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Calendar Rotation Strategy Backtesting

Introduction & Motivation

   After reading several articles [1] and mutual fund sources [2] online, I wanted to test the strength of a long-term investment strategy that holds stock during the winter months (October – March) and bonds during the summer months (May – September). The idea is that over the long run, stocks perform better during the summer months and tend to lag during the winter month. Here are two figures from [1] that illustrate this trend (note: created in January 2011).

Jan	-1.61%
Feb	-2.33%
Mar	1.12%
Apr	2.66%
May	0.71%
Jun	-2.28%
Jul	0.34%
Aug	-0.29%
Sep	-0.97%
Oct	0.51%
Nov	1.66%
Dec	1.26%
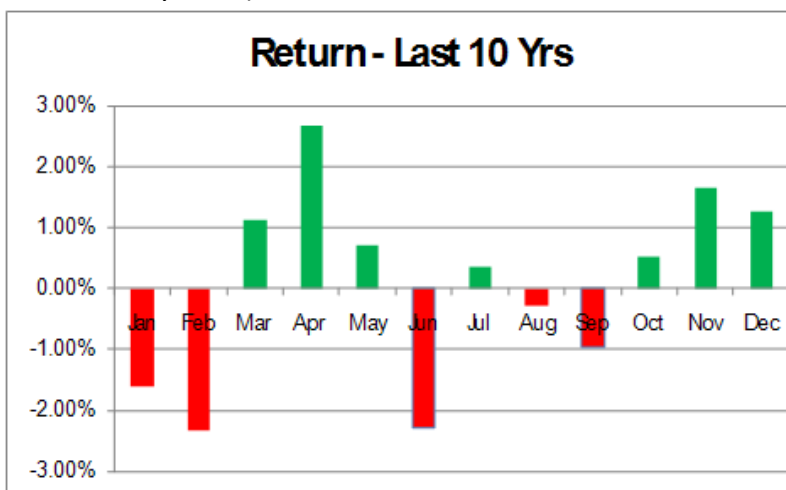
Jan	1.22%
Feb	-0.19%
Mar	1.15%
Apr	1.56%
May	0.72%
Jun	0.29%
Jul	0.25%
Aug	0.08%
Sep	-0.77%
Oct	0.58%
Nov	1.15%
Dec	1.71%
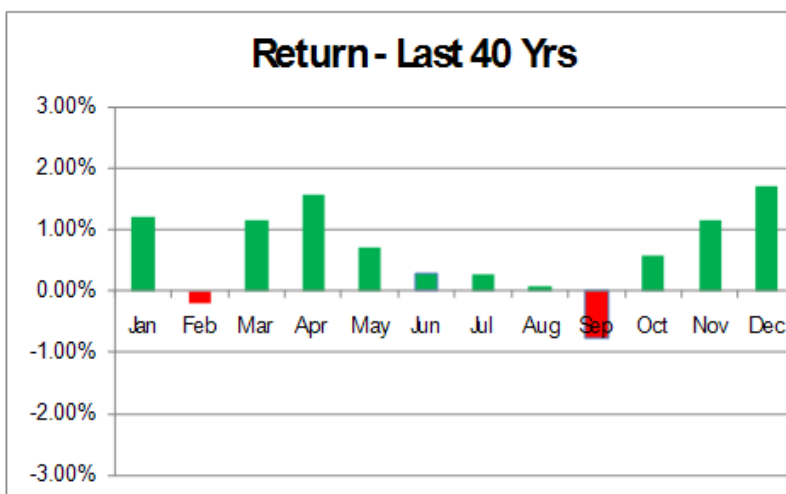
   In making the actual investments, I propose the use of ETFs over simple index funds. ETFs provide easy access to diversification within asset classes (equities or fixed income) at very low expense ratios. I would rather take the low expense ratios of ETFs over the "expert active management" of mutual funds, but that is a subject for another debate. When I go to make actual investments, I will favor mid-cap domestic equities and shorter term fixed income assets but make sure to include exposure to other areas such as international equities, corporate bonds, etc. too.

