the cost or return of every component of a household's balance sheet. Specifically, we observe directly the cost of debt to each household, and we obtain the returns on liquid and pension-related financial assets from market security data, the returns on private equity from the balance sheets of private firms in which the household has a stake, and the returns on real estate from detailed indexes specific to location and property type.

Second, the panel allows us to go beyond historical returns and also measure expected return and risk. Asset returns are known to be noisy, so that long histories are required to estimate an asset return's population mean from its sample mean (Merton 1980). For this reason, we use asset-pricing models appropriate for each asset class to estimate the expected return, systematic and idiosyncratic risk, and risk-adjusted return of the full balance sheet of every household at the yearly frequency. This step is also essential to assess the properties of household returns over a long horizon.

Third, we document the risk characteristics of total *gross* wealth, defined as the household's portfolio of financial, real estate, private equity, and pension assets, excluding debt from consideration. Compared to the median household, wealthier households allocate substantially higher shares of total gross wealth to risky financial assets, commercial real estate and, especially at the very top, private equity. This asset allocation channel is reinforced within each asset class by the wealthy's appetite for assets that load aggressively on priced factors. The gross wealth of households with higher net worth therefore entails higher levels of *systematic* risk. As a result, the expected return on total gross wealth monotonically increases with household net worth, exceeding the risk-free rate by 2.1% per year on average for the bottom 10% of households, 4.8% per year for the top 10%-5%, 6.3% per year for the top 1%-0.5%, and 8.9% per year for the top 0.01%. Moreover, the level of *idiosyncratic* risk also increases with net wealth due to the increasing share of directly held private and public equity. The idiosyncratic volatility of the gross wealth return thus ranges from 1.6% per year in the bottom decile to 6% per year for the top 10%-5%, 13.4% per year for the top 1%-0.5%, and 34.7% per year for the top 0.01%.

Fourth, we document the characteristics of household *net* wealth, defined as total gross wealth minus debt. The expected return on net wealth exceeds the risk-free rate by 0.5% for households in the second decile, approximately 4.5-5% for households in the 30th-90th percentiles, and 9.2% for households in the top 0.01%. At the very bottom of the distribution, debt costs are very high and debt is not primarily used to fund high-return investments, inducing very low expected returns on net wealth. On a wide middle range of the net worth distribution, the expected return on net wealth is virtually constant. Households in this range have highly levered positions in real estate that generate high expected returns; they also face high debt costs but the data show that the positive impact of leverage on expected returns dominates the negative impact of debt costs. In higher brackets, households have lower leverage and expected returns on gross and net wealth are very similar. In comparison with gross wealth, the expected return on net wealth is lower in bottom deciles but significantly higher in the middle of the distribution.

Fifth, we do not find evidence that the wealthy have exceptional investment skill. We establish that the historical returns on the wealth of Swedish households are predicted very accurately by their exposures to real estate and equity risks. In particular, we do not detect that the rich can better pick stocks and generate higher risk-adjusted returns than other households. Similarly, we do not measure abnormal risk-adjusted returns on private equity holdings, which confirms that Moskowitz and Vissing-Jørgensen's (2002) private equity results from the U.S. SCF also hold in our administrative Swedish dataset. We also verify the robustness of our results on a dataset containing the yearly returns of U.S. foundations over a 28-year period. Consistent with Saez and Zucman (2016), we show that wealthier foundations earn higher average returns on their assets, which mirrors the patterns in Swedish household wealth data. We establish that the historical returns of U.S. foundations are fully explained by their exposures to the equity market, while exceptional investment skill cannot be detected.

Sixth, we provide reduced-form evidence of the effect of return heterogeneity on the dynamic of inequality in Sweden. We find that, over the 2000 to 2007 period, household historical returns alone explain with good accuracy the level and volatility of changes in top wealth shares. These findings confirm that the empirical regularities documented in this paper are first-order for the wealth inequality literature.

Seventh, we use the population of Swedish twins to investigate scale and type dependence in returns. We find that expected returns earned by each member of a twin pair are very correlated, which is strong evidence of type dependence in returns. Yet, the estimated effect of wealth on expected returns is as large within a pair of twins as within the entire Swedish population. These results show that scale and type dependence both contribute strongly to the heterogeneity of returns.

Eighth, we estimate the cross-sectional dispersion of returns in the Swedish population and find a very large diversity of investment strategies, including among households with similar levels of initial wealth. At the annual frequency, the dispersion of returns is mostly driven by idiosyncratic risk and varying exposures to economy-wide shocks and, as a result, it is particularly large among the richer parts of the population. In the longer run, return dispersion is more likely driven by persistent investment strategies. To investigate this property, we estimate the dispersion of the geometric average of net wealth returns over a generation. This key moment is usually difficult to estimate because researchers have had so far access to panels with duration much shorter than a full generation. In such a context, we show that the sample standard deviation of arithmetic average returns is both a biased and noisy estimator of type dependence in returns. We instead develop an estimator based on our asset pricing approach and we provide simulation evidence that this estimator is unbiased and precise even in short panels. The standard deviation of the geometric average post-tax return on gross wealth is 2.8% per year in the Swedish data, which is very close to the value used for the U.S. in the calibrations of Benhabib, Bisin, and Luo (2018). Furthermore, this dispersion parameter sharply increases with net worth, ranging from 1.7%-2.1% for households in the bottom 90% of the distribution to 5.8% among the top 0.01%, mostly due to the large underdiversification of private business owners.

The findings of the paper have several key implications for the current debate on wealth inequality. Our results confirm the widespread conjecture (Arrow 1987, Piketty 2014) that wealthier households earn higher average returns. We show that, for the most part, the higher returns earned by the wealthy are compensations for high systematic risk that the rest of the population seem unwilling or unable to take. Exceptional investment skill or privileged access to private information seem to play only a minor role.

Our results imply that equilibrium models of inequality (Benhabib Bisin and Zhu 2011) can be strengthened by incorporating the empirical features of household portfolios uncovered in the present paper. We confirm the intuition from these models that heterogeneity in returns is empirically important and helps to explain wealth inequality at the top. Our asset pricing approach allows us to investigate the economic behavior underlying such heterogeneity and attribute it to portfolio risk exposures rather than investment skill. Furthermore, while models of inequality usually assume that the portfolio distribution is identical across households, we document that rich and poor bear different levels of systematic and idiosyncratic risk, which may generate even larger inequality. Recent models seeking to explain the dynamics of wealth inequality, such as Gabaix, Lasry, Lions, and Moll (2016), develop more detailed propositions regarding which features of the distribution of returns may matter for inequality. Following this line of work, we distinctly estimate type and scale dependence in returns and confirm that these two features of the distribution of returns coexist in practice. Finally, the evidence that business owners disproportionately contribute to return heterogeneity at the top of the distribution confirms the intuition from earlier theoretical papers that entrepreneurship is key to understanding wealth inequality (Cagetti and De Nardi 2006, Quadrini 2000).

Existing studies on the link between wealth and returns are restricted to financial wealth and often rely on survey evidence.[2] We confirm the stylized fact from this literature that expected returns on wealth monotonically increase with the rank in the distribution of wealth. However,

[2] See for instance Betermier, Calvet, and Sodini (2017), Calvet, Campbell, and Sodini (2007), Calvet and Sodini (2014), and Guiso, Jappelli, and Terlizzese (1996). The link between financial wealth and risk-taking is consistent with utility functions with decreasing relative risk aversion (Bakshi and Chen 1996; Campbell and Cochrane 1999; Carroll 2002; Chetty and Szeidl 2007).

we also provide evidence that, compared to our baseline results, there is little covariance of returns with wealth within the top 5% of the wealth distribution if one restricts the analysis to financial wealth or if one only relies on return data as coarse as in the best household finance survey available, the Survey of Consumer Finances. The comprehensive approach to wealth returns that we propose in the paper is therefore essential in order to investigate the determinants of top wealth shares.

To the best of our knowledge, the present paper is the first to use comprehensive micro data on household balance sheets to analyze the joint distribution of household wealth and its return characteristics. Fagereng et al. (2018) use a Norwegian dataset to provide evidence on the heterogeneity of wealth returns earned by individuals. Due to large oil reserves, Norway dramatically differs from other developed countries, including Sweden, along dimensions that are very relevant for the relationship between household wealth and returns. In particular, investments of the Norwegian household sector in risky financial assets are very small in proportion to national income, so our results should carry greater external validity. Besides data differences, the two papers sharply differ in methodology and results, and have profoundly different normative implications. Fagereng et al. (2018) employ the sample mean of historical returns over up to 11 years per individual as their main variable of interest. We show in simulations that this approach delivers biased and noisy estimates of long-term return dispersion and would require a much longer panel in order to be accurate. Furthermore, the Fagereng et al. (2018) measure of return differs from the economic concept of return on two key dimensions. The Norwegian study does not impute the non-pecuniary services provided by banks to their depositors, a major component of the return on bank deposits that is acknowledged in national accounts. In addition, Fagereng et al. (2018) measure the return on private equity by the ratio of accruals earnings to the book value of corporate equity, which poses several problems. Accruals earnings are far more persistent than the underlying economic cash flows (Burgstahler et al., 2006), and the book value of equity improperly accounts for intangible assets and growth options. When we apply the same return measurement method to Swedish households, the measured return on wealth is less volatile, more persistent and more positively correlated with wealth than under the baseline approach followed in this paper. These methodological choices likely explain why Fagereng et al. (2018) attribute a large share of return heterogeneity to differences in skill, in sharp contrast to the results of the present paper and the extant literature documenting the absence of skill even among investment professionals (e.g., Fama and French 2010).

The rest of the paper is organized as follows. Section I describes the data and main variables. Section II documents the risk and return characteristics of the total wealth held by households across different brackets of net worth. Section III investigate the patterns of household holdings of financial assets, real estate, and private equity that explain the heterogeneity of returns on total wealth. Section IV assesses how the heterogeneity of returns affects wealth inequality. Section V concludes. An Appendix available online presents details of data construction and estimation methodology as well as a battery of robustness checks.

I Data and Definition of Variables

I.A Household Panel and Definition of Balance Sheet Components

The panel is based on the Swedish Income and Wealth Registry, which is compiled by Statistics Sweden from tax returns and third-party information. The data include the debt and disaggregated worldwide financial and real estate holdings of every resident at year-end from 1999 to 2007. Bank account balances, stock and mutual fund investments, and real estate holdings are observed at the level of each account, security, or property.[3] The panel also provides for every household the total debt outstanding at year end and the interest paid during the year. Balance sheet items are almost all reported by third parties, such as banks and other financial institutions, which ensures high accuracy.[4]

[3] Bank account balances are reported if the account yields more than 100 Swedish kronor during the year (1999 to 2005 period), or if the year-end bank account balance exceeds 10,000 Swedish kronor (2006 and 2007). We impute unreported cash balances by following the method developed in Calvet, Campbell, and Sodini (2007), as is explained in the Internet Appendix.

[4] Earlier research describes the Swedish Income and Wealth Registry in greater detail (see, e.g., Betermier Calvet and Sodini 2017, Calvet Campbell and Sodini 2007, 2009, Calvet and Sodini 2014).

In this paper, we retrieve for the first time information on private equity holdings from income tax forms. For every unlisted limited liability company, these forms provide the number of shares held by each Swedish resident actively participating in the firm. The dataset encompasses almost all stakes in private companies held by individuals[5] from the year 2000 onward.[6] We impute the funded pension wealth of households from national accounts and individual income data, as Section *I.B* explains. The merged panel provides detailed information on the balance sheet of every household.

We use the following definitions of balance sheet components throughout the paper. A household's debt is the sum of mortgages and all other liabilities to financial institutions.[7] Gross financial wealth consists of bank account balances, mutual funds, stocks, bonds, derivatives, and capital insurance. We subdivide gross financial wealth into cash, i.e., bank accounts and Swedish money market funds, and risky financial wealth, i.e., all other securities. Pension wealth is the sum of each household member's rights to pension and life insurance payments that are backed by financial assets. Real estate wealth consists of residential properties (i.e., primary and secondary residences) providing real estate services to the household, and commercial properties (i.e., rental, industrial, and agricultural properties) serving primarily as investment vehicles. Private equity includes all the shares of unlisted companies.

We define *total gross wealth* as the sum of financial wealth, pension wealth, real estate wealth, and private equity. *Net wealth* (or *net worth*) is the difference between total gross wealth and household debt. The leverage ratio is equal to debt divided by total gross wealth. Unless stated otherwise, a household's *rank* will always refer to its position in the distribution of net wealth at the end of each calendar year in our sample.

[5]Using the subsample of households for which detailed dividend information is available, we find that passive participations account for less than 5% of all dividends received by Swedish residents from private firms.

[6]The dataset covers more than 80% of Swedish households. The remaining 20% are also represented through sampling weights, which we use throughout the entire analysis.

[7]We exclude student debt because it is entirely state-provided and heavily subsidized in Sweden during our sample period, with no interest spread and income-contingent repayments.

I.B Measuring the Value of Balance Sheet Components

Pricing data on Nordic stocks and mutual funds are available from FINBAS, a financial database maintained by the Swedish House of Finance. FINBAS provides the monthly returns, market capitalization, and book value of each publicly traded company for the 1983 to 2009 period. For securities not covered by FINBAS, we use pricing data from Datastream and Morningstar.

Since pension wealth is not recorded at the household level in Swedish registries, we follow the imputation procedure developed by Saez and Zucman (2016) for the U.S. and applied to Sweden by Alstadsæter et al. (2018). National accounts define the aggregate pension wealth of Swedish households as the market value of assets held by insurance companies and pension funds at the end of each calendar year. We distribute 40% of aggregate pension wealth to retirees and 60% to workers. Among retirees, pension wealth is allocated proportionately to pension benefits, which we observe in our data. Among workers, pension wealth is allocated proportionately to the capitalized value of their pension contributions, which we impute using individual income tax data. We use annual reports on the holdings of the main pension and insurance companies in Sweden to decompose pension wealth into a safe component (cash and bonds) and a risky component (equities and commercial real estate). Further details on the imputation methodology and composition of Swedish funded pension wealth can be found in the Internet Appendix.

Real estate prices are compiled by Statistics Sweden from two main sources. Every 3 to 7 years, tax authorities assess the tax value of every real estate property using detailed property characteristics and hedonic pricing. In addition, Statistics Sweden continuously collects data on every real estate transaction in the country, which permit the construction of sales-to-tax-value multipliers for different geographic locations and property types. The multipliers are available for 389 groups corresponding to 256 primary residence locations, 111 secondary residence locations, 21 farmland regions, and 1 rental group. The transaction-level data is also used to estimate the annual dispersion in capital gains within each of those real estate groups. We combine these pieces of information to compute yearly capital gains on every real estate property.

The valuation of unlisted business equity must overcome the lack of regular price information. We use a standard methodology based on valuation multiples of listed firms in the same industrial sector as the unlisted firm of interest (Damodaran 2012). In line with national accounting practices, we employ market-to-book multiples. Because these multiples do not use profit measures at the denominator, the corresponding valuation of the private firm is more robust to the possibility that the owner underreports her labor income from managerial work or that she overreports operating expenses due to her personal consumption of personal goods and services through the corporation. Since leverage might cause some firms to have negative book equity, we estimate the market value of a private firm's total assets using multiples, and then subtract financial debt. We discount the resulting equity value to account for the lack of marketability of entrepreneurial firms, which stems from the illiquidity of the shares and the transition costs of a change in control. We refer the reader to the Internet Appendix for detailed descriptions of the valuation of unlisted business equity.

