Seasonality in the 10-year Treasury Yield

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Abstract

In this paper, we study the seasonality in the 10-year nominal Treasury yield which is the most actively watched Treasury yield by the market. We analyze whether the recently implemented regular auction and reopening mechanism affects the seasonal variations in the 10-year Treasury yield in any way. We find that most anecdotally observed seasonalities in the 10-year Treasury yield are not statistically significant. The period of 1990-2018 is the only period where we find evidence to support a quarterly seasonal variation in the month-over-month change in the yield. The adopted regular issuance schedule has weakened this seasonality in the recent years.

Keywords: Seasonality, 10-year Treasury Yield, Asset pricing, Portfolio Management, Debt Financing

I. Introduction

A persistent seasonal asset-pricing anomaly has important implications for market efficiency since discovered or known anomalies typically disappear quickly through arbitrage in an efficient market. Previous literature has over the years documented seasonal asset return variations across different markets and asset classes. The most well-known anomalies include the turn-of-the-year or January effect, the turn-of-the-month and intra-month effect, and the day-of-the-week effect. Explanations for such anomalies include macroeconomic seasonalities (Kramer (1994)), standardization of payments and the resulting concentration of cash flows at certain times (Ogden, 1987, 1990), portfolio rebalancing (Haugen and Lakonishok, 1987; Ritter and Chopra, 1989), timing of the news announcement (Penman (1987)), tax-loss selling (Keim (1983)), and behavioral perspective such as seasonal mood swings (Kamstra, Kramer and Levi (2015)). The focus of seasonal studies has been on risky assets such as stocks and corporate bonds. Few studies have documented seasonalities in returns on riskless securities, and their findings are mixed. For example, while Schneeweis and Woolridge (1979), Chang and Pinegar (1986), Sharp (1988) and Krehbiel (1993) find no seasonalities in Treasury bond's monthly returns, others like Flannery and Protopadakis (1988), Clayton, Delozier and Ehrhardt (1989), and Athanassakos and Tian (1998) find Treasury returns' seasonality in days-of-the-week, month-of-the-year, and quarter-of-the-year.

In this paper, we examine the seasonality in the 10-year Treasury Note yield. The 10-year Treasury Note is the most widely followed US government issued debt security and its yield (the interest rate paid on the Note or the return on holding the Note to maturity) is used as a benchmark for many other interest rates. Debt financing through government securities (Treasuries) goes back to the 1920s. Treasuries have been sold in several ways throughout history, and have been regularly sold at auctions since 1974. Since November 2008, the 10-year Treasury Note has been on the current regular issuance schedule (which consists of four regular auctions in February, May, August and November), and eight re-openings (which are additional auctions in the two months following the regular auctions on securities of the same maturity date and coupon rate as the original issuance). Table I describes the current annual issuance schedule of the 10-year Treasury Note.

It is important to point out that in this paper we study the yield instead of the total return. Most available studies on Treasury returns' seasonalities use the holding period returns of Treasuries that are backed out from the bond yield indices. The problem with these returns is that they are impossible to calculate without making addition assumptions about coupon payments and time-to-maturity of the bonds included in the indices. The yield is typically used as an input in the bond return seasonality study. The value (and hence the return) of a Treasury security is determined by its cash flows and the discount rate, which is the yield. Therefore, seasonalities in the yield would have an effect on the Treasury security returns, although this will not translate to seasonalities in returns directly because the level of the yield will also affect the returns.

Table I. Annual Issuance Schedule of the 10-Year Treasury Note Since November 2008

Number of Issue	Original Issue	Reopening
1	February	March, April
2	May	June, July
3	August	September, October
4	November	December, January

Source: Current Schedule for Treasury Reopenings (www.treasurydirect.gov)

The 10-year Treasury yield is closely followed by market participants and is the most important benchmark for many, if not all interest rates. It also represents the intermediate and long-term Treasury return behavior (Balduzzi, Elton and Green (2001)). Since it is such an important input for virtually all asset pricing models, we believe it is important to study the seasonality in the 10-year Treasury yield. Once we have a good understanding of the dynamics of the yield, we can incorporate these characteristics into various valuation models. To our knowledge, only practitioners have followed the seasonalities in the Treasury yield and no academic research has studied this topic before. We intend to fill this gap in the literature.

Many practitioners have found that the 10-year Treasury yield typically goes up in the first half of the year, peaks in May, before heading back down for the rest of the year. The bottom typically happens around October and December. This pattern has been found in the period from 1990 to 2017, as well as in the last two decades from 2000 to 2017. Also, Kamstra, Kramer and Levi (2015) find that the market-driven price-setting mechanism has an effect on the Treasury returns' seasonality. They find that seasonal variations became a stable feature of the Treasury returns after auctions were introduced and Treasury issuances began following a regular predictable schedule in the early 1980s.

