Online Appendix for "Heterogeneity and Persistence in Returns to Wealth"

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In this Online Appendix we provide supplementary material to the article. In particular, Section OA.1 contains detailed information on the data sources and variables used in the analyses. Section OA.2 details how we estimate net saving flows to perform the Dietz' adjustment to our return measures. Section OA.3 discusses the bias from not observing the timing of net saving flows. Section OA.4 details the imputation of defined contribution private pension wealth; Section OA.5 discusses issues related to the imputation of services from safe assets; Section OA.6 how we construct the $\beta's$ for the stock market portfolio, private equity, and housing. Finally, Section OA.7 shows how we correct estimates of the higher moments of the fixed effect estimates to account for small-T bias. Additional figures and tables are in Section OA.8 and Section OA.9, respectively.

OA.1   Data sources and variable definitions

Our analysis employs several administrative registers maintained by Statistics Norway that we can link through unique identifiers for each individual, family and firm. All data sets below are available for (at least) the period 2004-2015, which constitutes the sample period of our analyses.

- We start by using a rich longitudinal database that covers every resident (since 1967). For each year, it contains individual socio-economic information (including sex, age, marital status, educational attainment) and geographical identifiers.

- Over the period 1993-2015, we can link this data set with tax record information for every Norwegian taxpayer. Because households in Norway are subject to a wealth tax, they are required to report every year their complete wealth holdings to the tax authority. Tax records thus include information on assets holdings and liabilities (such as financial portfolio holdings, debt, etc.) as well as a detailed account of the individual's income sources. Assets values and liabilities are measured at the last day of the year. Every year, before taxes are filed (in April), employers, banks, brokers, insurance companies and any other financial intermediaries are required by law to send both to the individual and to the tax authority, information on the value of the asset owned by the individual and administered by the employer or the intermediary, as well as information on the income earned on these assets. Most of the information contained in the tax form is pre-filled with the information provided by the third-parties and sent to the individual for approval; if the individual does not respond, the tax authority considers the information it has gathered as approved. For components of income or wealth that are not provided by third parties (e.g., foreign income or dividends received from owning shares of companies not registered in the Norwegian Central Securities Depository, VPS), the individual is asked to add this information to the tax form before submitting it to the tax authority, which checks its truthfulness and correctness.

- For the 2004-2015 period we can merge these data with a shareholder registry, containing security-level information on ownership of listed and unlisted shares of companies present in the VPS.

- We also utilize data from a housing transaction registry (containing information on properties that are transacted over this period), balance sheet and tax record data for unlisted companies, data from the universe of deposit and debt accounts (available

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for the 2002-2015 period), the national educational database (containing the highest achieved level of education), the population census of 2001 and 2011, and the real estate ownership registry combined with characteristics on the individual dwelling.

We described in the text how we combine these different sources of data to obtain measures of wealth and returns to wealth. Below we offer some extra details.

OA.1.1 Mapping from data to variable definitions

Here we describe the type of information we take from the different registries to construct the asset stocks and capital income flows used for the various definitions of wealth returns. Henceforth, TR x.y denotes item x.y in the Tax Records (https://www.skatteetaten.no/) and SR the Shareholder Registry (https://www.ssb.no/en/aksjer). The codings below refer to 2013 (some codings change over time). Some items in the TR are reported at their discounted values used to calculate a household's wealth tax. We revert these items to their market values.

- The stock of safe financial assets is defined as the sum of: Bank Deposits in Norwegian banks $w_{it}^{s,1}$ (TR 4.1.1), Cash $w_{it}^{s,2}$ (TR 4.1.3),[46] Deposits in foreign banks $w_{it}^{s,3}$ (TR 4.1.9), Bond funds & money market funds $w_{it}^{s,4}$ (TR 4.1.5), Bonds $w_{it}^{s,5}$ (TR 4.1.7.2)[47], and Outstanding claims and receivables (in Norway) $w_{it}^{s,6}$ (TR 4.1.6).[48]

- The stock of risky financial assets is defined as the sum of: Other taxable capital abroad $w_{it}^{m,x}$ (TR 4.6.2),[49] Capital assets in mutual funds $w_{it}^{m,l,i}$ (TR 4.1.4) and the Value of listed shares held directly $w_{it}^{m,l,d}$ (SR).[50]

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[46]This is the total amount in cash, postal orders, foreign currency, traveller's cheques, cash cheques, etc., exceeding NOK 3,000.

[47]This includes both government and corporate bonds.

[48]These are receivables and claims in Norway, such as loans to friends and family, salary and maintenance payments an individual is owed and/or advances they have paid for services not yet received as of December, 31.

[49]This includes the sum of foreign shares, outstanding claims abroad, bonds and endowment insurance (we observe only the sum, not the separate components).

[50]More precisely, the market value of directly held stocks $w_t^{m,l,d}$ is defined as $w_t^{m,l,d} = \sum_k p_{12/31,t}^k s_{it}^k$, where s_{it}^k are the shares of security k held as of 12/31 of year t (available from the Shareholder Registry) and $p_{12/31,t}^k$ the price at the same date (which is publicly observed). The market value of mutual funds $w^{m,l,i}$ is directly available from the tax records.

- The income flow from safe financial assets is defined as the sum of: Interest income on bank deposits etc. $y_{it}^{s,1}$ (TR 3.1.1), Foreign assets interest income $y_{it}^{s,2}$ (TR 3.1.11),[51] Interest on loans to companies $y_{it}^{s,3}$ (TR 3.1.3),[52] Yield and disbursements from endowment insurance $y_{it}^{s,4}$ (TR 3.1.4), the imputed value of income from outstanding claims and receivables $y_{it}^{s,5}$, which uses the average rate charged by Norwegian banks on corporate loans,[53] and capital gains on bond funds $y_{it}^{s,6}$.

- The income flow of risky financial assets is given by the sum of: Dividends received from ownership of listed shares $d_{it}^{l,d}$ (SR), Yields from mutual funds $y_{it}^{l,i}$ (TR),[54] Capital gains or losses from directly held listed shares $g_{it}^{l,d}$ (SR),[55] Dividends from ownership of Norwegian and foreign shares or unit trusts not registered with the VPS y_{it}^{x} (TR 3.1.7).

- Using the Shareholder Registry we can measure the Value of unlisted shares $w_{it}^{m,u}$ (SR).[56] Income from unlisted shares include Dividends received from ownership of unlisted shares d_{it}^{u} (SR), and Capital gains or losses g_{it}^{u} (SR and firm balance sheet information). To obtain an estimate of the latter, we use the after-tax retained profits of the company

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[51]This includes interest on deposits in foreign banks, income from foreign bonds and loans, and gains on the sale of real property abroad (again, we observe the sum, but not the separate components).

[52]This includes interest income received from loans to limited liability companies, public stock companies, foreign companies, businesses assessed as a partnership, etc.

[53]In previous drafts we were using Other interest income (TR 3.1.2) to measure the yield from outstanding claims and receivables, but this is missing or set to zero for most owners of this asset, likely understating its implicit return.

[54]We compute the yields from mutual funds as follows. From the tax records, we observe the market value of mutual funds owned as of 12/31 of year $t-1$, $w_{it-1}^{m,l,i}$. We assume that mutual investors own a composite index fund representative of the Oslo Stock Exchange (OSE) market (80%) and the MSCI World (20%), with (dividend-inclusive) price $q_{12/31,t-1}^{l,i}$ (on 12/31 of year $t-1$), which we take from the OSE price database. We can thus estimate the shares of this composite fund owned at the end of period $t-1$ as: $s_{it-1}^{l,i} = w_{it-1}^{m,l,i}/q_{12/31,t-1}^{l,i}$. A similar calculation for year t gives us an estimate of the shares owned at the end of that year, $s_{it}^{l,i}$. Finally, we measure the yield on mutual funds as: $y_{it}^{l,i} = (q_{12/31,t}^{l,i} - q_{12/31,t-1}^{l,i})s_{it-1}^{l,i} + ((q_{12/31,t}^{l,i} - \bar{q}_t^{l,i})(s_{it}^{l,i} - s_{it-1}^{l,i}))\mathbf{1}\{s_{it-1}^{l,i} \neq s_{it}^{l,i}\}$, where $\bar{q}_t^{l,i}$ is the geometric average of the composite index fund price in year t, which we use to account for sales or purchases of mutual fund shares during the year with unknown transaction date.

[55]We compute the capital gains/losses on directly held listed shares using the Shareholder Registry. In particular, for each security k, we observe the shares held by the individual as of 12/31 of each year: s_{it}^{k} and s_{it-1}^{k}. From the OSE price database we recover the security prices for 12/31 of year $t-1$, and for each day of year t, including of course $p_{12/31,t}^{k}$. We measure the total capital gains/losses on listed shares as: $g_{it}^{l,d} = \sum_k (p_{12/31,t}^{k} - p_{12/31,t-1}^{k})s_{it-1}^{k} + ((p_{12/31,t}^{k} - \bar{p}_t^{k})(s_{it}^{k} - s_{it-1}^{k}))\mathbf{1}\{s_{it-1}^{k} \neq s_{it}^{k}\}$, where $\bar{p}_t^{k}$ is the geometric average of the security price in year t, which we use to account for sales or purchases of securities during the year with unknown transaction date. When implementing this procedure we also account for possible company splits and splines.

[56]The SR reports the fraction of unlisted company k that the individual owned as of 12/31 of year t, s_{it}^{k}. We also observe the tax-assessed value of unlisted company k, V_t^{k}, so can compute the overall value of unlisted shares owned as: $\sum_k s_{it}^{k} V_t^{k}$.

(see footnote 16 in the main text), multiply by the lagged shares in the company owned by the individual, and then sum across all private businesses owned.

- The stock of housing is obtained using the procedure described in the text (Section 2.2), see Fagereng et al. (2018). From the Housing Transaction Registry we observe the purchase value of all residential units that were transacted during the 2004-2015 period. Using data from registries of ownership and dwelling characteristics, we obtain information on the characteristics of these units (size in square meters, number of rooms, location, etc.) and thus can recover the price per square meter at the time of the transaction. We then run a regression for the price per square meter (p^{sm}) against the house characteristics, time dummies, location dummies and various interactions (i.e., $p^{sm} = X'\gamma + \nu$). We finally impute the price for square meter for units that were not transacted as $X'\hat{\gamma}$. We obtain the value of one's housing as: $w_{it}^h = (X_{it}'\hat{\gamma})m_{it}$ where m is the square meter size of the unit owned. For individuals with a secondary property, we add the imputed value of this property. The yield from housing is: $y_{it}^h = d_{it}^h + g_{it}^h$, where d_{it}^h is imputed rent net of maintenance costs and $g_{it}^h = \Delta w_{it}^h$ is the capital gain or loss.

- The tax records contain information on the outstanding stock of total debt b_{it} (TR 4.8.1). We use the underlying data coming from the DLR (Deposit and Loan account registry) to separate debt into three categories. For each account, the registry contains information on the lender ID, loan balances as of 12/31, and interests paid during the year. First we separate out all accounts that have the State Educational Loan Fund as a lender (using the corresponding lender ID). These accounts are uniquely identified as student loans, hence allowing us to measure the stock of student debt b_{it}^s and the interest payments $y_{it}^{b,s}$. Second, we separate out consumer loan accounts. We do this by selecting the financial institutions that specialize in consumer loans (again using the lender ID); and in the other cases, we assume that all loan accounts with interest rates above 10% are consumer loans. Once we have identified consumer loans, we sum the outstanding loan balances of these accounts to obtain b_{it}^c and the interest payments to obtain $y_{it}^{b,c}$. Long-term debt is obtained as a difference: $b_{it}^l = b_{it} - b_{it}^s - b_{it}^c$. Correspondingly, we measure interest payments on these loans ($y_{it}^{b,l}$).

The mapping between the items above and the variables used in the empirical analysis are as follows:

Wealth components:

1. Safe financial assets ($w_i t^s$): The sum of Deposits ($w_{it}^{s,1} + w_{it}^{s,2} + w_{it}^{s,3}$), Bonds ($w_{it}^{s,4} + w_{it}^{s,5}$), Outst. claims ($w_{it}^{s,6}$).

2. Risky financial assets (w_{it}^m): The sum of Mutual funds ($w_{it}^{m,l,i}$), Listed stocks directly held ($w_{it}^{m,l,d}$), Foreign assets ($w_{it}^{m,x}$).

3. Financial wealth (w_{it}^f): The sum of 1. and 2.

4. Private equity: (w_{it}^u).

5. Housing: (w_{it}^h).

6. Non-financial (or real) wealth (w_{it}^r): The sum of 4. and 5.

7. Gross wealth (w_{it}^g): The sum of 3. and 6.

8. Total debt (b_{it}): The sum of Consumer debt (b_{it}^c), Student debt (b_{it}^s) and and Long-term debt (b_{it}^l).

9. Net worth is gross wealth minus debt: $w_{it}^n = w_{it}^g - b_{it}$.

Capital income components:

- Income from safe assets: ($\sum_j y_{it}^{s,j}$)

- Income from risky assets: ($y_{it}^x + y_{it}^{l,i} + d_{it}^{l,d} + g_{it}^{l,d}$).

- Income from private businesses: ($d_{it}^u + g_{it}^u$)

- Housing yield: y_{it}^h

- Interest payments on debt: y_{it}^b (and its decomposition in interest payments on consumer debt, student debt, and long-term debt, $y_{it}^{b,c}, y_{it}^{b,s}$ and $y_{it}^{b,l}$, respectively.