In the Internet Appendix, we verify that the wealth variables used in the paper closely match the aggregate values reported in national accounts.

I.C Measuring the Historical Return on Household Wealth

We measure the return on household *h*'s wealth during year *t* as the sum of the dividends and realized and unrealized capital gains accruing during year *t* on the household's holdings at the end of year *t*-1, divided by the value of wealth at the end of year *t*-1. We emphasize that we include both realized and unrealized capital gains in the definition of wealth returns.

Throughout the paper and unless stated otherwise, we report excess returns relative to the risk-free rate, expressed in annual arithmetic units and before personal taxes. Bank accounts, money market fund holdings and safe pension holdings are assumed to yield zero excess returns.[8]

[8] In the case of checking accounts, this choice is in line with the methodology of national accounts. It is justified by the fact that banks provide banking services in exchange for not having to remunerate the accounts. In the Internet Appendix, we compute the implicit non-pecuniary returns from these banking services and find that they are larger for poorer households. We only find a small negative correlation of these non-pecuniary returns with cognitive ability, suggesting that the heterogeneity of these non-pecuniary returns is a reflection of preferences rather than investment skill.

For each household, we proxy the return on financial assets with less than two years of price and dividend data by the return on other financial assets in the portfolio with more than two years of available data.[9] The return on risky pension wealth is set equal to the weighted average of the Swedish equity index return, the return on the global equity index with an exposure to currency risk set to 50%, and the Swedish real estate index return. The weights are obtained from the portfolio holdings published in the annual reports of pension and insurance companies. The return on the real estate portfolio is equal to the capital gain return plus the user cost of real estate services, as in Poterba (1992). All asset returns are winsorized at the 0.01% level. We proxy the household's debt cost by the average interest payment made in years t and $t+1$ divided by total debt at the end of year t, winsorized at the 5% right tail.

I.D Measuring the Expected Return and Risk Characteristics of Household Wealth

A simple approach to measuring a household portfolio's expected return is to compute the time-series average of the portfolio's historical returns. The problem, however, is that asset returns have large standard deviations, so that the sample means of household returns over an 8-year sample typically have large standard errors. In order to accurately estimate expected returns, we therefore follow Calvet, Campbell, and Sodini (2007) and specify asset returns as a function of a few aggregate risk factors.

Throughout the paper, we consider the following benchmarks. The risk-free rate is proxied by the monthly average yield on the one-month Swedish Treasury bill. The return on the Swedish stock market is measured by the SIX return index (SIXRX), which tracks the value of all the shares listed on the Stockholm Stock Exchange. The local equity market factor, L_MKT_t, is the SIX return minus the risk-free rate in month t. Other public equity benchmarks include the global stock market factor, MKT_t, the global value factor, HML_t, and the global size factor, SMB_t, from the AQR data library. The exchange rate factor, $EXCH_t$, consists of monthly returns on the carry

[9] Assets with missing return data primarily include capital insurance and represent about 10% of total financial wealth during the sample period with little variation across wealth groups.

trade in which the investor is long the U.S. Treasury bill and short its Swedish equivalent. For real estate, we consider the Statistics Sweden FASTPI index, which is based on all transactions on single-dwelling homes.

We index individual assets by i. For every asset i, we model the return in period t as:

$$r^e_{i,t} = \alpha_i + \beta_i' f_t + u_{i,t}, \tag{1}$$

where $r^e_{i,t}$ denotes the excess return of asset i in period t, α_i is a measure of risk-adjusted performance, f_t is a column vector of factors, β_i is a column vector of factor loadings, and $u_{i,t}$ is a residual uncorrelated to the factors. We estimate this equation by ordinary least squares for each single asset using all the historical return data available for this asset and the factors corresponding to each of the four broad wealth categories, as we explain in Section III. For every household h, the risk-adjusted performance, $\alpha_{h,t}$, and the factor loadings, $\beta_{h,t}$, of the portfolio at time t are the weighted averages of individual asset parameters:

$$\alpha_{h,t} = \sum_{i=1}^{I} w_{h,i,t-1}(r^e_{i,t} - \beta_i' f_t), \qquad \beta_{h,t} = \sum_{i=1}^{I} w_{h,i,t}\beta_i, \tag{2}$$

where $w_{h,i,t-1}$ and $w_{h,i,t}$ respectively denote the weight of asset i in the household's portfolio at times t-1 and t. Risk-adjusted performance is the difference between the return effectively earned by the household's actual portfolio during the year and the return that would have been generated by a purely passive portfolio with same risk exposures as the household's portfolio.

Crucially, the factor loadings of individual assets are estimated accurately from (1) because variances and covariances require only a few years of data to be precisely estimated. By contrast, sample means are accurate only when they are computed on much longer return series (Merton 1980). Fortunately, data on risk factors are available for relatively long time periods, at least 34 years in our case, so that the sample means of the factors provide accurate estimates of their population means. Over the 1983 to 2016 period, the average yearly excess return is 8.7% for the SIXRX Swedish equity index, 5.8% for the global market index, 4.7% for the global value factor, and insignificant for the size and currency factors. The mean excess return on the FASTPI

Swedish real estate index is 5.5% per year between 1980 and 2014. The full results are reported in the Internet Appendix. Because these risk premia are positive, the corresponding household-level factor loadings are essential determinants of expected returns.

The literature on portfolio management typically concludes that risk-adjusted performance is second-order relative to compensated risk, even among professional investors (Fama and French 2010; Moskowitz and Vissing-Jørgensen 2002). Tests of risk-adjusted performance in the investments of Swedish households, provided in Sections II and III and in the Internet Appendix, are consistent with this stylized fact. In some sections of the paper, we will therefore assume there is no risk-adjusted performance. The *expected return* of household h at time t is then $\mathbb{E}(r^e_{h,t}) = \beta'_{h,t-1}\,\mathbb{E}(f_t)$, which we conveniently estimate using household risk loadings and the factors' sample means.[10]

We measure household portfolio risk as follows. Using historical price data, we estimate the time-series covariance of historical returns, $\sigma_{i,j}$, for each pair of assets i and j. The *total variance* of household h's portfolio return at t is given by $\sigma^2_{h,t} = \sum_{i,j} w_{h,i,t-1} w_{h,j,t-1} \sigma_{i,j}$. The Sharpe ratio is the ratio of the expected return $\mathbb{E}(r^e_{h,t})$ to the return standard deviation $\sigma_{h,t}$.

The *systematic excess return*, $\beta'_{h,t-1} f_t$, is a linear combination of the returns on the five equity factors and the FASTPI Swedish residential real estate index. Consistent with the evidence in Curcuru et al. (2009), we set the correlation between the equity factors and the real estate index equal to zero. Systematic risk is estimated by the variance of the systematic return, $Var(\beta'_{h,t-1} f_t)$. The *idiosyncratic variance,* $\tilde{\sigma}^2_{h,t}$, is obtained by subtracting the variance of the systematic return from the total variance, $\sigma^2_{h,t}$. We also assume that idiosyncratic risk in one asset class is uncorrelated with (systematic and idiosyncratic) risk in the other three asset classes. The *share of idiosyncratic risk* is the ratio $\tilde{\sigma}^2_{h,t}/\sigma^2_{h,t}$.

For the purpose of identifying the effect of the covariance of returns and net worth on top

[10]To maximize precision, we use mean risk premia estimated over the longest available time series to compute expected returns. In the Internet Appendix, we verify that our results are not affected by the exclusion of information on risk premia posterior to the period in which household holdings are measured.

wealth shares, it is most appropriate to consider differences in arithmetic returns across brackets of net wealth. However, if one considers alternative measures of wealth inequality, such as the variance of logarithmic wealth, then the covariance of logarithmic returns with wealth may be a more important parameter to estimate (Campbell 2016). For computational convenience, we assume that arithmetic returns are lognormal and report under this hypothesis the expectation of log returns in addition to the moments of arithmetic returns.

II Total Wealth

This Section empirically investigates the main characteristics of household wealth.

II.A Top Wealth Shares

In Figure 1, we sort households into brackets of net wealth and report the average shares of net wealth, financial wealth, pension wealth, real estate, private equity and debt held by each bracket, as well as the number of Swedish households in each bracket. Concentration at the top is especially pronounced for private equity and to a lesser extent for financial wealth. The top 1% hold on average 21% of total net wealth in Sweden between 2000 and 2007, compared to 34% in the United States.[11] Wealth inequality is therefore substantial in Sweden, if somewhat less pronounced than in the United States.[12] The concentration of wealth also far exceeds the concentration of income. For instance, the top 1% of households sorted by income receive 9% of national income in Sweden and 20% in the United States over the same sample period.[13]

Wealth ranks are very persistent, especially at the top. In the Internet Appendix, we provide the transition probabilities between a household's rank in 2000 and its rank in 2007, conditional

[11]The U.S. estimate is based on the SCF. To put these estimates into perspective, about 2 million dollars are needed to enter the top 1% of Swedish households at the end of 2007, against 4.3 million dollars in the United States (Saez and Zucman 2016). Year-by-year thresholds and additional descriptive statistics for each wealth group can be found in the Internet Appendix.

[12]Wealth inequality in Sweden may be underestimated due to offshore tax evasion (Roine and Waldenström 2009). In the Internet Appendix, we discuss its implications for the interpretation of our findings and conclude that measuring offshore wealth would most likely confirm our results.

[13]These estimates are obtained from the World Top Incomes database.

on the survival of the household. Despite very significant movements in asset prices between 2000 and 2007, nearly two-thirds of households in the top 1% at the beginning of our sample are still in the top 1% eight years later, and almost all the remaining third are still in the top 5%. Such high persistence suggests that wealth ranks are tied to asset allocations, as we now show.

II.B Asset Allocation of Gross Wealth

Figure 2 illustrates the average allocation of gross wealth to financial assets, pension wealth, real estate, and private equity in different brackets of net worth. For households in the bottom 20% of the wealth distribution, cash is dominant and represents about 50% of gross wealth. In higher brackets, the share of cash decreases monotonically with net worth, reaching a low of 3% for households in the top 0.01%.

The weight of residential real estate and the weight of pension wealth are both hump-shaped functions of net worth. Residential real estate is rarely owned in bottom brackets but is the dominant investment category for households in the 60th to 99th percentiles, accounting for as much as 47% of gross wealth in the 70th to 90th percentiles. In top brackets, the share of residential real estate declines rapidly and is as low as 2.5% for households in the top 0.01%. Pension wealth is substantially held in the bottom parts of the distribution, representing about a third of gross wealth in the bottom 20%. It is the most important asset for households in the 20th to 60th percentiles, accounting for as much as 47% of gross wealth in the 40th to 50th percentiles. Then, just as residential real estate, the share of pension wealth quickly declines in higher brackets and hits a low of 0.4% in the top 0.01%.

Risky financial assets, commercial real estate, and private equity represent substantial proportions of the gross wealth held by the wealthy. The share of risky financial wealth is slightly hump-shaped in net worth, increasing from 5% in the bottom decile to 22% for the top 1%-0.5% and 18% for the top 0.1%. The share of commercial real estate, which is negligible in lower and middle brackets, is around 15% across the top 2.5%. Private equity is the dominant asset class at the high end of the distribution. The share of private equity is negligible in lower brackets but reaches 19% for the top 1%-0.5% and 64% for the top 0.01%. These results also imply that private equity plays a crucial role for the dynamics of inequality at the top.

The leverage ratio decreases with net wealth. However, most of the difference takes place between households below and above the median of the distribution of net wealth. Within the top decile, which holds a majority of Swedish wealth, there is no clear relationship between wealth and leverage. The different proportions of personal debt in household balance sheets along the wealth distribution have strong implications for the return on net wealth, as we further show in Section *II.D*.

In Figure 2, we illustrate the share of wealth allocated to risky assets, a simple and model-free measure of risk-taking that has received considerable attention in the portfolio choice and household finance literatures. Specifically, we define the risky share as the weight of risky financial assets, commercial real estate, and private equity in household gross wealth. The risky share fluctuates around 10% for the households in the bottom 70% of net worth and gradually increases to 26% for the top 10%-5%, 55% for the top 1%-0.5%, and 94% for the top 0.01%. The total risky share therefore quickly increases with wealth, especially within the top decile. We will show in Section *II.C* that the high risky shares of the wealthy allow them to earn high expected returns.

Overall, the top 1% of Swedish households allocate 7% of gross wealth to cash, 21% to risky financial assets, 7% to pension wealth, 22% to residential real estate, 16% in commercial real estate, and 27% to private equity. By comparison, the top 1% of U.S. households hold 8% in cash, 25% in risky financial assets, 9% in pension wealth, 19% in residential real estate, 7% in commercial real estate, and 33% in private equity.[14] The risky share selected by the top 1% is therefore similar in Sweden (64%) and in the U.S. (65%). In the Internet Appendix, we provide further evidence using the U.S. Survey of Consumer Finances (SCF) that the joint distribution of expected returns and net worth is very similar in both countries, provided we constrain the

[14]The U.S. estimates are based on the Survey of Consumer Finances (1998-2007).

Swedish data to have the same level of granularity as the SCF. When we instead use the full detail of our data, we document that the gap in expected returns between the very top and the rest of the distribution increases very substantially, which confirms the importance of using high-quality data for accurately measuring portfolio returns at the high end of the wealth distribution.

II.C Return on Gross Wealth

In Table I, we investigate the risk and return characteristics of household gross wealth. In each column, we report the expected excess return on (1) gross and (2) net wealth, the standard deviation of the return on (3) gross and (4) net wealth, the expected excess log return on (5) gross and (6) net wealth, (7) the share of idiosyncratic risk, (8) the Sharpe ratio, and (9) the cost of household debt, respectively, observed on average within various brackets of net worth. The estimation is conducted on households above the 10th percentile for net wealth statistics, and on the entire population otherwise. We will henceforth refer to households in the 40th to 50th percentile as the median decile.

Households in the median decile select moderate levels of risk and return. The mean return on gross wealth is 3.6% per year in excess of the Swedish Treasury bill. Since the yield on the Swedish Treasury bill rate is about 1 percentage point higher than the Swedish inflation rate throughout the sample period, the median household earns a real return on gross wealth of about 4.6% per year. The standard deviation of gross wealth is 8.3% per year. These relatively low levels of risk and return are consistent with the fact that the median household holds slightly more than 47% of gross wealth in funded pension schemes and 30% in residential real estate. The log wealth return has a slightly lower mean than the arithmetic return, as Jensen's inequality and moderate portfolio risk imply. The median household holds an underdiversified portfolio of risky assets. The idiosyncratic share, as defined in Section *I.D*, is estimated at 21%, consistent with the fact that wealth is largely concentrated in the primary residence. The Sharpe ratio of gross wealth is correspondingly equal to 0.44 for the median household.

The risk and return on gross wealth both go up monotonically with net worth. The mean excess return increases from 2.1% per year for the bottom 10% to 6.3% for the top 1%-0.5% and 8.9% for the top 0.01%. Similarly, the standard deviation increases from 5.3% per year for the bottom 10% to 18.1% for the top 1%-0.5% and 39.3% for the top 0.01%. The high expected returns earned by the wealthy are therefore associated with high levels of risk. As Figure 2 shows, the portfolio characteristics of wealthy households stem from low cash and pension holdings and aggressive positions in risky financial assets, real estate, and private equity.

