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Abstract
The period May 1 to the turn of the month of November (-6 trading day of October) has historically produced negligible returns. The rest of the year (late October to the end of April) has essentially all the year's gains. We show that there is a statistically significant difference and conclude that the strategy *go to cash in the weak period and go long in the strong period* has about 1 ½ times the returns of buy and hold for large cap S&P500 index and 2 times for the small cap Russell 2000 index during the period 1993-2019 in the index futures markets. Graphs and tables of returns for the entire 1993-2019 period are shown. The 2016-2019 time period had very high returns. For the S&P500, buy and hold and sell in May had essentially identical returns. The Russell 2000 sell in May is higher than buy and hold but with only three years data it is not statistically significantly higher than buy and hold.

JEL classification: C19, C41, G11.

Keywords: calendar anomalies, sell-in-May effect, monthly small cap and large cap returns, equity futures markets

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Sell in May and Go Away in the Equity Index Futures Markets, 1993-2019 *

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November 29, 2019

Abstract

The period May 1 to the turn of the month of November (-6 trading day of October) has historically produced negligible returns. The rest of the year (late October to the end of April) has essentially all the year's gains. We show that there is a statistically significant difference and conclude that the strategy *go to cash in the weak period and go long in the strong period* has about $1\frac{1}{2}$ times the returns of buy and hold for large cap S&P500 index and 2 times for the small cap Russell 2000 index during the period 1993-2019 in the index futures markets. Graphs and tables of returns for the entire 1993-2019 period are shown. The 2016-2019 time period had very high returns. For the S&P500, buy and hold and sell in May had essentially identical returns. The Russell 2000 sell in May is higher than buy and hold but with only three years data it is not statistically significantly higher than buy and hold.

JEL: C19, C41, G11
keywords: calendar anomalies, sell-in-May effect, monthly small cap and large cap returns, equity futures markets

1 Sell-in-May-and-go-away

August, September and October have historically had low stock market returns with many serious declines or crashes occurring in these months. The months of November to February have historically had higher than average returns; see, for example, Gultekin and Gultekin

*Thanks go to Alexandre Ziegler for helpful comments on an earlier version of this paper.

(1983) and various papers in Keim and Ziemba (2000), Ziemba (2012) and the tables in this paper. This suggests the strategy to avoid the bad months and be in cash then and only be long the stock market in the good months. Sell-in-May-and-go-away, which is sometimes called the *Halloween Effect*, is one such strategy that is often discussed in the financial press.