OA.2 Estimation of Net Wealth Flows

A more general version of the definition of the return to net worth, equation (1), reported in the main text is:

$$r_{it}^n = \frac{y_{it}^f + y_{it}^r - y_{it}^b}{w_{it}^g + \lambda F_{it}^g} \tag{OA.1}$$

Where λ capture the time of the year where net flows are invested. We do not observe the size of net flows of assets nor do we observe when they are added or subtracted to beginning-of-period wealth (i.e., the value of λ). As for the latter issue, we simply assume that flows are, on average, added/subtracted mid-year ($\lambda = 1/2$). As for the former, we observe snapshots of asset stocks at the beginning and end of period for each asset type k (w_{it}^k and w_{it+1}^k), as well as the income that is capitalized into w_{it+1}^k, $\tilde{y}_{it}^k$. These variables, together with the assets accumulation equation $w_{it+1}^k = w_{it}^k + \tilde{y}_{it}^k + F_{it}^k$, allow us to recover an estimate of F_{it}^k for each assets k. Hence, we can compute net flows to gross wealth, $F_{it}^g = \sum_k F_{it}^k$, and replace this estimate in equation (1). Note that in the estimate of the flow ($F_{it}^k = \Delta w_{it+1}^k - \tilde{y}_{it}^k$), the income that is capitalized into end-of-period wealth is specific to the asset type: for listed and unlisted stocks and for housing, it is the capital gain; for safe assets, such as bank deposits, it is the interest earned. Replacing our estimate of F_{it}^g into the measure of return (OA.1) yields:

$$r_{it}^n = \frac{y_{it}^f + y_{it}^r - y_{it}^b}{(w_{it}^g + w_{it+1}^g)/2 - \tilde{y}_{it}^g/2} \tag{OA.2}$$

The returns from the various asset components (financial wealth, housing, private equity) as well as the cost of debt are defined as yields accrued in period t over the sum of stocks at the beginning of period t and an estimate of the net flows during the period, which are analogous to (OA.1), namely:

$$r_{it}^k = \frac{y_{it}^k}{(w_{it}^k + w_{it+1}^k)/2 - \tilde{y}_{it}^k/2}$$

for $k = \{f, u, h\}$, respectively financial wealth, private equity, and housing.[57] The cost of debt is similarly defined as interest payments during year t over the sum of the outstanding stock of debt at the beginning of year t and the flows of the net flow of debt, which is estimated

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[57]In some of the analyses in the main text we also break the return to financial wealth into returns from sub-components (such as safe assets, listed shares, etc.), using similar definitions.

using:

$$r_{it}^b = \frac{y_{it}^b}{(b_{it} + b_{it+1})/2 - y_{it}^b/2}$$

For private equity returns we face the issue of companies that close and report zero value at the end of the period. In these cases, we assign a return of -1 if the company reports a capital loss. If the company reports a capital gain, we assume $F_{it}^u = 0$ and hence use the simple definition of return: $r_{it}^u = \frac{y_{it}^u}{w_{it}^u}$.

OA.3 Bias from not observing the timing of net saving flows

Consider the formula OA.1 we use to estimate returns:

$$\hat{r}_i = \frac{r(w_i + \lambda s_i)}{w_i + s_i/2} \qquad (\text{OA.3})$$

where we have omitted the time subscript, w and s are beginning-of-period and net saving flows during the period, and λ is the time these flows are kept invested during the year. Assume that the true return (r) is independent of wealth. It can be shown that this formula generates a spurious positive relationship between the estimated return and wealth ($\frac{\partial \hat{r}_i}{\partial w} > 0$) even when there is none if:

$$\frac{s}{w}(1 - \eta_{sw})(\lambda - \frac{1}{2}) > 0$$

where η_{sw} is the elasticity of saving with respect to wealth. On average, however, $E(\lambda) = \frac{1}{2}$, implying an unbiased estimate of the relationship between the return and wealth independently of the sign of η_{sw}.

OA.4 Defined Contributions Private Pension Wealth

The pension system in Norway is composed of three layers: state pensions, individual private pensions, and occupational pensions. State pensions guarantee a minimum amount of income to all individuals who are 67 and older; an additional component is paid as a function of lifetime earnings. They are not considered part of household wealth in Flow of Funds data. Individual pension (i.e., the equivalent of IRA accounts in the US) are quantitatively negligible (less than 1% of aggregate household gross wealth). Occupational pensions became mandatory for all private sector employers in 2006. In 2015, they represented roughly 12% of aggregate household gross wealth. Unfortunately, there is no data on occupational or

individual pension plans in the tax records we have available, including the investment choices of the individual vested in the plans.

Before 2006 contribution to private pension plans were voluntary and of the defined benefit type. Because we do not observe which employer contributes to these funds, we focus on the period 2006-2015. With the 2006 reform, defined contribution pension plans became the typical plan choice for most employers. National Accounts data provide three pieces of information: aggregate earned premiums collected by the DC funds (P_t), aggregate pension liabilities (DC_t), and aggregate disbursement from the plans. Summing social security earnings for all employees in the private sector, we also observe the total wage bill, Y_t.

Employers can contribute a fraction of their employees' earnings, but no less than 2%. We assume that the average contribution rate is consistent with National Accounts. In particular, we assume that the average contribution rate is $c_t = P_t/Y_t$. In the data, the average contribution rate over the period for which we have data is 2.5%, close to the minimum contribution rate. Finally, we impute the annual amount contributed to the individual's fund as $DC_{it} = c_t y_{it}$, where y_{it} are individual social security earnings.[58]

Since we do not observe investment choices in DC plans, we assume that individual contributions cumulate in the fund at a common rate r_t^{DC}. We choose r_t^{DC} to be consistent with National Accounts, i.e., we use aggregate data on pension liabilities (DC_t) and premiums earned (P_t) and define: $r_t^{DC} = \frac{DC_t}{DC_{t-1} + P_t} - 1$. It follows that defined contribution private pension wealth accumulates according to the simple formula: $DC_{it} = DC_{it-1}(1 + r_t^{DC}) + dc_{it}$.

Finally, the individual adjusted return to net worth (including DC pension wealth) is:

$$r_{it}^{n,adj} = r_{it}^n \frac{w_{it}^g}{w_{it}^g + DC_{it}} + r_t^{DC} \frac{DC_{it}}{w_{it}^g + DC_{it}}$$

OA.5 Adjusting the return to deposits to reflect unpriced banking services

There is a large literature in financial economics arguing about the importance of including non-pecuniary benefits when measuring the return to certain assets, especially for deposits (see Wang, 2003 for a discussion). This literature argues that any difference between effective deposit rates and the banks' cost of funds is to be classified in national accounts as final consumption expenditure (a component often called FISIM). An obvious issue is how to

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[58]In doing so, we also account for the fact that contributions apply only to workers earning at least the minimum amount needed for social security contributions (an amount known as G, adjusted over time with wage and price inflation - 1G equaled about USD 10,000 in 2011), and that contributions are capped at a multiple of G (12G).

obtain an estimate of these non-pecuniary benefits (in the case of deposits, the unpriced banking services received from the accounts). To compute the total return on deposits (the sum of pecuniary and non-pecuniary return) we follow the national accounts practice. First, we identify a "reference rate" r_t^R used to compute FISIM in national accounts (a rate at which banks borrow funds in the market). In the Norwegian case, this is known as the NIBOR rate. The estimate of the return from services obtained from deposit accounts is hence $r_{it}^{np} = (r_t^R - r_{it}^p)$, where r_{it}^p is the pecuniary return on the deposit of individual i in year t. The assumption is that a lower pecuniary rate must reflect higher unpriced banking services. Hence, the total return on bank deposits $(r_{it}^p + r_{it}^{np})$ is simply the "reference rate" itself, r_t^R. Imputing this return implies that the heterogeneity in returns to financial wealth and net worth so computed is a lower bound to the true return heterogeneity - in fact, this methodology eliminates *any* heterogeneity in deposit returns, including genuine heterogeneity not reflecting compensation for unpriced banking services. We also consider an extended measure in which we assume that individuals earn a common return both on deposits and bonds. As a common rate for bonds we use the rate on the 3-month Treasury bills (we experimented with different measures, with essentially no qualitative or quantitative difference). The results of using these alternative measures of financial wealth returns are reported in Figure 2, Figure 7, and Table 5 in the main text; and Figure OA.9 in this Online Appendix. We commented on the differences with our baseline measure in the text. In this Section we discuss various problems with such adjustments (we summarized these issues in Section 2.4).

The first issue to consider is that the national account practice of considering all the gap between the bank cost of raising funds and the rate paid on deposits as compensation for unpriced services is extreme and not entirely uncontroversial in the literature (see Basu et al., 2011). Some problems are conceptual: for example, it is not obvious that banking services should be compensated with a "barter exchange" (see Wang, 2003). Some problems are more practical: how should the reference rate be identified? In principle there is no reason why it should not vary across banks (they indeed borrow at different rates both in the inter-bank market as well as in the wholesale bonds market and may have loan portfolios of different riskiness and maturity),[59] or across households (the outside option can differ across individuals).

Second, if banks have some monopoly power, lower rates on deposits relative to banks' borrowing rates do not reflect more services but just appropriation of consumer surplus by the bank (or by its shareholders). There is a large literature that documents relevant

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[59]Current recommendations are to exclude the risk components from the calculation of FISIM.

mobility costs of bank customers and thus banks' monopoly power (for recent evidence see Ater and Landsman, 2013, and Bhutta et al., 2018). This is consistent with the fact that banks use teaser rates to attract depositors and then, once the latter have been captured, they lower the rates they pay. Indeed, our regressions on bank deposits lend support to this story. Consistent with banks' monopoly capture, we find that, *ceteris paribus*, the rate on deposits declines with the length of the customer's relationship with the bank (see Table 10).

Third, the services that are typically linked to the deposit accounts are transaction services (the liquidity discount of bank deposits is already reflected in the interest rate) that are often separately priced, implying that the national account correction is prone to introduce severe measurement error if applied to our context. A somewhat obvious indication that the national account methodology is problematic is that for some individuals (those with deposit returns above the reference rate), the methodology imputes *negative* banking services. Casual evidence suggests that Norwegian banks do price transaction services separately, one by one.[60] For instance, an analysis of checking account contract conditions at some selected large Norwegian banks reveals that these banks charge fees or commissions on check writing, money transfers, withdrawals at out-of-circuit ATMs, statement copies or check images, bill payments, cashier's checks, employer paycheck deposits, international wire transfers sent or received, overdraft facilities, etc. To shed light on the link between pricing of services and the interest paid on deposits, we collected data on average account costs and the return on deposits from https://www.finansportalen.no/bank/dagligbank/, a website that shows comparable information about deposit account contract terms for most banks in Norway. To make a fair comparison, we only selected banks that offer the *same* set of banking services and do so without restrictions (such as being part of a union or coop, or purchasing other services from the same bank). This resulted in 84 account offers from 80 banks. Since all banks offer the same services, we would expect banks that do not price the services explicitly (i.e., where the overall account costs are lower) to remunerate the deposit *less* if unpriced banking services was behind the heterogeneity in returns we measure. In fact, we find that the correlation between average account costs and the return offered on deposits is *negative* (-24%).

Fourth, part of the heterogeneity in deposits that we observe comes from the fact that some deposit accounts are checking accounts (for which the banking services correction may be warranted), but others are saving accounts, certificates of deposits, etc., implying that

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[60]See for example https://www.finansportalen.no/bank/dagligbank/ for an overall view of contractual conditions at all Norwegian banks, and https://www.dnb.no/en/personal/prices/account-cards-internet-banking.html for a specific look at DNB, the largest bank in Norway by market share.

the heterogeneity we measure reflects a genuine premium for liquidity, not a compensation for unpriced banking services. Some heterogeneity may also reflect scale effects: poorer consumers may have only one checking account, offering all the banking services they need but paying a low return, while wealthier consumers may be able to afford multiple accounts, some satisfying their demand for banking services at a low return, and others (online banking accounts, say), offering fewer services but higher returns. Imposing that all accounts pay the same return, regardless of preferences, scale, and nature of the account, is thus a rather extreme assumption. Indeed, one way to interpret the difference between the two panels of Figure 2 is that they represent two polar cases - one in which non-pecuniary benefits are already fully priced in the returns (Panel A, our baseline) and one in which *all* differences in pecuniary returns reflected unpriced non-pecuniary benefits (Panel B). Given the evidence from Section 5.1 and the discussion above, our preferred measure remains the former. We acknowledge that future work should be directed at obtaining independent measures of non-pecuniary benefits (rather than imposing the extreme national account adjustment).

OA.6 Construction of the $\beta's$

We construct the average stock market portfolio β in the following way. First, we use the time series of stock market returns for security k to compute the k-specific α and β, i.e., we run k separate regressions: $(r_t^k - r_t^s) = \alpha^k + \beta^k(r_t^m - r_t^s) + \epsilon_t^k$, where r_t^m is the composite market return and r_t^s the return on a risk-free asset (which we take to be the 3-month return on a Treasury bill). The individual investor's β is therefore $\beta_{it}^m = \sum_k \omega_{it}^k \beta_k$, where ω_{it}^k is the fraction of individual $i's$ stock market wealth in period t held in security k.

The β for private equity investments is constructed by first computing the annual firm-specific return (dividends paid plus retained profits over Dietz-adjusted tax-assessed value) r_{jt}^u. We can do this for the 1993-2015 period. We then regress, separately for each j, $(r_{jt}^u - r_t^s) = \alpha_j + \beta_j(r_t^m - r_t^s) + \epsilon_{jt}$. The individual private equity β is therefore $\beta_{it}^u = \sum_j \omega_{it}^j \beta_j$, where ω_{it}^j is the fraction of individual $i's$ total private business wealth in period t held in private business j.