This paper focuses on two questions. First, is the seasonality in the 10-year Treasury yield (peaks in May and bottoms in October/December) observed by practitioners statistically significant? We examine the seasonalities in three time periods that cover the longest available data with different periods of rate levels and issuance mechanisms. Secondly, has the current regular issuance schedule affected the seasonalities in the 10-year Treasury yield in any way? We will examine the period covering the current regular issuance schedule with prior periods and compare their differences in seasonal variations. We are not particularly interested in predicting or forecasting the seasonal yield rate.

The rest of the paper is organized in the following ways. Section II explains the data and methodology. Section III presents and discusses the test results and their implications. Section IV concludes the findings.

II. Data and Methodology

Our monthly 10-year Treasury yield data is obtained from FRED (Federal Research Economic Database) Federal Reserve Bank of St. Louis[1]. The regular auction and reopening information are collected from the TreasuryDirect website[2]. We study the 10-year Treasury yield in three periods: (1) 1954.02 - 2018.01 covers almost all the available data; (2) 1990.02 – 2018.01 corresponds to a period with relative similar level of yield rates, i.e., excluding the high yield rates period in the 1980s; (3) 2009.02 - 2018.01 covers the period since the current regular issuance schedule is implemented and consists of 36 original issuances and 72 reopenings.

Other than using the yield instead of the holding period return, our methodology follows those in the studies on seasonalities of the Treasury returns in Athanassakos and Tian (1998), Chen and Chan (1997) and Kamstra, Kramer and Levi (2015). A dummy variable regression analysis is used to test the seasonality in both calendar months and issuance quarters, which is defined based on the issuance months instead of calendar months. The four issuances described in Table I represent the four quarters in our study, i.e., Q1 is February to April, Q2 is May to July, Q3 is August to October, and Q4 is November to January. We feel that the issuance quarter is a better way to group the months because each quarter deals with the issues of the same Treasury Note. We want to note this difference because it may affect the results and interpretations of our quarterly seasonality results.

For seasonality in the nominal monthly yield, we test the seasonality in months and issuance quarters using, respectively,

$$Y_t = \alpha_0 + \sum_{j\neq 5}^{12} \beta_j M_t^j + \varepsilon_t \qquad (1)$$
$$Y_t = \alpha_0 + \sum_{k\neq 3}^{4} \beta_k Q_t^k + \varepsilon_t \qquad (2)$$

where Y_t is the monthly yield, M_t^j (Q_t^k) is a dummy variable that is equal to 1 if the current month (quarter) is j (k) and is 0 otherwise. j varies from 1 to 12 except 5, i.e., there are 11 dummy variables for every month except May, which is the month that is found by practitioners to have the peak yield (k varies from 1 to 4 except 3, i.e., there are 3 dummy variables for every quarter except Quarter 3). β_j measures the average yield difference of month j compared to May (β_k measures the average yield difference of quarter k compared to the Quarter 3). α_0 measures the average yield of month May (Quarter 3). The null hypothesis is the yields do not vary across different months (quarters) of the year, i.e., all βs are simultaneously equal to 0, or $\beta_1 = \beta_2 = \cdots = \beta_{j(\text{or } k)} = 0$. If the null hypothesis is rejected, there is a monthly (quarterly) seasonality. Statistically significant and negative β indicates that the associated month (quarter) has a lower yield than May (Quarter 3), and vice versa.

In addition, we test the seasonality in the month-over-month changes in yield both by month and by quarter using, respectively,

$$\Delta Y_t = \alpha_0 + \sum_{j\neq 5}^{12} \beta_j M_t^j + \varepsilon_t \qquad (3)$$
$$\Delta Y_t = \alpha_0 + \sum_{k\neq 3}^{4} \beta_k Q_t^k + \varepsilon_t \qquad (4)$$

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[1] non-seasonally adjusted 10-year Treasury Constant Maturity Rate, https://fred.stlouisfed.org/series/DGS10
[2] Announcements and Results by Auction Year, https://www.treasurydirect.gov/instit/annceresult/press/press_auctionresults.htm

where ΔY_t represents the month-over-month changes of yield $\Delta Y_t = Y_t - Y_{t-1}$, β_j (β_k) represents the differences in the month-over-month changes between the month j and May (quarter k and Quarter 3), and the dummy variables are the same as those defined in Equations (1) and (2).

An F-test is used to test the joint null hypothesis $\beta_1 = \beta_2 = \cdots \beta_{j(\text{or } k)} = 0$ and the overall fitness of the regression. We also check the serial correlation and heteroscedasticity of the regression residuals using the Durbin-Watson d statistics and the White's test (χ^2 test). If both the Durbin-Watson d statistics and the White's χ^2 test are rejected, coupled with the acceptable F-test for the overall fitness of the regression, then our regression results are reliable and we can make reasonably reliable inferences based on these results regarding whether or not there is a seasonality in the 10-year Treasury Note yield in the sample periods under study.