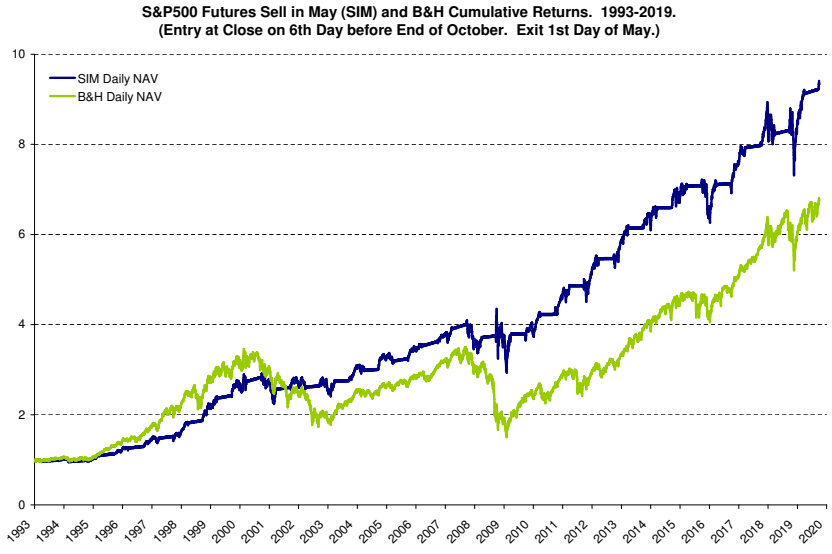


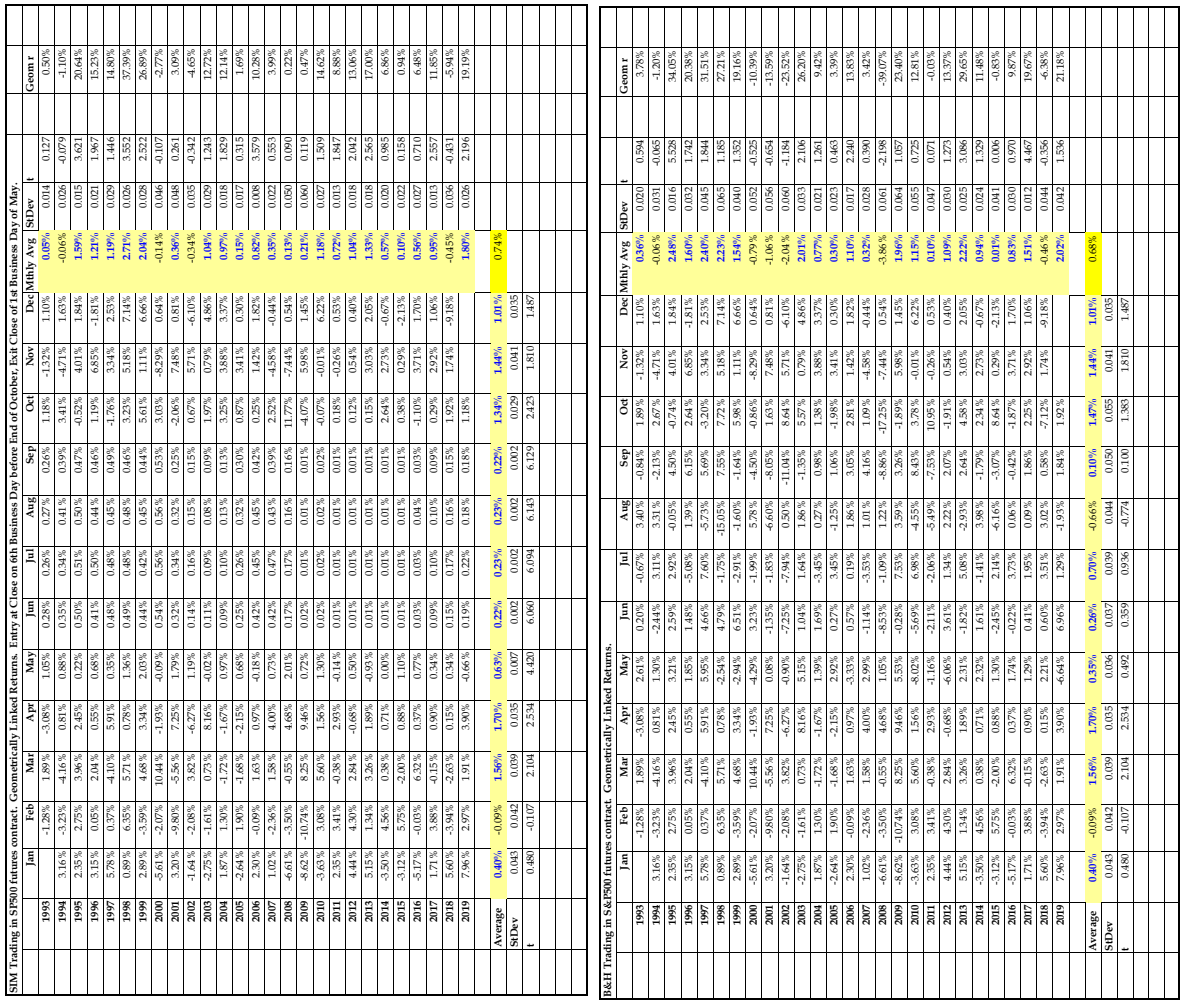
Figure 1: S&P500 Futures Sell in May (SIM) and B&H Cumulative Returns Comparison. 1993-2019. (Entry at Close on 6th Day before End of October. Exit 1st Day of May.)

For the S&P500 a buy and hold strategy turns \$1 on February 4, 1993 into \$6.71 on October 25, 2019; whereas, sell in May and move into cash had a final wealth of \$9.28, some 38.2% higher. For sell in May this counts interest (Fed funds effective monthly rate) and for the buy and hold this counts dividends (which for futures are capital gains). For the small cap Russell2000, the final wealths were \$6.67 and \$12.61, respectively, some 89.0% higher.

Figures 1 and 2 show this strategy using the rule sell on the first trading day in May and buy on the 6th trading day before the end of October, for the S&P500 and Russell 2000 index futures for the years 1993-2019, respectively. This rule did indeed beat a buy and hold strategy by about $1\frac{1}{2}$ times and 2 times in final wealth with lower standard deviation risk, respectively. Tables 1 and 2 show the monthly returns, respectively, for those 26 years to the end of October 2019. The strategy worked in most but not all years and in strategy design can be combined with other effects depending upon market conditions.

This advantage is greater in absolute total returns, but the percentage advantage was not

Table 1: Data by month for sell in May and go away versus buy and hold for the S&P500 equty index futures, 1993-2019