The share of idiosyncratic risk increases with net worth. The increase is moderate in most of the distribution, from 13% for the bottom 10% to 32% for the top 20%-10%. In higher brackets, the share of idiosyncratic grows very rapidly and hits a high of 74% for the top 0.01%. The expected log return is correspondingly hump-shaped in net wealth, increasing from 3.0% in the median bracket to 4.2% in the top 2.5%-1%, and then declining in higher brackets. The explanation is that throughout most of the wealth distribution, the expected return on gross wealth increases with net worth, while the level of idiosyncratic risk remains moderate. In higher brackets, however, idiosyncratic risk increases much faster than systematic risk and drives down the expected log return.

The Sharpe ratio fluctuates around 0.43 in the bottom half, increases to 0.51 (top 10%-5%) and then decreases to 0.27 (top 0.01%). As households get richer, the share of residential real estate declines and the share of financial assets grows rapidly, which improves diversification. At the top, underdiversified private equity plays a dominant role, which reduces the Sharpe ratio. Section III provides further evidence supporting these explanations.

II.D Debt Cost and Return on Net Wealth

In the last column of Table I, we report the average interest rate paid on household debt relative to the risk-free rate. The spread paid by the median household is 4.6% per year on average over the sample period, which corresponds to a real interest rate of 5.6% per year. Starting from the

10^{th} percentile of net worth, the spread decreases monotonically with net wealth, from 6.9% for households in the bottom 10%-20% to 2% per year for the top 1%-0.5% and 1% for the top 0.01%.[15] In the Internet Appendix, we find evidence that the lower credit risk and the larger loan sizes of wealthier households account for their smaller debt costs.

This result, together with results of the previous sections, suggests that the relationship between net worth and the return on net wealth is driven by two conflicting mechanisms. On the one hand, wealthier households invest more aggressively in risky assets and pay lower debt costs than the median household, so that the average return on net wealth increases with net worth. On the other hand, the leverage ratio decreases with net worth, which reduces the average return on net wealth in higher brackets. The combined effect of these mechanisms is an open empirical question that we now address.

In Table I, columns 2 and 4, we document the average characteristics of the return on net wealth across households. Specifically, the excess return on household h's net wealth between years t-1 and t is given by the usual formula:

$$r_{h,t}^{net} = r_{h,t}^{gross} + (r_{h,t}^{gross} - r_{h,t}^{debt}) \frac{\text{Debt}_{h,t-1}}{\text{Net Wealth}_{h,t-1}},$$

where $r_{h,t}^{gross}$ is the excess return on household h's gross wealth between t-1 and t, $r_{h,t}^{debt}$ is the debt cost in excess of the risk-free rate, $\text{Debt}_{h,t-1}$ is the debt level at the end of t-1, and $\text{Net Wealth}_{h,t-1}$ is net wealth at the end of t-1.[16]

The median household earns a mean return of 4.6% per year on net wealth and faces substantial risk, with a standard deviation of returns of 13.4% per year. Both estimates are higher than their gross wealth equivalents, consistent with the fact that the median household is substantially levered. By taking leveraged positions in real estate, households in the middle of the wealth distribution are prime beneficiaries of financial markets.

[15] A specific pattern arises among the bottom 10% who benefit from milder credit conditions than the bottom 10%-50%. We investigate the potential origins of this non-monotonicity in the Internet Appendix.

[16] Debt is truncated at 85% of gross wealth so that measurement error in the leverage ratio does not overly influence the estimated return on net wealth.

Households in the bottom 10%-20% earn a much lower return on net wealth than the rest of the population due to high debt costs. In the largest part of the population, from the 30th percentile to the 90th centile, the expected return on net wealth increases very slowly from 4.4% to 5%. The explanation is that over this range, the positive impact of the rapid increase in the expected gross wealth return (from 3.3% to 4.5%) is slowed down by a simultaneous reduction in leverage. In higher brackets, as the effect of leverage dies out, the expected excess return on net wealth increases and reaches 9.2% per year for the top 0.01%. Variation in leverage also implies that the standard deviation of net wealth is U-shaped in net worth above the 30th percentile, decreasing from 15.2% (bottom 30%-40%) to 11% (top 30%-10%) and then increasing to 40% (top 0.01%).

The hump-shaped nature of expected log returns is even more pronounced for net wealth than for gross wealth. Due to high leverage, households at the bottom of the distribution are exposed to large return shocks and therefore earn particularly low expected log returns.

Gross and net wealth therefore have strikingly different cross-sectional properties, which highlights that the welfare and distributional implications of financial markets cannot be properly understood without taking debt into account.

II.E Skill and Taxes

Besides risk-taking, investment skill and taxes are two possibly important sources of heterogeneity in returns across households. We assess their importance by using historical return and tax data over the period 2000-2008. We denote by $r^e_{h,t}$ the return on household h's wealth in year t and by $\beta'_{h,t-1} f_t$ the systematic return. We measure investment skill by the risk-adjusted performance, $\alpha_{h,t} = r^e_{h,t} - \beta'_{h,t-1} f_t$, defined in equation (2).

In Table II, we provide estimates of the historical return on (1) gross and (2) net wealth, the systematic return on (3) gross and (4) net wealth; and the risk-adjusted performance of (5) gross and (6) net wealth. Figure 3 illustrates the historical, systematic, and expected returns against the rank in the distribution of net worth. Over the period 2000-2008, the median household earned an average excess return of 1.4% per year, lower than the expected return of 3.6%. A passive strategy with the same risk exposures as the median household earns an average excess return of 1.3% over the period. The corresponding risk-adjusted performance of the median household's investments is therefore 0.1% over the period. The low historical returns of the median household are therefore due to the fact that the performance of the benchmarks is lower over the period 2000-2008 than over the longer period 1981-2016.

Along the distribution of net worth, historical excess returns on gross wealth over the period 2000-2008 increase with net worth, going from 0.1% for the bottom 10% to 3.6% for the top 10%-2.5% and 4.5% for the top 0.01%. The return generated by a passive strategy with similar risk exposures follows a broadly similar pattern. As a result, risk-adjusted performance remains close to 0% along the entire distribution, ranging from 0.2% for the bottom 10% to -0.4% for the top 0.1%-0.01% and -0.1% for the top 0.01%. Thus, there is no evidence that wealthier households have access to better information or exhibit investment skill.

In the last four columns of Table II, we report the personal capital tax rate as a fraction of (7) gross wealth and (8) net wealth, and the total capital tax rate as a fraction of (9) gross wealth and (10) net wealth across brackets of net worth. The personal tax rate only includes taxes on wealth (i.e., capital income tax, property tax, and wealth tax) that are directly paid by the household, while the total capital tax rate also includes taxes paid indirectly through firms.[17] The tax rates incorporate tax credits received when a capital loss is recorded. We also include the mortgage interest deduction when taxes are expressed as a function of net wealth (columns 8 and 10). All tax ratios are winsorized at the 0.1% level.

Over the period 2001-2008, the median household pays on average 0.7% of initial gross wealth per year in personal capital taxes and 0.5% in corporate taxes. However, once mortgage deductions are included, the median household actually receives a net subsidy representing 0.4%

[17] We include the corporate taxes actually paid by unlisted firms owned by the household and impute the corporate tax payments for listed stocks in the portfolio under the assumption that the corporate tax rate (as a share of the market value of equity) is uniform across listed firms.

of initial net wealth. Over most of the wealth distribution, tax rates are increasing in net worth. The personal capital tax rate goes from a subsidy of 3.9% of gross wealth for the bottom 10% to a tax of 1.1% of gross wealth for the top 10%-5% and 1.5% for the top 0.5%-0.1%. This pattern is primarily caused by the fact that (i) implicit rents from homeownership are not taxed (ii) capital stock taxes are progressive due to the existence of a wealth tax until 2006.

Capital tax rates exhibit a slight decline at the very high end of the wealth distribution. The personal capital tax rate decreases to 0.9% of (gross or net) wealth in the top 0.01% bracket. This drop is caused by the fact that the Swedish tax system used to exempt business assets from the wealth tax base and does not tax latent capital gains from entrepreneurial businesses. This positive effect is only partly offset by corporate taxation, which monotonically increases from 0.4% of gross wealth for the bottom 10% to 1.5% for the top 0.01%. The Internet Appendix further investigates the origins of these patterns.

Overall, the tax system exerts a modest influence on the distribution of wealth returns. In particular, it does not overturn the key result that richer households obtain significantly higher returns in the long run. Given that Sweden is among nations that tax capital the most, the influence of taxes on returns is likely even more modest in most other countries.

II.F Long-Run Evidence from U.S. Foundations

In the Internet Appendix, we verify the robustness of our findings on U.S. foundations tax data, which have been investigated by Saez and Zucman (2016). We compute the time series of historical returns earned by foundations over 28 years and estimate mean historical excess returns, risk loadings, and risk-adjusted performance. The average historical excess return is 3.0% per year for foundations worth between 0.1 and 1 million U.S dollars, and 4.3% per year for foundations worth more than 5 billion U.S. dollars, while the beta coefficient relative to the CRSP value-weighted U.S. equity index is estimated 0.39 and 0.55 for each group. The average return-to-beta ratios, 3.0%/0.39 and 4.3%/0.55 are therefore almost identical and equal to about 7.75%.

More generally, we show that risk exposures fully explain long-term performance, while we find no evidence of investment skill. These results provide a striking confirmation that the long-term performance of U.S. foundations is explained by their systematic risk exposures, consistent with the evidence we provide for Swedish households.

III Risk and Return Characteristics of Wealth Components

In this Section, we document the risk, return, and skill characteristics of the four main components of gross wealth: financial wealth, pension wealth, real estate, and private equity.

III.A Financial Wealth

We consider the following components of financial wealth. The stock portfolio contains directly held stocks, the fund portfolio contains mutual funds other than Swedish money market funds, and the risky portfolio contains the stock and fund portfolios. The *complete portfolio* contains cash and the risky portfolio.

We assume that every stock or fund satisfies the asset pricing model (1) at the monthly frequency.[18] As in Hou, Karolyi, and Kho (2011), the factors consist of the local equity market factor, L_MKT_t, the global market factor, MKT_t, the global value factor, HML_t, the global size factor, SMB_t, and the exchange rate factor, $EXCH_t$, defined in Section *I.D*.[19] We verify in the Internet Appendix that all our results are robust to using the domestic CAPM, in which the local market L_MKT_t is the unique factor, as an alternative asset pricing model.

In Table III, we report the expected excess return on (1) the risky and (2) complete portfolios, (3) the alpha coefficient and (4) corresponding p-value of the complete portfolio, and (5) the standard deviation, (6) idiosyncratic share, and (7) Sharpe ratio of the complete portfolio. Except

[18]Excess returns on individual assets are winsorized at the 1% level before each estimation.

[19]We add a currency risk factor because household portfolio returns are expressed in Swedish kronor while global factor returns are expressed in U.S. dollars. We do not include domestic versions of the value and size factors due to multicollinearity, and we do not consider the momentum factor because earlier work shows that it is not priced in Sweden (Rouwenhorst 1998).

in columns 3 and 4, the calculations assume that the alpha coefficient of each asset is equal to zero.

The expected excess return on financial wealth increases rapidly with net worth, ranging from 0.61% per year in the bottom decile, 1.24% in the median decile, 3.83% for the top 5%-2.5%, and 4.57% for the top 0.01%. A household in the top 0.01% earns an additional 3.34% per year on financial wealth compared to the median household. The large variation of mean returns with net worth is driven by two channels: (i) variation in the risky portfolio's share of the complete portfolio, and (ii) variation in the risky portfolio's loadings on the factors. As reported in the Internet Appendix, the share of the risky portfolio increases from 20% to 58% between the median and top 0.01%. If the top 0.01% held the same risky portfolio as the median household, they would earn an additional expected return of $(58/20-1)\times 1.24\%$, or 2.36% per year on financial wealth compared to the median bracket. Since the additional expected return is actually 3.34% per year, we attribute 2.36/3.34, or 71%, of the observed variation to differences in the risky share (channel (i)) and 29% to differences in factor loadings (channel (ii)). In the Internet Appendix, we show that rich households reach these higher loadings by investing in stocks rather than funds and in particular by picking stock portfolios with higher exposures to the value factor.

The estimates of expected returns discussed so far are by construction purely driven by household portfolio loadings on risk factors. In columns 3 and 4 of Table III, we also investigate if exceptional risk adjusted returns, arising for instance from access to privileged information or investment skill, also contribute to expected returns. Since we observe holdings only at year-end, we assume that households rebalance their portfolio every month to keep security weights constant during a holding period of 12 months after the end of year t.[20] Let $R_{h,t:t+m}$ denote the implied historical return during the m^{th} month of year $t+1$. We report the difference between a household portfolio's implied historical return and the return implied by the factors:

$$\alpha_{h,t:t+m} = R_{h,t:t+m} - \beta'_{h,t} R^F_{t:t+m},$$

[20]Frazzini, Kabiller and Pedersen (2018) make a similar assumption in order to assess Warren Buffet's risk-adjusted performance from the Securities and Exchange Commission's 13-F holdings data.

where $\beta_{h,t}$ is the vector of household loadings at the end of year t and $R^F_{t:t+m}$ is the vector of returns on the factors between t and $t+m$. The alpha coefficient is weighted by the share of directly-held stocks and funds in the complete financial portfolio. This guarantees that households owning very few risky assets do not carry too much weight in the estimation, which helps us achieve higher statistical efficiency (Seasholes and Zhu, 2010). We cluster standard errors by calendar month because household historical returns are subject to common macro shocks that market risk may not fully adjust for. The financial portfolio of the median household has a risk-adjusted performance of precisely 0%. No wealth group earns an alpha that is significantly different from the performance reached by the median household, either in statistical or economic terms. Therefore investment skill is not an important contributor to expected returns on financial wealth, consistent with the results obtained for total wealth in Section *II.E*.

Financial risk is positively related to net worth. The standard deviation of the complete portfolio return monotonically increases from 2.4% per year for the bottom 10% to 15.1% for the top 0.01%. The Sharpe ratio of the complete portfolio, which coincides with the Sharpe ratio of the risky portfolio, is slightly hump-shaped in net worth, increasing from 0.29 for the bottom 10% to 0.35 for the top 2.5%-1%, and then declining to 0.33 for the top 0.01%. The decline of the Sharpe ratio in top brackets points to the importance of idiosyncratic risk. Indeed, the risky portfolio's share of idiosyncratic risk decreases mildly from 24% in the bottom decile to 19.5% for the top 5%-2.5% and then increases rapidly in the highest brackets, reaching 30% for the top 0.01%. The large idiosyncratic risk of households at the very top has a number of possible explanations which investigate further in the Internet Appendix. This analysis shows that in higher brackets, households substitute diversified risky funds with more granular portfolios of directly-held stocks, most likely in order to save on fund fees and reach risk exposures that are not provided by existing funds.

Overall, wealthy households achieve high expected returns on financial wealth by investing aggressively in risky assets with high factor loadings, while investment skill seems to play no significant role. Furthermore, the share of idiosyncratic risk is U-shaped in wealth, which confirms that very rich households bear high idiosyncratic risk that can contribute to the dynamics of inequality, as we further discuss in Section IV.

