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Abstract

Using bond-level data for a sample ranging from 1987 to 2016 we document that the momentum effect is significant in the Canadian market for corporate bonds. The strategy yields momentum gains that are comparable to those observed for US corporate bonds. Conditioning on the market state (UP/ DOWN) doubles the returns on the momentum portfolio for holding periods ranging from one month up to two years. Further, momentum gains are exclusive to the UP market state. The conditional analysis further reveals that the state of the market brings about sizeable momentum returns also for investment grade bonds, especially in the most recent years of the sample.

Keywords: market states; investment grade; momentum; institution investors; Canadian corporate bonds.

JEL: G11, G12, G15

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Introduction

A recent report by the board of the International Organization of Securities Commissions (IOSCO) reckons that the number of issuances of Canadian corporate bonds has been steadily growing over the recent decade.[1] In 2016, the value of new corporate issuances in the US and Canada were $1.73 trillion and about $340 billion US dollars, respectively, which makes the value of the Canadian issuances about a fifth of that of the US. As of the end of the same year, the value of Canadian corporate bond outstanding amounted to about $1.13 trillion US dollars, whereas the equivalent figure for the US was around $8.1 trillion.[2]

While the Canadian corporate bond market is dwarfed by that of the US, a slightly different picture emerges when debt levels are compared to the respective levels of Gross Domestic Product (GDP). Debt outstanding for the Canadian corporate bond market was a solid 14% of that of its Southern neighbor, at the end of 2016. In contrast, over the same year, the Canadian GDP was about 8% of that of the US. Put differently, the size of the market for Canadian corporate bonds is larger than that of the US, in relative terms.

The literature on Canadian corporate bonds is rather sparse, despite the substantial size of the market. This study contributes to fill this gap by discussing the profitability of the asset pricing anomaly momentum in the Canadian setting, using bond-level data. The examined time period, spanning from August 1987 to December 2016, is only slightly short of three decades, and it is exceptionally long for the standards of the literature on Canadian financial markets. The sample includes 2,424 bullet bonds issued by 389 firms which are spread over ten industries.

[1] Figures on issuances are from the February 2017 IOSCO report which is available at the following website: http://www.iosco.org/library/pubdocs/pdf/IOSCOPD558.pdf, last accessed on April 18, 2017.

[2] To provide further terms of comparison, the corporate debt stock for the UK hovered around $1.6 trillion US dollars, at the end of 2016. Data on country-level debt outstanding are from Bloomberg L.P.

While being interesting in its own right, this study's analysis of the momentum effect for Canadian corporate bonds can also be viewed as an out-of-sample validation of the results obtained for the US corporate bond market (e.g., Jostova et al. (2013), Lin et al. (2017)). Comparing countries in which investors operate in similar environments assuages concerns of conclusions being driven by unobservable market or institutional norms. From this perspective, choosing Canada for an out-of-sample analysis of the momentum effect for US corporate bonds is favored by the many similarities between the two markets, which have been most recently highlighted in Patel and Yang (2015).[3]

The expectation of a significant momentum effect in the market for Canadian corporate bonds is created by the conclusions in Asness et al. (2013) who document the pervasiveness of momentum gains across several countries as well as asset classes. While their empirical analysis does not cover the Canadian corporate bond market, the authors find some momentum gains for indexes of Canadian equities and government bonds. Along the same lines of inquiry, Schmidt et al. (2015) and Cleary and Inglis (1998), provide empirical evidence showing that Canadian stocks yield significant momentum gains. To the extent to which investors participating in the Canadian financial market are subject to similar market forces and investor biases, evidence of significant momentum gains for Canadian equities and government bonds suggests that the momentum effect should be relevant also for the pricing of Canadian fixed income securities.

The first round of results presented in this study documents that the momentum strategy for Canadian corporate bonds yields significant gains. These profits are markedly persistent, as we find significant and positive momentum returns for holding period horizons ranging

[3]The institutional linkages between the Canadian and US financial markets are further reinforced by the considerable proportion of large companies listed on the Canadian stock market that are owned by US institutional investors (Tinic et al. (1987) and Mittoo (2003)).

from one month to two years. The comparison with the momentum gains documented in Jostova et al. (2013) for US corporate bonds suggests that the momentum effect is slightly weaker for Canadian bonds. The difference is however not extreme, as the spread is less than 20% of the annualized momentum returns for US bonds.[4]

Gebhardt et al. (2005) find that the momentum effect is not significant using a sample of investment-grade US corporate bonds, a result that is confirmed in Jostova et al. (2013). Our empirical analysis shows that there are no significant returns stemming from unconditional momentum strategies of investment-grade bonds also in the Canadian market. In particular, we find no momentum gains for holding periods ranging from one month up to two years.

Jostova et al. (2013) argue that there are significant momentum gains to be had in the US corporate bond market, which are however concentrated on speculative-grade bonds. Given the similarities between the Canadian and US corporate bond markets, these findings yield the expectation that the profitability of the momentum strategy for Canadian bonds should stem from the return continuation of low-grade securities. Unfortunately, the sparseness of Canadian speculative bonds prevents a direct examination of the profitability of the momentum strategy, for high-yield bonds. Indeed, for most of the months in our 1987-2016 sample, there are simply not enough low-grade Canadian bonds in the cross-section to form the decile (or even quintile) portfolios that define the momentum strategy. The marked paucity of Canadian speculative bonds is also documented in Patel and Yang (2015).

An examination of the composition of the short and long legs of the momentum portfolio suggests that the top and bottom deciles are characterized by high return dispersions as well as by large shares of speculative bonds, relative to the remaining deciles. While this finding

[4]For the six-month holding period, Jostova et al. (2013) documents an annualized return of 4.44%, over a sample ranging from 1973 to 2011, whereas, we find that the corresponding rate for Canadian bonds is 3.67% over the period from 1987 to 2016.

is suggestive, the numerosity of the speculative-grade sample is too low to allow drawing any firm conclusion on the link between credit risk and momentum profits.

The momentum effect has been shown to be state-dependent in the US equity market, with momentum gains stemming exclusively from portfolios formed in months following periods of aggregate market gains (Cooper et al. (2004)). In this study, we examine whether conditioning on the market state yields predictive power for the profitability of the momentum strategy also in the Canadian corporate bond market. Following Cooper et al. (2004), we define two states, namely the "UP" and "DOWN" market states, on the basis of the performance of the aggregate market index, here an equally weighted portfolio of the corporate bonds included in the sample. Momentum returns are classified as stemming from UP or DOWN markets on the basis of the market state in the portfolio formation month.

Our empirical results show that the market state effect is very significant in the Canadian corporate bond market. Significant momentum gains are obtained exclusively in UP markets. Further, subsequent testing shows that the difference between the performance of the momentum strategy in the UP and DOWN market states is statistically significant. The state effect is observed for holding period horizons ranging from one month up to two years. Conditioning on the market state has non-trivial implications for the profitability of the momentum effect, as forming the portfolio in UP market months yields gains that are twice as large as those entailed by the unconditional momentum strategy. To illustrate, the six-month formation period momentum strategy generates a significant monthly return of 0.63% for UP markets but an unconditional 0.30%, over the six-month holding period horizon.

A comparison of the conditional momentum returns documented in Cooper et al. (2004) for US equities and their analog for Canadian corporate bonds reveals strong similarities

between the market state effect for the two asset classes. Momentum gains can be obtained only in UP markets. The empirical evidence also shows that the UP-market momentum gains are about a third weaker for Canadian bonds than for US equities.[5] Further, momentum portfolios formed in DOWN market state yield insignificant returns over the short run. However, different from that observed for equities, momentum portfolios of Canadian corporate bonds formed in DOWN markets fail to yield significant reversal gains for longer holding periods.

As done in Cooper et al. (2004) for the equity market, we regard our evidence of a market state effect on momentum as being consistent both with an extended version of the behavioral theory developed by Daniel et al. (1998) and of the limited rationality argument proposed in Hong and Stein (1999). The market state influences investors' overconfidence (e.g., Gervais and Odean (2001)), which originates the momentum effect in Daniel et al. (1998). Hong and Stein (1999) argue that a decrease in risk aversion of momentum traders entails stronger momentum gains. The effect of the market state on agents' risk aversion can be linked to wealth fluctuations in the habit formation framework by Campbell and Cochrane (1999).

