Empirics of the Oslo Stock Exchange.
Basic, descriptive, results 1980-2011.

Bernt Arne Ødegaard

University of Stavanger

and

Norges Bank

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We give some basic empirical characteristics of the Oslo Stock Exchange in the period 1980 to 2009. We give statistics for number of firms, the occurences of IPO's, dividend payments, trading volume, and concentration. Returns for various market indices and portfolios are calculated and described. We also show the well known calendar anomalies, the link between number of stocks in a portfolio and its variance and how mean variance optimal portfolios would be constructed from various empirical portfolios.

Contents

Chapter 1

Introduction

This document is a source book for people doing empirical asset pricing using data from the Oslo Stock Exchange (OSE). The prime purpose of the paper is pedagogical, it is to be a useful resource for teaching finance in the Norwegian context. The same purpose is reflected in the lack of discussion of the results, the focus is on the numbers themselves, and students are meant to fill in the details. Having said that, the paper may still be useful for researchers since it summarizes in one place various properties of stock returns on the Norwegian stock exchange.

New versions

This paper will be updated with new data and additional analysis. The latest version will always be found at my homepage `http://www1.uis.no/ansatt/odegaaard`. I am open for suggestions to additional descriptive statistics you'd like to see, but I make no promises.

Data and data sources

The source data is is daily observations of prices and volume of all stocks listed on the OSE, as well as dividends and adjustement factors necessary for calculating returns. In addition to price data accounting data for all stocks listed at the OSE is used. The data comes from two sources. All accounting and equity data are from OBI (Oslo BørsInformasjon), the data provider of the Oslo Stock Exchange. Interest rate date is from Norges Bank. The data starts in 1980. The stock price data ends in December 2011. Unfortunately we have some delays with the accounting data, so the Fama French factors are only available through 2009, even if we have stock prices though 2010.

Can you get the indices?

The data from the OSE used in constructing the various indices is governed by an agreement with the exchange that do not allow distribution of data. The raw data on indices and portfolio returns produced in this research is therefore only available to students and researchers at the Norwegian School of Management BI.

However, after agreement from the OSE, a number of constructed indices *are* made available from my homepage, such as Fama-French factors, portfolio returns for size-sorted indices, and so on.

The various chapters

Chapter 2 characterizes the evolution of the OSE in the period 1980 to 2011, by showing time series plots of market values, number of stocks listed, and trading activity. Chapter 3 looks at IPO's, and details the annual number of IPO's at the OSE. Chapter 16 has some numbers on dividends at the OSE. Chapter 5 discusses

filtering of the data for returns calculations, in particular for asset pricing purposes Chapter 6 shows return statistics for the whole market. Chapter 7 breaks the stocks listed into sectors, shows distribution of sectors, and sector returns. Chapter 8 looks at the importance of a few large stocks.

Chapter 10 looks at crossectional portfolios. Chapter 9 replicates the classical analysis of e.g. Wagner and Lau (1971) which looks at the link between the number of assets in a portfolio and the variance of the portfolio, illustrated with simulations on Norwegian data. Chapter 11 looks at the volatility of stocks at the OSE. Chapter 13 shows some calendar effects. Chapter 14 discusses construction of the factor portfolios of Fama and French (1992) and Carhart (1997). Chapter 15 details the interest rate data.

Chapter 2

Characterizing the OSE

In this chapter we look at some aggregate descriptive measures of the Oslo Stock Exhhange

2.1   The evolution of market values

Let us start by looking at the aggregate value of all stock on the exchange. Figure 2.1 plots the time series evolution of the total market value of all stocks on the Oslo Stock Exchange.

Figure 2.1 Monthly market values

The plot shows monthly observations of aggregated market values the OSE, in billion NOK. The values are in nominal (current) NOK.

To judge the importance of the stock market in the Norwegian economomy figure 2.2 shows the total market value of all companies at the OSE as a fraction of the annual GDP (Gross Domestic Product) for Norway.

Figure 2.2 Market value OSE relative to annual GDP for Norway

Market value OSE as fraction of GDP(percent)
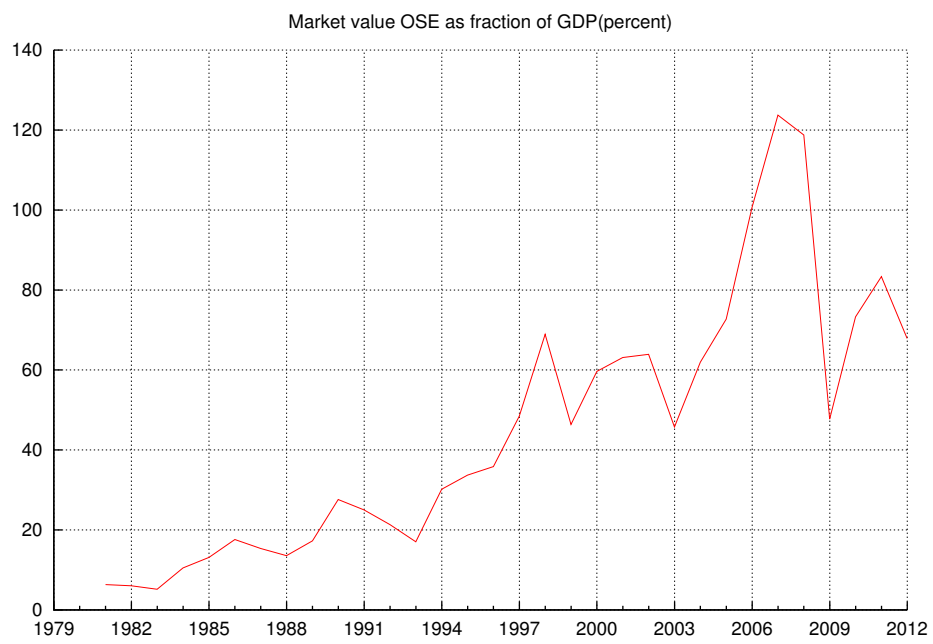
The plot shows annual observations of market values at the OSE, using all stocks on the Exchange, as a percentage fraction of GDP for that year. The data on GDP are from Statistics Norway.

2.2　The number of stocks listed

Figure 2.3 Number of active shares at the OSE each month

Number of active shares OSE
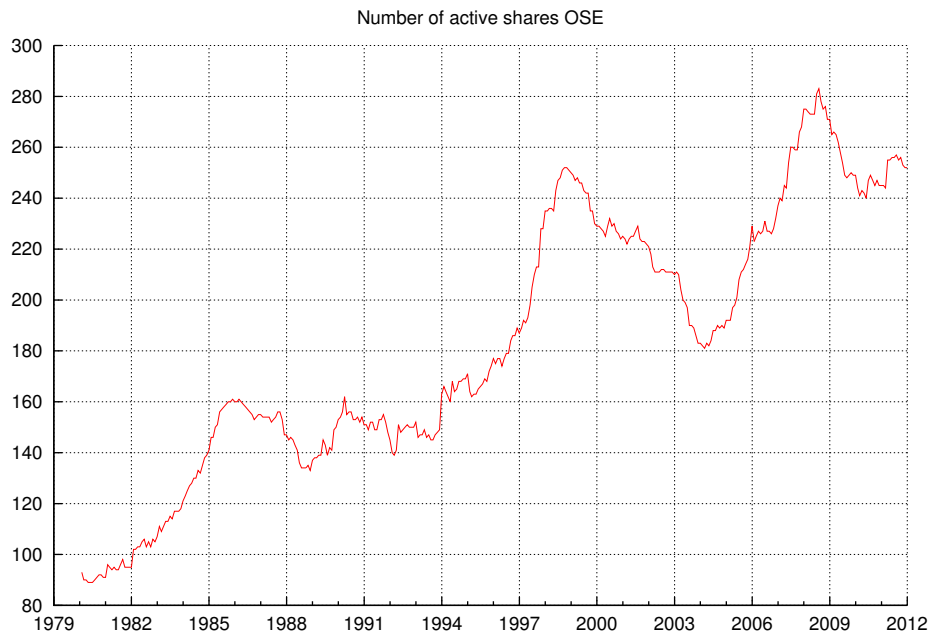
2.3   The evolution of trading activity

A simple measure of the activity at the OSE is the total trading volume in NOK.

Figure 2.4 Quarterly trading volume

Quarterly trade volume (bill)
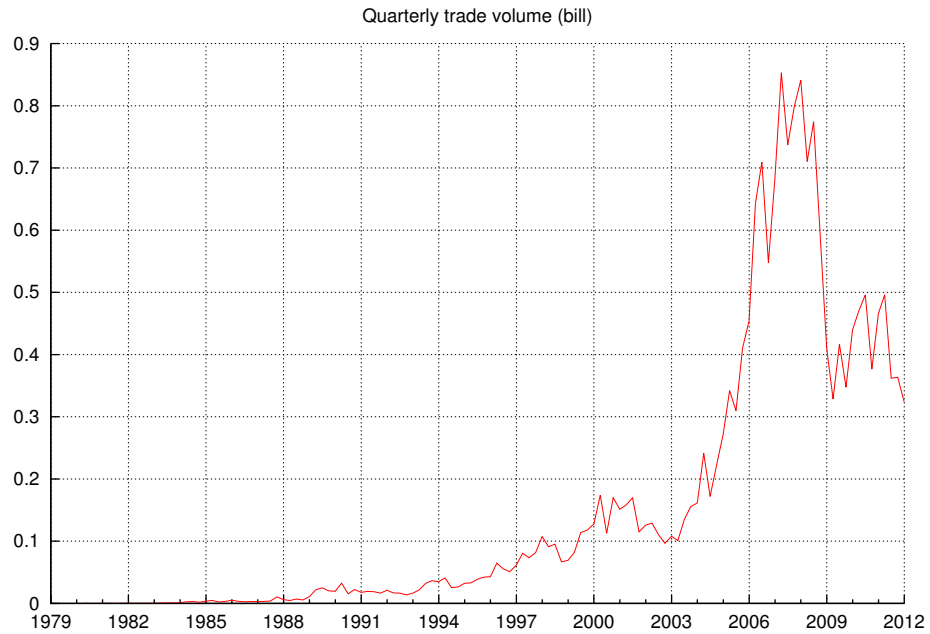
The plot shows quarterly trading volume at the OSE, in bill NOK, using all stocks on the Exchange.

Figure 2.5 Quarterly trading volume split size portfolios
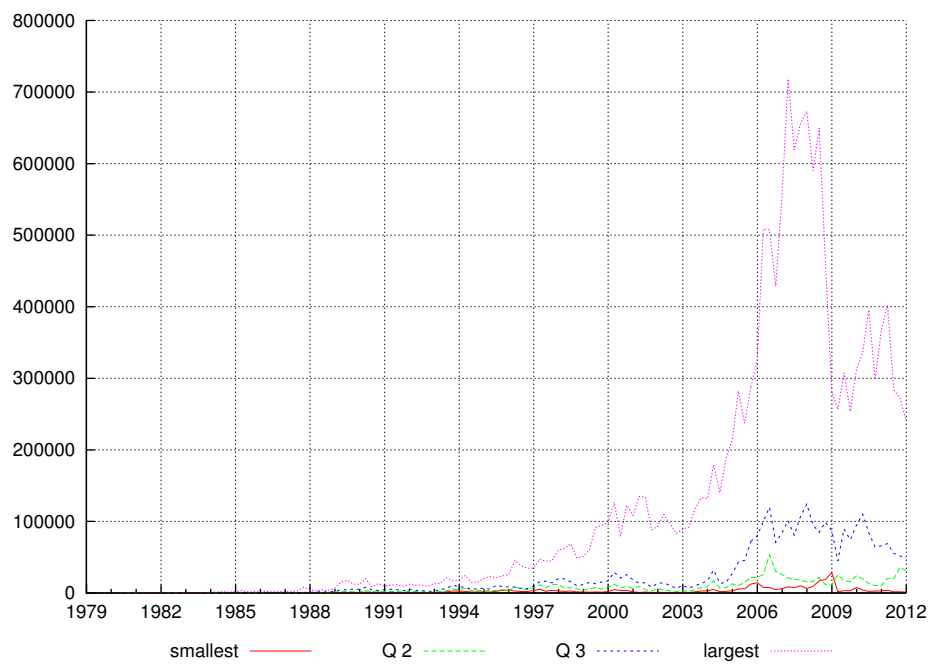
Trading volume at the OSE, in mill NOK. Stocks are sorted into four size based portfolios, and then we calculate the aggregate volume for the period.

Chapter 3

New listings

In this chapter we give some details on new listings at the OSE (Initial Public Offers – IPOs).

3.1 Numbers of new stocks starting to trade at OSE

Figure reffig:newlistings and table 3.1 shows how many firms are introduced at the OSE each year.

Figure 3.1 New listings per year
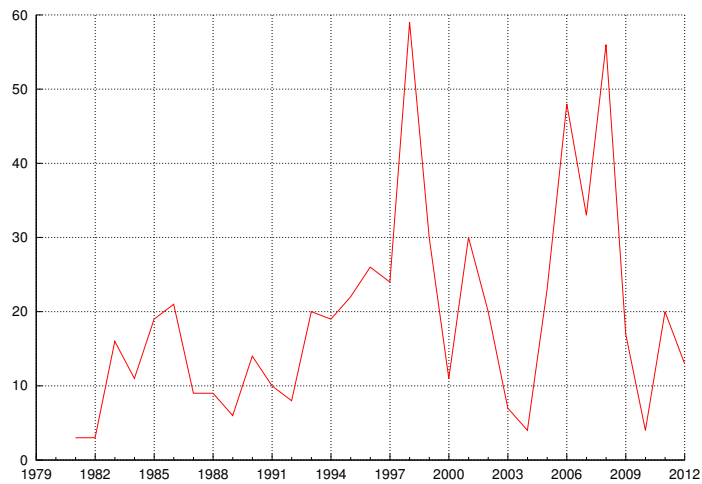
Each year we count the number of new equities in the OSE stock price data. Data for stocks listed at the Oslo Stock Exchange during the period 1980-2011.

Table 3.1 New listings per year

Year	Number of new listings
1980	3
1981	3
1982	16
1983	11
1984	19
1985	21
1986	9
1987	9
1988	6
1989	14
1990	10
1991	8
1992	20
1993	19
1994	22
1995	26
1996	24
1997	59
1998	30
1999	11
2000	30
2001	20
2002	7
2003	4
2004	23
2005	48
2006	33
2007	56
2008	17
2009	4
2010	20
2011	13

Each year we count the number of new equities in the OSE stock price data. Data for stocks listed at the Oslo Stock Exchange during the period 1980-2011.

3.2 Aggregate values

Figure 3.2 IPO's aggregate values

Panel A: Total value of all new companies at yearend.
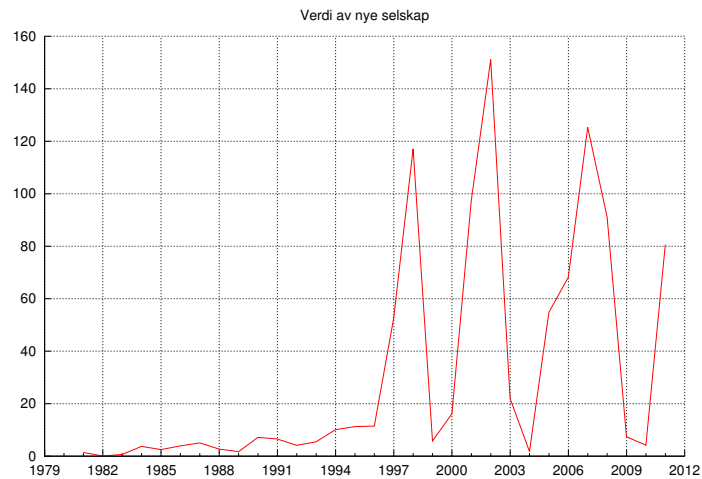
Panel B: Comparing total firm values and amounts raised at IPO date.
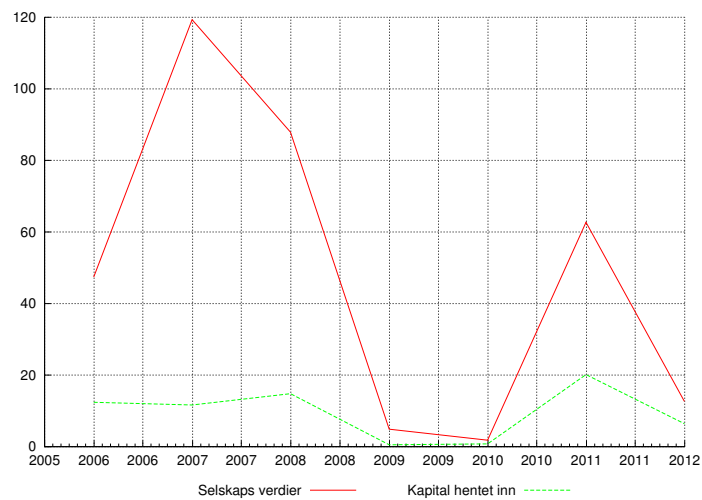
In the figure in panel A we sum the firm values at yearend for all stocks newly listed on OSE during the year. In the figure in panel B we show the same aggregate values, calculated at the IPO date, together with the aggregate amounts raised during the IPO (lower line). Data for stocks listed at the Oslo Stock Exchange during the period 1980-2011.

Chapter 4

Dividends

In this chapter we describe various aspects of dividend payments at OSE. First we look at the actual dividend amounts per security. Table 4.1 stratifies dividends amounts into four groups: no dividend payment, dividend up to NOK 5, dividend between NOK 5 and NOK 10, and dividend above NOK 10. The most striking feature of the table is the number of stocks which is not paying dividend at all, particularly in the early period. To further illustrate this particular point figure 4.1 shows the fraction of companies on the OSE which is not paying dividends. The figure clearly shows a regime change in dividend payments, where in 1985 close to 75% of the companies on the OSE did not pay dividends, which had fallen to less than 30% in 1995. This particular change is most likely a result of a tax change. In 1992 a new tax code was introduced. Under the new code dividends are much less tax disadvantaged. The huge increase in firms starting to pay dividends is most likely a result of this tax code change.

Figure 4.1 What fraction of securities do not pay dividends?
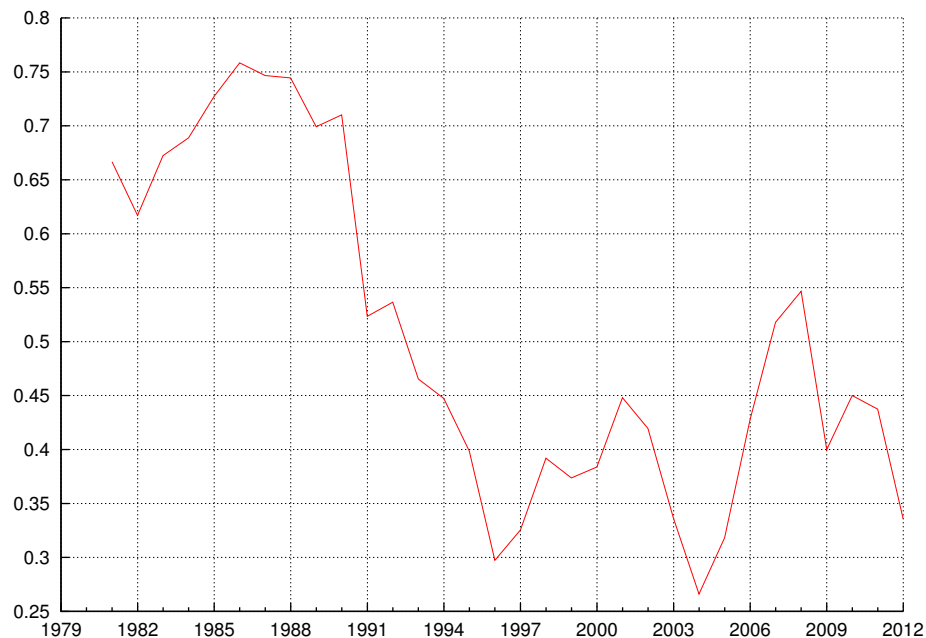
The plot shows what fraction of companies on the OSE does not pay dividend. For each year we count the number of firms listed on the exchange during the year, and the number of those paying dividends. We report what fraction the dividend payers are of the total. Data for stocks listed at the Oslo Stock Exchange during the period 1980-2011.

Table 4.1 How much are companies paying in dividends?

year	$d = 0$	$d \in (0, 5]$	$d \in (5, 10]$	$d > 10$
1980	22	1	4	6
1981	29	1	1	16
1982	39	1	0	18
1983	62	4	4	20
1984	88	15	2	16
1985	113	19	5	12
1986	109	22	8	7
1987	99	27	0	7
1988	79	25	3	6
1989	98	32	6	2
1990	78	56	10	5
1991	66	51	3	3
1992	47	51	2	1
1993	51	55	3	5
1994	57	65	17	4
1995	44	81	15	8
1996	55	83	15	16
1997	78	76	24	21
1998	71	80	15	24
1999	71	73	25	16
2000	82	59	13	29
2001	60	42	16	25
2002	40	40	19	20
2003	29	37	24	19
2004	42	47	19	24
2005	71	48	21	26
2006	101	49	21	24
2007	123	58	18	26
2008	60	48	19	23
2009	54	51	9	6
2010	63	55	19	7
2011	45	59	23	7

The table illustrates the amount paid in dividends by companies on the OSE. For each stock we find the annual amount of dividend payment per stock. Each year we then calculate the number of stocks with dividends of zero, dividends between zero and five, dividends between five and ten, and dividends above 10. Data for stocks listed at the Oslo Stock Exchange during the period 1980-2011.

