Is Household Diversification Increasing in Wealth? Norwegian Evidence.

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Abstract

We study the diversification properties of equity portfolios using data on all Norwegian households with equity investments. While households typically have undiversified equity portfolios, diversification *is* increasing in wealth.

Highlights

- We study the diversification properties of household equity portfolios.

- We use data on all Norwegian households with equity investments.

- Households typically have underdiversified equity portfolios.

- Households with higher portfolio wealth have more diversified portfolios.

- This is consistent with a transaction cost explanation of lack of diversification.

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Introduction

The topic of household portfolio diversification is much studied in the field of household finance.[1] In this literature one argues that the lack of diversification in individual households portfolios is a costly investment mistake. While there is clear evidence that many individual investors do have undiversified portfolios, there is less evidence on the importance of these individual "mistakes" in the aggregate. One way to ask that question is investigate whether an individual, or a household, is less prone to mistakes if the decision is more important. For financial decisions, importance is increasing in the amounts the decision affects. The typical investigations therefore links investment "mistakes" and financial wealth. In this paper we ask such a question, by asking whether equity diversification increases in wealth.

Early studies of portfolio diversification[2] used survey data to look at individual portfolios. More recently, a number of investigations have been done on Swedish and Finnish data,[3] where the investigators have access to complete equity portfolios for all households in the economy. In this paper we look at some of these questions using data from a third country, Norway, where we also have access to the complete equity holdings for all investors at the Oslo Stock Exchange, for a long period, 1989–2007.

Standard theories of equity portfolio composition (Brennan, 1975) analyze the portfolio decision as a result of trade-off between gains from diversification and transaction costs of trading financial assets. Even small transaction costs make it costly for an individual investor, with a limited investment amount, to achieve a well-diversified portfolio. But transaction costs are not proportional to investment wealth. As wealth increases, diversification benefits will increase relative to transaction costs. Under this type of theory we expect diversification to increase in wealth.

An alternative to such a standard model is a behavioral model, where portfolio choices depend on behavioral biases, or more generally, on nonstandard utility specifications. In many such models, these biases will be independent of wealth.

The analysis in the present paper gives some empirical evidence on whether increasing wealth makes it more likely that an investor/household will have a more diversified portfolio. We show that for the sample of all Norwegian households with equity investments, diversification *is* increasing in wealth. Our result is in the tradition of the analysis of Vissing-Jørgensen (2003), which argues that even small levels of transaction costs can explain the "participation puzzle" that so few investors invest in the stock market, without the need to appeal to behavioral theories.

The paper is structured as follows. Section 1 gives an overview of the household finance literature, and places the question we are asking in context. Section 2 describes the market and our data. Section 3 show some evidence on how diversified individual owners are in our sample, before section 4 gives our main empirical investigations. Section 5 contains several robustness exercises, before section 6 concludes.

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[1] See Campbell (2006), Guiso and Sodini (2013), Barber and Odean (2013) and Badarinza, Campbell, and Ramadorai (2016) for surveys of the field of household finance.

[2] See e.g. Blume and Friend (1975) and Goetzmann and Kumar (2008).

[3] See Grinblatt and Keloharju (2001) and Massa and Simonov (2006) for early studies of respectively Finland and Sweden.

1 Literature

The starting point of this paper is the literature on household finance. As defined by Campbell (2006), household finance is the study of how households use financial instruments and markets to attain their objectives. Household finance can be both normative (What should households do?) and positive (What are households actually doing?). Traditionally, household finance tended to focus on prescriptive statements of how households should save and invest over time.

The early positive household finance literature used surveys as a basis for analysis. A reason for the growth and quality improvements in positive academic analyses of household finance is that larger, crossectional data-sets on household decisions are becoming available to researchers. In the US, data-sets on actual household allocations and portfolio decisions were collected by both private entities, such as brokerage houses, and by regulatory authorities. But these data-sets tend to be limited to a small sub-sample of households in the economy. In Europe, where record keeping is more centralized, data-sets with complete data for whole economies can be analyzed. In particular data from the Scandinavian countries have been utilized for such analysis, as they tend to be very comprehensive, and allow for linking of disparate data through a common identifier.