Finally, we construct the housing β using a similar strategy. First, we obtain the average return on housing for x different municipalities, y different years, and three types of properties: flats, coop apartments, and detached houses (or a total of $l = 3xy$ housing typologies). Call this r_{lt}^h (where l indexes the typology, i.e., municipality/property type). We can measure housing returns for the 1993-2015 period using the methodology described in Section 2. We then regress, separately for each typology l, $(r_{lt}^h - r_t^s) = \alpha_l + \beta_l(r_t^h - r_t^s) + \epsilon_{lt}$, where r_t^h is

the economy-wide return on housing. The individual housing β is therefore $\beta_{it}^h = \sum_l \omega_{it}^l \beta_l$, where ω_{it}^l is the fraction of individual i's total housing wealth in period t held in property l.

OA.7 Correction of estimates of higher-order moments of individual fixed effects

We follow Wooldridge (2010a) and Wooldridge (2010b). In keeping with our application, we assume that N (cross-sectional size) is large, while T (time-series span) is small. Consider our return regression (6), omitting for simplicity the generation subscript g:

$$r_{it} = X_{it}'\beta + f_i + e_{it}$$

We assume that the error term $e_{it}|X_{it}, f_i \sim i.i.d.(0, \sigma_e^2)$. We also assume that the fixed effects have population mean equal to μ_f, population variance σ_f^2, and that $E(f_i f_j) = 0$ for all $i \neq j$. We also assume $E(e_{it}^l f_i^m) = 0$ for all l, m.

An estimate of the individual fixed effect that is unbiased but inconsistent for small T is:

$$\hat{f}_i = \frac{1}{T} \sum_{t=1}^{T} (r_{it} - X_{it}'\hat{\beta})$$

where

$$\hat{\beta} = (\sum_{i=1}^{N} \sum_{t=1}^{T} (X_{it} - \bar{X}_i)'(X_{it} - \bar{X}_i))^{-1} \sum_{i=1}^{N} \sum_{t=1}^{T} (X_{it} - \bar{X}_i)'(r_{it} - \bar{r}_i)$$

is the traditional within-group estimator, and $\bar{a}_i = T^{-1} \sum_{t=1}^{T} a_{it}$ (for $a = X, r$).

Note that even though $\hat{f}_i$ is inconsistent for f_i (if T is small), its sample average

$$\hat{\mu}_f = \frac{1}{N} \sum_{i=1}^{N} \hat{f}_i = \frac{1}{NT} \sum_{i=1}^{N} \sum_{t=1}^{T} (r_{it} - X_{it}'\hat{\beta})$$

is consistent for $\mu_f = E(f_i)$, no matter how large T is. Wooldridge (2010b) shows that the "naive" estimator for the variance of the fixed effects:

$$\hat{\sigma}_f^2 = \frac{1}{N-1} \sum_{i=1}^{N} (\hat{f}_i - \hat{\mu}_f)^2$$

is inconsistent for the population variance σ_f^2 when T is small, since $plim\ \hat{\sigma}_f^2 = \sigma_f^2 + \frac{\sigma_e^2}{T}$ (with the bias clearly disappearing when $T \to \infty$). We have eleven years of data, implying that this bias may be of some concern. However, it is immediate that one can correct for the

small T bias by using the corrected estimator:

$$\tilde{\sigma}_f^2 = \frac{1}{N-1} \sum_{i=1}^{N} \left(\hat{f}_i - \hat{\mu}_f \right)^2 - \frac{\hat{\sigma}_e^2}{T} \tag{OA.4}$$

where

$$\hat{\sigma}_e^2 = \frac{1}{N(T-1)-K} \sum_{i=1}^{N} \sum_{t=1}^{T} \left((r_{it} - \bar{r}_i) - (X_{it} - \bar{X}_i)'\hat{\beta} \right)^2$$

(i.e., the variance of the within-group residual), with K being the dimension of X_{it}. It is also easy to see that $\tilde{\sigma}_f^2$ is unbiased and consistent for σ_f^2 no matter the size of T as long as $N \to \infty$.

The skewness and kurtosis of the fixed effects are the third and fourth standardized moments of its distribution:

$$S_f = E\left(\frac{f_i - \mu_f}{\sigma_f}\right)^3 = \frac{\mu_f^{(3)}}{(\sigma_f^2)^{3/2}}$$

and:

$$K_f = E\left(\frac{f_i - \mu_f}{\sigma_f}\right)^4 = \frac{\mu_f^{(4)}}{(\sigma_f^2)^2}$$

respectively, where $\mu_k^{(j)}$ is the j-th central moments of the distribution of the r.v. k. Similarly to the derivation above one can show that the sample estimate of the j-th central moments of the distribution of the fixed effect is inconsistent for $N \to \infty$ and fixed T, since:

$$plim \frac{1}{N-1} \sum_{i=1}^{N} \left(\hat{f}_i - \hat{\mu}_f \right)^j = \mu_f^{(j)} + \frac{1}{T^{j-1}} \mu_e^{(j)}.$$

However, using similar reasoning to the one adopted above, one can get a consistent estimate of S_f and K_f, since the j-th central moments of the distribution of the disturbance e can be consistently estimated for $N \to \infty$. In particular, the estimators

$$\tilde{S}_f = \frac{\frac{1}{N-1} \sum_{i=1}^{N} \left(\hat{f}_i - \hat{\mu}_f \right)^3 - \frac{1}{T^2} \hat{\mu}_e^{(3)}}{\left(\tilde{\sigma}_f^2 \right)^{\frac{3}{2}}} \tag{OA.5}$$

and

$$\tilde{K}_f = \frac{\frac{1}{N-1} \sum_{i=1}^{N} \left(\hat{f}_i - \hat{\mu}_f \right)^4 - \frac{1}{T^3} \hat{\mu}_e^{(4)}}{\left(\tilde{\sigma}_f^2 \right)^2} \qquad (\text{OA.6})$$

yield, by applications of the continuous mapping theorem, consistent estimates of S_f and K_f, respectively. We use the formulae (OA.4), (OA.5), and (OA.6) to compute the corrected moments shown in Table OA.2.

OA.8 Additional Figures
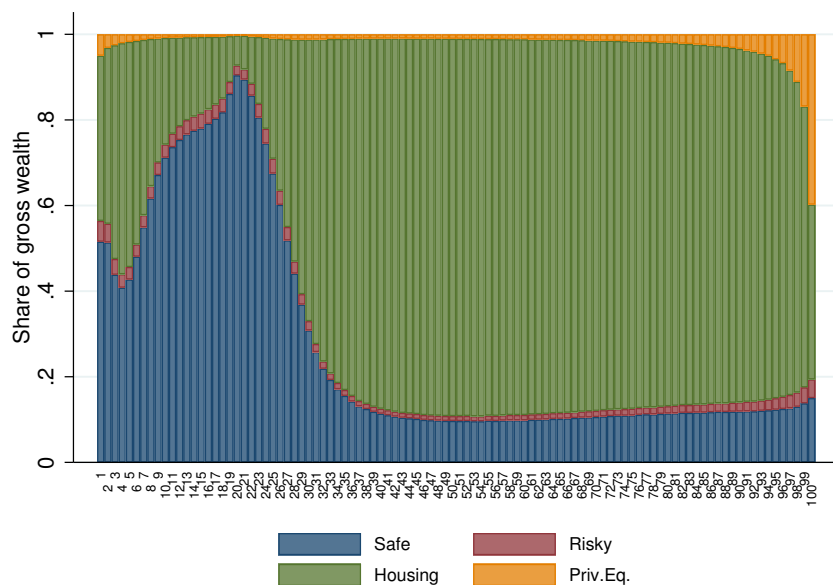
Figure OA.1. Composition of net worth (extended)
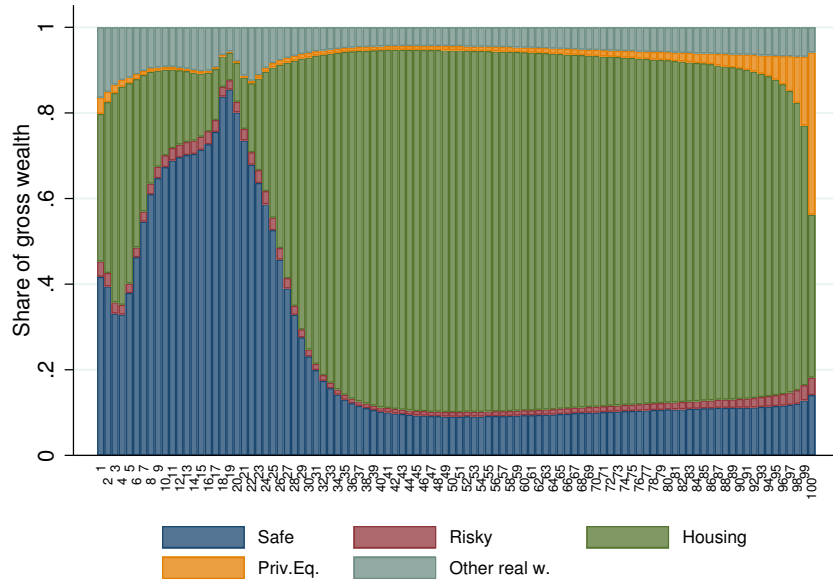
Panel A: Assets
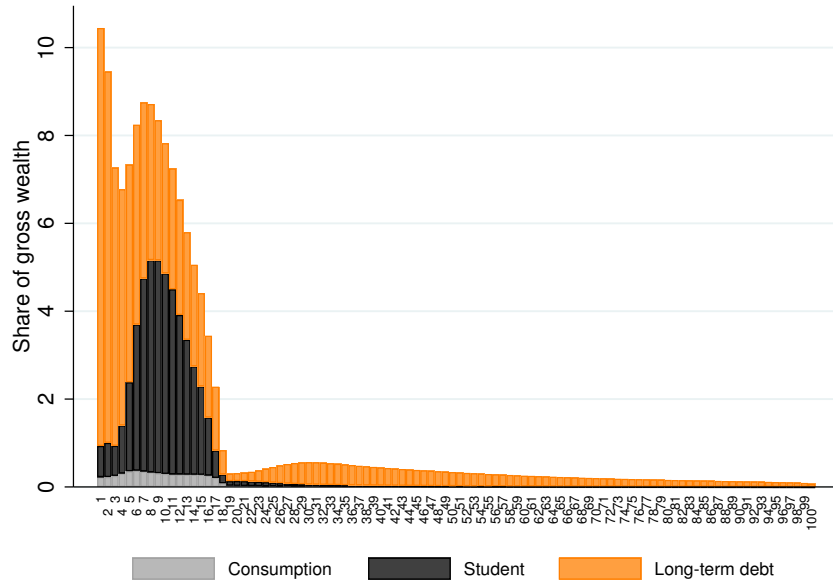
Panel B: Liabilities

Notes: Panel A plots the share of gross wealth in safe assets (cash/deposits, bonds, outstanding claims), risky assets (foreign assets, mutual funds, directly held listed stocks), housing, private business wealth, and other real wealth (vehicles, boats, cabins, and real estate abroad) for Norwegian taxpayers against percentiles of the net worth distribution. Panel B shows the shares in gross wealth for liabilities, distinguishing between consumer debt, student debt, and long-term debt (mortgages and personal loans), winsorized at the top 1%. Data are for 2005-2015.

Figure OA.2. Private businesses: Tax value vs book value

Cor: 0.884. N = 1,203,687.
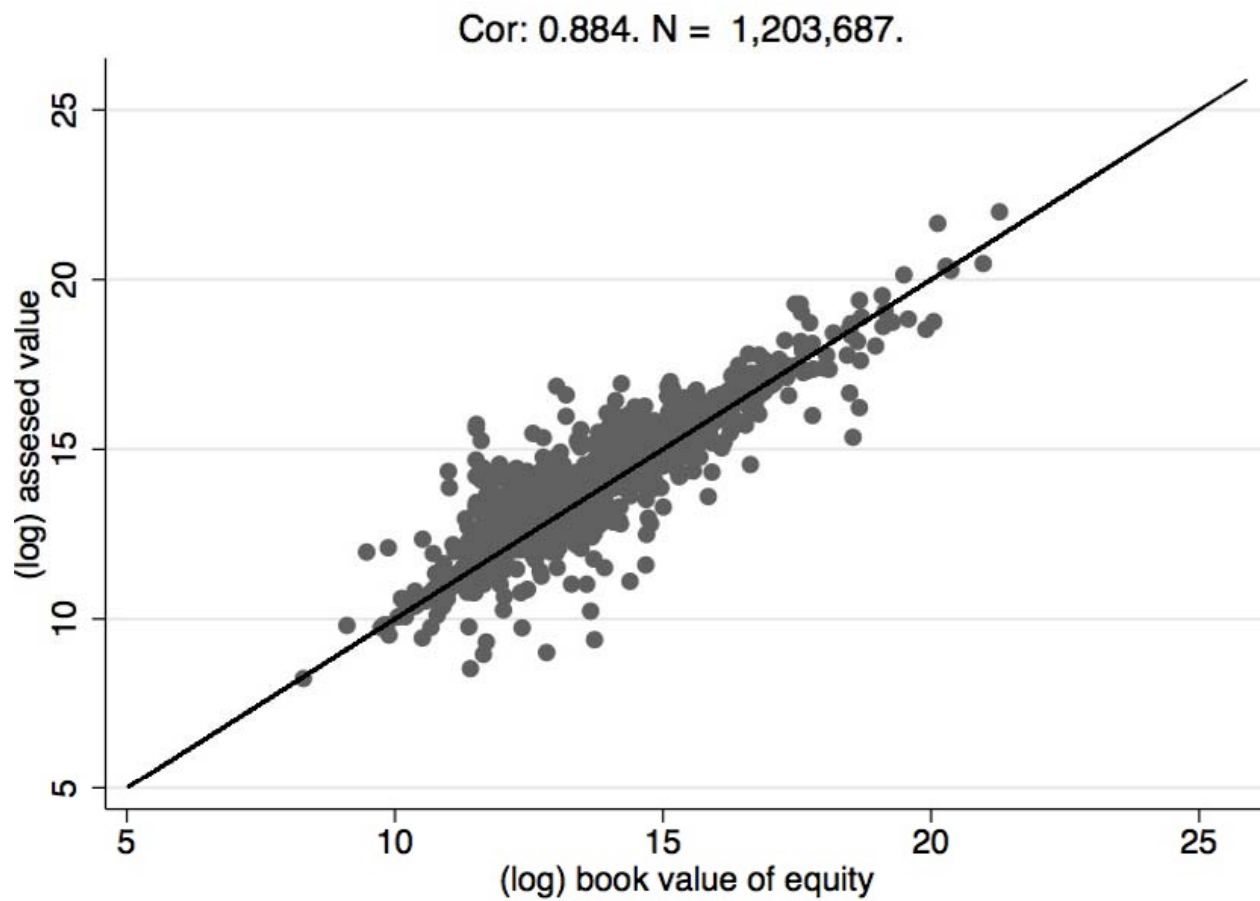
Notes: The figure plots the (log of the) book value of equity and the (log of the) firm assessed tax value for non-listed Norwegian firms between 2004 and 2013. The solid line is a 45-degree line.