III.B Pension Wealth

Pension wealth is a substantial component of household wealth in all wealth brackets outside the top 1%, as Figure 2 illustrates. In the last columns of Table III, we report the expected excess return (column 8), time-series standard deviation (column 9), and Sharpe ratio (column 10) of pension wealth. In the period we consider, Swedish households had little discretion over how to invest their funded pension savings.[21] For this reason, we make the simplifying assumption that all households hold the same pension investment portfolios, as Section *I.C* and the Internet Appendix explain.

The expected excess return on pension wealth is 3.5% per year. This value is higher than the expected return on the complete financial portfolio for households outside the top decile, consistent with the fact that funded pension wealth is heavily tilted toward risky assets. Pension wealth, however, has a lower expected return than real estate and therefore tends to lower the average performance on gross wealth of households in the upper half.[22] Pension wealth has an even more negative impact on the expected return on net wealth because it tends to lower the leverage ratio of the household balance sheet.

We compute the risk in pension wealth under the maintained assumption that it is fully diversified. This simplification is motivated by the fact that the size of pension funds should allow them to be better diversified than any group of households. The standard deviation is correspondingly estimated at 7.8% per year and the Sharpe ratio at 0.45.[23]

Overall, pension wealth increases on average the expected return on gross wealth of house-

[21] In particular, most of the funded pensions were invested in so-called *traditional life insurance* products, whose asset composition was at the discretion of a few life insurance companies.

[22] This view is consistent with the 5.5% average return on the FASTPI real estate index reported in Section *I.D* and is further supported by the evidence in Section *III.C*.

[23] The Sharpe ratio estimate is not much higher than the Sharpe ratio of 0.35 estimated for the financial portfolio held by the top 2.5%-1% of households. Our estimates of the standard deviation and Sharpe ratio of pension wealth therefore do not seem overly biased.

holds in the bottom four deciles of the distribution of net worth, but reduces the expected return on gross wealth of wealthier households. Pension wealth, however, is an important asset for most households that improves the size and diversification of total wealth.

III.C Real Estate

Real Estate CAPM. Consistent with the methodology used for other asset classes, we assume that the excess return on each property i follows a real estate CAPM:

$$r_{i,t}^{*,e} = \alpha_i + \beta_i r_{RE,t}^e + \varepsilon_{i,t}, \tag{3}$$

where $r_{RE,t}^e$ denotes the excess return on the FASTPI real estate index, β_i the sensitivity of the property to systematic risk, and $\varepsilon_{i,t}$ is an idiosyncratic shock.[24] Like other countries, Sweden applies to real estate specific tax rules that do not apply to other forms of investment. For this reason, the measure of property return in equation (3) is adjusted for taxes specific to real estate properties but not for other forms of personal taxes, such as the wealth tax or capital gain tax. Specifically, our measure is defined by $r_{i,t}^{*,e} = r_{i,t}^e + \tau_{i,t} - \kappa_{i,t}$, where $r_{i,t}^e$ is the excess return on the property before any taxes are paid, $\tau_{i,t}$ is the tax credit on mortgage interest, and $\kappa_{i,t}$ is the property tax rate.

From the marginal investor's perspective, $r_{i,t}^{*,e}$ is directly comparable to the pre-tax returns on other forms of wealth and is therefore well suited for asset pricing. From a household's perspective, we will consider the property return before any taxes are paid, $r_{i,t}^e$, which is the relevant concept if taxes are capitalized. The relevance of the two returns depends on whether or not property taxes and the mortgage interest rate deduction are capitalized, a highly debated question in real estate economics (see, e.g., Hamilton 1976, Oates 1969, Palmon and Smith 1998, Simon 1943, Zodrow 2001). In the Swedish panel, the adjustment $\kappa_{i,t} - \tau_{i,t}$ is small and the distinction between $r_{i,t}^e$ and $r_{i,t}^{*,e}$ has no material impact on our empirical results.

[24]It can be derived from a more general CAPM model provided stock returns do not correlate with the real estate market index return and property returns do not correlate with the stock market index return.

Because the total return on a property is not directly observed, the sensitivity of capital gains to the real estate index is used as a measure of β_i. Case, Cotter and Gabriel (2009) similarly consider a housing CAPM based on capital gain betas. The estimation of β_i on capital gains is unbiased under the following conditions. First, the excess return on a property i satisfies the accounting identity:

$$r_{i,t}^{*,e} = d_{i,t} - r_{f,t} - \delta_{i,t} + g_{i,t} + \tau_{i,t} - \kappa_{i,t}, \quad (4)$$

where $d_{i,t}$ is the property's rental yield, $\delta_{i,t}$ denotes the maintenance and depreciation rate, $g_{i,t}$ the rate of capital gain, and $r_{f,t}$ the risk-free rate. Second, the rental yield is provided by the user cost of real estate services. Consistent with Poterba (1992) and Himmelberg, Mayer and Sinai (2005), $d_{i,t}$ is the sum of the depreciation and maintenance rate, the property tax rate, the interest rate (net of interest tax credits), and a risk premium, γ_i, minus the expected capital gain:

$$d_{i,t} = r_{f,t} + \delta_{i,t} + \kappa_{i,t} - \tau_{i,t} + \gamma_i - \mathbb{E}_t(g_{i,t+1}),$$

The excess return on the property is therefore:

$$r_{i,t}^{*,e} = \gamma_i - \mathbb{E}_t(g_{i,t+1}) + g_{i,t}. \quad (5)$$

To the extent that the rate of capital gain is stationary, equation (5) implies that the total return $r_{i,t}^{*,e}$ and the capital gain $g_{i,t}$ have the same sensitivity β_i to the real estate index.

The sensitivity β_i is estimated on capital gains at the level of property groups. We classify real estate properties into 389 groups based on location and type of property. We assume that all properties in an asset class have the same sensitivity β_i. We obtain the real estate beta β_c of each property class c by regressing the return on an index of properties from that class on the FASTPI real estate index return over the 1982 to 2014 period. In contrast to equities, yearly real estate returns are positively autocorrelated over a horizon of up to three years. Since real estate holding periods are typically longer than a year, we use three-year moving average returns to measure the betas and the variance-covariance matrix of returns.

Under the Swedish tax system, the property tax rate and mortgage deduction are determined as follows. The property tax is not deductible from the income tax bill and is proportional to the value of the property. The property tax rate, $\kappa_{i,t}$, is 0.75% over most of the sample period for residential real estate. The mortgage deduction allows the owner-borrower to save $\tau^* = 30\%$ of her interest payments in taxes. We assume the marginal property buyer is 100% levered, with an interest rate risk premium of 2%, consistent with aggregate data on mortgage loans from the Swedish Central Bank. The mortgage deduction therefore represents a fraction $\tau_{i,t} = \tau^* (r_{f,t} + 0.02)$ of the value of the property.

In practice, we estimate the expected return on real estate properties by assuming that $\alpha_i = 0$ for every i. The expected return is therefore $\mathbb{E}(r_{i,t}^{*,e}) = \beta_i \mathbb{E}(r_{RE,t}^e)$ once taxes specific to real estate are paid, and $\mathbb{E}(r_{i,t}^e) = \beta_i \mathbb{E}(r_{RE,t}^e) + \kappa_{i,t} - \tau_{i,t}$ before taxes.

The real estate CAPM also allows us to measure the systematic and idiosyncratic risk involved in holding a real estate property. Let $c(i)$ denote the class of asset i. We decompose the idiosyncratic shock $\varepsilon_{i,t}$ as the sum of a class-level shock common to all properties in the class, $u_{c(i),t}$ and a shock specific to the property, $v_{i,t}$, so that

$$\varepsilon_{i,t} = u_{c(i),t} + v_{i,t}.$$

For each class c, we denote by $\sigma_{c,u}^2$ the variance of the common shock $u_{c,t}$, and we assume that the property-specific shock of every property in the class has variance $\sigma_{c,v}^2 = Var(v_{i,t})$. The total idiosyncratic variance of a property in c is given by $\sigma_{c,u}^2 + \sigma_{c,v}^2$, while the idiosyncratic share is the ratio of the total idiosyncratic variance to the total variance, $(\sigma_{c,u}^2 + \sigma_{c,v}^2)/[\beta_c^2 Var(r_{RE,t}) + \sigma_{c,u}^2 + \sigma_{c,v}^2]$.

We estimate the variance of the common shock, $\sigma_{c,u}^2$, from the residuals of a time-series regression of the return of class c on the real estate index return. We estimate the variance of the property-specific shock, $\sigma_{i,v}^2$, on a dataset of all real estate transactions in Sweden from 1992 to 1999. For each class c, the dataset provides two separate valuations for each property subject to a transaction. The first valuation, $P_{i,s}$, is the transaction price at the date of the sale, $t_{i,s}$. The second valuation, $P_{i,c}$, is the hedonic price computed by tax authorities using very detailed information on the characteristics of each property. The hedonic price is computed in semester t_c for all properties in the class on a rolling basis, so that each property is assessed every three to seven years.[25] For every sale semester t_s, we compute the cross-sectional variance of $\ln(P_{i,s}/P_{i,c})$ across all properties in the class, which we denote by $V^*_{c,s}$. We estimate $\sigma^2_{c,v}$ by regressing the cross-sectional variance, $V^*_{c,s}$, on the time lag $|t_s - t_c|$:

$$V^*_{c,s} = a_c + \sigma^2_{c,v} |t_s - t_c| + u_{c,s},$$

where the constant term a_c is a measure of the volatility in transaction and census prices coming from pure valuation errors.

Model-Free Approach. An alternative measurement of the expected return consists in using instead long-term averages of both the rental yield and the capital gain return. The pre-tax expected excess return on a real estate property is $\mathbb{E}(d_{i,t} - \delta_{i,t} - r_{f,t}) + \mathbb{E}(g_{i,t})$, as the accounting identity (4) implies. We first proxy for the expected rental yield using the average $\overline{d - \delta - r}$ of national account estimates of the rental yield and housing depreciation rate in excess of the risk-free rate over the period 1991-2014.[26] Second, we proxy for the expected capital gain using the historical average capital gains returns within the property class $\overline{g_{c(i)}}$. Third, we combine proxies for capital gains and net rents as follows:

$$\mathbb{E}(r^e_{i,t}) = \overline{d - \delta - r} + \overline{g_{c(i)}}. \tag{6}$$

We apply this approach to provide alternative estimates of expected returns on real estate. In practice, the preferred approach (5) and the alternative method based on historical data (6) pro-

[25]Importantly, this tax valuation is updated by tax authorities as soon as significant changes to the property's features are made.

[26]Swedish national accounts provide estimates of rental yields and depreciation rate for residential real estate only. We impute the corresponding yield for commercial real estate using the property and income tax differential between residential and commercial real estate. Furthermore, we start in 1991 because prior to this date the tax costs and benefits of residential real estate were specific to each household.

duce estimates of expected returns that never differ by more than 0.5% in yearly units, which confirms that our model is sound and consistent with the data.

Empirical Results. In Table IV, we report the risk and return characteristics of real estate wealth. For the median household, the expected total excess return, $\mathbb{E}(r^e_{i,t})$, is 4.55% per year, which is substantially higher than the 1.24% expected excess return on financial wealth and the 3.47% expected excess return on pension wealth (Table III) and almost exactly equal to the debt interest spread (Table I). Given that the interest spread is lower for households that get a mortgage (as we show in the Internet Appendix), these estimates confirm that the median household can enjoy high expected returns on total net wealth by making leveraged investments in real estate, as Table I shows. However, because real estate holdings are lumpy, the level of diversification is low compared to that of an equity index fund, with an idiosyncratic share of 54% for the median household.

In contrast to financial wealth, the expected return, volatility and diversification of real estate portfolios exhibit only modest variation with net worth. The share of idiosyncratic risk declines from 56% in the bottom decile to around 42% in the top decile, while the Sharpe ratio correspondingly increases from 0.35 to 0.43. Overall, the real estate portfolio tends to increase the expected return on gross and net wealth of households outside the top decile. As Table I shows, real estate is also a source of underdiversification that households in middle brackets partly mitigate by holding assets from other classes,

III.D Private Equity

Measuring expected returns on private equity is challenging because firm valuation is based on annual statements, so that the time series of returns is usually short. As is widely recommended in the academic and practitioner literature (Damodaran 2012), we bypass the issue by matching private firms to public firms with similar characteristics.

We develop an estimation methodology that allows us to infer the risk profiles of private firms from the risk profiles of publicly traded firms with similar characteristics. For this paper, the risk profile consists of the factor loadings and idiosyncratic volatility of equity returns, while the firm characteristics are size, profitability, asset tangibility, and international openness.

The estimation approach proceeds as follows. First, we obtain the risk profile of every *publicly traded firm* by running a time-series regression of its stock returns on the factors. Second, we regress the risk profile of public firms on firm characteristics, which provides both the sensitivities of the expected risk profile to characteristics and the distribution of the residual variation in risk profile. Third, we assume that the residual variation has the same distribution for private and public firms. We then obtain the distribution of a private firm's risk profile conditional on its characteristics.

The equity of limited-liability corporations with substantial financial debt behaves like a call option, with heavily non-normal returns (Merton 1974). For each private firm, we simulate returns by sampling $M = 100$ risk profiles from the distribution of the risk profile conditional on characteristics and 1,200 pseudo-realizations of the factors from their empirical distribution at the monthly frequency. Averaging over these simulations, we obtain the factor loadings, expected return, and idiosyncratic volatility of every private firm. In an influential study of U.S. private equity returns, Moskowitz and Vissing-Jørgensen (2002) show that entrepreneurial firms do not exhibit substantial risk-adjusted performance. In the Internet Appendix, we confirm that this result also holds in our Swedish panel when returns are risk-adjusted using the above procedure, a finding which we use in the rest of the paper.[27]

In Table V, we report how the risk and return characteristics of the household private equity portfolio vary with net worth. The expected return is roughly constant across brackets of net worth, starting at 10.8% in the bottom 10% and reaching 10% per year for the top 0.01%. Private equity therefore earns higher expected excess returns than financial wealth (0.6%-4.6% per year

[27]In a later study, Kartashova (2014) argues that U.S. private equity outperformed public equities from 1999 to 2007. In the Internet Appendix, we compare these asset classes in Sweden over about the same period (2000-2008) and find no differences in performance once one adjusts for differences in risk loadings. We also replicate the U.S. finding from Smith, Yagan, Zidar, and Zwick (2018) that profitability per worker is higher among private firms owned by wealthy households, but find that over-performance disappears in Sweden if one looks instead at profitability per equity invested.

across wealth brackets), pension wealth (3.5% per year) and real estate (4.4%-5.8% across wealth brackets), and produces even higher expected returns than the portfolios of public equity held directly or indirectly by the very wealthy (7.8% for the top 0.01%). In the Internet Appendix, we explain these results by the high loadings of private equity portfolios on the value factor.

Private equity is substantially riskier and less diversified than other forms of wealth. For the median household, the volatility of the private equity portfolio is 59% per year, compared to 4% for the complete financial portfolio, 8% for funded pension wealth, and 13% for the real estate portfolio. The volatility of private equity declines with net worth, reaching a low of about 47% in top brackets. This pattern is in part driven by better diversification: the share of idiosyncratic risk decreases from 82% for the bottom 10% to 79% for the top 0.01%. As a result, the Sharpe ratio increases from 0.18 for the bottom 10% to 0.23 for the top 0.01%.

Overall, private equity is an asset class with high expected returns but also large idiosyncratic risk. Because it is primarily held by the very wealthy, it plays a central role in the inequality dynamics, as the next section demonstrates.

