BEHAVIOR OF MONTHLY TOTAL RETURNS OF U.S. TREASURY BILLS: 1926 TO 2011

Hamid, Shaikh A.
Southern New Hampshire University

Habib, Abraham
University of Massachusetts Boston

ABSTRACT

We explore the behavior of total monthly returns of Treasury bills from January 1926 to December 2011. We examine three types of month effects: if the mean of T-bills total monthly returns of the data set, and of a given month were significantly different from zero; if the mean of T-bills total monthly returns of a given month was different from the mean of the other eleven months stacked; and if the variance of the T-bills total monthly returns for a given month was different from the variance of the other eleven months stacked. The mean of T-bills total monthly returns (0.294%) for the data set as well as the mean of all the months were significantly greater than zero. No month effect was detected either in terms of mean or in terms of variance. When the data are sliced into three sub-periods, we find results similar to what we find for the entire data set. The non-existence of significant differences in the means or the volatilities of the returns of a month compared to the other eleven months stacked shows that the T-bills market is largely efficient. This is contrary to what we found with similar studies on monthly returns of long-term Treasury and corporate bonds. The mean of T-bills total monthly returns during the Republican presidencies (0.372%) was higher than during the Democratic presidencies (0.215%). Compared to the other eleven months stacked, the variance of the returns of December during Republican presidencies was lower whereas it was higher during Democratic presidencies.

INTRODUCTION

The U.S. Treasury bills market is one of the most active markets in the world. U.S. Treasury securities are the debt financing instruments of the United States federal government. T-bills have maturities of 1-month, 3-month, 6-month, and 1-year. They are issued at a discount to face value and reach full value (par value) at maturity. The difference between the discount price and par value is the interest or return earned. They carry a par value of $1,000 and up to $5 million. T-bills are backed by the credit of the U.S. government, and are thus considered close to risk-free investment. From 1928 to 2011, U.S. three-month T-bills provided investors with a 3.61% compound annual return. With 3.11% compound annual inflation, the real return over this period has been 0.50%. During this period, the annual returns have ranged between 0% and 15%, with the returns ranging from 0% to 5% in 59 of the 84-year period. Historically, T-bills have realized the highest returns during the inflationary 1970's and early 1980's. T-bills have realized the lowest returns during the years of the Great Depression (the 1930's), during the 1940's, when interest rates were price controlled ("pegged") by the Federal Reserve, and recently during the "Great Recession" period and thereafter (2008 - 2011).

With such an active trading in T-bills and with sophisticated investors that include many foreign governments, the T-bills market is expected to exhibit a high degree of efficiency. For example, we will not expect to find monthly seasonality in the returns from T-bills. This paper explores

some aspects of the behavior of the monthly returns from T-bills in general and the presence of monthly seasonality in particular. Insight into the behavior of U.S. T-bills returns has implications for investors and policy makers. The next section deals with previous research on the U.S. T-bills returns behavior, followed by research methodology of this study, analysis of results, and summary and conclusion.

LITERATURE SURVEY

Contrasted to the extensive research on equity returns, few investigations examine seasonality in the fixed income markets and even fewer in the T-bills market. Gibbons and Hess (1981) found some day-of-the-week effects in the trading of thirty-day T-bills between 1963 and 1968. Ferri, Goldstein, and Oberhelman (1984) also look at the day-of-the-week effect in T-bills return. The result of this study show for the data tested that the day-of-the-week effect in the returns of the bill market are occasional but irregular features of the market. Eiseman and Timme (1984) explore intraweek seasonality in the federal funds market using data from January 1966 to June 1982, and found seasonality to vary over time in intensity and relative size. Park and Reinganum (1986) find unusual price behavior of T-bills that mature at the turn of calendar months. Flannery and Protopapadakis (1988) find intraweek seasonality continue to be significant but not uniform. Chen and Chan (1997) found using monthly returns from 1926 to 1990 T-bills return showed strong October effect during economic expansion and strong November effect during contraction.

RESEARCH METHODOLOGY

The goal of this research is to find if there was a month effect in U.S. T-bills total monthly returns for the period of the study (1926-2011) and if so, was it more pronounced during Democratic presidencies or Republican presidencies. Many studies have used the dummy variable methodology to detect market seasonality. Chien, Lee and Wang (2002) provide statistical analysis and empirical evidence that the methodology may lead to misleading results. We avoid this problem by following the methodology used in Hamid and Dhakar (2005) through which they analyze seasonality in the monthly changes of the Dow Jones Industrial Average.

We study the month effect in three different ways. Unless otherwise stated, significance in all cases is tested at the 5% level.
1.   If the mean of T-bills monthly total returns was different from zero. The mean of monthly total returns for a given month i is subjected to the following hypothesis test: H_o: $\mu_i = 0$ vs. H_a: $\mu_i \neq 0$. We use the standard t-test for testing this hypothesis.
2.   If the mean of T-bills total monthly returns of a given month was different from the mean of the other eleven months stacked. We conduct the following hypothesis test for a given month i: H_o: $\mu_i = \mu_j$ vs. H_a: $\mu_i \neq \mu_j$, where j represents the remaining 11 months other than i. Since the variances for many (i, j) periods and the sample sizes were unequal, we use the more conservative t-test assuming unequal variances.
3.   If the variance of the T-bills total monthly returns for a given month was different from the variance for the other months. We conduct the following hypothesis test for a given month i: H_o: $\sigma_i^2 = \sigma_j^2$ vs. H_a: $\sigma_i^2 \neq \sigma_j^2$, where j represents the remaining 11 months other than i. We use the standard F-test for testing this hypothesis.

In addition to the t-test and F-test, we use three nonparametric tests which do not depend on the assumption of normal distribution of the data series. Kruskal-Wallis nonparametric test is a test of differences in population medians. Mood's Median test is like Kruskal-Wallis test but is more robust against outliers. Mann-Whitney test is a 2-sample rank test (also called the two-sample Wilcoxon rank sum test) of the equality of two population medians.

To gain deeper insight into the month effect, we divide the data period (January 1926 to December 2011) into three sub-periods:

- 1926 to 1945 (which includes the Great Depression years, and the Second World War);
- 1946 to 1972 (which includes the Breton Woods fixed exchange rate era, and the break down of that era in 1972);
- 1973 to 2011 (which includes the volatile world we live in since the first oil crisis of 1973).

We analyze the behavior of T-bills total monthly returns for (a) the entire data, (b) the three sub-periods, (c) the Republican presidencies, and (d) the Democratic presidencies.