Figure 4.2 What are the aggregate dividend payments at the OSE?
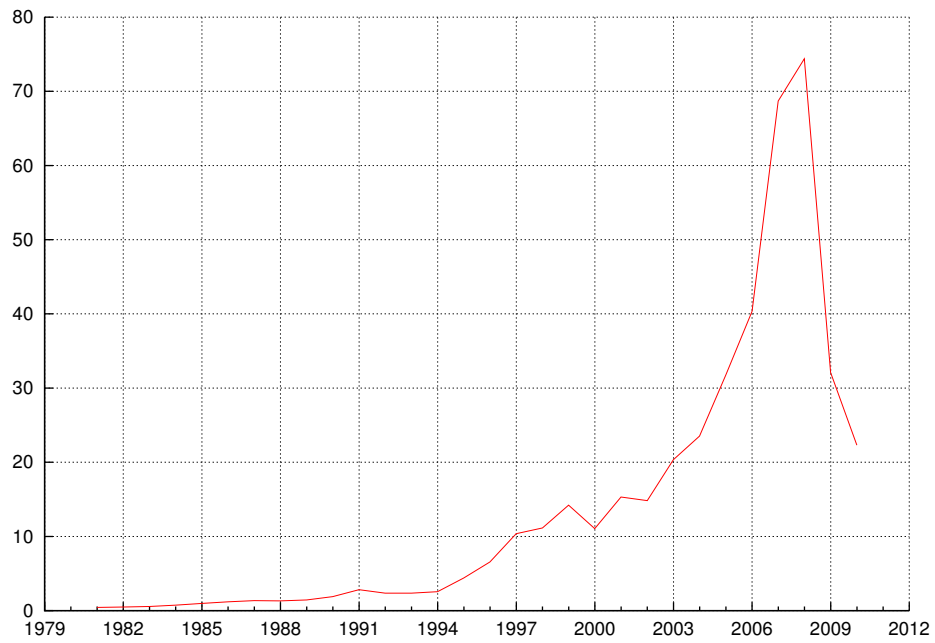
The plot shows the total dividend payments (in billions NOK) for all firms at the OSE. dividend. For each year we find all firms listed on the exchange during the year, and add the aggregate dividend payment for each firm. Data for stocks listed at the Oslo Stock Exchange during the period 1980-2011.

Chapter 5

Filtering of data

The basic data for the empirical investigations in this paper are daily observations of all equities traded at the Oslo Stock exchange. The data contains end of day bid and offer prices, as well as the last trade price of the day, if there was any trading. The data also include the total trading volume at a given date.

Not all stocks traded at the Oslo Stock Exchange should necessarily be used in calculating representative returns for the exchange, for example for empirical asset pricing investigations. In particular stocks which are seldom traded are problematic. In the following, in most calculations we therefore require the stocks to have a minimum number (20) of trading days before they enter the sample. Low valued stocks ("penny stocks") are also problematic since they will have very exaggerated returns. We therefore limit a stocks to have a price above NOK 10 before considering it in the sample. A similar requirement considers total value outstanding, which has a lower limit of NOK 1 million.[1] Table 5.1 provides some descriptive statistics for this filtering of the sample.

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[1]It should be noted that filtering such as this is very common for asset pricing investigations of this sort. See for example Fama and French (1992).

Table 5.1 Describing securities sample

year	number of securites listed	average number of trading days	Number of securities with		
			– more than 20 trading days – and price above 10 – and company value above 1 mill		
1980	96	48	33	33	33
1981	99	60	48	47	47
1982	116	60	60	58	58
1983	128	106	93	90	90
1984	148	127	122	121	121
1985	169	145	152	149	149
1986	183	135	157	146	146
1987	181	133	149	133	133
1988	163	118	128	113	113
1989	177	131	151	138	138
1990	190	127	163	149	149
1991	172	132	151	123	123
1992	172	111	131	101	101
1993	185	139	147	114	114
1994	195	139	164	143	143
1995	194	149	166	148	148
1996	206	161	189	170	169
1997	250	158	229	200	199
1998	269	146	248	190	190
1999	263	152	241	185	185
2000	259	157	239	183	183
2001	247	150	224	143	143
2002	226	147	210	119	119
2003	218	150	196	109	109
2004	207	180	200	132	132
2005	240	181	228	166	166
2006	260	181	251	195	195
2007	294	179	282	225	225
2008	292	179	281	150	150
2009	274	174	261	120	120
2010	264	189	257	144	144
2011	268	187	254	134	134
average	206	142	181	137	137

The table provides some descriptive statistics for the sample of equities traded on the Oslo Stock Exchange in the period 1980 to 2011. The first column lists the year. The second column lists the number of stocks listed during the year. The third column the average number of trading days for all listed stocks. The fourth column lists the number of stocks which traded for more than 20 days. The fifth column adds the requirement that the stock did not have a price below NOK 10. The final column additionally requires an equity market value above 1 mill NOK.

Chapter 6

Market portfolios

The first issue we consider is the evolution of the whole market at the Oslo Stock Exchange.

6.1 Constructing market portfolios

A typical question is what what one would earn if one invested in stocks at the Oslo Stock Exchange. However, there are (at least two) different ways to answer that question. If one picks a random stock, one wants to find the expected return for the typical stock, in which case an equally weighted average is the relevant measure. Alternatively, one can invest in the *whole market*, in which case a value weighted average is most relevant. Two indices are constructed to make this measurement. Stocks not satisfying the filter criterion discussed in chapter 5 are removed. Using the remaining stocks equally weighted and value weighted indices are constructed. The indices are constructed to include dividends and other distributions from the stocks.[1]

In addition to these indices two market indices constructed by the Oslo Stock Exchange are used. The OBX is a value weighted index consisting of the thirty most liquid stocks at the stock exchange. This index was constructed to be the basis for derivatives contracts, and initiated at the beginning of 1987. In addition we consider a value weighted index of all stock on the exchange, termed TOT. The Oslo Stock Exchange has changed indices during the period, in the period up to 1999 the total index was called the TOTX. In 1999 this index was replaced by the "All Share Index." TOT is constructed by splicing these two indices. Note that neither of these indices include dividends.

Table 6.1 shows monthly average returns for the various indices for the whole period 1980 till 2011 and for various subperiods.

An alternative view of the difference between equally weighted and value weighted indices is shown in figure 6.1, which illustrates the growth of the two indices in the period from 1980, in nominal terms

Let us also look at this looks in real terms, after correcting for inflation. In figure 6.2 we compare nominal and real numbers.

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[1]The indices do however not account for repurchases.

Table 6.1 Describing market indices at the Oslo Stock Exchange from 1980

Monthly returns

Period	index	Returns					Dividend Yield		Capital Gains	
		mean	(std)	min	med	max	mean	med	mean	med
1980–2011	EW	1.70	(5.75)	-18.33	2.09	19.06	0.20	0.05	1.51	1.82
	VW	1.99	(6.55)	-23.79	2.61	21.33	0.20	0.02	1.81	2.43
	OBX	0.91	(7.06)	-29.13	1.59	18.49				
	TOT	1.24	(6.53)	-27.42	2.00	17.45				
1980–1985	EW	3.03	(6.23)	-13.87	2.19	19.06	0.13	0.00	2.98	2.00
	VW	2.32	(7.01)	-18.62	2.88	19.72	0.21	0.00	2.21	2.51
	TOT	3.37	(6.24)	-13.52	3.26	15.91				
1985–1989	EW	1.60	(5.75)	-17.93	2.13	16.96	0.06	0.00	1.53	1.84
	VW	2.58	(6.85)	-23.79	3.34	19.34	0.13	0.00	2.44	3.30
	OBX	2.41	(8.57)	-29.13	3.82	18.49				
	TOT	1.61	(6.98)	-27.42	2.62	17.45				
1990–1994	EW	1.13	(6.79)	-16.51	0.47	15.04	0.14	0.00	0.99	0.37
	VW	1.38	(6.66)	-14.54	2.61	13.47	0.13	0.00	1.25	2.37
	OBX	0.24	(7.16)	-16.78	1.50	13.16				
	TOT	0.60	(6.79)	-16.77	2.00	12.69				
1995–1999	EW	2.15	(4.88)	-18.33	2.39	12.29	0.25	0.05	1.90	2.21
	VW	2.68	(5.98)	-20.55	2.56	21.33	0.19	0.02	2.49	2.23
	OBX	1.13	(5.78)	-23.61	1.49	16.65				
	TOT	1.42	(5.55)	-22.57	1.62	12.49				
2000–2004	EW	1.44	(5.36)	-14.37	2.12	11.58	0.32	0.11	1.13	1.67
	VW	1.74	(5.72)	-12.84	1.65	14.08	0.26	0.06	1.48	1.42
	OBX	0.45	(6.50)	-17.29	1.01	13.17				
	TOT	0.69	(5.79)	-14.64	1.39	11.29				
2005–2009	EW	1.23	(5.43)	-15.83	2.51	11.64	0.24	0.11	1.00	2.35
	VW	1.85	(7.09)	-21.50	3.82	14.39	0.22	0.06	1.63	3.36
	OBX	1.16	(7.88)	-25.35	2.97	17.23				
	TOT	1.18	(7.48)	-23.93	3.33	15.05				
2010–2011	EW	0.54	(3.99)	-6.96	1.03	7.83	0.27	0.12	0.24	0.52
	VW	0.96	(5.35)	-8.56	-0.33	10.95	0.30	0.15	0.65	-0.54
	OBX	0.39	(5.87)	-10.04	-0.80	10.84				
	TOT	0.36	(5.31)	-8.84	-0.78	10.83				

The table describes two indices constructed from Norwegian equity market data, one equally weighted and one value weighted, using data starting in 1980. The numbers are percentage monthly returns. mean: (equally weighted) average. med: median. *EW:* equally weighted index. *VW:* value weighted index. *TOT:* Total index provided by OSE: 1993-1999: TOTX, Afterwards: All Share Index. *OBX:* Index provided by OSE. Contains the 30 most liquid stocks at the OSE. Note that OBX starts in January 1987. Returns are percentage monthly returns. The returns are not annualized. Data for stocks listed at the Oslo Stock Exchange during the period 1980-2011. Calculations use the stocks satisfying the "filter" criteria discussed in chapter 5.

Figure 6.1 The evolution of market indicies
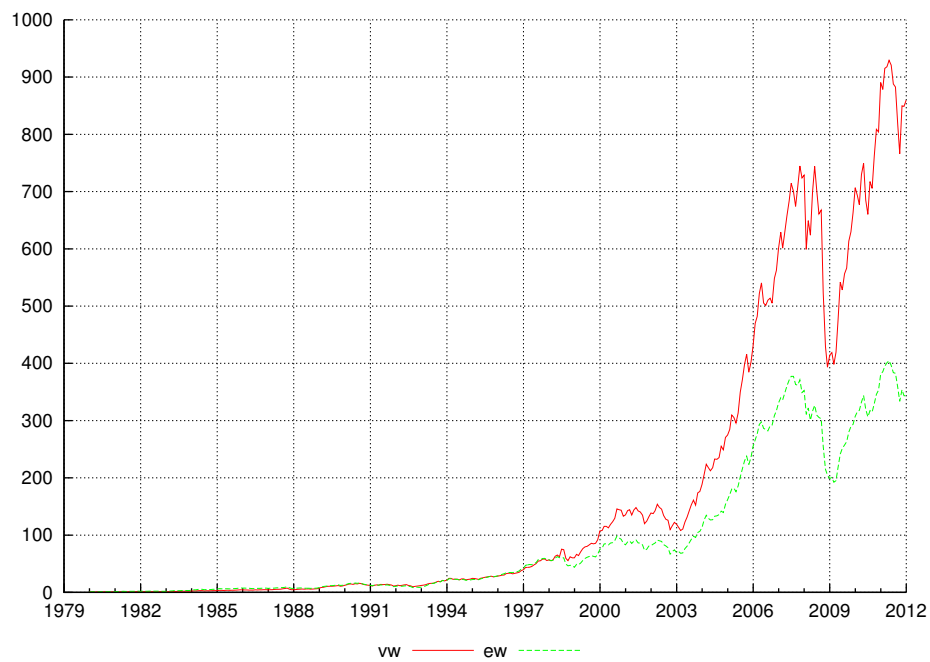
The figures illustrates the growth of two OSE stock indices, one equally weighted and one value weighted, using data starting in 1980. Growth is shown by finding how much one NOK invested in January 1980 would have grown to. Data for stocks listed at the Oslo Stock Exchange during the period 1980-2011. Calculations use the stocks satisfying the "filter" criteria discussed in chapter 5.

Figure 6.2 The evolution of market indicies correcting for inflation
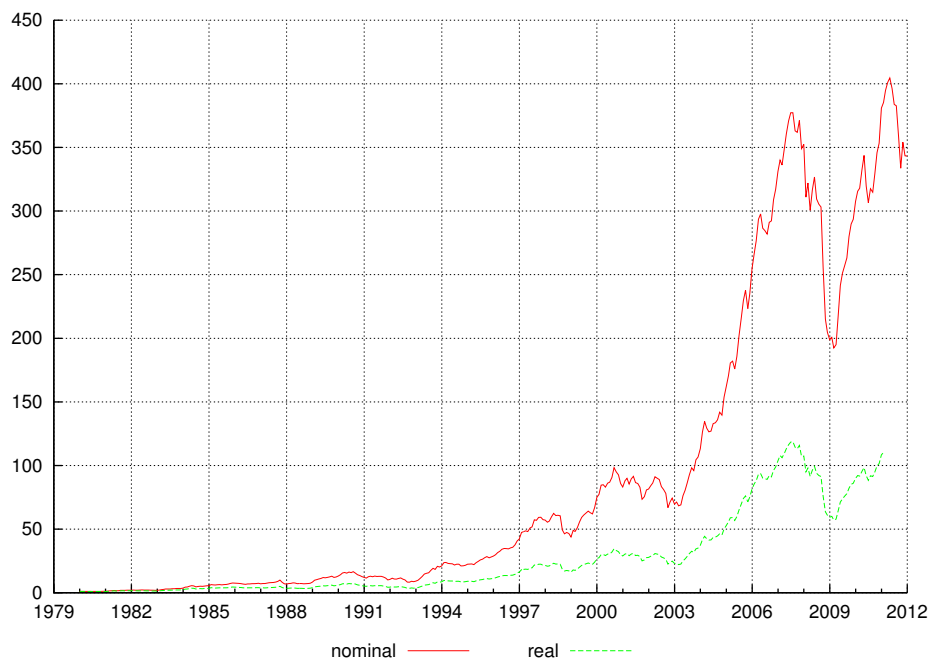
The figures illustrates the growth of the equally weighted OSE stock indicex, using data starting in 1980. Growth is shown by finding how much one NOK invested in January 1980 would have grown to in respectively nominal and real terms (i.e. in 1980 values). Data for stocks listed at the Oslo Stock Exchange during the period 1980-2011. Calculations use the stocks satisfying the "filter" criteria discussed in chapter 5.

To see how "different" the indices are table 6.2 show the correlations of their returns.

Table 6.2 Correlations between alternative market indices

Panel A: Monthly returns

	ew	vw	tot
vw	0.87		
tot	0.92	0.97	
obx	0.89	0.96	0.98

Panel B: Weekly returns

	ew	vw	tot
vw	0.81		
tot	0.77	0.98	
obx	0.86	0.98	0.98

Panel C: Daily returns

	ew	vw	tot
vw	0.84		
tot	0.85	0.99	
obx	0.83	0.98	0.98

The tables shows correlations between index returns for various market indices at the Oslo Stock Exchange. *EW:* equally weighted index. *VW:* value weighted index. *TOT:* Total index provided by OSE: 1993-1999: TOTX, Afterwards: All Share Index. *OBX:* Index provided by OSE. Contains the 30 most liquid stocks at the OSE. Note that OBX starts in January 1987.

6.2 The equity premium

The equity premium is the return of a stock or a stock portfolio in excess of a risk free return

$$er_i = r_i - r_f$$

where r_i is the return on a stock or a stock index, and r_f a risk free rate. Whether the average return on equity is "too high" to be justified is a a long standing issue in finance.[2] In this section some estimates of the equity premium are calculated .

Let us start by using monthly observations of stock index returns. Let r_{mt} be the market return observed at date t. This is an ex post return calculated as $r_{mt} = \frac{x_t - x_{t-1}}{x_{t-1}}$, where x_t is the index level at time t. If this is a monthly return, the relevant risk free interest rate is the one month interest rate observed at date $t-1$, because this is the interest rate that can be guaranteed for the period $t-1$ to t. The excess return is thus calculated as

$$er_t = r_{mt} - r_{f,t-1}$$

where $r_{f,t-1}$ is the one month interest rate observed at date $t-1$. Table 6.3 shows estimates of this monthly excess market return.

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[2]See the literature starting with Mehra and Prescott (1985). A survey is provided in Kocherlakota (1996).

Table 6.3 Excess returns of market indices at the Oslo Stock Exchange from 1982

Monthly excess returns

Period	index	Excess Returns					Excess Dividend Yield		Excess Capital Gains	
		mean	(std)	min	med	max	mean	med	mean	med
1980–2011	EW	1.05	(5.77)	-19.04	1.31	17.99	-0.45	-0.48	0.87	1.11
	VW	1.35	(6.57)	-24.90	1.93	20.94	-0.45	-0.47	1.17	1.74
	OBX	0.38	(7.08)	-30.24	1.01	17.43				
	TOT	0.62	(6.55)	-28.53	1.42	16.39				
1980–1985	EW	2.02	(6.23)	-14.94	1.19	17.99	-0.88	-1.01	1.97	0.91
	VW	1.31	(6.99)	-19.45	1.89	18.61	-0.80	-1.03	1.20	1.42
	TOT	2.29	(6.23)	-14.56	2.17	14.81				
1985–1989	EW	0.51	(5.76)	-19.04	0.95	15.94	-1.02	-1.06	0.45	0.73
	VW	1.50	(6.86)	-24.90	2.19	18.32	-0.95	-1.07	1.36	2.23
	OBX	1.35	(8.57)	-30.24	2.78	17.43				
	TOT	0.54	(6.98)	-28.53	1.60	16.39				
1990–1994	EW	0.36	(6.81)	-17.37	0.01	14.27	-0.64	-0.68	0.21	-0.08
	VW	0.60	(6.67)	-15.41	1.85	12.91	-0.65	-0.83	0.47	1.75
	OBX	-0.54	(7.17)	-17.65	0.62	12.58				
	TOT	-0.18	(6.80)	-17.64	1.32	12.11				
1995–1999	EW	1.70	(4.88)	-18.78	1.89	11.96	-0.19	-0.32	1.45	1.76
	VW	2.23	(5.98)	-21.00	2.11	20.94	-0.25	-0.39	2.04	1.79
	OBX	0.68	(5.79)	-24.06	1.09	15.97				
	TOT	0.98	(5.55)	-23.02	1.24	11.81				
2000–2004	EW	0.98	(5.41)	-14.96	1.58	11.37	-0.13	-0.13	0.68	1.21
	VW	1.29	(5.77)	-13.43	1.31	13.85	-0.19	-0.36	1.03	1.09
	OBX	-0.00	(6.55)	-17.89	0.66	12.93				
	TOT	0.24	(5.85)	-15.23	0.93	11.05				
2005–2009	EW	0.92	(5.51)	-16.47	2.21	11.40	-0.06	-0.13	0.69	2.11
	VW	1.55	(7.15)	-22.02	3.56	14.18	-0.09	-0.18	1.33	3.12
	OBX	0.85	(7.94)	-25.87	2.65	17.02				
	TOT	0.88	(7.54)	-24.45	3.02	14.84				
2010–2011	EW	0.34	(4.00)	-7.14	0.83	7.63	0.08	-0.08	0.04	0.34
	VW	0.76	(5.35)	-8.74	-0.53	10.75	0.10	-0.05	0.46	-0.74
	OBX	0.19	(5.87)	-10.22	-1.01	10.64				
	TOT	0.16	(5.31)	-9.02	-0.99	10.64				
1980–1989	EW	1.31	(6.15)	-19.04	1.09	17.99	-0.94	-1.03	1.25	0.80
	VW	1.32	(7.02)	-24.90	1.94	18.61	-0.87	-1.04	1.21	1.93
	OBX	1.35	(8.57)	-30.24	2.78	17.43				
	TOT	1.17	(6.95)	-28.53	1.80	16.39				
1990–1999	EW	1.03	(5.96)	-18.78	1.48	14.27	-0.42	-0.45	0.83	1.38
	VW	1.42	(6.39)	-21.00	1.93	20.94	-0.45	-0.46	1.26	1.79
	OBX	0.07	(6.55)	-24.06	0.98	15.97				
	TOT	0.40	(6.23)	-23.02	1.24	12.11				
2000–2009	EW	0.95	(5.46)	-16.47	1.79	11.40	-0.10	-0.13	0.68	1.45
	VW	1.42	(6.50)	-22.02	2.37	14.18	-0.14	-0.21	1.18	2.28
	OBX	0.42	(7.29)	-25.87	1.15	17.02				
	TOT	0.56	(6.76)	-24.45	1.58	14.84				
2010–2011	EW	0.34	(4.00)	-7.14	0.83	7.63	0.08	-0.08	0.04	0.34
	VW	0.76	(5.35)	-8.74	-0.53	10.75	0.10	-0.05	0.46	-0.74
	OBX	0.19	(5.87)	-10.22	-1.01	10.64				
	TOT	0.16	(5.31)	-9.02	-0.99	10.64				

The table describes market indices for the Oslo Stock Exchange using data starting in 1982. (The risk free rate is only available from 1982.) The numbers are percentage monthly excess returns, returns in excess of the risk free rate. *EW:* equally weighted index. *VW:* value weighted index. *OBX:* Index provided by OSE. Contains the 30 most liquid stocks at the OSE. Note that OBX starts in January 1987. *TOT:* Total index provided by OSE: 1993-1999: TOTX, Afterwards: All Share Index. Returns are percentage monthly returns. The returns are not annualized. Data for stocks listed at the Oslo Stock Exchange during the period 1980-2011. Calculations use the stocks satisfying the "filter" criteria discussed in chapter 5.