IV Return Heterogeneity and Wealth Inequality

We now investigate how the heterogeneity of household wealth returns impacts the level and dynamics of wealth inequality. In Section *IV.A*, we document that household historical returns explain most of the evolution of top wealth shares in Sweden over the sample period, as predicted by recent models of inequality. Section *IV.B* documents the dispersion of household annual returns and its link to systematic and idiosyncratic risk. Section *IV.C* uses twin analysis to identify the relative contributions of scale and type dependence to the dispersion of expected returns. Section *IV.D* develops a methodology to estimate the distribution of average returns over a generation, and shows that type and scale dependence are both key drivers of wealth returns over the long run.

IV.A The Link Between Returns and Inequality Dynamics: A Reduced-Form Approach

Intuition suggests that if returns vary across households, disparities in wealth should widen over time. As Benhabib and Bisin (2018) explain in a recent survey, most microfounded models consider heterogeneity in patience, taxes, and talent, but not in wealth returns, and have difficulties in matching the high level and fast growth of top wealth shares. By contrast, Benhabib, Bisin, and Zhu (2011) show that time-persistent idiosyncratic returns generate substantial additional wealth concentration at the top.

The wealth accumulation equation provides key insights on the properties of the wealth distribution in both reduced-form and microfounded models (Benhabib and Bisin 2018). For this reason, we investigate the contribution of return heterogeneity to wealth inequality in a simple, reduced-form model that incorporates heterogeneous household historical returns but abstracts away from household differences in patience, taxes, and talent.

We specify the counterfactual net worth of household h at the end of year $t+1$ by the accumulation equation:

$$W^*_{h,t+1} = W_{h,t}\,(1 + r_{h,t+1}) + s_{t+1}\,W_{h,t}, \tag{7}$$

where $W_{h,t}$ is the household's observed net worth at the end of year t, $r_{h,t+1}$ is the return on net wealth observed in our data during year $t+1$, and s_{t+1} is the saving rate during year $t+1$. The rate s_{t+1} is chosen so that the aggregate counterfactual net worth at $t+1$ matches actual aggregate net worth. Because s_{t+1} does not vary across households, the active saving rate, that is the ratio of labor income minus taxes and consumption to initial net worth, is constant across households. The accumulation equation (7) allows us to compute counterfactual top wealth shares at the end of year $t+1$. A modest difference between the counterfactual and historical evolutions of top wealth shares would be consistent with the view that diversity in talent, taxes, and patience play little role in the evolution of inequality at the top.

In Figure 4, we plot the annual evolution of the net wealth shares held by the top 1% (panel

A) and the top 0.01% (panel B) between 2000 and 2007. Each panel reports both the absolute change predicted by our model (solid line) and the corresponding empirical value (dotted line). The evolution of top wealth shares is remarkably well predicted by our reduced-form model. The correlation coefficient between predicted and actual growth in the time series is 0.96 for the top 1% and 0.80 for the top 0.01%. Asset returns explain most of the yearly variation in top wealth shares, which confirms the hypothesis put forth by historians of wealth inequality, such as Piketty (2014), that the yearly volatility of top shares is high because asset prices have high annual volatilities.

The model also captures the average evolution in top shares over the sample period. The average absolute change of the top 1% share is predicted to be 0.96% per year accordingly to the model and is equal to 0.86% in the data. For the top 0.01% share, the predicted average absolute change is 0.47% per year, which is very close to the empirical value of 0.48%. These results suggest that other potential drivers of the evolution of wealth inequality, such as consumption, labor income, inter vivos transfers, and household turnover, have a very small net effect on inequality growth at the top. In a companion paper (Bach, Calvet, Sodini, 2017), we investigate this hypothesis further and confirm that these forces only play a marginal role in our sample period and that heterogeneity in returns is the dominant mechanism.[28]

IV.B Dispersion of Annual Returns

Recent models tying the evolution of wealth inequality in the short to medium-run (Campbell, 2016; Hubmer Krusell Smith 2018) have emphasized the role of two specific features of the distribution of annual returns. First, inequality tends to increase if returns are positively correlated with the initial level of wealth. Columns 1 and 2 of Table II and Figure 3 show that this condition holds at the yearly frequency over the period 2001-2008. The average return on net wealth

[28] Saez and Zucman (2016) decompose the time variation of wealth inequality in the U.S. into an aggregate return effect and a synthetic saving effect, and find a large role of synthetic saving flows. In the Internet Appendix, we replicate their decomposition in our data and show that the synthetic saving effect is mostly caused by heterogeneity in individual returns within each wealth bin rather than differences in individual saving behavior. Note that these two explanations cannot be disentangled in the data Saez and Zucman (2016) have at their disposal.

of households in the top 0.01% exceeded by 2.4 percentage points the average return of households in the fifth decile of the distribution of net worth. This difference is entirely explained by differences in systematic risk.

Second, the theoretical literature emphasizes that inequality tends to increase over time if the cross-sectional variance of annual returns is substantial, and even more so if the dispersion is larger in top brackets. Using the asset pricing model laid out in Section I, we can trace the origins of such cross-sectional dispersion to the systematic and idiosyncratic risk exposures of household portfolios.

In Table VI, we report the cross-sectional standard deviation of: the pre-tax historical return $r_{h,t}$ on (1) gross and (2) net wealth, the pre-tax expected return on (3) gross and (4) net wealth, the pre-tax systematic return on (5) gross and (6) net wealth, and the post-tax historical return on (7) gross and (8) net wealth.

In the entire Swedish population, the pre-tax annual historical return on gross wealth has a cross-sectional standard deviation of 9%. Under the asset pricing model, the dispersion of the household return, $r^e_{h,t} = \mathbb{E}(r^e_{h,t}) + \beta_{h,t}(r^e_{h,t} - \mathbb{E}(r^e_{h,t})) + \varepsilon_{h,t}$, is driven by the dispersion of expected returns, the dispersion of innovations to systematic returns, and underdiversification. The expected return has a cross-sectional standard deviation of 1.9% (column 3). The systematic return has a cross-sectional standard deviation of 6.7%, more than three times larger than the standard deviation of expected returns. Underdiversification therefore accounts for 45% of the cross-sectional variance of gross returns.

Due to leverage, the cross-sectional standard deviation of pre-tax returns is twice larger for net wealth than for gross wealth in the full population, and 37% larger within the upper half. The relative shares of expected returns, systematic shocks and idiosyncratic shocks are very similar to what we find for gross wealth.

Taxes do not significantly alter our pre-tax results at the annual frequency. In the Internet Appendix, we explain this findings by showing that the dispersion of tax rates is an order of magnitude smaller than the dispersion of pre-tax annual returns. Furthermore, since households usually pay taxes on capital gains only in the tax year when an asset is sold, the correlation between pre-tax returns and taxes is empirically weak at the annual frequency.

The dispersion of returns is high within each bracket of net worth. Up until the 95th percentile, the standard deviation of annual returns conditional on wealth remains between 7% and 10%. In higher brackets, the dispersion of gross wealth returns increases dramatically and reaches 31% within the top 0.01%. This dramatic increase is largely driven by the growing share of underdiversified private equity investments documented in earlier sections. For net wealth, the cross-sectional standard deviation of returns is U-shaped in the wealth rank because many poor households are highly levered.

Overall, the cross-sectional dispersion of annual household returns is very substantial at the yearly frequency. Table VI documents that the large heterogeneity of returns arises mainly from factor innovations and risk-adjusted returns. As the asset pricing literature shows and the Internet Appendix confirms, factors and risk-adjusted returns exhibit no significant persistence, so that their average impact is likely to wane over the long run. By contrast, persistent differences in expected returns are likely to have a strong impact on long-run performance. For this reason, we now investigate the economic mechanisms driving expected returns.

IV.C Scale and Type Dependence in Expected Returns

To understand the determinants of long-run returns, we find it useful to decompose annual expected returns into a type effect, a scale effect, and a transitory component:

$$r_{h,t} = \theta_h + \phi(W_{h,t-1}) + v_{h,t}, \tag{8}$$

where θ_h denotes the type of household h, $\phi(\cdot)$ is a function of net wealth, and $v_{h,t}$ is a stochastic term with zero mean for every h and t. The sensitivity of ϕ with respect to wealth quantifies the scale dependence of expected returns, possibly coming from easier access to high-yield investments or decreasing absolute risk aversion. The type parameter θ_h incorporates household characteristics that persistently impact returns, such as skill, risk tolerance, sophistication, and informational advantages.

Gabaix et al. (2016) suggest that scale and type dependence can both exacerbate the concentration of wealth. The evidence reported in Sections II and III is consistent with these two hypotheses: wealthier households have distinct investment practices, which may be either because the wealthy include special types of investors or because wealth triggers specific investment behavior.[29] Scale and type dependence may also be complementary. We successively investigate these hypotheses in the rest of the Section.

Scale dependence is challenging to identify if type dependence in returns is substantial. Over time, high-type households are likely to join the highest parts of the distribution, so that wealth may correlate with returns even in the absence of scale dependence. Several approaches have been suggested to identify scale effects. In the context of our study, natural experiments akin to helicopter drops of money are inappropriate because we are particularly interested in the impact of large differences in wealth. Lotteries may be informative about the causal effect of entering the top half or the top decile of the distribution of wealth, but they probably do not cause sufficiently many entries into the top 1% to deliver powerful tests of the impact of such a treatment. Helicopter drops are also problematic because they usually target highly selected parts of the population and identification relies on the assumption that their effects on a given outcome quickly reaches a steady state.

We choose an alternative approach, inspired from Calvet and Sodini (2014), that considers how wealth differences between twin siblings impact differences in returns. This test is powerful because there is substantial variation in wealth rank between twins. For instance, if a twin is in the top 0.5% of the wealth distribution, the other twin is outside the top 0.5% with probability 82%. By contrast, a household initially in the top 0.5% only has a 24% probability of leaving

[29] This reflects a famous exchange of views between F. Scott Fitzgerald and Ernest Hemingway. When the former is reputed to have said: "The rich are different from you and me.", the latter replied: "Yes, they have more money."

this bracket over 7 years, so heterogeneity between twins is stronger than the time-series heterogeneity in a household's wealth rank generated by wealth mobility. Because the twin analysis is cross-sectional, it is less sensitive to the speed at which households adapt their behavior to their level of wealth. Finally, because the event that parents had twins was likely random at the time of our sample, the twin sample is representative of the entire population.

In econometric terms, the twin test consists of including a twin pair-year fixed effect in regressions of expected returns on the wealth rank. Because our analysis is at the household level, we only consider adult twins who belong to two distinct households. The identifying assumption is that twins with similar levels of wealth tend to have similar expected returns. In the Internet Appendix, we provide a number of placebo tests that all provide support for this identifying assumption. Because the twin subsample size is much smaller than the full sample, we consider a unique bracket for the top 0.5%, which contains about 180 households per year, while other brackets remain unchanged.

In Table VII, we report regressions of expected returns on the net wealth rank, estimated either on the full sample or on the subsample of twins. The results are reported for both gross and net wealth and are expressed relative to the median bracket, which is used as a benchmark. Columns 1 and 2 use the full sample and report essentially the same results as columns 1 and 2 of Table I, except for the normalization of expected returns and the change in the definition of brackets at the top. The expected return on gross wealth is 3.73% higher for the top 0.5% than for the median household, while the difference between the top 0.5% of and the median is 3.21% for net wealth. In columns 3 and 4, we run the exact same regression on the subsample of twins. We find that the top 0.5% earn on average 3.70% more on gross wealth and 2.97% more on net wealth compared to the median. The twin estimates are therefore very close to the full sample estimates, which suggests that the results from the twin subsample carry substantial external validity.

Columns 5 and 6 report regressions that include twin pair-year fixed effects. The R^2 coefficient goes up very significantly (from 0.35 to 0.57 for gross wealth, and from 0.08 to 0.22 for net wealth). These results show that twins share a common type of investment style, which provides evidence of type dependence in returns. The marginal effect of wealth is also very strong even within a twin pair: the top 0.5% earn 3.43% more on gross wealth and 2.72% more on net wealth, which is comparable to the full-sample estimates.

To illustrate the economic magnitude of scale and type dependence, we consider the decomposition of expected returns in equation (8), with the additional assumption that the investment type θ_h is entirely common to twins. This simplifying assumption will likely lead us to underestimate the contribution of type dependence if some investment type is not fully shared by twins. We also consider that the three explanatory factors in 8 are mutually independent. Under these assumptions, the R^2 coefficients reported in Table VII imply that scale dependence, type dependence, and transitory variation represent 35%, 22%, and 43%, respectively, of the variance of expected gross wealth returns. The corresponding shares are 8%, 14%, and 78%, respectively, for net wealth. Scale and type dependence therefore both drive expected returns at the yearly frequency. They may therefore have a major impact on long-run performance, which we now further explore.

IV.D Scale and Type Dependence in Long-Term Returns

We investigate the distribution of household wealth returns over an investment horizon of T_g periods. The arithmetic return of an investment over the full period is given by $1+R_h = \prod_{t=1}^{T_g}(1+r_{h,t})$, where $r_{h,t}$ is the arithmetic yearly return considered in earlier sections. If returns are stationary and serially uncorrelated,[30] the expected return over the full investment horizon satisfies

$$\mathbb{E}(1+R_h) = [1+\mathbb{E}(r_{h,t})]^{T_g}, \tag{9}$$

[30]This assumption directly follows from the asset pricing model if factors and risk-adjusted performance are serially uncorrelated. We test it and validate it empirically in the Internet Appendix.

and is therefore entirely driven by the expectation of the yearly arithmetic return. Equation (9) implies that scale effects identified on annual expected returns carry over to expected returns over T_g years. Since asset volatilities and household loadings are partly persistent, however, squared yearly returns are autocorrelated and additional analysis is required to characterize the variance of long-term performance.

The performance of household wealth is conveniently quantified by the geometric average return,

$$1 + r_h^G = (1 + R_h)^{1/T_g} = \left[\prod_{t=1}^{T_g}(1 + r_{h,t})\right]^{\frac{1}{T_g}}, \tag{10}$$

which allows us to produce comparable estimates at different horizons.

The analysis of long-run returns is motivated by Benhabib, Bisin, and Luo's (2018) model of inequality, whose key ingredient is the dispersion of the long-run return across households.[31] In their model, r_h^G is drawn at the beginning of the household's investment period and all the household's yearly returns $r_{h,t}$ are equal to r_h^G. A calibrated version of the model sets the investment horizon, T_g, to 36 years, which corresponds to a generation, and the standard deviation of r_h^G to 2.69% per year in order to fit the observed distribution of wealth in U.S. data.

The estimation of the mean and variance of long-run performance poses a number of challenges. First, in the Swedish panel, households are observed for at most 8 years, so that the long-run performance r_h^G is not observed. Second, given the evidence in earlier sections, the time-series persistence in $r_{h,t}$ stems from factor loadings and not from time-series dependence in the factors or risk-adjusted returns, so the persistence of household returns can be identified from historical return data only after a representative set of factor returns have been observed. Third, the historical return $r_{h,t}$ is highly noisy, and the dispersion of long-run returns is driven by both transitory and persistent components that must be disentangled in estimation. Finally, long-run performance r_h^G is a nonlinear function of the yearly arithmetic returns $r_{h,t}$, so the relationship between household factor loadings and long-run performance is nonlinear.

[31] Benhabib, Bisin, and Luo assume that agents cannot borrow so it is appropriate to view their calibration as referring to returns on gross wealth.

