The Momentum as a Systematic Risk Factor on the Bond Market: Evidence for the Croatian Government Bonds

*Zrinka ORLOVIĆ – Denis DOLINAR – Davor ZORIČIĆ**

Abstract

This research objective is to examine momentum strategies in the less developed and less liquid Croatian bond market. Both "pure" kuna (domestic currency) and euro-denominated (currency clause embedded) government bond issues are considered for a period of more than 16 years. Starting with daily data on government bond prices and using monthly return observations, this research tries to identify the presence and strength of the momentum as the systematic risk factor on developing bond market. Sub-samples were also tested to examine how different conditions, such as high and low interest rate levels, affect the performance of momentum strategies. The results support the possibility of creating profitable investment strategies based on the momentum for the sample of Croatian government bonds (assuming the possibility of short sale and ignoring transaction costs). Namely, statistically significant risk premiums are achieved for the most of analyzed holding periods.

Keywords: *momentum, government bonds, Croatian bond market, developing debt market, bond risk factors, factor investing*

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* Zrinka ORLOVIĆ, corresponding author – Denis DOLINAR – Davor ZORIČIĆ, University of Zagreb, Faculty of Economics and Business – Zagreb, Department of Managerial Economics, Trg J. F. Kennedy 6, 10000 Zagreb, Croatia; e-mail: zrinka.orlovic@efzg.unizg.hr, ORCID: 0000-0003-2508-2658; denis.dolinar@efzg.unizg.hr, ORCID: 0000-0001-9489-9990; davor.zoricic@efzg.unizg.hr, ORCID: 0000-0002-0206-3422

Introduction

Factor investing is a very popular topic in the field of portfolio management and thus is widely examined for developed capital markets. The significance of systematic risk factors became popular after the paper of Fama and French (1993). They were among the first to examine the performance of stock and bond systematic risk factors and to develop a multi-factor model which can explain the movement of prices on stocks and bonds. After them, many researchers tested the significance of various systematic risk factors mainly for stocks on various stock markets, from the most developed to less developed stock markets. More recent papers seek to adapt the factors developed for the stock market to the bond market and test the possibility of managing bond portfolio returns through investing in bond-related systemic risk factors. Still, the number of papers that deal with systematic risk factors on the bond market is modest. However, the interest of practitioners in factor investing in the bond market is on the rise and thus is taking the attention of academia.

Systematic risk factors in the bond market can be divided into two groups, time-series factors and cross-sectional factors. According to Maeso et al. (2019a) factors related to the yield curve are time-series factors because they explain a large percentage of bond returns for any maturities over a certain time. Risk factors which can explain at any point in time a difference in the cross-section of bond returns are cross-sectional factors. The focus of this paper is on cross-sectional factors, specifically momentum. The momentum factor is the most often examined factor for bond markets, thus our research will test the momentum on Croatian government bonds. Besides momentum, factors of cross-sectional systemic risk in the bond market usually include the size factor, the value factor and the low-risk factor, but these are more related to corporate bonds, which are not numerous in the Croatian bond market.

Momentum as a risk factor gained great popularity with the Carhart (1997) paper. Carhart extended the three-factor model by Fama and French (1993) in order to explain stock returns even better. The momentum factor is based on the assumption that a certain security, which realized positive returns in the past, will achieve positive returns in the future in the short term, i.e. up to a year. Also, momentum assumes that a certain security, which realized negative returns in the past, will achieve negative returns in the future. Therefore, momentum investing assumes buying securities which achieved positive returns in the past and selling securities which achieved negative returns in the past.

After the paper of Jegadeesh and Titman (1993) testing the significance of momentum became very common for stocks thus their methodology is frequently used. Besides stock markets, Moskowitz et al. (2012) find the importance of

momentum for various other asset classes, like equity indices, currencies, commodities, and bond futures. Since many papers have shown the importance of momentum for the stock markets (Zakamulin and Giner, 2022; Gao et al., 2021), Hanauer and Windmüller, 2023), and also for other capital investments (Rohrbach et al., 2017; Menkhoff et al., 2012), recently the same topic became interesting for bond markets.

Contributions of this paper to the field of momentum investing can be summarized in four ways. Firstly, the paper provides a detailed literature review of momentum investing among various bond markets. Secondly, based on the literature review no research was found that deals with this topic for emerging bond markets. To our best knowledge, this paper can be seen as an initial step when testing momentum or other cross-sectional factors on less developed bond markets. Thirdly, examining momentum for the sub-samples of high and low interest rate levels demonstrates how these conditions affect the momentum strategy. Lastly, the obtained results indicate the possibility of observing momentum investing as a profitable investment strategy for developing bond markets.

1. Literature Review

On the bond market the most frequently tested cross-sectional systematic risk factor is momentum. The momentum strategy implies buying bonds that have performed well in the past and selling bonds that have performed badly in the past. The reversal effect has also been observed on the bond market. The reversal effect implies that securities that have achieved positive returns in the past, in the short term, achieve significantly lower, even negative returns in the future, and vice versa. Since momentum and reversal effect are opposed to each other, they are sometimes analyzed within the framework of a single study.