DATA AND DESCRIPTIVE STATISTICS

The data consists of U.S. T-bills total monthly returns January 1926 to December 2011. The data is obtained from Stocks, Bonds, Bills, and Inflation Yearbook 2012. The data contains 518 months which saw Republican presidents, and 514 months which saw Democratic presidents. That gives us 1,032 months of observations.

The descriptive statistics for the monthly T-bills total monthly returns are shown in Table 1. The mean monthly return for the entire period was 0.29% and the median is 0.26%. The distribution of monthly means is positively skewed. The maximum monthly return was 1.35% in June 1981 and the minimum was -0.06% in November 1938.

Table 1: Descriptive Statistics for T-bills Total Monthly Returns:
January 1926 to December 2011

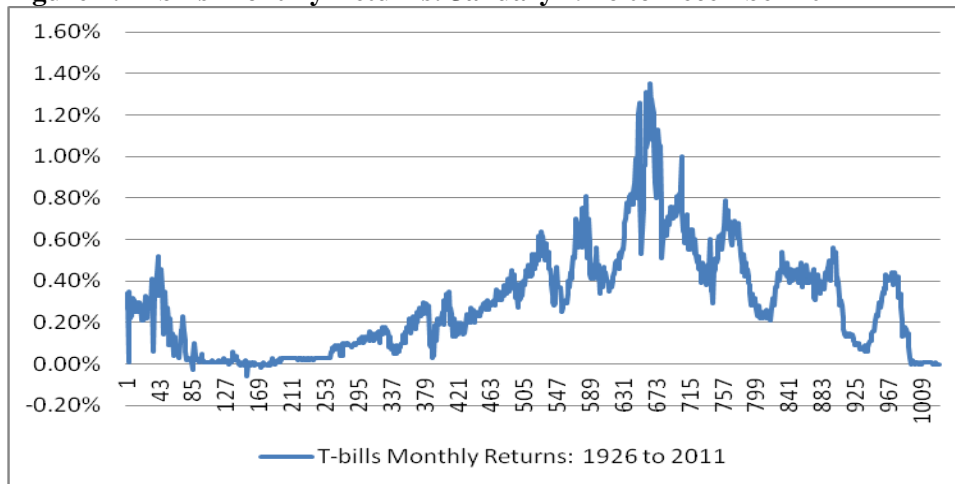| T-BILLS TOTAL MONTHLY RETURNS	
Mean	0.29%
Median	0.26%
Mode	0.30%
Std Deviation	0.25%
Kurtosis	1.28
Skewness	1.04
Minimum	-0.06%
Maximum	1.35%
Count	1032

The frequency distribution of T-bills monthly returns is far from being normally or log-normally distributed. The Kurtosis (1.28) is much less than it would be under normal distribution (3). The distribution is presented below. Only 12 (less than 1%) of the monthly returns were negative (between -0.06% and -0.01%). Nearly half of the returns (46%) were between 0% and 0.24%. A little over one-third of the returns (35%) were between 0.25% and 0.49%. That means a little over four-fifths of the returns (82%) were less than 0.49%. So less than one-fifth of the returns were 0.50% or higher (highest return was 1.35%). From December 2008 to December 2011, 36 of the returns were 0% (15) or 0.01% (21). The very high Jarque-Berra statistic of 313.25 also shows non-normality of the data series.

Table 2: Frequency Distribution of T-bills Monthly Returns: 1926 to 2011

Range of Returns	Frequency	Frequency(as % of Total)
-0.06% to -0.01%	12	1.16
0.00% to 0.24%	474	45.93
0.25% to 0.49%	360	34.88
0.50% to 0.74%	130	12.6
0.75% to 0.99%	38	3.68
1.00% to 1.35%	18	1.74
Total	1032	100%

Figure 2 shows the trend of monthly returns for the entire data set. The peak period was from January 1978 to December 1982 – the mostly Carter years during which the first and second oil shocks and the aftermath of the inflationary pressures of the Vietnam War led to double digit inflation rates and corresponding high T-bills monthly returns. During these five years the average return was 0.86% (0.29% for the entire data period) or 10.32% annualized.

Figure 1: T-bills Monthly Returns: January 1926 to December 2011

RESULTS AND ANALYSIS
ENTIRE PERIOD (1926 – 20011)

Firstly, we explore month effect for the entire U.S. T-bills total monthly returns data set. We test for the three types of month effects. Table 3 summarizes the statistical outputs and results of the tests.

Table 3: Month Effect in T-bills Total Returns: January 1926 to December 2011

	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	1032	86	86	86	86	86	86	86	86	86	86	86	86
Mean	0.294	0.292	0.274	0.298	0.300	0.296	0.291	0.296	0.293	0.298	0.307	0.283	0.297
Median	0.260	0.260	0.255	0.280	0.250	0.260	0.265	0.275	0.255	0.265	0.280	0.265	0.255
Minimum	-0.060	-0.010	-0.030	-0.010	-0.010	-0.020	0.000	-0.010	-0.010	0.000	0.000	-0.060	0.000
Maximum	1.350	1.040	1.070	1.210	1.260	1.150	1.350	1.240	1.280	1.240	1.210	1.070	1.310
Range	1.410	1.050	1.100	1.220	1.270	1.170	1.350	1.250	1.290	1.240	1.210	1.130	1.310
Std Dev	0.253	0.234	0.234	0.259	0.270	0.258	0.251	0.256	0.253	0.253	0.264	0.248	0.262
Sample Var	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
p-value (m=0)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
p-value (t test)		0.952	0.428	0.867	0.813	0.918	0.945	0.904	0.991	0.854	0.609	0.699	0.913
p-value (F test)		0.169	0.170	0.391	0.199	0.417	0.484	0.439	0.503	0.513	0.298	0.410	0.321
Mean % Change	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos
Month Effect (Mean)													
Month Effect (Var)													