We overcome these challenges by developing an estimation method based on the asset pricing models in Sections II and III. We specify household returns and loadings by:

$$r_{h,t} = \beta'_{h,t-1} f_t + \varepsilon_{h,t}, \tag{11}$$

$$\beta_{h,t-1} = \beta_h + \gamma_{t-1} + \delta_{h,t-1}. \tag{12}$$

Equation (11) is the usual factor model. The risk adjusted performance, $\varepsilon_{h,t}$, is assumed to have zero mean, consistent with Table II, and exhibits no time persistence, as we verify empirically in the Internet Appendix. Equation (12) expresses the vector of factor loadings of household h at date t-1 as the sum of a long-run level, β_h, a vector of time effects, γ_{t-1}, and an idiosyncratic term, $\delta_{h,t-1}$. The vector of factor loadings is imputed from portfolio weights and asset loadings, as equation (2) shows. We easily estimate the moments of β_h, γ_{t-1}, $\delta_{h,t-1}$, and $\varepsilon_{h,t}$ from holdings data.

The moments of the geometric average performance, r_h^G, can be derived from the moments of the components of yearly returns. Indeed, long-run performance, defined by equation (10), satisfies:

$$\ln(1+r_h^G) = \frac{1}{T_g}\sum_{t=1}^{T_g} \ln(1+r_{h,t}). \tag{13}$$

A second-order Taylor expansion implies that the logarithm of long-run performance is driven by the sample means of yearly returns and squared yearly returns:

$$\ln(1+r_h^G) \approx \bar{r}_h - \overline{r_h^2}/2,$$

where $\bar{r}_h = T_g^{-1}\sum_{t=1}^{T_g} r_{h,t}$, and $\overline{r_h^2} = T_g^{-1}\sum_{t=1}^{T_g} r_{h,t}^2$. In the Internet Appendix, we use this equation to efficiently estimate the mean and variance of moments of $\ln(1+r_h^G)$ from the moments of β_h, γ_t, $\delta_{h,t}$, and $\varepsilon_{h,t}$. By the Central Limit Theorem, the logarithm of the long-run return is approximately normal, and we use the Laplace transform to recover the mean and variance of r_h^G. The method is quite efficient because factor loadings are accurately estimated and sources of noise that do not impact long-term returns are naturally eliminated. We also report Monte Carlo simulations showing that our asset-pricing-based method is more precise and substantially less biased than alternative estimators, such as the one proposed by Fagereng et al. (2018).

In Table VIII, we use this methodology in the Swedish data to provide estimates of the cross-sectional mean and dispersion of geometric average returns over 36 years, the time period considered by Benhabib, Bisin, and Luo (2018) to constitute a full generation. We present estimates of the mean and dispersion both across the entire Swedish population and within brackets of the wealth distribution.

In columns 1, 3, 5, 7, 9 and 11, we display the mean of geometric average returns across fractiles of the wealth distribution using various return concepts. In the case of pre-tax returns, the mean geometric average return is a hump-shaped function of initial wealth with a peak at around the top 2.5%-1%. For post-tax returns, the mean geometric return is flat within the top 10%-95% and declines thereafter. There is therefore a stark difference with the result we obtain on expected arithmetic returns. The reason is that the geometric mean decreases on average with the level of cross-sectional dispersion in annual returns, which is very large among the very rich (see Section *IV.B*). Furthermore, we know from equation (9) that scale effects carry over to longer horizons.

In column 2, we show the dispersion of pre-tax returns on gross wealth. In the entire population the average return over a generation has a cross-sectional standard deviation of 2.1%, which is slightly lower than the 2.69% value used for the U.S. by Benhabib, Bisin, and Luo (2018). Importantly, and in contrast to their model, dispersion conditional on initial wealth is roughly constant in our data in the bottom 95% of the population but then grows rapidly with household wealth, reaching 5.3% per year for the top 0.01%. This property is particulary significant for the inequality debate, because Gabaix et al. (2016) and Hubmer Krusell and Smith (2018) suggest that higher dispersion in returns at the top generates a higher level and a faster increase of top wealth shares.

In column 4, we display the dispersion of pre-tax total returns on net wealth. The cross-sectional standard deviation over the full population is 7.4%, which is substantially higher than our estimate for gross wealth and the value used in Benhabib, Bisin, and Luo (2018). This high level of dispersion is largely driven by leveraged households in the bottom part of the distribution. Indeed the conditional dispersion is U-shaped, declining from 11.2% in the second decile to 3.8% in the ninth decile and then increasing to more than 7% in the top 0.5%. Given that households in bottom deciles only represent a tiny share of aggregate wealth, it is inappropriate to compare these estimates with the value used in a calibration designed to fit the level of top wealth shares. For this reason, we also report the dispersion of the average return over a generation in the top half of the population is 4.2%, which is much closer to the levels of dispersion estimated for gross wealth in our data set and used in the calibrations of Benhabib, Bisin, and Luo (2018).

In columns 6 and 8, we compute the dispersion of the average pre-tax return over a generation under a counterfactual scenario in which household portfolios are fully diversified. The dispersion of long-term average returns does not change much under such a scenario: it is 1.8% for gross wealth (compared to 2.1% in the data) and 7.7% for net wealth (compared to 7.4% in the data).[32] This reflects the fact that over 36 years, a large part of idiosyncratic shocks averages out. However, annual shocks to the entrepreneurial assets held by the wealthiest households are very large and make a substantial contribution to the dispersion of the average return over a generation among the very rich. For the top 0.01%, the dispersion of returns on net wealth would drop from 7.2% to 3.3% if wealth risk were fully diversified.

In columns 10 and 12, we display the dispersion of the average post-tax return over a generation. These estimates correspond more closely to the calibrations of Benhabib, Bisin, and Luo (2018), who also consider returns after taxes. Theory predicts that the effect of the taxation of capital on the dispersion of wealth returns crucially depends on whether capital stock or capital income is used as a tax base (Guvenen et al. 2018). Compared to our previous estimates, the estimated distribution of post-tax returns is more dependent on the structure of the Swedish tax

[32] The dispersion of the average return over a generation can be higher with a diversified portfolio because, in order to capture the dispersion of a geometric average, it must include higher order moments of returns, such as the variance of squared returns and the covariance of returns with squared returns. These higher order moments need not be smaller when a portfolio becomes more diversified.

system, which consists of a flat tax on capital income and a wealth tax over most of the period we consider. In the data, the taxation of capital significantly amplifies the dispersion of returns on gross wealth, which over the entire population increases from 2.1% before taxes to 2.8% after taxes. We show in the Internet Appendix that Swedish households with similar wealth and returns tend to pay very different amounts of capital taxes. Just as in many other Western countries, different tax rates apply to income from real estate, safe financial assets, risky financial assets, pension wealth, and private equity. Interestingly, however, the pattern is reversed for net wealth: the dispersion of net wealth returns drops from 7.4% before taxes to 5.1% after taxes. This reduction is entirely driven by the impact of the mortgage interest deduction, which reduces the negative impact of high interest rates on net wealth returns. Naturally, this effect is concentrated in the bottom half of the wealth distribution and is not observed in the top half.

V Conclusion

This paper uses a high-quality administrative panel to analyze the portfolios of Swedish households and their impact on the dynamics of wealth concentration. We document that the expected return on gross wealth strongly increases with net worth, primarily because wealthy households bear high systematic risk. By contrast, the expected return on net wealth is flat across most of the distribution because the middle class hold levered positions in real estate. Differences in investment skill or information do not seem to be first-order contributors to wealth inequality. Moreover, top households bear high idiosyncratic risk due to substantial business equity holdings. We provide reduced-form evidence that wealth returns largely explain historical inequality dynamics at the top. Both type and scale dependence of returns contribute to the link between returns and inequality, as suggested by the most recent theoretical literature on wealth inequality.

Our findings suggest that combining the household finance and inequality literatures can help shed light on central policy questions. First, one would like to investigate how wealth returns contribute to social mobility and household dynamics across wealth brackets. Second, taxation is often viewed as one of the main avenues for regulating wealth inequality. Optimal tax theory must be revisited to take into account the impact of taxes on household portfolios and risk-taking in a setting with large-scale heterogeneity in portfolio allocations. Last but not least, time variation in wealth concentration is a potential driver of asset prices and risk premia, as in the theoretical models of Gollier (2001) and Guvenen (2009). The empirical investigation of this mechanism, as well as the development of dynamic equilibrium models in which wealth inequality and asset prices are jointly determined are also envisioned. We leave the investigation of these topics for further research.

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Table I
Wealth Returns and Debt Costs

This table reports the average characteristics of household wealth returns and debt costs in different brackets of the net wealth distribution in Sweden between 2000 and 2007. We consider the following characteristics: the expected yearly excess arithmetic return on household (1) gross and (2) net wealth, the standard deviation of the yearly excess arithmetic return on (3) gross and (4) net wealth, the expected yearly excess logarithmic return on (5) gross and (6) net wealth, (7) the share of idiosyncratic risk in the yearly excess return on household (gross or net) wealth, (8) the Sharpe ratio of household gross wealth, and (9) the average interest spread on household debt. Idiosyncratic risk refers to risk uncorrelated to the Swedish and global stock market indexes, the global value factor, the global size factor, the currency factor, and the Swedish real estate index. Excess returns and interest rate spreads are computed before taxes and are relative to the yield on the Swedish T-bill.

	Wealth								Debt
	Expected Excess Return (% per year)		Standard Deviation of Return (% per year)		Expected Excess Logarithmic Return (% per year)		Share of Idiosyncratic Risk (%)	Sharpe Ratio of Gross Wealth	Cost of Debt minus Risk-Free Rate (% per year)
	Gross Wealth	Net Wealth	Gross Wealth	Net Wealth	Gross Wealth	Net Wealth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Wealth Group									
P0-P10	2.13	-	5.26	-	1.81	-	13.3	0.42	3.44
P10-P20	1.56	0.51	3.94	9.72	1.34	-1.77	6.0	0.41	6.90
P20-P30	2.85	3.39	7.17	15.09	2.41	1.07	12.7	0.42	6.12
P30-P40	3.32	4.44	8.02	15.24	2.81	2.42	18.9	0.43	5.19
P40-P50	3.56	4.55	8.27	13.43	3.03	3.07	21.5	0.44	4.56
P50-P60	3.79	4.72	8.50	12.70	3.23	3.45	26.6	0.46	3.67
P60-P70	3.99	4.80	8.65	11.95	3.40	3.69	30.2	0.48	3.06
P70-P80	4.19	4.86	8.84	11.35	3.57	3.86	32.0	0.49	2.66
P80-P90	4.48	5.00	9.31	11.15	3.78	4.03	32.3	0.50	2.41
P90-P95	4.85	5.29	10.23	11.72	4.01	4.21	32.4	0.51	2.25
P95-P97.5	5.20	5.60	11.54	12.92	4.14	4.29	34.0	0.51	2.16
P97.5-P99	5.67	6.07	13.94	15.38	4.17	4.28	38.3	0.48	2.11
P99-P99.5	6.30	6.73	18.06	19.71	3.99	4.04	45.4	0.44	2.02
P99.5-P99.9	7.08	7.55	24.69	26.59	3.28	3.27	55.0	0.38	1.89
P99.9-P99.99	8.06	8.55	34.60	36.50	1.83	1.81	67.6	0.30	1.51
Top 0.01%	8.89	9.24	39.29	40.55	1.66	1.67	73.9	0.27	1.00

Table II
Historical Return, Systematic Return, Skill and Taxes

This table reports measures of historical excess returns, risk-adjusted performance, and capital taxation in different brackets of the net wealth distribution in Sweden. We consider the following characteristics: the average historical excess return on (1) gross and (2) net wealth; the average systematic excess return on (3) gross and (4) net wealth implied by household factor loadings and historical realizations of the factors; the difference between the historical return and the systematic return on (5) gross and (6) net wealth; the ratio of capital taxes paid during the year over the stock of (7) gross and (8) net wealth at the beginning of the year; the sum of the capital taxes paid directly by households and the corporate taxes paid by companies in household portfolios during the year expressed as a fraction of (9) gross and (10) net wealth at the beginning of the year. All initial brackets are defined over the 2000 to 2007 period and all reported statistics are averages over the 2001 to 2008 period. The factors are the Swedish and global stock market indexes, the global value factor, the global size factor, the currency factor, and the Swedish real estate index. Excess returns are measured before taxes and are relative to the yield on the Swedish T-bill. Taxes on gross wealth include capital income taxes, taxes on net capital gains, property taxes, and the wealth tax. Taxes on net wealth include taxes on gross wealth minus mortgage interest deductions. Returns are winsorized at the 0.01% level and tax rates are winsorized at the 0.1% level.

	Historical Pre-Tax Return (% per year)		Systematic Pre-Tax Return (% per year)		Risk-Adjusted Performance (% per year)		Personal Capital Tax Rate (% of wealth)		Total Capital Tax Rate (% of wealth)	
	Gross Wealth (1)	Net Wealth (2)	Gross Wealth (3)	Net Wealth (4)	Gross Wealth (5)	Net Wealth (6)	Gross Wealth (7)	Net Wealth (8)	Gross Wealth (9)	Net Wealth (10)
Wealth Group										
P0-P10	0.13	-	-0.03	-	0.16	-	-3.88	-	-3.45	-
P10-P20	-0.99	-4.36	-1.10	-4.63	0.11	0.27	-0.49	-4.00	-0.14	-3.20
P20-P30	-0.18	-0.13	-0.39	-0.46	0.21	0.33	0.17	-2.20	0.73	-1.33
P30-P40	0.89	2.23	0.70	2.04	0.19	0.19	0.40	-1.27	0.94	-0.53
P40-P50	1.38	2.59	1.25	2.52	0.13	0.07	0.67	-0.36	1.19	0.30
P50-P60	2.19	3.30	2.11	3.29	0.08	0.01	0.73	0.00	1.20	0.57
P60-P70	2.75	3.66	2.72	3.71	0.03	-0.05	0.79	0.30	1.21	0.81
P70-P80	3.12	3.84	3.10	3.89	0.02	-0.05	0.86	0.56	1.28	1.05
P80-P90	3.41	3.96	3.43	4.02	-0.02	-0.06	0.98	0.82	1.40	1.30
P90-P95	3.57	4.01	3.65	4.10	-0.08	-0.10	1.11	1.03	1.57	1.55
P95-P97.5	3.61	4.00	3.69	4.08	-0.08	-0.07	1.24	1.20	1.77	1.79
P97.5-P99	3.54	3.94	3.62	3.99	-0.07	-0.05	1.36	1.36	2.02	2.07
P99-P99.5	3.30	3.75	3.45	3.84	-0.15	-0.09	1.47	1.49	2.33	2.43
P99.5-P99.9	3.17	3.65	3.50	3.92	-0.33	-0.27	1.51	1.56	2.63	2.76
P99.9-P99.99	3.65	4.24	4.09	4.61	-0.43	-0.37	1.27	1.33	2.59	2.73
Top 0.01%	4.46	4.95	4.61	5.02	-0.15	-0.07	0.90	0.92	2.39	2.47

Table III
Return on Financial and Pension Wealth

This table reports the average characteristics of excess returns on household financial and pension wealth in different brackets of the net wealth distribution in Sweden between 2000 and 2007. We consider the expected excess return on (1) the complete and (2) risky financial portfolio, (3) the complete financial portfolio's alpha coefficient, (4) the statistical significance of alpha relative to households in the median bracket, the complete financial portfolio's (5) standard deviation, (6) share of idiosyncratic risk, and (7) Sharpe ratio, and the pension portfolio's (8) expected excess return, (9) standard deviation, and (10) Sharpe ratio. The table uses an asset pricing model based on the Swedish and global stock market indexes, the global value factor, the global size factor, and the currency factor. In columns 1 and 2, expected excess returns are computed by multiplying portfolio factor loadings with the historical mean of the factors over the 1983 to 2016 period. In columns 3 and 4, alpha is computed monthly and expressed in natural annual units. We assume that households rebalance their portfolios every month to keep portfolio weights constant during the calendar year. The complete portfolio alpha is obtained by multiplying the risky portfolio alpha with the share of the risky portfolio in the complete financial portfolio. Standard errors used for the computation of p-values are clustered at the monthly level. In column 5, the standard deviation of the complete portfolio return is computed using portfolio weights and the historical variance-covariance matrix of risky asset excess returns. In column 6, the idiosyncratic share is the ratio of the idiosyncratic portfolio variance to total portfolio variance. In column 7, the Sharpe ratio is the portfolio's expected return divided by the portfolio return standard deviation. In columns 8 to 10, the characteristics of funded pension wealth are imputed from national statistics and the balance sheets of insurance companies, and are by construction assumed to be identical across households. Excess returns are measured before taxes and are relative to the yield on the Swedish T-bill.