In the market for Canadian corporate bonds, momentum profits appear to reach their highest values in the early part of the sample. These gains appear to decrease to lower levels starting from the early nineties. This shift coincides with a period during which the Canadian financial market underwent institutional changes which profoundly altered the market environment. We explore the possibility that the momentum effect may be radically different before and after this wave of institutional changes by examining the profitability of the strategy in a subsample starting in 1994. For the time being, it suffices to note that the

[5] A potential explanation of this cross-market difference may reside in the definition of the market states employed. Using equity market data, we show in an appendix that the definition of the market states in this study makes harder to detect state dependence than the one used in Cooper et al. (2004).

conclusions drawn on the basis of the full sample are confirmed from the subsample analysis.

The Canadian market for corporate bonds is dominated by institutional investors, in terms of trading volume. A natural question that then arises is whether the trading activities of institutional investors are associated with the significant momentum effect documented in this article. Unfortunately, the type of data that would allow separating the trades of institutional and retail investors is not available for Canadian corporate bonds, as yet.[6]

Using transaction-based quotes for US corporate bonds, Ronen and Zhou (2013) have shown that the trading activities of institutional investors tend to focus on a handful of bonds per issuer, these being termed the top bonds. Building on their insights, this study proposes a way around data unavailability by identifying top bonds with on-the-run issues.[7] The empirical analysis shows that the momentum effect is insignificant for portfolios of on-the-run issues, both unconditionally and conditionally on the state of the market. This finding is consistent with institutional investors being largely unaffected by the behaviors that have been invoked in the theoretical literature to explain the momentum effect. However, while our analysis gives a first stab to the challenge of identifying the momentum traders in the market for Canadian bonds, we feel that more research is warranted before firm conclusions can be drawn.

The rest of the paper is organized as follows. The next section describes the sample and offers basic summary statistics for the Canadian corporate bonds used in this study. Section 2 describes the momentum strategies employed to gauge the momentum effect. The

[6] As of November 2015, all fixed income trades in Canada have to be reported to the Investment Industry Regulatory Organization of Canada. Starting from July 2016, a subset of corporate bond transaction data has been made available to researchers. However, this promising data source cannot be employed to analyze the momentum strategy, as the time span covered is too limited.

[7] In another study of the Canadian corporate bond market, Cao et al. (2017) showed that on-the-run issues magnify the predictive power of bond yield changes for future stock returns, at the issuer level. This result is consistent with the prices of top bonds as being informationally richer than those of the remaining bonds in the cross-section.

unconditional assessment of the profitability of the momentum effect in the Canadian corporate bond market is in Section 3. The effect of the market state on momentum returns is documented in Section 4. The analysis of the 1994-2016 subsample can be found in Section 5. The evaluation of the momentum effect for on-the-run bonds is in Section 6. A short summary of the findings and one appendix conclude.

1 Data

Our sample covers monthly bond-level data over a period slightly shorter than three decades, ranging from August 1987 to December 2016, for 20,988 corporate bonds issued in Canada. The sample includes information on individual bonds monthly closing prices and yields. For each bond, we obtain the coupon, coupon frequency, the first coupon payment date, volume at issue, date of issue, and maturity date, as well as the issuer's industry code. Data are sourced from Bloomberg. Credit ratings are from DBRS (Dominion Bond Rating Service), the reference rating agency for long samples of Canadian securities.[8] We refer to issuer-level credit ratings when assigning rates to bond-month observations.[9]

We exclude from the sample all bonds denominated in currencies other than the Canadian dollar, and also bonds that have contingency provisions.[10] We obtain a subset of 4,249 bullet bonds, i.e. bonds with no contigency provisions attached, issued in Canadian dollars. We further exclude all bonds that have less than six observations. We also discard bonds for

[8] Whenever the DBRS ratings are not available we use the rating of Standard & Poor's. The two agencies use the same rating scale. For bonds requiring ratings earlier than 2000, we refer to Canadian Bond Rating Service (CBRS), which became a subsidiary of S&P in 2000.

[9] When the credit rating of an issuer is not available, then we employ its rating for senior unsecured debt. For bond issuers that have only one bond, which is neither senior nor unsecured, we use bond-level ratings, whenever possible.

[10] In particular, we exclude from the sample callable, putable, convertible, sinkable bonds, and bonds with floating coupon rate.

which relevant information (e.g., issue date) is unavailable or incomplete. For each bond, prices falling within six months of the bond maturity date are discarded from the sample, as these prices are typically particularly unreliable. To alleviate data quality concerns, especially for the early years of the sample, we winsorize returns at the 1% level. This procedure allows discarding outliers that are most likely to be associated with incorrect data entries. The conclusions of this study remain unaltered when we use unwinsorized data.

In the raw data, the total number of monthly prices after filtering is 120,945, for 2,428 bonds. Of the total number of observations, 108,299, i.e., slightly less than 90%, belong to bonds paying coupons semiannually, while 10,145, i.e., about 8.4%, are for bonds yielding annual coupons. The remaining observations are associated with quarterly or monthly coupon frequencies, or with zero-coupon bonds. We calculate monthly returns for each bond in the refined sample based on their monthly closing (last) prices. To calculate returns we define:

$$r_{i,t+1} = \frac{(P_{i,t+1} + AI_{i,t+1} + C_{i,t+1}) - (P_{i,t} + AI_{i,t})}{P_{i,t} + AI_{i,t}} \tag{1}$$

where, $r_{i,t+1}$ is the return on bond i for the one-month holding period from t to $t+1$, and $P_{i,t+1}$ is the last price of bond i at time $t+1$. The variable $C_{i,t+1}$ is the amount of coupon paid between time t and $t+1$, if any, and it is calculated as the ratio of annual coupon rate of bond i to the coupon frequency. The accrued interest $AI_{i,t+1}$ is defined as follows:

$$AI_{i,t+1} = C_{i,t+1}\left(\frac{d_{t+1}}{D_{t+1}}\right)$$

where d_{t+1} is the number of days between time $t+1$ and the last coupon payment date, and D_{t+1} is the number of days between two consecutive coupon payments enclosing time $t+1$. When dealing with the calculation of accrued interests, we take into account that calendar

months contain different numbers of days. After filtering, our sample contains 113,155 return observations for 2,424 bonds issued by 389 firms from 10 industries. Table 1 tabulates basic descriptive statistics for our sample.

Table 1: Descriptive Statistics

Panel A: Descriptive Statistics for the 1987-2016 Sample

	Count	Yield (%)	Return (%)	St. Dev.	Median (%)	Volume (M)	Coupon (%)
Pooled	113,155	4.593	0.50	0.013	0.36	297	6.064
			Subsamples by credit rating bands				
NIG	1,002	7.704	0.71	0.013	0.66	174	6.954
IG	101,193	4.549	0.52	0.013	0.37	300	6.079

Panel B: Descriptive Statistics for Bonds at Issue

Count	Yield (%)	Return (%)	St. Dev.	Median (%)	Volume (M)	Coupon (%)	Time to Maturity (months)
Pooled							
1,066	5.267	0.66	0.014	0.58	410	5.222	102
Maturity at issue less than 5 years							
164	3.931	0.46	0.008	0.42	409	3.941	38
5 to 10 years							
593	5.178	0.73	0.012	0.63	467	5.038	67
Over 10 years							
309	6.126	0.61	0.019	0.57	301	6.254	206

Panel A presents basic summary statistics for the Canadian corporate bonds in our sample, for the pooled sample and for the Non-Investment Grade (NIG) and Investment Grade (IG) categories. The covered time period is August 1987 to December 2016. The first column reports the count of bond-month observations in the sample, followed by the average yield and return, as well as the standard deviation and median of the monthly returns. The last two columns list the mean volume at issue (in millions of Canadian dollars) and the average coupon. Panel B reports the summary statistics (including time-to-maturity) for the subset of bonds for which the return at-issue is available. These bonds are also categorized into maturity bands. Data from Bloomberg L.P.

Panel A in Table 1 reports basic summary statistics for the whole sample, as well as for investment-grade and speculative bonds, separately. In the pooled sample, the coupon level

is about 6%, while the average yield is about 4.6%. Meanwhile, the average volume at issue, per bond, is 297 million Canadian dollars. The average monthly return is 50 bps, which amounts to about 6%, in terms of annualized return. The median monthly return is slightly lower, by 14 bps, which suggests the presence of a heavy right tail of the distribution. After sorting all bonds in our sample by their issue year, we calculate that about C$ 20 billions of new corporate bonds are issued per year (untabulated) from 1971 to 2016.