[1] http://squirrelers.com/2011/01/31/2126/
[2] http://time-price-research-astrofin.blogspot.com/2012/03/alphas-mid-cap-power-index-strategy.html

Backtesting MDY & SHY

Note: all simulations performed in Matlab using original code

Data: courtesy of Yahoo Finance for prices and NASDAQ for dividend yields and dates

      To test this strategy from 2003 to 2012, let's analyze the growth of $10,000 over the period and calculate the annualized return. Here are my asset choices for testing (keep in mind these are arbitrary—we can re-run the simulation using different data):

1. Equity ETF: SPDR S&P MidCap 400 (MDY)
2. Fixed Income ETF: iShares Barclays 1-3 Year Treasury Bond (SHY)

Before presenting results, here is the performance of the MDY and SHY over the same periods:

$$\text{Annualized Return} = \frac{P_{final} - P_{initial}}{P_{initial}} \times \frac{365}{duration_{days}} . \qquad (P = \text{Stock Price})$$

MDY: Annual Return over the period of 5/1/2003 – 12/31/2012 is about 16%

SHY: Annual Return over the period of 5/1/2003 – 12/31/2012 is about 5%

iShares Barclays 1-3 Year Treasury Bond (SHY)
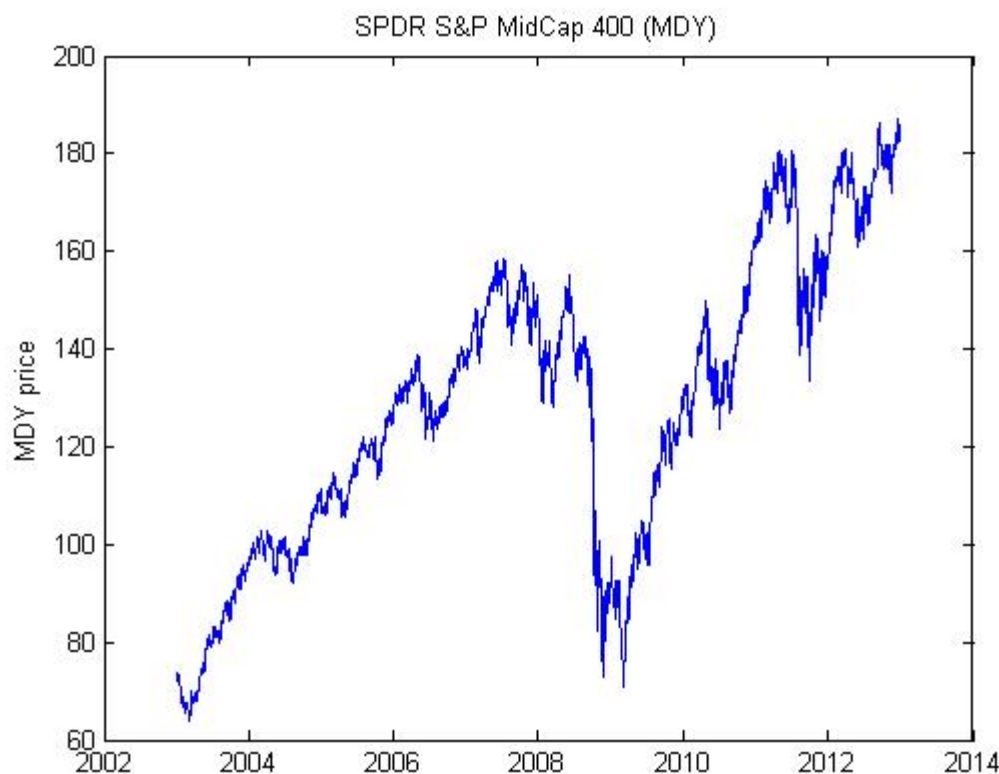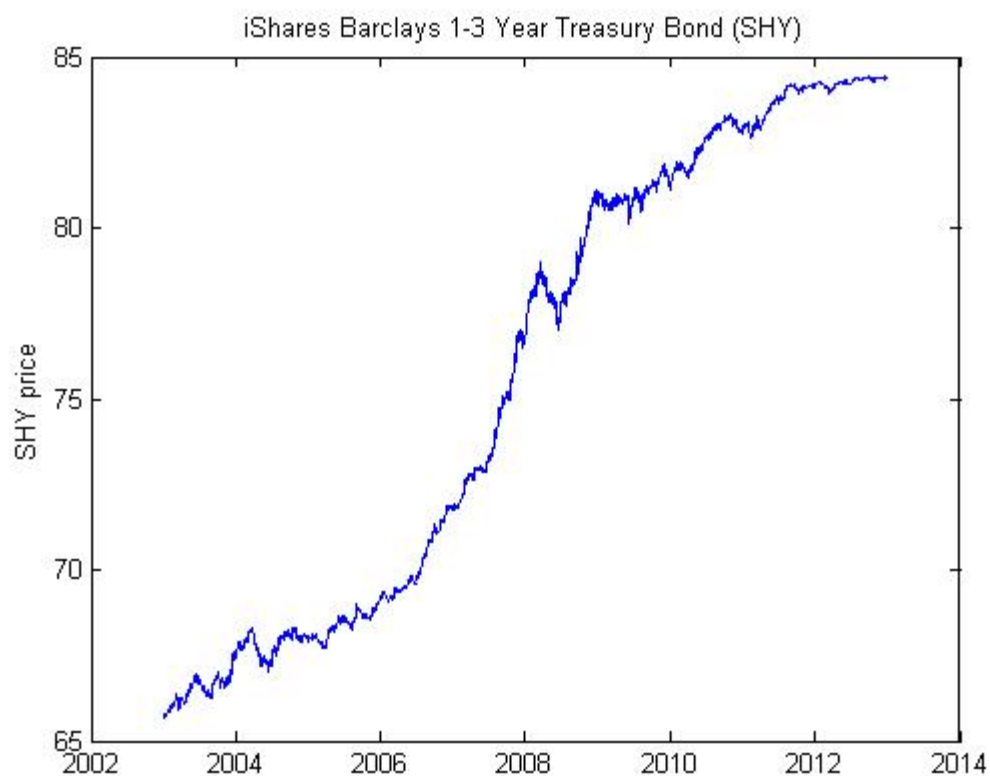
(SHY doesn't gain in value much, but it's pretty much constantly increasing)