The topics analyzed in household finance are many and varied. We will focus on sub-questions concerned with the composition of the financial assets of a household. There are two questions typically asked here: One is *stock market participation*, or more generally, participation in financial (risky) assets. As long as expected returns on risky assets are higher than the risk free rate, standard portfolio theory[4] shows that any investor, no matter how risk averse, should have some investment in risky assets. But this is not the case for the majority of households. This lack of investment in risky assets is called the *participation puzzle* (Haliassos and Bertaut, 1995). The participation puzzle is partly explained by costs of participating in the equity market (Vissing-Jørgensen, 2002), but other explanations, such as limitations on investor cognitive skill (Grinblatt, Keloharju, and Linnainmaa, 2011), and financial literacy (Van Rooij, Lusardi, and Alessie, 2011; Gaudecker, 2015) are also argued to explain the (lack of) participation. There are however a couple of interesting stylized facts about stock market participation, namely that it has increased over time, and that it is increasing in wealth (Guiso and Sodini, 2013).

The second question asked about the household portfolio concerns its *composition*: Among the households which do participate in the stock market, do they make sensible choices? Here the choice of *portfolio diversification* has a special role. Increasing diversification of a portfolio is the closest you can get to a free lunch in finance: By diversifying an investor can reduce the riskiness (standard deviation) of a portfolio without hurting its expected return. Diversification choices are therefore a nice laboratory to look at the rationality of household financial decisions.

The early empirical work on diversification used surveys of U.S. households (Blume and Friend, 1975). They find that portfolios are severely under-diversified. More recently Goetzmann and Kumar (2008), using data from U.S. brokerage accounts, confirm that household portfolios are under-diversified. A series of recent articles investigating data from Sweden[5] argue that the "diversification

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[4]See e.g. (Huang and Litzenberger, 1988, Ch 1).

[5]Including: Campbell (2006) Calvent, Campbell, and Sodini (2007) Calvet, Campbell, and Sodini (2009b) and Calvet,

problem" is less acute than earlier thought. The Swedish evidence show that household portfolios are more diversified than earlier thought, particularly when including holdings through mutual funds.

The survey by Guiso and Sodini (2013) suggests three different classes of theoretical explanations for an under-diversified portfolio. First, assuming that households show optimizing behavior, but their decisions are subject to various constraints. Among the constraints are transaction costs (Brennan, 1975), ambiguity (Boyle, Garlappi, Uppal, and Wang, 2012) and cost of information acquisition (Van Nieuwerburgh and Veldkamp, 2010).

Secondly, assuming preference differences among households, which are explanations leaning more towards behavioral finance. An early observation is that portfolios are tilted more towards familiar (close) stocks (Huberman, 2001). A more theoretical approach is to investigate consequences of households having prospect theory preferences (Polkovnichenko, 2005).

A third possibility is that different portfolios represent hedging of different endowments (Calvet, Gonzalez-Eiras, and Sodini, 2004).

Of these three explanations, the data we have access to allow us to test an implication of the first class of theories, that the effect of imperfections such as trading costs will be decreasing in wealth. Trading costs can lower significantly the number of equities in the optimal portfolio.[6] Trading costs have both fixed components (costs of setting up an equities accounts, costs of becoming informed about equity investments), and variable components. The variable components depend on the amount of trading, but the transaction costs will never be more than proportional to the investment amount. It is also a one-time costs when a trade is made. If stocks are held over long periods, the trading costs will be small relative to holding period returns.[7] Hence, as wealth invested in the stock market increases, trading costs increase by less than wealth. The implication is that the optimal degree of diversification in a portfolio will be increasing in portfolio value. This is the implication that we will test.

There are three extant studies of the financial allocations of Norwegian households that the present paper complements in terms of analysis. Ødegaard (2009) uses the same data as the present paper, but the focus of that analysis is on the very large equity stakes. If an owner holds a controlling stake in a company, that owner will typically have a wealth constraint that limits diversification. But the potential diversification loss may be potentially be offset by control benefits. The analysis in Ødegaard (2009) evaluates the magnitude of the diversification loss for such large investors, and relates it to the potential size of the control benefits that may offset the loss from reduced diversification.