The following literature review can be divided into two main segments – one that tests momentum for corporate bonds and the second one that covers government bonds. Regardless, these papers do have common similarities. Firstly, all these papers tested momentum for developed bond markets. Secondly, the empirical studies are based on monthly bond data spanning an observation period of 10 years at least. And thirdly, most of the papers follow the methodology presented in the paper by Jegadeesh and Titman (1993) who tested momentum in the stock market. Namely, Jegadeesh and Titman (1993) collected the data for U.S. stock returns and tested strategies considering look-back and holding periods of 3, 6, 9 or 12 months. They concluded that such momentum strategies generate significant positive stock returns (risk premiums) for the mentioned look-back and holding periods.

Hottinga et al. (2001) are among the first to test the momentum factor for a sample of corporate bonds. They collected monthly data for the period from 1989 to 1999 for A-rating bonds. They showed that bonds that in the past achieved lower returns compared to the market will still beat the market in the near future and achieve significantly better returns compared to the past. Therefore, for this sample of data reversal effect was identified. For the period from January 1973 to December 2006, Gebhardt et al. (2005) also found the existence of the reversal effect for corporate bonds. A similar conclusion was presented in the paper of Khang and King (2004) for the period from 1978 to 1998 for U.S. investment-grade corporate bonds. They found that there is a reversal effect for the observed bonds in the short term of 1 to 6 months, while from 7 to 12 months, the reversal effect of corporate bonds decreases. The same analysis was carried out for government bonds and stocks. They showed the existence of momentum for observed stocks, but not for government bonds. Pospisil and Zhang (2010) also tested the existence of momentum or reversal effect for the period from December 1996 to August 2009 for U.S. corporate bonds, i.e. investment-grade and high-yield bonds respectively. For investment-grade corporate bonds, as in previous research, they concluded that there is a reversal effect, while for high-yield corporate bonds they identified the momentum factor. For investment-grade corporate bonds, Jostova et al. (2013) came to the opposite conclusion. For the period from January 1973 to July 2011, they showed the possibility of realizing investment profit by exposing to the momentum factor. They also tested momentum for non-investment corporate bonds, where the momentum effect is more pronounced with regard to investment-grade bonds. Also, for the U.S. market Bektić et al. (2019) conducted research on stock and bond data from June 2000 to December 2016. Based on the measure of residual equity momentum they divided corporate bonds into portfolios. Since the difference between high- and low-momentum bond portfolios generate positive returns, they conclude that investing based on the momentum factor can add value to corporate bond investors. Li and Galvani (2021) used monthly data from July 2002 to June 2017 for the U.S. bond market. They constructed momentum portfolios by considering the trading volume of bonds. When the three bonds with the highest total volumes of institutional trades were identified, they were referred to as top bonds, while the remaining bonds were named as nontop bonds. They concluded that the momentum effect is stronger and has a longer duration for non-top bonds compared to top bonds.

Most of the aforementioned studies used data for corporate bonds, and to our knowledge, there are only a few studies that tested systematic risk factors on government bonds. For example, Van Luu and Yu (2012) examine the significance of the momentum factor for government bonds for several financial markets

(Australia, Canada, Japan, United Kingdom, U.S. and Germany) for the period from 1987 to 2011. They concluded that returns achieved through momentum investing for the mentioned markets are statistically significant. Asness et al. (2013) test the value factor and the momentum factor on government bonds for 10 countries for the period from January 1982 to July 2011 and show that positive returns are achieved for both factors. Geczy and Samonov (2017) tested the momentum for different types of assets, including U.S. government bonds, for the period from 1978 to 2014. Their findings indicated that momentum is statistically significant for government bonds, where the look-back period is set to 10 months and the holding period to 1 month. Maeso et al. (2019b) collected data on U.S. government bonds for the period from December 1973 to June 2018. They considered bonds with a minimum maturity of 2 years and a maximum maturity of 15 years and observed monthly returns for these bonds. They showed that those bonds which in the past 9 and 12 months achieved a positive return usually have such a trend in the next 9 and 12 months, thus corroborating the existence of momentum. Also, Baltussen et al. (2021) examined the significance of the momentum for government bonds and showed that momentum generates positive returns.

The majority of momentum studies emphasize developed markets, yet emerging bond markets remain underexplored. Studies by Asness et al. (2013), Baltussen et al. (2021), and Maeso et al. (2019) confirm momentum's profitability in developed economies, but the same cannot be assumed for emerging markets with lower liquidity and trading volumes. Also, Van Luu and Yu (2012) and Geczy and Samonov (2017) demonstrate the presence of momentum in bond markets across various developed economies, the question remains whether these strategies are effective under conditions of low liquidity and limited bond issuance typical of emerging markets. This research responds to this gap by investigating momentum within the Croatian government bond market, representing a less liquid and less developed financial market. By focusing on Croatian bonds, we contribute novel insights on the significance of momentum strategies in a less liquid, emerging bond market setting, relevant for global investors seeking diversified, momentum-based strategies.