Note 1. "Positive" implies that the mean percentage change was significantly greater than zero. "Negative" implies that the mean percentage change was significantly less than zero.
Note 2. "Higher" implies that the mean percentage change was significantly greater than the rest of the months. "Lower" implies that the mean percentage change was significant smaller than the rest of the months.
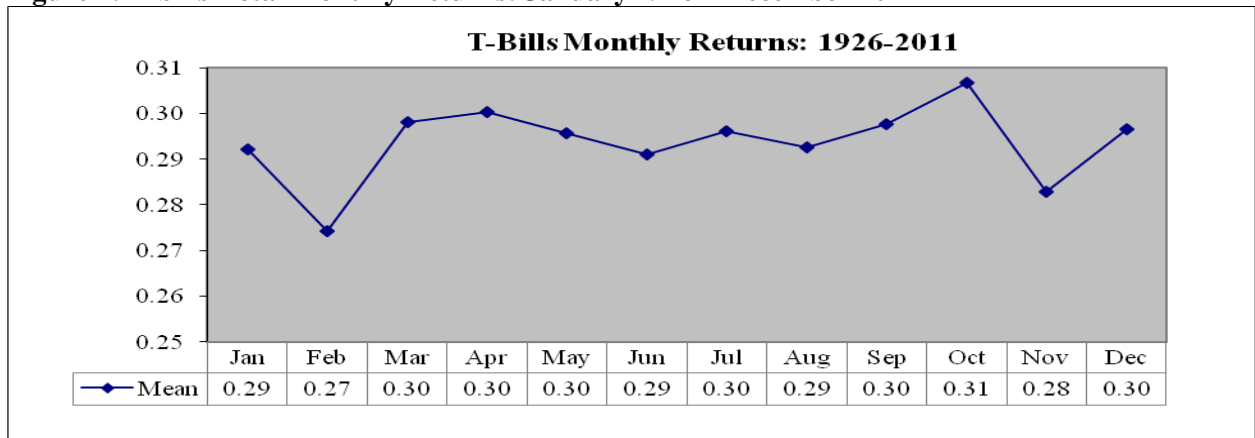Note 3: All returns in all tables are in percentage.

The mean of monthly returns for the entire data set of 0.294% was significantly greater than zero (p value=0.00). The means of monthly returns of all the individual months were significantly greater than zero. October experienced the highest mean return (0.307%) followed by September and March (both 0.298%). February had the lowest mean (0.274%). As implied by the blank spaces in the second last row of Table 2, the returns of none of the months was significantly different from the returns of the other eleven months stacked. As implied by the blank spaces in the last row of Table 2, the standard deviations of none of the months was significantly different from the standard deviation of the returns of the other eleven months stacked. The non-existence of significant differences in the means or the volatilities of the returns of a month compared to the other eleven months stacked shows that T-bills prices were largely efficient. This is contrary to what we found with similar studies on monthly returns of long-term Treasury and corporate bonds.

Figure 3 graphs the mean of monthly returns for the entire data set. On average, there was a slight fall from January to February, a rise in March and then a rather flat trend until August and then rising in September and October. We then see a fall in November and then rise in December. If intently viewed, the figure shows a rather symmetrical distribution in the means of monthly returns with July as the mid-point.

Nonparametric Kruskal-Wallis test result (not reported for brevity) shows no significant difference in the medians of the returns of the twelve months (H statistic = 0.85; p value=1.00). Mood's Median test also shows no difference in the medians of the monthly returns (Chi-Square statistic = 0.88; p value=1.00).

Figure 2: T-bills Total Monthly Returns: January 1926 – December 2011

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0.29	0.27	0.30	0.30	0.30	0.29	0.30	0.29	0.30	0.31	0.28	0.30

FIRST SUB-PERIOD (1926-1945)

Table 4 below shows that for this sub-period, in spite of the Great Depression leading to deflation and the pegging of interest rates during World War II, the mean of monthly returns (0.088%) was significantly greater than zero (p value=0.00). The means of monthly returns of all the individual months were significantly greater than zero (p values between 0.00 and 0.01). As implied by the blank spaces in the second last row of Table 4, the returns of none of the months was significantly different from the mean returns of the other eleven months stacked. As implied by the blank spaces in the last row of Table 4, the standard deviations of none of the months was significantly different from the standard deviation of the returns of the other eleven months stacked. The absence of monthly seasonality in returns goes to show the efficiency of T-bills prices in the first sub-period.

Table 4: Month effects in T-bills Total Returns: 1926-1945

	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	240	20	20	20	20	20	20	20	20	20	20	20	20
Mean	0.088	0.094	0.096	0.102	0.092	0.087	0.101	0.085	0.080	0.079	0.093	0.086	0.068
Median	0.030	0.030	0.020	0.020	0.030	0.030	0.025	0.030	0.030	0.030	0.025	0.020	0.020
Minimum	-0.060	-0.010	-0.030	-0.010	-0.010	-0.020	0.000	-0.010	-0.010	0.000	0.000	-0.060	0.000
Maximum	0.520	0.340	0.360	0.350	0.360	0.440	0.520	0.330	0.400	0.350	0.460	0.380	0.370
Range	0.580	0.350	0.390	0.360	0.370	0.460	0.520	0.340	0.410	0.350	0.460	0.440	0.370
Std Dev	0.125	0.122	0.135	0.134	0.118	0.131	0.152	0.116	0.124	0.109	0.145	0.131	0.106
Sample Var	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
p-value (m=0)	0.000	0.003	0.005	0.003	0.002	0.008	0.008	0.004	0.009	0.004	0.010	0.009	0.010
p-value (t test)		0.834	0.795	0.640	0.890	0.945	0.699	0.876	0.753	0.692	0.896	0.931	0.384
p-value (F test)		0.466	0.358	0.366	0.391	0.423	0.137	0.363	0.511	0.222	0.211	0.415	0.183
Mean % Change	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos
Month Effect (Mean)													
Month Effect (Var)													

Figure 4 shows the trend of mean of monthly returns from 1926 to 1945. The mean of monthly returns increased from 1926 to 1929, decreased thereafter until 1933, and was within a narrow band after that until 1945. The returns were close to zero in four of those years: 1938 to 1941.

America entered the war in 1941 and high financing needs could have caused returns to be higher but yields were kept low to finance war needs.