Døskeland and Hvide (2011) studies the possibility that equity holders diversify less than optimally because they may be better informed. Døskeland and Hvide ask whether investors have preferences for stocks in the same industry that they work. Deciding to invest in such professionally close stocks, deviating from optimal portfolio diversification, may be because these investors have a better understanding of their own industry, and therefore be able to generate superior returns. Døskeland and Hvide shows that investors do seem to concentrate their portfolio in "close" stocks, but they do not seem to be rewarded for it. Instead, Døskeland and Hvide show that these "close" portfolios are

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Campbell, and Sodini (2009a).

[6]See for example the exposition in Levy and Livingston (1995).

[7]Amihud and Mendelson (1986).

underperforming.[8]

Fagereng, Gottlieb, and Guiso (2017) uses tax records, and has access to the complete portfolio of individual households, both financial assets and real assets, but their focus is on stock market participation, and how it varies with age. They show that there is a life cycle effect, stock market participation falls as investors gets closer to retirement age.

2 Market and Data

The firms in the sample are listed on the Oslo Stock Exchange (OSE), which is a moderately sized exchange by international standards. In 1997, the 217 listed firms had an aggregate market capitalization which ranked the OSE twelfth among the 21 European stock exchanges for which comparable data are available. The number of companies on the exchange has increased from 172 in 1989 to 292 in 2007.[9]

In the period of our analysis all listed Norwegian companies tracked their equity owners through a electronic centralized registry.[10] All owners at the OSE needed to maintain an account with the registry.[11] Trades at the exchange are reported to the registry, which takes care of transfers of ownership. The registry then provides companies with lists of their owners (stockholders). The primary data used in this paper is monthly snapshots of these ownership data. At each date we observe the number of stocks held by every owner. Each owner has a unique identifier which allows us to follow the owners' holdings over time. For each owner the data include a sector code that allows us to distinguish between such types as financial owners (e.g. mutual funds), industrial (nonfinancial corporate) owners, individual owners (households), state owners and foreign owners. Note that the ownership identifiers are anonymized, they do not allow us to link these equity ownership data with characteristics of the individual owners beyond the sector code. Hence, the wealth we look at in the rest of the paper is only the value of an individual's equity investment, not the total assets of that individual, which typically would include housing, and the present value of future income. In addition to the ownership data we use stock market prices and trading volumes from the Oslo Stock Exchange Data Service (OBI).

To show that this is a large sample, in figure 1 we count the number of household investors observed each month. Note that this picture excludes all other owner types, as these are typically very different in nature. The number of Norwegian households with *some* direct equity holdings varies between two and four hundred thousand, and is increasing until about 2002, after which it flattens out. This flattening is probably linked to the bursting of the dotcom bubble at that time. To give some further perspectives on the sample, we also split the data based on portfolio wealth, by providing separate counts of the number of portfolios with values above respectively fifty thousand,

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[8]The Norwegian results are actually conflicting with two other similar studies, albeit in different countries, Massa and Simonov (2006) and Bernile, Korniotis, Kumar, and Wang (2015), which both find evidence that such "close" portfolios have higher performance. On the other hand, Seasholes and Zhu (2010) has results similar to Døskeland and Hvide (2011).

[9]For some information about the structure of the Norwegian stock market we refer to Bøhren and Ødegaard (2000, 2001), and Næs, Skjeltorp, and Ødegaard (2009).

[10]Verdipapirsentralen (VPS) –the Norwegian Central Securities Registry.

[11]A household will typically have just one VPS account, but there is no regulation outlawing different members of a household, such as a husband and a wife, having separate VPS accounts

hundred thousand and one million NOK.[12] The number of households with sizeable equity portfolios is increasing in the more recent period, after a short fall around 2003.