Figure OA.3. Net worth composition (all percentiles)

Panel A: Assets
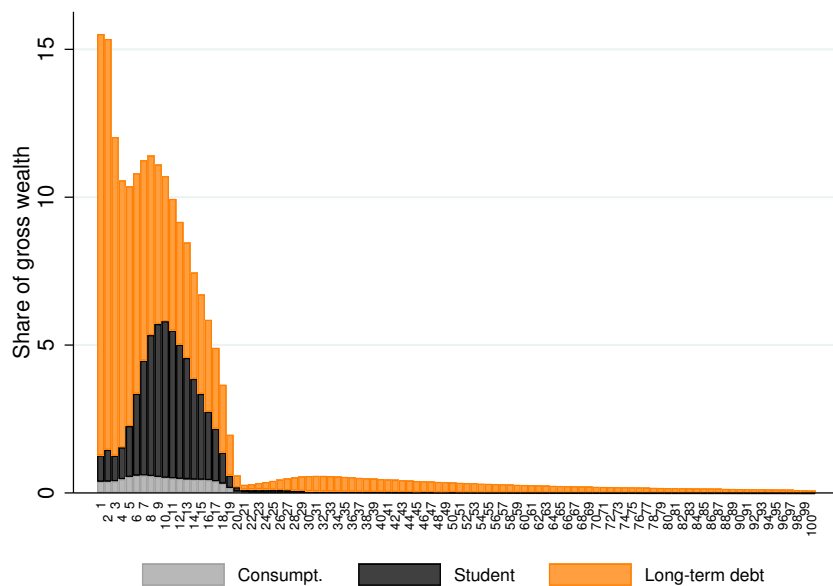
Panel B: Liabilities

Notes: Panel A plots the share of gross wealth in safe assets (cash/deposits, bonds, outstanding claims), risky assets (foreign assets, mutual funds, directly held listed stocks), housing, and private business wealth for Norwegian taxpayers against percentiles of the net worth distribution. Panel B shows the shares in gross wealth for liabilities, distinguishing between consumer debt, student debt, and long-term debt (mortgages and personal loans), winsorized at the top 1%. Data are for 2005-2015.

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Figure OA.4. Composition of Financial Wealth (all percentiles)
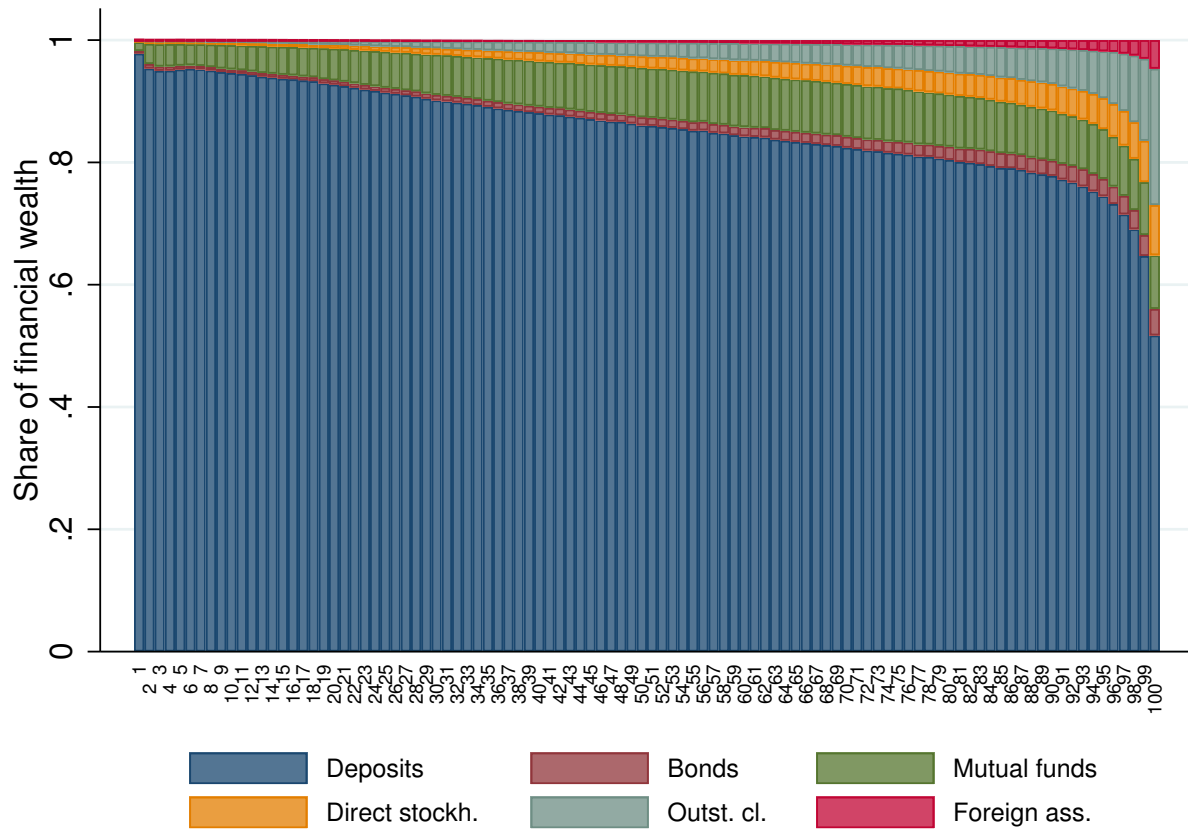
Notes: The figure plots the share of financial wealth in cash/deposits, bonds, mutual funds, directly held listed stocks, outstanding claims, and foreign assets for Norwegian taxpayers against percentiles of the financial wealth distribution. Data are for 2005-2015.

Figure OA.5. Standard deviation of returns, 2005-2015
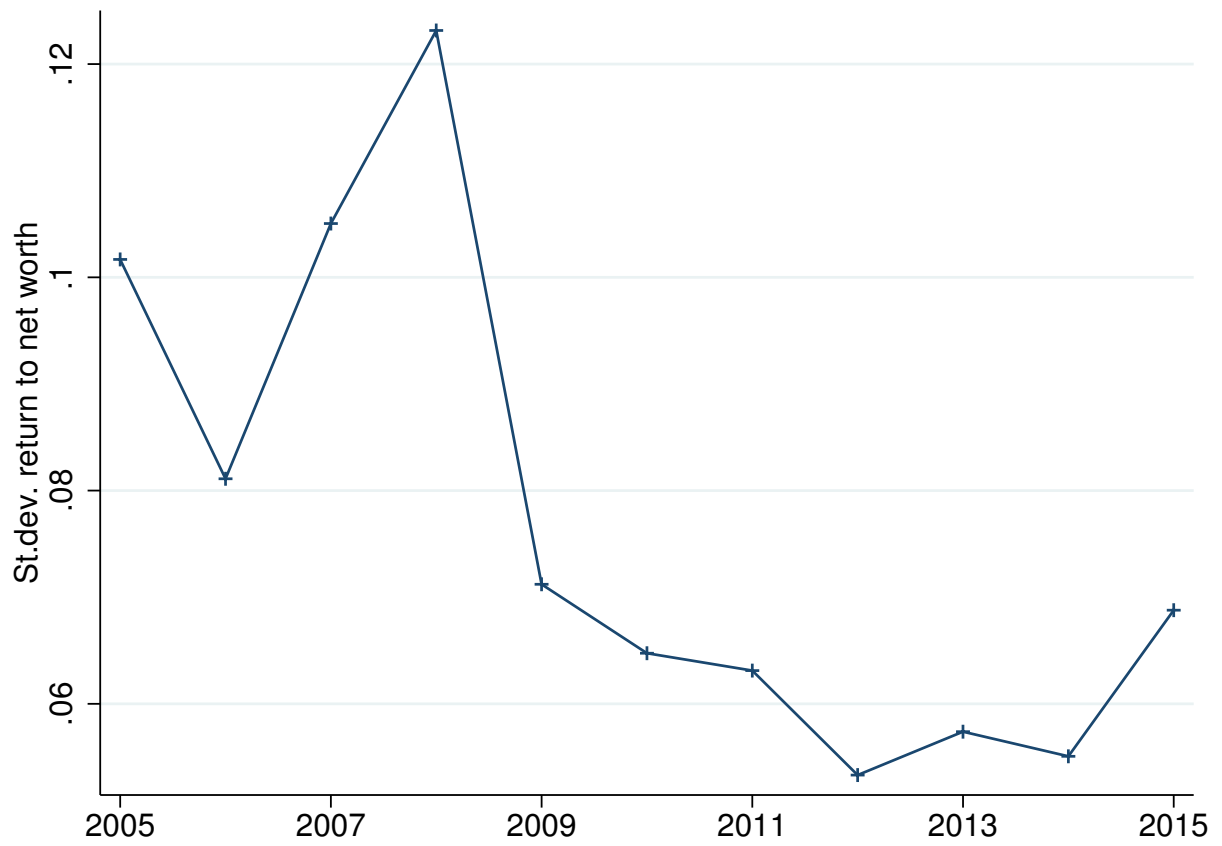
Notes: The figure shows the cross-sectional standard deviation of the value-weighted returns to net worth against time.

Figure OA.6. Relative standard deviations
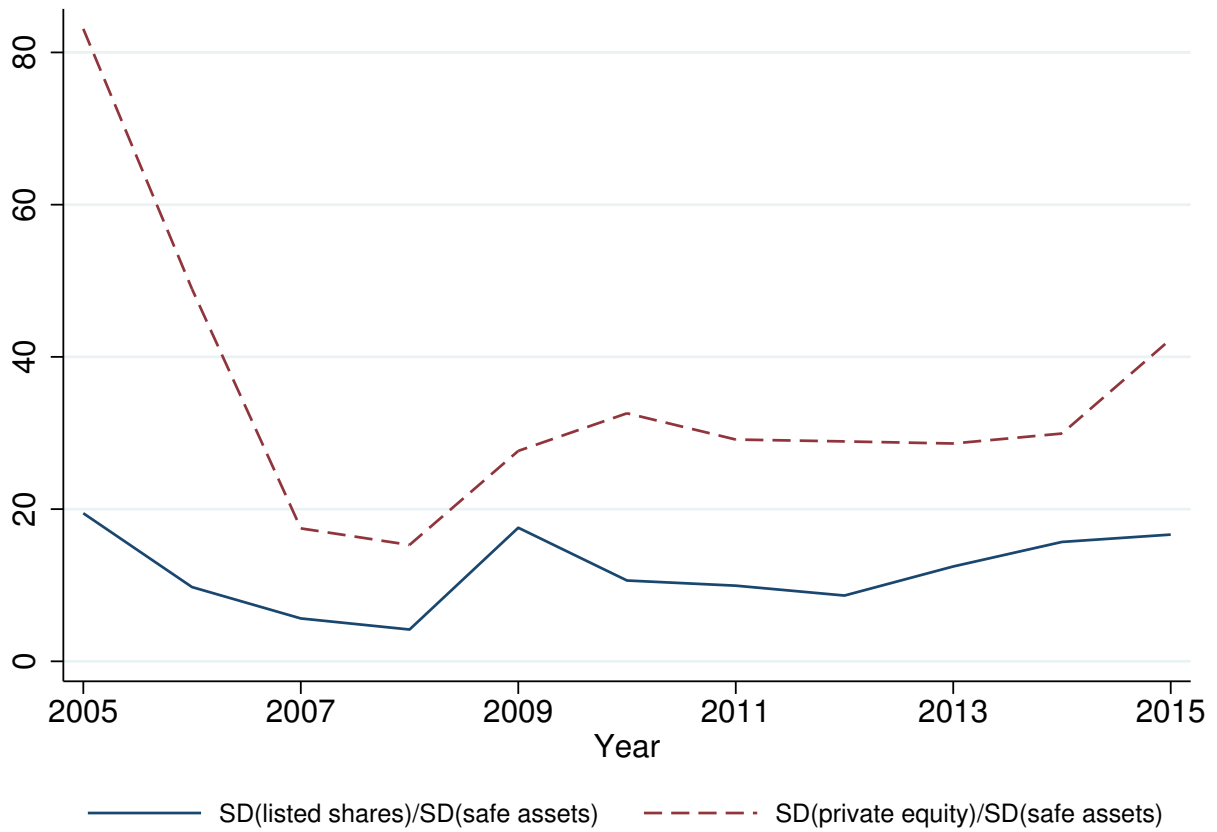
Notes: The figure plots the standard deviation of the returns to private equity and the standard deviation of the returns to listed shares relative to the standard deviation of the returns to safe assets. All returns are value weighted.

