

Heidorn, Thomas; Maier, F.; Winker, M.

**Working Paper**

## The effectiveness of seasonal investments in European Share Portfolios

Frankfurt School - Working Paper Series, No. 224

**Provided in Cooperation with:**

Frankfurt School of Finance and Management

*Suggested Citation:* Heidorn, Thomas; Maier, F.; Winker, M. (2017) : The effectiveness of seasonal investments in European Share Portfolios, Frankfurt School - Working Paper Series, No. 224, Frankfurt School of Finance & Management, Frankfurt a. M.

This Version is available at:

<https://hdl.handle.net/10419/150534>

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**Frankfurt School – Working Paper Series**

**No. 224**

**The Effectiveness of Seasonal  
Investments in European Share  
Portfolios**

by Heidorn, T., Maier, F., Winker, M.

January 2017



**German Excellence. Global Relevance.**

Sonnemannstr. 9–11 60314 Frankfurt am Main, Germany

Phone: +49 (0)69 154 0080 Fax: +49 (0)69 154 008 728

Internet: [www.frankfurt-school.de](http://www.frankfurt-school.de)

## **Abstract**

In this paper, calendar seasonality patterns are examined from day-of-the-week effect across weekly patterns, monthly analysis and whole-year seasonal strategies such as Sell in May and Halloween effect. The analysis is done across six indices, DAX, MDAX, SDAX, Eurostoxx 50, Stoxx Europe Mid 200 and Stoxx Europe Small 200. The observation period is from 1990 to 2015.

The evidence found in this paper cannot support the Monday effect across all Indices. . The Sell in May effect and Halloween effect were found to be existent over the whole observation period and being mostly influenced by the absence of investment in August and September.

Keywords: seasonality, day-of-the-week effect, Sell in May, Halloween effect, Monday effect,

JEL classification: F33, F37, G11, G13, G18, G20, G24, G28

ISSN: 14369753

Contact:

**Thomas Heidorn**

Frankfurt School of Finance and Management

Sonnemannstraße 9-11,

60314 Frankfurt am Main

Deutschland / Germany

t.heidorn@fs.de

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## 1. Introduction

Seasonal investments have been in the focus of investors for a long time. The Sell in May strategy (and go away) is one of the most famous “rules” of seasonality known by investors. Even if not having detailed knowledge about research in this field, most investors will have heard that sentence. This is a quite special approach, as this street wisdom is not only a strategy, but also a mix of anecdote and saying. There are of course many other sayings about seasonality, for example, “Sell in summer and redeem on Halloween”, or “In summer get investments turned or get burned”, which also are well known. However, “Sell in may” stayed unique over time.

Albeit it is not exactly known from who the saying first was used or when it arose, it is well-known that it is used with its second part “but remember to come back in September” and therefore completes a seasonal strategy when to buy and when to sell shares on the market. To round up the historical roots of this strategy, the original sentence was “but remember to come back on St. Leger’s day”. St. Leger Stakes is a famous horse race located in Doncaster/South Yorkshire, England and takes place in September. The month replaced the name of the horse race over the time, not changing the meaning of the saying at all. (Bouman, Jacobsen,2002)

This paper investigates for German and European indices the performance of seasonal investment rules. The paper starts with results for weekly investments, finding surprisingly stable patterns. After taking a look at the Halloween effect, seasonal investment guidelines are given. The paper concludes with a short look at the daily performance of the indices, but these are not very stable across indices.

## 2. Analysis of seasonal investment strategies

To better understand seasonal patterns the paper starts with a weekly analysis for DAX, MDAX, SDAX, Eurostoxx 50, Stoxx Europe Mid 200 and Stoxx Europe Small 200. The observation period is from 1990 to 2015 using daily returns. To make all indices comparable, all indices were chosen as price indices.

### 2.1 The analysis of weekly returns

The Analysis of the weeks is the starting point of seasonal investment strategies. This approach leads to a more detailed insight of how returns are distributed over the year. The table (1) on the next page shows the overall performance of an investment from 1990 until 2015 strictly limited to one individual calendar week.

In Table 1, lines are colored green, if a particular week produced a positive return through all six indices, and vice versa it is colored red if all six indices had a negative performance in a certain calendar week. In total, there are 19 green and 12 red lines.

During the first 19 weeks there are nine green lines, but no single red one. Between the 51st and the 1st row, there are four green lines behind each other.

Eleven out of twelve red lines occur between the 20th and 39th week with its strongest concentration of four red lines in a row between 36th and 39th week.

By looking at the distribution of the green lines, there seems to be a certain order where green lines occur. Especially in the first half of the year every fourth or fifth line is green, here calendar week 1,5,9,14,19 and 22.

calendar week	Performance 1990-2015					
	DAX	MDAX	SDAX	Eurostoxx 50	Stoxx Eur Mid	Stoxx Eur Small
1	41%	39%	54%	31%	39%	45%
2	-10%	-3%	0%	-8%	0%	5%
3	-7%	1%	-4%	-4%	2%	9%
4	-5%	6%	11%	-5%	-2%	-1%
5	44%	50%	42%	33%	34%	40%
6	-2%	19%	24%	-3%	9%	11%
7	24%	25%	20%	16%	20%	20%
8	-17%	-12%	11%	-15%	-8%	-9%
9	7%	7%	-4%	17%	18%	22%
10	8%	-1%	0%	-2%	-5%	-1%
11	-6%	3%	-5%	0%	-3%	-6%
12	10%	4%	2%	14%	7%	2%
13	15%	20%	16%	14%	13%	15%
14	25%	38%	29%	28%	28%	25%
15	1%	6%	11%	-6%	3%	3%
16	15%	15%	13%	19%	18%	20%
17	1%	11%	14%	0%	8%	12%
18	-8%	5%	4%	-6%	0%	2%
19	0%	15%	9%	7%	19%	17%
20	-18%	-13%	-11%	-12%	-15%	-20%
21	1%	9%	7%	-5%	-2%	-1%
22	14%	5%	13%	8%	12%	11%
23	-2%	8%	-2%	-3%	-4%	-7%
24	-6%	-9%	-6%	-8%	-10%	-11%
25	-12%	-11%	-9%	-17%	-22%	-27%
26	13%	5%	-2%	16%	2%	-3%
27	20%	16%	7%	7%	11%	6%
28	-1%	-5%	-3%	-12%	-15%	-16%
29	15%	13%	5%	7%	19%	18%
30	-24%	-21%	-19%	-10%	-16%	-16%
31	-9%	1%	-10%	-5%	2%	-2%
32	-11%	-7%	-13%	-2%	-7%	-9%
33	-25%	-17%	-18%	-21%	-12%	-11%
34	-8%	-7%	-4%	3%	6%	0%
35	2%	10%	9%	-3%	5%	6%
36	-20%	-12%	-17%	-13%	-13%	-12%
37	-11%	-5%	-4%	-12%	-10%	-11%
38	-24%	-31%	-29%	-19%	-27%	-32%
39	-18%	-12%	-16%	-4%	-9%	-15%
40	-1%	-9%	-8%	4%	-2%	-6%
41	3%	-2%	-17%	-12%	-20%	-19%
42	28%	18%	17%	35%	23%	14%
43	13%	13%	7%	7%	7%	5%
44	12%	12%	2%	7%	16%	9%
45	18%	12%	-5%	10%	11%	9%
46	14%	-18%	-6%	12%	-9%	-15%
47	5%	-13%	-8%	0%	-8%	-13%
48	51%	40%	26%	45%	48%	43%
49	3%	2%	-8%	-5%	-4%	-1%
50	-23%	-18%	-20%	-23%	-20%	-21%
51	27%	17%	7%	34%	23%	18%
52	22%	19%	22%	25%	23%	23%
53	2%	2%	5%	2%	3%	5%

Table 1: single calendar week investment 1990-2015; Bloomberg/STOXX, own compilation

After calendar weeks 36-39, which are all red, calendar week 40 is the first line not being red, followed by 44, 48 and 52/53 being green and continuing the four/five-week pattern.