Finally, we test the seasonality in yield using the non-parametric Kruskal-Wallis test. Kruskal-Wallis test is similar to the F-test regarding the joint null hypothesis, except that it compares medians instead of means and does not make specific assumptions regarding the probability distribution of the variables. In other words, it does not assume normality in distributions like the F-test does. Given that we do not know the probability distribution of the yield, it is important that we check the results of a non-parametric test.

III. Results

a. Anecdotal Assessments

We start by reviewing the summary statistics and graphic plots of the nominal monthly 10-year Treasury yield over time. Table II reports the key summary statistics of the three periods under study. Figure 1 and 2 plot the non-inflation adjusted nominal monthly yield and the month-over-month changes in yield over time. It is obvious that the yield in the 1980s were at exceptionally high levels compared to the other time periods, and the month-over-month changes in yield in the early 1980s were higher than the rest of the periods as well. The charts show that the yields probably have a unit root or are difference stationary. That is, the month-over-month changes in yield are stationary. The Augmented Dickey-Fuller tests conducted on all three periods under study (results not reported here) indicate that the nominal monthly yield are indeed difference stationary in all three periods.

Table II. Summary Statistics of Monthly Yields for Three Periods Under Study

	(I)1954-2018	(II)1992-2018	(III)2009-2018
Mean	5.90	4.63	2.47
Median	5.47	4.57	2.34
St. Dev	2.84	1.91	0.61
Kurtosis	0.50	-0.89	-0.62
Skewness	0.87	0.21	0.55
Range	13.82	7.39	2.35
Minimum	1.50	1.50	1.50
Maximum	15.32	8.89	3.85
Count	768	336	108