Furthermore, recent studies primarily focus on corporate bonds, with fewer studies examining government bonds, particularly in emerging economies. Li and Galvani (2021) and Bektic (2019) provide insights into momentum effects in corporate bonds.

However, there is limited literature on momentum strategies in government bonds, which tend to exhibit different risk-return dynamics. Additionally, the existing literature lacks research on government bonds with currency clauses, which are relevant in markets like Croatia. By analyzing both "pure" kuna and

euro-denominated Croatian government bonds, our study examines how currency clauses may impact the effectiveness of momentum strategies, providing new insights into currency-related risk within the government bond sector. This contribution is present, as currency exposure is a key risk factor for investors in emerging economies.

To date, no study has investigated the impact of interest rate levels on the performance of momentum strategies. In addition to testing momentum across the entire sample period, we analyzed its performance during periods of high and low interest rates. By comparing these two sub-samples and reporting results for the full sample period, we aim to explore how different interest rate environments influence bond performance. This approach provides deeper insights into the effectiveness of momentum strategies for Croatian government bonds and highlights the role of interest rate trends in shaping bond market dynamics. In sum, this study addresses the following key gaps in the literature: it expands momentum research into emerging bond markets, explores currency clause impacts on government bond momentum, and tests the significance of momentum strategies in a low-liquidity environment.

Also, examines the influence of interest rate levels on momentum performance by analyzing two sub-samples – periods of high and low interest rates. These contributions not only extend the understanding of momentum as a systematic risk factor but also provide valuable insights for investors seeking to apply factor-based strategies in developed and emerging markets.

2. Data

In this paper we observe Croatian government bonds without a currency clause ("pure" kuna) and Croatian government bonds with a currency clause (euro-denominated) respectively. Daily prices of bonds were downloaded via Bloomberg for the period from April 2006 to December 2022. The cutoff date is set to December 31st, 2022 since from that date the euro became Croatia's new official currency. Since Croatian government bonds were issued in two currencies (kuna and euro) it is reasonable that they have different risk exposures. Thus, it is important to analyze these two samples of bonds separately. Based on a time series of daily dirty prices realized monthly returns were obtained for each bond and as such were used to test the momentum.

For the period from April 2006 to December 2022 the Croatian bond market was constituted by 19 coupon government bonds without currency clause and 18 coupon government bonds with currency clause. Table 1 reports descriptive statistics of observed bonds.

T a b l e 1

Descriptive Statistics of Observed Bonds (April 2006 – December 2022)

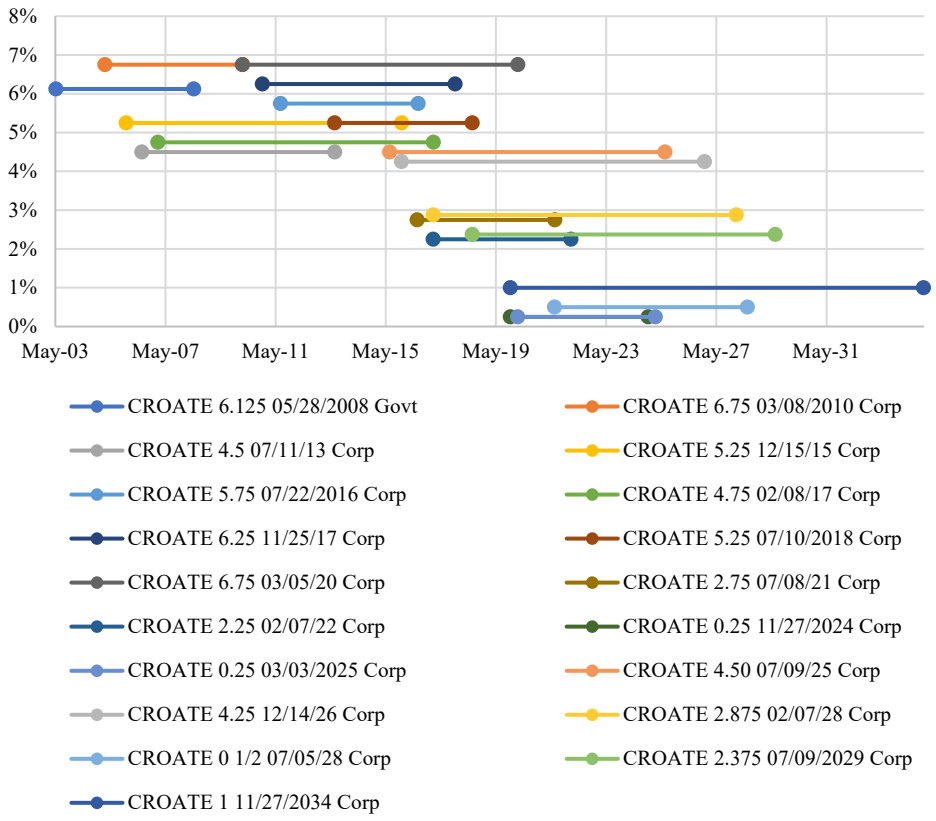
	Coupon government bonds without currency clause	Coupon government bonds with currency clause
Number of monthly observations	1273	1070
Mean value of monthly returns (%)	–0.04	–0.12
Mean value of monthly prices	105.06	105.17
Mean value of coupon rate (%)	3.81	3.81

Source: Author's calculation.