The second and third rows of results in Panel A reports summary statistics for bond-month observations sorted into the investment and non-investment grade categories.[11] The vast majority of the monthly returns in our sample belong to bonds issued by firms rated at, or above, the BBB low threshold. Of the 102,195 observations for which credit rating is available, only 1,002 are associated with the pricing of high-yield bonds. Hence, there are roughly 100 bond-month returns in the investment-grade category for each bond-month observation in the low-grade group. Untabulated statistics show that an overwhelming majority of the returns on high-grade bonds (i.e., 49,279 observations) falls into the "A"-rating category, whereas the low-grade category of BB accounts for 68% of the non-investment-grade bond returns. The sparseness of high-yield bonds in our sample is consistent with the observations of Patel and Yang (2015).

To shed further light on the structure of the Canadian market for corporate bonds, we calculate basic summary statistics for the sub-sample of bonds for which we can obtain a return-at-issue.[12] The yields and returns of the bonds in this sub-sample offer an approximation of the at-issue cost of borrowing for Canadian firms tapping the domestic corporate bond market.[13] The at-issue sub-sample includes 1,066 returns and yields for 254 firms. This

[11] For 10,960 of the 113,155 observations in our sample (i.e., about 10%), credit ratings are not available.

[12] In the literature on municipal bond offerings, many studies employ yields at issue (e.g., Butler (2008)).

[13] To calculate the return-at-issue, we use the first two available end-of-the-month prices, within the first two months following the date of issue.

sub-sample of bonds are sorted into maturity bands to gather stylized facts on the effect of maturity length on bond borrowing costs. Detailed summary statistics for at-issue bonds are reported in Panel B of Table 1. The statistics in Panel B indicate that Canadian corporate bonds are issued with an average maturity of about nine years, with more than half of the issues maturing in 5 to 10 years. Coupons and yields appear to be increasing with maturity length.

2 The Momentum Strategies

We form the momentum portfolio of bonds as already done in Gebhardt et al. (2005) and Jostova et al. (2013) who in turn rely on the six-month formation period momentum strategy introduced by Jegadeesh and Titman (1993). Presently, the momentum portfolio formed in month t is obtained after sorting bonds into deciles on the basis of their historical cumulative returns over the formation period, which consists of six months.[14] An equally weighted portfolio of the bonds in the top (bottom) decile identifies the long (short) leg of the momentum anomaly. For all strategies, we skip a month between the formation and holding periods. This month is henceforth called the formation month. We consider holding period horizons spanning from one month up to two years.

To foster consistency with previous studies on the conditional and unconditional momentum effect, we consider two types of returns, these being holding period monthly returns and cumulative returns. Following Jegadeesh and Titman (1993), for each holding period n, the holding period monthly return is the cross-sectional average at time t of the returns on n overlapping momentum portfolios. Each of this overlapping strategies is formed in one of

[14] All the results presented in this paper are robust when we consider momentum portfolios that are symmetric in the length of the formation and holding periods, ranging from one to 24 months. The results are available upon request.

the n months preceding time t. The series of the n-month holding period monthly returns is denoted by $\mathrm{R}_{n,t}$.

Later on in this study, we shall perform a conditional analysis of the return on the momentum strategy using cumulative rather than monthly holding period returns. The time-t cumulative return of a portfolio formed at time $t-n$, which is denoted by $\mathrm{CR}_{n,t}$, is the sum of the n monthly returns stemming from the portfolio in the months ranging from $t-n+1$ to t.

Holding period monthly returns are cross-sectional averages of overlapping momentum portfolios which are formed in different months. Because the formation months are staggered, it is unclear the degree to which the returns on the overlapping portfolios are influenced by any given realization of a conditioning variable. In contrast, cumulative returns are calculated for momentum portfolios that are formed in a given month, and thus they can be linked to a unique realization of the conditioning variable under consideration. This key difference between cumulative and monthly holding period returns make the latter less suitable than the former to perform a conditional analysis of the predictive type. Consistently, this study's conditional analysis of the performance of the momentum strategy focuses on cumulative returns. In doing so, we are following the approach proposed in Cooper et al. (2004) to analyze the predictive ability of the market state for future momentum gains, in the US equity market.[15]

The impact of rebalancing on portfolio performance may be particularly relevant in the corporate bond market, due to high transaction costs.[16] The buy-and-hold portfolios gener-

[15]Recent literature has examined the conditional profitability of the momentum strategy for the one-month holding period (e.g., Lin et al. (2017)), an approach that does not require the use of overlapping portfolios. However, using cumulative returns allows evaluating conditional profitability for holding period horizons longer than one month.

[16]To the authors' knowledge there is no scholarly evidence on the role of transaction costs in the Canadian bond market. For the US market, Edwards et al. (2007) note that transaction costs for corporate bonds are

ating cumulative returns are thus potentially more cost-efficient than the monthly rebalanced portfolios yielding the holding period monthly returns. From this perspective, an additional advantage of considering cumulative rather than holding period monthly returns is that the estimated profits are less susceptible to be wiped away by transaction costs.

3 Profitability of the Momentum Strategy

Panel A.1 of Table 2 reports the (unconditional) monthly holding period returns for the momentum strategy with six-month formation period. The results indicate that the momentum strategy yields significant gains for holding period horizons ranging from one month up to two years. These returns are comparable to those documented for the US in Jostova et al. (2013), in which the authors document a significant momentum profit, of 37 bps per month, for the six-month holding period return. The analog portfolio for Canadian bonds yields the very similar rate of return of 30.6 bps. This return rate appears to be almost constant, at about 30 bps, for all the considered holding periods. Considering cumulative returns, in Panel B.1, rather than monthly holding period rates, does not modify the assessment of the profitability of the momentum effect for Canadian corporate bonds. For instance, the cumulative return of the strategy at the two-year mark is 6.65%, which corresponds to a monthly return of 28 bps.

The analysis of the (unconditional) profitability of the momentum strategy summarized in Panel A.2 of Table 2 reveals that there are no momentum gains for high-grade corporate bonds. Panel B.2 of the same table confirms that the use of cumulative returns does not alter this conclusion. Evidence of no momentum gains for high-grade bonds is consistent with the conclusions of Gebhardt et al. (2005) and Jostova et al. (2013) for the US corporate

substantially higher than those of equities.

bond market. Getting ahead of ourselves, however, we note that the conditional analysis will reveal that these insignificant cumulative returns are partially the result of the aggregation of significantly different levels of momentum profitability across the market states.

Table 2: Unconditional Returns on the 6-month Formation Period Momentum Strategy

		Panel A: Holding period monthly returns $R_{n,t}$				**Panel B: Holding period cumulative returns $CR_{n,t}$**			
Holding Period	N	Loser (P1)	Winner (P10)	Winner-Loser	Months	Loser (P1)	Winner (P10)	Winner-Loser	Months
			A.1. Pooled Sample			B.1. Pooled Sample			
1	251	0.534	0.934	0.318	341	0.63	0.969	0.34	341
		(9.681)	**(10.723)**	**(4.300)**		**(8.098)**	**(8.605)**	**(3.906)**	
3	236	0.568	0.951	0.320	341	1.889	2.799	0.910	339
		(10.573)	**(10.762)**	**(4.731)**		**(10.630)**	**(12.234)**	**(5.014)**	
6	215	0.549	0.956	0.306	341	3.785	5.588	1.803	336
		(10.274)	**(10.593)**	**(4.996)**		**(9.986)**	**(10.050)**	**(4.295)**	
12	181	0.589	0.989	0.300	341	7.630	11.082	3.452	330
		(10.180)	**(10.945)**	**(5.653)**		**(9.754)**	**(8.044)**	**(3.430)**	
18	151	0.578	1.043	0.290	341	11.686	16.800	5.114	324
		(10.026)	**(11.340)**	**(6.006)**		**(9.352)**	**(6.690)**	**(2.858)**	
24	125	0.594	1.058	0.293	341	15.714	22.359	6.646	318
		(9.984)	**(11.573)**	**(6.711)**		**(8.982)**	**(5.675)**	**(2.347)**	
			A.2. Investment-grade Subsample			B.2. Investment-grade Subsample			
1	227	0.551	0.727	0.104	334	0.652	0.724	0.073	334
		(9.600)	**(8.323)**	(1.440)		**(7.953)**	**(7.947)**	(0.922)	
3	213	0.574	0.711	0.053	334	1.941	2.117	0.176	332
		(10.175)	**(8.244)**	(0.825)		**(10.420)**	**(10.106)**	(1.066)	
6	194	0.552	0.706	0.043	334	3.812	4.175	0.363	329
		(10.098)	**(8.264)**	(0.769)		**(9.670)**	**(9.572)**	(1.142)	
12	162	0.569	0.720	0.065	334	7.569	8.273	0.705	323
		(10.097)	**(8.658)**	(1.506)		**(8.899)**	**(9.758)**	(1.471)	
18	136	0.577	0.707	0.042	332	12.030	12.599	0.569	315
		(9.474)	**(8.579)**	(1.131)		**(9.148)**	**(9.787)**	(0.772)	
24	112	0.600	0.713	0.033	332	16.099	16.536	0.438	309
		(9.427)	**(8.950)**	(1.119)		**(8.654)**	**(9.205)**	(0.421)	