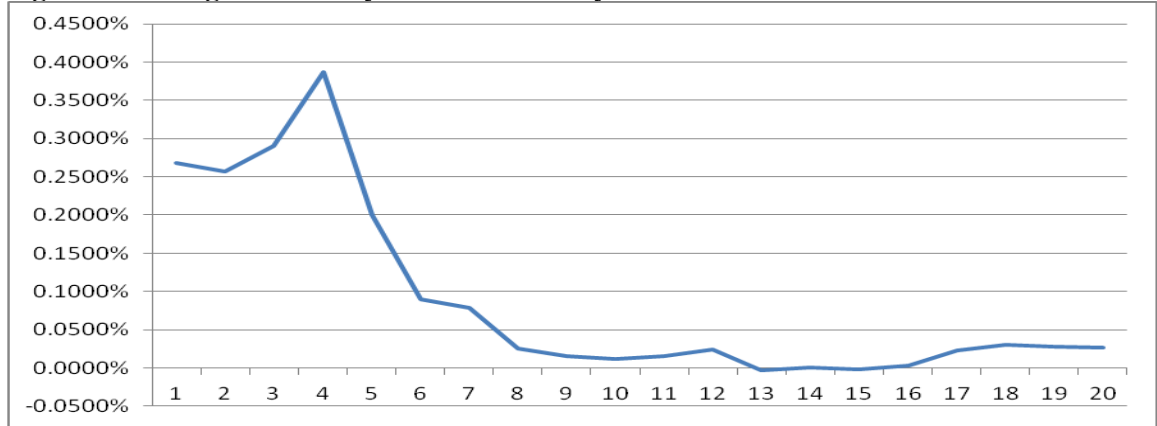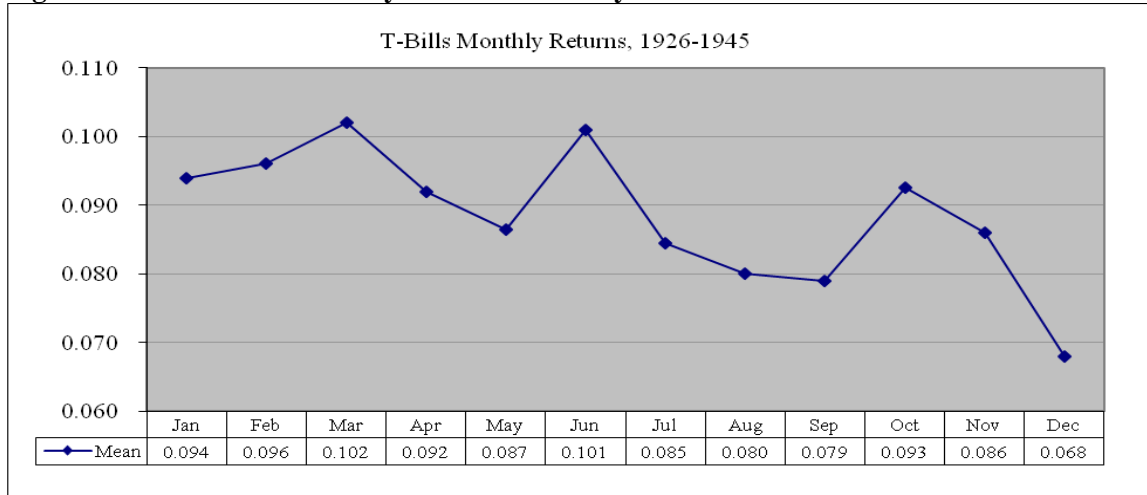**Figure 3: Average of Monthly Returns: January 1926 to December 1945**

Figure 5 shows that the monthly means of the twelve months from 1926 to 1945 shows some cyclicity with peaks in March, June, and October. There is also an overall falling trend with the low in December.

Figure 4: T-bills Total Monthly Returns: January 1926 to December 1945

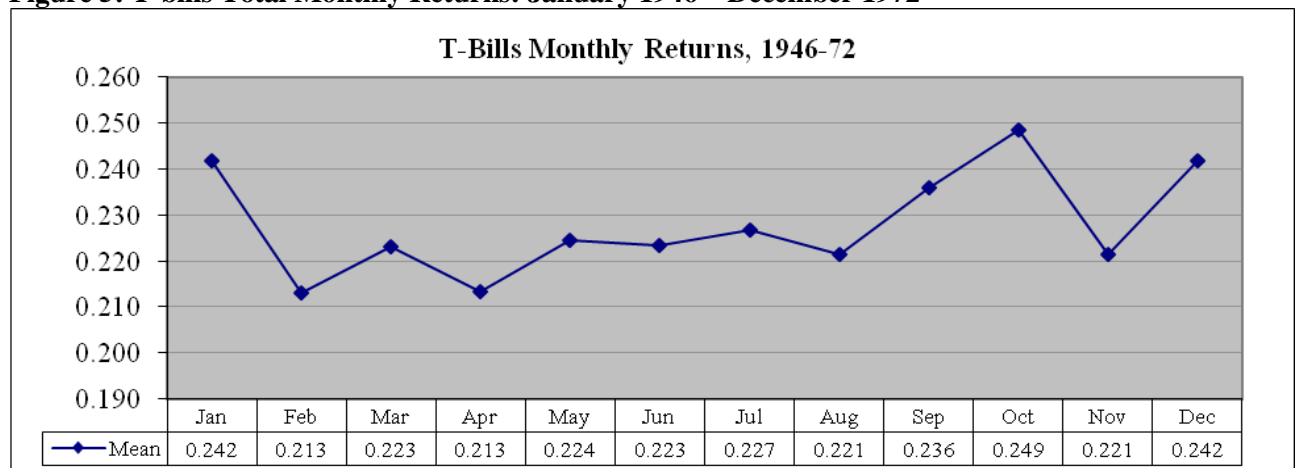|	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0.094	0.096	0.102	0.092	0.087	0.101	0.085	0.080	0.079	0.093	0.086	0.068

SECOND SUB-PERIOD (1946-1972)

This was an era of fixed-exchange rates and relative domestic progress and prosperity. This was an era in which America helped Europe to rise up from the ashes of the Second World War under the Marshall Plan and also helped Japan to get back on its feet. (The Marshall Plan itself was worth over $120 billion in today's dollars.) Table 5 shows that compared to the previous sub-period, the mean of T-bills monthly total returns more than doubled (0.228% vs. 0.088%) and this was significantly greater than zero (p = 0.00). The means of all the individual months were positive and significantly greater than zero. As implied by the blank spaces in the second last row of Table 5, the returns of none of the months was significantly different from the returns of the other eleven months stacked. As implied by the blank spaces in the last row of Table 5, the standard deviations of none of the months was significantly different from the standard deviation of the returns of the other eleven months stacked.

Table 5: Month effects in T-bills Total Returns: 1946-1972

	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	324	27	27	27	27	27	27	27	27	27	27	27	27
Mean	0.228	0.242	0.213	0.223	0.213	0.224	0.223	0.227	0.221	0.236	0.249	0.221	0.242
Median	0.205	0.240	0.190	0.200	0.190	0.230	0.200	0.220	0.170	0.190	0.250	0.200	0.230
Minimum	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030
Maximum	0.640	0.600	0.620	0.570	0.530	0.530	0.580	0.530	0.530	0.620	0.600	0.520	0.640
Range	0.610	0.570	0.590	0.540	0.500	0.500	0.550	0.500	0.500	0.590	0.570	0.490	0.610
Std Dev	0.142	0.147	0.142	0.141	0.134	0.136	0.145	0.147	0.146	0.149	0.147	0.144	0.144
Sample Var	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
p-value (m=0)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
p-value (t test)		0.610	0.573	0.850	0.562	0.892	0.865	0.964	0.813	0.771	0.451	0.810	0.603
p-value (F test)		0.418	0.525	0.506	0.372	0.408	0.459	0.424	0.440	0.395	0.423	0.485	0.479
Mean % Change	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos
Month Effect (Mean)													
Month Effect (Var)													

Figure 6 below shows means of monthly total returns for the second sub-period. Contrasted to the trend for the first sub-period, we see an overall rising trend from February to December. The cyclicity is less pronounced for this sub-period. The mean returns were between 0.21% and 0.25% with no significant difference in the returns.