SIM Trading in SP500 futures contract. Geometrically Linked Returns. Entry at Close on 6th Business Day before End of October, Exit Close of 1st Business Day of May.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mthly Avg	StDev	t	Geom r
1993		-1.28%	1.89%	-3.08%	1.05%	0.28%	0.26%	0.27%	0.26%	1.18%	-1.32%	1.10%	**0.05%**	0.014	0.127	0.50%
1994	3.16%	-3.23%	-4.16%	0.81%	0.88%	0.35%	0.34%	0.41%	0.39%	3.41%	-4.71%	1.63%	-0.06%	0.026	-0.079	-1.10%
1995	2.35%	2.75%	3.96%	2.45%	0.22%	0.50%	0.51%	0.50%	0.47%	-0.52%	4.01%	1.84%	**1.59%**	0.015	3.621	20.64%
1996	3.15%	0.05%	2.04%	0.55%	0.68%	0.41%	0.50%	0.44%	0.46%	1.19%	6.85%	-1.81%	**1.21%**	0.021	1.967	15.23%
1997	5.78%	0.37%	-4.10%	5.91%	0.35%	0.48%	0.48%	0.45%	0.49%	-1.76%	3.34%	2.53%	**1.19%**	0.029	1.446	14.80%
1998	0.89%	6.35%	5.71%	0.78%	1.36%	0.49%	0.48%	0.48%	0.46%	3.23%	5.18%	7.14%	**2.71%**	0.026	3.552	37.39%
1999	2.89%	-3.59%	4.68%	3.34%	2.03%	0.44%	0.42%	0.45%	0.44%	5.61%	1.11%	6.66%	**2.04%**	0.028	2.522	26.89%
2000	-5.61%	-2.07%	10.44%	-1.93%	-0.09%	0.54%	0.56%	0.56%	0.53%	3.03%	-8.29%	0.64%	-0.14%	0.046	-0.107	-2.77%
2001	3.20%	-9.80%	-5.56%	7.25%	1.79%	0.32%	0.34%	0.32%	0.25%	-2.06%	7.48%	0.81%	**0.36%**	0.048	0.261	3.09%
2002	-1.64%	-2.08%	3.82%	-6.27%	1.19%	0.14%	0.16%	0.15%	0.15%	0.67%	5.71%	-6.10%	-0.34%	0.035	-0.342	-4.65%
2003	-2.75%	-1.61%	0.73%	8.16%	-0.02%	0.11%	0.09%	0.08%	0.09%	1.97%	0.79%	4.86%	**1.04%**	0.029	1.243	12.72%
2004	1.87%	1.30%	-1.72%	-1.67%	0.97%	0.09%	0.10%	0.13%	0.13%	3.25%	3.88%	3.37%	**0.97%**	0.018	1.829	12.14%
2005	-2.64%	1.90%	-1.68%	-2.15%	0.68%	0.25%	0.26%	0.32%	0.30%	0.87%	3.41%	0.30%	**0.15%**	0.017	0.315	1.69%
2006	2.30%	-0.09%	1.63%	0.97%	-0.18%	0.42%	0.45%	0.45%	0.42%	0.25%	1.42%	1.82%	**0.82%**	0.008	3.579	10.28%
2007	1.02%	-2.36%	1.58%	4.00%	2.03%	0.44%	0.42%	0.45%	0.44%	5.61%	1.11%	6.66%	**2.04%**	0.028	2.522	26.89%
2008	-6.61%	-5.30%	-0.55%	4.68%	2.01%	0.17%	0.17%	0.16%	0.16%	11.77%	-7.44%	0.54%	**0.13%**	0.050	0.690	0.22%
2009	-8.62%	-10.74%	8.25%	9.46%	0.72%	0.02%	0.01%	0.01%	0.01%	-4.07%	5.98%	1.45%	**0.21%**	0.060	0.119	0.47%
2010	-3.63%	3.08%	5.60%	1.56%	1.30%	0.02%	0.02%	0.02%	0.02%	-0.07%	-0.01%	6.22%	**1.18%**	0.027	1.509	14.62%
2011	2.35%	3.41%	-0.38%	2.93%	-0.14%	0.01%	0.01%	0.01%	0.01%	0.18%	-0.26%	0.53%	**0.72%**	0.013	1.847	8.88%
2012	4.44%	4.30%	2.84%	-0.68%	0.50%	0.01%	0.01%	0.01%	0.01%	0.12%	0.54%	0.40%	**1.04%**	0.018	2.042	13.06%
2013	5.15%	1.34%	3.26%	1.89%	-0.93%	0.01%	0.01%	0.01%	0.01%	0.15%	3.03%	2.05%	**1.33%**	0.018	2.565	17.00%
2014	-3.50%	4.56%	0.38%	0.71%	0.00%	0.01%	0.01%	0.01%	0.01%	2.64%	2.73%	-0.67%	**0.57%**	0.020	0.985	6.86%
2015	-3.12%	5.75%	-2.00%	0.88%	1.10%	0.01%	0.01%	0.01%	0.01%	0.38%	0.29%	-2.13%	**0.10%**	0.022	0.158	0.94%
2016	-5.17%	-0.03%	6.32%	0.57%	0.77%	0.03%	0.03%	0.04%	0.03%	-1.10%	3.71%	1.70%	**0.56%**	0.027	0.710	6.48%
2017	1.71%	3.88%	-0.15%	0.90%	0.34%	0.09%	0.10%	0.10%	0.09%	0.29%	2.92%	1.06%	**0.95%**	0.013	2.557	11.85%
2018	5.60%	-3.94%	-2.63%	0.15%	0.34%	0.15%	0.17%	0.16%	0.15%	1.92%	1.74%	-9.18%	-0.45%	0.036	-0.431	-5.94%
2019	7.96%	2.97%	1.91%	3.90%	-0.66%	0.19%	0.22%	0.18%	0.18%	1.18%			**1.80%**	0.026	2.196	19.19%
Average	**0.40%**	**-0.09%**	**1.56%**	**1.70%**	**0.63%**	**0.22%**	**0.23%**	**0.22%**	**0.22%**	**1.34%**	**1.44%**	**1.01%**	**0.74%**			
StDev	0.043	0.042	0.059	0.035	0.007	0.002	0.002	0.002	0.002	0.029	0.041	0.035				
t	0.480	-0.107	2.104	2.534	4.420	6.060	6.094	6.143	6.129	2.423	1.810	1.487				