Panel A and Panel B report the average monthly and cummulative returns on the momentum portfolios with holding periods of 1, 3, 6, 12, 18 and 24 months. Since the $CR_{n,t}$ series are the summation of overlapping returns, we employ a heteroskedasticity-and-autocorrelation consistent (HAC) estimator for the t-statistics reported in Panel B. The average number of bonds available in the monthly cross-section, denoted by N is reported in Column 2. The number of months for which momentum returns are calculated is reported in the last column of each panel. Sub-panels 1 and 2 report holding period monthly and cumulative returns for the pooled sample and for the investment grade subsample. The time period covered is from August 1987 to December 2016.

Jostova et al. (2013) show that the profitability of the winners-minus-losers strategy for US corporate bonds is concentrated in low-grade securities. The size of the market for Canadian speculative bonds is negligible compared to that of high-grade bonds. As reported in Table 1, only 1% of the bond-month observations in our sample are associated with low-grade bonds. Furthermore, about 92% of the bond issuers in our sample are rated above BBB low, across the entire sample period. The small scale of the high-yield bond market in Canada renders unfeasible the formation of momentum portfolios for speculative-grade bonds. Therefore whether there are significant momentum profits in Canadian high-yield bonds cannot be directly investigated with the available data.

The separate examination of the short and long legs of the 6-month formation and holding period momentum portfolio in Table 3 reveals that the past winner (decile 10) portfolio includes about 3.5 times as many speculative-grade bonds than the past loser side (decile 1 portfolio). The percentage of non-investment grade bonds is also multiple times larger in the top decile portfolio than in the remaining deciles. The winner and loser decile portfolios are also exceptional in terms of return dispersion. The cross-sectional standard deviation of formation period returns in the top and bottom deciles are at least one order of magnitude larger than that observed for other deciles. This evidence suggests that a high concentration of speculative bonds may matter in determining the strength of the momentum effect. However, we cannot form a firm conclusion on this matter with the currently available sample.

4 UP and DOWN Markets

Figure 1 plots the 48-month moving average of the returns on the six-month formation and holding period momentum strategy. The plot reveals that momentum returns have been

Table 3: Credit Rating Distribution Across Decile Portfolios for the 6-m Holding Period Strategy

	P1 (Loser)	P2	P3	P4	P5	P6	P7	P8	P9	P10 (Winner)
mean (bondN)	21.6	21.4	21.6	21.5	21.8	21.3	21.6	21.5	21.6	21.5
std (formation-rtn)	0.01	0.002	0.002	0.001	0.001	0.001	0.002	0.002	0.003	0.036
mean (%IG)	88.1	87.8	90.7	91.7	92.7	93.6	93.6	92.8	90.8	84.9
mean (%NIG)	0.4	0.2	0.1	0.2	0.2	0.2	0.2	0.3	0.6	1.4
mean (%non-rated)	11.5	12	9.2	8.1	7.1	6.2	6.2	6.9	8.6	13.7

The table reports, for each of the 6-month holding period decile portfolio, the average number of bonds included, the standard deviation of the cumulative returns in the formation period (six months), the sample mean of the cross-sectional averge share of investment grade bonds, during the portfolio formation month, as well as the corresponding shares of non-investment grade bonds and of bonds that are not rated.

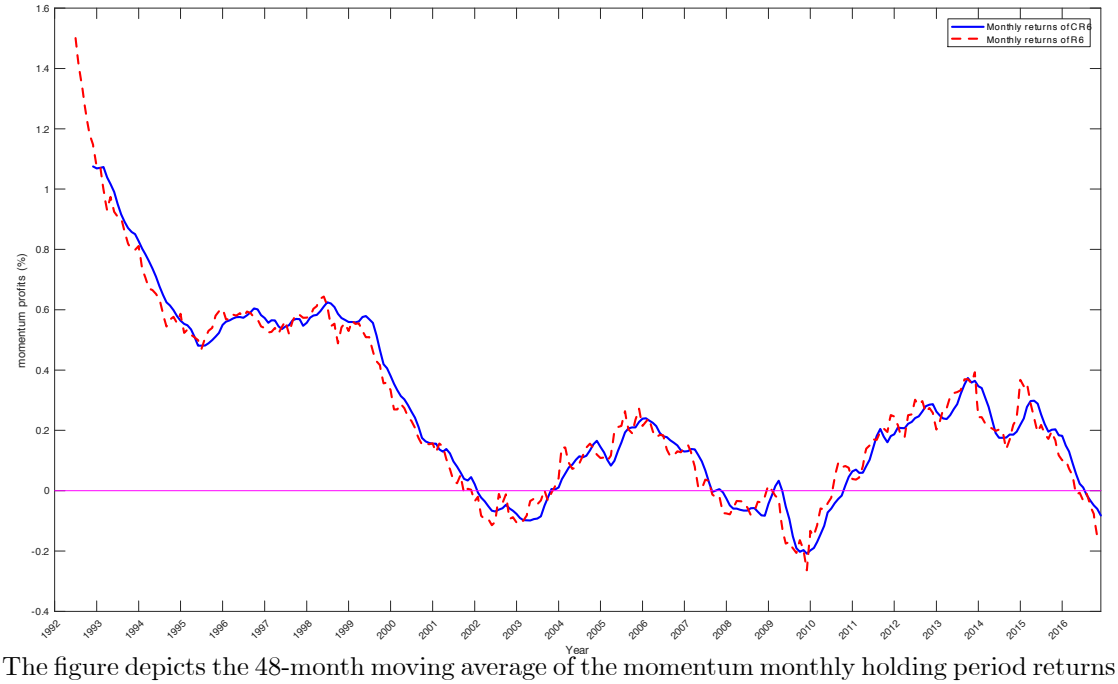
fluctuating over time. A time-varying profitability of the momentum strategy begets the question of whether there is an observable conditioning variable that is able to account for periods of high and low momentum profits. For instance, Cooper et al. (2004) relies on the market state and find that the momentum effect in the US stock market is exclusive to holding periods following positive aggregate stock market performances. The empirical analysis summarized in this section investigates whether a similar market state effect is detectable for Canadian corporate bonds.

To commence, a month t is in the UP (DOWN) market state if the overall market performance over the year preceding month t is above (below) the sample average of the return on the equally weighted (EW) market portfolio.[17] More precisely, at time t the market is in the UP (DOWN) state if the average of all the monthly bond returns available for the time-period from $t-12$ to $t-1$ is above (below) the sample average of the return on the EW index.[18] The market is in an UP state in 141 months of the 341 months in our

[17] In each month, the equally weighted market portfolio includes all the bonds in the cross-section of the final sample, i.e., the sample used to construct the momentum portfolios.

[18] The use of the median, rather than the average, of the monthly returns on the EW market index does not alter the conclusion of this paper. Further details and a discussion of the definition of the market states

Figure 1: 48-month Moving Average Momentum Profits Over Time



The figure depicts the 48-month moving average of the momentum monthly holding period returns ($R_{6,t}$) and cumulative returns ($CR_{6,t}$), where the latter series is converted into monthly returns. The sample ranges from August 1987 to December 2016.

sample.

To evaluate the predictive ability of the market state, we follow Cooper et al. (2004) and focus on the cumulative returns of the six-month formation period momentum portfolio. A momentum return is categorized as in the UP (DOWN) market state when the market state in the formation month is UP (DOWN). Hence the series of cumulative returns on portfolios with six-month formation and holding periods, namely $\mathrm{CR}_{6,t}$, is in the UP state at time t if at time $t-6$ the market is in the UP (DOWN) state.