Figure 1 and Figure 2 show the basic nominal characteristics of observed government bonds: issue date, maturity date and coupon rate. A comparison of the two figures reveals that government bonds with a currency clause were issued with longer maturities. Also, coupon rates for both samples showed considerable similarity and a downward-sloping trend over the observed period.

F i g u r e 1

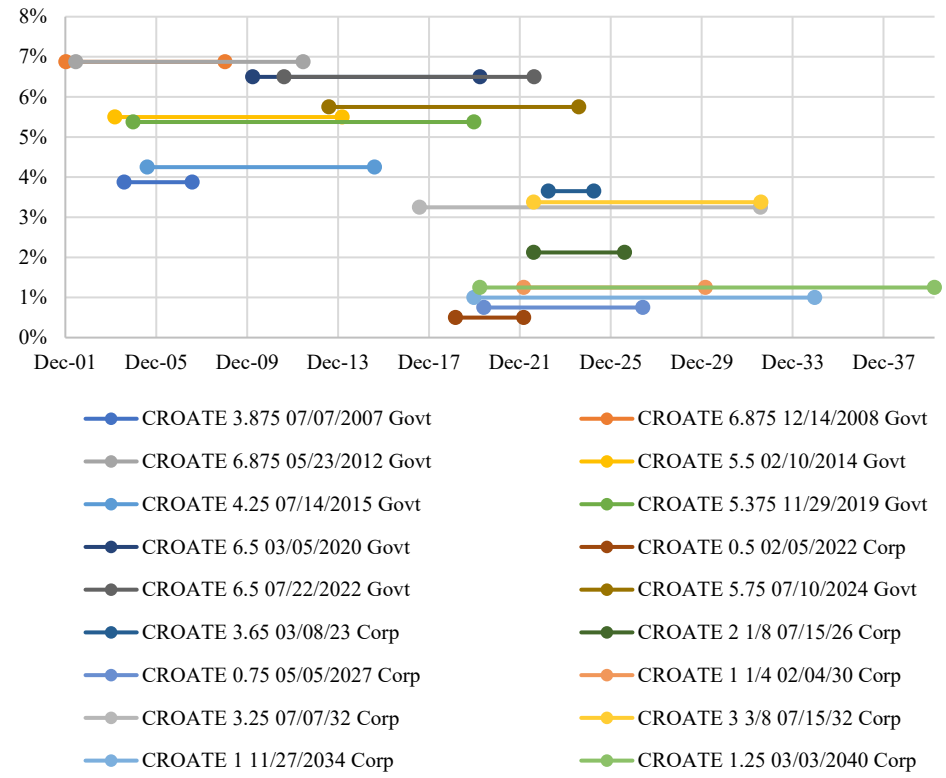
Issuances of Croatian Government Bonds without Currency Clause



Source: Author's calculation.

F i g u r e 2

Issuances of Croatian Government Bonds with Currency Clause



Source: Author's calculation.

3. Methodology

Maeso et al. (2019b) defined three strategies based on the momentum for the bond market: (1) cross-sectional momentum as a long-short strategy or as a long-only strategy, (2) time series momentum as self long-short strategies, and (3) time series momentum as market long-short strategies. Within this research we used the methodology of cross-sectional momentum as a long-short strategy. The choice of this method comes from the fact that the time series momentum requires the use of a risk-free interest rate that is usually approximated as a yield on the Treasury bills. Unfortunately, a continuous (balanced) time series of Croatian Treasury bill yields is not available.

Following the methodology of Maeso et al. (2019) we observed a fixed look-back period of L months and a fixed holding period of H months. Namely, four strategies were implemented in such a way that the look-back period corresponded

to the holding period. Therefore, the following strategies (*L, H*) were considered: (3,3), (6,6), (9,9) and (12,12). At the end of each month *t*, all bonds N_t that are present within that month, as well as in the look-back period ($t - L$) and in the holding period ($t + L$) are considered. For month *t* the realized return for each bond *i* was calculated for a look-back period of *L* months, as well as for a holding period of *H* months.

For example, (3,3) momentum strategy combines the average monthly return for the look-back period of three months and the average monthly return for the holding period of the next three months. Also, the time series of realized monthly returns of the equally weighted portfolio of all bonds that are present in month *t* were calculated. Thus, an average monthly return could be calculated for such a portfolio for a look-back period of *L* months.