R&H Trading in S&P500 futures contract. Geometrically Linked Returns.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mthly Avg	StDev	t	Geom r
1993		-1.28%	1.89%	-3.08%	2.61%	0.20%	-0.67%	3.40%	-0.84%	1.89%	-1.32%	1.10%	**0.36%**	0.020	0.594	3.78%
1994	3.16%	-3.23%	-4.16%	0.81%	1.30%	-2.44%	3.11%	3.31%	-2.13%	2.67%	-4.71%	1.63%	-0.06%	0.031	-0.065	-1.20%
1995	2.35%	2.75%	3.96%	2.45%	3.21%	2.59%	2.92%	-0.05%	4.50%	-0.74%	4.01%	1.84%	**2.48%**	0.016	5.528	34.05%
1996	3.15%	0.05%	2.04%	0.55%	1.85%	1.48%	-5.08%	1.39%	6.15%	2.64%	6.85%	-1.81%	**1.60%**	0.032	1.742	20.38%
1997	5.78%	0.37%	-4.10%	5.91%	5.95%	4.66%	7.60%	-5.73%	5.69%	-3.20%	3.34%	2.53%	**2.40%**	0.045	1.844	31.51%
1998	0.89%	6.35%	5.71%	0.78%	-2.54%	4.79%	-1.75%	-15.03%	7.55%	7.72%	5.18%	7.14%	**2.23%**	0.065	1.185	27.21%
1999	2.89%	-3.59%	4.68%	3.34%	-2.94%	6.51%	-2.91%	-1.60%	-1.64%	5.98%	1.11%	6.66%	**1.54%**	0.040	1.352	19.16%
2000	-5.61%	-2.07%	10.44%	-1.93%	-4.29%	3.23%	-1.99%	5.78%	-4.50%	-0.86%	-8.29%	0.64%	-0.79%	0.052	-0.525	-10.39%
2001	3.20%	-9.80%	-5.56%	7.25%	0.08%	-1.35%	-1.83%	-6.60%	-8.05%	1.63%	7.48%	0.81%	-1.06%	0.056	-0.654	-13.59%
2002	-1.64%	-2.08%	3.82%	-6.27%	-0.90%	-7.25%	-7.94%	0.50%	-11.04%	8.64%	5.71%	-6.10%	-2.04%	0.060	-1.184	-23.52%
2003	-2.75%	-1.61%	0.73%	8.16%	5.15%	1.04%	1.64%	1.86%	-1.35%	5.57%	0.79%	4.86%	**2.01%**	0.033	2.106	26.20%
2004	1.87%	1.30%	-1.72%	-1.67%	1.39%	1.69%	-3.45%	0.27%	0.98%	1.38%	3.88%	3.37%	**0.77%**	0.021	1.261	9.42%
2005	-2.64%	1.90%	-1.68%	-2.15%	2.92%	0.27%	3.45%	-1.25%	1.06%	-1.98%	3.41%	0.30%	**0.30%**	0.023	0.463	3.39%
2006	2.30%	-0.09%	1.63%	0.97%	-3.33%	0.57%	0.19%	1.86%	3.05%	2.81%	1.42%	1.82%	**1.10%**	0.017	2.240	13.83%
2007	1.02%	-2.36%	1.58%	4.00%	2.99%	-1.14%	-3.53%	1.01%	4.16%	1.09%	-4.58%	-0.44%	**0.32%**	0.028	0.390	3.42%
2008	-6.61%	-3.50%	-0.55%	4.68%	1.05%	-8.53%	-1.09%	1.22%	-8.86%	-17.25%	-7.44%	0.54%	-3.86%	0.061	-2.198	-39.07%
2009	-8.62%	-10.74%	8.25%	9.46%	5.53%	-0.28%	7.53%	3.59%	3.26%	-1.89%	5.98%	1.45%	**1.96%**	0.064	1.057	23.40%
2010	-3.63%	3.08%	5.60%	1.56%	-8.02%	-5.69%	6.98%	-4.55%	8.43%	3.78%	-0.01%	6.22%	**1.13%**	0.055	0.725	12.81%
2011	2.35%	3.41%	-0.38%	2.93%	-1.16%	-2.11%	-2.06%	-5.49%	-7.53%	10.95%	-0.26%	0.53%	**0.10%**	0.047	0.071	-0.03%
2012	4.44%	4.30%	2.84%	-0.68%	-6.06%	3.61%	1.34%	2.22%	2.07%	-1.91%	0.54%	0.40%	**1.09%**	0.030	1.273	13.37%
2013	5.15%	1.34%	3.26%	1.89%	2.31%	-1.82%	5.08%	-2.93%	2.64%	4.58%	3.03%	2.05%	**2.22%**	0.025	3.086	29.65%
2014	-3.50%	4.56%	0.38%	0.71%	2.32%	1.61%	-1.41%	3.98%	-1.79%	2.34%	2.73%	-0.67%	**0.94%**	0.024	1.329	11.48%
2015	-3.12%	5.75%	-2.00%	0.88%	1.30%	-2.45%	2.14%	-6.16%	-3.07%	8.64%	0.29%	-2.13%	**0.01%**	0.041	0.006	-0.83%
2016	-5.17%	-0.03%	6.32%	0.57%	1.74%	-0.22%	3.73%	0.06%	-0.42%	-1.87%	3.71%	1.70%	**0.83%**	0.030	0.970	9.87%
2017	1.71%	3.88%	-0.15%	0.90%	1.29%	0.41%	1.95%	0.09%	1.86%	2.25%	2.92%	1.06%	**1.51%**	0.012	4.467	19.67%
2018	5.60%	-3.94%	-2.63%	0.15%	2.21%	0.60%	3.51%	3.02%	0.58%	-7.12%	1.74%	-9.18%	-0.46%	0.044	-0.336	-6.38%
2019	7.96%	2.97%	1.91%	3.90%	-6.64%	6.96%	1.29%	-1.93%	1.84%	1.92%			**2.02%**	0.042	1.536	21.18%
Average	**0.40%**	**-0.09%**	**1.56%**	**1.70%**	**0.35%**	**0.26%**	**0.70%**	**-0.66%**	**0.10%**	**1.47%**	**1.44%**	**1.01%**	**0.68%**			
StDev	0.043	0.042	0.059	0.035	0.056	0.037	0.039	0.044	0.050	0.055	0.041	0.035				
t	0.480	-0.107	2.104	2.534	0.492	0.359	0.936	-0.774	0.110	1.383	1.810	1.487				

Table 2: Data by month for sell in May and go away versus buy and hold for the Russell 2000 equity futures, 1993-2019