Figure 1. Non-Inflation Adjusted Nominal Monthly Yield 1954-2018

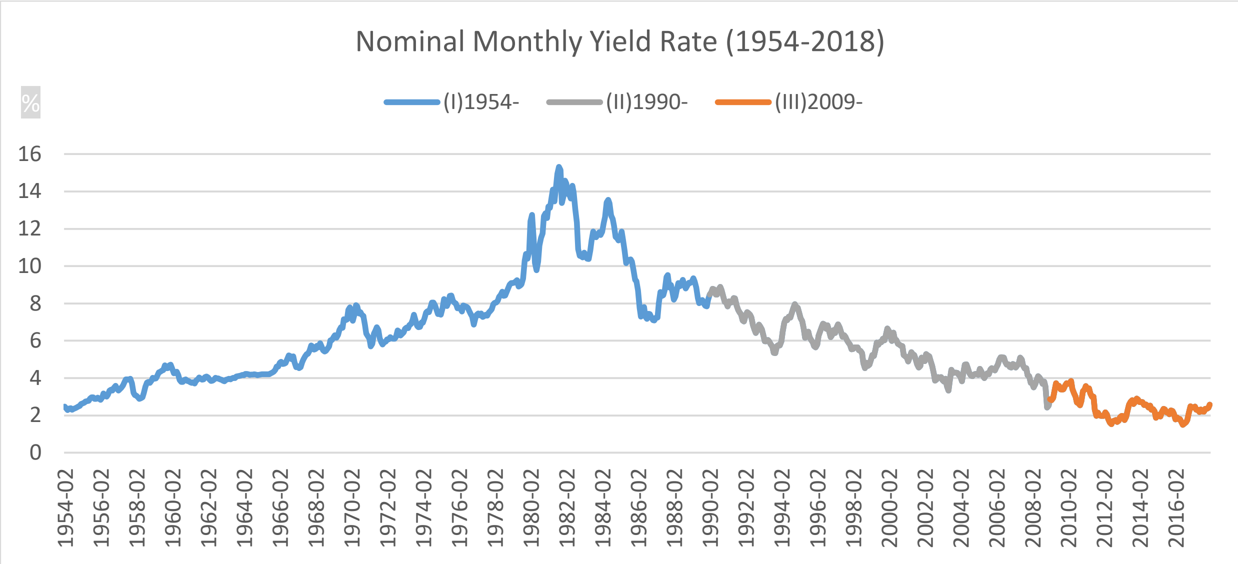


Figure 2. Month-over-month Changes in Yield Rates 1954-2018

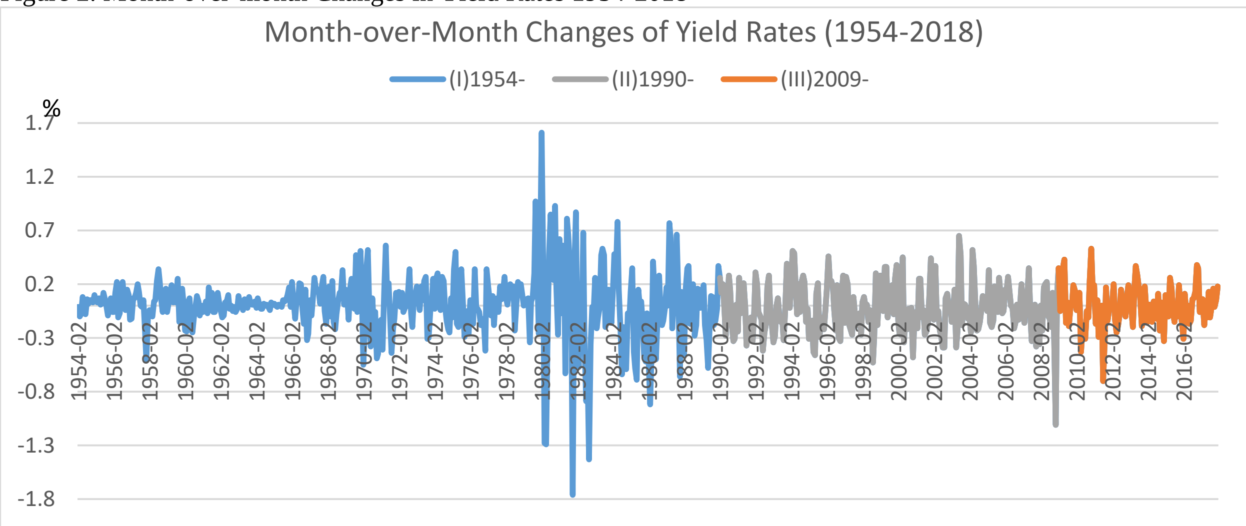
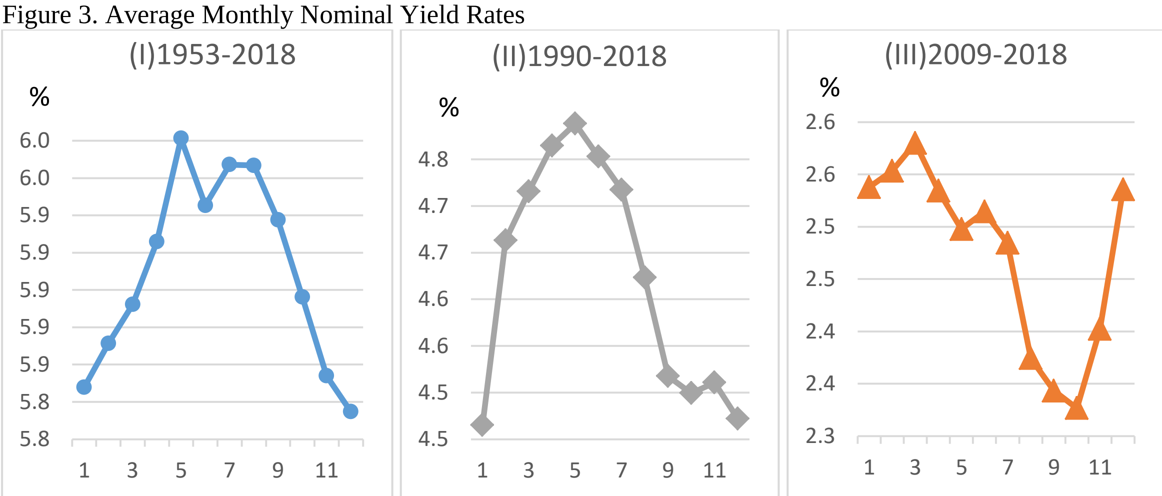


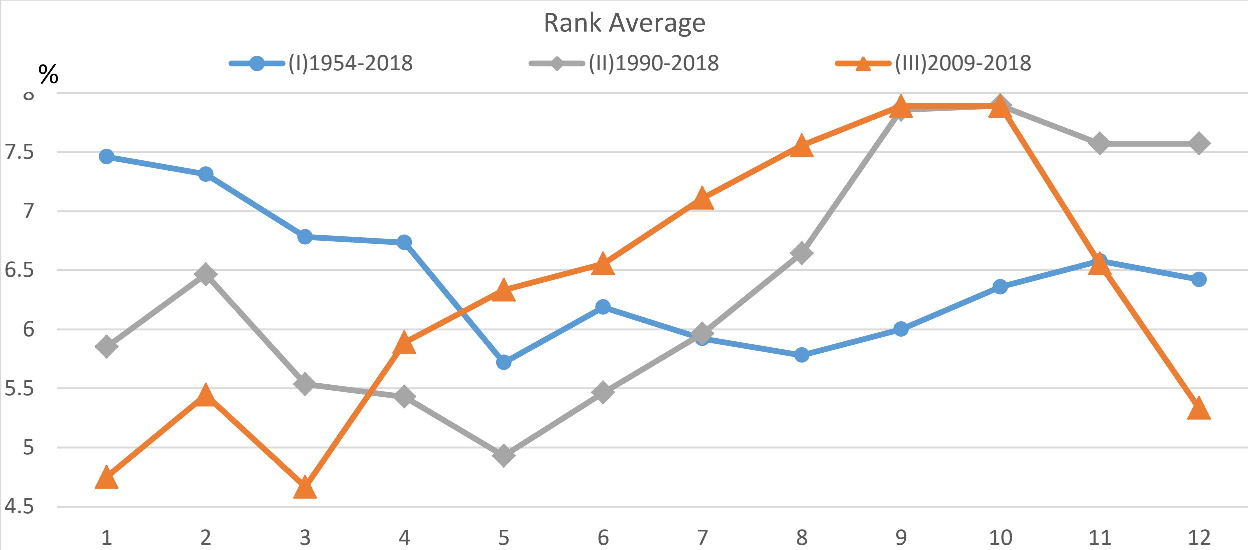
Figure 3. Average Monthly Nominal Yield Rates