**Figure 1** Number of Norwegian households owning equity
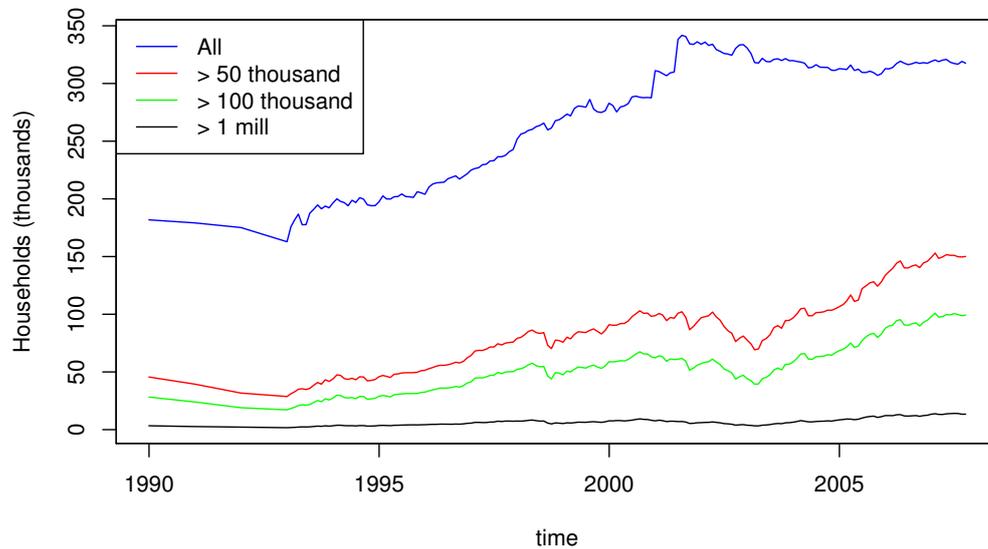
The figure shows the number of households in the data. The top line (blue) is the total number of private individuals (households) with nonempty accounts. The lower lines condition on wealth: The red line shows the number of individuals with equity wealth above 50 thousand NOK, the green the number of individuals with equity wealth above 100 thousand NOK, and the black line the number of individuals with equity wealth above 1 million NOK. The wealth boundaries are in constant 2007 kroner. Numbers in thousands.

To further illustrate some properties of the equity portfolios, figure 2 plots the average and median portfolio wealth for the households in the sample.

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[12]At the 2007 exchange rate of 5.57, these levels correspond to roughly 9, 18 and 180 thousand USD.

Figure 2 Average and median wealth for Norwegian household's equity portfolios
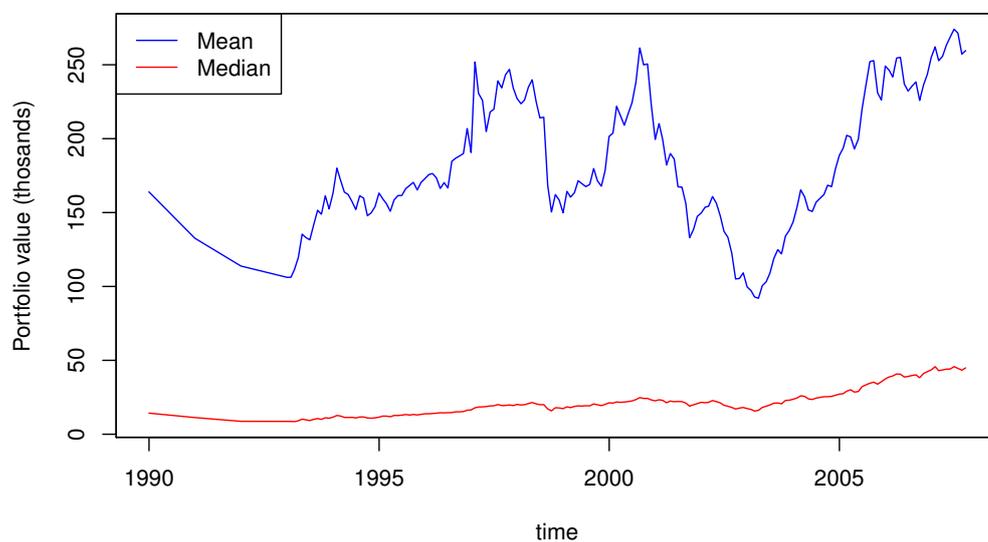
The figure shows the average (median) of equity wealth in the total sample of individuals (households). On each date we find the portfolio values for all individuals with nonempty VPS accounts, and calculate the crossectional average (in blue) and median (in red). Numbers in thousands.