SIM Trading in Russell 2000 futures contract. Geometrically Linked Returns. Entry at Close on 6th Business Day before End of October, Exit 1st Business Day of May.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mthly Avg	StDev	t	Geom r
1993		-4.11%	2.63%	-3.00%	1.02%	0.28%	0.26%	0.27%	0.26%	1.45%	-4.21%	4.15%	-0.09%	0.027	-0.113	-1.35%
1994	2.97%	-1.33%	-4.34%	-0.40%	1.66%	0.35%	0.34%	0.41%	0.39%	2.11%	-4.69%	2.91%	**0.03%**	0.025	0.046	0.05%
1995	-1.57%	4.21%	1.42%	2.41%	0.13%	0.50%	0.51%	0.50%	0.47%	-1.37%	4.48%	3.20%	**1.24%**	0.020	2.179	15.69%
1996	-0.23%	1.60%	3.55%	4.63%	1.08%	0.41%	0.50%	0.44%	0.46%	-0.10%	3.92%	2.08%	**1.53%**	0.017	3.185	19.77%
1997	2.07%	-2.82%	-4.14%	-0.01%	1.73%	0.48%	0.48%	0.45%	0.49%	-2.38%	-1.01%	2.20%	-0.21%	0.020	-0.357	-2.67%
1998	-2.33%	7.35%	5.24%	0.01%	0.93%	0.49%	0.48%	0.48%	0.46%	4.01%	4.37%	6.94%	**2.37%**	0.031	2.660	31.80%
1999	0.41%	-7.88%	1.31%	8.67%	1.59%	0.44%	0.42%	0.45%	0.44%	2.58%	4.77%	12.72%	**2.16%**	0.050	1.488	27.52%
2000	-2.78%	16.94%	-5.93%	-6.67%	3.34%	0.54%	0.56%	0.56%	0.53%	2.82%	-10.19%	8.57%	**0.69%**	0.072	0.333	5.69%
2001	4.30%	-7.17%	-3.60%	6.81%	1.69%	0.32%	0.34%	0.32%	0.25%	0.22%	7.55%	6.14%	**1.43%**	0.043	1.154	17.40%
2002	-1.21%	-2.89%	8.11%	0.73%	0.60%	0.14%	0.16%	0.15%	0.15%	2.29%	8.78%	-5.71%	**0.94%**	0.041	0.804	10.92%
2003	-2.90%	-3.12%	1.10%	9.38%	0.21%	0.11%	0.09%	0.08%	0.09%	4.38%	3.44%	1.96%	**1.24%**	0.034	1.275	15.19%
2004	4.25%	0.81%	0.85%	-5.21%	0.66%	0.09%	0.10%	0.13%	0.13%	3.20%	8.49%	3.12%	**1.39%**	0.032	1.478	17.30%
2005	-4.37%	1.49%	-2.64%	-5.99%	1.08%	0.25%	0.26%	0.32%	0.30%	0.34%	4.45%	0.03%	-0.37%	0.028	-0.467	-4.79%
2006	8.61%	-0.64%	5.44%	-0.39%	-0.63%	0.42%	0.45%	0.45%	0.42%	0.84%	2.14%	0.94%	**1.50%**	0.028	1.880	19.14%
2007	1.20%	-1.21%	1.67%	1.35%	0.60%	0.42%	0.47%	0.43%	0.39%	2.45%	-7.56%	0.36%	**0.05%**	0.026	0.065	0.21%
2008	-7.41%	-3.94%	0.47%	3.99%	1.82%	0.17%	0.17%	0.16%	0.16%	16.38%	-11.89%	5.33%	**0.45%**	0.069	0.226	2.87%
2009	-11.11%	-12.22%	8.44%	15.52%	-0.15%	0.02%	0.01%	0.01%	0.01%	-6.56%	3.10%	7.72%	**0.40%**	0.080	0.174	1.34%
2010	-3.67%	4.48%	7.84%	5.67%	2.04%	0.02%	0.02%	0.02%	0.02%	0.03%	3.46%	7.68%	**2.30%**	0.036	2.242	30.49%
2011	-0.27%	5.47%	2.28%	2.64%	-1.30%	0.01%	0.01%	0.01%	0.01%	1.11%	-0.35%	0.29%	**0.83%**	0.018	1.555	10.16%
2012	7.09%	2.38%	2.19%	-1.55%	-0.33%	0.01%	0.01%	0.01%	0.01%	0.44%	0.54%	3.16%	**1.16%**	0.023	1.764	14.58%
2013	6.32%	1.12%	4.25%	-0.40%	-2.54%	0.01%	0.01%	0.01%	0.01%	-1.72%	4.00%	1.73%	**1.07%**	0.026	1.421	13.15%
2014	-2.85%	4.75%	-0.96%	-4.01%	0.03%	0.01%	0.01%	0.01%	0.01%	4.99%	0.05%	2.48%	**0.38%**	0.026	0.492	4.21%
2015	-3.29%	6.06%	1.40%	-2.60%	0.65%	0.01%	0.01%	0.01%	0.01%	-0.26%	3.25%	-5.39%	-0.01%	0.030	-0.012	-0.60%
2016	-8.85%	0.03%	7.55%	1.62%	0.91%	0.03%	0.03%	0.04%	0.03%	-2.79%	11.18%	2.62%	**1.03%**	0.049	0.729	11.68%
2017	0.19%	1.88%	-0.04%	1.01%	0.79%	0.09%	0.10%	0.10%	0.09%	0.17%	2.85%	-0.58%	**0.55%**	0.010	2.008	6.80%
2018	2.56%	-4.11%	1.37%	0.76%	0.71%	0.15%	0.17%	0.16%	0.15%	3.03%	1.50%	-12.09%	-0.47%	0.041	-0.400	-6.40%
2019	11.21%	5.02%	-2.01%	3.26%	-0.84%	0.19%	0.22%	0.18%	0.18%	0.83%			**1.82%**	0.039	1.495	19.06%
Average	-0.06%	**0.45%**	**1.61%**	**1.42%**	**0.65%**	**0.22%**	**0.23%**	**0.23%**	**0.22%**	**1.43%**	**1.63%**	**2.41%**	0.86%			
StDev	0.052	0.057	0.039	0.050	0.012	0.002	0.002	0.002	0.002	0.039	0.056	0.049				
t	-0.062	0.410	2.135	1.486	2.869	6.060	6.094	6.143	6.129	1.912	1.491	2.481				