Figure OA.7. Heterogeneity in returns to financial wealth by share of risky assets, year-by-year
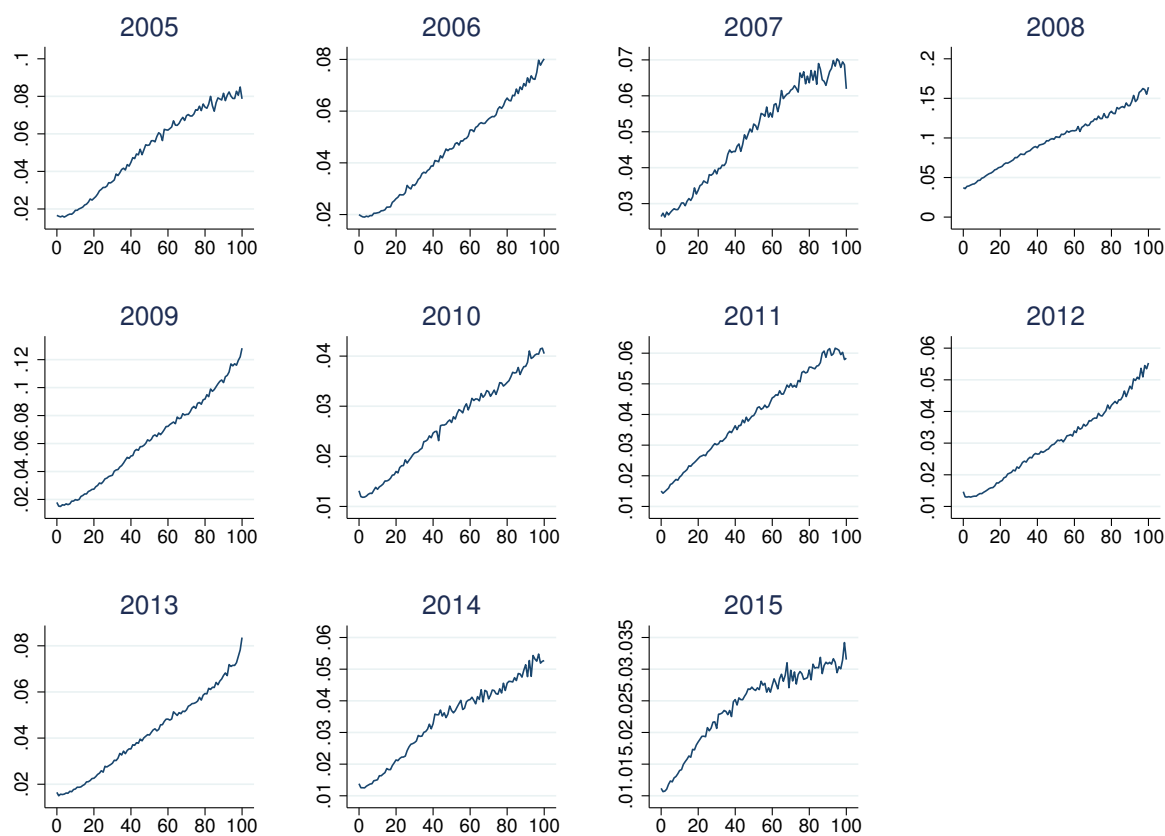
Notes: The figure plots the cross-sectional standard deviation of individual returns to wealth by value of the share of wealth in risky financial assets (directly and indirectly held stocks and foreign risky assets) for each year between 2005 and 2015.

Figure OA.8. Standard deviation of returns to financial wealth and financial wealth percentiles
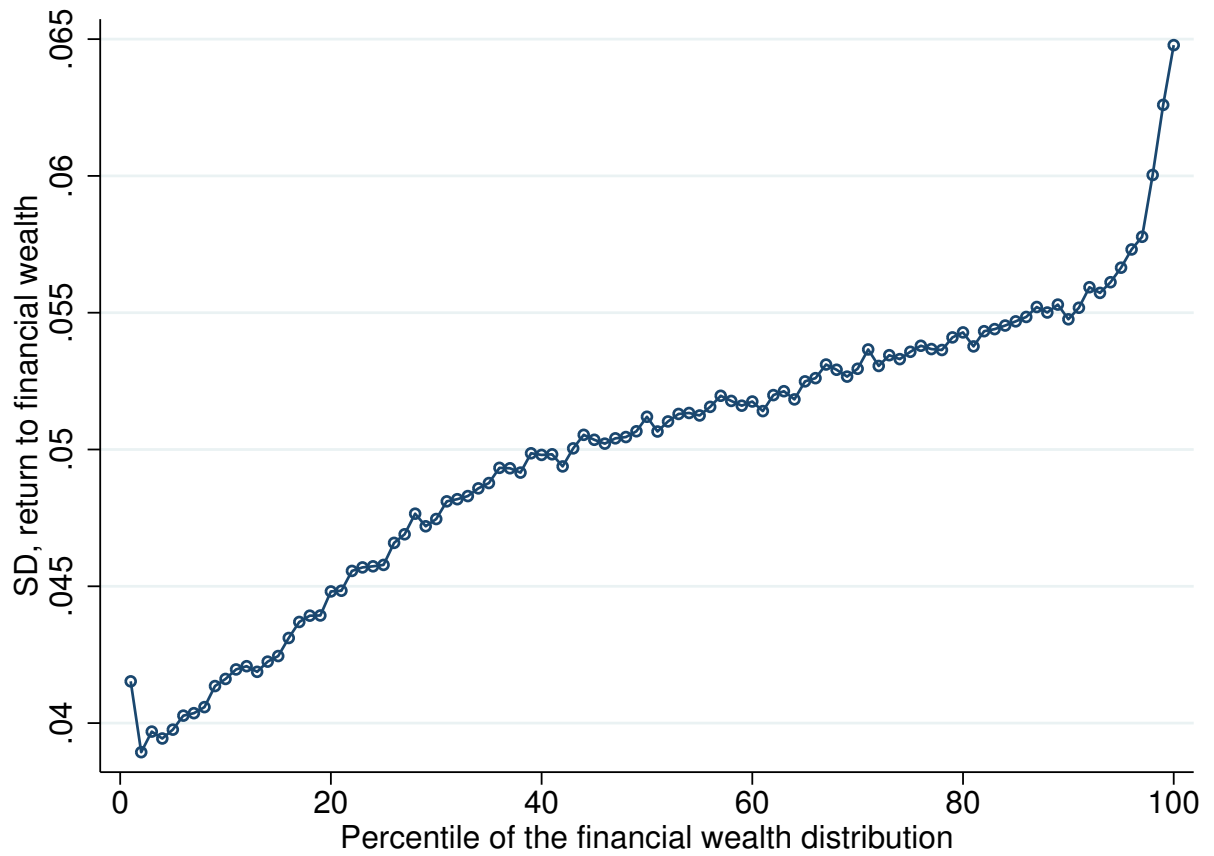
Notes: The figure plots the cross sectional standard deviation of the return to financial wealth against the financial wealth percentile.

Figure OA.9. Heterogeneity of financial wealth returns, assuming common return on safe assets
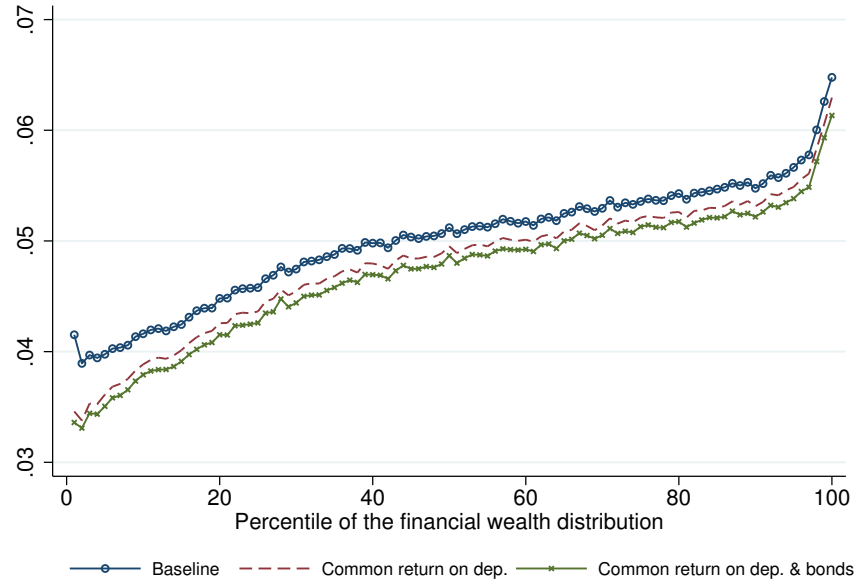
Panel A: Heterogeneity by financial wealth percentile
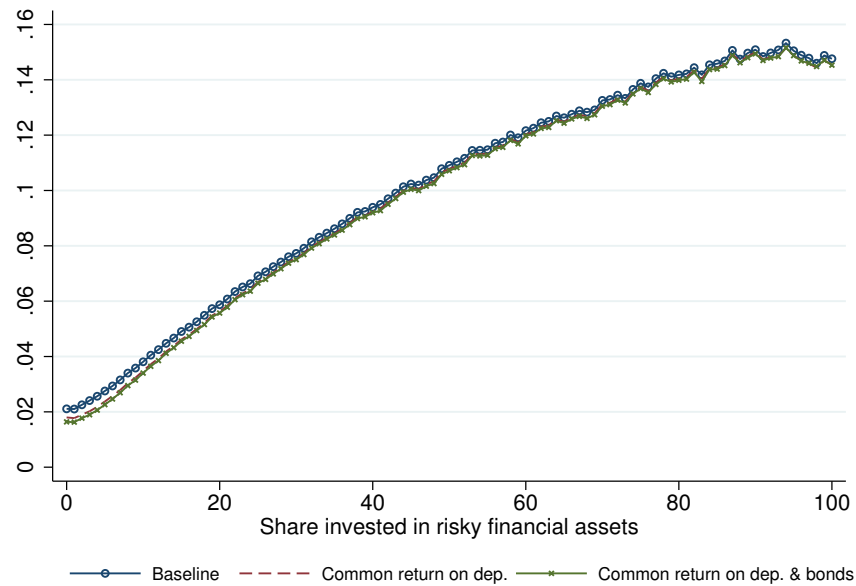
Panel B: Heterogeneity by share of risky assets in financial portfolio

Notes: Panel A plots the standard deviation of the returns to financial wealth against financial wealth percentiles for three measures: *i*) baseline, *ii*) assuming a common return on deposits (equal to the NIBOR rate), *iii*) assuming a common return on deposits and bonds (equal to the 3-month T-bill rate). Panel B plots the standard deviation of the returns to financial wealth against the share of risky assets in the financial portfolio for the same three measures.

Figure OA.10. The correlation between financial wealth and its return, year-by-year

**Figure OA.11. Return on deposit accounts: A case study of Sparebanken Vest**
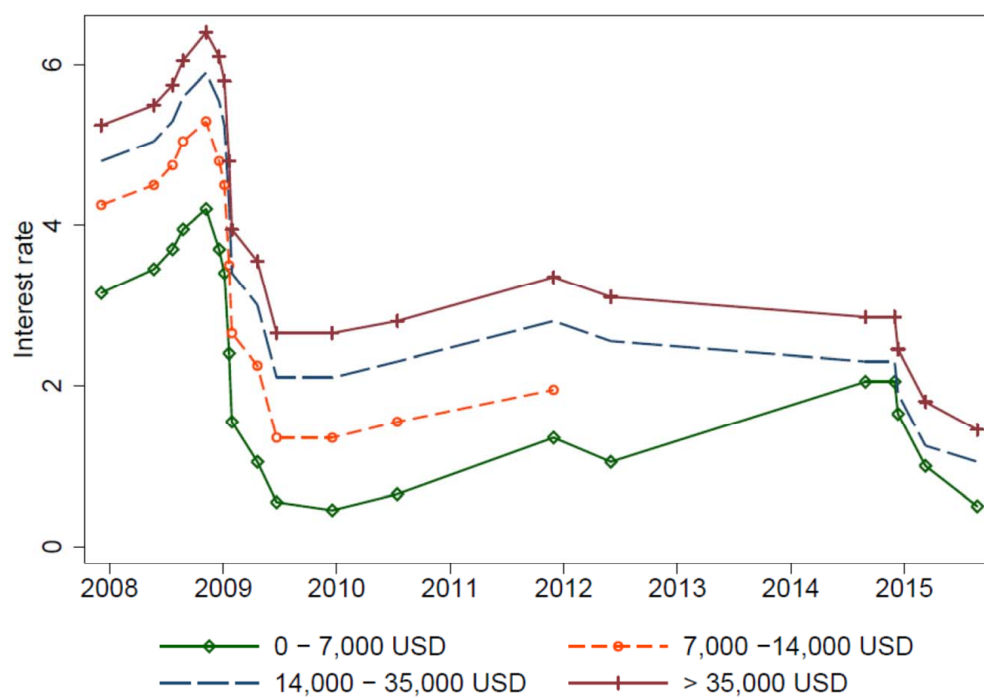
Notes: The figure shows the time pattern of the interest rate paid on deposit accounts of different sizes by Sparebanken Vest.
Source: https://www.finansportalen.no/.

