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DOES THE AUCTION CYCLE HAVE AN EFFECT ON THE MOMENTUM STRATEGIES IN TURKISH BOND MARKET?

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Abstract

The time-series momentum and debt auction cycles are vastly studied field in the academic literature. However, both fields are not studied for the emerging markets. In this study, time-series momentum and debt auction cycles are studied for the 5-year and the 10-year maturity Turkish bonds between the March 2010 and August 2017 with various look-back periods. Instead of using only bond performances as the momentum indicator, other momentum indicators are employed. The U.S. 10-year maturity bond yield and the Istanbul Stock Exchange 100 total return index are the best performing momentum indicators in the sample period. There is an improvement of 10.46% annual return while using the U.S. 10-year maturity bond yield as the momentum indicator. In addition to the time-series momentum strategy, the treasury debt auction cycle effect is calculated as 14 bps and 7 bps for 5-year and 10-year maturity bonds respectively. In accordance with the auction cycle effect, an auction adjusted momentum strategy is adjusted. This new adjusted momentum strategy improves annual returns from 0% to 6.90% (%3.5 on average) across all the momentum indicators and the look-back periods with respect to the simple momentum strategies.

Keywords: Time Series Momentum, Debt Auctions, Emerging Markets, Fixed Income, Bonds, Primary Market, Secondary Market

1. INTRODUCTION

Since the rapid rise in the global savings, known as the savings glut, the yields in developed markets have fallen vastly. The drop in the developed market yields has generated a yield seeking behavior that is also called "the yield hunt" for the pension funds managers, the asset managers, the wealth funds and the individual investors. The yield seeking behavior has led scopes of the savings managers to shift towards high yielding emerging market assets with strengthening economic fundamentals with decreasing debt-to-GDP ratios. At the beginning of

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the yield hunt, emerging market countries borrowings were mostly dominated in hard-currencies such as U.S. Dollar, British Sterling, Euro, and Japanese Yen. The demand for the yield supported emerging market countries to transform their borrowings into local currency. However, fluctuations in global risk appetite let emerging markets exposed to fund inflows or outflows, which became one of the major determinants of emerging market returns, caused by foreign investors. Therefore, the market timing and the momentum strategies have a significant role for substantial excess returns for asset managers. In analogy to Beetsma et al. (2016), the public debt auctions have an increasing impact on the secondary market yields in developed markets. The emerging countries bond markets, which have thinner liquidity than the developed markets, are also affected by the public debt auctions called as the public debt auction cycles.

In this study, the determinants of momentum and the effect of public debt auctions are studied for Turkish government local currency bond market. Results suggest that the momentum is existent in the Turkish government bond markets. Additionally, the public debt auctions have a delaying effect on the momentum which is a valuable information for the market timing in the bond markets.

2. BACKGROUND INFORMATION

2.1.Non-Technical Summary

The time series momentum and the auction cycle are widely studied fields in the finance literature. The former field pays attention to the effect of the past returns on the future returns of a financial asset. The latter field investigates the transient yield increasing effect of the treasury debt auctions on the secondary bond markets. However, these fields are insufficiently researched for the emerging countries' bond markets, in particular for the Turkish bond markets. In this paper, both the time series momentum and the debt auction cycle are studied for the recent period between March 2010 and August 2017. The 5-year maturity and 10-year maturity fixed coupon bonds of Turkey are selected assets for this study, since they are the most liquid traded bonds.

In this study, investments are made weekly, i.e. one trade every Friday on the closing prices. While making these investments, 1-week, 4-week and 13-week look-back periods are selected. The look-back periods should be understood as the previous performance of the chosen momentum indicator, e.g. the return of the Istanbul Stock Exchange total return index

for the chosen period. The time series momentum is evident for the 5-year maturity and 10-year maturity fixed coupon bonds in the sample period.

In addition to the simple momentum strategy, other momentum indicators are employed with the same look-back periods. The Istanbul Stock Exchange 100 total return index and the U.S. 10-year maturity bond yield are two best performing indicators for the selected maturity Turkish bonds.

Recent empirical research has documented that bond yields follow an inverted V-shaped pattern at the treasury debt auctions periods in European bond markets (Beetsma, Giulidori, Hanson, & de Jong, 2018b). The existence of the auction cycle is also revealed in the Turkish bond markets in this study.

As a result, the study arrives at an adjusted strategy that employs the time series momentum strategy according to the treasury debt auction cycles. The weekly positioning is determined mainly by the momentum indicators' performance. However, a long position in the bonds is taken on the auction weeks regardless of the momentum indicators' buy or sell signal. The results show that the momentum strategy with an auction adjustment results a significant improvement in the sample period.

2.2. Treasury Bond Auctions

The treasuries, the municipalities and the corporations fulfill their funding needs via the debt auctions process, the bought deal process and the continuous offerings for the public financing purposes (Fabozzi & Mann, 2012).The bought deal process and the continuous offerings are not in the scope of this study; hence only the debt auction process is described in detail below.

The widely used bond auctions are the single-price auction, known as uniform auction or the Dutch auction, and the multi-price auction, called as discriminatory auction or "pay-as-bid". In the uniform auctions, all financiers (or bidders) would purchase the bonds at the market-clearing price (the lowest wining price or the highest wining yield). On the other hand, the discriminatory auction, the mostly used auction type, has a different distribution structure in which the bidders would purchase the bonds at the price they quoted instead of purchasing at the single market-clearing price with the other bidders.

The Turkish treasury employs the discriminatory auction for the bills, the fixed coupon bonds, the floating rate notes and the inflation linked bonds sales as most of other country

treasuries. Each last workday of the month, the Turkish treasury announces its planned bond auctions with the intended borrowing amounts, the bond types, the auction dates and the maturities of the bonds for the next three months. The treasury also announces the detailed information of the auctions at least one workday before the auction date. The intraday process of the auctions are as follows; the non-competitive bidding, the competitive (multi-price) auction bidding and the optional bids (Post-Auction bids). The dealers submit their intended buying amount at the average price and yield on the auction to the Turkish treasury for the non-competitive bidding before 11:30 a.m. (local time). Following that, the treasury announces the amount of non-competitive bids covered until 12:00 p.m. After the non-competitive bid result announcement, the bidders submit their bid prices and amount before 13:30 p.m. The result of the auction is announced after 13:30 p.m. Finally, the bidders, who participated in the competitive auction and purchased the bond at the higher price than the auction average price, can submit their intent to buy the auctioned bond at the average price. The bidders can purchase at the average price up to 40% of the net value of the auction bids that are higher than the average auction price (Turkey Prime Ministry Undersecretariat of Treasury, 2013).

2.3. Momentum Trading

The momentum trading can be broadly categorized into two groups as the cross-sectional momentum and the time-series momentum. This study investigates the Turkish fixed coupon bonds; therefore, the time-series momentum is preferred because of the liquidity conditions.

The cross-sectional momentum takes the historical relative performance of at least two financial assets. To exemplify, if stock A outperforms stock B previous year, the momentum strategy recommends the stock A would outperform the stock B again in the next period. Hence, buying Stock A and selling stock B is the best option.