B&H Trading in Russell 2000 futures contract. Geometrically Linked Returns.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mthly Avg	StDev	t	Geom r
1993		-4.11%	2.63%	-3.00%	4.04%	1.55%	0.57%	3.97%	2.54%	2.99%	-4.21%	4.15%	**1.01%**	0.033	1.027	11.11%
1994	2.97%	-1.33%	-4.34%	-0.40%	-1.09%	-3.42%	2.02%	5.45%	-0.54%	-0.35%	-4.69%	2.91%	-0.23%	0.031	-0.261	-3.29%
1995	-1.57%	4.21%	1.42%	2.41%	2.26%	4.68%	5.33%	1.46%	1.86%	-5.01%	4.48%	3.20%	**2.06%**	0.029	2.450	27.15%
1996	-0.23%	1.60%	3.55%	4.63%	3.21%	-3.59%	-9.10%	5.05%	4.20%	-1.46%	3.92%	2.08%	**1.15%**	0.042	0.958	13.66%
1997	2.07%	-2.82%	-4.14%	-0.01%	10.37%	4.81%	4.17%	2.06%	7.77%	-4.55%	-1.01%	2.20%	**1.74%**	0.046	1.314	21.67%
1998	-2.33%	7.35%	5.24%	0.01%	-6.28%	1.29%	-9.21%	-19.83%	8.54%	4.31%	4.37%	6.94%	**0.03%**	0.083	0.014	-3.65%
1999	0.41%	-7.88%	1.31%	8.67%	1.80%	4.80%	-3.79%	-3.87%	0.51%	0.54%	4.77%	12.72%	**1.67%**	0.056	1.028	19.92%
2000	-2.78%	16.94%	-5.93%	-6.67%	-6.58%	9.91%	-3.18%	6.11%	-1.77%	-5.10%	-10.19%	8.57%	-0.06%	0.084	-0.023	-4.30%
2001	4.30%	-7.17%	-3.60%	6.81%	1.95%	3.12%	-4.88%	-3.58%	-13.45%	5.57%	7.55%	6.14%	**0.23%**	0.066	0.120	0.27%
2002	-1.21%	-2.89%	8.11%	0.73%	-4.62%	-4.97%	-15.26%	-0.41%	-7.28%	3.03%	8.78%	-5.71%	-1.81%	0.067	-0.940	-21.68%
2003	-2.90%	-3.12%	1.10%	9.38%	10.64%	1.67%	6.18%	4.48%	-1.93%	8.30%	3.44%	1.96%	**3.27%**	0.047	2.413	45.41%
2004	4.25%	0.81%	0.85%	-5.21%	1.50%	4.24%	-6.86%	-0.65%	4.73%	1.83%	8.49%	3.12%	**1.43%**	0.042	1.165	17.36%
2005	-4.37%	1.49%	-2.64%	-5.99%	6.26%	4.19%	6.07%	-2.19%	0.73%	-3.41%	4.45%	0.03%	**0.39%**	0.042	0.319	3.72%
2006	8.61%	-0.64%	5.44%	-0.39%	-6.06%	1.29%	-3.68%	2.43%	1.44%	5.31%	2.14%	0.94%	**1.40%**	0.040	1.221	17.19%
2007	1.20%	-1.21%	1.67%	1.35%	3.61%	-0.75%	-7.26%	1.77%	2.32%	2.35%	-7.56%	0.36%	-0.18%	0.036	-0.171	-2.86%
2008	-7.41%	-3.94%	0.47%	3.99%	4.35%	-7.61%	3.44%	3.41%	-8.31%	-20.92%	-11.89%	5.33%	-3.26%	0.082	-1.380	-35.52%
2009	-11.11%	-12.22%	8.44%	15.52%	3.00%	1.18%	9.60%	2.84%	5.47%	-6.83%	3.10%	7.72%	**2.23%**	0.084	0.915	25.31%
2010	-3.67%	4.48%	7.84%	5.67%	-7.60%	-8.06%	6.88%	-7.39%	12.12%	4.11%	3.46%	7.68%	**2.13%**	0.070	1.058	25.39%
2011	-0.27%	5.47%	2.28%	2.64%	-1.86%	-2.64%	-3.62%	-8.71%	-11.66%	15.25%	-0.35%	0.29%	-0.27%	0.068	-0.136	-5.56%
2012	7.09%	2.38%	2.19%	-1.55%	-6.60%	4.51%	-1.36%	3.38%	2.87%	-2.17%	0.54%	3.16%	**1.20%**	0.036	1.143	14.59%
2013	6.32%	1.12%	4.25%	-0.40%	4.02%	-0.85%	7.00%	-3.15%	6.07%	2.46%	4.00%	1.73%	**2.71%**	0.031	2.991	37.18%
2014	-2.85%	4.75%	-0.96%	-4.01%	0.85%	5.04%	-6.18%	5.08%	-6.55%	6.78%	0.05%	2.48%	**0.37%**	0.046	0.283	3.38%
2015	-3.29%	6.06%	1.40%	-2.60%	2.29%	0.49%	-1.22%	-6.29%	-5.32%	5.69%	3.25%	-5.39%	-0.41%	0.043	-0.332	-5.76%
2016	-8.85%	0.03%	7.55%	1.62%	2.29%	-0.52%	6.07%	1.79%	0.77%	-4.73%	11.18%	2.62%	**1.65%**	0.053	1.086	19.92%
2017	0.19%	1.88%	-0.04%	1.01%	-2.10%	3.30%	0.71%	-1.40%	6.31%	0.66%	2.85%	-0.58%	**1.07%**	0.023	1.616	13.25%
2018	2.56%	-4.11%	1.37%	0.76%	5.88%	0.80%	1.51%	4.08%	-2.29%	-11.11%	1.50%	-12.09%	-0.93%	0.056	-0.572	-12.21%
2019	11.21%	5.02%	-2.01%	3.26%	-8.01%	6.86%	0.61%	-5.23%	2.06%	2.52%			**1.63%**	0.057	0.910	15.89%
Average	-0.06%	**0.45%**	**1.61%**	**1.42%**	**0.65%**	**1.16%**	-0.57%	-0.35%	**0.42%**	**0.23%**	**1.63%**	**2.41%**	0.74%			
StDev	0.052	0.057	0.039	0.050	0.052	0.043	0.061	0.057	0.061	0.069	0.056	0.049				
t	-0.062	0.410	2.135	1.486	0.646	1.415	-0.485	-0.314	0.353	0.170	1.491	2.481				