However, it it not clear that one want to use this high frequency data to estimate the longer term equity premium. One problem is that the monthly risk free rate is rather volatile.[3]

An alternative is to use annual index returns and annual interest rates. Table 6.4 gives estimates of annual excess returns using a one year interest rate.

Table 6.4 Annual excess returns

Annual excess returns

Index	Period	Average Annual Excess Return
EW	(1980–2011)	18.14
VW	(1980–2011)	22.17
OBX	(1987–2011)	5.84
TOT	(1983–2011)	10.08

EW: equally weighted index. *VW:* value weighted index. *OBX:* Index provided by OSE. Contains the 30 most liquid stocks at the OSE. Note that OBX starts in January 1987. *TOT:* Total index provided by OSE: 1993-1999: TOTX, Afterwards: All Share Index. Note that the risk free rate series starts in 1982.

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[3]See chapter 15 for some data on interest rates.

6.3   Sharpe Ratios for market indices

The Sharpe ratio is a relative measure of how much return one gets per unit of risk, where risk is measured by the standard deviation. The Sharpe ratio is defined as

$$SR_i = \frac{E[r_i] - r_f}{\sigma(r_i - r_f)}$$

The Sharpe Ratios in table 6.5 are estimated by replacing $E[r_i - r_f]$ and $\sigma(r_i - r_f)$ by their sample averages.

Table 6.5 Sharpe ratios market indices at the Oslo Stock Exchange from 1980

Monthly returns

	EW	VW
1980–2011	0.18	0.20
1980–1989	0.21	0.19
1990–1999	0.17	0.22
2000–2011	0.16	0.21
1980–1984	0.33	0.16
1985–1989	0.09	0.22
1990–1994	0.05	0.09
1995–1999	0.35	0.37
2000–2004	0.18	0.22
2005–2009	0.17	0.22
2010–2011	0.09	0.14

The table shows ex post Sharpe ratios for market indices constructed from Norwegian equity market data. Note that the Sharpe ratios are not annualized. *EW:* equally weighted index. *VW:* value weighted index. *OBX:* Index provided by OSE. Contains the 30 most liquid stocks at the OSE. Note that OBX starts in January 1987. *TOT:* Total index provided by OSE: 1993-1999: TOTX, Afterwards: All Share Index. Returns are percentage monthly returns. The returns are not annualized. Data for stocks listed at the Oslo Stock Exchange during the period 1980-2011. Calculations use the stocks satisfying the "filter" criteria discussed in chapter 5.

6.4 Distribution of market returns

The statistical descriptions of the previous chapters does not give a complete picture of the distributional properties of the market returns. One way to show more detail is to plot the actual distributions. Figures 6.3, 6.4 and 6.5 shows histograms of respectively monthly, weekly and daily returns for the EW index.

Figure 6.3 Histogram of monthly stock returns
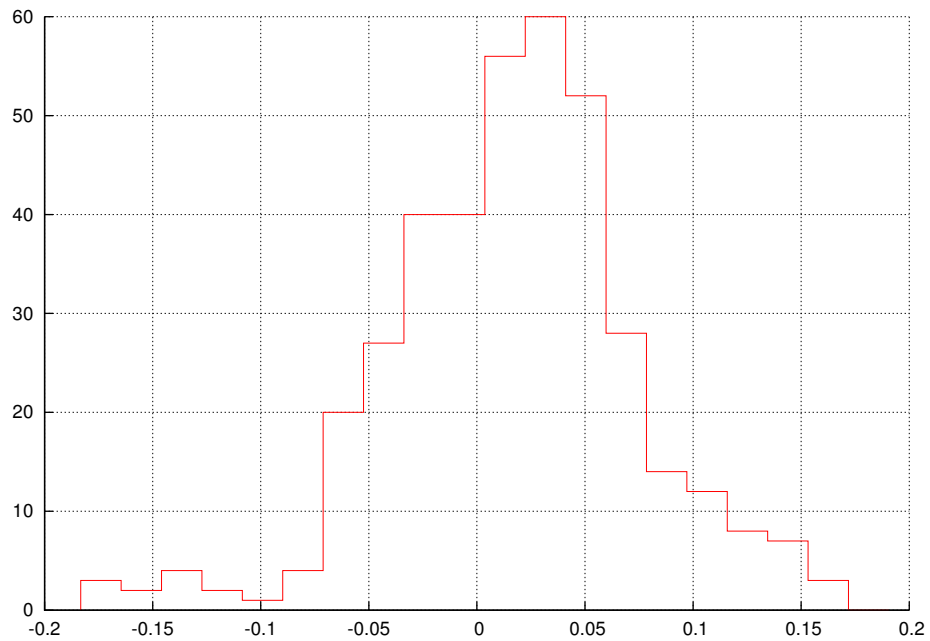
The figure shows the distribution of monthly stock return for the EW index. *EW:* equally weighted index. Data for stocks listed at the Oslo Stock Exchange during the period 1980-2011. Calculations use the stocks satisfying the "filter" criteria discussed in chapter 5.

Figure 6.4 Histogram of weekly stock returns
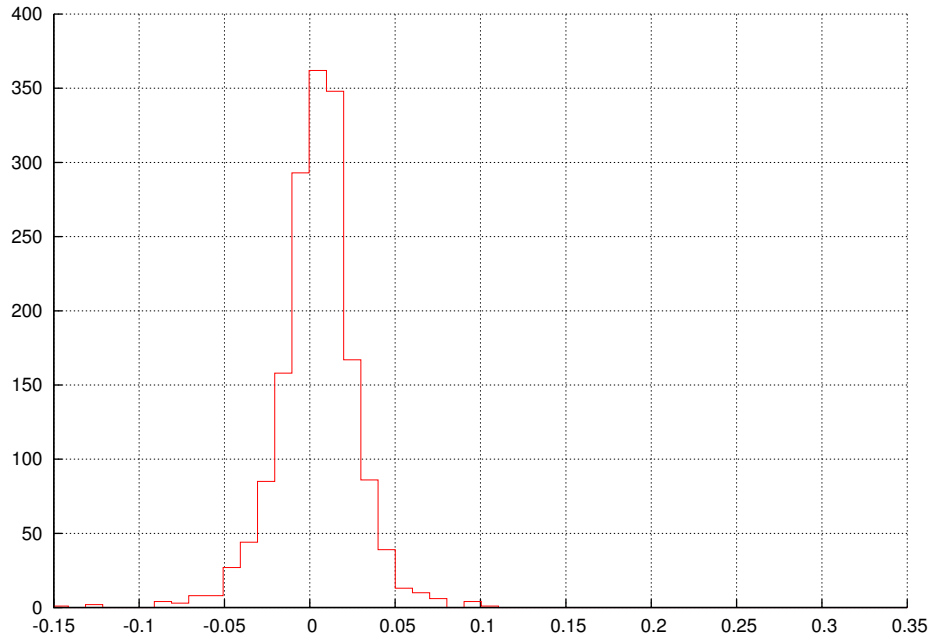
The figure shows the distribution of weekly stock return for the EW index. *EW: equally weighted index.* Data for stocks listed at the Oslo Stock Exchange during the period 1980-2011. Calculations use the stocks satisfying the "filter" criteria discussed in chapter 5.

Figure 6.5 Histogram of daily stock returns

The figure shows the distribution of daily stock return for the EW index. *EW: equally weighted index.* Data for stocks listed at the Oslo Stock Exchange during the period 1980-2011. Calculations use the stocks satisfying the "filter" criteria discussed in chapter 5.
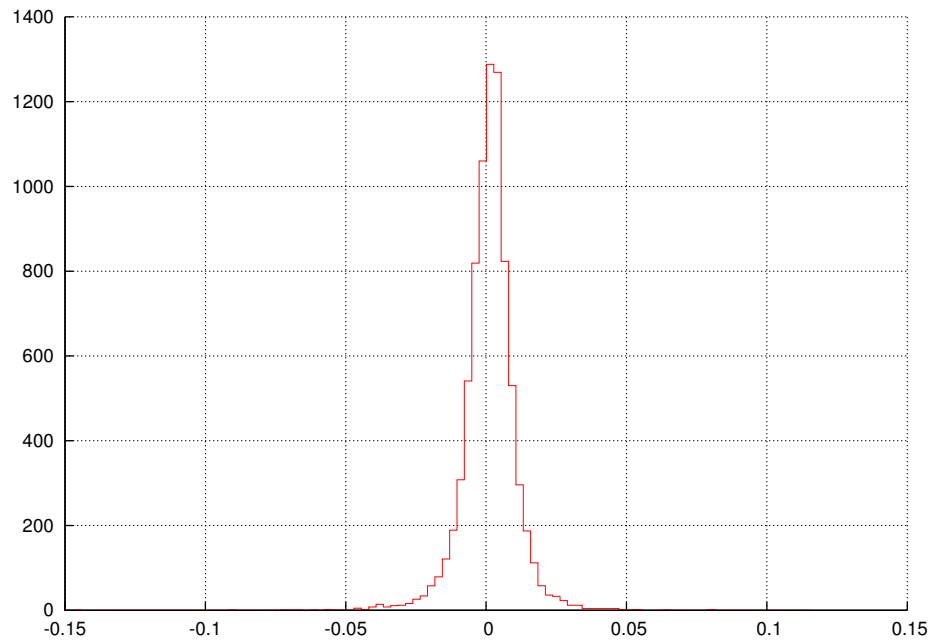
6.5 Some alternative portfolios

In addition to the broad market indices *EW* and *VW* a couple of alternative indices are constructed. If we want to make an investment in the market, but worry about transaction costs, one solution is to invest in a lower number of stocks. To look at how representative such portfolios are we construct indices using the 20 largest stocks at the OSE. Two such portfolios are calculated, `20EW` and `20VW`. For both indices we choose the 20 largest stocks at the beginning of the year. These stocks are then used to create portfolios for the next year, either equally weighted or value weighted. At each yearend the sample of stocks is changed to be the 20 largest stocks at that time.

Table 6.6 Some special indices at the Oslo Stock Exchange from 1980

Average returns

Period	index	Returns				
		mean	(std)	min	med	max
1980–2011	20EW	1.15	(7.52)	-29.82	1.70	43.04
	20VW	1.70	(7.03)	-28.26	2.21	35.99
1980–1985	20EW	1.99	(6.15)	-14.41	1.49	17.81
	20VW	1.77	(7.33)	-19.23	1.90	21.78
1985–1989	20EW	1.44	(7.52)	-29.49	2.42	17.03
	20VW	2.37	(7.67)	-28.26	2.93	17.92
1990–1994	20EW	0.43	(7.29)	-18.83	1.50	12.59
	20VW	1.18	(6.65)	-14.67	2.45	12.69
1995–1999	20EW	2.22	(7.79)	-24.98	1.65	43.04
	20VW	2.38	(7.07)	-23.11	1.88	35.99
2000–2004	20EW	0.43	(7.70)	-24.37	1.26	16.44
	20VW	1.55	(5.94)	-16.43	1.67	14.83
2005–2009	20EW	0.97	(8.22)	-29.82	2.81	14.31
	20VW	1.62	(7.58)	-22.90	3.89	14.75
2010–2011	20EW	-0.07	(7.45)	-13.46	-0.81	12.33
	20VW	0.76	(5.72)	-9.04	-0.48	11.32

Correlations with other indices

	20ew	20vw
20vw	0.93	
ew	0.84	0.78
vw	0.93	0.97
tot	0.90	0.91
obx	0.90	0.92

The table describes indices for the Oslo Stock Exchange using data starting in 1980. The numbers are percentage monthly returns.

Chapter 7

Industry sectors (GICS)

7.1   The GICS standard

The *Global Insustry Classification Standard* (GICS) is a grouping of companies into industry sectors. The GICS standard was introduced by Morgan Stanley Capital International (MSCI). It has since been adopted by many stock exchanges throughout the world. The Oslo Stock Exchange groups the companies on the exchange using the industry categories of the standard. The standard groups companies into one of the 10 groups listed in table 7.1.

Table 7.1 The GICS standard

	English	Norwegian
10	Energy and consumption	Energi
15	Material/labor	Materialer
20	Industrials	Industri
25	Consumer Discretionary	Forbruksvarer
30	Consumer Staples	Konsumentvarer
35	Health Care/liability	Helsevern
40	Financials	Finans
45	Information Technology	Informasjonsteknologi (IT)
50	Telecommunication Services	Telekommunikasjon og tjenester
55	Utilities	Forsyningsselskaper

7.2   Grouping firms on the Oslo Stock Exchange

The Oslo Stock Exchange has since 1997 been using the GICS standard to group the firms on the exchange. We use the OSE classification. For firms delisted before 1997 the OSE does not provide a classification. The classification for the missing firms have been backfilled manually for the period 1980–1997. To see how the firms on the OSE distibutes by category table 7.3 shows, for each year, the number of active firms in each of the 10 categories. The companies are clearly concentrated into a few sectors. For the early part of the period, the two sectors with most companies are 20, Industrials, and 40, Financials. This pattern changes in the last 15 years, with 10, Energy (which includes oil related companies), and 45, IT, showing a marked increase. For some sectors, there is a paucity of companies on the OSE. Both categories Health Care (35) and Utilites (55) are in fact empty till the mid nineties. The OSE is concentrated in only a few of the 10 GICS categories.

Table 7.2 The distribution across industries

Panel A: Number of Companies

Industry	Whole Period	1980-89	1990-99	2000-09	2010–
10 Energy	30.7	14.7	25.5	52.0	65.0
15 Material	10.8	11.4	10.5	10.5	12.0
20 Industry	48.8	39.9	57.8	48.8	45.5
25 ConsDisc	16.6	12.8	19.2	17.8	12.0
30 ConsStapl	8.6	9.1	4.4	12.4	18.0
35 Health	5.5	1.7	3.3	11.4	17.5
40 Finan	37.3	32.9	35.8	43.2	44.0
45 IT	23.5	8.3	18.9	43.2	30.0
50 Telecom	1.0	0.5	0.5	1.9	2.0
55 Util	0.7	0.0	0.4	1.7	1.0

Panel B: Fraction of value

Industry	Whole Period	1980-89	1990-99	2000-09	2010-
10 Energy	23.5	9.9	19.2	41.4	45.1
15 Material	6.4	10.4	6.0	2.8	1.3
20 Industry	29.8	39.8	35.4	14.0	14.4
25 ConsDisc	5.8	4.0	7.2	6.2	5.7
30 ConsStapl	7.4	6.8	8.8	6.6	6.5
35 Health	5.4	4.0	7.8	4.4	1.4
40 Finan	16.5	21.3	15.6	12.5	13.9
45 IT	5.5	6.6	3.8	6.2	3.2
50 Telecom	3.5	0.0	0.8	9.7	10.4
55 Util	0.5	0.0	0.4	1.1	0.5

In the table we first calculate numbers for each year, and then report averages across years. The top table counts the number of firms on the exchange. The second the fraction of the value of the exchange (at yearend) in each sector.

Table 7.3 The number of companies in the different GICS Industry Sectors

Panel A: Subperiod 1980–1989

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Energy and consumption	9	9	12	12	14	17	18	20	19	17
Material/labor	10	11	12	11	12	12	12	12	11	11
Industrials	28	28	30	35	42	48	51	47	45	45
Consumer Discretionary	6	7	12	13	15	18	18	15	13	11
Consumer Staples	9	9	9	9	10	11	11	9	7	7
Health Care/liability	1	1	1	2	2	2	2	2	2	2
Financials	27	28	29	30	35	36	38	38	32	36
Information Technology	2	2	3	6	7	13	13	13	12	12
Telecommunication Services	0	0	0	0	0	0	1	2	2	0
Utilities	0	0	0	0	0	0	0	0	0	0
All	92	95	108	118	137	157	164	158	143	141

Panel B: Subperiod 1990–1999

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Energy and consumption	21	22	21	20	20	21	25	38	35	32
Material/labor	9	9	9	9	10	11	12	13	12	11
Industrials	45	43	44	53	58	61	58	69	75	72
Consumer Discretionary	10	9	14	17	18	21	22	25	28	28
Consumer Staples	7	5	3	4	3	2	3	5	6	6
Health Care/liability	2	2	2	2	3	3	3	5	5	6
Financials	35	29	29	28	31	38	38	38	45	47
Information Technology	11	10	10	10	11	14	21	29	34	39
Telecommunication Services	0	0	0	0	0	0	1	1	1	2
Utilities	0	0	0	0	0	0	1	1	1	1
All	140	129	132	143	154	171	184	224	242	244

Panel C: Subperiod 2000–2009

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Energy and consumption	33	35	35	36	34	52	61	84	79	71
Material/labor	13	9	9	8	9	9	10	14	12	12
Industrials	60	58	49	42	41	43	45	50	51	49
Consumer Discretionary	25	22	20	21	18	16	18	13	13	12
Consumer Staples	6	8	9	8	9	13	14	18	20	19
Health Care/liability	7	7	7	8	10	11	13	16	18	17
Financials	48	45	44	42	38	43	40	46	43	43
Information Technology	49	44	43	40	41	46	47	43	43	36
Telecommunication Services	3	2	2	2	1	1	2	2	2	2
Utilities	1	1	1	2	2	2	2	2	2	2
All	245	231	219	209	203	236	252	288	283	263

Panel D: Subperiod 2010–2011

	2010	2011
Energy and consumption	68	62
Material/labor	12	12
Industrials	46	45
Consumer Discretionary	13	11
Consumer Staples	19	17
Health Care/liability	17	18
Financials	44	44
Information Technology	32	28
Telecommunication Services	2	2
Utilities	2	0
All	255	239

The tables list, for each year, the number of active firms on the exchange in each GICS sector. Data for stocks listed at the Oslo Stock Exchange during the period 1980-2011.

Table 7.4 The fraction of market values in the different GICS Industry Sectors

Panel A: Subperiod 1980–1989

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Energy and consumption	10.80	9.50	8.46	8.77	8.96	8.17	7.06	10.02	10.42	16.58
Material/labor	8.86	8.95	8.25	10.10	10.84	11.12	11.19	11.75	10.47	12.03
Industrials	57.85	50.62	38.83	36.54	31.98	32.54	34.32	32.76	42.52	40.33
Consumer Discretionary	1.01	1.53	3.19	2.38	3.54	5.39	7.59	6.27	5.30	3.39
Consumer Staples	2.30	4.75	5.50	5.02	6.89	6.47	9.33	11.42	7.79	8.50
Health Care/liability	1.13	1.23	2.34	3.43	3.09	4.45	3.65	5.91	9.34	5.67
Financials	18.29	23.89	27.13	21.40	21.83	20.98	23.82	24.97	14.48	16.56
Information Technology	0.81	3.73	5.96	12.23	12.18	10.53	10.20	5.27	2.74	1.85
Telecommunication Services	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.18	0.10	0.00
Utilities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Panel B: Subperiod 1990–1999

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Energy and consumption	21.72	22.63	19.10	17.80	15.76	16.37	23.56	24.57	15.45	15.38
Material/labor	8.14	6.49	6.04	8.02	8.13	6.66	4.57	2.95	3.69	5.17
Industrials	39.30	40.15	40.22	36.94	40.88	37.97	35.38	27.84	27.40	28.04
Consumer Discretionary	2.63	2.15	4.91	5.82	5.24	5.00	5.70	9.33	15.08	16.45
Consumer Staples	10.45	11.53	15.32	11.81	6.41	6.49	6.84	6.28	6.38	6.23
Health Care/liability	6.58	11.19	12.28	5.69	5.36	6.15	2.59	8.38	14.20	5.60
Financials	16.40	8.55	8.53	16.55	18.15	20.34	17.36	14.70	18.39	17.16
Information Technology	1.81	1.50	1.76	1.98	1.35	3.59	4.62	4.69	5.37	11.28
Telecommunication Services	0.00	0.00	0.00	0.00	0.00	0.00	0.70	1.33	2.04	3.74
Utilities	0.00	0.00	0.00	0.00	0.00	0.00	1.28	0.75	1.04	0.76

Panel C: Subperiod 2000–2009

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Energy and consumption	9.84	25.68	42.16	42.39	42.72	51.48	51.24	46.30	55.60	47.02
Material/labor	5.25	4.74	3.95	3.60	3.24	2.72	1.73	1.39	0.67	0.63
Industrials	27.17	26.45	9.53	6.89	10.36	11.31	10.55	11.77	13.59	12.66
Consumer Discretionary	10.04	5.79	6.50	8.35	9.11	6.20	4.50	3.76	3.67	4.23
Consumer Staples	7.92	6.76	7.07	5.02	5.64	5.80	6.01	7.39	7.23	7.33
Health Care/liability	7.49	7.96	8.05	8.60	7.62	0.38	0.38	0.76	1.33	1.07
Financials	17.20	14.56	14.97	12.87	13.96	11.27	10.39	10.04	7.55	12.19
Information Technology	10.62	7.19	3.70	4.32	4.42	3.89	6.23	9.32	7.16	5.48
Telecommunication Services	13.26	9.23	8.57	9.99	9.69	7.66	9.96	10.46	8.67	9.83
Utilities	0.60	0.54	0.91	1.03	0.93	1.11	1.34	1.67	1.95	1.27

Panel C: Subperiod 2000–2011

	2010	2011
Energy and consumption	43.93	46.37
Material/labor	1.43	1.14
Industrials	12.69	16.10
Consumer Discretionary	6.51	4.91
Consumer Staples	7.47	5.53
Health Care/liability	0.95	1.93
Financials	14.38	13.41
Information Technology	4.26	2.15
Telecommunication Services	9.54	11.17
Utilities	1.05	0.00

The tables list, for each year, the percentage fraction of the value of the OSE is in each GICS sector. Measurement done at yearend. Data for the period 1980–2011.