Figure 5: T-bills Total Monthly Returns: January 1946 – December 1972

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0.242	0.213	0.223	0.213	0.224	0.223	0.227	0.221	0.236	0.249	0.221	0.242

THIRD SUB-PERIOD (1973-2011)

From a mean monthly change of 0.088% in the first sub-period and 0.228% in the second sub-period, the mean return increased to 0.444% in the third sub-period as can be seen in Table 6. It was significantly greater than zero. All months experienced mean returns significantly greater than zero. As implied by the blank spaces in the second last row of Table 6, the returns of none of the months was significantly different from the returns of the other eleven months stacked. As implied by the blank spaces in the last row of Table 6, the standard deviations of none of the months was significantly different from the standard deviation of the returns of the other eleven months stacked.

So we find no month effect in terms of either the mean return of a month being significantly different from the mean of the other eleven months, or the volatility of a month being
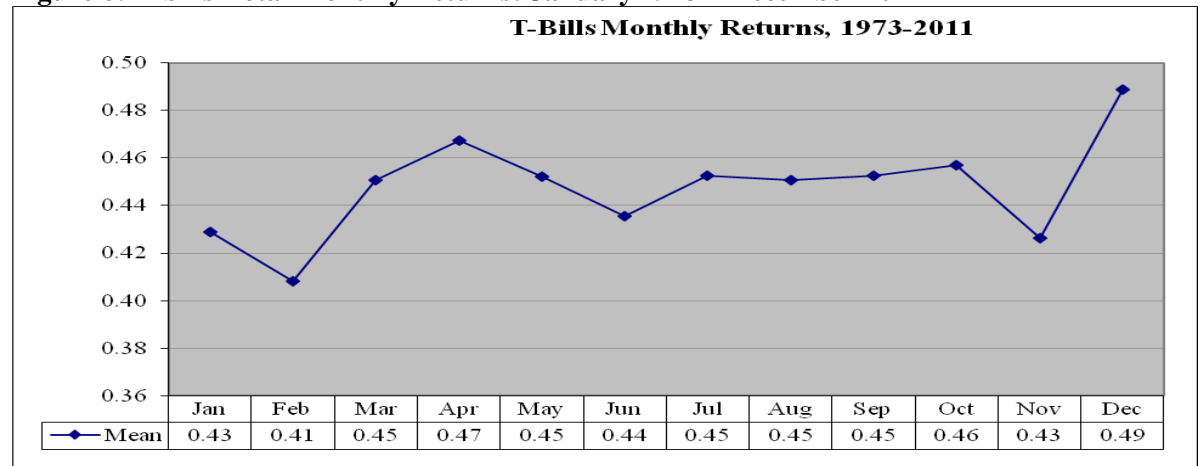
significantly different from the volatility of the other eleven months – either in the entire data period or in the data of any of the three sub-periods.

Table 6: Month effects in T-bills Total Returns: 1973-2011

	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	468	39	39	39	39	39	39	39	39	39	39	39	36
Mean	0.444	0.429	0.408	0.451	0.467	0.452	0.435	0.453	0.451	0.453	0.457	0.426	0.489
Median	0.430	0.430	0.390	0.430	0.440	0.430	0.410	0.450	0.440	0.440	0.420	0.400	0.480
Minimum	0.000	0.000	0.000	0.010	0.000	0.000	0.000	0.000	0.010	0.000	0.000	0.000	0.000
Maximum	1.350	1.040	1.070	1.210	1.260	1.150	1.350	1.240	1.280	1.240	1.210	1.070	1.310
Range	1.350	1.040	1.070	1.200	1.260	1.150	1.350	1.240	1.270	1.240	1.210	1.070	1.310
Std Dev	0.267	0.242	0.249	0.281	0.295	0.275	0.267	0.271	0.261	0.264	0.284	0.265	0.261
Sample Variance	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
p-value (m=0)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
p-value (t test)		0.677	0.389	0.834	0.573	0.805	0.879	0.794	0.822	0.789	0.726	0.710	0.295
p-value (F test)		0.213	0.271	0.371	0.226	0.453	0.504	0.501	0.423	0.457	0.339	0.471	0.447
Mean % Change	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos
Month Effect (Mean)													
Month Effect (Var)													

Figure 7 below shows that the trend of the means of the monthly returns of this sub-period is pretty similar to the trend we saw for the previous sub-period; we see an overall rising trend. The returns have ranged from a low of 0.41% in February to a high of 0.49% in December. The returns are depressed little bit because of the low yields since 2007 – close to 0%.

Figure 6: T-bills Total Monthly Returns: January 1973 – December 2011

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0.43	0.41	0.45	0.47	0.45	0.44	0.45	0.45	0.45	0.46	0.43	0.49

COMPARISON OF THREE SUB PERIODS

Figure 8 shows the means of the various months for the three sub-periods. As we saw for the entire data set, we see a similar pattern for each of the three sub-periods.