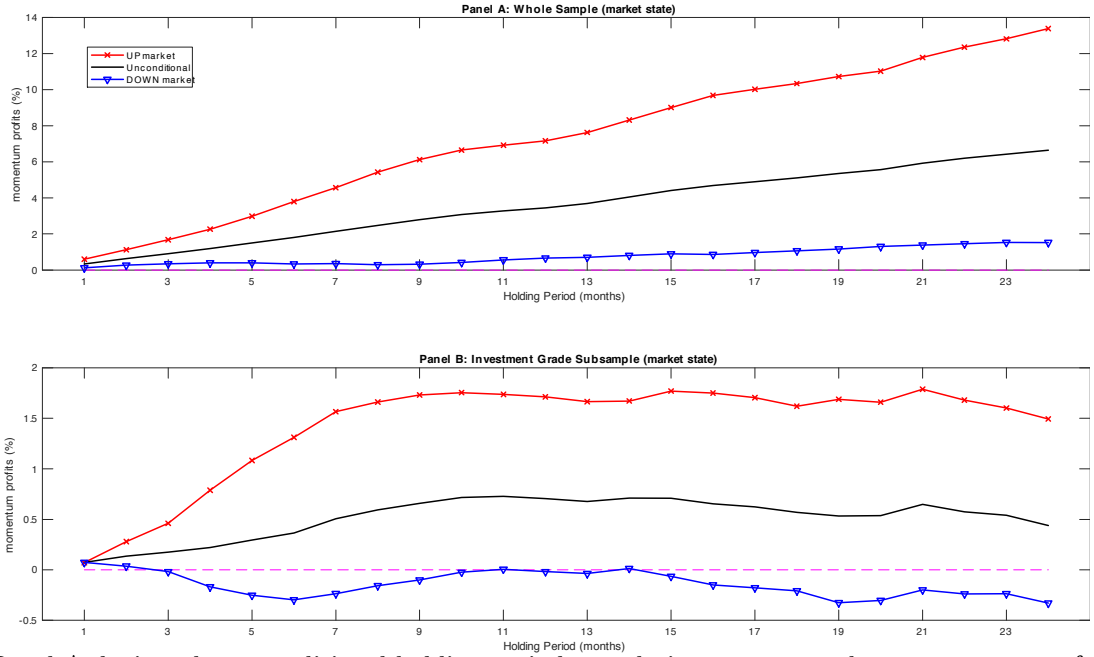
In Panel A of Figure 2 we plot the conditional and unconditional momentum cumulative returns for the six-month formation period strategy, where conditioning is on the market state in the portfolio formation month. The plot clearly suggests that the unconditional momentum gains documented in Panel B.1 of Table 2 are the result of the aggregation over market states of a very state-dependent return series. Indeed, the most striking feature of the conditional momentum return series, as plotted in Panel A of Figure 2, is their diverging paths. In particular, the figure shows that the spread between the momentum returns in UP versus DOWN markets increases over time, in an almost perfectly monotonic fashion.

The visual evidence is corroborated by the results of the statistical analysis, which is conducted following the approach proposed in Cooper et al. (2004) to foster consistency with the literature on the momentum effect. Presently, to ascertain whether momentum gains are zero in UP or DOWN market states, we evaluate a linear model of the cumulative returns on the six-month formation strategy $\mathrm{CR}_{n,t}$ as a function of the dichotomous variables identifying the market states. Formally, the equation is:

$$CR_{n,t} = \beta_{UP} D^{UP}_{t-n} + \beta_{DOWN} D^{D}_{t-n} + \varepsilon_t, \tag{2}$$

are presented in the appendix.

Figure 2: Conditional Cummulative Momentum Profits Over Time



Panel A depicts the unconditional holding period cumulative returns on the momentum portfolio for holding period horizons ranging from 1 month to 2 years, as well as the corresponding momentum returns stratified on the state of the market. Panel B represents the analogous time series for the investment grade subsample. The time period covered ranges from August 1987 to December 2016.

where $t-n$ is the formation month, the variable D_t^{UP} is one if at t the market is UP and zero otherwise, the variable D_t^D is one if at t the market is DOWN and zero otherwise, and ε_t are zero-mean disturbances. Further, to ascertain whether momentum gains are different conditionally on market state, we evaluate a second linear model in which the momentum series of $\mathrm{CR}_{n,t}$ is modeled as a function of a constant and of the UP market indicator for the formation month. Formally, the model is:

$$CR_{n,t} = \alpha + \gamma_{UP} D_{t-n}^{UP} + \nu_t \tag{3}$$

where once more $t-n$ is the formation month and ν_t are zero-mean error terms. Since the $\mathrm{CR}_{n,t}$ series are the summation of overlapping returns, we employ a heteroskedasticity-and-autocorrelation consistent (HAC) estimator for the variance of the coefficients in equations 2 and 3 (e.g., Gallant (1987), West and Newey (1987), and Cooper et al. (2004)). The number of lags is set equal to the number of overlapping months in the holding period (i.e., for the series $\mathrm{CR}_{n,t}$ then we consider $n-1$ lags). The regression approach preserves the time-series structure of the data and yields standard errors that are robust for autocorrelation.

The stratified averages and corresponding t-statistics of the cumulative returns on the momentum strategy, as well as for the long and short side of the momentum portfolio, are reported in Panel A of Table 4 for the full sample and in Panel B for the investment-grade subsample. The table also includes the assessment of the significance of the coefficient γ_{UP} from equation 3.

The estimates reported in Panel A of Table 4 indicate that there are significant momentum profits associated with the six-month formation momentum strategy, but only if the market state is UP. Insignificant returns are associated with DOWN markets. Further,

the coefficient γ_{UP} from equation 3 is significant, thus indicating that the returns of the momentum strategy are indeed statistically different across the two market states. These conclusions are strongly supported by the empirical analysis for holding periods ranging from one month to two-years.

The comparison of the conditional and unconditional stratified returns in Panel B.1 of Table 2 and Panel A of Table 4 shows that the stratified momentum profits in UP states are about twice as large as the corresponding unconditional average returns. Taken together, the empirical evidence presented in Table 4 indicate that momentum gains are concentrated in periods following buoyant market conditions, a conclusion that is consistent with the finding of Cooper et al. (2004).

The comparison of the conditional momentum returns documented in Cooper et al. (2004) for US equities and their analog for Canadian corporate bonds reveals strong similarities between the market state effect for the two asset classes. Momentum gains can be obtained only in UP markets. However, for US equities there are significant reversal profits, i.e., momentum losses, for holding periods longer than one year. It appears not to be the case for Canadian corporate bonds, as the positive and significant momentum gains in UP markets as documented in Panel A of Table 4 extend up to the two-year horizon.

The empirical evidence also shows that the UP-market momentum gains are weaker for Canadian bonds than for US equities.[19] While being smaller than those observed for equities, the conditional returns stemming from momentum portfolios of Canadian corporate bonds are economically relevant. In UP markets, the six-month formation period momentum strategy generates a significant monthly return of 63 bps, over a six-month holding period

[19] A potential explanation of this cross-market difference may reside in the definition of market state employed. Using equity market data, we show in an appendix that the definition of the market states in this study makes harder to detect state-dependence than the one used in Cooper et al. (2004).

horizon. To compare, for US equities the analog rate is 93 bps, as estimated in Cooper et al. (2004).

In the DOWN market state, Cooper et al. (2004) show that US equities yield significant reversal gains for holding period horizons longer than one year, as well as insignificant momentum losses over the short-run. We document that in the market for Canadian bonds, in DOWN markets, neither reversal nor momentum gains are detectable, for all the holding periods considered.

Panel B of Figure 2 represents the cumulative return on the six-month formation strategy for investment-grade bonds, conditional on the UP and DOWN market states. The plot also reports the unconditional cumulative returns on the same portfolio. At a glance it stands out that the spread between momentum returns in UP and DOWN markets is consistently large, starting from the six-month holding period horizon. Further, the figure shows that the momentum profits stem solely from the UP market state, and that, for most of the months, the strategy yields very small losses in the DOWN market state. The statistical analysis, in Panel B of Table 4, broadly confirms the conclusions suggested by the visual evidence. Overall, the conditional analysis reveals that there are significant momentum profits to be gained also for high-grade corporate bonds, albeit weak ones, in the UP market state. These gains appear to be concentrated around the one-year holding period horizon.