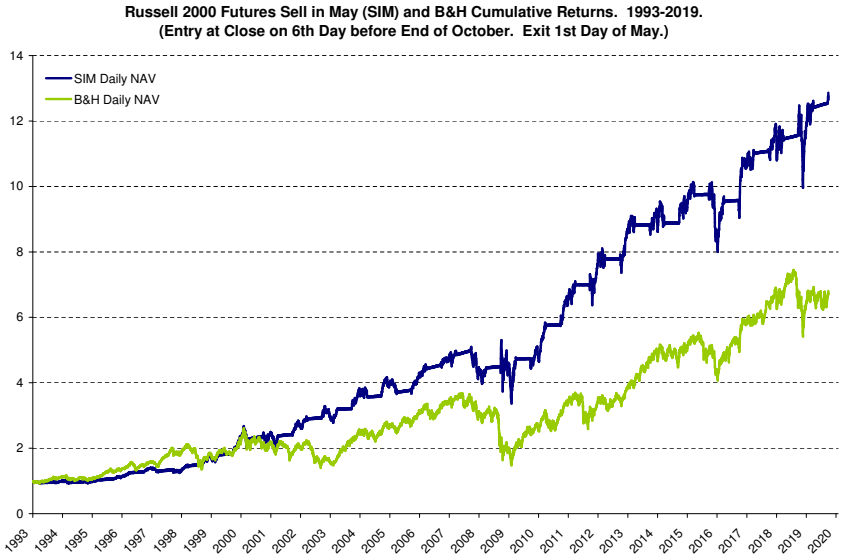


Figure 2: Russell 2000 Futures Sell in May (SIM) and B&H Cumulative Returns Comparison. 1993-2019. (Entry at Close on 6th Day before End of October. Exit 1st Day of May.)

as high as it was going to 2016. For example, the current advantage for the S&P500 was 38.2% versus 84.2% from 1993-2016 and for the Russell 2000 the advantage was 89.0% versus 147.1%. This was caused by the huge rise of equity prices in the period 2016-2019. In this three year period, the sell in May and buy and hold strategies have essentially equivalent gains. For the Russell 2000 , the sell in May strategy had higher gains than buy and hold but with just three years' data, it is not significantly higher statistically.

2 Statistical Tests

To show statistical significance, we tested the following three hypotheses:

1. Is the mean return for sell in May higher than buy and hold for the S&P500?
2. Is the mean return for sell in May higher than buy and hold for the Russell 2000 ?
3. Is the sell in May Russell 2000 mean return greater than the sell in May S&P500 mean return?

The essence is to show that the returns during October to May are more than those from May to October and that it is true for both the S&P500 and the Russell 2000 with the

small cpas higher with the sell in May strategy.

The CME began trading Russell 2000 futures in February 1993. Since we used both S&P500 and Russell 2000 for our analysis February 1993 was chosen as a starting point to have fair comparisons.

In testing the null hypothesis regarding the equality of mean rates of return in two populations, the null and alternative hypothesis are:

$$H_0 : r_{B\&H} - r_{SIM} \geqslant 0$$
$$H_a : r_{B\&H} - r_{SIM} < 0$$

The first population (B&H) average is the daily rate of return (r_1) in the period with entry at the close of the first trading day in May and exit at the close of the sixth trading day before the end of October. The second population (SIM) average is the daily rate of return (r_2) in the period with entry at the close of the sixth trading day before the end of October and exit at the close of the first trading day in May next year. The data set for the analysis is from February 5, 1993 to October 24, 2019 some 6,767 days. The test considers two independent groups of returns that are assumed to follow normal distributions. The sample sizes are n_1 = 3,315 and n_2 = 3,451 days and their variances are ${s_1}^2$ and ${s_2}^2$, respectively.

The data show that cumulative returns for SIM are higher than the cumulative returns for B&H, hence a one-tail test is appropriate. To prove the hypothesis that the SIM mean returns are significantly higher than those for the B&H strategy, the null hypothesis that the SIM mean returns are significantly lower or equal to those for B&H strategy was tested and a two-sample, independent, one-tail Z test at the 0.05 level of significance was conducted.

$$Z = \frac{\bar{r}_{B\&H} - \bar{r}_{SIM}}{\sqrt{\frac{s^2_{B\&H}}{n^2_{B\&H}} + \frac{s^2_{SIM}}{n^2_{SIM}}}}$$

The Z-score for the SP futures was -1.95 which is in the rejection area whose cutoff is -1.645. The P-value was 0.0256 which is lower than 5%. The null hypothesis is thus rejected and the conclusion is that the average daily return for SIM strategy is significantly higher than average daily return for B&H strategy. The Z-score for the Russell 2000 futures was -2.15 which is in the rejection area whose cutoff is -1.645. The P-value was 0.0158 which is lower than 5%. The null hypothesis is rejected and the conclusion is that the average daily return for the SIM strategy is significantly higher than the average daily return for the B&H strategy.

To test whether we can fail to reject the hypothesis that the SIM Russell 2000 mean returns are not equal the SIM S&P500 mean returns the null hypothesis that the SIM Russell 2000 mean returns are equal the SIM S&P500 mean returns is tested using a two-sample, independent two-tail Z test at the 0.05 level of significance. The Z-score for the test is -0.30 whose cutoff is -1.96 and the p-value was 0.7642. Based on the results, the null-hypothesis cannot be rejected.

We use a one-tail test to determine if there is a relationship between the returns, either higher or lower. Figures 1 and 2 show that the SIM futures cumulative return steadily outperforms the B&H returns. The S&P500 buy and hold strategy turns \$1 on February 4, 1993 into \$6.71; whereas, sell in May and move into cash, counting interest (Fed funds effective monthly rate for sell in May) and dividends for the buy and hold, had a final wealth of \$9.28, some 38.2% higher. For the Russell2000, the final wealth were \$6.67 and \$12.61, respectively, some 84.0% higher.

When the SIM is in the market, the daily returns are the same as B&H strategy, but during the other period we are not in the market, the daily returns are different for the two strategies. The reason for the difference in cumulative returns is caused by the lower stock market returns during the SIM cash period. As this is directional, a one-tail test is appropriate. Even a more conservative two-tail test with z=-1.95 gives a P-value for the S&P500 futures of 0.0512 which is slightly above the 0.05 cutoff. For the Russell2000 futures, with z=-2.15 the p-value was 0.0316 which passes the test so we reject the null-hypothesis even with a two-tail test.