This analysis shows that there is a concentration of positive returns at the beginning and the end of the year and a concentration of negative returns during the middle of the year. In addition, a certain pattern of strongly positive followed by mixed returns within a month seems to occur.

To compare seasonal investment strategies and to find out if they were /are effective a graph of the six analyzed indices is shown, giving visual evidence of how long-only investments since 1990 have performed.

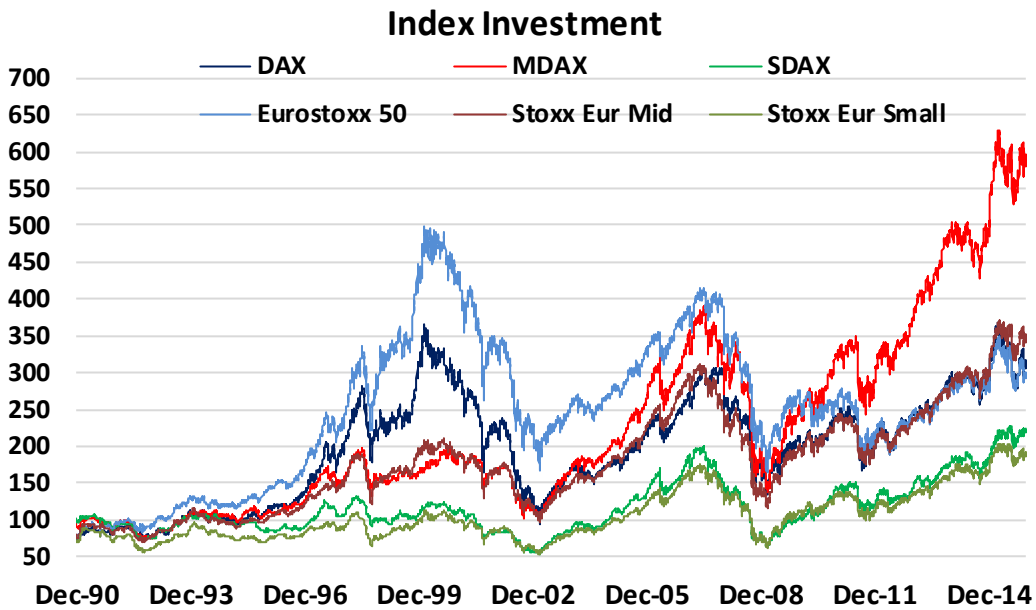


Figure 1: index investment graph; Bloomberg/STOXX, own compilation

## 2.2 Sell in May

### 1.2.1 History and special feature of Sell in May

By analyzing the “Sell in May” strategy, there is a certain range of interpretation. As the only hints are to sell in May and to buy/ come back in September, it is nothing said about at which time of the months the selling or purchase should occur. As it probably makes a difference whether to sell/buy always at the beginning or at the end of a month, the analysis here was done in four different versions:

- “Sell in may **AS**”: Sell at end of **A**pril and buy at beginning of **S**eptember
- “Sell in May **MS**” Sell at end of **M**ay and buy at beginning of **S**eptember
- “Sell in May **AO**”: Sell at end of **A**pril and buy at beginning of **O**ctober
- “Sell in May **MO**”: Sell at end of **M**ay and buy at beginning of **O**ctober

All four versions are covered within the saying, as selling on the last trading day of April is similar to selling on the first trading day of May and vice versa for September/October. First, an investment graph is shown and discussed and further the risk- and risk-return ratios are examined. At the end of this analysis, the discussion interprets and compares the results with regard to relevant literature findings.

### 1.2.2 Analysis of Sell in May versions

The analysis starts with a look at the four investment graphs:

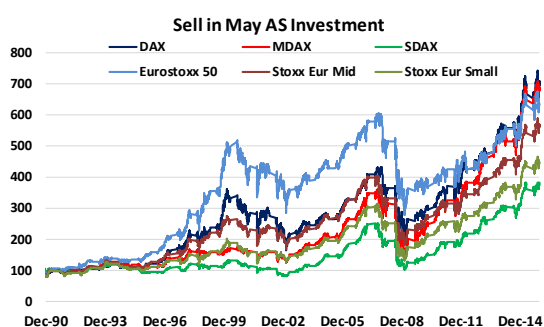


Figure 2: Sell in May AS investment graph; Bloomberg/STOXX, own compilation

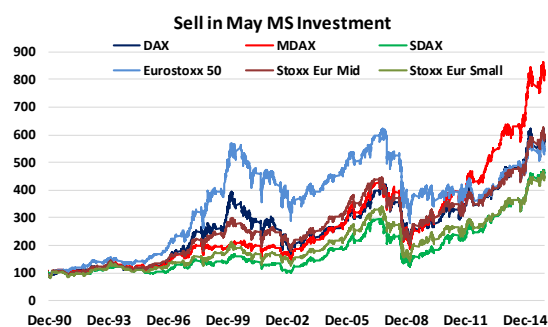


Figure 3: Sell in May MS investment graph; Bloomberg/STOXX, own compilation

The first two graphs show a similar picture with diverse performance among the indices up to Dec 99 and from then on highly correlated developments ongoing with a large difference in their magnitude. All indices face a huge drop in 2007/2008 during the financial crisis. In both versions, the performance of all indices except for the MDAX was at least twice the performance of their index long-only investment.



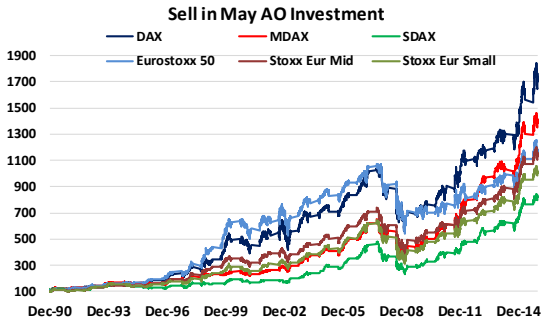


Figure 4: Sell in May AO investment graph; Bloomberg/STOXX, own compilation

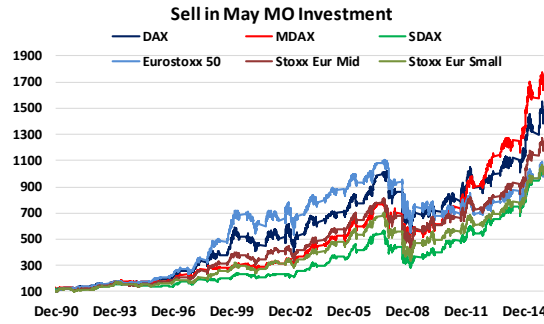


Figure 5: Sell in May MO investment graph; Bloomberg/STOXX, own compilation

The second pair of investment graphs also shows a similar, positive picture. But here the development is more constant among the indices. The magnitude is significantly larger than their long-only indices and the first two Sell in May versions. All indices within the Sell in May AO and -MO version face a drop during the financial crisis, but the drop seems to be less severe than within the Sell in May AS and MS version. Both Sell in May AO and MO versions have a performance up to four times the long-only investment and a performance about twice as high as their corresponding Sell in May AS and MS versions.