On the other hand, the time-series momentum pays attention to historical performance of the single financial asset instead of relative performances of the two financial assets. The time-series momentum suggests that performance of the asset would continue the next period. For this reason, buying (selling) an asset with positive (negative) returns is be the best option.

3. LITERATURE REVIEW

3.1. Literature Review on Time Series Momentum

Momentum in the financial markets is a well-known behavioral anomaly that has been vastly studied in the academic literature. In broad terms, the momentum is defined as the pricing over-reaction to the past excess returns with the assumption of the excess returns tend to resume in the next period. In the literature, momentum is divided into two main categories as cross-sectional and time series momentum.

As the earlier studies for the cross-sectional momentum, Jegadeesh & Titman (1993) (2001) document outperformances of the individual stocks with superior past returns relative to the stocks with the inferior past returns. They argue that the outperformance remains up to five years. Menkhoff, Sarno, Schmeling, & Schrimpf (2012) investigate the excess returns between the past winner currencies and the past loser currencies. They claim that the currency momentum returns are not related to widely studied carry trade returns. Durham (2013) documents that the cross-sectional momentum also applies for the bond markets across the different maturities which is widely known as the yield curve trading.

On the other hand, the time series momentum focuses on the effects of the securities' own prior periods' excess returns on the following periods' performances. Chan, Jegadeesh, & Lakonishok (1996) point out that the previous returns and the previous earnings surprises of individual stocks predict the future returns which suggests gradual adjustments to new information by the market participants. Moskowitz, Ooi, & Pedersen (2012) investigate the time series momentum with 58 liquid instruments across all asset classes. Accordingly, the prior performances of the instruments tend to persist for one to twelve months. Griffin, Ji, & Martin (2003) study whether momentum profits are related to macroeconomic risks. Accordingly, the relation does not exist, and the momentum gains are reliable regardless of the economic states. Pastor & Stambaugh (2003) discover the momentum strategy profits are affected mostly by the liquidity risk factors. To extend this study, Asness, Moskowitz, & Pedersen (2013) investigate the negative-correlation between momentum and value strategies across asset classes. They argue that the funding liquidity has positive impact on the momentum returns and negative impact on the value returns, which partly explain the negative correlation between value and momentum. Followingly, Cakici & Tan (2013) and de Groot, Pang, & Swinkels (2010) discover the value and momentum effects exist also in the emerging markets and frontier emerging

markets.

Luu & Yu (2012) examines the momentum in six major government-bond markets as Australia, Canada, Germany, Japan, the U.K., and the U.S. After dividing bonds into different maturity buckets, they use their prior excess returns as a predictor for the buckets' future returns. Ilmanen (1995) (1997) points out that the previous equity performances predict future bond returns. Followingly, Duyvesteyn & Martens (2014) employ other measures such as the past equity returns and the yield curve steepness in addition to the past bond returns for the prediction of emerging market bond future returns. None of the cited studies examines the momentum in Turkish Bond Market, therefore, this study may fill the gap in the academic literature.

3.2. Literature Review on the Public Debt Auction Cycle

Literature on the relation between the primary market (public debt auctions) and the secondary market is scarce especially for the emerging markets, which makes this research more interesting.

The bonds issued by the treasury are grouped into two as "on-the-run" and "off-the-run" bonds. "On-the-run" bonds are the recently issued bonds with high liquidity feature. On the other hand, "off-the-run" bonds are the previously issued bonds. Warga (1992) claims that "on-the-run" bonds are more preferred by the bond dealers thanks to its high-liquidity, which generates a price premium for "on-the-run" bonds. Fleming & Remolona (1997), Fleming & Rosenberg (2007) and Lou, Yan, & Zhang (2013) find the initial results of the public debt auction cycle in the U.S. markets. They find out that the secondary market yields have an inverted V-shaped pattern which tend to move up before the auctions, then revert to its pre-auction levels after the auctions. Beetsma et al. (2016) investigate the debt auction cycle of the German and Italian bond markets. This auction effect increases as the market uncertainty and the auction volume surges. Afterwards, Beetsma, Giuliodori, Hanson, & de Jong (2018a) investigate effect of foreign public debt auctions to the sovereign public debt auctions in the Euro Area. They find an empirical evidence of the spill-over effect of other Euro Area counties' auctions can amount about five basis points. In addition to the auction cycle, Beetsma et al. (2018b) investigate the effect of Euro Zone public debt auctions to the secondary market with regards to the bid-to-cover ratio. Accordingly, higher bid-to-cover ratio and the market volatility increase secondary market yield decrease after the auctions or vice versa. To the best of our knowledge, there is a shortage in the literature for auction cycles of emerging markets

and Turkey. This study is aimed to fulfill this shortage for Turkey.

4. DATA AND METHODOLOGY

4.1. Data

Data for this research can be grouped into two categories as the historical treasury bond auction information data and the historical market data. Turkish Treasury has initiated to issue 10-year local currency bonds since 2010. Therefore, the sample period has selected between March 2010 and August 2017 with weekly frequency. Entire dataset has been obtained from the Bloomberg Terminal except TR Libor Rates data which is provided by The Banks Association of Turkey.

Treasury bond auction data, published by Republic of Turkey Prime Ministry Undersecretariat of Treasury, contains the issue dates, the value dates, the total amount sold and the yields of Turkish treasury fixed coupon bonds historically. However, in this research the only information used is 5-year and 10-year fixed coupon treasury bonds' issue dates and non-competitive issue compound yield for this paper. The non-competitive issue yield is the auction average yield, sold by Turkish treasury. The reason for that is to observe the existence of the treasury bond auctions effects on momentum. The remaining part of the data is intended to be used for further researches.

Unlike the U.S. treasury bonds, for Turkish treasury bond market, generic historical prices are not available on the financial data vendors. To cope up with this issue, the historical compound yield data has been used in this research. The estimated price changes are calculated with the multiplication of the compound yield net change and the estimated durations of the corresponding bonds. Estimated durations for 10-year and 5-year maturity bonds are estimated as 6.5 and 3.5 respectively with respect to the actual Turkish treasury bonds. To assess weekly net returns of each bond, weekly borrowing cost are calculated from TR Libor 1-week mid-rate (Turkish Lira Reference Interest Rate).

Instead of using net returns of only bonds itself, a broader perspective is adopted by taking notice of different momentum indicators which can be categorized into two classes: the global momentum indicators and the local momentum indicators. As global momentum indicators, the mostly known assets and indices such as the U.S. Treasury 10-year maturity bond yield, SP500 Volatility Index (VIX), MSCI World Total Net Return, MSCI Emerging

Markets Total Net Return are employed. In addition, as the local momentum indicators, total Net Return of Turkish Stock Market Index (XU100), Turkey 5-year maturity Dollar CDS (Credit Default Swap), 5-year and 10-year maturity bond excess returns are employed.

4.2. Methodology

In this study, one-week investment horizon is considered to be a reasonable length for the examination of momentum and treasury issuance effect. Based on the momentum measures and the auction calendar, one unit of long or short position is taken on 5-year and 10-year maturity Turkish treasury bond every week. Mainly, two strategies have been employed in this study. The first strategy tries to capture returns via momentum and the second strategy attempts to capture lagged momentum that is caused by the treasury issuance. The weekly borrowing cost are calculated from one-week TR Libor mid yield for the excess return calculations.