Now, here is the growth of $10,000 using the calendar rotation strategy, assuming all dividends are reinvested. It delivers a 26% return.
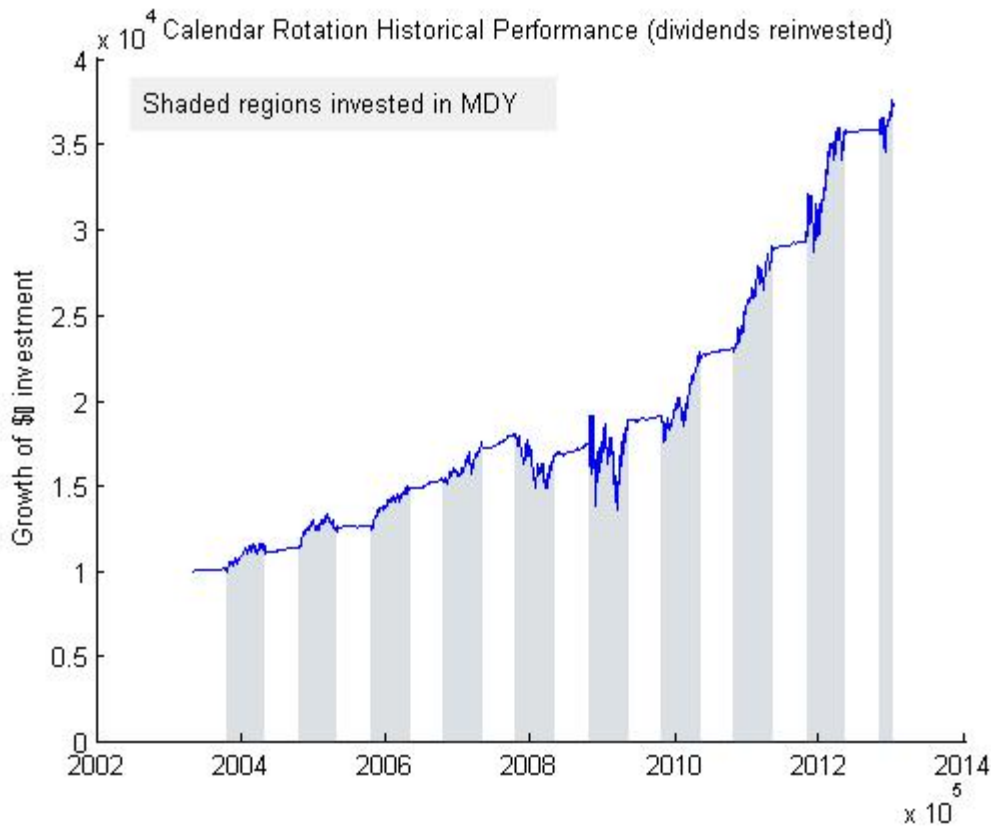
Here is an analysis of the overall return, followed by each equity period and then each fixed income period.

```
Overall Return (final_val-initial_val)/initial_val: 2.546852
  Duration: 3529 days
    at EQ->FI date 05/01/03
    at FI->EQ date 10/15/03
  Annualized = Overall * 365/duration: 0.263418
EQ period: start; end; gain; duration (days); return (annualized)
ret =

  Columns 1 through 5

        10144          11388          12583          15303          17762
        11018          12414          14812          17024          16478
        874.2         1026.2         2229.1         1720.6        -1284.3
          199            197            196            199            201
      0.15807        0.16695        0.32991        0.20622        -0.1313

  Columns 6 through 10

        17136          18722          22527          28355          34510
        18497          21702          28194          34213          35469
       1360.7         2980.6         5666.3         5857.7         958.03
          198            198            197            199             77
      0.14638        0.29349        0.46603        0.37892        0.13159

FI period: start; end; gain; duration (days); return (annualized)
ret =

  Columns 1 through 5
```

```
   10000          11018          12414          14812          17024
   10144          11388          12583          15303          17762
   143.71         370.33         168.32         491.44         738.34
     166            167            168            168            165
  0.031599       0.073462       0.029457       0.072085       0.095942

Columns 6 through 10

   16478          18497          21702          28194          34213
   17136          18722          22527          28355          34510
   658.33          224.7         825.14         161.17         297.95
     167            167            167            168            165
  0.087321       0.026551        0.0831        0.01242        0.019265
```