	Expected Return (% per year)		Alpha of Complete Financial Portfolio (% per year)		Risk and Efficiency of Complete Financial Portfolio			Risk and Efficiency of Pension Porfolio		
	Complete Financial Portfolio	Risky Financial Portfolio	Estimate	p-value Against Median	Standard Deviation of Return	Share of Idiosyncratic Risk (%)	Sharpe Ratio	Expected Return	Standard Deviation of Return	Sharpe Ratio
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Wealth Group										
P0-P10	0.61	5.91	0.02	0.75	2.4	23.8	0.291	3.47	7.8	0.445
P10-P20	0.55	5.77	0.00	0.98	2.0	22.6	0.289	3.47	7.81	0.445
P20-P30	1.13	6.03	0.02	0.38	4.0	22.1	0.299	3.47	7.81	0.445
P30-P40	1.18	6.26	0.00	0.97	4.1	22.8	0.304	3.47	7.81	0.445
P40-P50	1.24	6.36	0.00	REF.	4.2	23.4	0.308	3.47	7.81	0.445
P50-P60	1.53	6.40	-0.02	0.56	5.1	23.5	0.311	3.47	7.81	0.445
P60-P70	1.83	6.47	-0.04	0.61	5.9	23.0	0.316	3.47	7.81	0.445
P70-P80	2.20	6.56	-0.06	0.58	6.9	22.1	0.321	3.47	7.81	0.445
P80-P90	2.72	6.77	-0.09	0.59	8.3	21.0	0.330	3.47	7.81	0.445
P90-P95	3.32	7.09	-0.13	0.57	9.9	20.0	0.340	3.47	7.81	0.445
P95-P97.5	3.83	7.37	-0.17	0.57	11.3	19.6	0.347	3.47	7.81	0.445
P97.5-P99	4.24	7.60	-0.23	0.55	12.4	19.8	0.351	3.47	7.81	0.445
P99-P99.5	4.58	7.75	-0.19	0.71	13.5	20.9	0.349	3.47	7.81	0.445
P99.5-P99.9	4.65	7.79	-0.09	0.88	14.0	22.8	0.342	3.47	7.81	0.445
P99.9-P99.99	4.50	7.81	0.07	0.91	14.2	25.4	0.335	3.47	7.81	0.445
Top 0.01%	4.57	7.79	0.84	0.16	15.1	30.1	0.331	3.47	7.81	0.445

Table IV
Return on Real Estate Portfolio

This table reports the average characteristics of excess returns on household real estate wealth in different brackets of the net wealth distribution in Sweden between 2000 and 2007. We report the yearly expected excess return on household real estate wealth estimated using (1) a real estate CAPM and (2) the historical average return of each real estate class from 1981 to 2014. We also compute the real estate portfolio yearly return's (3) standard deviation, (4) share of idiosyncratic risk, and (5) Sharpe ratio. Real estate classes are municipalities for primary residences, groups of contiguous municipalities for vacation homes, counties for agricultural properties, and the entire country for rental properties. All returns are measured in excess of the yield on the Swedish T-bill. In columns 1, 2, and 5, expected returns are measured before taxes and include the rental yield, which is estimated using either the user cost of real estate (column 1) or the rental yield measured in Swedish national accounts (column 2). In column 4, idiosyncratic risk refers to return risk uncorrelated to the Swedish real estate index. It includes both shocks specific to each property class and shocks specific to each individual property within a class.

	Characteristics of Household Real Estate Portfolio Return (Annual Units)				
	Expected Return (%)		Measures of Risk and Performance		
	Asset Pricing Model	Historical Average	Standard Deviation (%)	Share of Idiosyncratic Risk (%)	Sharpe Ratio
	(1)	(2)	(3)	(4)	(5)
Wealth Group					
P0-P10	4.42	4.35	12.7	55.6	0.35
P10-P20	4.12	3.99	12.4	58.7	0.33
P20-P30	4.24	4.14	12.5	57.2	0.34
P30-P40	4.42	4.34	12.6	55.3	0.35
P40-P50	4.55	4.48	12.7	53.7	0.36
P50-P60	4.66	4.61	12.8	52.4	0.36
P60-P70	4.76	4.75	12.8	51.0	0.37
P70-P80	4.88	4.93	12.7	49.2	0.38
P80-P90	5.08	5.21	12.7	46.0	0.40
P90-P95	5.31	5.53	12.7	42.5	0.42
P95-P97.5	5.43	5.76	12.7	40.9	0.42
P97.5-P99	5.50	5.92	12.8	40.6	0.43
P99-P99.5	5.53	5.97	12.8	41.0	0.43
P99.5-P99.9	5.53	5.93	12.9	42.1	0.43
P99.9-P99.99	5.57	6.01	13.0	44.1	0.43
Top 0.01%	5.75	6.29	13.2	42.8	0.44

Table V
Return on Private Equity Portfolio

This table reports the average characteristics of excess returns on household private equity wealth in different brackets of the net wealth distribution in Sweden between 2000 and 2007. We consider: (1) the expected return on household private equity wealth, (2) the standard deviation of the private equity return, (3) the share of idiosyncratic risk, and (4) the Sharpe ratio of household private equity wealth. The risk profiles of portfolio firms are inferred from the risk profiles of publicly traded firms with similar characteristics. Excess returns are measured before taxes and are relative to the yield on the Swedish T-bill.

	Characteristics of Household Private Equity Portfolio Return (Annual Units)			
	Expected Return (%)	Standard Deviation (%)	Share of Idiosyncratic Risk (%)	Sharpe Ratio
	(1)	(2)	(3)	(4)
Wealth Group				
P0-P10	10.79	67.3	82.3	0.177
P10-P20	10.31	67.3	82.5	0.170
P20-P30	10.06	63.6	82.8	0.173
P30-P40	9.92	62.4	82.7	0.178
P40-P50	10.05	59.2	82.7	0.183
P50-P60	10.10	58.0	82.5	0.187
P60-P70	10.00	56.1	82.3	0.191
P70-P80	9.89	54.4	82.0	0.195
P80-P90	9.64	51.8	81.5	0.199
P90-P95	9.47	49.9	80.8	0.204
P95-P97.5	9.46	48.8	80.3	0.209
P97.5-P99	9.50	48.4	79.8	0.212
P99-P99.5	9.49	47.8	79.7	0.215
P99.5-P99.9	9.63	48.6	80.0	0.214
P99.9-P99.99	9.83	50.6	80.9	0.208
Top 0.01%	10.06	46.5	78.9	0.229

Table VI
Dispersion of Annual Returns Within Wealth Brackets

This table reports the cross-sectional standard deviation of annual excess returns on household wealth in different brackets of the net wealth distribution in Sweden between 2000 and 2007. We compute the cross-sectional standard deviation of the following measures: the historical pre-tax return on (1) gross or (2) net wealth, the expected pre-tax return on (3) gross or (4) net wealth, the systematic pre-tax return on (5) gross or (6) net wealth, and the historical post-tax return on (7) gross or (8) net wealth. In columns 5 and 6, the systematic return is obtained by multiplying household factor loadings with historical realizations of the factors between 2001 and 2008. In columns 7 and 8, the post-tax return is obtained by subtracting capital taxes and mortgage subsidies from the pre-tax return. The cross-sectional dispersion of returns within a given wealth fractile is computed conditional on the wealth rank at the beginning of the year. Excess returns are relative to the yield on the Swedish T-bill.

	Cross-Sectional Standard Deviation of Household Annual Wealth Return							
	Historical Pre-Tax Return (% per year)		Expected Pre-Tax Return (% per year)		Systematic Pre-Tax Return (% per year)		Historical Post-Tax Return (% per year)	
	Gross Wealth	Net Wealth	Gross Wealth	Net Wealth	Gross Wealth	Net Wealth	Gross Wealth	Net Wealth
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Wealth Group								
Full population	9.04	17.75	1.85	5.25	6.72	13.19	9.67	17.47
Top half of population	9.58	13.13	1.60	2.74	6.58	8.49	9.81	13.52
P0-P10	8.04	-	1.73	-	6.28	-	11.54	-
P10-P20	6.84	26.89	1.55	9.81	6.05	23.43	8.15	23.23
P20-P30	8.39	23.33	1.52	6.88	6.62	16.68	8.84	23.87
P30-P40	8.60	19.78	1.43	5.59	6.45	13.31	8.95	20.93
P40-P50	8.30	15.68	1.36	4.24	6.10	10.50	8.68	16.65
P50-P60	8.30	13.81	1.41	3.49	5.92	9.15	8.67	14.56
P60-P70	8.24	12.42	1.43	2.91	5.69	8.09	8.57	12.97
P70-P80	8.29	11.50	1.44	2.50	5.62	7.47	8.56	11.90
P80-P90	8.80	11.45	1.44	2.17	5.94	7.34	9.02	11.73
P90-P95	9.95	12.49	1.49	2.03	6.72	7.91	10.12	12.66
P95-P97.5	11.73	14.36	1.62	2.08	7.75	8.86	11.87	14.48
P97.5-P99	14.61	17.46	1.87	2.31	9.49	10.70	14.70	17.52
P99-P99.5	18.42	22.15	2.17	2.62	11.37	12.66	18.49	22.16
P99.5-P99.9	23.81	27.37	2.60	3.05	13.85	15.21	23.90	27.40
P99.9-P99.99	30.53	34.27	2.96	3.32	16.24	17.34	30.60	34.30
Top 0.01%	31.32	34.05	3.34	3.57	17.05	17.67	31.38	34.12

Table VII
Scale Dependence in Expected Returns

This table reports regressions of a household's expected excess wealth return on the household's net wealth rank over the 2000-2007 period. Expected returns are measured pre-tax and are in excess of the average expected return earned by households in the median bracket. In columns 1 and 2, we report OLS regressions of the expected return of gross and net wealth on the household's wealth rank and year fixed effects, estimated on a representative sample of the Swedish population. In columns 3 and 4, we reestimate the same specification on the sample of households headed by the member of a twin pair. In columns 5 and 6, we report regressions of expected wealth returns on the household's wealth rank and *twin pair-year* fixed effects.

	Expected Return Relative to Median Wealth Bracket					
	OLS Full Sample		OLS Twin Sample		Twin Pair-Year Fixed Effects Twin Sample	
	Gross Wealth	Net Wealth	Gross Wealth	Net Wealth	Gross Wealth	Net Wealth
	(1)	(2)	(3)	(4)	(5)	(6)
Wealth Group						
P0-P10	-1.43	-	-1.33	-	-1.24	-
P10-P20	-2.01	-4.03	-2.15	-4.71	-1.84	-5.17
P20-P30	-0.71	-1.16	-0.78	-1.66	-0.88	-1.99
P30-P40	-0.25	-0.11	-0.28	-0.21	-0.32	-0.25
P40-P50	REF.	REF.	REF.	REF.	REF.	REF.
P50-P60	0.23	0.17	0.18	0.01	0.23	0.04
P60-P70	0.43	0.25	0.40	0.10	0.51	0.28
P70-P80	0.62	0.31	0.54	0.00	0.72	0.33
P80-P90	0.91	0.46	0.79	0.06	1.01	0.44
P90-P95	1.29	0.74	1.18	0.32	1.35	0.69
P95-P97.5	1.64	1.05	1.45	0.57	1.58	0.74
P97.5-P99	2.11	1.52	2.07	1.22	2.07	1.36
P99-P99.5	2.74	2.18	2.60	1.81	2.48	1.61
Top 0.5%	3.73	3.21	3.70	2.97	3.43	2.72
Adjusted R^2	0.34	0.08	0.35	0.08	0.57	0.22
Number of twin pairs per year	-	-	11,543	9,942	11,543	9,942

Table VIII
Average Return over a Generation

This table reports the cross-sectional mean and standard deviation of a household's average excess wealth return over a generation computed in different brackets of the Swedish net wealth distribution. The average excess return of a household over a generation is defined as the 36-year geometric average of annual gross wealth returns minus the gross yield on the Swedish T-bill. Columns 1 to 4 consider the pre-tax return on gross or net wealth. Columns 5 to 8 focus on the pre-tax systematic return on gross or net wealth, which illustrates the long-run implications of full diversification. Columns 9 to 12 report the geometric average return on gross or net wealth after capital taxes and subsidies are deducted. The cross-sectional moments of returns within a given wealth fractile are computed conditional on the wealth rank upon entry in the panel.