Table 7.5 Industry returns

Panel A: Equally weighted industry indices

	First year	Last year	Average return	Standard deviation	average n	T
10 Energy(ew)	1980	2011	2.24	9.55	20.6	384
15 Material(ew)	1980	2011	1.77	11.94	6.9	384
20 Industry(ew)	1980	2011	1.72	6.30	32.5	384
25 ConsDisc(ew)	1980	2011	1.62	7.34	11.2	384
30 ConsStapl(ew)	1980	2011	1.88	6.67	7.0	384
35 Health(ew)	1980	2011	2.00	11.91	4.4	384
40 Finan(ew)	1980	2011	1.18	5.22	29.0	384
45 IT(ew)	1980	2011	2.45	11.16	12.1	384
50 Telecom(ew)	1987	2011	1.27	10.63	1.4	200
55 Util(ew)	1996	2011	0.84	6.78	2.6	192

Panel B: Value weighted industry indices

	First year	Last year	Average return	Standard deviation	average n	T
10 Energy(vw)	1980	2011	1.91	8.23	20.6	384
15 Material(vw)	1980	2011	1.59	12.19	6.9	384
20 Industry(vw)	1980	2011	1.76	7.62	32.5	384
25 ConsDisc(vw)	1980	2011	2.30	10.62	11.2	384
30 ConsStapl(vw)	1980	2011	2.14	7.61	7.0	384
35 Health(vw)	1980	2011	2.89	23.27	4.4	384
40 Finan(vw)	1980	2011	1.49	7.01	29.0	384
45 IT(vw)	1980	2011	3.21	13.86	12.1	384
50 Telecom(vw)	1987	2011	1.34	11.35	1.4	200
55 Util(vw)	1996	2011	0.85	7.44	2.6	192

The table describes portfolio returns of 10 industry portfolios gruoped by GICS. We report the first and last years of each index, the average monthly return (in percent), the average number of equities in the portfolio (avg n), and the number of months of returns used in the calculation (T). The index described in Panel A is an equally weighted index using all stocks in a given industry.

7.3 Sector indices

The company distribution listed in table 7.3 is the basis for construction of sector indices for the OSE. Using the standard liquidity criteria discussed in chapter 5. Table 7.5 describes average monthly returns for the 10 indices. In table 7.6 the correlations between the same 10 indices are calculated.

7.4 References

The GICS standard is described in the Wikipedia (`en.wikipedia.org`), as well as at the homepages of Morgan Stanley (`www.msci.com`) and Standard and Poors (`www.standardandpoors.com`).

Table 7.6 Correlations across industry sectors

Panel A: Equally weighted industry indices

	10	15	20	25	30	35	40	45	50
15 Material(ew)	0.42								
20 Industry(ew)	0.75	0.52							
25 ConsDisc(ew)	0.50	0.53	0.62						
30 ConsStapl(ew)	0.58	0.46	0.62	0.52					
35 Health(ew)	0.27	0.21	0.34	0.32	0.26				
40 Finan(ew)	0.63	0.47	0.69	0.59	0.61	0.26			
45 IT(ew)	0.55	0.29	0.50	0.46	0.47	0.33	0.45		
50 Telecom(ew)	0.41	0.20	0.38	0.38	0.31	0.37	0.41	0.57	
55 Util(ew)	0.42	0.28	0.51	0.31	0.45	0.16	0.43	0.37	0.29

Panel B: Value weighted industry indices

	10	15	20	25	30	35	40	45	50
15 Material(vw)	0.45								
20 Industry(vw)	0.72	0.50							
25 ConsDisc(vw)	0.43	0.51	0.51						
30 ConsStapl(vw)	0.58	0.44	0.60	0.47					
35 Health(vw)	0.09	0.11	0.14	0.17	0.15				
40 Finan(vw)	0.58	0.54	0.62	0.60	0.65	0.13			
45 IT(vw)	0.40	0.29	0.43	0.38	0.46	0.09	0.41		
50 Telecom(vw)	0.38	0.20	0.47	0.36	0.38	0.16	0.42	0.54	
55 Util(vw)	0.36	0.29	0.44	0.32	0.46	0.07	0.46	0.38	0.35

The table shows correlations between monthly returns for 10 industry portfolios grouped by GICS.

Table 7.7 Annualized excess returns

Panel A: Equally weighted industry indices

|	Average excess return				
	1980–2011	1980–1989	1990–1999	2000–2009	2010-2011
Energy and consumption	19.2	27.0	10.1	23.43.9	
Material/labor	13.5	17.4	14.9	8.314.0	
Industrials	12.9	19.3	8.2	13.70.5	
Consumer Discretionary	11.6	13.7	15.6	7.90.5	
Consumer Staples	14.8	27.4	9.6	10.7-1.7	
Health Care/liability	16.2	18.6	22.5	10.04.2	
Financials	6.4	8.2	8.2	4.6-2.9	
Information Technology	21.6	30.6	27.0	9.410.6	
Telecommunication Services	10.2	-63.3	47.3	5.52.5	
Utilities	5.6		-4.3	11.4-3.6	
Average risk free rate	5.9	12.6	7.3	4.52.3	

Chapter 8

A few large stocks

The OSE has always had a few large companies which in terms of market capitalization have a dominant position on the exchange. For many years it was Norsk Hydro, but with the listing of the large, state dominated companies Telenor and Statoil this changed. To illustrate to what degree the exchange is likely to be affected by these large companies table 8.1 shows, for each year, the four largest companies, and each company's fraction of the value of the exchange.

Table 8.1 The four largest companies each year

| year | Largest | | | | | | | | |
|------|---------|------|---------|------|---------|------|---------|------|
| 1980 | Norsk Hydro | 52.6 | Saga Petroleum | 9.4 | Den norske Creditbank | 4.5 | Christiania Bank og Kreditkasse | 3.8 |
| 1981 | Norsk Hydro | 33.7 | Den norske Creditbank | 5.3 | Saga Petroleum | 4.8 | Actinor | 4.3 |
| 1982 | Norsk Hydro | 29.4 | Den norske Creditbank | 6.9 | Norsk Data | 5.7 | Storebrand | 4.4 |
| 1983 | Norsk Hydro | 23.1 | Norsk Data | 7.4 | Den norske Creditbank | 4.7 | Alcatel STK | 4.2 |
| 1984 | Norsk Hydro | 16.3 | Norsk Data | 8.0 | Den norske Creditbank | 3.6 | Alcatel STK | 3.4 |
| 1985 | Norsk Hydro | 16.1 | Norsk Data | 7.4 | Den norske Creditbank | 3.9 | Hafslund | 3.7 |
| 1986 | Norsk Hydro | 14.9 | Norsk Data | 7.1 | Den norske Creditbank | 3.6 | Christiania Bank og Kreditkasse | 3.2 |
| 1987 | Norsk Hydro | 14.9 | Hafslund | 5.3 | Bergesen d.y | 3.7 | Norsk Data | 3.2 |
| 1988 | Norsk Hydro | 23.7 | Hafslund | 9.1 | Bergesen d.y | 5.8 | NCL Holding | 3.6 |
| 1989 | Norsk Hydro | 20.3 | Bergesen d.y | 6.4 | Hafslund | 5.3 | Saga Petroleum | 5.2 |
| 1990 | Norsk Hydro | 23.1 | Saga Petroleum | 7.1 | Hafslund | 6.0 | Orkla | 4.1 |
| 1991 | Norsk Hydro | 20.2 | Hafslund | 10.6 | Saga Petroleum | 7.8 | Kværner | 5.7 |
| 1992 | Norsk Hydro | 26.2 | Hafslund | 11.0 | Saga Petroleum | 7.8 | Orkla | 6.8 |
| 1993 | Norsk Hydro | 23.2 | Kværner | 8.0 | Orkla | 7.3 | Hafslund | 5.9 |
| 1994 | Norsk Hydro | 24.7 | Kværner | 5.5 | Hafslund | 5.2 | Orkla | 4.9 |
| 1995 | Norsk Hydro | 21.4 | Hafslund | 5.8 | Orkla | 5.4 | Saga Petroleum | 4.0 |
| 1996 | Norsk Hydro | 19.3 | Orkla | 5.2 | Transocean Offshore | 5.2 | Den norske Bank | 3.8 |
| 1997 | Norsk Hydro | 13.4 | Transocean Offshore | 5.5 | Nycomed Amersham | 5.4 | Orkla | 5.0 |
| 1998 | Norsk Hydro | 13.1 | Royal Caribbean Cruises | 10.3 | Nycomed Amersham | 7.5 | Orkla | 4.9 |
| 1999 | Norsk Hydro | 13.7 | Royal Caribbean Cruises | 9.4 | Nycomed Amersham | 4.8 | Den norske Bank | 3.9 |
| 2000 | Norsk Hydro | 15.1 | Nycomed Amersham | 6.9 | Royal Caribbean Cruises | 6.0 | Orkla | 5.8 |
| 2001 | Statoil ASA | 18.1 | Norsk Hydro | 13.8 | Telenor ASA | 9.6 | Nycomed Amersham | 7.5 |
| 2002 | Statoil ASA | 22.4 | Norsk Hydro | 14.8 | Telenor ASA | 8.5 | Nycomed Amersham | 7.7 |
| 2003 | Statoil ASA | 21.0 | Norsk Hydro | 14.3 | Telenor ASA | 10.3 | Nycomed Amersham | 8.5 |
| 2004 | Statoil ASA | 19.8 | Norsk Hydro | 12.2 | Telenor ASA | 9.3 | Den norske Bank | 7.7 |
| 2005 | Statoil ASA | 23.2 | Norsk Hydro | 12.5 | Telenor ASA | 7.9 | Den norske Bank | 6.7 |
| 2006 | Statoil ASA | 18.2 | Norsk Hydro | 12.8 | Telenor ASA | 10.1 | Den norske Bank | 6.1 |
| 2007 | Statoil ASA | 17.5 | Telenor ASA | 10.5 | Renewable Energy Corporation ASA | 6.6 | Den norske Bank | 5.3 |
| 2008 | Statoil ASA | 27.4 | Telenor ASA | 8.6 | Orkla | 5.2 | Yara International ASA | 4.9 |
| 2009 | Statoil ASA | 24.8 | Telenor ASA | 10.7 | Den norske Bank | 8.1 | Yara International ASA | 6.1 |
| 2010 | Statoil ASA | 19.5 | Telenor ASA | 10.3 | Den norske Bank | 8.8 | Yara International ASA | 6.4 |
| 2011 | Statoil ASA | 24.6 | Telenor ASA | 11.8 | Den norske Bank | 7.1 | Seadrill Limited | 7.0 |

The table lists the four largest companies on the exchange in terms of the market capitalization. For each company we list the name and the fraction of the market capitalization this company had at yearend.

Figure 8.1 The three largest companies at the OSE

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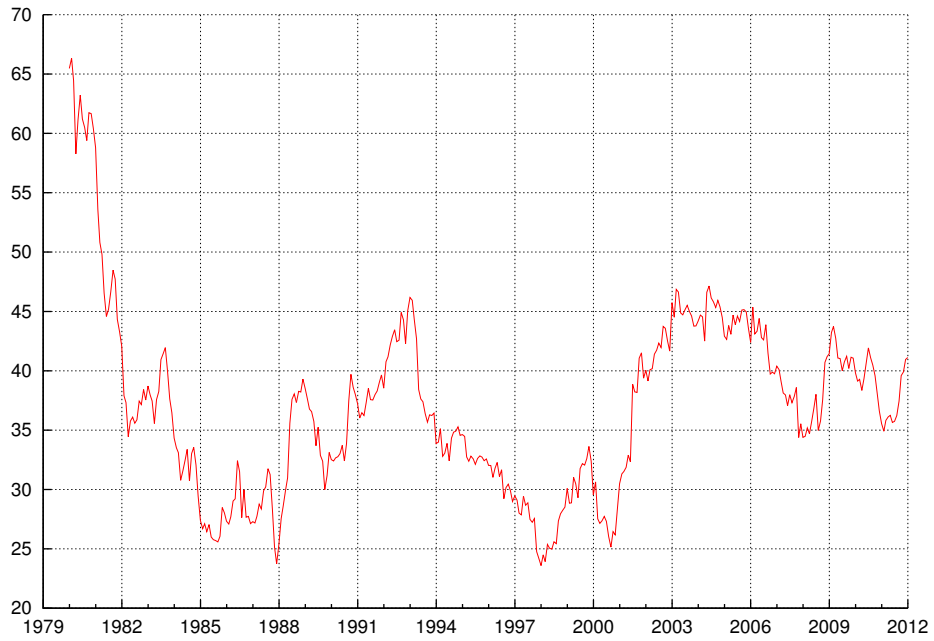
The figure plots the time series evolution of what fraction of the exchange the three largest compenies at the OSE have.

**Figure 8.2** The largest companies at the OSE
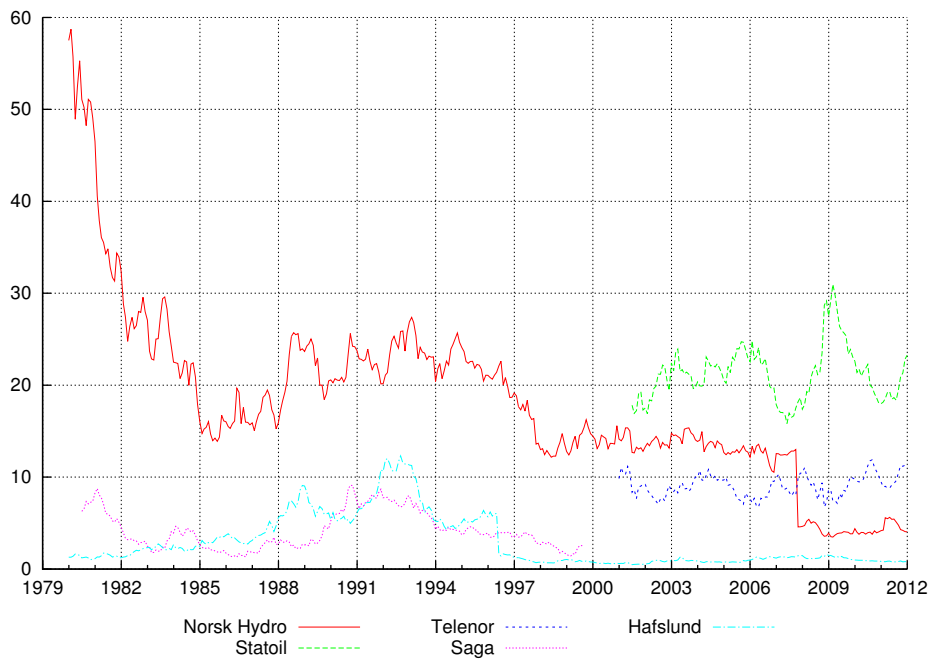
The figure plots the time series evolution of what fraction of the exchange the largest compenies at the OSE have.

Chapter 9

How many stocks are necessary for a well diversified portfolio?

In a first course in finance the concept of risk is usually introduced using a picture like figure 9.1, which illustrates the relationship between the number of stocks in an equally weighted portfolio and the standard deviation of the portfolio. This picture is then used to introduce the difference between systematic and unsystematic risk, where the unsystematic risk is the risk that can be diversified away by increasing the number of stocks in the portfolio. We will not go this route, we will instead look directly at the relationship between number of stocks and standard deviation. This difference can namely be used to say something about when we have achieved "most" of the relevant diversification.

Figure 9.1 Relationship between number of stocks in an equally weighted portfolio and the portfolios standard deviation
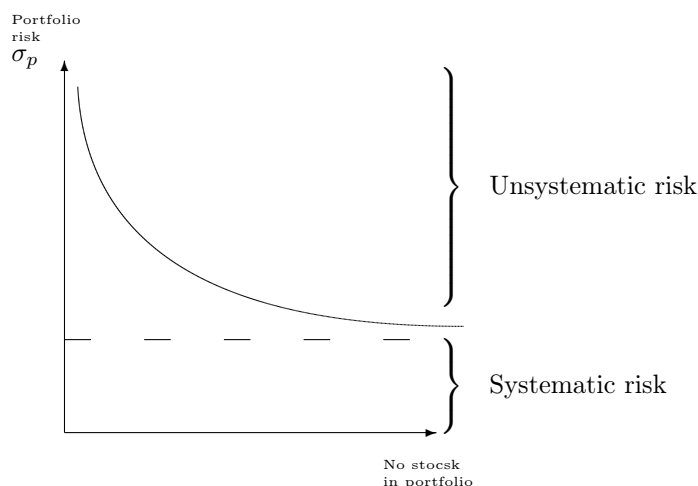
Empirical curves like this can be found in any number of classical empirical papers. By creating random portfolios by the well known "Throwing Darts at The Wall Street Journal" method, and increasing the number of stocks in the portfolio, one find empirical versions of the curve in figure 9.1. The curve always has the same shape, the portfolio standard deviation decreases with the number of stocks, but flattens out after a while. The number of stocks at which the curve flattens out is used as a measure of how many stocks are "enough" to achieve most of the diversification. In US papers there is some variation in this number, for example Evans and Archer (1968) argues for 10 stocks being enough, Wagner and Lau (1971) concludes that most of the diversification is achieved at 15 stocks, while Statman (1987) argues for 30 stocks.

We here perform similar calculations as the US papers using data for the Oslo Stock Exchange.

9.1 Methods

All stock at the OSE in the period 1980-2011 with a minimum of liquidity is included.[1] A portfolio is simulated by randomly drawing n shares at the first date. Going forward, each month the return of an equally weighted portfolio of the chosen stocks is calculated. If a stock is delisted, the last observed price is used as the price for realizing the stock, and the stock is replaced by randomly drawing another stock. Stock returns of the simulated trading strategies are calculated for the period 1980 to 2011, and the standard deviation of the portfolio is calculated. This random portfolio construction is repeated 100 times. Finally we calculate the average of these estimated standard deviations.

9.2 Results

Figure 9.2 shows results for the whole period. The shape of the curve is similar to what is found in other stock markets. The gains to diversification are obvious, and particularly strong up to five stocks. There is a marked fall down to 10-15 stocks, but after that the curve levels out, even though it is still decreases down to the maximal portfolio of 40 stocks.

Figure 9.2 Relation between number of stocks and standard deviation for portfolios at OSE
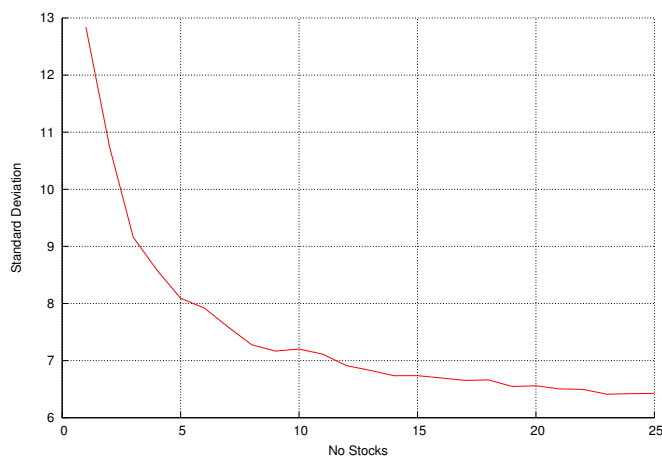
Average standard deviation of monthly portfolio returns for 100 simulated stock portfolio at OSE. Each portfolio is an equally weighted portfolio of n stocks, where n varies along the horizontal axis. Numbers in percent.

In figure 9.3 we split the simulations into two subperiods, 1980–1994and 1995–2011.