The next two tables show the risk- and risk-return ratios of all four Sell in May versions:

Sell in May AS	Max Drawdown %					
	DAX	MDAX	SDAX	Eurostoxx 50	Stoxx Eur Mid	Stoxx Eur Small
5 year-rolling windows						
1990-1994	-25,4%	-23,4%	-23,3%	-18,3%	-20,4%	-23,3%
1991-1995	-16,9%	-19,1%	-23,9%	-11,2%	-19,4%	-23,6%
1992-1996	-16,9%	-19,1%	-24,1%	-11,2%	-19,4%	-23,6%
1993-1997	-17,9%	-19,1%	-24,1%	-15,2%	-19,4%	-23,6%
1994-1998	-24,4%	-20,6%	-24,1%	-22,4%	-21,0%	-23,6%
1995-1999	-24,4%	-20,6%	-17,0%	-22,4%	-21,0%	-21,4%
1996-2000	-24,4%	-20,6%	-14,6%	-22,4%	-21,0%	-21,4%
1997-2001	-42,4%	-28,0%	-29,9%	-35,5%	-34,9%	-39,8%
1998-2002	-46,6%	-28,0%	-38,6%	-36,4%	-34,9%	-39,8%
1999-2003	-54,9%	-29,7%	-39,9%	-45,3%	-38,0%	-39,8%
2000-2004	-54,9%	-29,7%	-39,9%	-45,3%	-38,0%	-39,8%
2001-2005	-47,7%	-26,7%	-34,8%	-38,4%	-30,7%	-28,1%
2002-2006	-45,6%	-22,9%	-25,7%	-36,3%	-30,7%	-24,4%
2003-2007	-30,5%	-16,0%	-17,3%	-26,9%	-20,9%	-16,9%
2004-2008	-45,6%	-52,7%	-54,6%	-45,2%	-51,3%	-54,4%
2005-2009	-51,9%	-58,6%	-59,4%	-54,2%	-55,6%	-58,5%
2006-2010	-51,9%	-58,6%	-59,4%	-54,2%	-55,6%	-58,5%
2007-2011	-51,9%	-58,6%	-59,4%	-54,2%	-55,6%	-58,5%
2008-2012	-51,8%	-54,9%	-53,2%	-53,2%	-50,6%	-53,2%
2009-2013	-27,4%	-29,3%	-24,4%	-29,8%	-22,3%	-23,3%
2010-2014	-14,5%	-15,2%	-13,4%	-15,6%	-13,5%	-13,8%
2011-2015	-15,1%	-15,2%	-13,4%	-15,6%	-13,5%	-13,8%

Table 2: Sell in May AS Maximum Drawdown 5y rolling windows; Bloomberg/STOXX, own compilation

Sell in May MS	Max Drawdown %					
	DAX	MDAX	SDAX	Eurostoxx 50	Stoxx Eur Mid	Stoxx Eur Small
5 year-rolling windows						
1990-1994	-24,5%	-20,4%	-21,1%	-16,2%	-20,1%	-20,0%
1991-1995	-20,6%	-19,1%	-21,8%	-15,5%	-23,9%	-24,7%
1992-1996	-20,6%	-19,1%	-22,0%	-15,5%	-23,9%	-24,7%
1993-1997	-20,6%	-19,1%	-22,0%	-15,5%	-23,9%	-24,7%
1994-1998	-23,7%	-20,6%	-22,0%	-22,1%	-23,9%	-24,7%
1995-1999	-23,7%	-20,6%	-15,4%	-22,1%	-20,6%	-20,9%
1996-2000	-25,1%	-20,6%	-15,4%	-22,1%	-20,6%	-22,6%
1997-2001	-46,8%	-26,6%	-30,9%	-37,4%	-35,3%	-39,0%
1998-2002	-53,3%	-29,5%	-38,9%	-40,9%	-35,3%	-39,0%
1999-2003	-60,6%	-31,8%	-40,1%	-49,1%	-40,5%	-39,8%
2000-2004	-60,6%	-31,8%	-40,1%	-49,1%	-40,5%	-39,8%
2001-2005	-52,0%	-28,9%	-33,7%	-42,2%	-33,1%	-27,3%
2002-2006	-48,5%	-26,6%	-25,2%	-39,0%	-33,1%	-27,3%
2003-2007	-30,5%	-16,2%	-17,3%	-26,9%	-20,9%	-16,9%
2004-2008	-45,4%	-51,7%	-54,1%	-45,9%	-50,5%	-54,6%
2005-2009	-51,7%	-57,8%	-58,9%	-54,7%	-54,8%	-58,7%
2006-2010	-51,7%	-57,8%	-58,9%	-54,7%	-54,8%	-58,7%
2007-2011	-51,7%	-57,8%	-58,9%	-54,7%	-54,8%	-58,7%
2008-2012	-51,7%	-54,4%	-52,7%	-53,8%	-49,8%	-53,4%
2009-2013	-27,4%	-29,3%	-24,4%	-29,8%	-22,3%	-23,3%
2010-2014	-16,8%	-15,3%	-13,0%	-19,2%	-14,5%	-16,7%
2011-2015	-16,9%	-15,3%	-13,0%	-19,2%	-13,9%	-13,5%

Table 3: Sell in May MS Maximum Drawdown 5y rolling windows; Bloomberg/STOXX, own compilation

The Maximum Drawdowns for the Sell in May AS and MS versions are both high, with the -MS version having Drawdowns close to the index investment figures especially during crisis years around 2000 and 2008.