3 How diversified are individual equity owners?

We start by showing some simple evidence for the diversification of individual owners. We look at the number of shares in individual portfolios. In figure 3 we use data for one date, September 2007, and show histograms of the distribution of the number of shares in individuals' portfolios.[13] The figures clearly show a lack of diversification. The most common case is one share, and more than 50% of the portfolios contain 3 or less shares. These numbers are comparable to similar evidence from the US, such as Blume and Friend (1975) and Goetzmann and Kumar (2008).

To see how sensitive these results are to wealth, in panel B of the figure we condition on wealth by only including portfolios with total values above 1 million NOK.[14] The distribution is clearly shifting towards the right, households invest in more stocks. But the number of households concentrating such a large investment in one stock is still substantial.[15]

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[13]In an Internet Appendix we complement this by corresponding figures for several more dates.

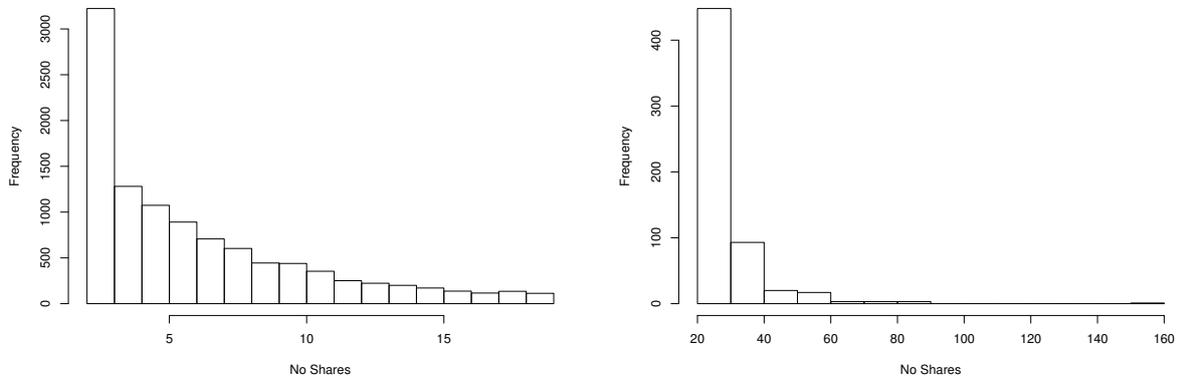[14]At the 2007 exchange rate this corresponds to 126,100 USD.

[15]Some of this can be related to owners holding a concentrated portfolio for control purposes. We will in section 5.2 look at the sensitivity of results to such considerations.

Figure 3 Number of shares in households' portfolios

Panel A: All households
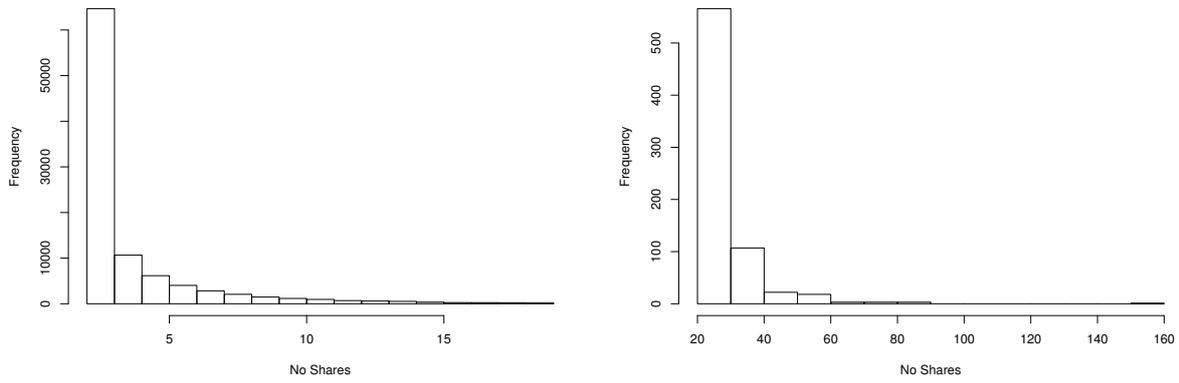

Panel B: Households with wealth > 1 million

Histograms describing the distribution of number of shares in individual portfolios. Illustrated separately for number of shares below 20 (left-hand plot) and the upper tail, of number of shares above or equal 20 (right-hand plot). Data for all households at the OSE in September 2007. The figures in panel A uses all individuals, and the figures in panel B uses individuals with equity portfolio wealth above 1 million NOK.