(a) (b) (c)

Figures 3 (a) – (c) plot the average monthly yield for the three periods. While the peaks and bottoms of the curves do not exactly fall into the same months, they do resemble a similar pattern. For the first two periods of 1953-2018 and 1990-2018, both peaks occur in May and bottoms occur between December and January. For the third period of 2009-2018 though, both the peak and bottom move two months earlier to March and October respectively. The average differences between the highest and lowest month for the three periods are: 14.66bp, 32.32bp, and 25.33bp respectively.

Figure 4. Average Rank of the Monthly Yield in a Year



Because the yield ranged at different levels over the three periods, which may have affected the average monthly rates, we look at the ranks of the monthly yield in a year. The ranks will be independent to the levels of yield rates at different periods of time. The monthly yield is ranked from the highest (1) to the lowest (12) in a year and the average of these ranks over the period are presented in Figure 4. We can see that for both periods of 1954-2018 and 1990-2018, the highest yield (with the lowest rank) of the year falls in May. The highest yield for the period of 2009-2018 is March, although January seems to be close too. For both periods of 1990-2018 and 2009-2018, the lowest yield of the year happens in the month of September and October.

Figure 5. Average Month-over-Month Changes of Yield Rates by Quarter

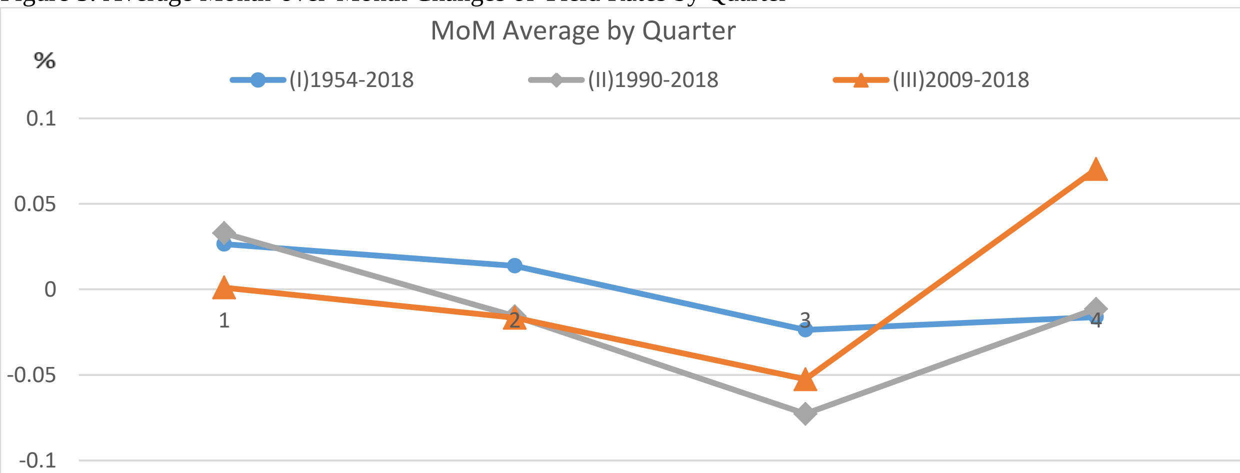


Figure 5 plots the average month-over-month changes of yield by quarter. The patterns in all three periods are the same: the month-over-month changes decrease monotonically in the first two quarters until reaching the bottom in Quarter 3 before picking up again. This is consistent with our findings in Figure 4 in that the yield rates bottom out in Quarter 3.

b. Statistical Analysis

The anecdotal seasonal variations observed in the previous sub-section are tested in this section using more rigorous statistical methods. Table III.A. and III.B. report the results of various tests conducted on the monthly seasonalities in the three sample periods, and Table IV.A. and IV.B. report test results for the quarterly seasonalities.

Table III.A. Monthly Seasonality in the Nominal Yield Rates Regression results are based on Equation (1) $Y_t = \alpha_0 + \sum_{j\neq5}^{12} \beta_j M_t^j + \varepsilon_t$. M_t^j is a dummy variable that varies from 1 to 12 except 5. β_j is reported as "Coefficient." None of the coefficients is significant at 10% level of significance.