4.3. Momentum Methodology

In this study, the time series momentum is employed. The momentum methodology adopts a weekly trading strategy by taking one unit of long or short position in 5-year and 10-year maturity Turkish treasury bonds considering prior cumulative return of several momentum indicators. However, the methodology never allows to take a zero-position on any week for the robustness check. To identify the best past return horizon, one-, four-, and thirteen- week cumulative past excess returns of momentum indicators that are employed. For example, if the excess return (after considering the funding cost) of 10-year maturity Turkish treasury bond is positive (negative) on last thirteen weeks, then the methodology signals for taking a long (short) position in 10-year maturity Turkish treasury bond for one-week duration. The positions are hypothetically opened and closed at the weekly closing prices of each week on the last business day. The returns are calculated additively instead of compounding weekly. In other words, previous profits and losses do not affect the size of the positions for the following week. In addition, the stop-loss methodology, which automatically closes the position if the position's loss exceeds a pre-determined level, is not used for the momentum portfolio.

4.4. Debt Auction Cycle Strategy

The debt auction cycle strategy takes Turkish treasury bond auctions into consideration. Streetwise knowledge points out that treasury bond auctions delay momentum on the bond market regarding supply pressure, which is called as "the debt auction cycle effect" in the academic literature. To examine the bond auctions effect, regardless of momentum signal, one unit of long position from the non-competitive price (the weighted average of the accepted bids) is taken on every treasury auctions of 5-year and 10-year maturity bonds. Afterwards, the position taken on the auctions are closed on the last working day of the week. In the case of consistent gains in the strategy, it can be concluded as the bond issuance effect has a momentum delaying impact (the supply side pressure effect).

5. RESULTS

5.1. Initial Results of Turkish Debt Auction Cycle Effect

In parallel to the Beetsma, Giuliodori, de Jong, & Widijanto (2016), 128 fixed coupon bond auctions of the Turkish Treasury, from July 2010 to August 2017, were examined. Because of the better secondary market liquidity conditions, the 5-year and the 10-year maturity bond auctions are selected for this study. However, despite the relatively better liquidity for the 5-year and the 10-year maturity bonds, the pre-auction secondary market data is still insufficient to use the same methodology of Beetsma et al. (2016) (2018a) (2018b), using the intraday pre-auction secondary market levels, in Turkish bond markets. The reason for that is the emerging markets such as Turkey have higher bid-ask spreads and less trading volumes than the developed markets such as Euro Area, Japan, and the U.S.

Therefore, another methodology is used for measurement of the auctions effect on the secondary market. According to this methodology, the yield difference between the auction non-competitive auction bid accepted yield (which is set by the accepted average yield in the competitive biddings) and the last traded yield of corresponding week has been calculated. If there is a consistent yield decline (positive returns) on the positions taken at the auction weeks, the public debt auction cycle's existence could be empirically proved in the Turkish bond markets.

According to the methodology, the auction cycle effect is observed in the sample period. The cumulative yield decline is 4.09% (on average 0.07%) for the 10-year maturity bonds and 9.27% (on average 0.14%) for the 5-year maturity bonds. The summary statistics, the historical

return graphs of the 5-year and 10-year auctions are available on Table 3, Figure 7 and Figure 8 respectively. The average yield decline in the 5-year and 10-year bond auctions are 14 bps and 7 bps respectively. However, because of the duration differences and the funding costs of the positions, one may argue that the net return comparison would be more useful for this study. Hence, the net returns for the 5-year and the 10-year maturity bonds are also calculated. In Table 4, net returns in the auction cycles are 0.48% and 0.40% respectively. Analyzing the net returns leads to almost the same results as the net yield changes. Both results suggest that the 5-year maturity bonds have more sensitivity to the public debt auction cycles in the selected sample period.

Another issue to be considered for the auction cycle analysis could be the economic cycles. A declining yield trend may overshadow the net returns gained on the auction weeks. However, Figure 1 shows that the yields of the 5-year and the 10-year maturity bonds are stationary in the sample period. The returns gained by the auctions are consistent regardless of the upward and the downward trends in the sample period (Figure 2), which could be an empirical evidence of the public debt auction cycle's existence.

5.2. Event Study Analysis and Interpretation of Results

5.2.1. The Momentum Strategies Results

In Table 5 and Table 6 Positive annual returns and positive Sharpe ratios[††] refer that the momentum exists in the Turkish bond markets. However, some of the momentum indicators such as the credit default swaps (CDS), the S&P500 volatility index (VIX), the MSCI World Index (MXWO), and the MSCI Emerging Markets Index (MXEF) do not signal the same direction as the other indicators do. The reason for the negative correlation of the stock market performance (MSCI World Index performance and the MSCI Emerging Markets Index) might represent the growth expectations which influence the stock markets' positive performances. The global growth expectations have an impact on the inflation expectations and therefore the yields.

On the other hand, the best performing momentum indicators for Turkish Bonds are the bond's past performance itself, the total return index of the Istanbul Stock Exchange 100

[††] Sharpe Ratio is an indicator of risk-adjusted returns. By using that measurement, the annual returns obtained by different momentum indicators are compared reliably. Higher sharpe ratio refers to better strategy. For further explanation please visit Appendix B.

(XU100T), and the U.S. 10-year maturity bond yield. Contrary to the MSCI World and the MSCI Emerging Markets, the past performance of the XU100T can give a clue about the capital flows to Turkish assets. Explanation for that might be the systematic impact of capital inflows and outflows on the Turkish assets. The U.S. 10-year maturity bond yield (US10) is the best performing momentum indicator for the 5-year and the 10-year maturity Turkish bonds in the chosen sample period (please see the Figure 2 for the historical performance graph). The cumulative returns do not follow a mean-reverting pattern in the sample period. In addition to the best performance indicators, the best performing momentum period is the 13 weeks horizon overall.

Table 1. Long-only Portfolio Comparison

LONG ONLY PORTFOLIO STATISTICS VS ADJUSTED MOMENTUM STRATEGY					
Maturity	**Strategy**	**Total Return**	**Annual Return**	**Standart Deviation**	**Sharpe Ratio**
10-year Bond	Long Only	4,30%	0,60%	7,65%	0,08
5-Year Bond	Long Only	13,09%	1,83%	11,54%	0,16
10-Year Bond	Adj. Momentum with US10 (13-week)	81,96%	11,46%	11,44%	1,00
5-Year Bond	Adj. Momentum with US10 (13-week)	59,53%	8,32%	7,60%	1,09

One can argue that a long only portfolio instead of using the auction cycle adjusted momentum strategy might perform almost the same. To cope up with this disbelief, a comparison between a long-only bond portfolio and the adjusted momentum bond portfolio is performed. The long-only portfolio holds 1 unit of 5-year or 10-year maturity Turkish bonds with the auction cycle adjustment for the entire sample period. However, for an accurate performance comparison, funding cost is taken into consideration also for the long only portfolio. The best performing strategy, the auction cycle adjusted momentum strategy employing US 10-year maturity bond yield as the momentum indicator with 13-week lookback period, is selected. Table 1 summarizes the performances of the two selected portfolios. Accordingly, the long-only portfolio performs worse compared to the adjusted momentum strategy for both returns and volatility adjusted returns (Sharpe ratio). Both results support the superiority of the strategy in the sample period.