## The Effectiveness of Seasonal Investments in European Share Portfolios

Sell in May AO 5 year-rolling windows	Max Drawdown %					
	DAX	MDAX	SDAX	Eurostoxx 50	Stoxx Eur Mid	Stoxx Eur Small
1990-1994	-13,2%	-13,5%	-11,4%	-11,5%	-14,5%	-18,7%
1991-1995	-13,2%	-12,8%	-11,4%	-10,2%	-16,0%	-18,7%
1992-1996	-12,7%	-14,4%	-15,1%	-9,3%	-19,3%	-20,1%
1993-1997	-12,7%	-14,4%	-15,4%	-9,3%	-19,3%	-20,1%
1994-1998	-17,9%	-14,4%	-15,4%	-15,7%	-19,3%	-20,1%
1995-1999	-17,9%	-14,4%	-15,4%	-15,7%	-13,7%	-16,4%
1996-2000	-17,9%	-11,6%	-13,2%	-15,7%	-11,2%	-13,1%
1997-2001	-17,9%	-11,6%	-13,2%	-15,7%	-11,2%	-13,2%
1998-2002	-31,0%	-16,3%	-15,0%	-24,6%	-23,8%	-26,0%
1999-2003	-31,0%	-16,3%	-17,5%	-24,6%	-23,8%	-26,0%
2000-2004	-31,0%	-16,3%	-17,5%	-24,6%	-23,8%	-26,0%
2001-2005	-35,1%	-17,0%	-17,5%	-30,7%	-25,3%	-26,0%
2002-2006	-35,1%	-17,0%	-17,5%	-30,7%	-25,3%	-21,7%
2003-2007	-35,1%	-17,0%	-11,9%	-30,7%	-25,3%	-21,1%
2004-2008	-35,1%	-17,0%	-15,1%	-30,7%	-25,3%	-21,1%
2005-2009	-21,9%	-16,2%	-15,1%	-18,9%	-15,6%	-13,5%
2006-2010	-23,6%	-26,2%	-30,2%	-23,6%	-26,6%	-27,3%
2007-2011	-39,8%	-39,7%	-44,2%	-40,5%	-42,4%	-47,4%
2008-2012	-46,8%	-47,3%	-50,1%	-49,9%	-47,4%	-52,1%
2009-2013	-46,8%	-47,3%	-50,1%	-49,9%	-47,4%	-52,1%
2010-2014	-46,8%	-47,3%	-50,1%	-49,9%	-47,4%	-52,1%
2011-2015	-39,0%	-43,1%	-38,2%	-42,0%	-38,7%	-42,4%

Table 4: Sell in May AO Maximum Drawdown 5y rolling windows; Bloomberg/STOXX, own compilation

Sell in May MO 5 year-rolling windows	Max Drawdown %					
	DAX	MDAX	SDAX	Eurostoxx 50	Stoxx Eur Mid	Stoxx Eur Small
1990-1994	-13,2%	-13,5%	-11,4%	-11,5%	-15,3%	-18,7%
1991-1995	-12,7%	-14,4%	-15,1%	-9,3%	-19,3%	-20,1%
1992-1996	-12,7%	-14,4%	-15,4%	-9,3%	-19,3%	-20,1%
1993-1997	-17,9%	-14,4%	-15,4%	-15,7%	-19,3%	-20,1%
1994-1998	-17,9%	-14,4%	-15,4%	-15,7%	-19,3%	-20,1%
1995-1999	-17,9%	-11,6%	-13,2%	-15,7%	-11,2%	-13,1%
1996-2000	-20,5%	-11,6%	-13,2%	-15,7%	-14,2%	-18,8%
1997-2001	-31,0%	-16,3%	-17,5%	-24,6%	-23,8%	-26,0%
1998-2002	-31,0%	-16,3%	-17,5%	-24,6%	-23,8%	-26,0%
1999-2003	-35,1%	-17,0%	-17,5%	-30,7%	-25,3%	-26,0%
2000-2004	-35,1%	-17,0%	-17,5%	-30,7%	-25,3%	-26,0%
2001-2005	-35,1%	-17,0%	-11,9%	-30,7%	-25,3%	-21,1%
2002-2006	-35,1%	-17,0%	-15,1%	-30,7%	-25,3%	-21,1%
2003-2007	-30,5%	-16,2%	-17,2%	-26,9%	-20,9%	-16,9%
2004-2008	-39,8%	-39,7%	-44,2%	-40,0%	-42,4%	-47,4%
2005-2009	-46,8%	-47,3%	-50,1%	-49,9%	-47,4%	-52,1%
2006-2010	-46,8%	-47,3%	-50,1%	-49,9%	-47,4%	-52,1%
2007-2011	-46,8%	-47,3%	-50,1%	-49,9%	-47,4%	-52,1%
2008-2012	-46,8%	-43,1%	-42,6%	-48,8%	-41,5%	-46,0%
2009-2013	-27,4%	-29,3%	-24,4%	-29,8%	-22,3%	-23,3%
2010-2014	-18,3%	-14,6%	-13,0%	-19,7%	-14,5%	-16,7%
2011-2015	-18,3%	-13,6%	-12,1%	-19,7%	-14,5%	-13,1%

Table 5: Sell in May MO Maximum Drawdown 5y rolling windows; Bloomberg/STOXX, own compilation

The Drawdown figures for the Sell in May AO and MO versions are smaller than the index investment figures. Furthermore, there is a significant difference between the figures of the AS/MS-versions and the figures from the AO/MO-versions, letting the AO/MO versions being superior to their second pair of Sell in May models. This “splitting” is also true by looking at volatility figures.

Sell in May AS 5 year-rolling windows	Sharpe Ratio					
	DAX	MDAX	SDAX	Eurostoxx 50	Stoxx Eur Mid	Stoxx Eur Small
1990-1994	0,16	0,33	0,20	0,40	0,24	0,20
1991-1995	0,33	0,25	-0,17	0,75	0,51	0,38
1992-1996	0,56	0,52	0,19	0,99	0,93	0,75
1993-1997	0,69	0,62	0,09	0,97	0,94	0,67
1994-1998	0,59	0,43	-0,07	1,00	0,82	0,37
1995-1999	1,00	0,39	0,05	1,49	1,36	0,80
1996-2000	0,91	0,55	0,42	1,24	1,09	0,75
1997-2001	0,57	0,36	0,11	0,79	0,61	0,36
1998-2002	0,13	0,07	-0,27	0,38	0,29	0,18
1999-2003	0,07	0,04	-0,17	0,15	0,07	0,09
2000-2004	-0,09	0,33	0,27	-0,05	-0,01	0,09
2001-2005	0,00	0,43	0,47	0,01	0,25	0,38
2002-2006	0,22	1,11	1,62	0,19	0,76	1,08
2003-2007	0,78	1,32	1,81	0,59	0,91	1,15
2004-2008	0,10	0,18	0,27	-0,02	-0,01	0,02
2005-2009	0,05	0,08	0,02	-0,08	-0,03	0,01
2006-2010	0,12	0,24	0,22	-0,13	0,06	0,15
2007-2011	0,02	0,02	-0,13	-0,16	-0,14	-0,10
2008-2012	0,05	0,15	0,07	-0,17	0,01	0,05
2009-2013	0,64	0,92	1,09	0,31	0,81	0,90
2010-2014	0,76	1,06	1,32	0,35	0,82	0,91
2011-2015	0,75	0,94	1,06	0,48	0,77	0,78

Table 6: Sell in May AS Sharpe ratio 5y rolling windows; Bloomberg/STOXX, own compilation