	(I) 1954.02-2018.01			(II) 1990.02-2018.01			(III) 2009.02-2018.01		
Variable	Coefficient	t-stats	p-value	Coefficient	t-stats	p-value	Coefficient	t-stats	p-value
C	5.9713	16.6743	0.0000	4.7982	13.1208	0.0000	2.4978	11.7422	0.0000
M1	-0.1334	-0.2635	0.7923	-0.3232	-0.6250	0.5324	0.0400	0.1330	0.8945
M2	-0.1100	-0.2172	0.8281	-0.1250	-0.2417	0.8092	0.0556	0.1847	0.8539
M3	-0.0891	-0.1759	0.8605	-0.0725	-0.1402	0.8886	0.0822	0.2733	0.7852
M4	-0.0553	-0.1092	0.9131	-0.0236	-0.0456	0.9637	0.0367	0.1219	0.9032
M6	-0.0359	-0.0710	0.9434	-0.0354	-0.0684	0.9455	0.0167	0.0554	0.9559
M7	-0.0141	-0.0278	0.9779	-0.0707	-0.1367	0.8913	-0.0133	-0.0443	0.9647
M8	-0.0145	-0.0287	0.9771	-0.1650	-0.3190	0.7499	-0.1233	-0.4100	0.6827
M9	-0.0438	-0.0864	0.9312	-0.2707	-0.5235	0.6010	-0.1544	-0.5134	0.6089
M10	-0.0850	-0.1678	0.8668	-0.2889	-0.5587	0.5768	-0.1711	-0.5688	0.5708
M11	-0.1273	-0.2514	0.8015	-0.2775	-0.5366	0.5919	-0.0956	-0.3176	0.7514
M12	-0.1466	-0.2894	0.7724	-0.3161	-0.6112	0.5415	0.0378	0.1256	0.9003
R-squared		0.0003			0.0039			0.0192	
F-statistic (p-value)		0.0202	(1)		0.1156	(0.9998)		0.1712	(0.9987)
White's χ^2 (p-value)		0.3810	(1)		0.9374	(1)		4.4943	(0.9532)
Durbin-Watson stat		0.0088			0.0136			0.0851	
Kruskal-Wallis (p)		0.3037	(1)		1.2783	(0.9998)		1.5476	(0.9996)

Table III.A. shows that in both periods of 1954-2018 and 1990-2018, all months are found to have negative β coefficients or smaller yields than May; in the third period of 2009-2018, only July to November have negative β coefficients or lower yields than May, with August to October having large difference amounts ranging from 12 basis points to 17 basis points. However, none of the above differences are statistically significant. In addition, the null hypothesis of no monthly differences in yield rates is not rejected by the F-test at either the 5% or 10% significance level in all three periods. In other words, there is no statistically significant differences in the nominal monthly yield rates or no monthly seasonalities in all three periods. To check the reliability of the results, serial correlation and heteroscedasticity of the regression residuals are tested. While the Durbin-Watson d statistics found positive first order serial correlation in all three cases, the White's χ^2 test found no heteroscedasticity in all three cases. The presence of serial correlation in the regression residuals invalidates the normality assumptions of the F-test and OLS, therefore the inferences of seasonalities based on their results become unreliable. The nonparametric Kruskal-Wallis test also shows that the null hypothesis of no monthly yield differences is not rejected in all three periods. The findings from both the parametric and nonparametric tests do not support the existence of seasonality in monthly yield rates in all three periods.

Table III.B. Monthly Seasonality in the Month-over-Month Yield Rate Changes Regression results are based on Equation (3) $\Delta Y_t = \alpha_0 + \sum_{j\neq 5}^{12} \beta_j M_t^j + \varepsilon_t$, where ΔY_t is the month-over-month change of yield rates, M_t^j is a dummy variable with j varies from 1 to 12 except 5. β_j is reported as "Coefficient". * and ** denote significance at the 10% and 5% levels respectively.

	(I) 1954.02-2018.01			(II) 1990.02-2018.01			(III) 2009.02-2018.01		
Variable	Coefficient	t-stats	p-value	Coefficient	t-stats	p-value	Coefficient	t-stats	p-value
C	0.0553	1.6435	0.1007	0.0236	0.5722	0.5676	-0.0367	-0.5811	0.5625
M1	-0.0422	-0.8864	0.3757	-0.0307	-0.5272	0.5984	0.0389	0.4358	0.6640
M2	-0.0303	-0.6369	0.5244	-0.0264	-0.4536	0.6504	0.0589	0.6599	0.5109
M3	-0.0344	-0.7222	0.4704	0.0289	0.4965	0.6198	0.0633	0.7097	0.4796
M4	-0.0216	-0.4530	0.6507	0.0254	0.4352	0.6637	-0.0089	-0.0996	0.9209
M6	-0.0913	-1.9172	0.0556*	-0.0589	-1.0115	0.3125	0.0533	0.5977	0.5515
M7	-0.0334	-0.7025	0.4826	-0.0589	-1.0115	0.3125	0.0067	0.0747	0.9406
M8	-0.0558	-1.1720	0.2416	-0.1179	-2.0230	0.0439**	-0.0733	-0.8218	0.4132
M9	-0.0845	-1.7760	0.0761*	-0.1293	-2.2191	0.0272**	0.0056	0.0623	0.9505
M10	-0.0966	-2.0288	0.0428**	-0.0418	-0.7172	0.4738	0.0200	0.2241	0.8231
M11	-0.0977	-2.0518	0.0405**	-0.0121	-0.2084	0.8350	0.1122	1.2576	0.2116
M12	-0.0745	-1.5659	0.1178	-0.0621	-1.0666	0.2869	0.1700	1.9051	0.0598*
R-squared		0.0137			0.0467			0.1004	
F-statistic (p-value)		0.9568	(0.4848)		1.4416	(0.1528)		0.9735	(0.4757)
White's χ^2 (p-value)		5.6893	(0.8933)		13.5010	(0.2619)		15.31	(0.1687)
Durbin-Watson stat		1.3934			1.5159			1.4848	
Kruskal-Wallis (p)		14.0434	(0.2306)		16.0266	(0.1401)		8.5035	(0.6676)