Based on the realized returns of the look-back period for *L* months, the bonds were divided into two new portfolios. One portfolio consists of bonds whose average return is higher than the average return of an equally weighted portfolio, and such bonds are called winners and are part of the winner portfolio. The second portfolio is called the looser portfolio, and it consists of bonds whose average return is lower than the average return of an equally-weighted portfolio. For each bond, weight is calculated so that the sum of all bonds is equal to zero, which can be expressed using the following equations:

$$w_{i,t} = \frac{1}{N_t}\left(r_{i,t}^{L} - r_{m,t}^{L}\right) \tag{1}$$

$$\sum_{i=1}^{N_t} w_{i,t} = 0 \tag{2}$$

where N_t represents the number of bonds in the observed month *t*. $r_{i,t}^{L}$ is realized return of a bond *i* for a look-back period of L month in the observed month *t*, while $r_{m,t}^{L}$ is the realized return of an equally weighted portfolio for a look-back period for L month in the observed month *t*. Using the above-mentioned inputs, it is possible to obtain the weights for all bonds in the observed month ($w_{i,t}$).

The cross-sectional long-short momentum strategy requires the weights of bonds to be normalized. The obtained weights $w_{i,t}$ of each bond are normalized in a way that winning portfolios and losers portfolios are considered separately, that is, the total sum of weights of bonds in the winning portfolio is equal to 1, as in the case of the losers portfolio. The following equation shows how normalized weights for each bond are obtained:

$$w_{i,t}^{norm} = \frac{w_{i,t}}{\sum_{i=1}^{N_t} w_{i,t}^{+}} \tag{3}$$

where $\sum_{i=1}^{N_t} w_{i,t}^{+}$ is the total weight of winner bonds in the equally weighted portfolio. Alternatively, $\sum_{i=1}^{N_t} w_{i,t}^{-}$ is the total weight of looser bonds in the equally-weighted portfolio. Based on normalized weights, it is possible to create a cross-sectional long-short momentum strategy which means simultaneously taking a long position (buying bonds) in the winner portfolio and a short position (selling bonds) in the looser portfolio (also called WML strategy). The normalization of the weights of all bonds enables the full offset of a long position with a short position, which means that the cross-sectional momentum is implemented in the form of a zero-cost investment strategy.[1]

To estimate the momentum factor, i.e. the WML premium that can be achieved based on the implementation of the WML strategy, it is necessary to multiply the normalized weights with the returns realized for the holding period of *H* months (equation 4). This step is carried out for all observed months.

$$WML_t = \sum_{i=1}^{N_t} w_{i,t}^{norm} \times r_{i,t}^{H} \tag{4}$$

If the obtained WML values are statistically greater than 0, then the existence of the momentum factor has been identified. Conversely, if the time series of WML values is on average statistically less than 0, then the reversal effect is present. To determine the significance of the momentum/reversal factor, a t-test was performed. Additionally, the Newey-West test was conducted to account for potential autocorrelation in the momentum premiums, ensuring robust statistical inference.

[1] Jegadeesh and Titman (1993) calculate the momentum factor based on a decile-based strategy, according to which they buy 10% of securities that have achieved the highest returns and sell 10% of securities that have achieved the lowest returns. Therefore, they take long and short positions on only a few investments.

Lewellen (2002) claims that it is necessary to consider all investments that are present at some point, which is why a weight is assigned to each investment. Maeso et al. (2019b) also followed that principle. This research follows that principle since there is a relatively small number of government bonds available on the Croatian bond market. Thus consequently, it is not possible to implement the decile-based strategy.

4. Results

First part od empirical results for the profitability of the cross-sectional long-short momentum investment strategy refers to the overall observation period (from April 2006 to December 2022). Estimated momentum premiums for a sample of Croatian government bonds without a currency clause and for a sample of Croatian government bonds with a currency clause are shown separately. The results obtained for the sample of bonds without the currency clause are shown in Table 2. It can be concluded that the investment strategy proved to be profitable for the holding period of 6 and 12 months, considering that the obtained mean value is positive and statistically significant. However, for the 12-month holding period, while the standard t-test indicates statistical significance, the Newey-West test showed that the results are not statistically significant, suggesting caution in interpreting this outcome. For the holding period of 9 months, the obtained mean value is positive, but based on the conducted t-test, it is not statistically significant. For the holding period of 3 months, the mean value is negative and statistically significant, which indicates the presence of a reversal effect.

T a b l e 2

Long-Short Cross-Sectional Momentum Premium for Government Bonds without Currency Clause – Full Sample

	(3,3)	(6,6)	(9,9)	(12,12)
Mean return (annualised)	–0.09590	0.17777	0.05112	0.21595
Standard deviation of mean return (annualised)	0.31804	0.50116	0.58698	0.66305
t-test	–5.13***	5.18***	1.29	4.39***
Newey-West (t-test)	1.95*	2.76**	0.41	1.28
n	195	189	183	177

Note: ***Significant at the 1% significance level; ** Significant at the 5% significance level; * Significant at the 10% significance level

Source: Author's calculation.

For the sample of bonds with a currency clause the results are presented in Table 3. The results strongly suggest the existence of a momentum factor since conducted premiums of long-short cross-sectional momentum strategy are po sitive and statistically significant for all examined holding periods. Both the standard t-test and the Newey-West test produced consistent results, confirming the statistical significance of the momentum premiums across the holding periods examined.