As you can see, returns during the equity period vary, but they are all positive except for the 2008 period. Returns from the fixed income period are consistently positive and low.

In order to ensure I chose the best times to sell all fixed income and buy all equities in the Fall and vice versa in the Spring, I varied the transition dates by weeks at a time and found that the optimal times yield:

```
Max Return of 0.263418
     at EQ->FI date 05/01
     at FI->EQ date 10/15
```

Note that the return is not drastically affected by the transition dates. The following graph shows the effect of varying the transition dates on the return:
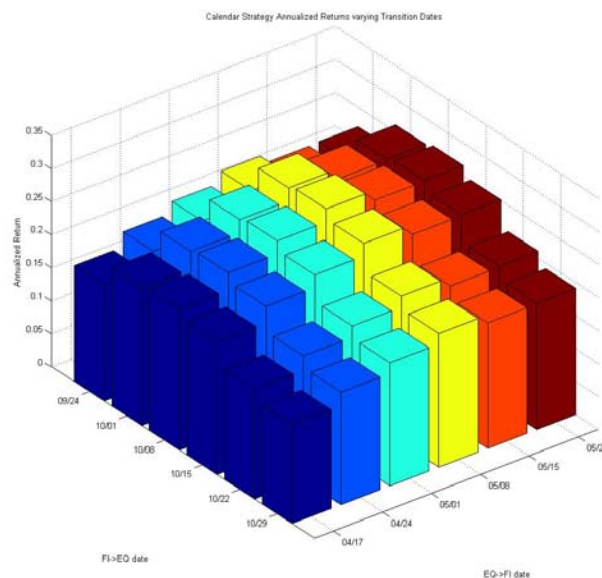
Backtesting SPY & SHY