Evidence of a significant market state dependence of the momentum effect in the Canadian corporate bond market may be interpreted in view of the limited rationality argument proposed in Hong and Stein (1999) as well as the behavioral theory developed by Daniel et al. (1998). Buoyant markets are associated with reduced risk aversion of momentum traders, which causes increased spells of underreaction to information, resulting in stronger momentum gains. From this standpoint, the distinctive performances of the momentum strategy

across market states can be viewed as evidence that the marginal investor in the Canadian corporate bond market is a momentum trader, and that the risk aversion of momentum traders declines following enduring market gains. An alternative explanation for the market state effect is that upbeat markets increase investors' overconfidence, which in turns yields larger momentum gains. From this perspective, the results discussed in this section are consistent with investors overconfidence increases following good market runs.

Viewing from the perspective of the behavioral theory of Daniel et al. (1998), the results discussed in this section suggest that the market state is a good gauge of investors' overconfidence. The literature, however, has proposed alternative measures of overconfidence, where this behavioral bias is measured by aggregate overpricing. The sentiment measure proposed in Baker and Wurgler (2006), in particular, has been shown to be linked to the profitability of several anomalies, among which is the momentum strategy in equity markets (Stambaugh et al. (2012)). In an unreported analysis, we find that sentiment has no predictive power for future momentum returns in the Canadian corporate bond market.

In Panel A of Table A2 in the Appendix, we explore the market state effect for US corporate bonds using transaction data from the Trade Reporting and Compliance Engine (TRACE) database. As TRACE was launched in 2002 the sample is shorter than the one analyzed in this study of the Canadian market for corporate bonds. Nevertheless, significant similarities do emerge. The momentum effect is profitable exclusively in the UP state in both the US and Canadian corporate bond markets. These momentum gains are significantly different from the momentum returns associated with DOWN markets, which in turn are either negative (for the US sample) or insignificant (for Canadian bonds).

In Panel B of Table A2, we restrict our sample to the period defined by the availability of TRACE data. The results show that the profitability of the momentum strategy in UP

markets is lower in the short-run for Canadian corporate bonds than for the US corporate bonds. For instance, the six-month formation period momentum strategy yields a monthly return of 46 bps and 58 bps for Canadian and US bonds, respectively, for the holding period of six months. However, over the long-run, the momentum returns in UP markets tend to converge to about 30 bps for both markets. Previous evidence shows that both US equities and corporate bonds yield significant reversal gains in the long-run, but not momentum profits, in DOWN markets. In contrast, both the momentum and reversal effects appear to be absent when the market state is DOWN for Canadian bonds, both for the 1987-2016 and the TRACE-defined time period.

Table 4: Momentum Portfolio Returns Conditional on Market States

Holding Period / N (UP/DOWN)		LONG			SHORT			LONG-SHORT		
		UP	DOWN	UP-DOWN	UP	DOWN	UP-DOWN	UP	DOWN	UP-DOWN
					Panel A: Pooled Sample					
1	141	1.228	0.764	**(2.181)**	0.625	0.64	(-0.085)	0.603	0.124	**(2.960)**
	199	**(7.168)**	**(6.196)**		**(4.649)**	**(6.218)**		**(4.711)**	(1.266)	
3	141	3.506	2.281	**(2.755)**	1.830	1.933	(-0.293)	1.675	0.347	**(3.883)**
	197	**(9.446)**	**(8.613)**		**(6.861)**	**(8.233)**		**(6.416)**	(1.519)	
6	141	7.346	4.311	**(3.185)**	3.551	3.971	(-0.577)	3.795	0.340	**(5.181)**
	194	**(9.086)**	**(7.096)**		**(6.785)**	**(7.593)**		**(7.054)**	(0.763)	
12	141	14.099	8.850	**(2.775)**	6.940	8.181	(-0.933)	7.158	0.669	**(4.818)**
	188	**(8.214)**	**(6.233)**		**(8.022)**	**(7.159)**		**(5.293)**	(0.917)	
18	141	21.345	13.342	**(2.774)**	11.005	12.273	(-0.656)	10.340	1.068	**(4.564)**
	182	**(7.099)**	**(5.694)**		**(8.013)**	**(7.008)**		**(4.625)**	(0.838)	
24	137	28.404	17.853	**(2.254)**	15.014	16.329	(-0.537)	13.390	1.524	**(3.422)**
	180	**(5.493)**	**(5.413)**		**(7.473)**	**(7.189)**		**(3.717)**	(0.707)	
					Panel B: Investment Grade Subsample					
1	141	1.042	0.509	**(2.918)**	0.971	0.435	**(3.381)**	0.071	0.074	(-0.017)
	199	**(7.069)**	**(4.772)**		**(7.890)**	**(4.481)**		(0.538)	(0.801)	
3	141	3.478	1.184	**(6.154)**	3.018	1.203	**(5.119)**	0.460	-0.019	(1.488)
	197	**(12.299)**	**(4.769)**		**(10.498)**	**(5.713)**		**(1.782)**	(-0.092)	
6	141	6.630	2.467	**(6.829)**	5.318	2.764	**(3.935)**	1.311	-0.297	**(2.995)**
	194	**(14.184)**	**(5.332)**		**(8.927)**	**(7.266)**		**(2.940)**	(-0.800)	
12	141	10.804	6.456	**(3.496)**	9.092	6.474	**(1.990)**	1.712	-0.019	**(2.594)**
	188	**(9.923)**	**(7.816)**		**(7.362)**	**(7.592)**		**(2.619)**	(-0.039)	
18	141	15.119	10.733	**(2.349)**	13.499	10.942	(1.389)	1.620	-0.208	**(1.854)**
	182	**(9.991)**	**(7.780)**		**(8.221)**	**(7.514)**		**(1.873)**	(-0.243)	
24	137	19.407	14.452	**(2.135)**	17.913	14.781	(1.340)	1.494	-0.330	(1.266)
	180	**(9.763)**	**(7.617)**		**(8.359)**	**(7.119)**		(1.465)	(-0.242)	

The table reports market-state stratified averages, and their statistics, as estimated by Equation 2 for the pooled sample (Panel A) and the investment-grade subsample (Panel B) . Each panel tabulates the conditional mean returns and their t-statistics for the winner and loser portfolios, as well as for the resulting momentum strategy in UP and DOWN markets. The portfolio holding periods are of 1, 3, 6, 12, 18 and 24 months. Each UP-DOWN column reports the t-statistics of the γ coefficient from Equation 3. This coefficient evaluates whether the stratified returns are statistically different across the market states. Panel B reports the analogous results for the investment-grade subsample. The time period covered is from August 1987 to December 2016.

5 Subsample Analysis (1994-2016)

The plot of momentum average returns documented in Figure 1 reveals that the momentum strategy used to be particularly profitable in the early years of the sample, reaching values as large as 12% in terms of annualized return rate. Gauging from the visual evidence, the assessment of the profitability of the momentum strategy conducted for the 1987-2016 sample could be profoundly conditioned from the strong momentum returns observed in the early years. Additionally, we note that the market for Canadian corporate bonds was extremely small during those early years of the sample. As a result, early price quotes might carry a large liquidity premium which is difficult to assess, in the absence of reliable bid and ask prices. Taken together, these considerations suggest that the robustness of the results discussed up to this point should be verified through a subsample analysis.

Landon (2009) examines the effective tax rate on Government of Canada bonds and shows that following a wave of institutional amendments, the composition of the investor pool in Canada might have changed around the year 1993. Relying on his conclusions, we identify the cut-off point defining the early and most recent subsamples as the end of 1993.

Table 5: Unconditional Returns on the 6-month Formation Period Momentum Strategy (1994-2016)