## 9.3 How close do we get to a stock market index?

Table 9.1 show detailed results for the various simulations. In addition it shows comparable numbers for two stock market indices, one equally weighted (EW) and one value weighted (VW).

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[1]The filter criteria discussed in chapter 5 are applied, stocks traded less than 20 days a year, and stocks with prices below 10 are removed.

Figure 9.3 Relation between number of stocks and standard deviation for portfolios at OSE for subperiods

Subperiod 1980-1995
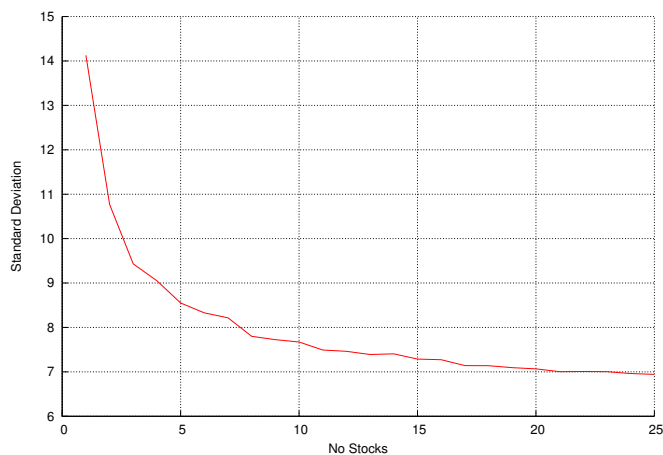
Subperiod 1996-2011
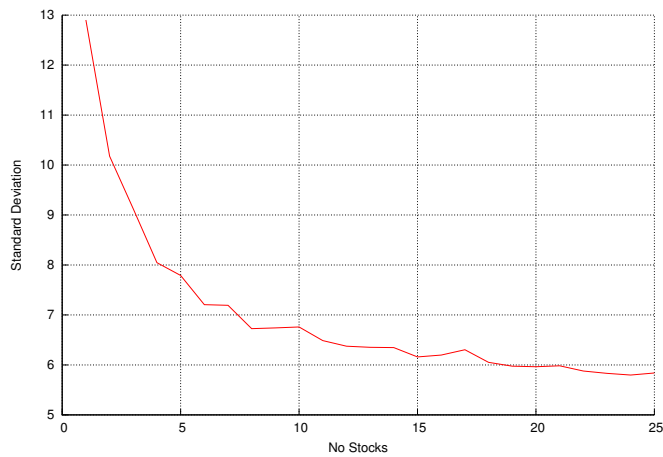
Average standard deviation of monthly portfolio returns for 100 simulated stock portfolio at OSE. Each portfolio is an equally weighted portfolio of n stocks, where n varies along the horizontal axis. Numbers in percent. Two subperiods: 1980–1995, 1996–2011.

Table 9.1 Relation between number of stocks and standard deviation for portfolios at OSE

No stocks in portfolio	Standard Deviation (%)		
	1980–2011	1980–1995	1996–2011
1	12.84	14.13	12.90
2	10.74	10.77	10.18
3	9.16	9.43	9.13
4	8.59	9.05	8.05
5	8.09	8.55	7.79
6	7.92	8.33	7.21
7	7.59	8.22	7.19
8	7.28	7.80	6.73
9	7.17	7.72	6.74
10	7.20	7.67	6.76
11	7.11	7.49	6.49
12	6.91	7.46	6.37
13	6.83	7.39	6.35
14	6.74	7.41	6.35
15	6.74	7.29	6.16
16	6.70	7.27	6.20
17	6.65	7.14	6.30
18	6.66	7.14	6.05
19	6.55	7.10	5.97
20	6.56	7.07	5.96
21	6.51	7.00	5.98
22	6.50	7.01	5.88
23	6.41	7.00	5.83
24	6.42	6.96	5.80
25	6.43	6.94	5.84
EW	5.75	6.22	5.23
VW	6.55	6.76	6.34

Average standard deviation of monthly portfolio returns for 100 simulated stock portfolio at OSE. Each portfolio is an equally weighted portfolio of n stocks, where n varies along the horizontal axis. Numbers in percent. Three subperiods: 1980–1995, 1996–2011 and 1980–2011. At the bottom of the table results for two indices. *EW:* equally weighted index. *VW:* value weighted index.

9.4 Conclusion

We have seen how many stock are necessary to get a reasonably "well diversified" stock portfolio at the Oslo Stock Exchange. The numbers are surprisingly comparable to US results, with most of the relevant diversification achieved after 10 stocks. Even though Oslo Stock Exchange is very much smaller than the NYSE, and concentrated in only a few sectors, that the magic number 10 should appear to be valid here too *is* surprising. The Law of Large Numbers appears to work also at the Oslo Stock Exchange.

Chapter 10

Crossectional portfolios

In finance a number of so called "anomalies" has been introduced, which shows links between the crossection of asset prices and an observable characteristic of the stock in question, such as firm size and book to market portfolios. Each of them earned the name "anomaly" because it could not be explained by the standard benchmark asset pricing model, the CAPM, which relates asset returns to one "factor," namely the stock beta.

Let us look at some of these "anomalies" using data for Norway. We do it in a very simple manner, by sorting the stocks on the Oslo Stock Exchange into portfolios based on the characteristic in question, and then calculate average returns for each of the portfolios. Tables 10.1 to 10.4 show the resulting averages for the whole period.

Table 10.1 Size sorted portfolios

5 portfolios

Portfolio	mean	(std)	Returns min	med	max	Number of securities min	med	max
1 (smallest)	2.73	(6.4)	-16.7	1.85	31.0	7	26	37
2	1.54	(6.5)	-19.3	1.18	28.7	6	25	37
3	1.76	(6.4)	-19.9	1.66	33.8	7	25	38
4	1.34	(6.7)	-20.8	1.77	32.7	6	24	37
5	1.10	(7.3)	-28.8	1.74	23.8	6	25	37

10 portfolios

Portfolio	mean	(std)	Returns min	med	max	Number of securities min	med	max
1 (smallest)	3.05	(7.7)	-18.1	1.75	46.7	4	13	18
2	2.40	(7.1)	-18.4	2.02	31.9	3	13	19
3	1.55	(7.1)	-24.1	1.28	32.3	3	12	19
4	1.54	(7.1)	-23.7	1.31	25.7	3	12	18
5	1.92	(7.3)	-19.2	1.76	53.3	3	12	19
6	1.61	(6.8)	-29.6	1.92	27.8	4	13	19
7	1.37	(7.3)	-24.2	1.51	48.0	3	12	18
8	1.31	(7.0)	-24.0	1.46	19.8	3	12	19
9	1.14	(8.0)	-28.5	1.54	22.8	3	13	19
10	1.09	(8.0)	-33.9	1.50	58.5	3	12	18

The table shows average returns for portfolios sorted on the given characteristic. For each portfolio we use the value of the characteristic the previous yearend to group the stocks on the OSE into respectively five and ten portfolios. Data for stocks listed at the Oslo Stock Exchange during the period 1980-2011.

Table 10.2 Book/Market sorted portfolios

5 portfolios

Portfolio	mean	(std)	Returns min	med	max	Number of securities min	med	max
1 (smallest)	1.74	(8.1)	-24.2	1.70	44.3	8	22	36
2	1.28	(6.4)	-19.8	1.56	22.3	7	22	35
3	1.83	(6.7)	-22.3	1.74	34.3	7	22	37
4	1.98	(6.9)	-23.6	2.34	26.8	8	22	36
5	2.28	(7.0)	-19.8	1.80	32.0	7	21	36

10 portfolios

Portfolio	mean	(std)	Returns min	med	max	Number of securities min	med	max
1 (smallest)	1.80	(9.4)	-26.0	1.30	64.3	4	11	18
2	1.68	(8.3)	-24.0	1.56	44.7	3	11	18
3	1.53	(7.1)	-25.4	1.52	24.3	4	11	18
4	1.04	(7.0)	-21.0	1.26	26.7	3	11	18
5	1.87	(7.0)	-27.1	1.61	21.6	3	11	18
6	1.79	(7.8)	-26.0	1.58	66.2	4	11	19
7	1.97	(7.2)	-21.7	1.91	38.5	4	11	18
8	2.00	(7.9)	-37.5	2.15	33.3	3	11	18
9	2.20	(7.3)	-21.3	2.05	27.1	4	11	18
10	2.35	(8.1)	-22.1	1.39	38.2	3	11	18

The table shows average returns for portfolios sorted on the given characteristic. For each portfolio we use the value of the characteristic the previous yearend to group the stocks on the OSE into respectively five and ten portfolios. Data for stocks listed at the Oslo Stock Exchange during the period 1980-2011.

Table 10.3 Spread sorted portfolios

5 portfolios

Portfolio	mean	(std)	Returns min	med	max	Number of securities min	med	max
1 (smallest)	1.28	(6.9)	-25.8	1.53	21.8	9	23	35
2	1.42	(6.6)	-23.1	2.25	21.4	8	23	35
3	1.51	(6.4)	-18.3	1.33	25.9	9	24	35
4	1.86	(6.3)	-16.8	1.47	32.8	7	23	35
5	2.53	(6.6)	-15.5	1.55	35.4	8	23	35

10 portfolios

Portfolio	mean	(std)	Returns min	med	max	Number of securities min	med	max
1 (smallest)	1.28	(7.8)	-25.5	1.92	53.9	5	12	18
2	1.26	(7.1)	-26.8	1.65	20.4	4	11	17
3	1.49	(7.4)	-25.5	1.87	24.2	4	12	18
4	1.35	(6.5)	-21.1	2.16	25.5	4	12	17
5	1.56	(7.0)	-24.1	1.34	48.3	4	12	18
6	1.44	(6.7)	-19.9	1.07	25.9	4	12	17
7	1.64	(6.9)	-16.9	1.04	31.7	3	11	18
8	2.08	(7.2)	-20.7	1.22	34.0	4	12	17
9	2.34	(7.1)	-18.8	1.66	33.6	4	12	18
10	2.75	(7.9)	-20.6	1.53	54.3	4	11	17

The table shows average returns for portfolios sorted on the given characteristic. For each portfolio we use the value of the characteristic the previous yearend to group the stocks on the OSE into respectively five and ten portfolios. Data for stocks listed at the Oslo Stock Exchange during the period 1980-2011.

Table 10.4 Momentum sorted portfolios

5 portfolios

Portfolio	mean	(std)	Returns min	med	max	Number of securities min	med	max
1 (smallest)	2.09	(7.6)	-22.1	1.85	27.7	7	25	37
2	1.40	(6.2)	-22.2	1.11	27.7	6	24	37
3	1.44	(5.6)	-20.8	1.44	19.4	7	25	37
4	1.47	(5.9)	-17.8	1.68	26.3	6	24	37
5	2.10	(7.6)	-24.1	1.82	45.3	6	25	37

10 portfolios

Portfolio	mean	(std)	Returns min	med	max	Number of securities min	med	max
1 (smallest)	1.81	(7.8)	-23.9	1.75	33.0	4	13	19
2	2.38	(9.2)	-25.3	1.76	49.6	3	12	18
3	1.50	(6.9)	-27.3	1.22	24.8	3	12	19
4	1.31	(6.6)	-20.5	1.23	36.5	3	13	18
5	1.45	(6.3)	-20.3	0.95	25.5	3	12	19
6	1.44	(5.9)	-23.1	1.57	21.7	4	13	18
7	1.52	(6.4)	-23.7	1.89	30.9	3	12	19
8	1.42	(6.3)	-21.2	1.55	23.4	3	12	18
9	1.82	(7.7)	-23.8	1.84	42.8	3	13	19
10	2.39	(8.5)	-24.4	1.61	53.9	3	12	18

# Chapter 11

The variability of the Oslo Stock Exchange

In this chapter we discuss the variability of stock returns at the OSE. There are different ways of measuring variability. The most common is to look at the *volatility*, or standard deviation, of returns. We will look at some time series of volatility. Let us first consider the market as a whole, and look at the volatility of market indices. The next way to investigate volatility is to consider individual stocks, and calculate the volatility across stocks.

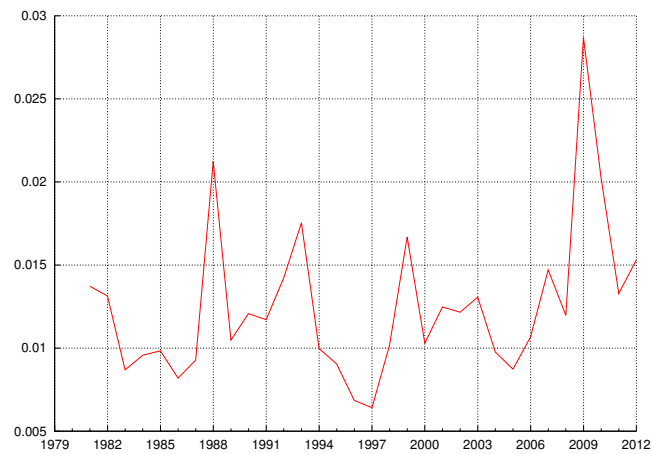### 11.0.1   The volatility of market indices

Let us look at the time series evolution of the two indices VW and EW which we have calculated earlier. In figure 11.1 we each year calculate the volatility of that years returns on the market index. In figure 11.2 we do similar calculations at higher frequencies.

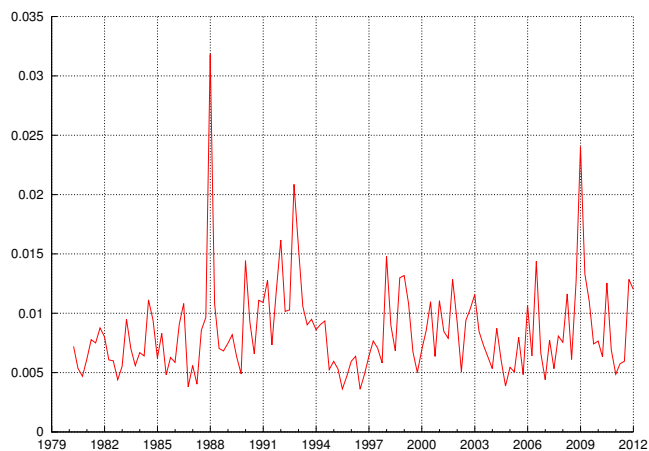**Figure 11.1** The annual volatility of market indices at the OSE
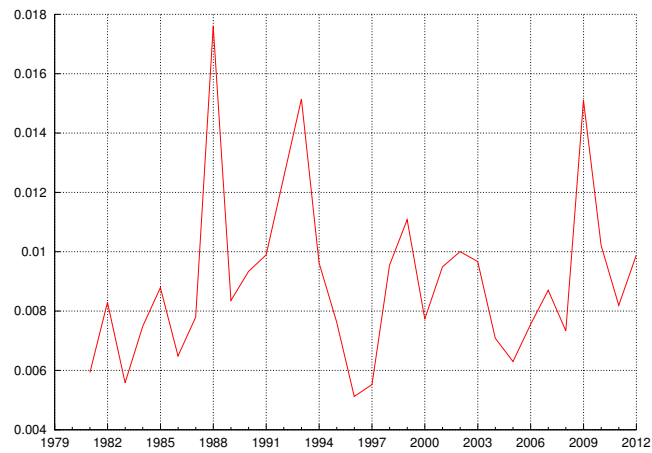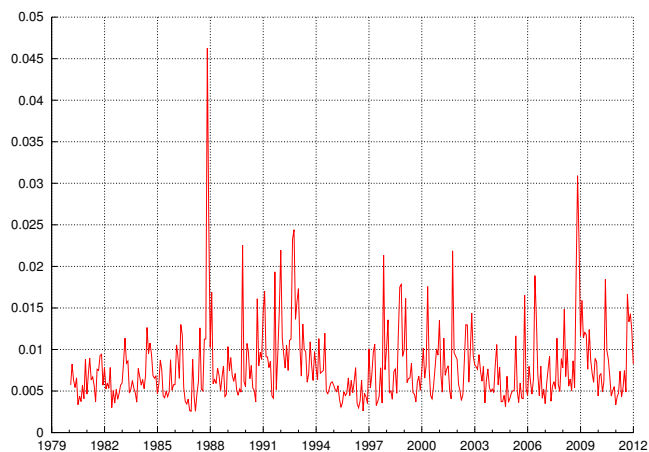
EW index

VW index

For each of the indices EW and VW we calculate the volatility of one year of daily returns, and plot the time series of resulting estimates.

Figure 11.2 Higher frequency estimates of volatility of market indices at the OSE
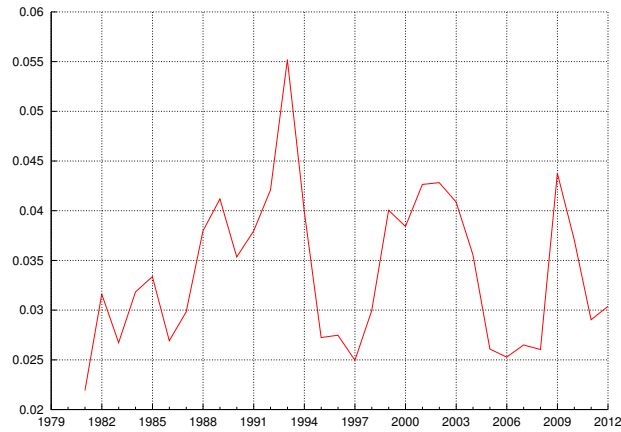
Quarterly estimates

Monthly estimates

For the index EW we calculate the volatility of one quarter(top figure) and one month(bottom figure) of daily returns, and plot the time series of resulting estimates.

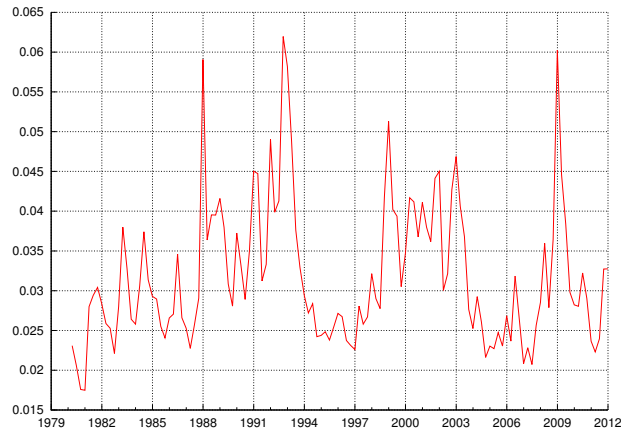## 11.0.2 The average volatility across stocks

Instead of looking at the market, it may be more informative to look at the volatility of individual stocks, and ask: What is the average volatility for individual stocks. In figure 11.3 we show such averages, where we calculate the

Figure 11.3 Average volatility for all firms at the OSE

Annual calculations

Quarterly calculations

Monthly calculations

The tables show averages of estimated volatility across stocks. For each stock the standard deviation of stock returns is calculated using one year's worth of daily returns (top figure), one quarters worth (middle figure) or one month's worth (bottom figure). These estimates are then averaged across stocks. The calculation is done at the ends of respecitely years, quarters and months. When taking the average we Windsorize the data by removing the most extreme one percent. Data for stocks listed at the Oslo Stock Exchange during the period 1980-2011.