5.2.2. The Momentum Strategy Results with the Auction Cycle Adjustment

The effect of the auction cycle to the momentum strategy improves the performance considerably in the sample period (Table 7 and Table 8). The annual returns and Sharpe ratios are enhanced by 3.51% and 0.39 respectively by the auction cycle adjustment. The annual returns are improved across most of the momentum indicators and the momentum periods. This result supports this study's proposition that the debt auction cycle has a momentum delaying effect in the sample period.

5.3. Possible Explanations for Auction Cycle Returns

The auction cycle returns in the sample period are analyzed for the 5-year and the 10-year maturity Turkish bonds. A regression analysis is performed to analyze the effect of the previously selected momentum indicators' historical volatility on the auction returns.

Table 2. R-Squares of Regressions

R-Squares of Regressions									
Period	**Maturity**	**5-year**	**10-year**	**XU100T**	**US10**	**CDS-TR**	**VIX**	**MXEF**	**MXWO**
13 Weeks	**10-Year**	0,0%	0,1%	0,8%	0,1%	0,2%	1,2%	0,0%	0,0%
	5-Year	1,5%	0,9%	1,1%	10,8%	4,2%	2,5%	6,3%	12,4%
4 Weeks	**10-Year**	0,6%	0,0%	3,8%	0,0%	0,0%	5,1%	2,0%	4,6%
	5-Year	11,6%	5,3%	3,7%	5,1%	17,7%	3,4%	5,7%	8,1%

4- week and 13-week periods are used for the historical volatility calculations. Similar to the dominant performance of the 5-year maturity bonds in the auction cycle strategy, 5-year maturity bond auction returns are more predictable compared to the 10-year maturity bond auction returns by the use of selected momentum indicators' volatility. In Table 2, R-Square results of the regressions of the selected momentum indicators and different periods support the former statement. On the other hand, one can conclude that the driving factors of the 10-year maturity bond auction cycle effect are not the same as the 5-year maturity bond auctions. For the 5-year bond auctions; the MSCI World Equity Index volatility and the US 10-year maturity bond yield volatility are the best performing factors across the 4-week period and the 13-week period. However, after narrowing down the analysis to only 4-week period, volatility of the 5-

year maturity Turkish credit default swaps and 5-year Turkish bond yield volatility have more explanatory power.

6. CONCLUSION

A simple momentum strategy is applied on the 5-year and the 10-year maturity Turkish bonds in the sample period from March 2010 to August 2017 with 1-week, 4-week and 13-week look-back periods. The annual returns with the simple momentum strategy were 2.28% and 2.71% for the 5 and the 10-year maturity Turkish bonds respectively.

In addition to this simple momentum strategy, as Duyvesteyn and Martens (2014) employ other momentum indicators, this study employed other momentum indicators such as the U.S. 10-year maturity bond yield, the Istanbul Stock Exchange 100 total return index, the credit default swap spread of Turkey, the S&P 500 volatility index, the MSCI World Equity Index and MCSI Emerging Market Equity Index. Consequently, the U.S. 10-year maturity bond yield, the Istanbul Stock Exchange total return index and time series momentum of bonds perform well across all look-back periods as momentum indicators.

The underperformance of the 5-year maturity CDS, VIX, MXWO and MXEM Index can be explained in two ways. First, the CDS and the VIX have a mean-reverting structure which may not be coherent with any momentum strategy. Secondly, the growth expectations on MXWO and MXEM reflect on the inflation expectations thus drive the yields upwards.

The best performing momentum indicator is the U.S. 10-year maturity bond yield in the sample period. The indicator results in 10.46% annual return for the entire period. This outperformance could be explained by the risk-free asset structure of the U.S. 10-year maturity bond. It is well-known that the treasury bond yields in the emerging markets are highly sensitive to the risk-free yields. The investors demand more (less) premium when risk-free yields are rising (declining).

However, the liquidity-thin emerging markets' supply pressure of public debt auctions needs further attention beyond the study of Duyvesteyn and Martens (2014). The lack of liquidity in the emerging markets leads to the higher treasury debt auction cycle effect than the developed markets. After a minor change to Beetsma et al. (2016a, 2016b, 2018) methodology,

the treasury debt auction cycle effect is calculated to be 7 bps for the 10-year maturity bonds and 14 bps for the 5-year maturity bonds for the Turkish bond market.

In accordance with the auction cycle effect, the employed simple momentum strategy is adjusted by taking a long position on the auction weeks regardless of the momentum indicator. This new adjusted momentum strategy improves annual returns by 0% to 6.90% (%3.5 on average) across all the momentum indicators and the look-back periods in the sample period.

Finally, the time series momentum is observed in the Turkish bond market from March 2010 to August 2017. However, the supply side pressure by the treasury auctions have a delaying effect on the time series momentum. In addition, employing other momentum indicators results in better returns than employing the bond momentum itself. The adjusted momentum strategy enhances the annual returns by 6.49% to 10.86% considering the long-only portfolio.

7. FUTURE WORK

The bond momentum strategies and the debt auction cycles are not widely studied fields for the emerging markets in the finance literature. To expand the literature, it would be important to analyze the effect of several factors such as monthly announced issue amounts, total bond redemption amount and the bond auction of the other countries on the Turkish markets for future study. In addition, the cross-sectional momentum across the different maturities by taking auction cycles into consideration would be an interesting study for the literature. Lastly, applying this study and the future work studies above to the other emerging market country bonds would be a well contribution to the financial literature.

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APPENDIX A

List of Tables

Table 3. Summary Statistics of Yield Changes after Bond Auctions

Net Change (bps)	*10 Year Bond*	*5 Year Bond*
Mean	-0,07	-0,14
Standard Error	0,02	0,03
Median	-0,08	-0,10
Mode	-0,28	-0,07
Standard Deviation	0,19	0,27
Sample Variance	0,04	0,07
Kurtosis	0,45	0,25
Skewness	0,59	-0,58
Range	0,92	1,26
Minimum	-0,39	-0,90
Maximum	0,53	0,36
Sum	-4,09	-9,27
Count	61	67

Table 4. Summary Statistics of Net Returns After Bond Auctions

Net Return (bps)	*10 Year Bond*	*5 Year Bond*
Mean	0,40%	0,48%
Standard Error	0,15%	0,11%
Median	0,43%	0,34%
Standard Deviation	1,14%	0,93%
Sample Variance	0,01%	0,01%
Kurtosis	0,50	0,18
Skewness	-0,60	0,58
Range	5,50%	4,35%
Minimum	-3,19%	-1,24%
Maximum	2,30%	3,10%
Sum	24,33%	31,98%
Count	61	67