	Properties of Geometric Average Yearly Return Over 36-Year Period											
	Pre-Tax (% per year)				Fully Diversified Portfolio, Pre-Tax (% per year)				Post-Tax (% per year)			
	Gross Wealth		Net Wealth		Gross Wealth		Net Wealth		Gross Wealth		Net Wealth	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Wealth Group												
Full population	2.77	2.12	1.56	7.38	2.94	1.79	2.07	7.72	2.56	2.80	2.55	5.07
Top half of the population	3.44	2.05	3.43	4.19	3.63	1.60	3.83	3.06	2.48	2.39	2.82	4.39
P0-P10	1.86	2.09	-	-	2.05	1.72	-	-	4.22	4.02	-	-
P10-P20	1.41	1.72	-4.63	11.15	1.50	1.50	-3.88	12.98	2.26	2.77	1.45	5.43
P20-P30	2.25	1.95	-0.38	7.91	2.39	1.60	0.15	8.65	2.22	2.58	2.18	6.22
P30-P40	2.65	1.86	1.45	5.99	2.80	1.57	2.12	6.10	2.32	2.36	2.73	5.48
P40-P50	2.85	1.81	2.35	4.98	3.00	1.52	2.89	4.48	2.22	2.32	2.73	5.01
P50-P60	3.07	1.83	2.90	4.39	3.22	1.54	3.35	3.93	2.32	2.32	2.88	4.53
P60-P70	3.26	1.82	3.28	3.71	3.41	1.53	3.65	3.20	2.43	2.27	2.94	4.06
P70-P80	3.43	1.87	3.50	3.89	3.59	1.51	3.85	2.88	2.50	2.25	2.88	4.12
P80-P90	3.65	1.95	3.73	3.84	3.82	1.51	4.05	2.43	2.61	2.27	2.86	4.05
P90-P95	3.86	2.10	3.91	4.47	4.06	1.54	4.24	2.29	2.69	2.37	2.83	4.59
P95-P97.5	3.95	2.30	3.93	4.10	4.20	1.61	4.36	2.21	2.65	2.52	2.67	4.27
P97.5-P99	3.93	2.78	3.82	5.00	4.29	1.74	4.41	2.61	2.47	2.93	2.38	5.07
P99-P99.5	3.63	3.47	3.28	6.67	4.28	1.92	4.29	2.96	2.06	3.55	1.70	6.43
P99.5-P99.9	2.91	4.31	2.27	8.82	4.02	2.13	3.94	3.42	1.26	4.32	0.58	8.59
P99.9-P99.99	1.28	5.32	0.16	9.16	3.53	2.63	3.47	3.46	-0.25	5.21	-1.44	8.88
Top 0.01%	0.33	5.27	-0.81	7.22	2.96	2.85	2.81	3.26	-0.83	5.42	-2.01	7.42

Figure 1
Wealth Concentration in Sweden

This figure illustrates the average shares of different forms of wealth held by households in top brackets of the net wealth distribution in Sweden between 2000 and 2007. The shares are reported for net wealth, financial wealth, pension wealth, real estate wealth, private equity, and debt. P90-P95 refers to households ranked between the 90th and 95th percentiles of the net wealth distribution, and so on. The number of households in the Swedish population contained in each bracket is reported in boxes and illustrated by the black line. The graph shows that the top 0.01% of the net wealth distribution consists of 490 households owning 5.4% of the net wealth, 6.2% of the total financial wealth, less than 1% of the pension and real estate wealth, 25.8% of the private equity and less than 1% of the debt held by all Swedish residents.

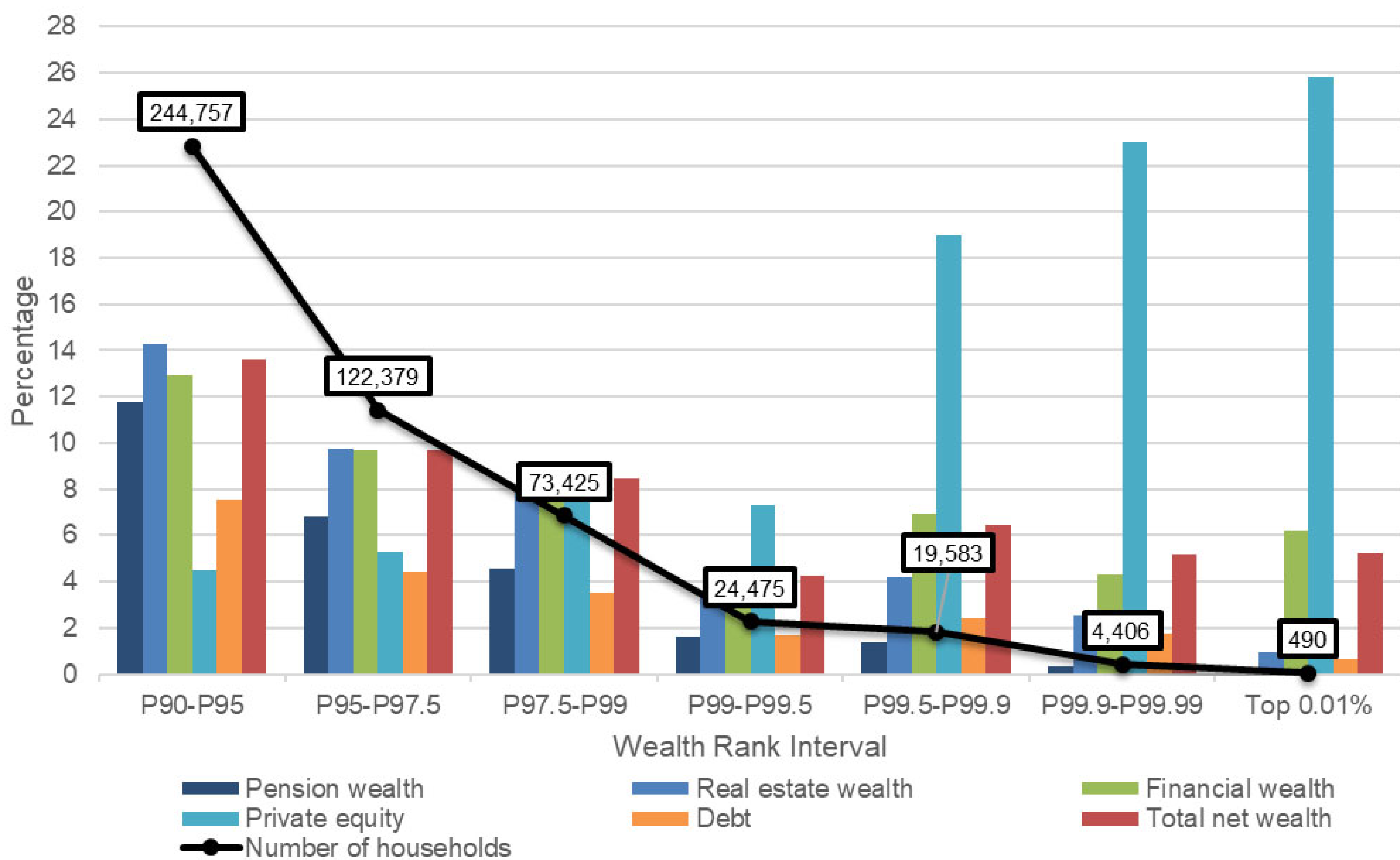


Figure 2
Allocation of Gross Wealth

This figure illustrates the average share of gross wealth held by Swedish households in different brackets of the net wealth distribution in Sweden between 2000 and 2007. The shares are reported for cash (bank account balances and money market funds), risky financial assets, pension wealth, residential real estate, commercial real estate, and private equity. The black line illustrates the leverage ratio, defined as the ratio of total household debt to gross wealth. P0-P10 refers to households ranked between the 0th and 10th percentiles of net wealth, and so on.

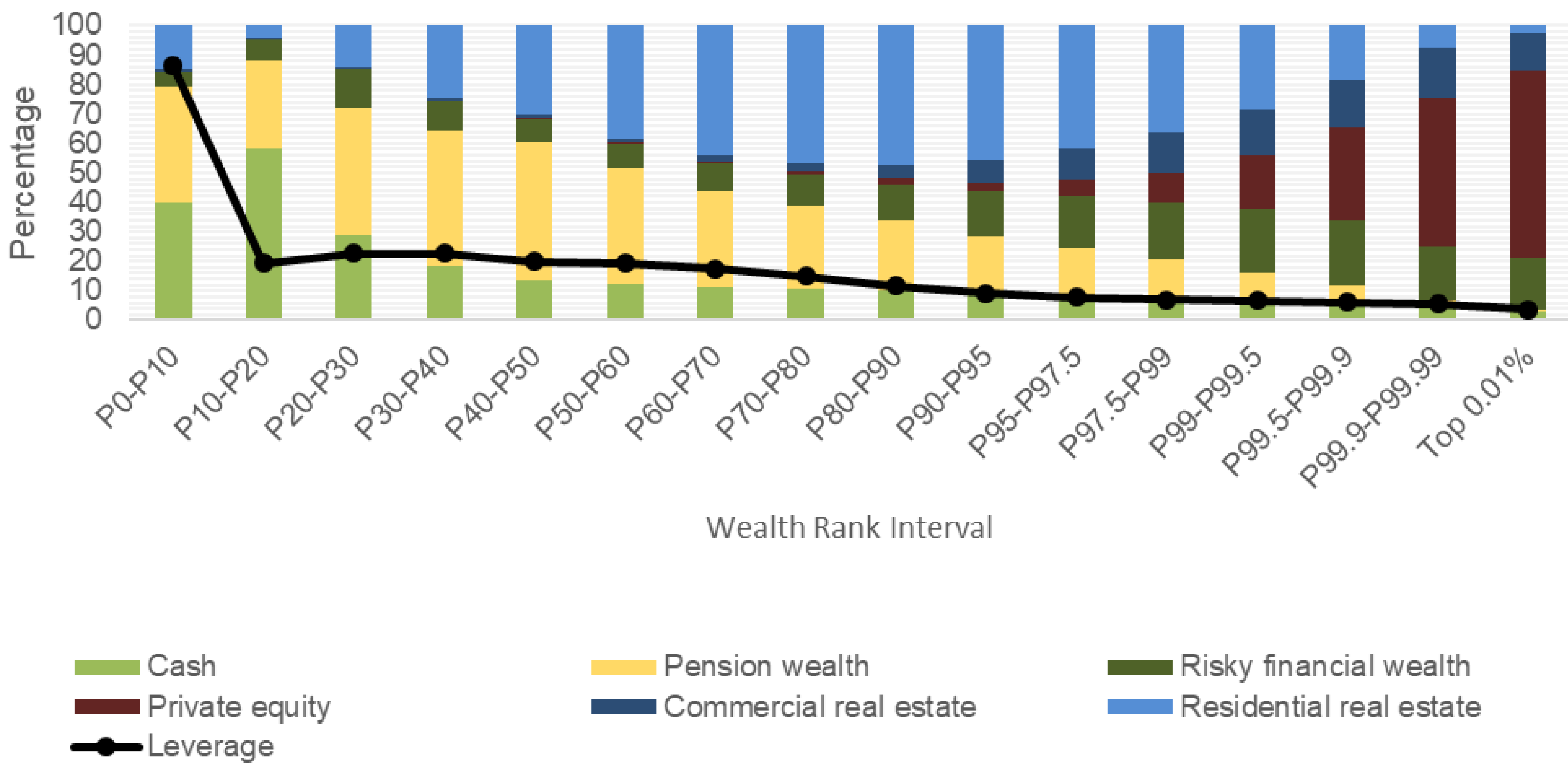
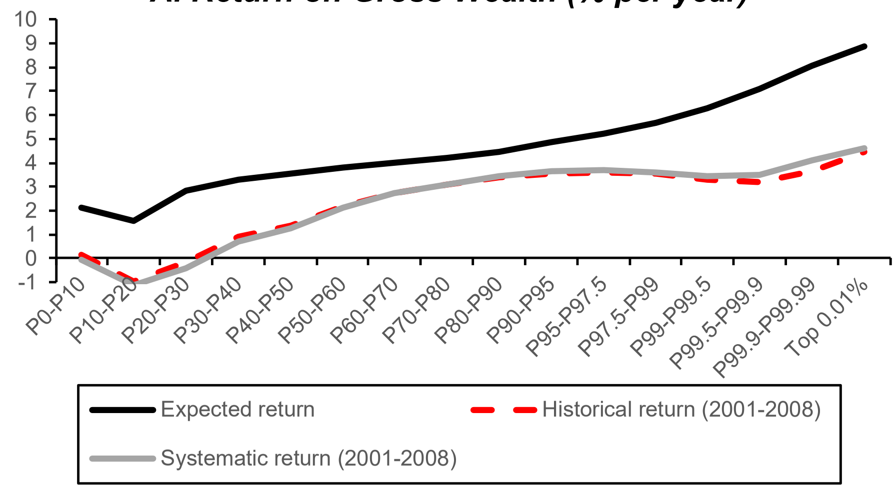


Figure 3
Mean Excess Return Along the Distribution of Net Wealth

This figure illustrates the mean yearly arithmetic excess return on household gross wealth (Panel A) and net wealth (Panel B) in different brackets of net worth. Returns are measured before taxes and are in excess of the yield on the Swedish T-bill. In each panel, we report the average value in each bracket of: (i) household mean historical returns from 2001 to 2008 (dotted red line); (ii) household systematic returns, which we obtain by multiplying household factor loadings with historical realizations of factor returns from 2001 to 2008 (grey line); and (iii) household expected returns, which we compute as in the rest of the paper by multiplying household factor loadings with the historical average of factor returns from 1983 to 2016 (black line). The factors consist of the Swedish and global stock market indexes, the global value factor, the global size factor, the currency factor, and the Swedish real estate index.

A. Return on Gross Wealth (% per year)



B. Return on Net Wealth (% per year)

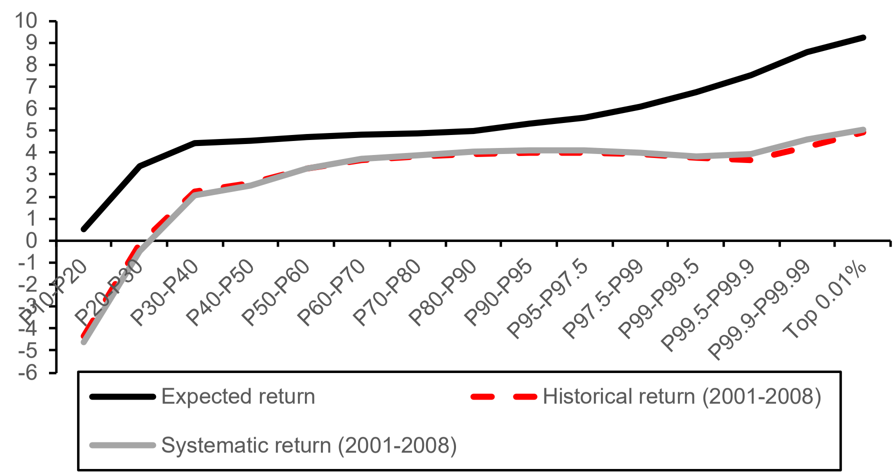
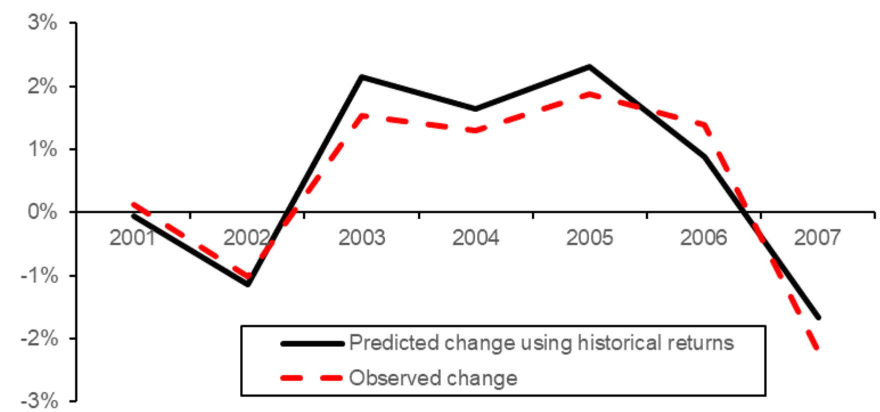


Figure 4
Historical Household Returns and the Dynamics of Top Wealth Shares

This figure illustrates the annual absolute change in the share of net wealth held by households in the top 1% (Panel A) and the top 0.01% (Panel B) between 2000 and 2007. In each panel, the dotted line plots the absolute change in the historical top share, Share(*t*) – Share(*t-1*). The solid line plots the absolute change in the top share predicted by a wealth accumulation process in which each household earns each year its individual historical return; the imputation makes the simplifying assumption that in a given year, the ratio of saving from labor income (net of taxes and transfers) to initial wealth is uniform across households.

A. Annual Absolute Change of the Top 1% Share



B. Annual Absolute Change of the Top 0.01% Share