		Panel A: Holding period monthly returns $R_{n,t}$				**Panel B: Holding period cumulative returns $CR_{n,t}$**			
Holding Period	N	Loser (P1)	Winner (P10)	Winner-Loser	Months	Loser (P1)	Winner (P10)	Winner-Loser	Months
			A.1. Subsample 1994-2016			B.1. Subsample 1994-2016			
1	294	0.397	0.679	0.183	276	0.506	0.692	0.186	276
		(9.156)	**(7.999)**	**(2.274)**		**(7.417)**	**(7.458)**	**(2.220)**	
3	276	0.419	0.691	0.168	276	1.589	2.071	0.482	276
		(9.354)	**(7.996)**	**(2.327)**		**(9.333)**	**(9.709)**	**(2.527)**	
6	252	0.431	0.679	0.147	276	3.275	4.179	0.904	276
		(8.913)	**(7.787)**	**(2.284)**		**(8.726)**	**(9.090)**	**(2.338)**	
12	211	0.474	0.683	0.163	276	6.772	8.62	1.847	276
		(8.969)	**(8.197)**	**(3.000)**		**(9.408)**	**(8.542)**	**(2.467)**	
18	176	0.47	0.695	0.163	276	10.546	13.331	2.785	276
		(8.699)	**(8.121)**	**(3.288)**		**(9.772)**	**(7.509)**	**(2.096)**	
24	145	0.464	0.703	0.168	276	14.332	18.094	3.762	276
		(8.161)	**(8.431)**	**(3.961)**		**(9.565)**	**(6.330)**	(1.664)	
			A.2. IG Subsample 1994-2016			B.2. IG Subsample 1994-2016			
1	266	0.442	0.647	0.119	276	0.531	0.657	0.125	276
		(9.214)	**(7.370)**	(1.467)		**(7.677)**	**(7.174)**	(1.525)	
3	249	0.444	0.651	0.1	276	1.636	1.934	0.298	276
		(9.345)	**(7.369)**	(1.362)		**(9.414)**	**(9.086)**	(1.576)	
6	227	0.453	0.627	0.068	276	3.329	3.813	0.484	276
		(9.020)	**(7.145)**	(1.033)		**(8.693)**	**(8.600)**	(1.307)	
12	189	0.479	0.647	0.098	276	6.798	7.706	0.908	276
		(9.243)	**(7.444)**	**(1.848)**		**(9.052)**	**(9.855)**	(1.681)	
18	157	0.496	0.643	0.064	276	10.942	11.73	0.788	276
		(8.745)	**(7.495)**	(1.381)		**(9.871)**	**(10.268)**	(0.966)	
24	129	0.502	0.647	0.057	276	14.716	15.417	0.701	276
		(8.230)	**(7.850)**	(1.552)		**(9.619)**	**(9.839)**	(0.613)	

Panel A and Panel B report the average monthly and cummulative returns on the momentum portfolios with holding periods of 1, 3, 6, 12, 18 and 24 months. Since the $CR_{n,t}$ series are the summation of overlapping returns, we employ a heteroskedasticity-and-autocorrelation consistent (HAC) estimator for the t-statistics reported in Panel B. The average number of bonds available in the monthly cross-section, denoted by N is reported in Column 2. The number of months for which momentum returns are calculated is reported in the last column of each panel. Sub-panels 1 and 2 report holding period monthly and cumulative returns for the pooled sample and for the investment grade subsample. The time period covered is from January 1994 to December 2016.

The results reported in Panel A.1 of Table 5 for the 1994-2016 sample indicate that the momentum strategy yields significant holding period monthly returns over horizons ranging from one month to two years, as it is the case in the full sample. However, the momentum effects appear to be weaker in the reduced sample. Similar conclusions can be drawn considering cumulative returns, reported in Panel B.1 of Table 5.

Weaker momentum average returns in the most recent sample may be attributed to many causes. For instance, the momentum effect in the corporate bond market may be vanishing in recent years because of its exposure to the scholarly debate. Indeed, McLean and Pontiff (2016) have suggested that once the academic literature identifies an abnormally profitable strategy, its gains enter a descending trajectory, as more traders crowd the profitable positions.[20] However, such line of argumentation may be less than compelling for Canadian corporate bonds, as this article is the first to explore the momentum effect for Canadian corporate bonds.

At this stage of our investigation, we are unable to explain the drop in momentum gains occurred in the early nineties. We, however, conjecture that the changes in the pool of investors documented by Landon (2009) for Government of Canada bonds may have also affected the market for corporate bonds. From this perspective, the possibility exists that momentum traders, *a la* Hong and Stein (1999) have become less prevalent following the wave of institutional reforms that characterized the first part of the sample. The exploration of this possibility is left for future research.

As reported in Table 6, the conditional analysis of returns on the momentum strategy in the 1994-2016 subsample reveals that momentum gains are exclusive to UP markets, as observed for the full sample. While the conditional returns in the subsample are smaller

[20] The first paper to discuss momentum gains in the corporate bond market, for the US, dates back to 2005 Gebhardt et al. (2005).

than those obtained for the full sample, as it was the case for the unconditional subsample analysis, they are economically and statistically meaningful. In Panel A of Table 6, across holding periods ranging from one month to two years, the strategy yields a monthly return of about 40 bps, which is smaller but comparable to the analog rate of 0.55 observed for the full sample. Interestingly, however, in Panel B of Table 6, the momentum gains yielded by investment-grade bonds in UP market turn out to be small but significant for the full range of holding period horizons considered. These returns are economically significant, at least over the short-run. For instance, the annualized rate of return for the six month holding period strategy in UP markets is 4.12% in Panel B of Table 6. These rates are much larger than the corresponding returns reported in Panel B of Table 4 for high-grade bonds in UP markets when the full time period sample is considered. Put differently, conditioning on the market state brings about significant gains for investment-grade bonds. These conditional profits appear to have been increasing over time.

Table 6: Momentum Portfolio Returns Conditional on Market State (1994-2016)

Holding Period / N (UP/DOWN)		LONG			SHORT			LONG-SHORT		
		UP	DOWN	UP-DOWN	UP	DOWN	UP-DOWN	UP	DOWN	UP-DOWN
					Panel A: Subsample 1994-2016					
1	88	0.796	0.643	(0.727)	0.371	0.569	(-1.485)	0.425	0.074	**(1.972)**
	188	**(4.395)**	**(6.034)**		**(3.902)**	**(6.108)**		**(2.844)**	(0.753)	
3	90	2.316	1.953	(0.780)	1.235	1.761	(-1.658)	1.081	0.192	**(2.274)**
	186	**(5.739)**	**(8.022)**		**(5.404)**	**(7.865)**		**(3.341)**	(0.846)	
6	93	5.156	3.683	(1.689)	2.495	3.672	**(-1.828)**	2.661	0.011	**(4.005)**
	183	**(6.739)**	**(7.233)**		**(6.097)**	**(7.166)**		**(5.020)**	(0.027)	
12	99	10.563	7.533	**(2.003)**	5.405	7.537	**(-1.832)**	5.158	-0.005	**(4.655)**
	177	**(7.715)**	**(7.061)**		**(9.389)**	**(7.113)**		**(4.963)**	(-0.008)	
18	105	16.514	11.377	**(2.397)**	9.315	11.302	(-1.144)	7.199	0.076	**(4.884)**
	171	**(7.796)**	**(6.457)**		**(9.805)**	**(7.055)**		**(4.678)**	(0.071)	
24	107	22.389	15.374	(1.632)	12.978	15.189	(-0.924)	9.411	0.185	**(2.812)**
	169	**(5.294)**	**(6.021)**		**(8.306)**	**(7.143)**		**(3.049)**	(0.097)	
					Panel B: IG Subsample 1994-2016					
1	88	1.026	0.484	**(2.792)**	0.739	0.434	**(2.204)**	0.287	0.049	(1.308)
	188	**(6.348)**	**(4.623)**		**(7.120)**	**(4.827)**		**(1.852)**	(0.521)	
3	90	3.45	1.2	**(5.878)**	2.418	1.257	**(3.317)**	1.031	-0.057	**(2.823)**
	186	**(11.243)**	**(5.049)**		**(8.296)**	**(6.268)**		**(3.113)**	(-0.267)	
6	93	6.57	2.412	**(6.733)**	4.511	2.729	**(2.563)**	2.059	-0.317	**(3.775)**
	183	**(14.062)**	**(5.257)**		**(6.941)**	**(7.085)**		**(3.686)**	(-0.813)	
12	99	10.501	6.143	**(4.274)**	8.032	6.108	**(1.807)**	2.469	0.035	**(3.424)**
	177	**(12.923)**	**(7.723)**		**(8.166)**	**(7.455)**		**(3.400)**	(0.070)	
18	105	14.482	10.039	**(2.815)**	12.263	10.131	(1.329)	2.219	-0.091	**(2.094)**
	171	**(12.722)**	**(7.943)**		**(9.375)**	**(7.729)**		**(2.250)**	(-0.101)	
24	107	18.564	13.424	**(2.442)**	16.392	13.654	(1.327)	2.172	-0.23	(1.564)
	169	**(11.178)**	**(7.973)**		**(10.201)**	**(7.302)**		**(1.994)**	(-0.159)	

The table reports market-state stratified averages, and their statistics, as estimated by Equation 2 for the pooled sample (Panel A) and the investment-grade subsample (Panel B) . Each panel tabulates the conditional mean returns and their t-statistics for the winner and loser portfolios, as well as for the resulting momentum strategy in UP and DOWN markets. The portfolio holding periods are of 1, 3, 6, 12, 18 and 24 months. Each UP-DOWN column reports the t-statistics of the γ coefficient from Equation 3. This coefficient evaluates whether the stratified returns are statistically different across the market states. Panel B reports the analogous results for the investment-grade subsample. The time period covered is from January 1994 to December 2016.