Sell in May MS 5 year-rolling windows	Sharpe Ratio					
	DAX	MDAX	SDAX	Eurostoxx 50	Stoxx Eur Mid	Stoxx Eur Small
1990-1994	0,19	0,37	0,30	0,47	0,31	0,24
1991-1995	0,39	0,35	-0,03	0,83	0,54	0,39
1992-1996	0,56	0,70	0,42	1,01	0,95	0,78
1993-1997	0,69	0,86	0,50	0,99	0,98	0,66
1994-1998	0,68	0,68	0,24	1,09	0,89	0,38
1995-1999	1,10	0,72	0,43	1,62	1,50	0,90
1996-2000	0,91	0,77	0,69	1,29	1,10	0,73
1997-2001	0,54	0,51	0,31	0,81	0,64	0,39
1998-2002	0,04	0,08	-0,20	0,34	0,24	0,15
1999-2003	-0,06	0,05	-0,03	0,06	0,04	0,11
2000-2004	-0,19	0,31	0,29	-0,12	-0,02	0,10
2001-2005	-0,03	0,52	0,56	-0,01	0,35	0,52
2002-2006	0,15	0,97	1,35	0,14	0,72	0,99
2003-2007	0,79	1,29	1,57	0,60	0,97	1,20
2004-2008	0,11	0,19	0,18	-0,03	0,02	0,02
2005-2009	0,09	0,12	0,03	-0,05	0,05	0,08
2006-2010	0,08	0,19	0,17	-0,19	0,03	0,09
2007-2011	-0,01	0,03	-0,08	-0,22	-0,13	-0,12
2008-2012	-0,07	0,09	0,03	-0,29	-0,06	-0,05
2009-2013	0,55	0,86	1,03	0,18	0,70	0,78
2010-2014	0,60	0,97	1,18	0,16	0,63	0,66
2011-2015	0,63	0,96	1,10	0,37	0,73	0,74

Table 7: Sell in May MS Sharpe ratio 5y rolling windows; Bloomberg/STOXX, own compilation

The Sharpe ratios are in both versions predominantly positive with a few exceptions, showing a pattern that more negative figures occur in the MS-version than in the AS-version. The Calmar ratios are in line with the findings of the Sharpe ratios.

Sell in May AO 5 year-rolling windows	Sharpe Ratio					
	DAX	MDAX	SDAX	Eurostoxx 50	Stoxx Eur Mid	Stoxx Eur Small
1990-1994	0,64	1,07	0,98	0,81	0,89	0,98
1991-1995	0,62	0,64	0,26	0,94	0,78	0,75
1992-1996	0,79	0,77	0,48	1,10	1,14	1,13
1993-1997	0,72	0,68	0,28	0,93	0,95	0,80
1994-1998	0,70	0,58	0,17	1,12	1,02	0,69
1995-1999	1,04	0,46	0,24	1,56	1,51	1,08
1996-2000	0,97	0,59	0,60	1,33	1,24	1,02
1997-2001	0,85	0,64	0,60	1,09	1,04	0,89
1998-2002	0,64	0,62	0,49	0,90	0,96	0,97
1999-2003	0,54	0,52	0,50	0,55	0,58	0,71
2000-2004	0,33	0,81	0,91	0,30	0,43	0,64
2001-2005	0,38	0,88	1,02	0,31	0,67	0,88
2002-2006	0,46	1,31	1,79	0,38	0,91	1,23
2003-2007	0,70	1,15	1,61	0,52	0,85	1,02
2004-2008	0,07	0,26	0,40	-0,03	0,08	0,07
2005-2009	0,02	0,10	0,12	-0,09	0,03	0,03
2006-2010	0,08	0,24	0,30	-0,14	0,11	0,16
2007-2011	0,04	0,12	0,03	-0,13	-0,02	0,00
2008-2012	0,07	0,26	0,19	-0,12	0,10	0,13
2009-2013	0,58	0,85	0,95	0,25	0,75	0,83
2010-2014	0,68	1,10	1,27	0,29	0,81	0,89
2011-2015	0,81	1,11	1,20	0,54	0,90	0,92

Table 8: Sell in May AO Sharpe ratio 5y rolling windows; Bloomberg/STOXX, own compilation

Sell in May MO 5 year-rolling windows	Sharpe Ratio					
	DAX	MDAX	SDAX	Eurostoxx 50	Stoxx Eur Mid	Stoxx Eur Small
1990-1994	0,68	1,07	1,01	0,84	0,82	0,91
1991-1995	0,70	0,76	0,42	1,03	0,82	0,78
1992-1996	0,79	0,96	0,72	1,11	1,17	1,18
1993-1997	0,72	0,93	0,70	0,96	0,99	0,80
1994-1998	0,80	0,85	0,50	1,22	1,09	0,70
1995-1999	1,15	0,80	0,63	1,69	1,66	1,19
1996-2000	0,98	0,80	0,88	1,38	1,25	1,00
1997-2001	0,83	0,81	0,83	1,11	1,08	0,94
1998-2002	0,55	0,65	0,59	0,85	0,92	0,96
1999-2003	0,39	0,54	0,68	0,46	0,55	0,74
2000-2004	0,22	0,78	0,93	0,22	0,43	0,66
2001-2005	0,35	0,98	1,12	0,29	0,79	1,05
2002-2006	0,38	1,13	1,47	0,32	0,86	1,12
2003-2007	0,72	1,13	1,39	0,53	0,90	1,07
2004-2008	0,09	0,27	0,31	-0,04	0,11	0,08
2005-2009	0,06	0,14	0,14	-0,07	0,11	0,10
2006-2010	0,04	0,19	0,25	-0,20	0,08	0,10
2007-2011	0,01	0,14	0,08	-0,18	0,00	-0,02
2008-2012	-0,06	0,20	0,15	-0,25	0,03	0,02
2009-2013	0,43	0,75	0,88	0,10	0,61	0,67
2010-2014	0,51	0,99	1,13	0,09	0,60	0,64
2011-2015	0,69	1,13	1,24	0,42	0,85	0,87

Table 9: Sell in May MO Sharpe ratio 5y rolling windows; Bloomberg/STOXX, own compilation

The Sharpe ratios for the AO- and Mo-version show throughout positive figures. All indices have a maximum of one negative figure for the whole observation except for the Eurostoxx 50. The European Large-caps face a series of negative figures from 2004-2008 until 2008-2012 rolling window. Overall the Sharpe ratio and the Calmar ratio for both AO/MO versions are superior to the figures from the AS/MS versions.

### 1.2.3 Discussion of Sell in May Effect

The analysis of Sell in May with regard to literature can be confusing. While Bouman and Jacobsen (2002) have one of the most cited papers about “Sell in may” and were the first to write about the Halloween effect, the same paper was the basis for an imprecise handling of the Sell in May effect, which is originally combined with “and come back in September”, but was used by them in combination with the Halloween effect. As further evidence about “Sell in May” with reference to Bouman and Jacobsen was done, research papers were setting Sell in May equal to the period of the Halloween effect, that is the period from November to April and was originally discussed by John Downes in 1990 (a.g.i. Bouman, Jacobsen, 2002). The results indeed were not confusing or imprecise, the Sell in May effect was throughout confirmed in several papers across many countries (Andrade et al., 2013; Guo et al, 2014).

As the paper analyzed four different versions, there are certain patterns that show all versions likewise. One of them is the outperformance of their index investment. But there is a clear cut within the magnitude. The Sell in May AS and MS versions in comparison are about the same. The AO- and MO-version are about the same as well, but at a significantly higher return scale. In general, all risk- and risk-return ratios show that the Sell in May AO and MO versions were always superior to their corresponding AS and MS version. In addition, within those two the AS/AO version was always slightly superior to its corresponding MS/MO version.

The crucial point between outperforming the index “only” significantly or outperforming the index abnormally high seems to be the matter of coming back at the end of September to in-

crease profits substantially even within the Sell in May- versions. That, in fact, is not surprising by looking at the severe negative returns of September in the monthly analysis.

Depending on the definition of the four discussed versions in this paper, Sell in May indeed is converging towards the Halloween effect: The Sell in May AO version has the only difference of being invested in the beginning of October instead of November in comparison to Halloween.