Figure 7: Comparison of Three Sub-periods Contrasted With Entire Data Set
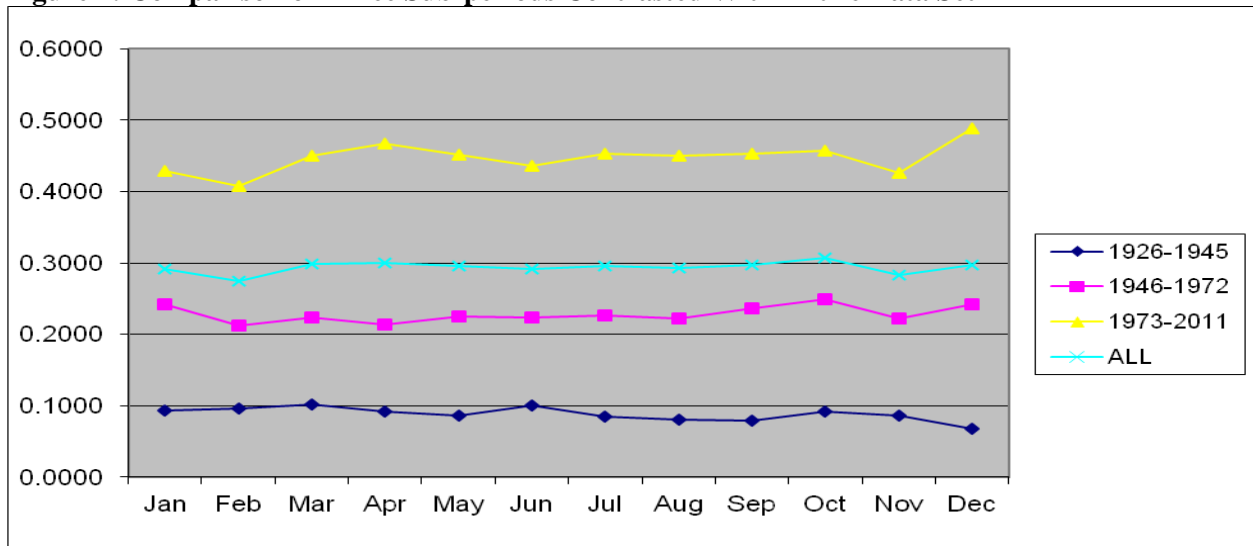
An interesting trend is the increase in the mean of monthly returns for each of the three successive sub-periods (0.09%, 0.23%, 0.44%) and corresponding increase in the medians (0.03%, 0.21%, 0.43%) and an increase in the standard deviations of the monthly changes (0.13%, 0.14%, 0.27%).

The means of the three sub-periods are significantly different: the means of the second and third sub-periods are significantly higher than the mean of the first sub-period, and the mean of the second sub-period is significantly higher than the mean of the first sub-period – all for p values of 0.00.

Nonparametric Kruskal-Wallis test result (not reported for brevity) shows significant difference in the medians of the returns of the three sub-periods (H statistic = 386.53; p value=0.00). Mood's Median test also shows significant difference in the medians of the monthly returns (Chi-Square statistic= 263.59; p value=0.00).

While the means and medians increased, the standard deviations also increased significantly based on F-test. The standard deviation of the second sub-period is significantly higher than that of the first sub-period for a p-value of 0.04. The standard deviation of the third sub-period is significantly higher than that of the first for a p-value of 0.00. The standard deviation of the third sub-period is significantly higher than that of the second sub-period for a p-value of 0.00. The stable period during Breton Woods fixed exchange rate system did not lower the standard deviation of the second sub-period possibly as a result of the effects of the Korean War and the Vietnam War. The even higher standard deviation during the third sub-period (0.27%) is attributable to the volatile world after the break-up of the Breton Woods system and the effects of globalization and technological innovations causing wide-spread dissemination of news and the need for market participants to react faster to such news.

MONTH EFFECT: REPUBLICAN AND DEMOCRATIC PRESIDENTIAL PERIODS

Given the important impact presidencies have on the economy, we explored the three types of month-effects in T-bills total monthly returns during the Republican and Democratic presidencies.
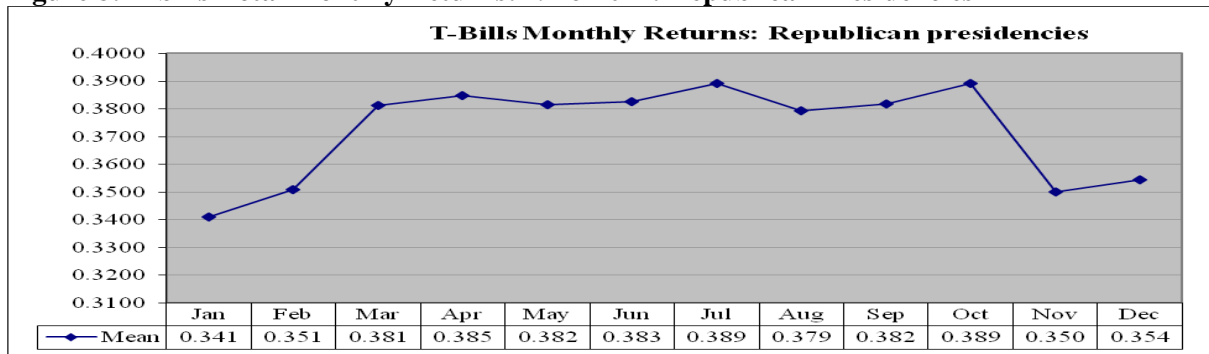
REPUBLICAN PRESIDENCIES

Table 7 shows the statistical output for T-bills total monthly returns during Republican presidencies over the entire period. The mean of T-bills total monthly returns (0.372%) over the 518 Republican months was significantly greater than zero. The median of T-bills total monthly returns during Republican periods was 0.335%. The means of T-bills total monthly returns for all the individual months were significantly greater than zero. We do not see a month effect in terms of mean: the mean return of none of the months was significantly different from the mean returns of the other eleven months stacked. The mean of monthly returns for the twelve months were within 0.34% and 0.39%. However, we see a month effect in terms of variance: the standard deviation of the returns of December was significantly lower than that of the other eleven months stacked. We would not expect to see such an anomaly in a highly efficient market; the volatility of no month should be significantly different from that of the other eleven months.

Table 7: Month effects in T-bills Total Return: Republican presidencies

	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	518	44	44	43	43	43	43	43	43	43	43	43	43
Mean	0.372	0.341	0.351	0.381	0.385	0.382	0.383	0.389	0.379	0.382	0.389	0.350	0.354
Median	0.335	0.310	0.330	0.350	0.340	0.320	0.350	0.320	0.320	0.320	0.370	0.350	0.340
Minimum	-0.030	0.000	-0.030	0.080	0.080	0.010	0.020	0.030	0.030	0.030	0.020	0.020	0.000
Maximum	1.350	0.800	1.070	1.210	1.130	1.150	1.350	1.240	1.280	1.240	1.210	1.070	0.870
Range	1.380	0.800	1.100	1.130	1.050	1.140	1.330	1.210	1.250	1.210	1.190	1.050	0.870
Std Dev	0.246	0.204	0.232	0.241	0.261	0.264	0.262	0.272	0.265	0.255	0.258	0.226	0.225
Sample Var	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
p-value (m=0)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
p-value (t test)		0.304	0.532	0.798	0.737	0.804	0.784	0.668	0.852	0.793	0.648	0.510	0.318
p-value (F test)		0.052	0.313	0.449	0.307	0.278	0.294	0.192	0.260	0.391	0.349	0.237	0.000
Mean % Change	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos
Month Effect (Mean)													
Month Effect (Var)													Lower

Figure 9 shows that the mean returns of March through October ranged within a narrow range of 0.38% to 0.39%. The returns of the first two and last two months ranged within a narrow band of 0.341% and 0.354%. The figure resembles a plateau between March and October.