50

Figure 11.4 Average volatility for size sorted portfolios, firms at the OSE

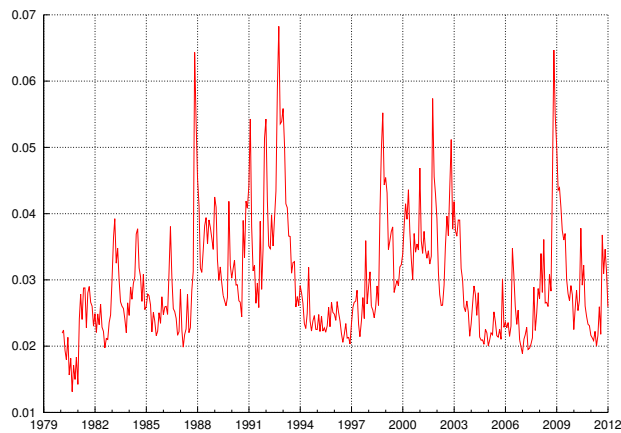Annual data

Quarterly data
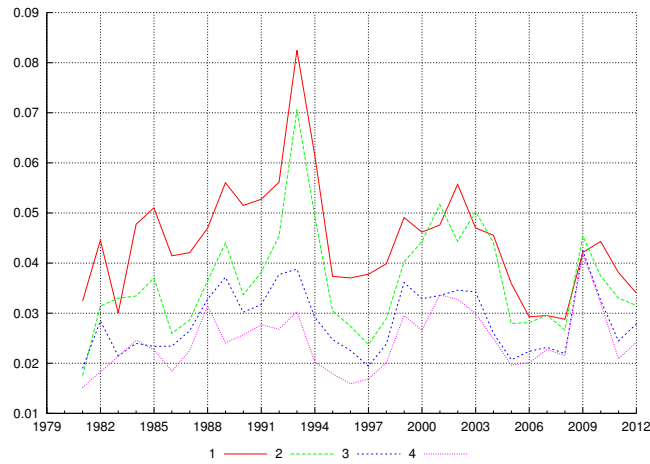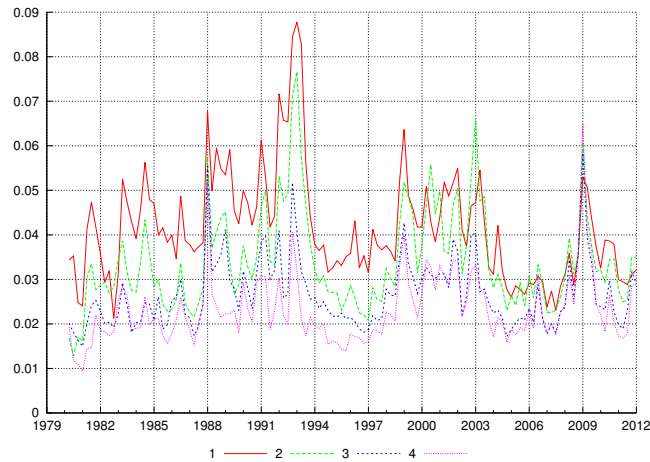

Monthly data
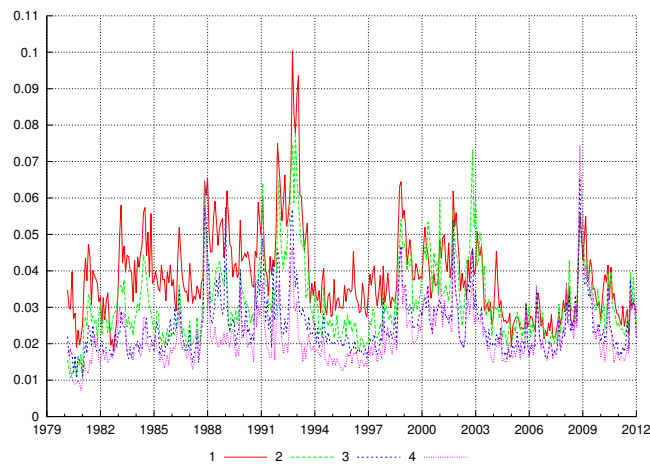
The tables show averages of estimated volatility across stocks. For each stock the standard deviation of stock returns is calculated using one year's worth of daily returns (top figure), one quarters worth (middle figure) or one month's worth (bottom figure). We then group stocks into four portfolios based on firm size, and average across these portfolios. Data for stocks listed at the Oslo Stock Exchange during the period 1980-2011.

Chapter 12

Time series properties at the Oslo Stock Exchange

12.0.3   Observations on market indices

Let us look at the time series evolution of the two indices VW and EW which we have calculated earlier. In figure 12.1 we each year calculate the (first order) autocorrelation of that years returns.

Figure 12.1 The annual autocorrelations of market indices at the OSE

EW index
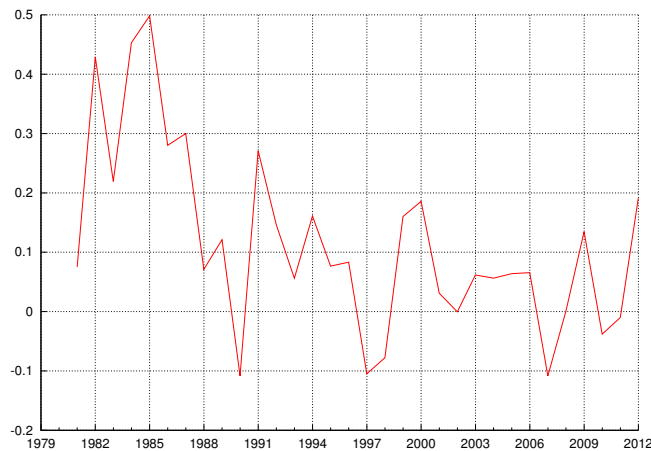
For each of the indices EW and VW we calculate the autocorrelation (lag one) of one year of daily returns, and plot the time series of resulting estimates.

Table 12.1 shows estimates of autocorrelations for various market indices, for the whole period 1980 to 2011, and for subperiods.

Table 12.1 Autocorrelation of market returns

Index		1980–2011	1980–1989	1990–1999	2000–2011
ew(daily)	Mean	0.0012	0.0013	0.0012	0.0010
	Stdev	0.010	0.009	0.010	0.009
	Autocorr(1)	0.12	0.19	0.12	0.07
	Autocorr(2)	0.05	0.07	0.03	0.04
ew(weekly)	Mean	0.0045	0.0063	0.0042	0.0032
	Stdev	0.024	0.027	0.023	0.022
	Autocorr(1)	0.14	0.17	0.19	0.05
	Autocorr(2)	0.11	0.10	0.15	0.09
ew(monthly)	Mean	0.0170	0.0235	0.0164	0.0120
	Stdev	0.058	0.061	0.059	0.052
	Autocorr(1)	0.27	0.22	0.30	0.29
	Autocorr(2)	0.09	-0.05	0.15	0.14
vw(daily)	Mean	0.0010	0.0012	0.0010	0.0010
	Stdev	0.013	0.012	0.012	0.015
	Autocorr(1)	0.07	0.15	0.11	0.00
	Autocorr(2)	-0.02	-0.02	-0.02	-0.01
vw(weekly)	Mean	0.0046	0.0055	0.0043	0.0041
	Stdev	0.029	0.029	0.027	0.032
	Autocorr(1)	0.04	0.14	0.09	-0.05
	Autocorr(2)	0.06	0.15	0.10	-0.01
vw(monthly)	Mean	0.0199	0.0236	0.0203	0.0166
	Stdev	0.066	0.070	0.064	0.063
	Autocorr(1)	0.13	0.16	0.05	0.17
	Autocorr(2)	-0.07	-0.18	-0.12	0.05

We provide some estimates of autocorrelation for market indices at the OSE.

12.0.4 Autocorrelation of individual stocks

Table 12.2 Autocorrelation of individual stock returns

Panel A: Averages across all stocks
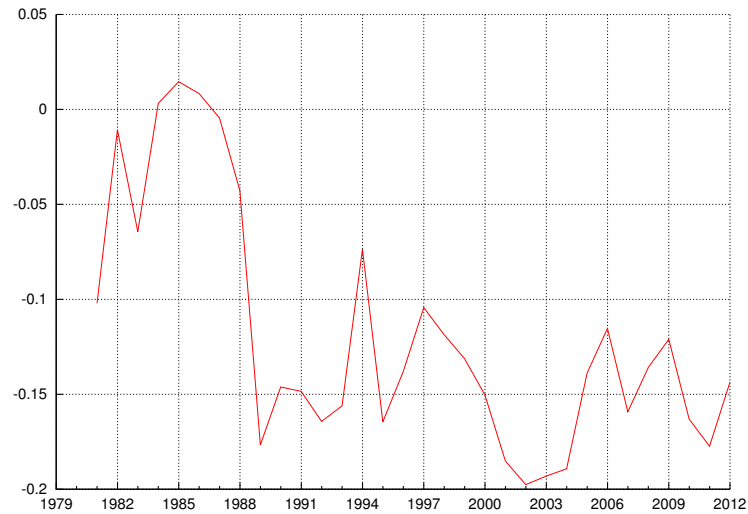
Panel B: Quartile plots
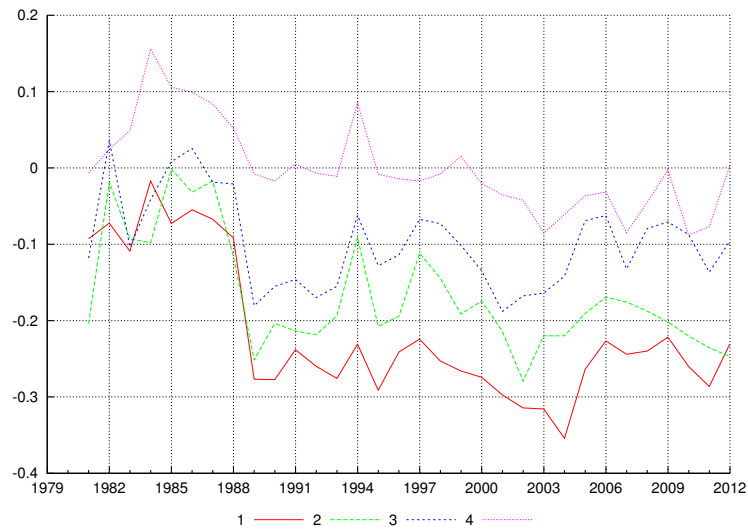
Chapter 13

Calendar effects

There is a large empirical literature in finance on the general topic of *calendar effects*, which can be summarized as predictable variation in stock returns based on calendar time. In this chapter we replicate some of the standard investigations using data from the OSE.

13.1 Variations in daily returns over the week

We calculate daily stock returns and group the returns by the day of the week.

Table 13.1 Day of the week effects

Weekday	EW	VW	TOTINDX	OBX
Monday	0.07	0.06	0.01	-0.02
Tuesday	0.06	0.05	0.01	0.01
Wednesday	0.10	0.08	0.02	0.01
Thursday	0.14	0.16	0.10	0.09
Friday	0.22	0.18	0.15	0.13

The table shows percentage daily returns split on day of the week.

Table 13.2 Friday the thirteenth

	EW		VW		TOT		OBX	
All Fridays	0.22		0.18		0.15		0.13	
Friday thirteenths	0.29	52	0.28	52	0.31	47	0.30	40
Other Fridays	0.22	1552	0.18	1552	0.15	1406	0.13	1213

The table shows percentage daily returns.

13.2   Variation in daily returns over the month

Ariel (1987) looks at this in the US.

Table 13.3 Day of the month effects

Day	EW	VW	TOTINDX	OBX
1	0.07	0.13	0.12	0.18
2	0.22	0.34	0.29	0.33
3	0.14	0.07	0.05	0.04
4	0.15	0.18	0.15	0.15
5	0.10	0.06	-0.02	-0.09
6	0.20	0.21	0.13	0.11
7	0.09	0.10	0.02	-0.05
8	0.11	0.05	-0.02	-0.03
9	0.16	0.08	0.08	0.10
10	0.08	0.07	-0.00	-0.07
11	0.13	0.14	0.07	0.03
12	0.10	0.03	-0.03	-0.14
13	0.13	0.15	0.11	0.14
14	0.17	0.16	0.06	0.13
15	0.05	-0.02	-0.06	-0.09
16	0.10	0.13	0.06	0.06
17	0.18	0.11	0.09	0.06
18	0.03	0.08	0.01	0.05
19	-0.01	-0.00	-0.07	-0.11
20	-0.04	-0.03	-0.12	-0.12
21	0.09	0.12	0.10	0.09
22	0.05	0.03	-0.01	-0.07
23	0.15	0.15	0.08	0.12
24	0.01	-0.03	-0.09	-0.08
25	0.05	-0.01	-0.03	-0.08
26	0.10	0.09	0.04	0.05
27	0.21	0.24	0.20	0.18
28	0.08	0.01	0.02	0.01
29	0.16	0.17	0.17	0.17
30	0.37	0.30	0.27	0.20
31	0.24	0.23	0.22	0.22

The table shows percentage daily returns split on day of the month.

13.3 Variation in monthly returns over the year

The best known empirical regularity in the US is the January effect.

Table 13.4 Monthly effects

Month	EW	VW	TOT	OBX
Jan	5.9	4.2	3.5	1.8
Feb	2.9	1.8	1.5	1.9
Mar	2.3	2.0	2.5	2.7
Apr	3.4	4.6	3.7	2.9
May	1.6	2.4	1.8	1.3
Jun	-0.5	0.5	-0.8	-0.5
Jul	2.8	3.1	2.2	2.3
Aug	0.1	0.8	-0.5	-1.2
Sep	-1.3	-0.8	-1.9	-2.7
Oct	0.8	1.6	0.3	-0.0
Nov	0.3	0.2	-0.6	-0.8
Dec	2.2	3.5	3.1	3.3

The table shows percentage monthly returns split by month.

Table 13.5 Monthly effects, by size portfolios

Whole period, 1980–2011

Month	1(small)	2	3	4	5(large)
Jan	9.1	5.9	6.5	4.4	3.3
Feb	4.9	3.0	3.6	1.8	0.9
Mar	3.3	2.5	1.8	2.2	1.9
Apr	3.9	3.5	3.6	2.9	3.2
May	2.1	1.5	1.5	1.8	1.2
Jun	-0.0	-0.2	-0.4	-1.0	-0.7
Jul	3.5	2.3	2.4	2.7	3.4
Aug	1.2	0.1	-0.0	-0.3	-0.8
Sep	0.4	-1.1	-1.4	-2.6	-1.9
Oct	0.1	1.0	1.4	0.7	0.7
Nov	1.7	-0.3	-0.0	0.5	-0.3
Dec	0.8	0.7	2.6	3.5	3.1

Table 13.6 Monthly effects, by size portfolios, split in subperiods

Panel A: Subperiod 1980–1989

Month	1(small)	2	3	4	5(large)
Jan	15.4	9.8	9.9	6.9	6.9
Feb	6.3	1.9	4.2	1.6	0.7
Mar	6.4	4.1	2.7	1.9	1.7
Apr	4.2	5.1	4.0	3.2	4.3
May	0.3	-1.2	0.3	0.0	-0.6
Jun	-0.8	-1.8	-1.5	-2.4	-1.2
Jul	5.6	4.2	3.3	3.8	5.0
Aug	2.5	1.4	0.2	2.3	2.1
Sep	4.1	0.2	1.5	1.4	1.4
Oct	-0.6	0.2	2.0	-0.6	-2.5
Nov	3.9	-0.5	0.1	-0.4	-0.9
Dec	0.2	0.5	2.2	4.5	1.8

Panel B: Whole period, 1990–1999

Month	1(small)	2	3	4	5(large)
Jan	8.0	6.3	6.1	4.6	4.0
Feb	5.8	5.5	3.6	1.3	0.9
Mar	3.6	3.1	2.8	3.2	2.6
Apr	5.7	2.6	4.3	2.7	2.6
May	4.6	3.3	2.4	3.7	2.1
Jun	0.5	-0.5	-0.9	-1.5	1.0
Jul	3.7	1.7	2.4	2.6	3.5
Aug	-0.3	-1.5	-1.8	-4.3	-4.7
Sep	-0.7	-1.3	-2.6	-5.2	-2.8
Oct	-0.0	1.2	0.9	1.2	2.6
Nov	-0.5	-1.1	-0.9	-0.9	-1.2
Dec	2.2	0.7	2.6	2.5	4.2

Panel C: Subperiod 2000–2011

Month	1(small)	2	3	4	5(large)
Jan	4.9	2.4	3.9	2.3	-0.3
Feb	3.1	1.9	2.9	2.5	1.1
Mar	0.3	0.6	0.2	1.7	1.3
Apr	2.1	2.9	2.7	2.8	2.9
May	1.5	2.2	1.8	1.6	1.8
Jun	0.1	1.3	0.9	0.5	-1.8
Jul	1.6	1.4	1.7	1.9	1.9
Aug	1.4	0.4	1.3	0.7	-0.0
Sep	-1.8	-1.9	-2.8	-3.9	-3.8
Oct	0.8	1.5	1.3	1.3	1.7
Nov	1.7	0.4	0.6	2.3	1.0
Dec	0.1	0.9	3.1	3.5	3.2

The table shows percentage monthly returns split by month. Size portfolios.

Chapter 14

Factor Portfolios for Asset Pricing

In this chapter we discuss construction of pricing factors a la Fama and French (1996) and Carhart (1997). Using the definitions in these papers similar algorithms are applied to asset pricing data for the Oslo Stock Exchange. We then see whether these factor portfolios are helpful in describing the crossection of Norwegian asset returns.

14.1 Fama French factors

The two factors `SMB` and `HML` were introduced in Fama and French (1996). For the construction they split data for the US stock market as shown in figure 14.1.

Figure 14.1 The construction of the two Fama and French (1996) factors

		Book/Market		
		L	H	M
Size	Small	S/L	S/M	S/H
	Big	B/L	B/M	B/H

The pricing factors are then constructed as:

$$\mathtt{SMB} = \mathrm{average}(S/L, S/M, S/H) - \mathrm{average}(B/L, B/M, B/H)$$

$$\mathtt{HML} = \mathrm{average}(S/H, B/H) - \mathrm{average}(S/L, B/L)$$

Similar factors are constructed for the Norwegian stock market by doing a split just like that done by FF, a double sort into six different portfolios. End of June values of the stock and B/M are used to perform the sorting. Within each portfolio returns are calculated as the value weighted average of the constituent stocks. Table 14.1 describes these six portfolios.

Table 14.1 Average returns for the six portfolios used in the FF construction

1980–2011

	SL		SM		SH
2.62	(8.03)	2.86	(7.22)	2.86	(7.25)
	BL		BM		BH
1.58	(7.52)	1.91	(6.99)	2.69	(9.06)

1980–1989

	SL		SM		SH
3.78	(9.50)	3.55	(8.46)	4.78	(8.41)
	BL		BM		BH
2.04	(8.63)	2.71	(7.83)	4.01	(9.52)

1990–1999

	SL		SM		SH
2.38	(7.64)	2.89	(7.14)	2.99	(7.87)
	BL		BM		BH
1.78	(6.81)	1.44	(6.55)	1.83	(9.22)

2000–2011

|	SL		SM		SH
2.00	(7.08)	2.35	(6.21)	1.39	(5.22)
	BL		BM		BH
1.09	(7.21)	1.74	(6.65)	2.48	(8.46)

The table shows average returns for the six portfolios S/L, S/M, S/H, B/L, B/M and B/H.

14.2   Momentum

14.2.1   The Carhart factor `PR1YR`

Carhart (1997) introduced an additional factor that accounts for momentum. Figure 14.2 illustrates this factor construction. Each month the stock return is calculated over the previous eleven months. The returns are ranked, and split into three portfolios: The top 30%, the median 40% and the bottom 30%. The Carhart (1997) factor `PR1YR` is the difference between the average return of the top and the bottom portfolios. The ranking is recalculated every month.

Figure 14.2 The construction of the Carhart (1997) factor `PR1YR`
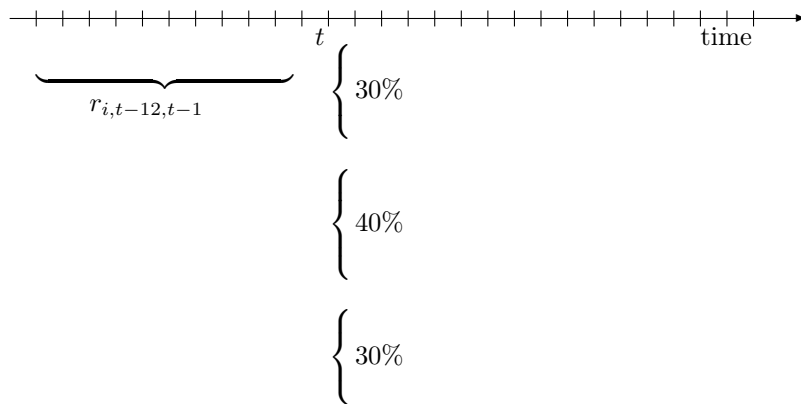
14.2.2   An alternative momentum factor: `UMD`

Ken French introduces an alternative momentum factor `UMD`, which he describes as follows:

> ....a momentum factor, constructed from six value-weight portfolios formed using independent sorts on size and prior return of NYSE, AMEX, and NASDAQ stocks. Mom is the average of the returns on two (big and small) high prior return portfolios minus the average of the returns on two low prior return portfolios. The portfolios are constructed monthly. Big means a firm is above the median market cap on the NYSE at the end of the previous month; small firms are below the median NYSE market cap. Prior return is measured from month -12 to - 2. Firms in the low prior return portfolio are below the 30th NYSE percentile. Those in the high portfolio are above the 70th NYSE percentile.   (from Ken French's web site)

14.3   Describing the calculated factors

Table 14.2 gives some descriptive statistics for the calculated factors. The averages seem to be significantly different from zero, at least for some of them, and they are relatively little correlated.

Table 14.2 Descriptive statistics for asset pricing factors.

Average

	SMB		HML		PR1YR		UMD	
1980–2011	0.72	(0.00)	0.67	(0.02)	0.90	(0.00)	0.80	(0.01)
1980–1989	1.12	(0.02)	1.48	(0.01)	2.27	(0.00)	1.87	(0.00)
1990–1999	1.07	(0.02)	0.33	(0.51)	-0.18	(0.69)	-0.23	(0.66)
2000–2011	0.14	(0.69)	0.38	(0.34)	0.79	(0.06)	0.88	(0.08)

Correlations

	SMB	HML	PR1YR
HML	-0.17		
PR1YR	0.15	0.02	
UMD	0.13	-0.05	0.77

The table describes the calculated asset pricing factors. SMB and HML are the Fama and French (1996) pricing factors. PR1YR is the Carhart (1997) factor. The table list the average percentage monthly return, and in parenthesis the p-value for a test of difference from zero.

Chapter 15

Interest Rates

In this chapter we discuss interest rate data.