## 2.3 Halloween effect

The Halloween effect describes as before mentioned the investment period from November to April, starting with the investment beginning at the turn of October to November, that is Halloween or All Hallow’s Eve.

### 2.3.1 Analysis

The analysis starts with the investment graph of the Halloween effect:

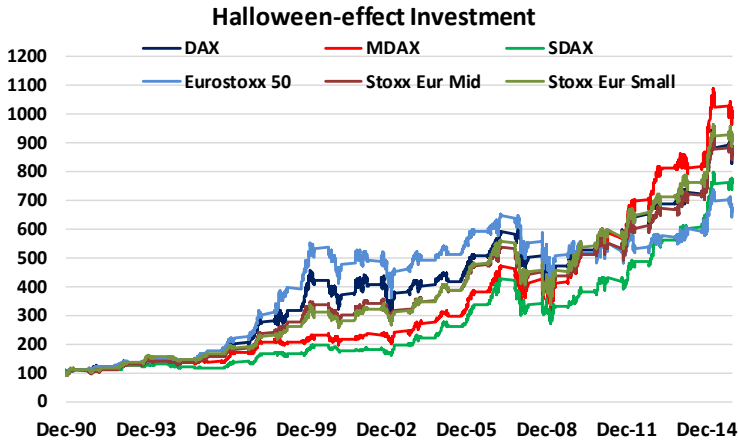


Figure 6: Halloween effect investment graph; Bloomberg/STOXX, own compilation

Halloween effect	Return absolute %					
	5 year-rolling windows	DAX	MDAX	SDAX	Eurostoxx 50	Stoxx Eur Mid
1990-1994	42,0%	40,5%	25,9%	43,3%	37,0%	52,4%
1991-1995	44,7%	31,4%	7,7%	63,7%	48,8%	53,3%
1992-1996	52,4%	34,9%	16,7%	69,8%	64,4%	66,3%
1993-1997	83,1%	49,8%	20,9%	88,5%	62,6%	59,3%
1994-1998	105,9%	56,1%	32,0%	142,3%	81,8%	57,2%
1995-1999	178,6%	49,5%	33,6%	243,8%	141,3%	92,4%
1996-2000	172,0%	56,8%	57,9%	221,3%	124,4%	96,7%
1997-2001	147,9%	60,5%	46,9%	176,3%	101,0%	81,7%
1998-2002	63,4%	33,9%	27,8%	93,4%	71,2%	64,7%
1999-2003	38,6%	17,4%	17,8%	38,2%	28,0%	36,2%
2000-2004	9,2%	38,2%	40,9%	4,2%	12,8%	27,6%
2001-2005	20,1%	47,4%	49,1%	9,3%	35,0%	45,0%
2002-2006	27,4%	84,0%	111,1%	16,3%	52,1%	65,7%
2003-2007	59,6%	92,3%	117,6%	36,6%	48,8%	59,5%
2004-2008	19,8%	70,4%	77,0%	7,4%	25,7%	28,3%
2005-2009	20,1%	58,6%	44,8%	6,3%	26,0%	30,2%
2006-2010	20,8%	74,2%	54,4%	-7,4%	29,2%	39,3%
2007-2011	7,5%	39,1%	11,6%	-12,1%	8,8%	12,4%
2008-2012	13,6%	65,8%	35,2%	-11,8%	29,1%	34,5%
2009-2013	50,0%	100,7%	63,8%	11,9%	70,4%	83,0%
2010-2014	46,9%	85,6%	88,5%	11,0%	58,7%	62,7%
2011-2015	58,2%	80,2%	84,6%	31,5%	61,5%	59,6%

Table 10: Halloween effect returns 5y rolling windows; Bloomberg/STOXX, own compilation

The graph (figure 6) shows a clear trend of positive returns for all observed indices. They gained between 500% and 900% value over the observation period.

There is a change in magnitude, as Large-caps faced higher returns until the financial crisis, being left behind by the Mid- and Small-caps afterwards. With the exception of Eurostoxx 50, all indices had throughout positive returns, most of them in two-digit and even three-digit space.

The next two tables show the corresponding risk figures and risk-return ratios:

Halloween effect 5 year-rolling windows	Max Drawdown %						Volatility p.a. %					
	DAX	MDAX	SDAX	Eurostoxx 50	Stoxx Eur Mid	Stoxx Eur Small	DAX	MDAX	SDAX	Eurostoxx 50	Stoxx Eur Mid	Stoxx Eur Small
1990-1994	-15,2%	-17,3%	-12,0%	-11,7%	-13,3%	-14,4%	16,8%	11,0%	9,0%	13,0%	10,4%	9,7%
1991-1995	-10,9%	-10,7%	-12,4%	-7,6%	-14,6%	-14,5%	15,2%	9,7%	8,0%	12,3%	10,1%	9,3%
1992-1996	-10,9%	-10,7%	-12,7%	-7,6%	-14,6%	-14,5%	13,6%	8,8%	7,1%	11,1%	9,1%	8,2%
1993-1997	-10,9%	-10,7%	-12,7%	-7,6%	-14,6%	-14,5%	15,5%	9,7%	7,3%	12,5%	9,1%	7,9%
1994-1998	-11,7%	-10,7%	-12,7%	-8,5%	-14,6%	-14,5%	17,5%	10,4%	7,8%	14,6%	10,2%	9,0%
1995-1999	-14,2%	-10,1%	-10,3%	-9,8%	-6,9%	-9,4%	19,3%	10,8%	8,8%	16,5%	10,6%	9,4%
1996-2000	-19,8%	-10,2%	-9,4%	-11,4%	-12,4%	-15,8%	22,1%	12,2%	10,2%	19,5%	13,0%	11,9%
1997-2001	-30,4%	-16,3%	-14,9%	-25,3%	-22,1%	-23,3%	24,2%	13,4%	10,8%	21,5%	14,4%	13,1%
1998-2002	-30,4%	-16,3%	-16,3%	-25,3%	-22,1%	-23,3%	25,9%	13,0%	11,0%	22,7%	14,9%	13,4%
1999-2003	-38,4%	-17,0%	-18,1%	-34,5%	-25,3%	-23,3%	28,7%	13,8%	11,1%	25,3%	15,8%	13,7%
2000-2004	-38,4%	-17,0%	-18,1%	-34,5%	-25,3%	-23,3%	27,3%	13,8%	10,7%	24,0%	15,6%	13,6%
2001-2005	-36,0%	-17,0%	-15,2%	-31,5%	-25,3%	-21,1%	24,9%	12,6%	9,7%	21,6%	13,8%	11,6%
2002-2006	-36,0%	-17,0%	-11,9%	-31,5%	-25,3%	-21,1%	22,7%	11,7%	9,5%	19,8%	12,5%	10,5%
2003-2007	-30,5%	-15,5%	-16,3%	-26,9%	-20,9%	-16,9%	19,9%	13,9%	11,7%	18,0%	13,1%	11,9%
2004-2008	-29,9%	-25,5%	-29,7%	-29,2%	-30,7%	-33,7%	20,2%	20,6%	16,7%	20,1%	17,3%	17,2%
2005-2009	-38,0%	-34,2%	-37,1%	-40,8%	-36,8%	-39,6%	23,6%	25,1%	18,6%	23,9%	20,3%	21,4%
2006-2010	-38,0%	-34,2%	-37,1%	-40,8%	-36,8%	-39,6%	24,1%	26,0%	19,0%	24,9%	21,0%	22,2%
2007-2011	-38,0%	-34,2%	-37,1%	-40,8%	-36,8%	-39,6%	25,5%	27,2%	20,0%	26,4%	22,3%	23,3%
2008-2012	-38,0%	-32,0%	-28,4%	-39,3%	-30,0%	-32,2%	25,9%	27,0%	19,2%	26,8%	22,1%	23,2%
2009-2013	-27,4%	-29,3%	-24,4%	-29,8%	-22,3%	-23,3%	21,1%	21,8%	15,2%	22,2%	17,9%	19,3%
2010-2014	-12,3%	-11,4%	-10,7%	-14,3%	-13,0%	-11,7%	17,7%	16,9%	13,5%	18,9%	14,9%	15,1%
2011-2015	-13,7%	-11,6%	-10,7%	-14,3%	-13,0%	-11,7%	18,6%	16,5%	13,6%	18,9%	14,9%	14,8%