Figure 8: T-bills Total Monthly Returns: 1926-2011: Republican Presidencies

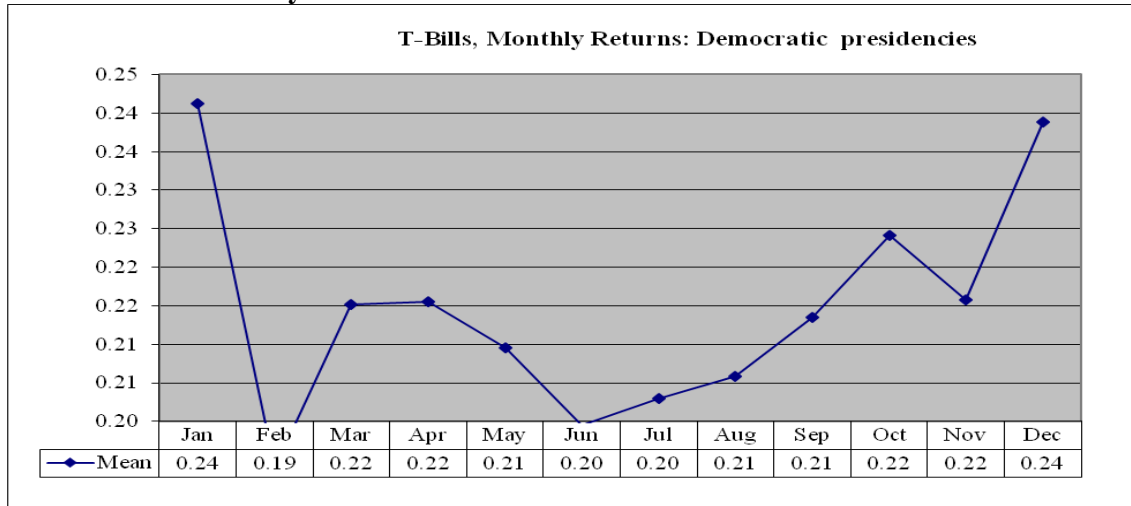|	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0.341	0.351	0.381	0.385	0.382	0.383	0.389	0.379	0.382	0.389	0.350	0.354

DEMOCRATIC PRESIDENCIES

Table 8 shows the statistical output for T-bills total monthly returns during Democratic presidencies over 1926-2011. The mean of T-bills total monthly returns (0.215%) over the 514 Democratic months is significantly greater than zero. The overall median of T-bills total monthly returns during Democratic presidencies was 0.120% compared to 0.335% during Republican presidencies. The returns of all the months were significantly greater than zero. Ten of the 12 months during democratic presidencies experienced returns significantly greater than zero. We do not see a month effect in terms of mean: as in the case of Republican presidencies. The mean return of none of the months was significantly different from the mean returns of the other eleven months stacked. The mean of monthly returns for the twelve months were within 0.19% and 0.24%. As in the case of the Republican presidencies, we see a month effect in terms of variance, but of the opposite type: the standard deviation of the returns of December was significantly higher than that of the other eleven months. We would not expect to see such an anomaly in a highly efficient market; no month should exhibit volatility significantly different from that of the other eleven months.

Table 8: Month effects in T-bills Total Returns: Democratic presidencies

	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count	514	42	42	43	43	43	43	43	43	43	43	43	43
Mean	0.215	0.241	0.194	0.215	0.216	0.210	0.200	0.203	0.206	0.213	0.224	0.216	0.239
Median	0.120	0.155	0.110	0.110	0.120	0.120	0.120	0.130	0.130	0.120	0.140	0.110	0.120
Minimum	-0.06	-0.01	-0.01	-0.01	-0.01	-0.02	0.000	-0.01	-0.01	0.000	0.000	-0.06	0.000
Maximum	1.310	1.040	0.890	1.210	1.260	0.820	0.810	0.770	0.770	0.830	0.950	0.990	1.310
Range	1.370	1.050	0.900	1.220	1.270	0.840	0.810	0.780	0.780	0.830	0.950	1.050	1.310
Std Dev	0.234	0.255	0.211	0.251	0.254	0.223	0.204	0.204	0.210	0.224	0.245	0.253	0.286
Sample Var	0.001	0.001	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001
p-value (m=0)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
p-value (t test)		0.482	0.540	0.965	0.954	0.905	0.647	0.731	0.806	0.999	0.765	0.949	0.540
p-value (F test)		0.239	0.186	0.272	0.242	0.340	0.120	0.116	0.178	0.354	0.353	0.258	0.038
Mean % Change	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos	Pos
Month Effect (Mean)													
Month Effect (Var)													Higher

Figure 10 shows a slightly upward rising trend in the means of monthly returns for the twelve months.

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Figure 9: T-bills Total Monthly Returns: 1926-2011: Democratic Presidencies

T-Bills, Monthly Returns: Democratic presidencies

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0.24	0.19	0.22	0.22	0.21	0.20	0.20	0.21	0.21	0.22	0.22	0.24

COMPARISON BETWEEN REPUBLICAN AND DEMOCRATIC PRESIDENCIES: 1926-2011

Figure 11 below shows the mean monthly T-bills total returns for the entire period, as well as the mean monthly returns under Republican and Democratic presidencies. The pattern is pretty similar for all three trend lines from February onwards. The high point is October for the entire data period and the Republican presidencies; it is January during Democratic presidencies.

Figure 10: Monthly Mean Returns Contrasted: Republican vs. Democratic Presidencies