Figure OA.12. The correlation between wealth and return for sub-components of safe and risky assets
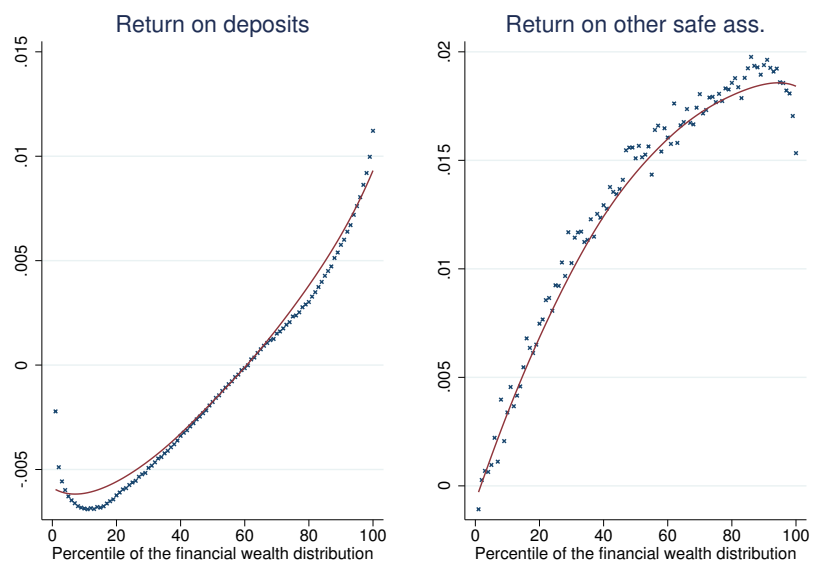
Panel A: Safe financial assets
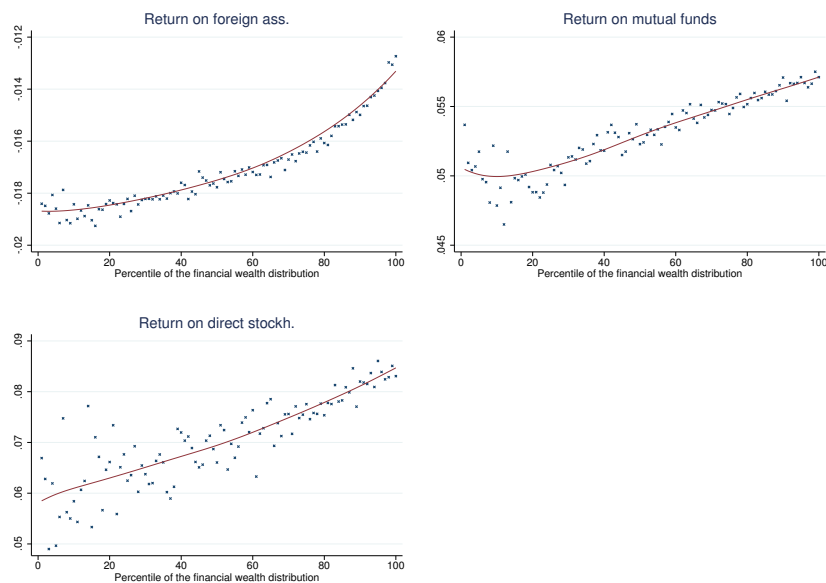

Panel B: Risky financial assets

Notes: The figure shows the relation between returns to several components of financial wealth and the financial wealth percentiles. Data are for 2005-2015.

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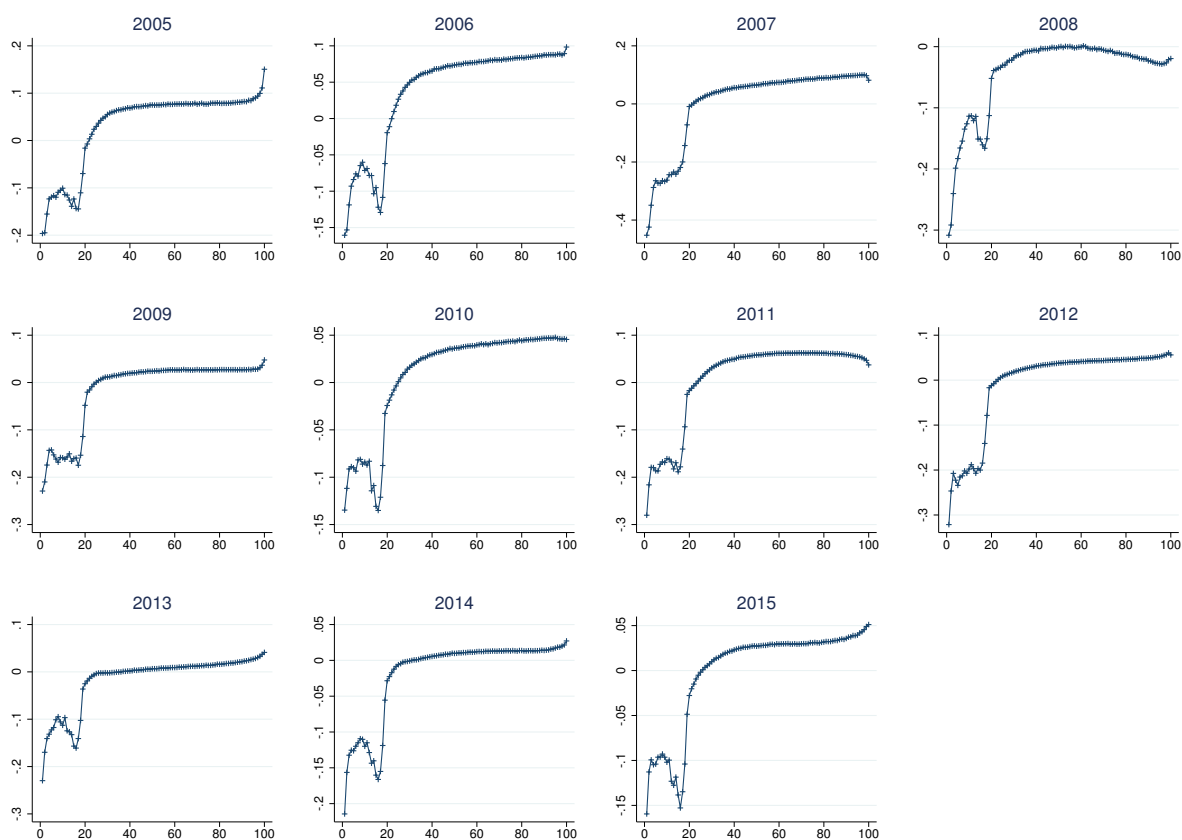**Figure OA.13. The correlation between financial wealth and the return to safe assets, year-by-year**
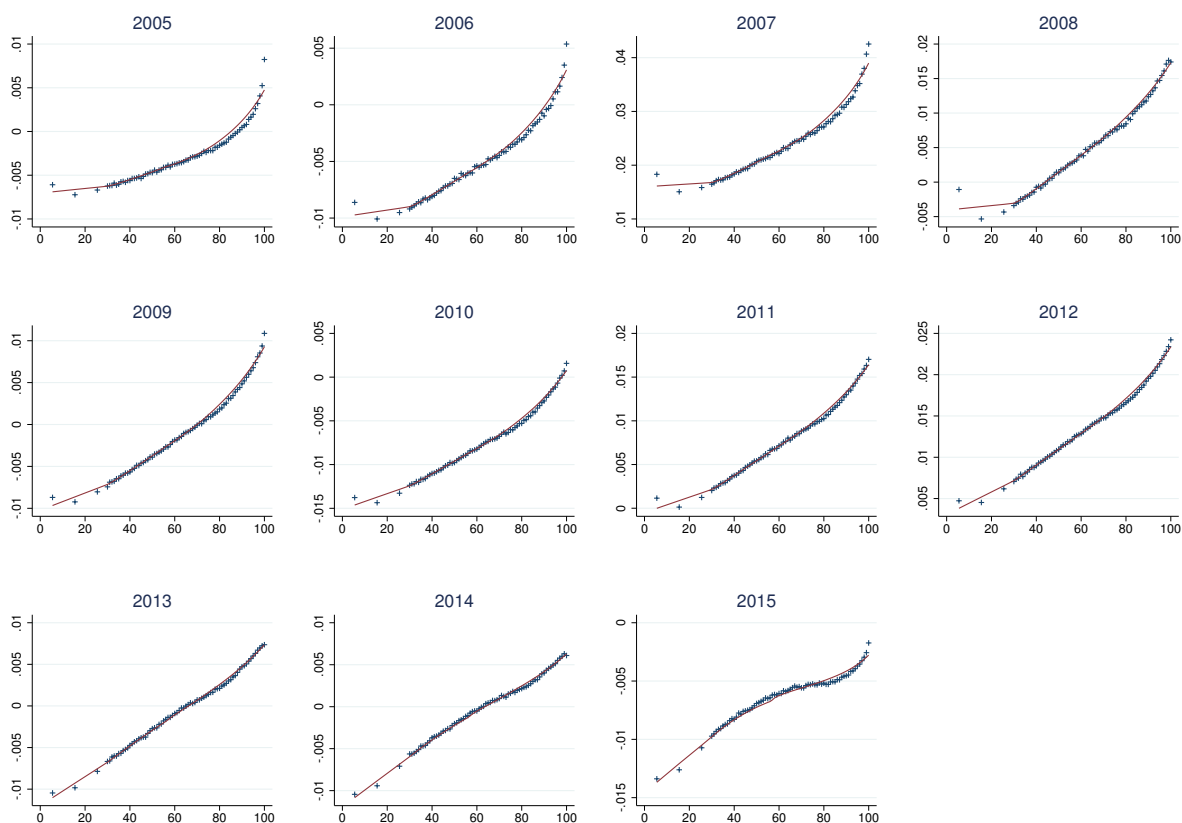
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Figure OA.14. The correlation between financial wealth and the return to direct stockholding, year-by-year
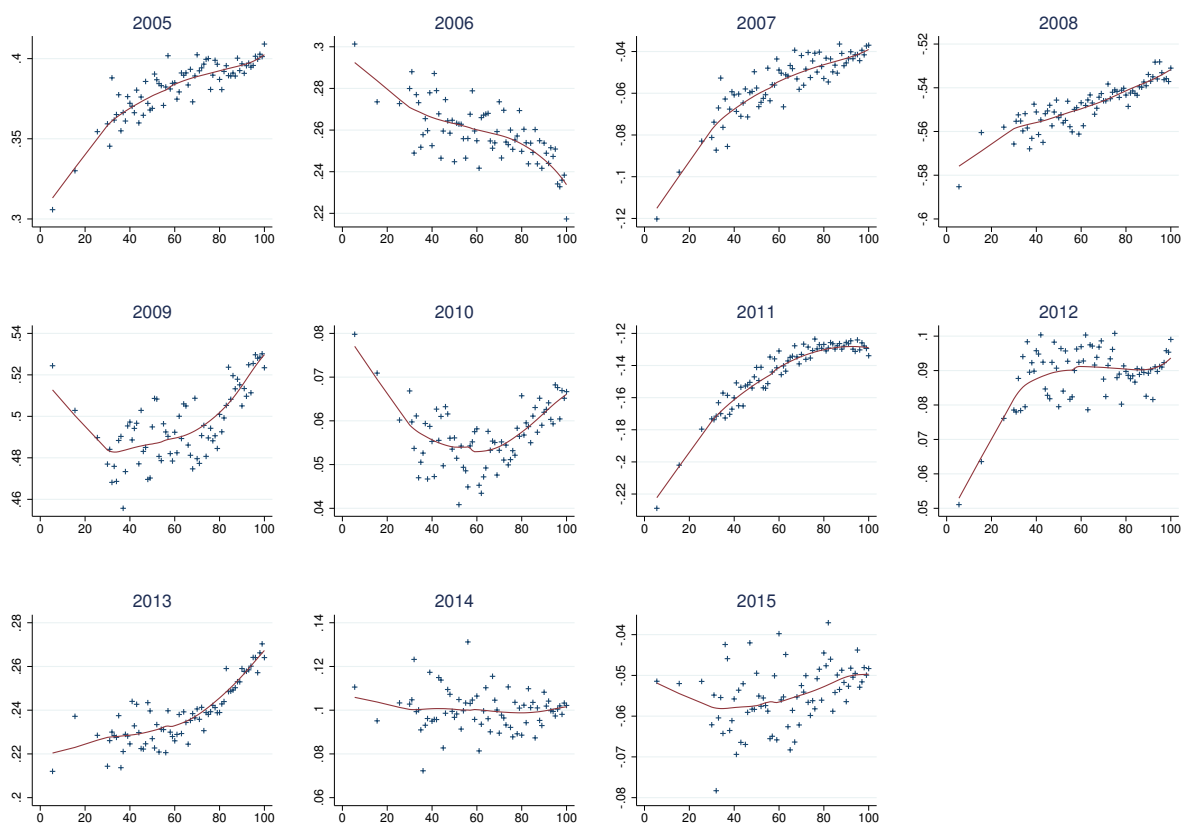
Figure OA.15. The relation between net worth and its return, year-by-year