In the last three years 2017-2019 with President Trump, there was a large increase in stock prices. We tested the equality of the mean rates of return of B&H and SIM for the S&P500 and Russell 2000 for this period. The assumptions and hypotheses were the same as for the longer period, 1993-2019, but the test used was two tailed. The total period for the analysis from January 2, 2017 - October 25, 2019 was 716 days. The Z-score for S&P500 futures was -0.50 with a cutoff of -1.96 and p value of 0.7642. The Z-score for Russell 2000 futures was -0.64 a cutoff of -1.96 and p value of 0.5222. Hence the null hypothesis cannot be rejected for both cases and B&H and SIM were statistically equal even though the Russell 2000 SIM was higher than its B&H.

Future rollover costs were not taken into account. While they were a significant cost in the 1990s, current commissions for a round trip are under \$5. The data uses the front month contract. In real trading one could use only two rollovers a year getting a position in the December contract in October, rolling over into the June contract at expiration into December and exiting position in May. This would possibly have larger bid-ask spreads and be less liquid. The point is that this cost is minor.

3 Discussion

Various hypotheses for the sell in May effect have been proposed. Doeswijk (2005) reviews two prominent ones. Bouman and Jacobsen (2002) confirm the empirical and historical basis of the maxim, finding that the Sell in May effect holds in 36 of the 37 countries included in their analysis. They consider vacation timing as a potential cause of the Sell in May effect, suggesting the timing of summer vacations may cause temporal variation in appetites for risk aversion. However, they find evidence of the Sell in May effect in their subset of Southern hemisphere countries, which under their hypothesis would be expected to have a different seasonal pattern.

Another hypothesized link between seasonality and stock returns is the Seasonal Affective Disorder (SAD), which was studied by Kamstra, Kramer, and Levi (2003) and Garrett, Kamstra, and Kramer (2004). SAD is a disorder in which the shorter, relatively sunless days of fall and winter cause depression, which some recent research links to an unwillingness to take risk. Kamstra, Kramer, and Levi (2003) conclude that the SAD explanation does not lead to a profitable trading strategy because the risk premium varies with the seasonal effects. Like the vacation timing hypothesis, Doeswijk found the SAD hypothesis insufficient because SAD is known to start as early as September so the historically high November returns cannot be explained.

After discussing these two hypotheses, Doeswijk (2005) offers a new hypothesis to explain the Sell in May effect. He posits that, in the fourth quarter of each year, investors are overly optimistic about the upcoming year. This excessive optimism leads to attractive initial returns followed by a renewed realism that readjusts expectations. Unlike the SAD hypothesis, which suggests a varying risk premium, the Optimism Cycle hypothesis reflects a constant risk premium but a varying perception of the economic outlook. To test this hypothesis, Doeswijk ran three analyses: 1) the global zero-investment seasonal sector-rotation strategy 2) the seasonality of earnings growth revisions and 3) the initial returns of IPOs as a proxy for investor optimism.

According to the Optimism Cycle, investors are over-optimistic at the end and beginning of the year. If this hypothesis is correct, a winning investment strategy is going long in cyclical stocks and short in defensive stocks during the winter period from November through April (winter) and following the opposite strategy from May through October (summer). (These stock groups are chosen for their relative exposure to the general economy, with cyclical stocks having a high exposure and defensive stocks a low exposure.) To test this strategy, Doeswijk uses the MSCI World index of global stock returns from 1970-2003 and tests the data as a whole, in two 17-year sub-periods, using several variations on timing of the winter period, and various sector definitions. The study runs regressions using monthly market capitalization-weighted price return indices and their monthly log returns.

Doeswijk found that, on average during the study period, winter returns are a significant 7.6% higher than summer returns and the strategy is successful in 65% of the years. On a monthly basis, the average performance of the global zero-investment strategy is 0.56%, which is significant at the 1% confidence level. Using further regression analysis techniques, Doeswijk also isolates the market timing effects from the seasonality and found that seasonality alone accounts for approximately half of the excess returns.

Like the Optimism Cycle strategy, both other analyses in the Doeswijk study support the Optimism Cycle hypothesis. Doeswijk found that expected earnings growth rates follow a seasonal cycle and that these changes have an effect on stock performance. The third analysis uses initial IPO returns, which show a remarkable seasonality, as a proxy for investor confidence. Using this investor confidence proxy as an independent variable, the regression result for remaining excess return is not statistically significant, which supports the Optimism Cycle hypothesis.

Along with the three supporting analyses, Doeswijk explains a qualitative argument in favor of his Optimism Cycle hypothesis. He argues that, since this phenomenon is one based on an aspect of human psychology, it tricks investors into repeating the same biases every year. Importantly, this cycle of optimism and pessimism is not generally accepted, which Doeswijk argues allows for investors who understand it to profit from it as a free lunch until it is more widely accepted and the arbitrage opportunity is absorbed into the market.

Ziegler and Ziemba (2015) also studied the effect of weather on the sell in May research in many countries and found that when the weather is good, the returns are higher on average. Additional references related to this sell in May phenomenon are Agrrawal and Skaves (2015), Bee, Dupuis and Trapin (2016), Dzhabarov and Ziemba (2010), Fiore and Saha (2015), Jacobsen and Visaltanachoti. (2009), Keloharju and Linnainmaa (2015), Patel and Sewell (2015), Swinkels and van Vliet (2012), Witte (2010), Zhang and Jacobsen (2012).

4 Conclusions

Whatever the reasons, it is clear that thre is some sell in May anomaly effect in US and other equity markets. See Dzhabarov, Ziegler and Ziemba (2019). Receiving double or more final wealth with less standard deviation risk and a higher Sharpe ratio indicates that the strategy adds value on average. Given tax considerations, implementation of this could done be by shorting index futures which is simpler than exiting equity positions for onshore accounts. For offshore accounts, investing in futures and exiting during the May to October period is likely best.

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