It should be noted that when forming strategies for a sample of bonds with a currency clause there were some missing or insufficient observations till July 2009. Thus, the time series of momentum premium for bonds with a currency clause is smaller compared to bonds without a currency clause.

T a b l e 3

Long-Short Cross-Sectional Momentum Premium for Government Bonds with Currency Clause – Full Sample

	(3,3)	(6,6)	(9,9)	(12,12)
Mean return (annualised)	0.14606	0.17108	0.73104	0.97524
Standard deviation of mean return (annualised)	0.34028	0.62756	0.73100	0.81629
t-test	6.21***	3.74***	11.20***	12.30***
Newey-West (t-test)	3.84***	2.16**	5.40***	5.51***
n	185	177	175	172

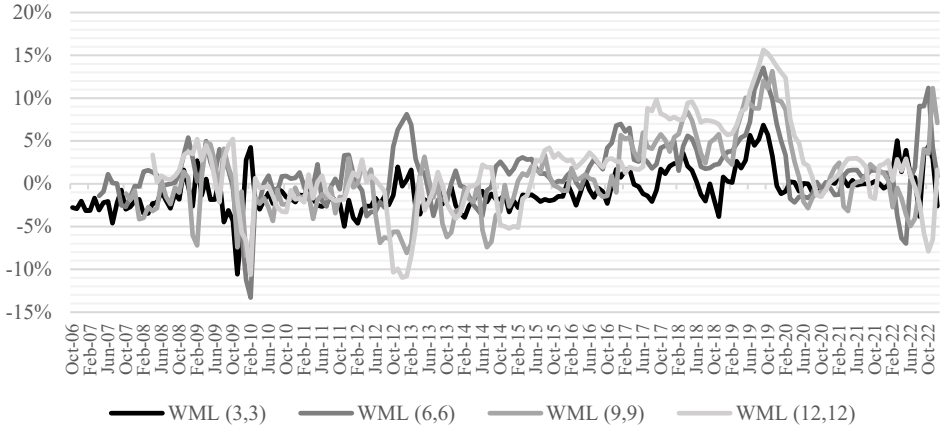
Note: ***Significant at the 1% significance level; ** Significant at the 5% significance level; * Significant at the 10% significance level

Source: Author's calculation.

The time series of realized premiums for bonds without a currency clause and bonds with a currency clause are shown in Figure 3 and Figure 4. For both samples a similar trend is present for all strategies with some deviations over time. Figure 3 and Figure 4 highlight realized positive premiums over time since curves for observed strategies are on average above zero. Also, it can be seen that for the observed period greater variations of momentum premiums are present for the sample of bonds without currency clause in comparison to the sample of bonds with currency clause.

F i g u r e 3

Time Series of Momentum Premium for the Sample of Croatian Government Bonds without Currency Clause



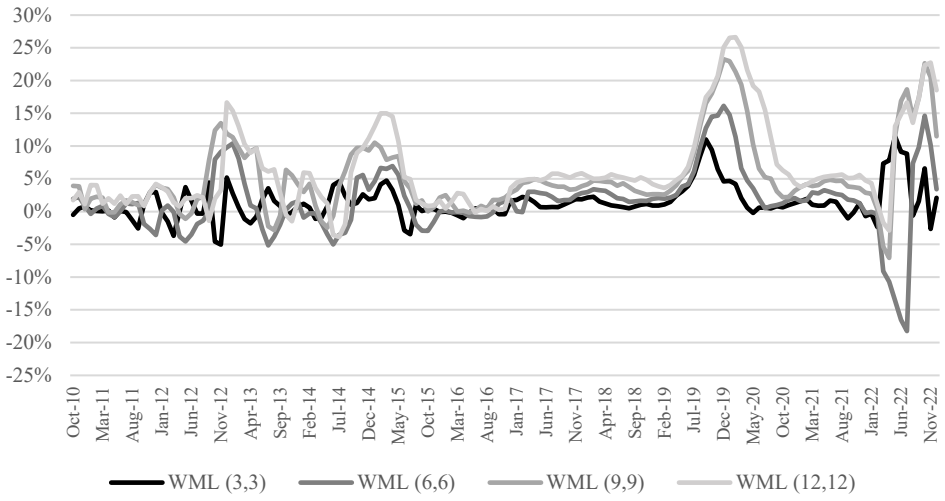
Source: Author's calculation.

Most of the time during the analyzed period, interest rates were on a declining trajectory, leading to an increase in the price of issued bonds. Such a scenario favors certain investment strategies, especially those capitalizing on bond price

appreciation in a falling interest rate environment. To account for this, the full time period was divided into two sub-samples. The first sub-sample, covering April 2006 to December 2015, includes bonds issued during times of higher coupon rates. In contrast, the second sub-sample, from January 2016 to December 2022, comprises bonds with lower coupon rates, indicative of a period with reduced yields.