Table III.B. reports the seasonality test results on the month-over-month changes in yield rates. We see that the results have more statistical significance than those of the nominal monthly yield rates. For the period of 1954.02-2018.01, not only are all the signs of dummies variable coefficients negative, those of June, September, October and November are also statistically negatively significant at the 10% confidence level, and those of October and November are even statistically negatively significant at the 5% confidence level. For the period of 1990.02-2018.01, most of the months have negative coefficients except for March and April which have positive coefficients, indicating bigger changes of yield rates than May. August and September are statistically negatively significant at the 5% confidence level. For the most recent period of 2009.02-2018.01 however, only April and August have negative coefficients and the rest have positive coefficients with December being statistically positively significant at the 10% confidence level. These results indicate more significant differences among the three periods in terms of the biggest month-over-month changes in yield rates over time.

The *F*-statistics of the regressions for all three periods still do not reject the null hypothesis but their p-values are not as strong as those in the monthly seasonality tests in Table III.A. Both the Durbin-Watson *d* statistics and White's χ^2 test reject serial correlation and heteroscedasticity in the regression residuals, indicating more reliability of the regression on changes of yield rates than that on the nominal yield rate itself. The nonparametric Kruskal-Wallis test results are much better too especially for the period from 1990-2018. However, they are still not enough to reject the null hypothesis. These findings do not support the existence of seasonality in monthly differences of yield rates in all three periods.

Table IV.A. Quarterly Seasonality in the Nominal Yield Rates Regression results are based on Equation (2) $Y_t = \alpha_0 + \sum_{k\neq3}^{4} \beta_k Q_t^k + \varepsilon_t$, Q_t^k is a dummy variable varies from 1 to 4 except 3. β_k is reported as "Coefficient". None of the coefficients is significant at 10% level of significance.

	(I) 1954.02-2018.01			(II) 1990.02-2018.01			(III) 2009.02-2018.01		
Variable	Coefficient	t-stats	p-value	Coefficient	t-stats	p-value	Coefficient	t-stats	p-value
C	5.9235	28.8002	0.0000	4.5567	21.8421	0.0000	2.3481	19.8668	0.0000
Q1	-0.0370	-0.1273	0.8987	0.1679	0.5689	0.5698	0.2078	1.2430	0.2166
Q2	0.0311	0.1069	0.9149	0.2062	0.6989	0.4851	0.1507	0.9018	0.3692
Q4	-0.0880	-0.3026	0.7623	-0.0640	-0.2171	0.8283	0.1437	0.8597	0.3919
R-squared		0.0002			0.0035			0.0159	
F-statistic (p-value)		0.0621	(0.9798)		0.3888	(0.7611)		0.5604	(0.6423)
White's χ^2 (p-value)		0.3366	(0.9530)		0.7248	(0.8673)		2.7336	(0.4345)
Durbin-Watson stat		0.0089			0.0149			0.0928	
Kruskal-Wallis (p)		0.2415	(0.9706)		1.1303	(0.7698)		1.2594	(0.7388)

Table IV.A. reports the regression results of the quarterly seasonality in the nominal yield rates. The results are better than those of the monthly seasonality test reported in Table III.A. For the period of 1954-2018, both Q1 and Q4 have lower yield rates but Q2 has a higher yield rate than Q3. For the period of 1990-2018, Q4 has a lower yield rate but both Q1 and Q2 have higher yield rates than Q3. For the period of 2009-2018, all three quarters have higher yield rates than Q3. None of these differences however are statistically significant. *F*-test upholds the null hypothesis that yield rates in all quarters are no different. Durbin-Watson d statistics indicate there are serial correlation while White's χ^2 test does not find heteroscedasticity in the regression residuals in all three periods. The Kruskal-Wallis test shows that there is no quarterly seasonality in the monthly yield rates in all three periods.