4 Is diversification increasing in wealth?

We now look at the major empirical question of the paper, linking measures of portfolio diversification to wealth. We consider two measures of diversification. The first measure is the number of equities in a portfolio. A potential problem with the number of equities is that it does not control for skewness in weights. (A portfolio with 99% in one stock and the remaining 1% of the portfolio in four shares is by this metric equally diversified as an equally weighted portfolio of five shares.) A measure that also take weights into account is a therefore a Herfindahl index of the portfolio weights.[16] We call this the Diversification Index.

Figure 4 The relationship between diversification (number of shares) and portfolio value (wealth)
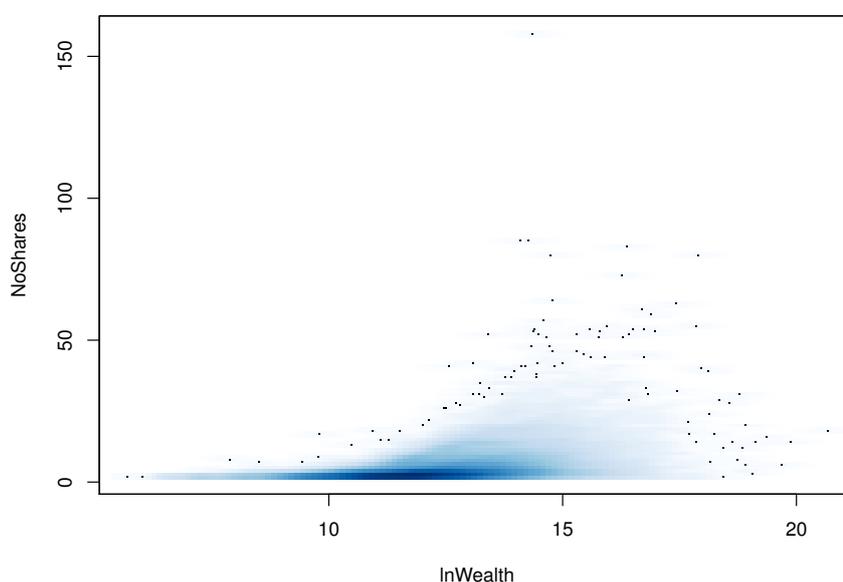
The relationship between the number of assets in an individual (household) portfolio and the logarithm of that individual's equity wealth (total equity portfolio value). Data for September 2007. All households.

In figure 4 we plot the relationship between the number of shares in a portfolio and the logarithm of wealth in that portfolio.[17] From the plot we observe that the number of shares do seem to be increasing in wealth. To confirm that we perform a number of regressions.

First, we look at one crossection, and regress the two diversification measures on the logarithm of portfolio value (wealth) for that household, as shown in equation (1):

$$\text{Diversification Measure}_i = a + b\ln(\text{wealth}_i) + \varepsilon_i \tag{1}$$

The results are shown in Table 1. In both cases we find a significant relationship indicating that

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[16]The Herfindahl index is the sum of squared portfolio weights for the assets in a portfolio. If we let w_i be the portfolio weight of asset i in an owners portfolio, we sum over the n assets in the portfolio: $HI = \sum_{i=1}^{n} w_i^2$.

[17]This uses data for the last observation in the data, 2007.

diversification increases with wealth. The coefficient in the regression of the number of shares on log wealth is positive, above one, indicating that as wealth increases, the number of shares increases. The coefficient on log wealth in the regression of the Herfindahl index on log wealth is significantly negative. As this index is *decreasing* in diversification this coefficient tells the same story, as wealth increases, the Herfindahl index falls, i.e. diversification increases.