F i g u r e 4

Time Series of Momentum Premium for the Sample of Croatian Government Bonds with Currency Clause



Source: Author's calculation.

T a b l e 4

Long-Short Cross-Sectional Momentum Premium for Government Bonds without Currency Clause – Sub-Samples

	Sub-sample: April 2006 to December 2015				**Sub-sample: January 2016 to December 2022**			
	(3,3)	**(6,6)**	**(9,9)**	**(12,12)**	**(3,3)**	**(6,6)**	**(9,9)**	**(12,12)**
Mean return (annualised)	–0.20809	0.02272	–0.19883	–0.09978	0.07470	0.40181	0.43645	0.68173
Standard deviation of mean return (annualised)	0.18218	0.31387	0.30431	0.35373	0.19401	0.34711	0.37927	0.43785
t-test	–9.60***	0.53	–4.54***	–1.78*	2.40**	6.55***	6.38***	8.32***
Newey-West (t-test)	–10.19***	0.37	–3.75***	–1.36	1.65*	3.94***	3.11***	3.38***
N	111	105	99	93	84	84	84	84

Note: ***Significant at the 1% significance level; ** Significant at the 5% significance level; * Significant at the 10% significance level

Source: Author's calculation.

The results in Table 4 for a sample without a currency clause show that, in the first sub-sample – a period characterized by higher coupon rates from April 2006 to December 2015 – the mean returns are mostly negative. This suggests that the momentum strategy underperformed and, in effect, behaved more like a reversal strategy, where bonds with strong past performance tended to underperform in subsequent periods. In contrast, the second sub-sample, from January 2016 to December 2022, reflects a period of lower coupon rates and declining interest rates. Here, the momentum strategy yields consistently positive and statistically significant mean returns, especially with longer look-back and holding periods.

When comparing the results for the full sample of bonds without a currency clause – where momentum is significant for the (6,6), and reversal is significant for the (3,3) strategy – the sub-sample analysis provides a clearer picture of momentum dynamics. While the full sample shows mixed results, the sub-sample analysis reveals a distinct pattern: during periods of high interest rates, the reversal strategy is significant, whereas during periods of low interest rates, the momentum strategy dominates. Overall, these findings indicate that the success of a momentum strategy in the bond market is highly sensitive to the interest rate environment for bonds without a currency clause. The strategy performs better in periods of declining rates, but it may act as a reversal strategy during periods of higher and more volatile rates.

T a b l e 5

Long-Short Cross-Sectional Momentum Premium for Government Bonds with Currency Clause – Sub-Samples

	Sub-sample: April 2006 to December 2015				**Sub-sample: January 2016 to December 2022**			
	(3,3)	**(6,6)**	**(9,9)**	**(12,12)**	**(3,3)**	**(6,6)**	**(9,9)**	**(12,12)**
Mean return (annualised)	0.05180	0.05164	0.47052	0.58721	0.30203	0.31775	1.06051	1.47346
Standard deviation of mean return (annualised)	0.19554	0.32874	0.37737	0.42153	0.25242	0.52144	0.59737	0.65270
t-test	2.21**	1.01	7.57***	7.93***	6.26***	3.09***	8.58***	10.52***
Newey-West (t-test)	2.17**	0.73	4.24***	4.46***	3.60***	2.18**	4.20***	4.40***
N	111	93	91	88	74	84	84	84

Note: ***Significant at the 1% significance level; ** Significant at the 5% significance level; * Significant at the 10% significance level

Source: Author's calculation.

For the sample of bonds with a currency clause, positive momentum premiums are present in both sub-samples. During the first sub-sample (April 2006 to December 2015), the annualized mean returns of the strategy increase with longer holding periods. The t-tests show statistically significant results at the 1% level

for the shortest (3,3) and the longest (9,9 and 12,12) periods, indicating strong statistical significance for specific horizons. In the second sub-sample (January 2016 to December 2022), momentum premiums are higher compared to the first sub-sample, which coincided with a period of higher interest rates. All premiums in this sub-sample are statistically significant.

When comparing these results with those for the entire period, the findings are consistent. Table 3 also reported statistically significant momentum premiums for the full sample. It can be concluded that for bonds with a currency clause, particularly euro-denominated bonds, the impact of interest rates does not fundamentally alter the results of the strategy. However, it is evident that in the sub-sample with high interest rates, momentum premiums are much larger compared to the sub-sample with low interest rates.

The presented results for the sample of bonds without and with a currency clause for a holding period of 12 months are not consistent with the conclusions of Hotting et al. (2001) and Gebhardt et al. (2005) who found the existence of the reversal effect. Kang and King (2004) also confirm the existence of the reversal effect for a holding period of up to 12 months, where the impact is stronger up to 6 months, and with the increase of the holding period, the significance of the reversal effect decreases. It should be pointed out that the Kang and King (2004) research was conducted on a sample of corporate bonds. Pospisil and Zhang (2010) made a step forward in regards to the aforementioned research because they tested momentum for investment-grade bonds and high-yield bonds. They concluded that the reversal effect is present for investment-grade corporate bonds, while for the high-yield corporate bonds, they proved the existence of momentum for a holding period of 1 to 12 months, which is in line with the results obtained for the sample of Croatian bonds with a currency clause. Jostov et al. (2013) confirm the existence of the momentum factor for holding periods of 1 and 6 months, for non-investment-grade corporate bonds, as well as for investment-grade corporate bonds.