For this paper we limit ourselves to estimates of two different interest rate series, a short term (monthly) risk free rate and an annual risk free rate. For details about Norwegian interest rate data we refer to (Eitrheim et al., 2006, Ch 6). For most of the period we use interbank rates, NIBOR as the estimate of the risk free rate. Both monthly and annual NIBOR rates are available from 1986. The period before 1986 is slightly "messy" regarding interest rate data, and we need to use some imperfect proxies. For monthly risk free interest from 1982 to 1986 we use the overnight NIBOR rate as an approximation. Before 1982 for the monthly data, and before 1986 for the annual data, we use the shortest possible bond yield for treasuries in Eitrheim et al. (2006) as estimates for interest rates. For the 1980 to 86 period this means we use the two year bond yield as an estimate of the risk free rate.

Figure 15 plots the monthly risk free interest rate. The "spike" in the interest rate in 1992 is due to a currency crisis.

Figure 15.1 Short term (monthly) risk free interest rate
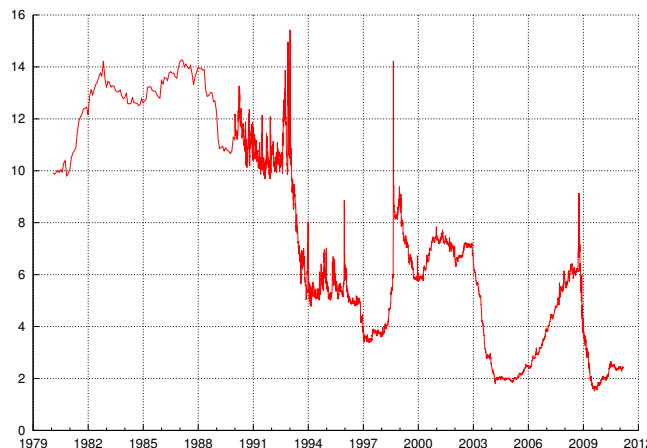
The figure plots annualized percentage one month interest rate for the period 1980 to 2011.

For some of the longer term calculations we also use the annual (one year) interest rate. Figure 15 illustrates this interest rate.
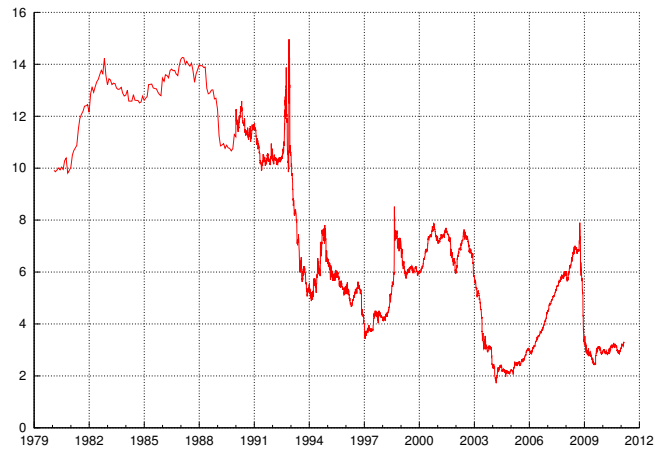
Figure 15.2 One year risk free interest rate

The figure plots annualized percentage one year interest rate for the period 1980 to 2011.

15.1   Sources

All interest rate data is available from the webcite of the Central Bank of Norway (`www.norges-bank.no`).

Chapter 16

Time series of various aggregates

We look at various accounting summaries.

16.1 Book to Market Ratios

One compares a market value (typically when looking at the market value of stocks listed on an exchange) with a value of the same variable from the accounts.

### 16.1.1 Book value to market value equity

We start by looking at the ratio of book value of equity to market value of equity.

Table 16.1 Book to Market ratio of equity

		1980–2011			1980–1989			1990–1999			2000–2009			2010–2011		
		average		med	average		med	average		med	average		med	average		med
		vw	ew		vw	ew		vw	ew		vw	ew		vw	ew	
All		0.57	0.83	0.55	0.50	0.63	0.38	0.57	0.74	0.58	0.65	1.20	0.73	0.63	1.21	0.85
Industry	Energy	0.66	0.76	0.61	0.62	0.58	0.57	0.68	0.82	0.66	0.67	0.90	0.78	0.54	0.78	0.83
	Material	1.04	1.06	0.86	0.78	0.79	0.55	0.93	1.19	0.89	1.44	1.23	0.89	0.53	0.69	0.58
	Industry	0.59	0.73	0.60	0.45	0.54	0.39	0.57	0.83	0.69	0.74	0.86	0.81	0.56	0.99	0.88
	ConsDisc	0.68	0.69	0.45	0.71	0.84	0.34	0.52	0.58	0.45	0.84	0.64	0.56	0.65	0.64	0.68
	ConsStapl	0.59	0.56	0.47	0.74	0.65	0.30	0.44	0.41	0.43	0.62	0.65	0.57	0.73	0.79	0.65
	Health	0.32	0.34	0.25	0.46	0.47	0.26	0.25	0.30	0.29	0.23	0.26	0.23	0.26	0.28	0.24
	Finan	0.71	1.23	0.71	0.60	0.58	0.33	0.55	0.68	0.53	1.04	2.68	1.59	0.97	2.62	1.95
	IT	0.38	0.45	0.33	0.31	0.41	0.31	0.46	0.51	0.36	0.40	0.45	0.35	0.98	0.59	0.53
	Telecom	0.50	0.49	0.42	0.18	0.42	0.42	0.02	0.19	0.19	0.58	0.52	0.44	0.57	0.34	0.34
	Util	0.71	0.66	0.59				0.46	0.46	0.45	0.81	0.74	0.66	0.76	0.75	0.75
Size	1 (small)	1.15	1.32	0.76	0.74	0.80	0.51	0.84	0.94	0.67	2.08	2.45	1.49	1.81	2.45	1.78
	2	0.73	0.74	0.52	0.60	0.61	0.43	0.73	0.74	0.51	0.88	0.91	0.65	0.98	1.06	0.95
	3	0.72	0.72	0.58	0.62	0.60	0.32	0.74	0.74	0.64	0.81	0.83	0.70	0.84	0.88	0.72
	4 (large)	0.54	0.63	0.53	0.48	0.56	0.41	0.53	0.63	0.54	0.62	0.70	0.59	0.60	0.63	0.57

We calculate the market value of equity as the market value of the firms shares at yearend, and compare it to the latest accounting estimate of the value of equity.The table shows averages. Along the rows the firms are grouped. The first row gives the average for all firms. The next rows group the firms on the exchange by the GICS standard. At the bottom we group the firms on the exchange by their size, as measured by equity value. The columns group the averages by subperiods, first the whole period

Figure 16.1 Book to Market ratio of equity
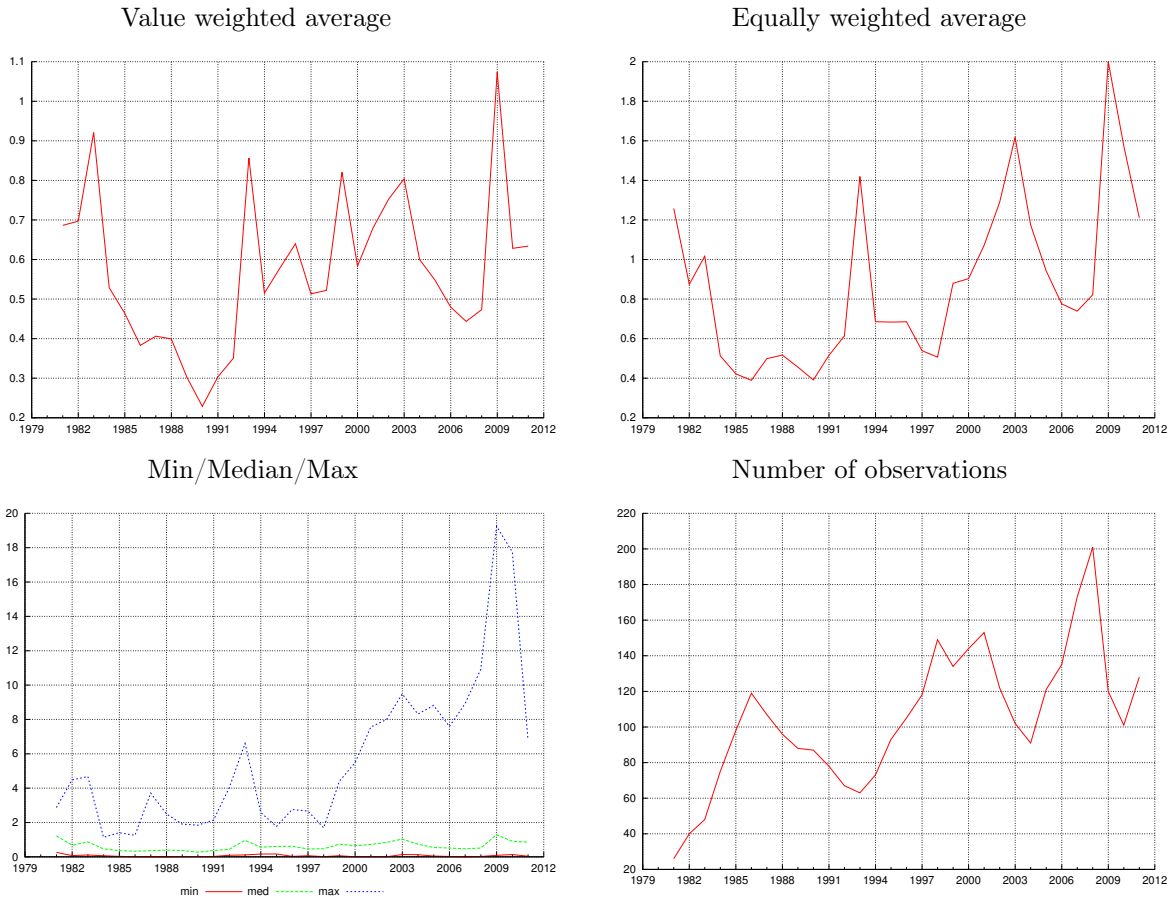
Value weighted average

Equally weighted average
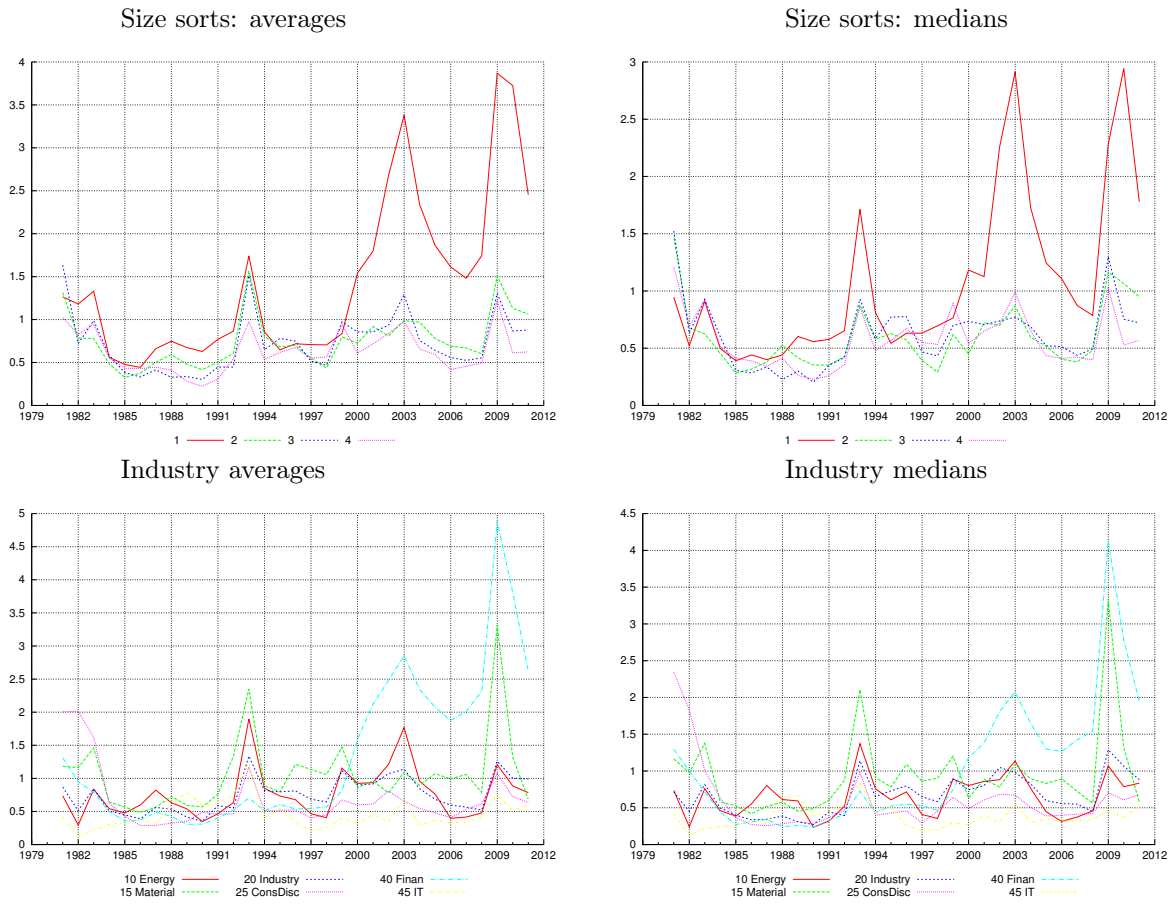
Min/Median/Max

Number of observations

We calculate the market value of equity as the market value of the firms shares at yearend, and compare it to the latest accounting estimate of the value of equity. The figures show time series of various averages for the whole sample. The value weighted average on top left uses the firm equity value for value weighting. The equally weighted average on top right uses all firms on the exchange for which we have data. The figure on the bottom right shows the highest (max), median, and lowest (min) value on each date. On the bottom right we show the number of observations on each date.

Figure 16.2 Size and industry sorted averages of B/M of equity

Size sorts: averages

Size sorts: medians

Industry averages

Industry medians

We calculate the market value of equity as the market value of the firms shares at yearend, and compare it to the latest accounting estimate of the value of equity.The figures show time series of various averages for the industry portfolios (top) and size portfolios (bottom).

16.1.2   Book value to market value firm

We next look at the ratio of book value of firm to its market value. The market value of the firm is approximated as the sum of market value of equity and the book value of debt.

Table 16.2 Book to Market ratio of firm

		1980–2011			1980–1989			1990–1999			2000–2009			2010–2011		
		average		med	average		med	average		med	average		med	average		med
		vw	ew		vw	ew		vw	ew		vw	ew		vw	ew	
All		0.99	0.98	0.88	0.95	0.99	0.97	0.97	0.92	0.82	1.07	1.05	0.86	1.11	1.38	1.10
Industry	Energy	0.94	0.98	0.93	0.96	0.91	0.95	0.87	0.89	0.87	1.00	1.22	0.94	1.11	1.50	1.11
	Material	1.23	1.16	1.05	1.05	1.06	1.05	1.01	1.08	1.01	1.68	1.39	1.10	0.64	0.88	0.68
	Industry	0.95	0.99	0.98	0.96	0.97	0.97	0.84	0.90	0.96	1.05	1.15	1.06	1.04	1.47	1.39
	ConsDisc	0.91	0.88	0.86	0.94	0.96	0.97	0.70	0.77	0.73	1.16	0.95	0.87	1.17	1.05	1.27
	ConsStapl	0.88	0.85	0.81	0.99	0.94	0.90	0.74	0.70	0.69	0.94	0.95	0.88	1.16	1.20	1.13
	Health	0.55	0.56	0.57	0.78	0.81	0.73	0.48	0.50	0.55	0.41	0.35	0.32	0.37	0.36	0.30
	Finan	2.60	1.60	0.87	1.42	1.27	0.94	3.61	1.77	0.85	2.74	1.76	0.98	2.38	3.02	2.46
	IT	0.64	0.67	0.61	0.71	0.77	0.72	0.68	0.66	0.60	0.54	0.59	0.49	1.40	0.83	0.69
	Telecom	0.69	0.64	0.69	0.82	0.88	0.88	0.17	0.25	0.23	0.86	0.77	0.74	0.87	0.55	0.55
	Util	0.95	0.89	0.87				0.71	0.71	0.71	1.10	1.01	1.01	1.45	1.35	1.35
Size	1 (small)	0.97	1.00	0.95	1.02	1.04	1.01	0.97	0.98	0.93	0.95	1.02	0.93	1.63	1.73	1.22
	2	0.90	0.91	0.86	0.96	0.96	0.97	0.81	0.81	0.79	0.97	1.00	0.81	1.30	1.40	1.20
	3	0.99	0.98	0.87	0.99	0.98	0.92	0.94	0.93	0.86	1.08	1.07	0.87	1.30	1.28	1.13
	4 (large)	1.00	1.04	0.90	0.95	1.02	0.99	0.98	1.04	0.85	1.07	1.07	0.87	1.08	1.23	1.04

We calculate the market value of firm as the sum market value of the firms shares at yearend and the book value of debt, and compare it to the latest accounting estimate of the value of firm. The table shows averages. Along the rows the firms are grouped. The first row gives the average for all firms. The next rows group the firms on the exchange by the GICS standard. At the bottom we group the firms on the exchange by their size, as measured by equity value. The columns group the averages by subperiods, first the whole period

Figure 16.3 Book to Market ratio of firm
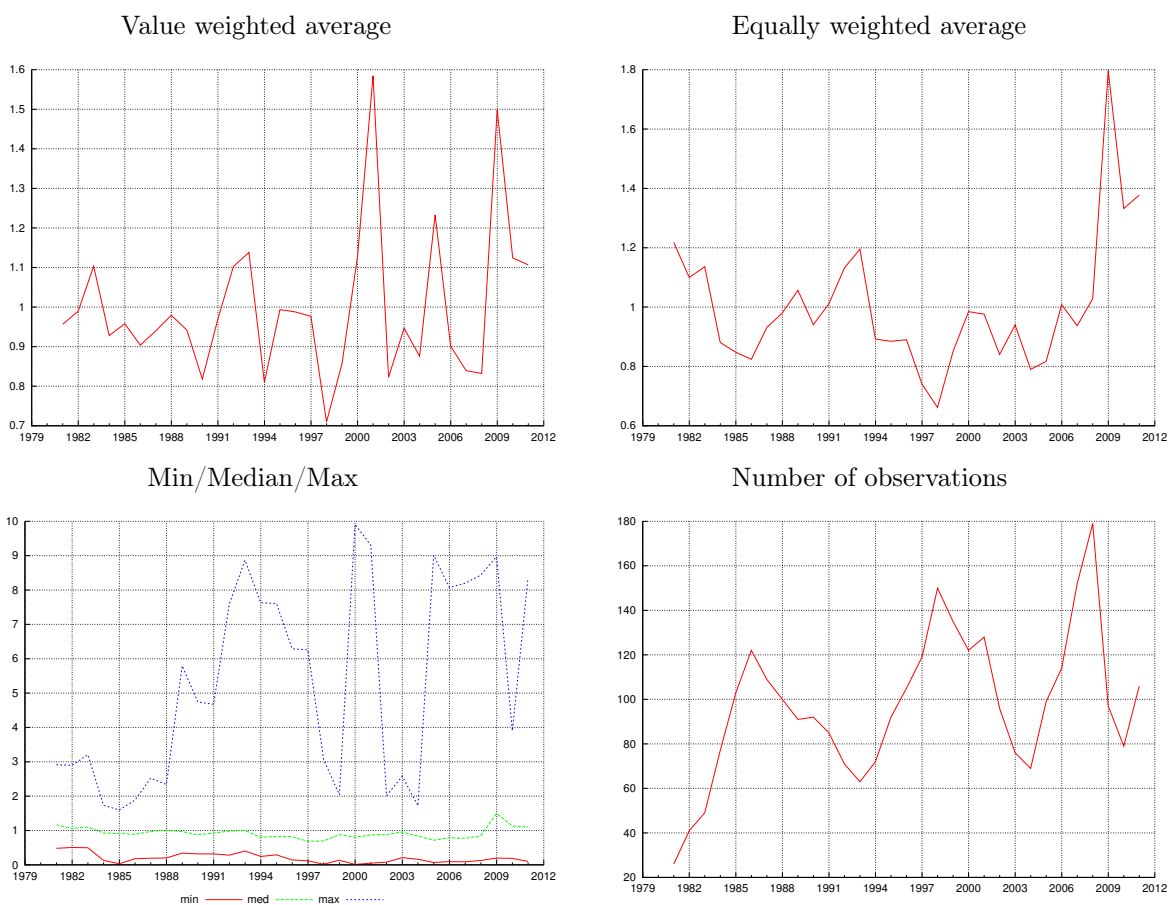
We calculate the market value of firm as the sum market value of the firms shares at yearend and the book value of debt, and compare it to the latest accounting estimate of the value of firm.The figures show time series of various averages for the whole sample. The value weighted average on top left uses the firm equity value for value weighting. The equally weighted average on top right uses all firms on the exchange for which we have data. The figure on the bottom right shows the highest (max), median, and lowest (min) value on each date. On the bottom right we show the number of observations on each date.