A friend recommended I test the strategy on the SPDR S&P 500 (SPY) ETF, a more popular ETF that closely tracks the S&P 500. I repeated the same procedure as with MDY. First, the return to compare against for SPY is **9%** (the result of investing totally in SPY over the timeframe). Here is a graph showing the growth of $10,000 following the calendar rotation strategy, using May 1 and October 15 as the transition dates (again, reinvest all dividends):
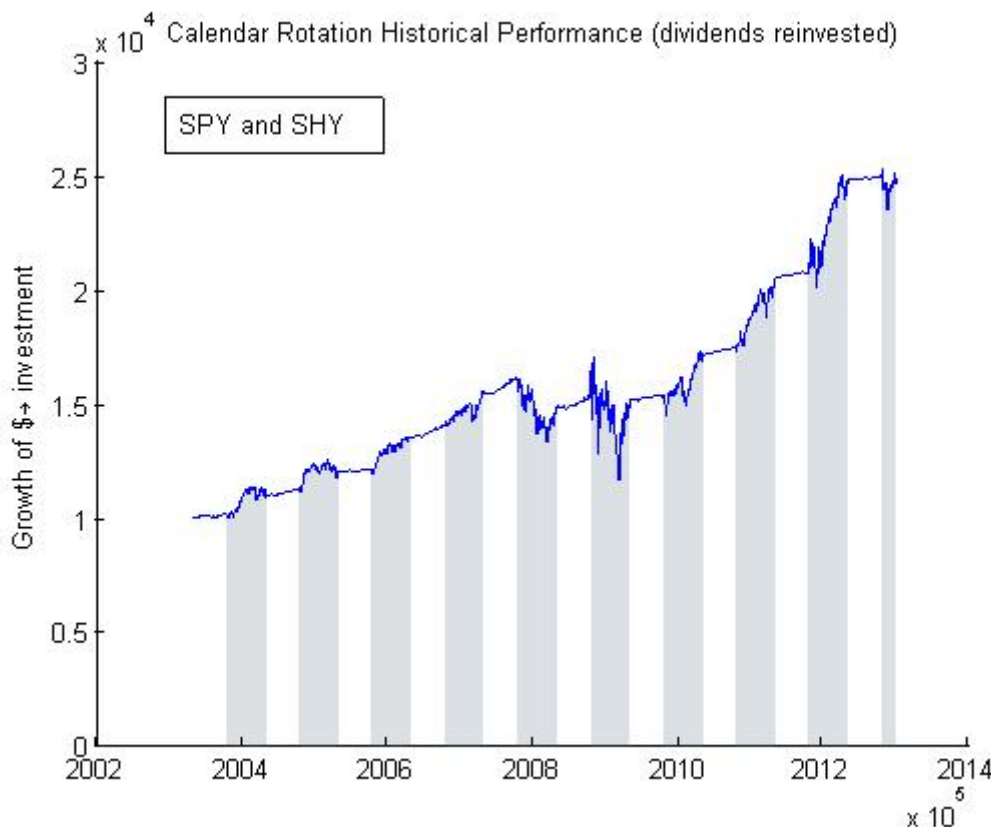

```
>> CalBackScript_SPY
Overall Return (final_val-initial_val)/initial_val: 1.450985
  Duration: 3529 days
    at EQ->FI date 05/01/03
    at FI->EQ date 10/15/03
  Annualized = Overall * 365/duration: 0.150074
EQ period: start; end; gain; duration (days); return (annualized)
ret =

  Columns 1 through 5

       10144         11254         12075         14009         16071
       10904         11937         13590         15403         14558
      759.92         683.3        1514.3        1393.9       -1513.2
         199           197           196           199           201
     0.13741        0.1125       0.23353        0.1825      -0.17098


  Columns 6 through 10

       15238         15355         17420         20715         24869
```

```
    15074          16849          20485          24630          24510
  -164.32          1493.9         3065.3         3915.3        -358.77
      198             198            197            199             77
 -0.019878         0.17934        0.32603        0.34667      -0.068386
```

```
FI period: start; end; gain; duration (days); return (annualized)
ret =
```

```
  Columns 1 through 5
```

```
    10000          10904          11937          13590          15403
    10144          11254          12075          14009          16071