**Table 1** Regressing Diversification on wealth. All individuals. 2007

	Dependent variable:	
	No Shares	DI(Herfindahl Index)
	(1)	(2)
ln(Wealth)	1.052***	−0.034***
	(0.007)	(0.0005)
Constant	−8.816***	0.925***
	(0.085)	(0.006)
Observations	97,788	97,788
Adjusted R^2	0.187	0.050
Note:	*p<0.1; **p<0.05; ***p<0.01	

Results of the regression Diversification measure$_i$ = a + b ln(wealth$_i$) + ε_i. The first column uses the number of shares in a household's portfolio as the diversification measure. The second column uses the Herfindahl Diversification Index.

Table 1 shows results for the last date in the sample. To show that this relationship is stable over time, we repeat regression (1) on an annual basis. To summarize the results in a compact way, Figure 5 shows a time series plot of the coefficients b in the regression of the number of shares on wealth.[18] As Figure 5 shows, the coefficient is consistently positive, varying between 0.9 and 1.5 over the period 1989 to 2007, confirming that the tendency for diversification to increase with wealth is present for the whole of this almost twenty year period.

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[18]The period by period regressions are listed in an Internet Appendix.

Figure 5 Summarizing regression slopes over time. 1989–2007.
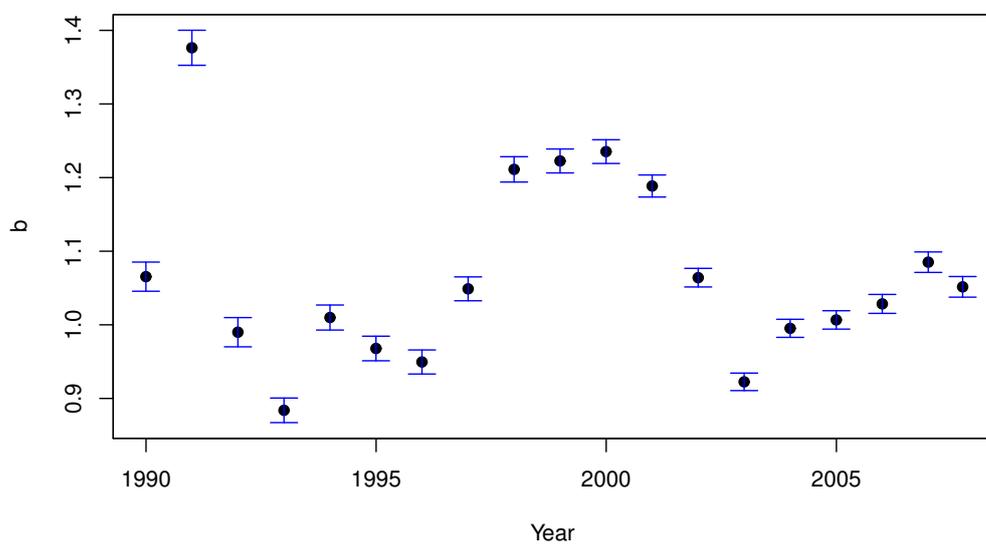
The figure shows coefficient estimates of b in the regression No Shares $= a + b \ln$ Wealth $+ \varepsilon$, estimated once a year. The regression uses data for all households. Also indicated: 2 standard deviation error bars around the point estimate.

5 Robustness

In this section we investigate the robustness of the previous result by narrowing the sample.

5.1 Robustness: Excluding small owners

The above regressions include the full range of wealth, i.e. also portfolios where wealth may be small relative to transaction costs. We investigate the robustness of the results by conditioning on wealth. We use two subsamples. The first exclude the very small investors, by only considering investors with wealth invested in the stock market above 100 thousand NOK. The second include only the relatively wealthy, by only including investors with total equity portfolio value above 1 million NOK. These robustness estimates confirm the results we found using all owners, that diversification is increasing in wealth.