Previous studies are not entirely suitable for comparison with the results obtained in this study, considering that the momentum factor in those studies was tested on corporate bonds, while in this study it was tested on government bonds. Therefore, it is more convenient to compare the results with Asness et al. (2013) who analyzed the government bond trading data for 10 different countries. They showed that based on past twelve-month bond returns, it is possible to achieve positive returns in the future, which indicates the existence of the momentum factor. The same was concluded by Geczy and Samonov (2017), who determined that the momentum factor is statistically significant for U.S. government bonds. Also, Van Luu and Yu (2012) showed for several financial markets (Australia,

Canada, Germany, Japan, United Kingdom, and the U.S.) that the momentum premium for government bonds is statistically significant. The findings for the Croatian bond market in this paper support the results of above mentioned similar studies conducted for developed markets.

Maeso et al. (2019) showed that the momentum of the time series for U.S. government bonds is statistically significant for all holding periods, i.e. for 3, 6, 9 and 12 months. From this it follows that our results obtained for the sample of bonds with a currency clause on the Croatian bond market follow the results of Maeso et al. (2019). It can also be observed that the value of the t-test for the U.S. sample in the work of Maeso et al. (2019) as well as for the sample of bonds with a currency clause increases with the increase of the holding period. For the sample of bonds without a currency clause, the results can be linked for 6 and 12 months strategies, where the momentum for the specified sample was also statistically significant.

The empirical results for the Croatian government bond market showed that momentum strategies are profitable since positive risk premiums are statistically significant, which is especially highlighted for the sample of bonds with a currency clause. These results strongly suggest that bonds which performed well in the past are also going to perform well in the future for a time horizon of up to 12 months.

Also, vice versa, bonds which performed badly in the past are going to have relatively low performance in the future. When comparing results obtained for two samples, without and with currency clause, it can be seen that statistically significant momentum premiums for a holding period of 6 months are quite similar. A significant difference is visible for the holding period of 12 months since the momentum premium is on average four times higher for the sample of government bonds with currency clause. The sub-sample analysis further illustrates the sensitivity of momentum strategies to interest rate environments. For bonds without a currency clause, the first sub-sample (2006 – 2015), characterized by higher coupon rates, showed that the strategy often behaved as a reversal strategy. In contrast, during the second sub-sample (2016 – 2022), marked by declining interest rates, momentum strategies yielded consistently positive and statistically significant premiums, particularly for longer holding periods. For bonds with a currency clause, the momentum premiums were positive and statistically significant across both sub-samples, with stronger premiums observed during the second sub-sample, indicating the robustness of the strategy regardless of the interest rate environment.

Conclusion

Momentum is a systematic risk factor well-known in the finance literature. Momentum strategy implies taking a long position (buying) the asset that performed well in the past and taking a short position (selling) the asset that performed badly in past. The significance of the momentum factor helps investors to identify the trend of the movement of a particular asset and to accordingly take an appropriate investment strategy. Many papers are testing the significance of factor momentum on stock markets. Testing the significance of momentum strategy on other asset classes is also frequently represented. Thus, in the last ten years momentum strategies on the developed bond market were examined, primarily for corporate bonds, but also for government bonds, however with less intensity.

To our knowledge, no research tested the significance of momentum on less developed bond markets. We collected data on Croatian government bonds for a time span of more than 16 years in order to test momentum. For the full sample of Croatian government bonds without a currency clause, momentum was identified for the holding periods of 6 and 12 months, while for the full sample with a currency clause for all observed holding periods (3, 6, 9 and 12 months) the momentum risk premium was statistically significant. Sub-sample analysis revealed that for bonds without a currency clause, momentum effects were predominantly observed during the second sub-sample period (2016 – 2022), characterized by declining interest rates. In contrast, for bonds with a currency clause, momentum premiums were statistically significant across both sub-samples, with stronger premiums observed during the second sub-sample. These results are valuable in the context of the identification of systematic risk factors in the Croatian bond market. Obtained results should encourage other researchers to test momentum on other less developed bond markets, and consequently include other cross-sectional factors.

Limitations of this research primarily stem from characteristics of a less developed and less liquid bond market. In the observed period an average of six government bonds were present in both samples, which is significantly lower in comparison to any other developed financial market. Also, to extend results for other momentum strategies like time series momentum and to get a broader understanding of momentum in the bond market, continuous and credible observations of the risk-free rate are crucial. Further research will observe the Croatian bond market as a whole since Croatia adopted the euro as its official currency in January 2023. Thus, all Croatian bond issuances become euro-denominated. This also opens the possibility of testing momentum for government bonds for several regional markets together.

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