Table 5. Annual Returns Across the Indicators and Periods

ANNUAL RETURN				
Indicator	**Asset**	**1 Week**	**4 Weeks**	**13 Weeks**
10 year Bond	10 year Bond	2,24%	1,25%	2,71%
5 year Bond	5 year Bond	0,95%	-0,33%	2,28%
XU100T	10 year Bond	0,66%	4,69%	4,16%
XU100T	5 year Bond	1,63%	2,49%	2,23%
US10	10 year Bond	8,78%	10,46%	8,09%
US10	5 year Bond	4,94%	4,87%	5,06%
CDS	10 year Bond	-4,45%	-3,88%	0,84%
CDS	5 year Bond	-1,36%	-2,12%	0,89%
VIX	10 year Bond	-3,23%	-2,03%	-5,34%
VIX	5 year Bond	-1,00%	-0,97%	-1,74%
MXWO	10 year Bond	-0,74%	-4,30%	-5,18%
MXWO	5 year Bond	1,45%	-0,69%	-1,77%
MXEF	10 year Bond	-1,45%	0,46%	-0,03%
MXEF	5 year Bond	0,18%	0,90%	0,85%

The annual returns of the momentum indicators and look-back periods are presented as a heatmap table. The green colored cells represent higher returns and the red colored cells represent lower returns. Accordingly, the U.S. 10-year maturity bond yield, the Istanbul Stock Exchange 100 total return index and the bond own historical performances are the best

momentum indicator for both the 5-year and 10-year maturity bonds in the sample period. On the other side, the 5-year maturity CDS of Turkey, the VIX index, the MSCI World Index and the MSCI EM Index are the underperforming momentum indicators. The best performing momentum indicator in the sample period is the U.S. 10-year maturity bond yield across all the look-back periods.

Table 6. Sharpe Ratios across the Indicators and Periods

SHARPE RATIO				
Indicator	**Asset**	**1 Week**	**4 Weeks**	**13 Weeks**
10 year Bond	10 year Bond	0,17	0,10	0,21
5 year Bond	5 year Bond	0,12	-0,04	0,29
XU100T	10 year Bond	0,05	0,36	0,32
XU100T	5 year Bond	0,21	0,32	0,29
US10	10 year Bond	0,68	0,81	0,63
US10	5 year Bond	0,63	0,62	0,65
CDS	10 year Bond	-0,34	-0,30	0,06
CDS	5 year Bond	-0,17	-0,27	0,11
VIX	10 year Bond	-0,25	-0,16	-0,41
VIX	5 year Bond	-0,13	-0,12	-0,22
MXWO	10 year Bond	-0,06	-0,33	-0,40
MXWO	5 year Bond	0,19	-0,09	-0,23
MXEF	10 year Bond	-0,11	0,04	0,00
MXEF	5 year Bond	0,02	0,12	0,11

The Sharpe ratios of the momentum indicators and look-back periods are presented as a heatmap table. The Sharpe ratios are calculated as the total returns divided by standard deviations. The green colored cells represent higher Sharpe ratios and the red colored cells represent lower Sharpe ratios. Accordingly, the U.S. 10-year maturity bond yield, the Istanbul Stock Exchange 100 total return index and the bond own historical performances are the best momentum indicator for both the 5-year and 10-year maturity bonds in the sample period. On the other side, the 5-year maturity CDS of Turkey, the MSCI World Index and the MSCI EM Index are the underperforming momentum indicators. The best performing momentum indicator in the sample period is the U.S. 10-year maturity bond yield across all the look-back periods. The results are coherent with the Table 5.

Table 7. Auction Cycle Adjusted Annual Returns across the Indicators and Periods

ANNUAL RETURN				
Indicator	**Asset**	**1 Week**	**4 Weeks**	**13 Weeks**
10 year Bond	10 year Bond	4,00%	4,41%	5,68%
5 year Bond	5 year Bond	2,32%	4,32%	5,67%
XU100T	10 year Bond	2,19%	4,04%	6,71%
XU100T	5 year Bond	3,90%	3,67%	6,29%
US10	10 year Bond	9,47%	10,45%	11,46%
US10	5 year Bond	7,83%	8,35%	8,32%
CDS	10 year Bond	-1,45%	1,91%	6,21%
CDS	5 year Bond	3,10%	4,80%	7,15%
VIX	10 year Bond	0,75%	2,31%	1,29%
VIX	5 year Bond	3,66%	3,87%	3,93%
MXWO	10 year Bond	3,02%	1,83%	-2,76%
MXWO	5 year Bond	5,02%	3,65%	0,95%
MXEF	10 year Bond	-0,50%	3,92%	5,89%
MXEF	5 year Bond	1,84%	3,84%	6,62%

The auction cycle adjusted annual returns of the momentum indicators and look-back periods are presented as a heatmap table. The green colored cells represent higher returns and the red colored cells represent lower returns. Accordingly, the U.S. 10-year maturity bond yield, the Istanbul Stock Exchange 100 total return index and the bond own historical performances are the best momentum indicator for both the 5-year and 10-year maturity bonds in the sample period however after the auction cycle adjustment MSCI EM Index and the 5-year maturity CDS of Turkey perform well. The auction cycle adjustment enhances the annual returns around 3.0-3.3%. On the other side, the MSCI World Index and the VIX are the underperforming momentum indicators. The best performing momentum indicator in the sample period is the U.S. 10-year maturity bond yield across all the look-back periods.

Table 8. Auction Cycle Adjusted Sharpe Ratios across the Indicators and Periods

SHARPE RATIO				
Indicator	**Asset**	**1 Week**	**4 Weeks**	**13 Weeks**
10 year Bond	10 year Bond	0,35	0,38	0,50
5 year Bond	5 year Bond	0,30	0,56	0,74
XU100T	10 year Bond	0,19	0,35	0,58
XU100T	5 year Bond	0,51	0,48	0,82
US10	10 year Bond	0,82	0,91	1,00
US10	5 year Bond	1,02	1,10	1,09
CDS	10 year Bond	-0,13	0,16	0,54
CDS	5 year Bond	0,40	0,63	0,93
VIX	10 year Bond	0,06	0,20	0,11
VIX	5 year Bond	0,48	0,50	0,51
MXWO	10 year Bond	0,26	0,16	-0,24
MXWO	5 year Bond	0,66	0,47	0,12
MXEF	10 year Bond	-0,04	0,34	0,51
MXEF	5 year Bond	0,24	0,50	0,87

The auction cycle adjusted Sharpe ratios of the momentum indicators and look-back periods are presented as a heatmap table. The Sharpe ratios are calculated as the total returns divided by standard deviations. The green colored cells represent higher Sharpe ratios and the red colored cells represent lower Sharpe ratios. Accordingly, the U.S. 10-year maturity bond yield, the Istanbul Stock Exchange 100 total return index and the bond own historical performances are the best momentum indicator for both the 5-year and 10-year maturity bonds in the sample period however after the auction cycle adjustment MSCI EM Index and the 5-year maturity CDS of Turkey perform well. On the other side, the VIX index and the MSCI World Index are the underperforming momentum indicators. The best performing momentum indicator in the sample period is the U.S. 10-year maturity bond yield across all the look-back periods. The results are coherent with Table 7.