T-Bills Total Monthly Returns: Republican vs. Democrat Presidencies
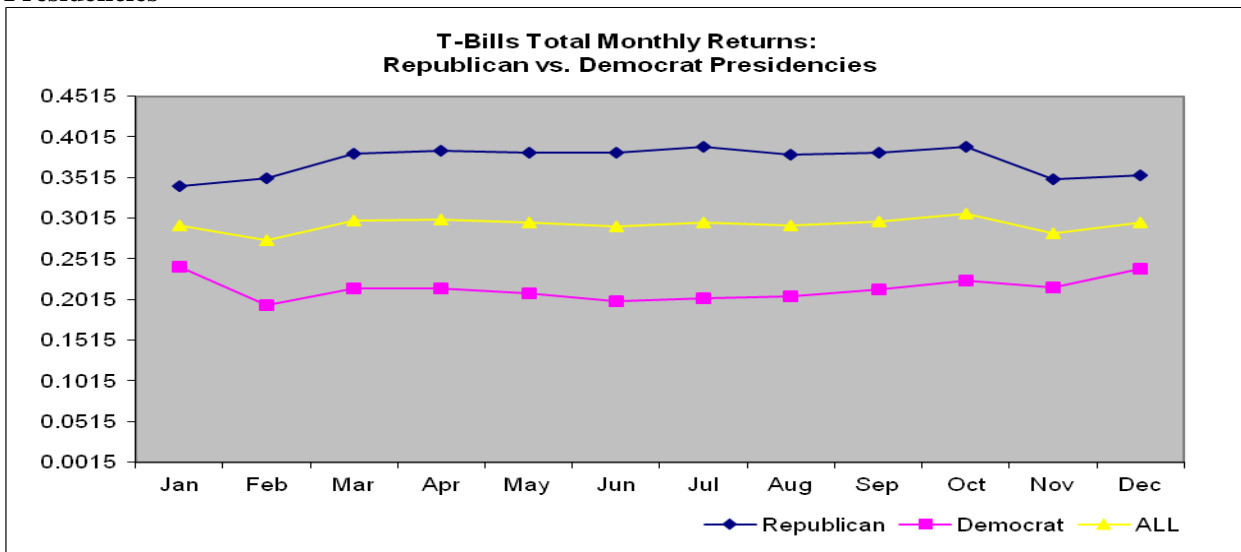
Two-sample t-test assuming equal variances shows a significant difference (p value=0.00) between the mean monthly returns during Republican presidencies (0.372%) and Democratic presidencies (0.215%). However, F-test (p value=0.27) shows no significant difference in the standard deviations of monthly returns during Republican presidencies (0.246%) and during Democratic presidencies (0.234%).

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Nonparametric Kruskal-Wallis test result (not reported for brevity) shows significant difference in the medians of the returns during Republican and Democratic presidencies (H statistic = 133.45; p value=0.00. Two-sample rank test (called the Mann-Whitney test) of the equality of two population medians also shows significant difference in the medians of the returns under the two types of presidencies (W statistic = 322853.0; p value=0.00).

It would be interesting to see if borrowing during the Republican presidencies was significantly higher than during Democratic presidencies to warrant the higher average returns achieved by investors during Republican presidencies. However, we have to note that such results are not just the action of the presidents in power but also caused by actions of the Congress and the Federal Reserve System. It will be very hard, if not impossible, to isolate the relative impact of the actions of the three parties.

If war periods cause higher prices, Democrats have had more than their share of war presidents: Woodrow Wilson was the war president during First World War, Franklin Delano Roosevelt during Second World War, Harry Truman during Korean War, and Kennedy and Johnson presided over the major part of the Vietnam War. The Depression Years, which depressed prices greatly, were presided over by Republican President Herbert Hoover. These factors could well have accounted for the lower monthly returns during Democratic presidencies.

MEAN RETURNS DURING EXPANSIONS AND RECESSIONS

The mean monthly returns for the 839 months that saw economic expansion was 0.29%. The mean monthly returns for the 203 months that saw economic recession was 0.30%. There is no significant difference between the two means (p value=0.70). The standard deviations of the monthly returns in the two periods are respectively 0.24% and 0.31% -- and the difference is significant based on F-test for a p-value of 0.00. Recessions bring greater uncertainty and hence we would expect to see greater variance of returns in such periods. But we do not see a significant difference in the means of the two economic conditions.

MEAN RETURNS DURING CRISES

The mean of T-bills monthly total returns during the various crisis years were as follows:

Great Depression (October 1929 to November 1933):	0.1182%
World War II (January 1, 1939 to August 15, 1945):	0.0151%
World War II (December 7 to August 15, 1945)[1]:	0.0264%
Korean War (June 27, 1950 to July 27, 1953):	0.1324%
Vietnam War (August 1964 to January 1973)[2]:	0.3961%
Vietnam War (August 1964 to April 30, 1975)[3]:	0.4362%

Notes:
1. This period takes into account the formal declaration of war against Japan after the bombing of Pearl Harbor by the Japanese on December 7, 1941.
2. The start of the Vietnam War is assumed as August 1964 when President Johnson got Congressional authorization for use of force for going into combat operations. Prior to that, the U.S. had mainly training and support role with the South Vietnamese Armed Forces. The war formally ended on April 30, 1975, but in this scenario, the end of U.S. active involvement is taken as the Paris accord of January 1973.
3. This scenario takes into account the final fall of the South Vietnamese regime.

Part of the Vietnam War period was Republican President Nixon's presidency (January 1969 to August 1974) and then it was Republican President Ford (August 1974 to January 1977). The Vietnam War cost $118 billion, and started the inflationary cycle that tarnished the Carter presidency (February 1977 to January 1981). The mean of monthly returns during this period was 0.694% -- or 8.32% annualized – much higher than for the entire data period (3.53%). The foregoing mean returns are all lower than the mean return for the entire data period (0.294%) except for the mean return during Vietnam War.

SUMMARY AND CONCLUSION

This paper explores the behavior of the U.S. T-bills total monthly returns over the period January 1926 to December 2011. We looked at seasonality via the month effect in T-bills total monthly returns. We looked at three types of month effects: if the means of monthly T-bills total monthly returns of the entire data set and of each of the twelve months were significantly different from zero; if the mean of total monthly returns for each month was different from the means of the other months stacked; if the variance of the total monthly returns for each month was different from the variance of the other eleven months stacked.

The means of T-bills total monthly returns for the entire data set as well as for each month were significantly greater than zero ($p = 0.00$). We find that there is some semblance of symmetrical distribution in the monthly returns with July as the mid-point. The means of monthly returns as well as the standard deviations of the returns of none of the months were significantly different from that of the other eleven months.

We sliced the data into three sub-periods to gain greater insight on monthly seasonality. We find significant increase in the means and medians of monthly returns for each of the three successive sub-periods and also an increase in the standard deviations of the monthly returns for the successive sub-periods – which was not significant. The mean of monthly returns for each sub-period and for each month in each sub-period were significantly greater than zero. As in the case of the entire data period, the means of monthly returns as well as the standard deviations of the returns of none of the months in any of the sub-periods were significantly different from that of the other eleven months. The absence of seasonality in monthly returns for the entire data period as well as for the three sub-periods is a testament to the efficiency of the T-bill market to a high degree.

The mean of T-bills total monthly returns for the 518 months of Republican presidencies (0.372%) was significantly higher than the mean of the 514 months of Democratic presidencies (0.214%) and so were the medians. There was no significant difference in the variances of returns of the two presidencies. However, the variance of the returns of December during Republican presidencies was significantly lower compared to the other eleven months; the variance of December was higher compared to the other eleven months during Democratic presidencies.

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