Figure 16.4 Size and industry sorted averages of B/M of firm

Size sorts: averages

Size sorts: medians

Industry averages

Industry medians

We calculate the market value of firm as the sum market value of the firms shares at yearend and the book value of debt, and compare it to the latest accounting estimate of the value of firm.The figures show time series of various averages for the industry portfolios (top) and size portfolios (bottom).
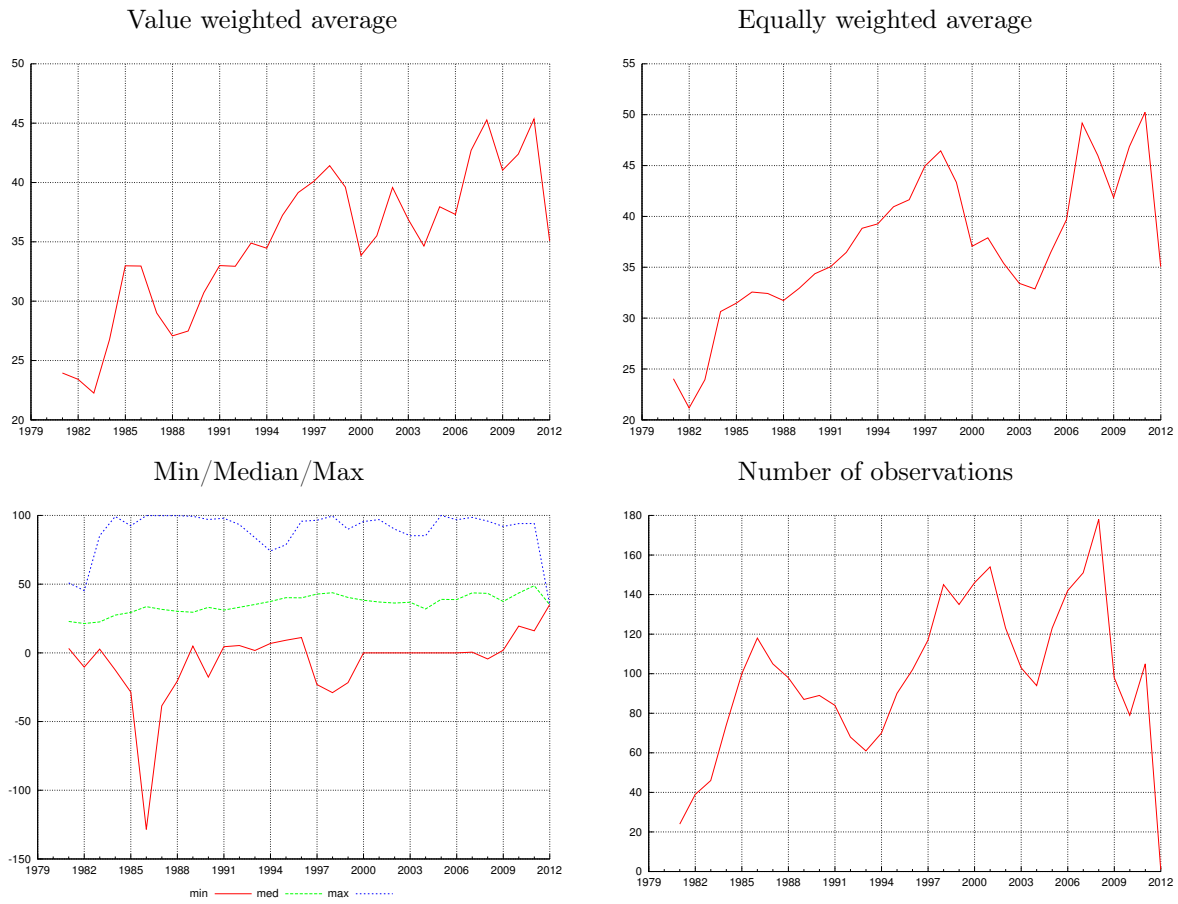
16.2 Equity to assets

Table 16.3 Equity to Assets

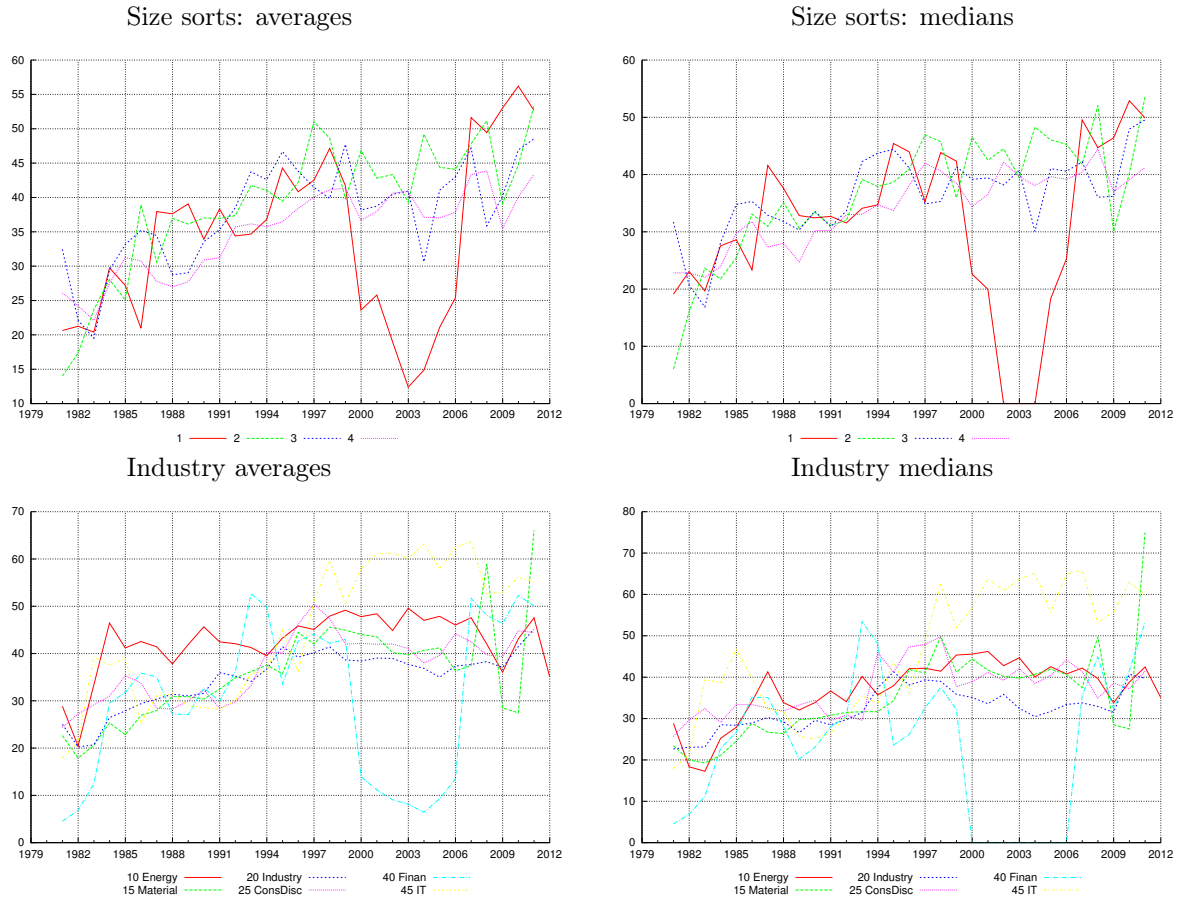| | | 1980–2011 | | | 1980–1989 | | | 1990–1999 | | | 2000–2009 | | | 2010–2011 | | |
		average		med	average		med	average		med	average		med	average		med
		vw	ew		vw	ew		vw	ew		vw	ew		vw	ew	
All		34.28	36.30	36.23	27.66	29.58	29.48	36.67	40.40	39.14	39.33	39.96	38.06	40.21	42.65	41.97
Industry	Energy	34.31	42.53	39.67	27.90	37.96	30.46	36.67	44.44	40.81	38.77	45.25	41.49	37.85	41.32	38.77
	Material	33.94	35.20	31.66	24.85	25.63	25.46	37.87	39.78	37.68	38.47	39.41	40.41	76.85	66.07	74.97
	Industry	33.99	34.26	31.53	25.65	27.41	28.43	36.35	38.13	36.64	40.75	37.95	33.15	46.59	45.16	39.73
	ConsDisc	35.85	36.84	37.71	28.59	29.99	32.48	38.35	40.00	40.07	41.26	41.32	39.83	43.88	44.48	41.48
	ConsStapl	38.38	37.57	37.18	33.11	33.87	33.28	37.85	39.34	42.50	45.43	40.70	43.64	52.78	51.93	51.17
	Health	45.41	53.32	52.08	33.55	34.89	35.96	47.58	57.18	52.68	54.60	69.37	72.92	54.82	68.92	73.89
	Finan	24.36	28.94	26.18	22.70	24.76	22.91	34.14	38.80	31.34	17.65	25.59	0.00	42.44	50.10	53.24
	IT	45.80	43.65	43.85	34.34	30.06	31.93	42.42	43.02	39.99	61.41	59.13	63.28	56.22	55.17	60.00
	Telecom	29.08	25.91	37.95	16.47	14.36	14.36	-13.30	-7.23	-22.37	45.29	42.75	44.95	55.63	49.26	49.26
	Util	37.80	38.89	35.95				37.53	37.53	36.56	38.21	39.90	37.70	39.23	44.08	44.08
Size	1 (small)	34.40	32.61	32.45	29.08	28.88	28.09	39.34	38.43	35.00	37.01	32.89	22.63	49.18	52.67	49.88
	2	38.33	38.41	37.91	29.29	28.78	28.06	42.13	42.50	38.91	44.36	44.59	43.50	54.34	53.38	53.54
	3	37.33	37.03	35.31	29.89	29.77	31.77	42.11	41.79	40.16	40.95	40.50	40.00	48.79	48.53	49.55
	4 (large)	33.65	34.57	34.43	27.14	27.55	26.04	35.60	37.29	34.58	38.99	39.42	39.40	44.66	43.36	41.22

The ratio of Equity to Assets. Source for calculation: Oslo Stock Exchange. The table shows averages. Along the rows the firms are grouped. The first row gives the average for all firms. The next rows group the firms on the exchange by the GICS standard. At the bottom we group the firms on the exchange by their size, as measured by equity value. The columns group the averages by subperiods, first the whole period

Figure 16.5 Equity to Assets

Value weighted average

Equally weighted average

Min/Median/Max

Number of observations

The ratio of Equity to Assets. Source for calculation: Oslo Stock Exchange. The figures show time series of various averages for the whole sample. The value weighted average on top left uses the firm equity value for value weighting. The equally weighted average on top right uses all firms on the exchange for which we have data. The figure on the bottom right shows the highest (max), median, and lowest (min) value on each date. On the bottom right we show the number of observations on each date.

Figure 16.6 Size and industry sorted averages of Equity to Assets

Size sorts: averages

Size sorts: medians

Industry averages

Industry medians

The ratio of Equity to Assets. Source for calculation: Oslo Stock Exchange. The figures show time series of various averages for the industry portfolios (top) and size portfolios (bottom).
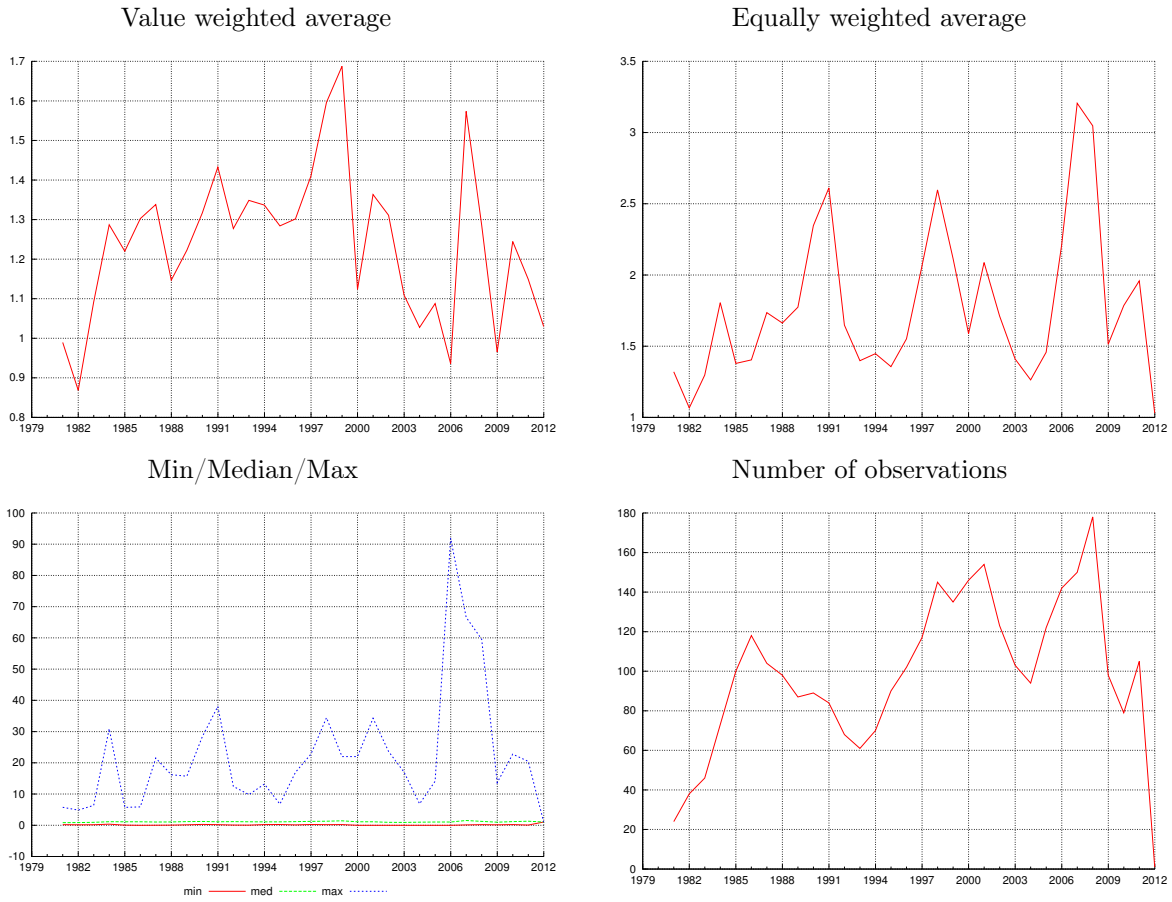
16.3 Dividend to price ratio

Table 16.4 D/P ratio

| | | 1980–2011 | | | 1980–1989 | | | 1990–1999 | | | 2000–2009 | | | 2010–2011 | | |
| | | average | | med | average | | med | average | | med | average | | med | average | | med |
		vw	ew		vw	ew		vw	ew		vw	ew		vw	ew	
All		1.25	1.80	1.12	1.18	1.58	1.10	1.38	1.84	1.15	1.19	1.97	1.04	1.09	1.49	1.16
Industry	Energy	1.50	2.55	1.58	1.74	2.78	1.54	1.49	2.10	1.56	1.24	2.75	1.52	1.10	1.41	1.29
	Material	1.13	1.33	0.98	1.23	1.28	0.90	1.06	1.17	1.03	1.03	1.45	0.93	3.34	3.38	2.21
	Industry	1.33	1.89	1.19	0.98	1.61	1.10	1.48	2.04	1.28	1.50	1.94	1.09	1.04	1.11	0.90
	ConsDisc	0.72	0.93	0.89	0.91	0.95	0.94	0.74	0.95	0.89	0.52	0.91	0.87	0.56	0.79	0.71
	ConsStapl	1.30	1.13	1.00	1.02	1.04	0.94	1.36	1.04	1.01	1.61	1.30	1.03	1.54	1.16	1.33
	Health	2.51	3.34	2.06	1.45	1.41	1.28	3.80	4.07	1.10	2.18	4.59	2.63	3.48	5.65	3.68
	Finan	1.77	1.67	0.83	1.82	1.52	0.85	2.85	2.61	1.02	0.54	0.83	0.00	2.00	3.99	1.08
	IT	1.74	1.78	1.27	1.22	1.36	1.14	1.43	1.58	1.18	2.54	2.38	1.68	1.50	1.60	1.61
	Telecom	0.80	0.88	0.88	0.97	0.79	0.79	0.92	0.92	0.77	0.72	0.89	0.93	0.70	0.97	0.97
	Util	1.63	2.26	1.18				1.11	1.11	1.07	1.89	2.79	2.46	1.90	2.62	2.62
Size	1 (small)	1.62	1.66	0.96	1.60	1.82	0.99	1.63	1.78	1.09	1.69	1.43	0.62	2.88	2.92	0.95
	2	1.81	1.91	1.16	1.44	1.51	1.04	1.84	2.01	1.20	2.13	2.15	1.30	1.77	1.82	1.37
	3	1.92	1.89	1.16	1.65	1.59	1.04	2.03	2.03	1.23	2.17	2.09	1.13	1.45	1.48	1.33
	4 (large)	1.14	1.38	1.07	1.09	1.32	1.03	1.26	1.45	1.16	1.05	1.35	1.09	1.08	1.28	1.22

The ratio of Dividends to Price. Source of calculation: Oslo Stock Exchange. The table shows averages. Along the rows the firms are grouped. The first row gives the average for all firms. The next rows group the firms on the exchange by the GICS standard. At the bottom we group the firms on the exchange by their size, as measured by equity value. The columns group the averages by subperiods, first the whole period

Figure 16.7 D/P ratio

Value weighted average

Equally weighted average

Min/Median/Max

Number of observations

The ratio of Dividends to Price. Source of calculation: Oslo Stock Exchange. The figures show time series of various averages for the whole sample. The value weighted average on top left uses the firm equity value for value weighting. The equally weighted average on top right uses all firms on the exchange for which we have data. The figure on the bottom right shows the highest (max), median, and lowest (min) value on each date. On the bottom right we show the number of observations on each date.

Figure 16.8 Size and industry sorted averages of D/P
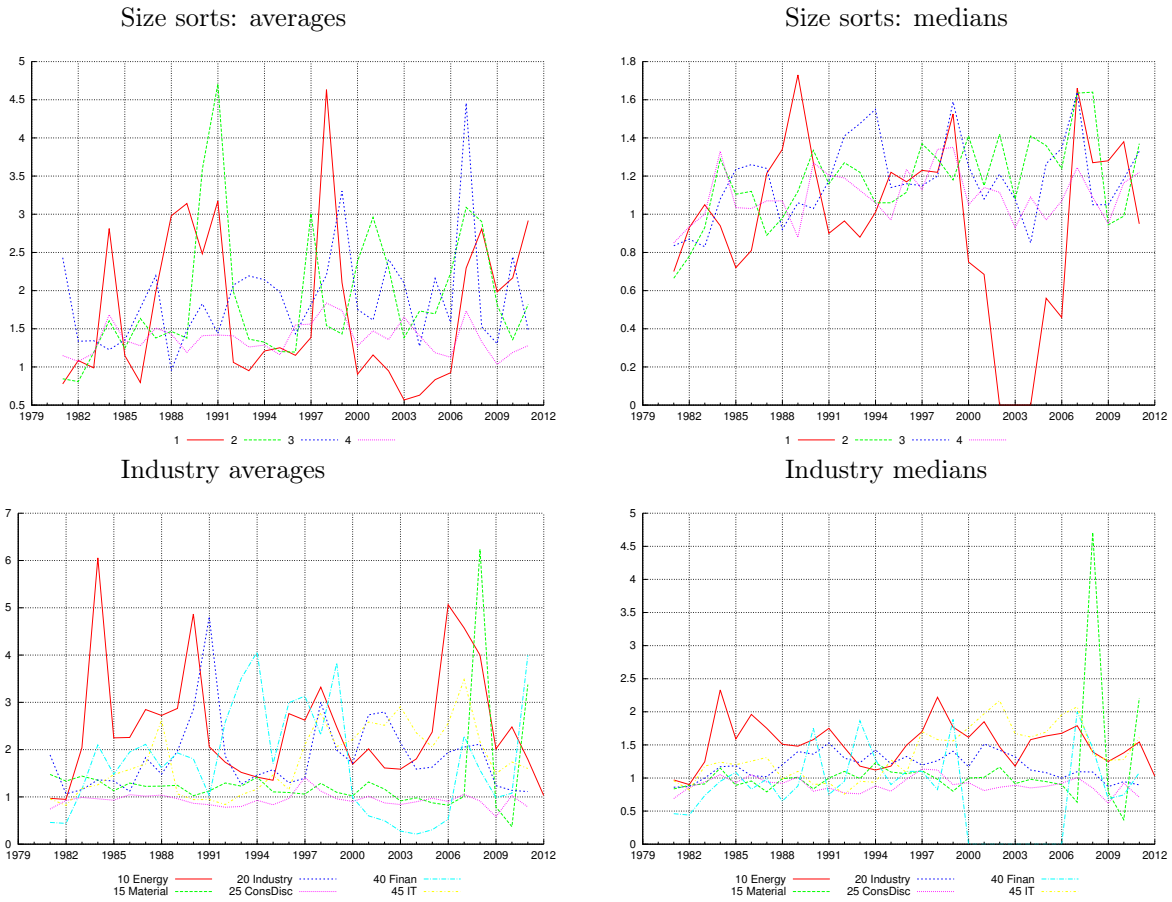
Size sorts: averages

Size sorts: medians

Industry averages

Industry medians

The ratio of Dividends to Price. Source of calculation: Oslo Stock Exchange. The figures show time series of various averages for the industry portfolios (top) and size portfolios (bottom).

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