   143.71          349.92         138.62         419.61         667.73
      166             167            168            168            165
 0.031599         0.070141       0.02523        0.067084       0.095894
```

```
  Columns 6 through 10
```

```
    14558          15074          16849          20485          24630
    15238          15355          17420          20715          24869
   680.08          281.53         570.73         229.77         238.56
      167             167            167            168            165
   0.1021         0.040821       0.074035       0.024369       0.021426
```
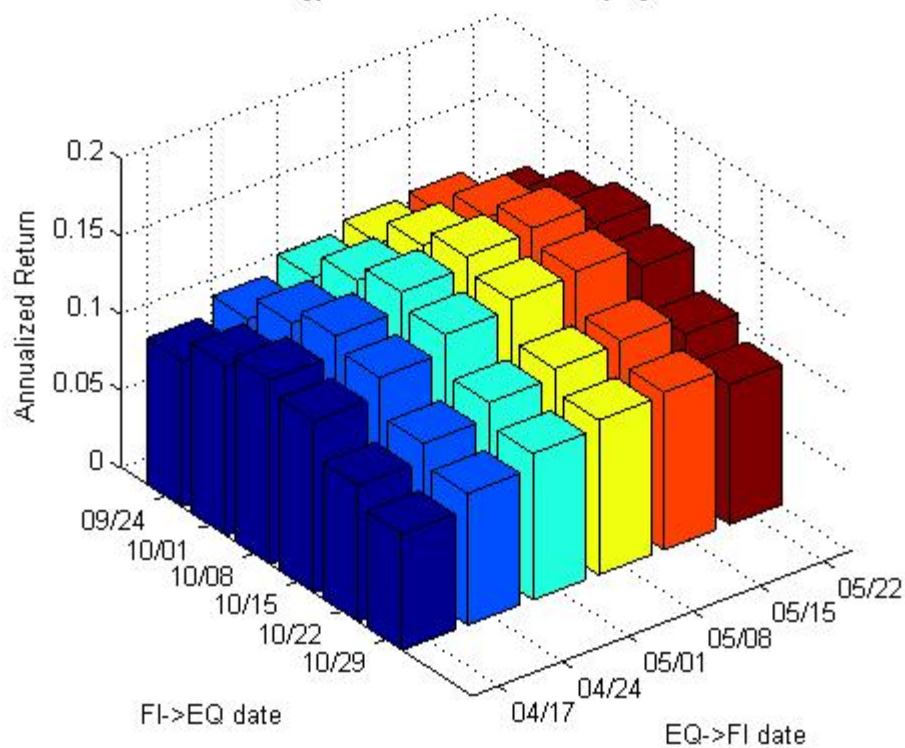
Varying the start and end dates, I find the optimal dates are very similar to the MDY and SHY case:

```
Max Return of 0.152280
      at EQ->FI date 05/01
      at FI->EQ date 10/22
```


Calendar Strategy Annualized Returns varying Transition Dates

Conclusion

The calendar rotation strategy looks good. Here are a summary of the returns, compared against the default "invest in all equities all the time" strategy:

	Fixed Income = SHY	
	All Equity	Calendar Rotation
Equity = MDY	12.6%	26.3%
Equity = SPY	9.1%	15.2%

The main disadvantage to the strategy is that effectiveness is only plausibly guaranteed in the long run. One must hold to the strategy for many years, even if the first few turn out bad due to bad timing, in order to see it work. Additionally, *past performance does not guarantee future results*, so it is entirely possible this strategy may fail in the future due to a change in culture, trends, market conditions, etc.

Future work might analyze the strategy over different kinds of equities and fixed income assets. For example, would the trend prove stronger if shorter term bonds were used instead of 1-3 year treasury bonds? There are many different possibilities to try.