Table 2 Regressing diversification on wealth, conditioning on wealth. 2007

	Wealth > 100 thousand		Wealth>1 million	
Dependent variable:	No Shares	DI (Herfindahl index)	No Shares	DI
ln(Wealth)	1.534***	−0.027***	1.806***	−0.002
	(0.014)	(0.001)	(0.084)	(0.003)
Constant	−15.127***	0.833***	−18.942***	0.461***
	(0.187)	(0.011)	(1.233)	(0.049)
Observations	64,496	64,496	10,950	10,950
Adjusted R^2	0.149	0.014	0.040	−0.0001

Note:		*p<0.1; **p<0.05; ***p<0.01

Results of regressions Diversification measure$_i$ = $a + b\ln(\text{wealth}_i) + \varepsilon_i$ where diversification measure is either number of shares or DI (Herfindahl Index). Each column is a separate regression. The first two columns shows results using a sample where owners with portfolio wealth below NOK 100,000 is removed. The last two columns only uses individuals with portfolios with a value higher than NOK 1 million.

5.2 Robustness: Control Benefits and Diversification

As a second robustness check we consider one possible issue with our earlier estimations. We have so far not considered a possible counter-effect to the diversification argument, namely *benefits of control*. In the corporate governance literature, there is a benefit to having a large equity stake in a single stock, if that equity stake is so large that the investor achieves a *voice* in corporate decisions. For example, a number of the Norwegian companies listed on the OSE are family controlled, where the original owner maintains a large equity stake. This issue was analyzed in Ødegaard (2009). As shown in that paper, owners with controlling stakes have undiversified portfolios. This is most likely due to wealth constraints. The wealth necessary to achieve a controlling stake may not leave much wealth left over to buy additional equities for diversification purposes. The analysis also discusses the potential control benefits that may offset some of these cost.

For the purpose of the present paper, the issue of private benefits is however an unnecessary

distraction. To control for this issue, we run robustness regressions where we remove all owners for which control may be an explanation. To proxy for potential control issues, we remove all owners who have an equity stake higher than two and a half percent of outstanding shares in a company. Table 3 shows results for the same regression specifications as before, but now also removing owners with stakes above 2.5%. The results are essentially the same as the earlier results in terms of coefficient estimates. This is easy to understand when you consider the sample size. The restriction on large, concentrated owners remove only a few cases. For example, for the sample of owners with portfolio wealth above 1 million, the number of observations go from 10,950 to 10,913, ie. a reduction of 37 observations, or a reduction of 0.33% of the sample.

Table 3 Regressions conditioning away potentially private benefit cases

	All		Wealth > 100 thousand		Wealth > 1 mill	
Dependent variable:	No Shares	DI (Herfindahl index)	No Shares	DI	No Shares	DI
ln(Wealth)	1.052***	−0.034***	1.540***	−0.028***	1.865***	−0.004
	(0.007)	(0.0005)	(0.015)	(0.001)	(0.086)	(0.003)
Constant	−8.818***	0.928***	−15.204***	0.840***	−19.783***	0.492***
	(0.085)	(0.006)	(0.187)	(0.011)	(1.265)	(0.050)
Observations	97,751	97,751	64,459	64,459	10,913	10,913
Adjusted R^2	0.187	0.051	0.149	0.015	0.041	0.0001

Note: *p<0.1; **p<0.05; ***p<0.01

The table report results of crossection regressions Diversification measure$_i$ = $a + b\ln(\text{Wealth}_i) + \varepsilon_i$. The sample removes portfolios where one of the ownership stakes is higher then 2.5% percent of outstanding shares. Two diversification measures: Number of shares in portfolio, and DI, a Herfindahl index of ownership fractions. The first two columns shows results for all owners, the next two for owners with wealth above NOK 100,000 and the last two for owners with wealth above 1 million NOK.

6   Conclusion

We show, using all owners at the Oslo Stock Exchange, that diversification in equity portfolios, as measured with the number of stocks in a portfolio, is increasing in the total amount invested in the portfolio (portfolio wealth). This is shown to hold for the whole period 1989–2007.

The result from the sample of all Norwegian equity owners thus confirms evidence from other markets, such as Sweden, where Calvet et al. (2009b) also show that diversification is increasing in wealth (and other measures of financial sophistication). This result is similar to the observation by e.g. Guiso and Sodini (2013) that stock market participation *overall* is increasing in wealth.

In terms of theories of under-diversification, the link between wealth and diversification is consistent with theories of tradeoff between diversification benefits and imperfections to trade, such as transaction costs. This link is not consistent with some behavioral theories of under-diversification.

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