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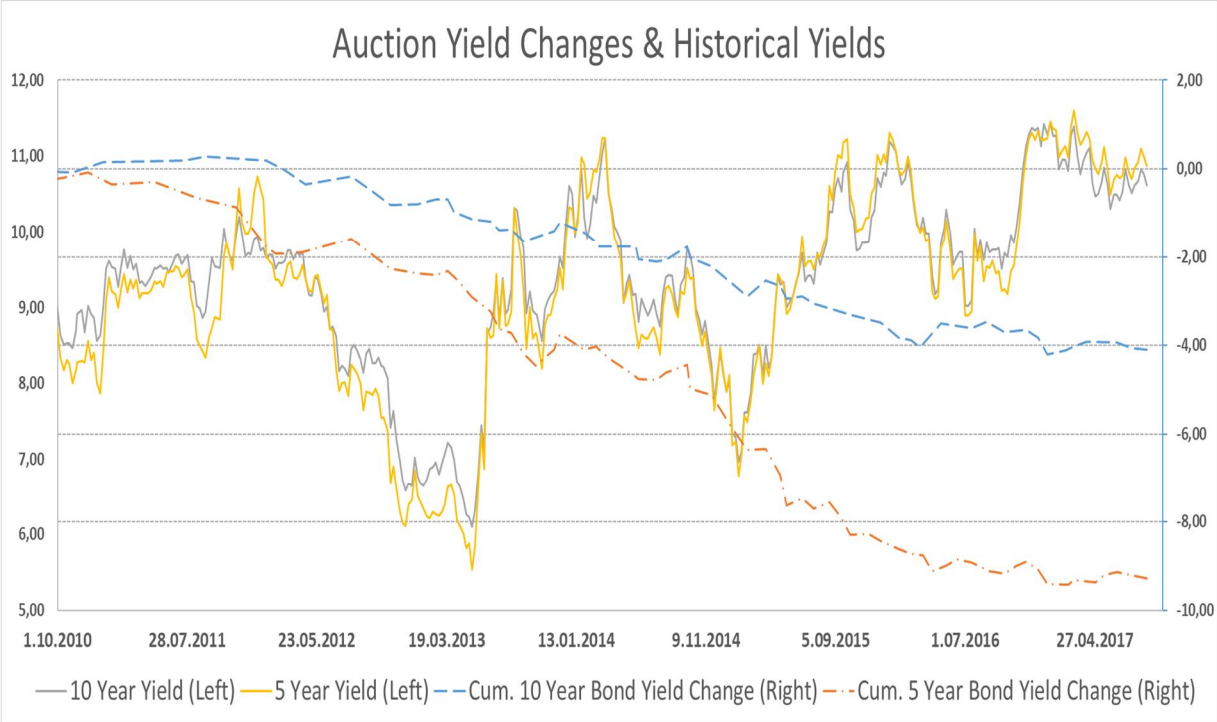

Figure 1. Cumulative Yield Changes After Auctions and Historical Yields

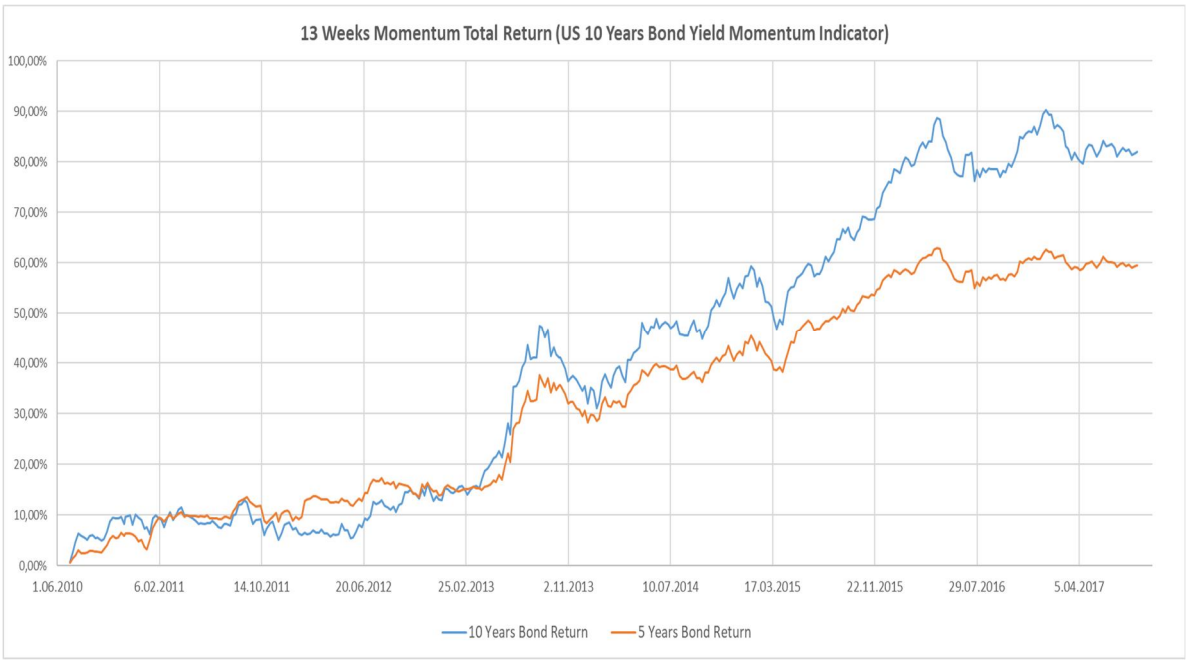

Figure 2. Cumulative Auction Cycle Adjusted Momentum Returns by US 10 Year Yield as the Indicator

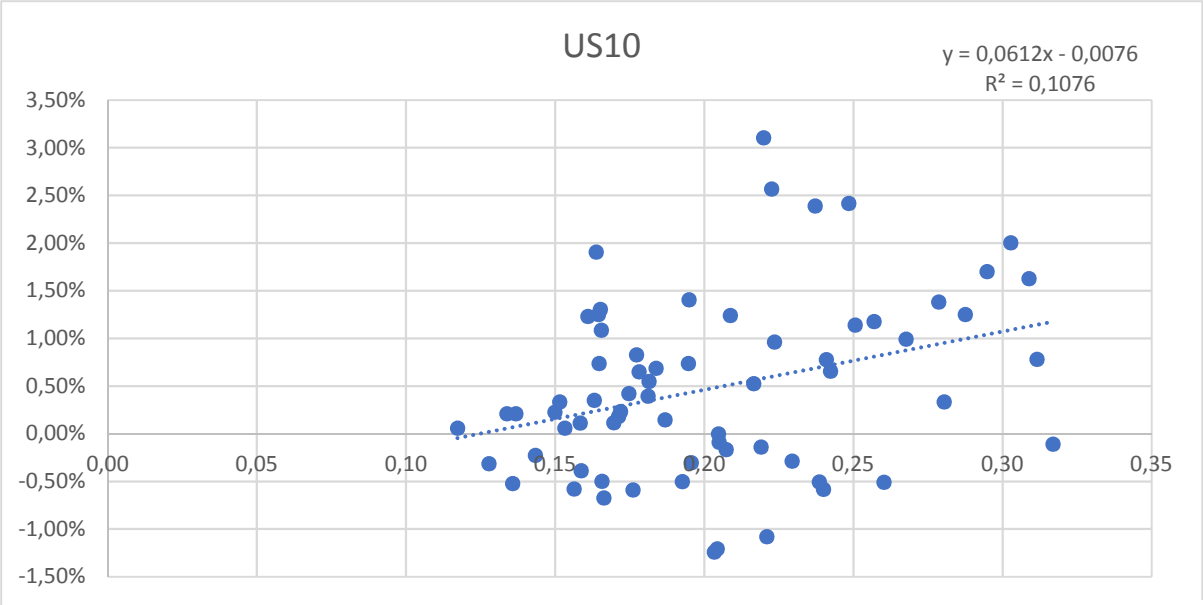

Figure 3. 5-year Maturity Turkish Bond Auction Returns and the 13-week Volatility of the US 10-year Bond Yield