Table IV.B. Test of Quarterly Seasonality in Month-over-Month Yield Rate Changes Regression results are based on Equation (4) $\Delta Y_t = \alpha_0 + \sum_{k\neq3}^{4} \beta_k Q_t^k + \varepsilon_t$, where ΔY_t is month-over-month change in yield rates, Q_t^k is a dummy variable varies from 1 to 4 except 3. β_k is reported as "Coefficient". * and ** denote significance at the 10% and 5% levels respectively.

	(I) 1954.02-2018.01			(II) 1990.02-2018.01			(III) 2009.02-2018.01		
Variable	Coefficient	t-stats	p-value	Coefficient	t-stats	p-value	Coefficient	t-stats	p-value
C	-0.0236	-1.2185	0.2234	-0.0727	-3.0679	0.0023	-0.0526	-1.4672	0.1453
Q1	0.0502	1.8295	0.0677*	0.1056	3.1492	0.0018**	0.0537	1.0594	0.2919
Q2	0.0374	1.3627	0.1734	0.0570	1.7006	0.0899*	0.0359	0.7087	0.4801
Q4	0.0075	0.2733	0.7847	0.0613	1.8285	0.0684*	0.1230	2.4257	0.0170**
R-squared		0.0059			0.0293			0.0565	
F-statistic (p-value)		1.5175	(0.2086)		3.3354	(0.0197**)		2.0744	(0.1081*)
White's χ^2 (p-value)		0.0601	(0.9962)		1.6301	(0.4225)		3.2575	(0.3536)
Durbin-Watson stat		1.4017			1.5264			1.5278	
Kruskal-Wallis (p)		5.2510	(0.1543)		9.5210	(0.0231*)		5.3296	(0.1492)

Table IV.B. reports the regression results of quarterly seasonality in the month-over-month changes in yield rates. Again the results are more statistically significant compared to those on the nominal yield rates themselves. In particular, results for the period of 1990-2018 strongly support the existence of a quarterly seasonality in the month-over-month changes of yield rates. It has the most significant results among all regressions: *F*-statistics and all three dummy variable coefficients are statistically significant; the Durbin-Watson d statistics and White's χ^2 test reject serial correlation and heteroscedasticity in the residuals. All three quarters Q1, Q2 and Q4 are found to have bigger month-over-month changes of yield rates than Q3, with Q1 having more than 10 basis points at the 1% confidence level. The Kruskal-Wallis test shows that the null hypothesis can be rejected at the 5% confidence level.

For the period of 2009-2018, the p-value of the F-statistics is 0.1081, which is technically not significant at 10% level but is very close. Both the Durbin-Watson d statistics and White's χ^2 test also reject serial correlation and heteroscedasticity in the residuals. Q4 is statistically positively significant at the 5% confidence level with more than 12 basis points bigger month-over-month changes in yield rates than those in Q3. The other two quarters Q1 and Q2 are positive but not statistically significant. The p-values of the Kruskal-Wallis test is close to 0.15, not enough to reject the null hypothesis at 10% confidence level but much better than results reported in the other tables.

c. Summary Results

Our analysis shows that first, while the patterns of May being the month of the highest nominal 10-year Treasury yield rate, and Quarter 3 having the smallest changes in yield rates, are present in some time periods, many of these patterns are not statistically significant using the dummy variable regression analysis under the conventional parametric and nonparametric tests. Secondly, the month-over-month changes in yield rates show more significant seasonal variations than the nominal yield rate itself, both by month and by quarter. Finally, seasonal variations do seem to change over time. The recently implemented regular auction and reopening schedule, which is measured by the period of 2009-2018, does not seem to cause more seasonality in either the yield rates itself or the changes in yield rates. If anything, it may have dampened any seasonal patterns during this most recent period. This finding is contrary to those of Kamstra, Kramer and Levi (2015) who find seasonal variations in the Treasury returns after the Treasury issuance began following a regular predicable schedule in the early 1980s.

The period of 1990-2018 is the only period that has strong statistically significant evidence to support the existence of seasonality in the month-over-month changes in yield rates, and Quarter 3 is found to have the statically significant smallest monthly change in yield rates among all quarters. Period 2009-2018 is the next closest to having the statistical significance to support some seasonality in Quarter 4. It is important to note that our Quarter is defined based on the issuance and not the calendar months. Quarter 4 includes months November, December and January. Therefore, any December/January effect may have been either averaged out or amplified in our Quarter 4 result.

IV. Conclusion

In this paper, we study the seasonality in the 10-year Treasury nominal yield rate and its month-over-month changes. We find that the statistical significance of the seasonality depends on the time period studied and whether the focus is on months versus quarters. We find that most anecdotally observed seasonalities by practitioners do not pass the rigorous statistical tests for significance. The period of 1990-2018 is the only one for which we found good evidence to support a quarterly seasonal variation in the month-over-month changes in yield rates that was statistically significant. The adopted regular issuance schedule in recent years however has weakened this seasonality.

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