Table 11: Halloween effect risk figures 5y rolling windows; Bloomberg/STOXX, own compilation

The Maximum Drawdowns for the Halloween effect are significantly below index average for all six indices. The volatility figures are at least slightly below their corresponding index investment figures.

Halloween effect 5 year-rolling windows	Sharpe Ratio						5y Calmar Ratio					
	DAX	MDAX	SDAX	Eurostoxx 50	Stoxx Eur Mid	Stoxx Eur Small	DAX	MDAX	SDAX	Eurostoxx 50	Stoxx Eur Mid	Stoxx Eur Small
1990-1994	0,43	0,64	0,53	0,57	0,62	0,91	0,48	0,41	0,39	0,64	0,49	0,61
1991-1995	0,50	0,58	0,19	0,84	0,82	0,96	0,70	0,52	0,12	1,36	0,57	0,62
1992-1996	0,65	0,70	0,44	1,00	1,15	1,30	0,81	0,58	0,25	1,46	0,72	0,74
1993-1997	0,83	0,87	0,53	1,08	1,13	1,23	1,18	0,79	0,30	1,77	0,70	0,67
1994-1998	0,89	0,90	0,73	1,33	1,25	1,05	1,33	0,87	0,45	2,27	0,87	0,65
1995-1999	1,18	0,78	0,68	1,70	1,81	1,48	1,60	0,83	0,58	2,87	2,80	1,49
1996-2000	1,00	0,77	0,93	1,35	1,35	1,22	1,12	0,93	1,02	2,30	1,42	0,91
1997-2001	0,82	0,74	0,74	1,05	1,04	0,97	0,65	0,61	0,54	0,89	0,68	0,54
1998-2002	0,40	0,46	0,46	0,62	0,76	0,78	0,34	0,37	0,31	0,56	0,51	0,45
1999-2003	0,23	0,24	0,30	0,26	0,32	0,46	0,18	0,19	0,18	0,19	0,20	0,27
2000-2004	0,07	0,49	0,67	0,03	0,16	0,37	0,05	0,39	0,39	0,02	0,10	0,21
2001-2005	0,15	0,64	0,86	0,08	0,45	0,66	0,10	0,47	0,55	0,06	0,24	0,37
2002-2006	0,22	1,11	1,70	0,15	0,70	1,01	0,14	0,76	1,36	0,10	0,35	0,50
2003-2007	0,49	1,00	1,43	0,36	0,63	0,82	0,32	0,90	1,03	0,24	0,40	0,58
2004-2008	0,18	0,55	0,72	0,07	0,27	0,30	0,12	0,44	0,41	0,05	0,15	0,15
2005-2009	0,16	0,39	0,41	0,05	0,23	0,25	0,10	0,28	0,21	0,03	0,13	0,14
2006-2010	0,16	0,45	0,48	-0,06	0,25	0,31	0,10	0,34	0,24	-0,04	0,14	0,17
2007-2011	0,06	0,25	0,11	-0,10	0,08	0,10	0,04	0,20	0,06	-0,06	0,05	0,06
2008-2012	0,10	0,39	0,32	-0,09	0,24	0,26	0,07	0,33	0,22	-0,06	0,17	0,19
2009-2013	0,40	0,69	0,68	0,10	0,63	0,67	0,31	0,51	0,43	0,08	0,50	0,55
2010-2014	0,45	0,78	1,00	0,11	0,65	0,68	0,65	1,15	1,27	0,15	0,75	0,87
2011-2015	0,52	0,76	0,96	0,30	0,67	0,66	0,70	1,08	1,22	0,39	0,78	0,83

Table 12: Halloween effect risk-return ratios 5y rolling windows; Bloomberg/STOXX, own compilation

With the Eurostoxx 50 being the only index that has a short period of negative Sharpe- and Calmar ratio from rolling windows 2006-2010 until 2008-2012, all indices have purely positive ratios. The figures are significantly higher than their index investment figures. While keeping up with the index figures during strong years around 2000, the Halloween effect figures beat the index on the other rolling windows.

### 2.3.2 Discussion of the Halloween Effect

The literature about the Halloween-effect is sometimes distorted as the discussion of the Sell-in May effect has shown. Anyhow the summary of literature findings for the Halloween effect are simple and short: yes, the effect exists. Yes, it exists for various time frames and is analyzed for several markets (Bouman, Jacobsen, 2002; Andrade et al, 2013). On the other side research was done with the question if the Halloween effect is more or less driven by the January effect. (Lucey, Zhao, 2008). Some others conclude the (strong) Halloween effect is dependent on some (negative) outliers outside the investment period of November-April (Maberly, Pierce, 2004). Other studies show that the effect is significant for the U.S. from 1954-2008, even taking transaction costs, outliers and a potential January effect into account (Haggard, Witte, 2010).

The same study mentioned maybe the most crucial point by saying that “Further research is needed to reconcile these results with rational human behavior” (Haggard, Witte, 2010: p. 386).

It sounds irrational to sell before summer and buy back stocks within a year just because the autumn has come. It sounds odd to sell positions, albeit you believe in the future potential of your allocated companies. In addition to this, many institutional investors are limited in their freedom to act. Not all investors are allowed to buy and sell significantly large amounts of their assets, holding them cash, changing the investment structure within a year clearly. Same limitation is true for the usage of derivatives as an alternative hedging instead of selling.

Anyhow, literature is overall of one voice that returns in the period from November to April are better than the period from May until October, for whatever reasons are seen to be the roots for this pattern. And while a big part of the financial industry is eager always to compete with each other, trying to outperform their competitors and outperforming their benchmarks, staying away from the market for half a year does not sound like the stroke of genius everybody is looking for. Nobody knows how stock prices will behave in future, but having a plausible strategy, based on fundamental research, why to invest or not is good to protect oneself against criticism, if future investments have gone wrong. All strategies can fail, but no professional wants to be blamed for being foolish. Maybe that is another reason why the Halloween effect still exists.

## 2.4 Conclusion: Summer hedge

The paper has shown a range of seasonality patterns. Effects such as Sell in May and Halloween effect are across all indices and over the whole observation period persistent. The more granular one zooms in on a seasonal pattern, the more it becomes diverse or inconsistent. And the more one should ask oneself if the result is due to data mining or not. But taking a wider scope, all the strong months are still outside of summer.