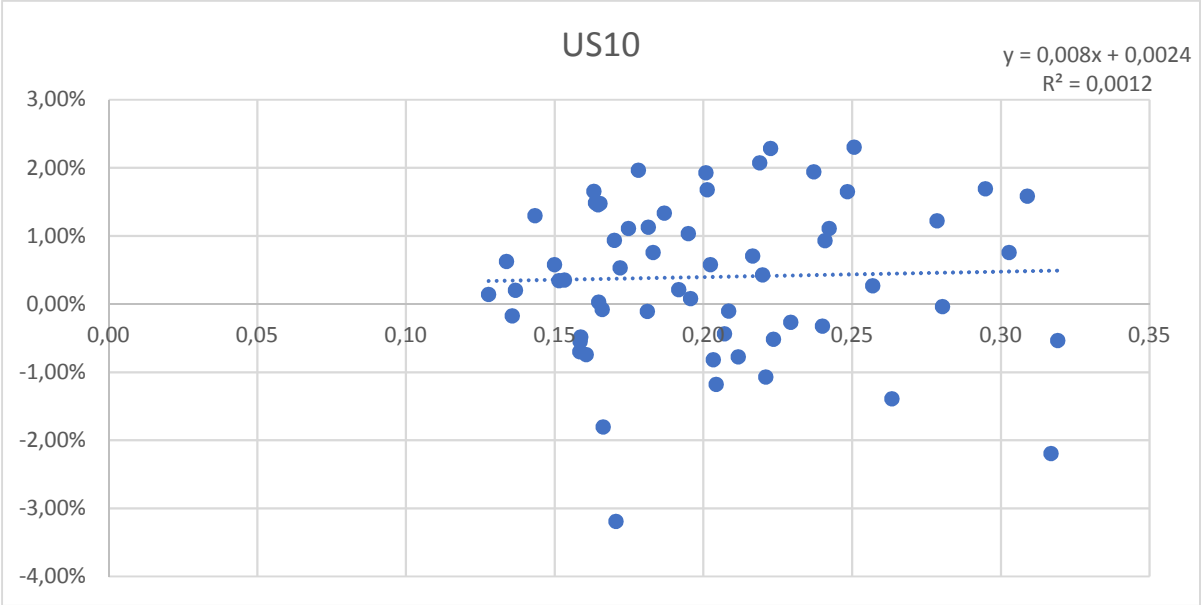

Figure 4. 10-year Maturity Turkish Bond Auction Returns and the 13-week Volatility of the US 10-year Bond Yield

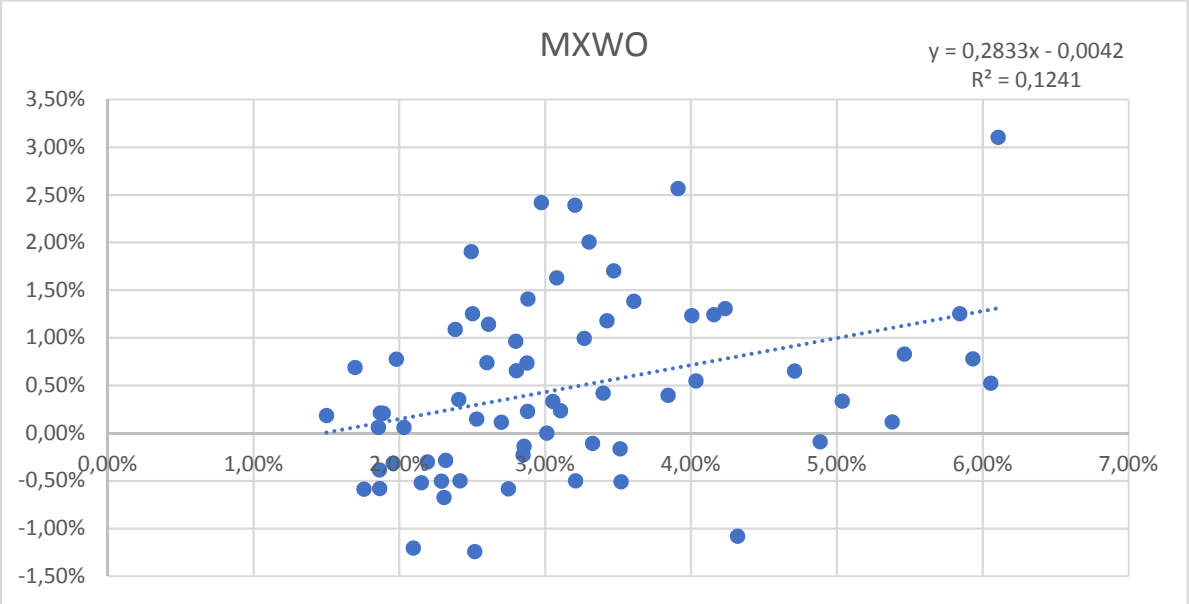

Figure 5. 5-year Maturity Turkish Bond Auction Returns and the Volatility of the MSCI IndexWorld Equity