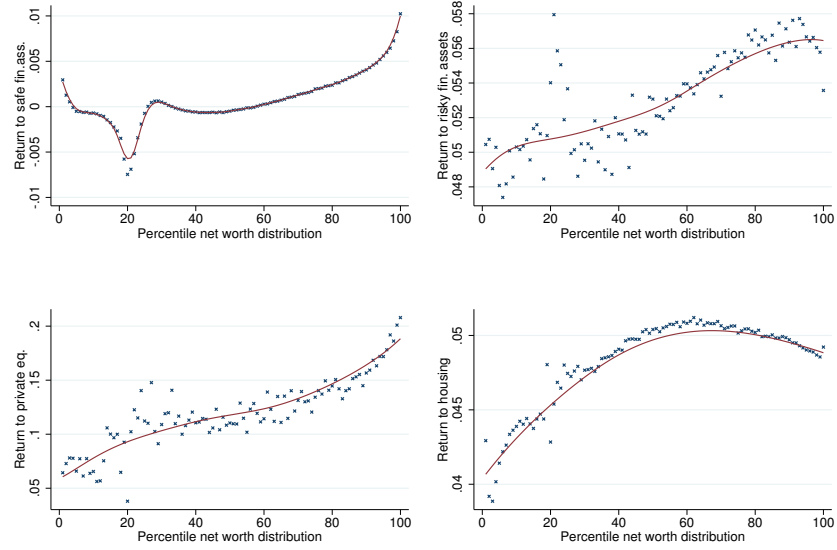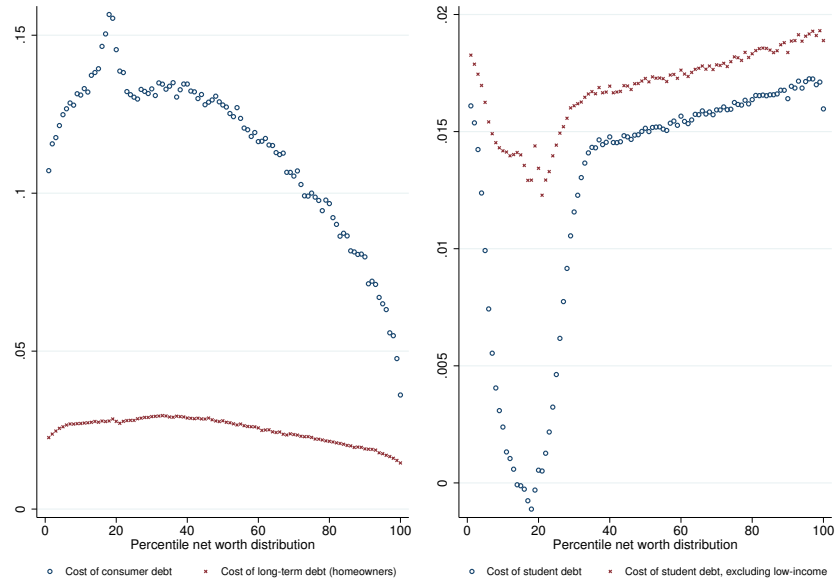*Notes:* The figure shows the relation between returns to net worth and net worth percentiles for each year between 2005 and 2015.

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Figure OA.16. Scale dependence in sub-components of net worth

Panel A: Financial non-financial wealth components
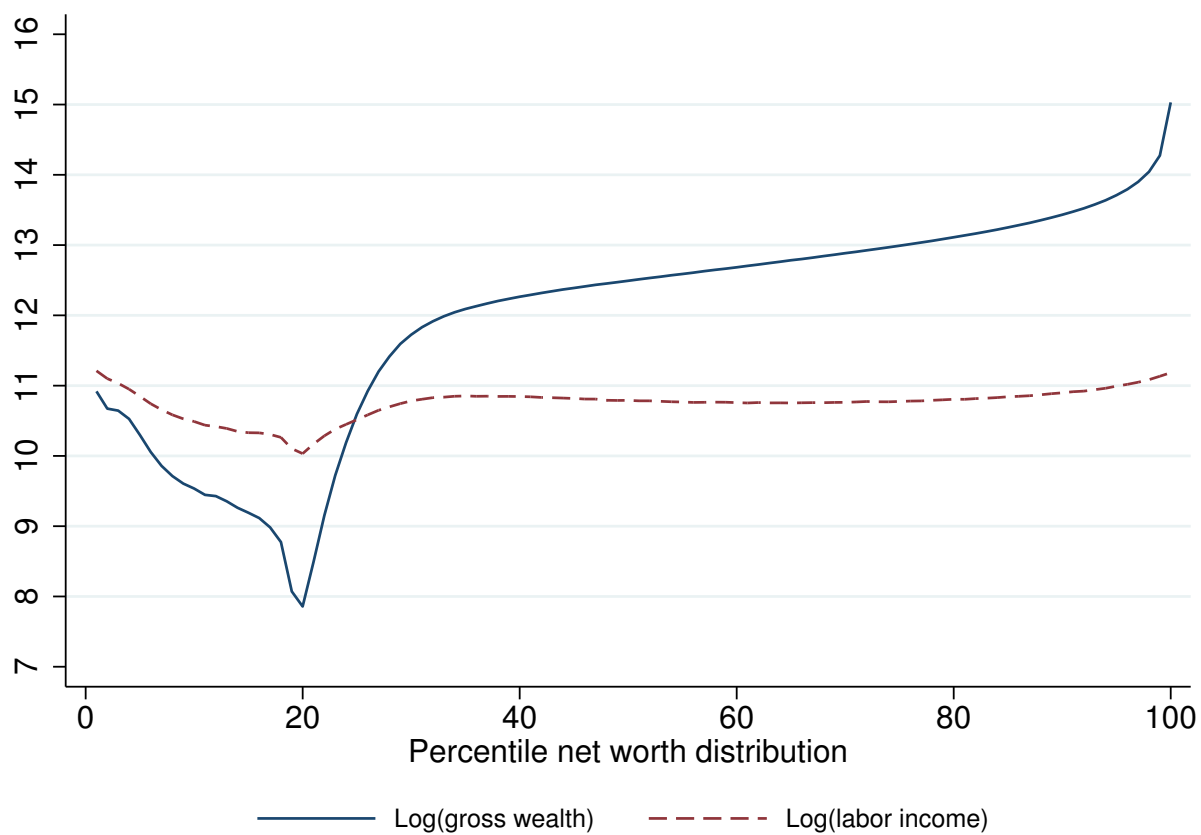

Panel B: Debt components

Notes: The figure reports average returns on components of assets (Panel A) and liabilities (Panel B) by net worth percentile. Data are for 2005-2015.

Figure OA.17. Digging deeper into compositional effects

Notes: The figure plots average gross wealth and labor income (in logs) against the net worth percentile (pooling all years from 2005 to 2015).

Figure OA.18. The correlation between financial wealth and the return to private equity, year-by-year
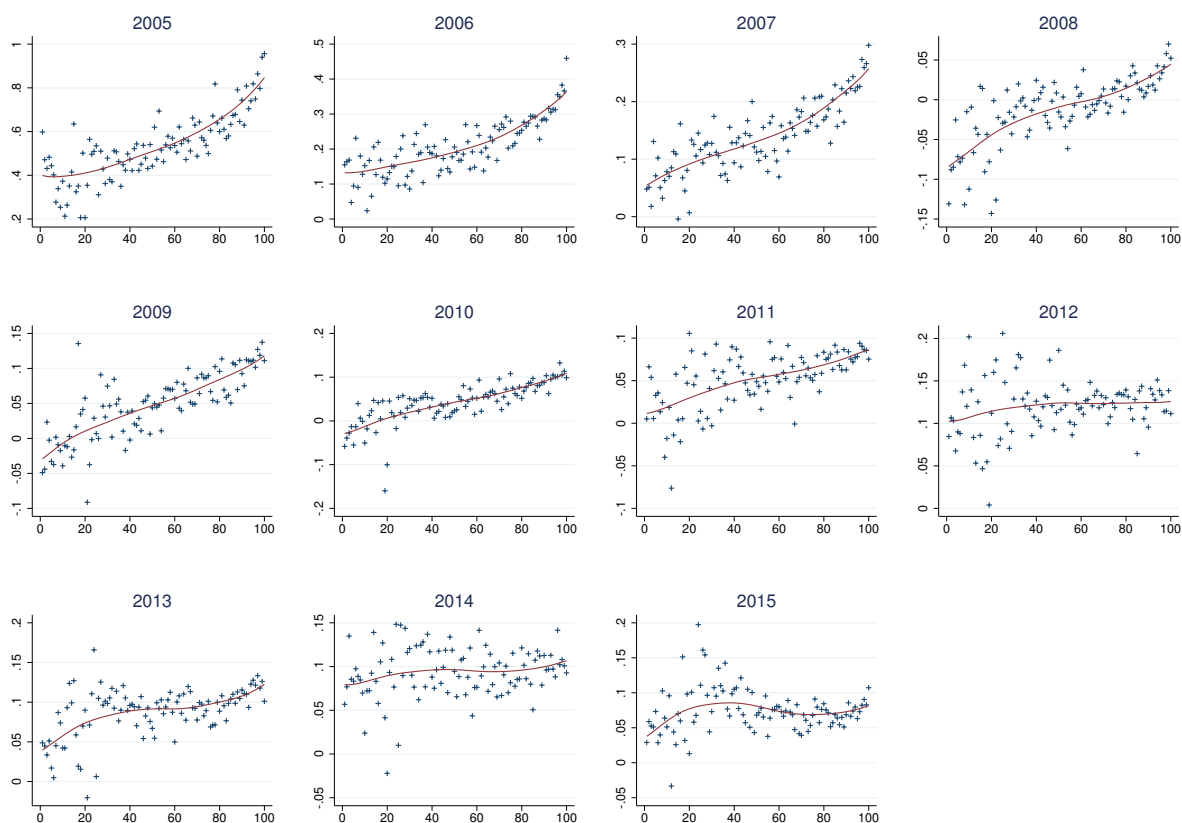
Notes: The figure shows the relation between returns to private equity and net worth percentiles for each year between 2005 and 2015.

Figure OA.19. Autocovariances of return residuals
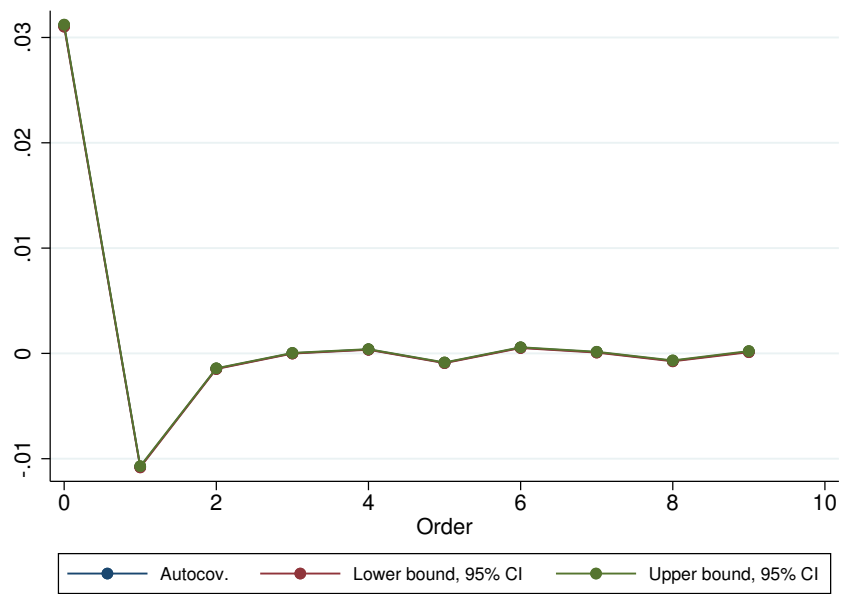
Notes: The figure shows the sequence of estimated $cov(\triangle \hat{u}_{i(g)t}, \triangle \hat{u}_{i(g)t-j})$ for $j = 0, .., 9$ from the regression in Table 4, column 3.