The following figure shows the negative summer effect. It is representing a long-only investment into the individual indices but hedged during August and September.

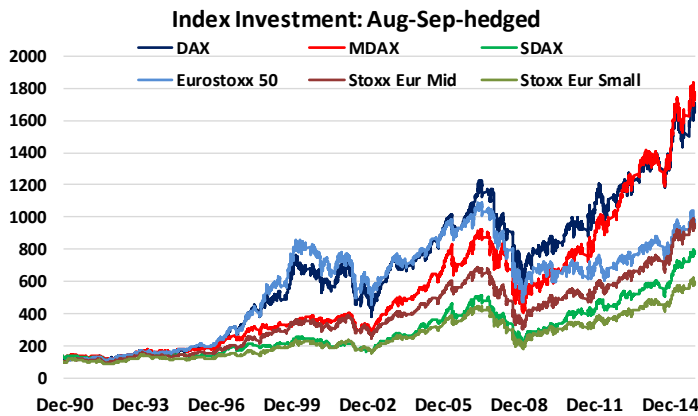


Figure 7: index investment graph: Aug-Sep-hedged; Bloomberg/STOXX, own compilation

The reader will likely notice the similarity of the graph to the strategies of Sell in May and Halloween effect, outperforming the index-investment significantly. So the absence of investments during August and September is the reason for those strategies to be what they are.

If investors want to decide how to implement such a strategy- using derivatives for hedging or doing physical selling- at least for the DAX, there is a possibility to invest directly into an index. The DAXplus® seasonal strategy is an official index that tracks the performance of the DAX index including a total hedge of August and September. Several investment structures are already available on the market tracking this index.

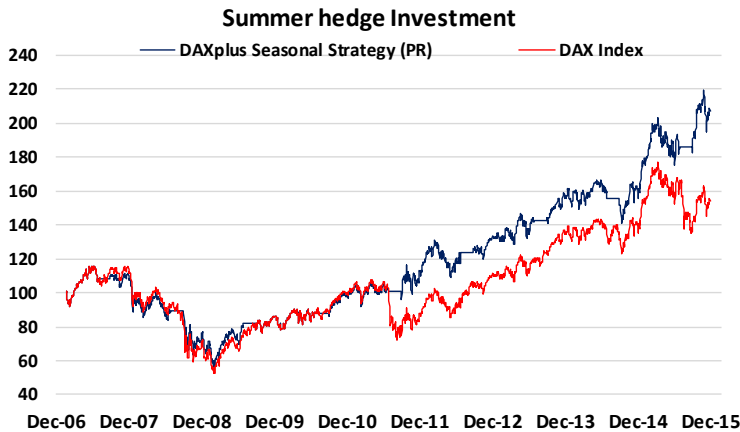


Figure 8: summer hedge investment graph; Bloomberg/DAXplus®, own compilation



Why are so many negative returns happening during summer? Looking at the individual incidents, one could argue that there are many outliers in recent history, like the bankruptcy of Lehman Brothers or the slithering of Greece into (almost) bankruptcy, etc. that are not necessarily linked to summer months and are unlikely to happen again. Good point.

But maybe this is, however, just what this paper is all about. Summer heat is likely to be followed by a storm, just another seasonality.

### 3. Monday effect and other weekday seasonality

By analyzing return distributions of weekdays, different outcomes of each day suggest that there is a certain seasonality. Literature defines these outcomes as the weekend effect (Cross, 1973) where the focus is on the difference between the returns on Friday and Monday. Some famous papers suggest that there is only a Monday effect (French, 1980; Kamara, 1997), where in general Monday returns are lower than the returns of the other weekdays. Recent papers are even more universal and talk about weekday effect / day-of-the-week effects only (Ke et al., 2007). In general, the effect differs from region to region, having Agrawal and Tandon (1994) found different results for either Monday or Tuesday having the lowest returns. A recent paper of Apolinario et al. (2006) is looking at European stock markets from 1997-2004 but finding that there is no significant weekday effect in almost all eighteen observed markets (incl. DAX), with only two exceptions.

The following table shows the performance of a single-weekday investment of each index that was observed in this paper from 1990-2015:

single-weekday investment	Monday	Tuesday	Wednesday	Thursday	Friday
DAX	66%	48%	18%	23%	-12%
MDAX	-27%	-7%	80%	75%	176%
SDAX	52%	-34%	0%	-4%	133%
Eurostoxx 50	-12%	63%	3%	71%	19%
Stoxx Eur Mid	-46%	15%	46%	55%	148%
Stoxx Eur Small	-52%	-15%	22%	42%	170%

Table 13: single weekday investment 1990-2015; Bloomberg/STOXX, own compilation

The picture shows that, taking all indices into account, there is no unique picture of Monday or weekend effect in the German and European market. But looking more granular at individual indices, there seems to be a pattern of Friday having significantly large returns especially in Mid- and Small-caps and Monday showing negative returns in those two size segments (except for SDAX). While the Eurostoxx 50 at least has a positive result on Friday, the DAX seems to be the antagonist of the established Monday- or weekend-effect. The DAX faced its worst (and only negative) investment on Friday, while Monday is the one that performed best overall.

Reasons for different results are widely discussed. One possible fundamental reason is the timing of corporate releases (see Damodaran, 1989). If the timing of especially negative news about companies is done after Friday close, this would be an explanation for negative Monday returns and would be a hint for tail risks, as news are not released every week but influencing the price significantly. But in this case, this would mean timing of DAX and SDAX is about positive releases after Friday close, while MDAX companies would focus on negative releases at the same time. The idea of short sellers closing positions before markets are closed for several days (Chen, Singal, 2003) seems to be a good explanation if one suggests that short sellers do not necessarily return on Monday, but maybe re-open their short positions on Tuesday. Then, this explanation could be true for all indices except for the DAX.

On the other side the seasonality for the DAX could be evolving, as “The more general point is that all weekday effects in all stock markets may be in a permanent state of flux” (Doyle, Chen 2009: p. 1389) and therefore, depending on researcher and chosen time horizon may find the Monday effect, or its reversal, or completely nothing or a new set up. At least for the U.S. there is a long-run analysis that supports this idea of a fluctuating Monday effect (Urqhart, McGroarty, 2014) and for the DAX there has been a Monday effect at least in the time of the 1970s and 1980s (see Alt, Fortin, Weinberger, 2011: p.459)

In any case, the question is, how to exploit such an effect, if it occurs. And this is the crucial point. Being invested only one day a week gives the opportunity to collect interest on other investments during the rest of the week. But there are several reasons that destroy that illusion. First, there is always a time lag between selling and valuta and hence reducing the possible profit of gaining interests. Second, the fact of 52 trades a year increases costs significantly. Third, this strategy is hardly scalable, as big tickets in a short time frame influence the prices. In addition, algorithms will likely detect the seasonality pattern of large orders, trying to exploit them by themselves. Last, one should keep in mind the observed trend shifts in certain patterns. All this makes it hard to build a profitable investment strategy on this.

In any case, the weekday seasonality can give a hint which day, in general, is more favorable for selling or buying certain stocks or indices, if investments or divestments are already planned.

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