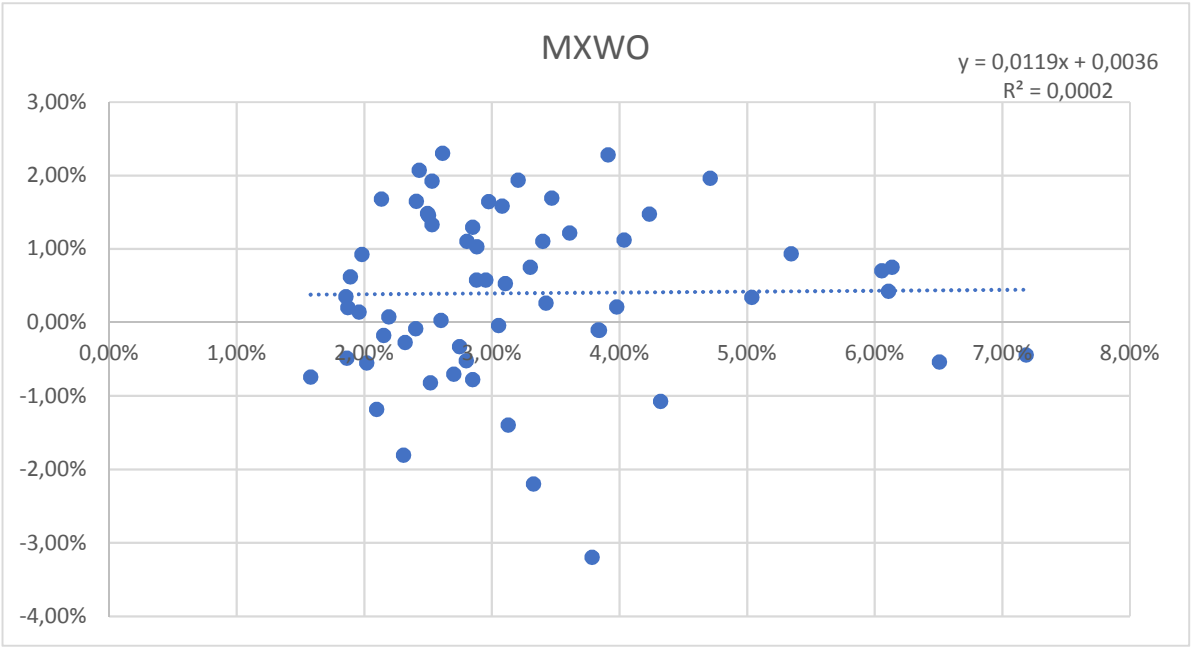

Figure 6. 10-year Maturity Turkish Bond Auction Returns and the Volatility of the MSCI World Equity Index

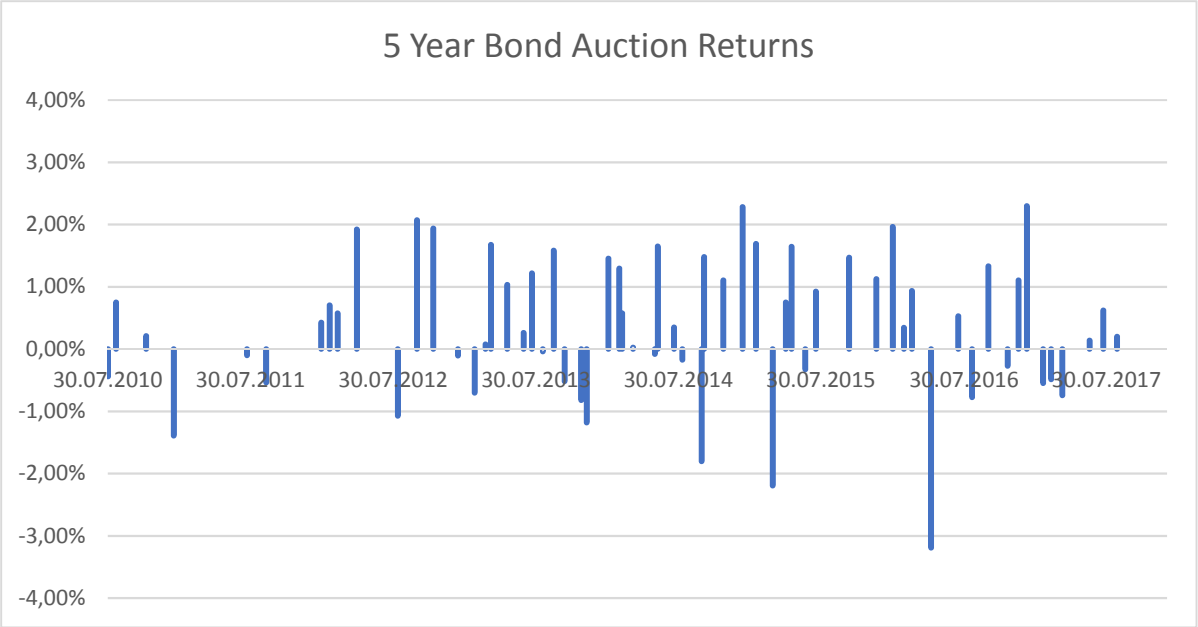

Figure 7. 5-Year Maturity Bond Auction Returns

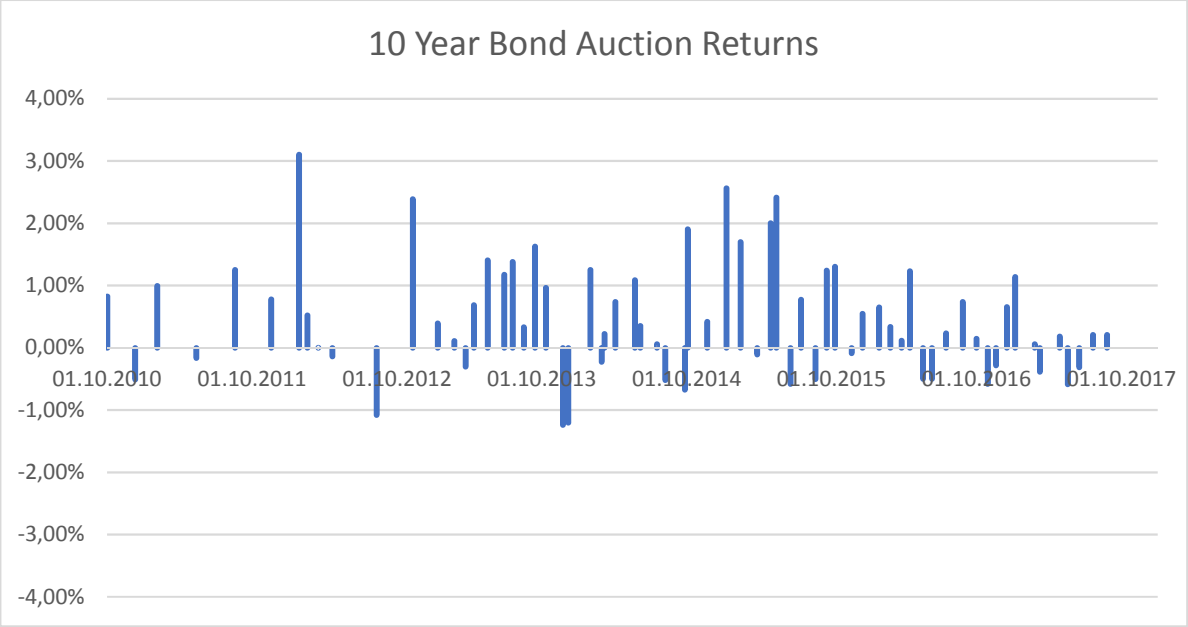

Figure 8. 10-Year Bond Auction Returns

APPENDIX B

Sharpe Ratio for Risk-Adjusted Return Measurement

The Sharpe ratio is a risk-adjusted return measure as the ratio of the return in excess of the risk-free rate divided by the volatility of returns (Fabozzi & Mann, 2012). In order to compare at least two return series, using the Sharpe ratio gives more useful information than the returns. For example, consider two trading strategies A and B. Strategy A and Strategy B have 10% annual return. On the other hand, the Sharpe ratios of Strategy A and Strategy B are 1.10 and 0.90 respectively. In this scenario, Strategy A performs better than Strategy B.

$$Sharpe\ Ratio = \frac{(\text{Annual Return} - \text{Risk Free Rate})}{\text{Portfolio Standard Deviation}}$$