Figure OA.20. The distribution of fixed effects, components of net worth
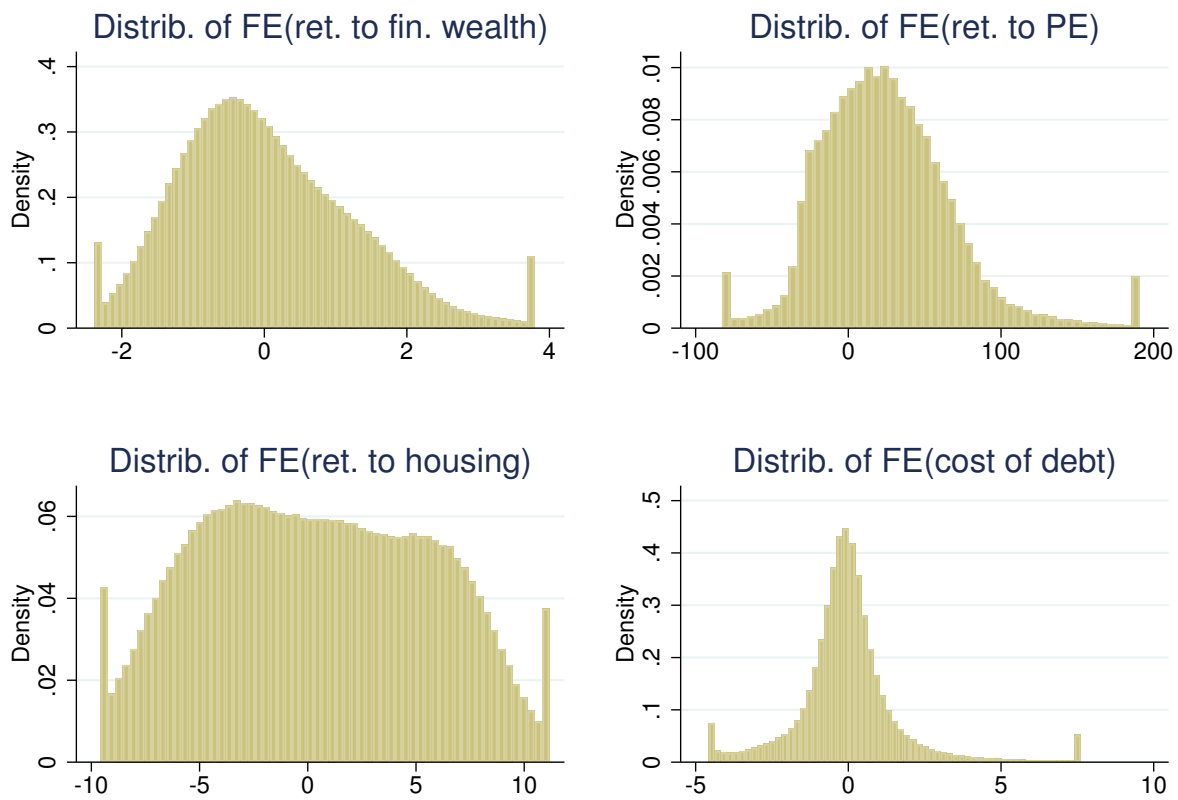
Notes: The figure reports the distribution of the return fixed effects on the components of net worth: financial wealth (top left panel), private business wealth (top right panel), housing wealth (bottom left panel) and debt (bottom right panel). Fixed effects are obtained from the estimates of Table 6.

Figure OA.21. Intergenerational correlation of return fixed effects
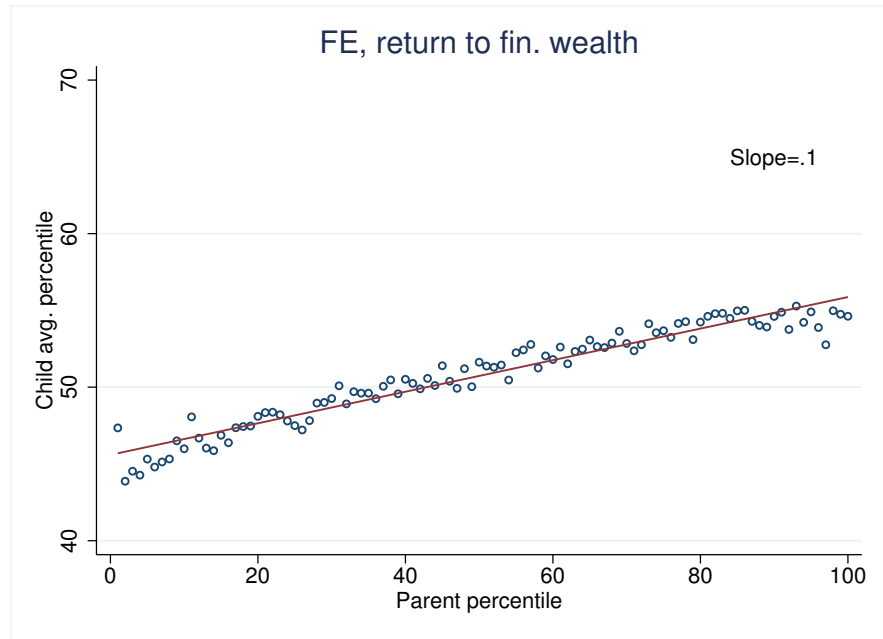
Panel A: Financial wealth
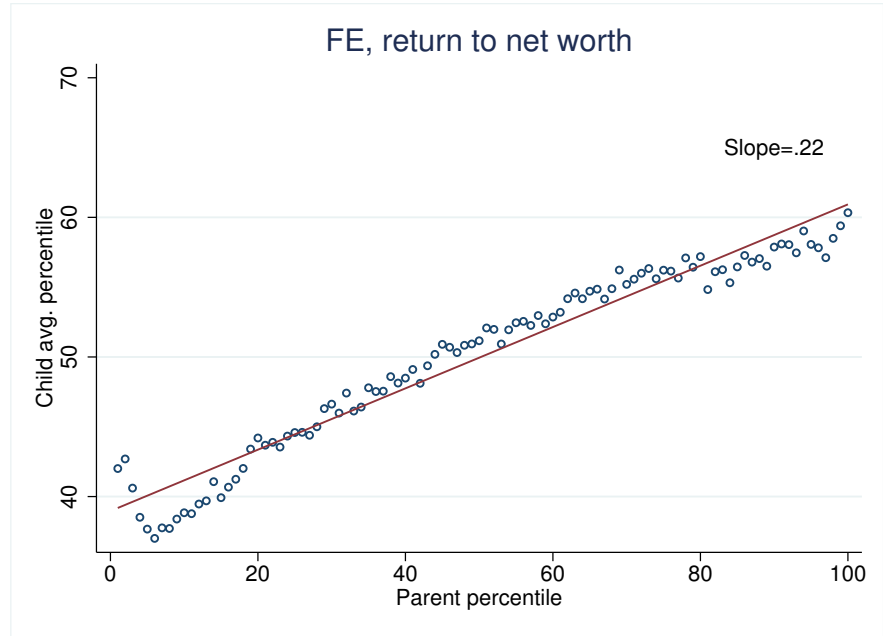
Panel B: Net worth

Notes: Panel A shows the rank correlation between the fixed effect in the return to financial wealth of children (vertical axis) and fathers (horizontal axis). Panel B repeats the exercise for the fixed effect in the return to net worth. In both graphs we also plot a simple linear regression fit and the value of the slope regression coefficient.

Figure OA.22. **Moments of cumulative returns on gross assets: people in the first decile of net worth.**
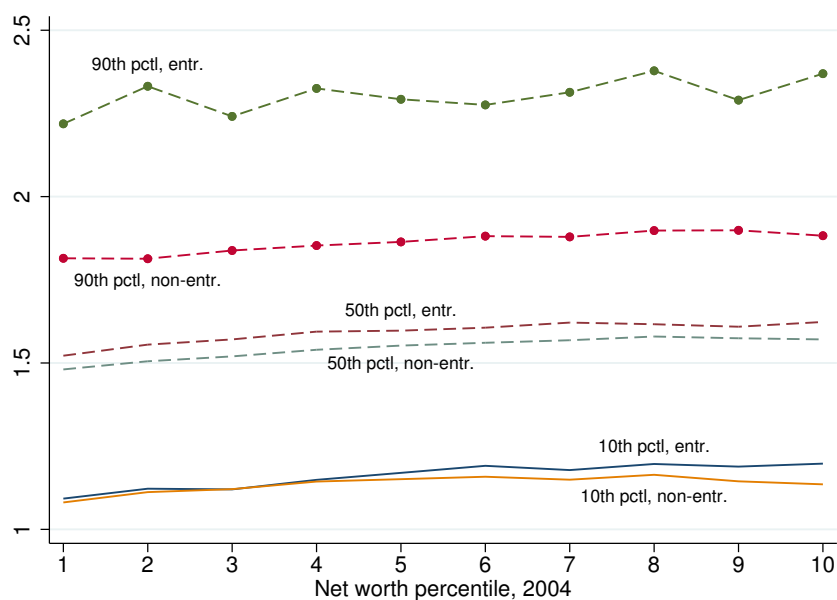
Notes: The figure shows selected moments (10th, 50th, and 90th percentile) of the distribution of cumulative returns to gross wealth (for the 2005-15 period) for individuals in the bottom decile of the net worth distribution in 2004.

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OA.9 Additional Tables

Table OA.1. Explaining after-tax returns to net worth

	(1)	(2)	(3)
Years of education	0.0657	0.0940	
	(0.0011)	(0.0011)	
Econ/Business educ.	0.0839	0.0668	
	(0.0084)	(0.0083)	
Male	0.0358	0.0313	
	(0.0055)	(0.0055)	
Mutual fund share	2.5913		
	(0.1054)		
Direct stockh. share	3.9336		
	(0.1606)		
Bonds share	2.9440		
	(0.1106)		
Foreign w. share	0.9484		
	(0.1781)		
Outst.cl. share	4.5367		
	(0.1096)		
Private equity share	5.7959		
	(0.0540)		
Housing share	7.1692		
	(0.0155)		
Leverage, long-term debt	-2.7468		
	(0.0095)		
Leverage, cons. debt	-4.2099		
	(0.0254)		
Leverage, student debt	0.5615		
	(0.0081)		
Average β stock m.	0.0022		
	(0.0150)		
Average β PE	0.0063		
	(0.0007)		
Average β Housing	0.3393		
	(0.0227)		
Demographics	Y	Y	Y
Year effects	Y	Y	Y
Shares*Year effects	N	Y	Y
Individual FE	N	N	Y
Observations	30,788,959	30,788,959	30,788,959
Adjusted R^2	0.247	0.299	0.466
P-value all $f_i = 0$			<0.0001

Notes: The table shows regression estimates of individual returns to after-tax net worth (equation (5)). Columns 1-2 are OLS regressions without individual fixed effects; column 3 includes individual fixed effects. All regressions include a full set of dummies for wealth percentiles computed on one-year lagged wealth, year dummies, age dummies, and location dummies. Specifications in columns 2 and 3 include interactions between time effects and the portfolio shares, and time effects and the betas for stock market wealth, private equity wealth, and housing wealth. Clustered (by household) standard errors are reported in parentheses.

Table OA.2. Fixed effect statistics, correcting for small-T bias

| | Before-tax return to net worth | | After-tax return to net worth | |
	Uncorrected	Corrected	Uncorrected	Corrected
Stand. dev.	6.02	5.21	4.25	3.58
Skewness	-5.26	-5.11	-3.43	-3.32
Kurtosis	78.42	77.87	56.68	56.20

Notes: The table shows the standard deviation, skewness coefficient, and kurtosis coefficient of the fixed effects of the before-tax and after-tax returns to net worth, uncorrected and corrected for small-T bias as explained in Section OA.7.

Table OA.3. Intergenerational return percentile regressions: Robustness

| | Financial wealth | | | Before-tax net worth | | | After-tax net worth | | |
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Father's return	0.2251	0.0825	0.0849	0.0937	0.0671	0.0938	0.1259	0.1017	0.1445
	(0.0007)	(0.0007)	(0.0008)	(0.0010)	(0.0009)	(0.0011)	(0.0009)	(0.0009)	(0.0011)
Wealth controls	N	Y	Y	N	Y	Y	N	Y	Y
Year FE	N	Y	Y	N	Y	Y	N	Y	Y
Demographics	N	Y	Y	N	Y	Y	N	Y	Y
Individual FE	N	N	Y	N	N	Y	N	N	Y
Adjusted R^2	0.064	0.180	0.147	0.003	0.122	0.389	0.007	0.098	0.341

Notes: The table reports the results of regressing the child's return to financial wealth (columns 1-3), net worth (columns 4-6) or after-tax return to net worth (column 7-9) on the corresponding father's return. Standard errors are clustered at the child's level and reported in parentheses.

Table OA.4. Upward and downward mobility and cumulative asset returns

Sample	*Bottom 99% in 2004*		*Movers from top 1% in 2004*	
Dependent variable	Move to top 1%		$\|P(w_{i,2015}) - P(w_{i,2004})\|$	
	(1)	(2)	(3)	(4)
R_i	0.0102	0.0104	-2.7486	-4.6142
	(0.0004)	(0.0004)	(0.2801)	(0.5028)
Average log(income)		0.0027		-0.2168
		(0.0001)		(0.3746)
Parents' wealth pctl. in 2004		0.0001		-0.1156
		(0.0000)		(0.0195)
Age in 2004		-0.0000		-0.3178
		(0.0000)		(0.0479)
Years of schooling		0.0004		-0.4474
		(0.0000)		(0.1103)
Econ/Bus. degree		0.0054		0.1069
		(0.0003)		(0.7165)
Observations	1,990,212	1,123,167	11,275	3,112
Adjusted R^2	0.007	0.013	0.020	0.080

Notes: The table shows regression for the probability to move to the top 1% in 2015 for the sample that is in the bottom 99% of the net worth distribution in 2004 (columns 1-2); and for the absolute value of the difference between percentile in 2015 and percentile in 2004 for the sample that moved away from the top 1% in 2004 (columns 3-4). R_i is the cumulative net worth return between 2005 and 2015. Clustered (by individual) standard errors are reported in parentheses.

Table OA.5. Wealth mobility from the bottom decile, 2004-2015

	Entrepreneurs	Non-Entrepreneurs
Moving to top 10% in 2015	20.8%	7.4%
Moving to top 5% in 2015	13.5%	3.9%
Moving to top 1% in 2015	4.1%	0.8%

Notes: The table reports the probability of moving from the bottom decile of the net worth distribution in 2004 to the top 10, 5 and 1% of the net worth distribution in 2015, separately for entrepreneurs and non-entrepreneurs.