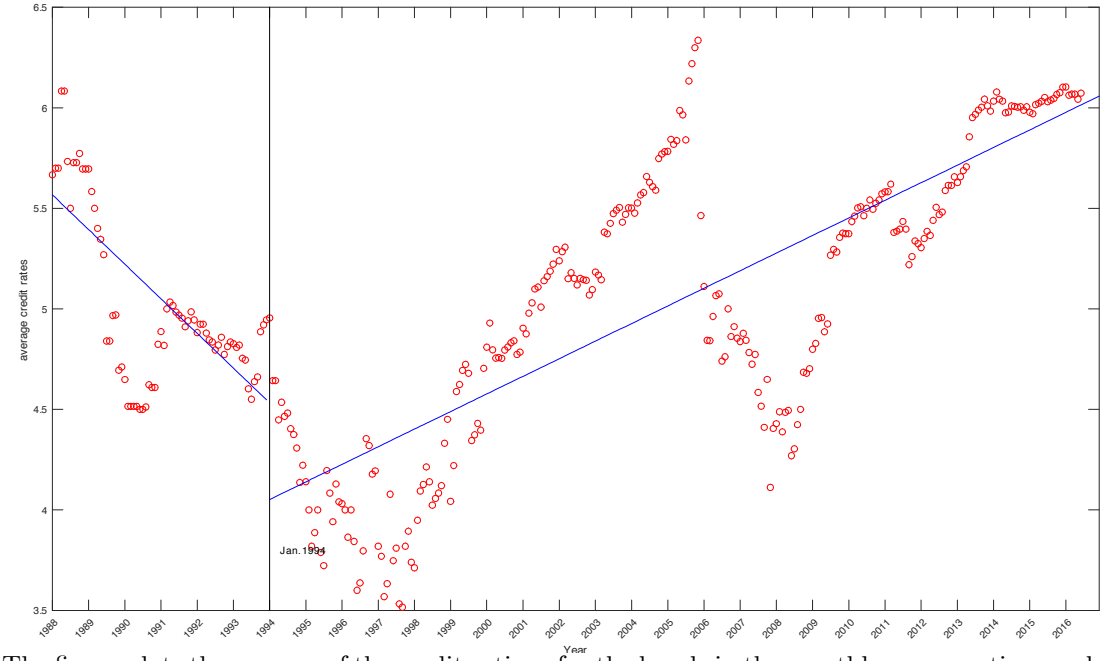
We find it puzzling that the subsample analysis yields evidence of opposite trends in the returns on momentum portfolios of investment-grade bonds versus those of momentum strategies that rely on the full cross-section of bonds, in UP markets. We propose that a potential explanation resides in the dynamic of credit ratings, in the subsamples.

Empirically, we find that there is an overall declining trend for the cross-sectional average of the credit ratings assigned to investment-grade bonds in the 1994-2016 subsample. Put differently, the post-1994 ratings in our sample suggest that the credit quality of high-grade bonds has been declining over time. Figure 3 visually confirm the statistical analysis, by showing the fitted trend regression lines for the monthly cross-sectional average of credit ratings in the pre-1994 and 1994-2016 subsamples, under the convention that lower credit quality corresponds to larger values of the credit risk measure.

Declines in the average rating of investment-grade bonds may cause market participants to view these securities as increasingly similar to speculative securities. Should the momentum effect be particularly marked for speculative bonds in Canada, as it is the case in the US corporate bond market, then declining credit scores would be positively associated with an increase in momentum gains for high-grade bonds. The effect is only visible in UP markets, as in DOWN market the analysis reveals that the momentum effect yields insignificant returns. From this perspective, the documented higher momentum gains for investment-grade bonds in the most recent subsample are consistent with an overall decline in credit ratings of investment-grade bonds. The effect is less marked in the full sample, as ratings appear to have been on an upward trend in the early years of the period under consideration.[21] Consistently, a comparison between the full and reduced sample shows that significant momentum

[21] An univariate regression of the cross-sectional rating (with high values meaning lower ratings) on a time-trend, and a constant, yields a positive and statistically significant trend coefficient in the sub-sample. The analog coefficient for the 1987-1993 sample is negative.

Figure 3: Pre- and Post- 1994 Credit Rating Trends



The figure plots the average of the credit ratings for the bonds in the monthly cross-section, under the convention that lower credit quality corresponds to larger values. Hence the highest DBRS rating, namely AAA, corresponds to value 1 whereas the lowest category, namely D, corresponds to level 22. The figure also depicts the pre-1994 and post-1994 fitted trends of the credit ratings. The time period covered is from August 1987 to December 2016.

gains for investment-grade bonds are larger in the 1994-2016 subsample. This result is also confirmed by the point-estimates of the unconditional returns.[22]

6 Momentum in Top-Bonds

Institutional traders dominate the market for Canadian corporate bonds, with retail investors accounting for only 3% of the trading volume in 2016 (e.g., Devani and Zhang (2017)) Further, this study documents a significant, and persistent, momentum effect for Canadian corporate bonds. These two pieces of evidence, taken together, raise the question of whether institutional investors operating in the Canadian market for corporate bonds are momentum traders. Momentum profits stemming from the trades of institutions would not be surprising, as previous literature has shown that, at least in the US, institutional investors do enact momentum strategies in their portfolios (e.g., Grinblatt et al. (1995) and Sias (2004)).

Unfortunately, the type of data that could be used to separate the trades of institutional and retail investors is not yet available for Canadian corporate bonds. However, this study proposes a way around this obstacle by capitalizing on the findings of Ronen and Zhou (2013) to identify bonds traded by institutional investors.

Using transaction-based quotes for US corporate bonds, Ronen and Zhou (2013) have shown that the trading activities of institutional investors tend to focus on a handful of bonds per issuer, these being termed the top bonds. The authors show that for US firms issuing only investment grade bonds, the most recent issues are the top bonds in a remarkable 94% of the instances (e.g., see Table 6 in Ronen and Zhou (2013)). Building on this characterization of top bonds, in this study we identify the top bond of each issuer with its most recently

[22] Compare Panels A.2 and B.2 of Tables 2 and Table 5.

issued bond (i.e., with the on-the-run issue).[23] This identification strategy is supported by the observation that about 90% of the bonds in our sample are issued by firms that are rated at or above the BBB low threshold for the entire lifespan of the bond.[24]

We cull from our sample a subsample of on-the-run issues. Past winners and losers are then identified ranking into deciles firms on the basis of the cumulative returns of their top bonds, over the six months preceding the formation month. Hence, the strategy identifies a set of firms, rather than a set of bonds, as past winners and past losers. In this sense, the top-bond momentum strategy is firm-based, as it is the case for the momentum strategy in the equity market.

The empirical results, reported in Table 7, show that the momentum effect is insignificant for portfolios of on-the-run issues. Furthermore, unreported results also document insignificant momentum returns for top bonds both in the UP and DOWN market states. To the extent to which the returns on top bonds capture the trades of institutional investors, these findings are consistent with institutional investors in the Canadian bond market being largely unaffected by the biases that have been proposed to explain the momentum effect, in the theoretical literature. This result would leave retail investors responsible for the momentum effect. However, given the small trade volume associated with retail investing, we feel that this conclusion needs further scrutiny. We leave this challenge for future research.

For the year 2016, Devani and Zhang (2017) show that Canadian corporate bonds attract most of the trades in the first two weeks after issuances. Moreover, the bond-level trade volume drops dramatically after one week from issuance. On the basis of these pieces of

[23] In cases where a firm issued multiple bonds on the same date, the top bond is the one with the longest time to maturity. This selection protocol is corroborated by the finding that in 84.18% of the instances firms' top bonds are those on-the-run issues with the longest maturity (Ronen and Zhou (2013)).

[24] About 65% (162 bonds) of the remaining 10% have no ratings over their lifespan. Only eight bonds issued by three firms are rated low-grade over the entire time period under examination.

information, we conclude that the on-the-run issue is the most liquid bond in the cross-section of bonds, at the issuer level, also in the Canadian market. From this perspective, thus, focusing on momentum portfolios in top bonds is also a way to examine whether liquidity has some bearing on the strength of the momentum effect. The empirical evidence appears to suggest that the momentum effect may be associated with low-liquidity bonds.

7 Conclusions

In this paper, we investigate the momentum effect in the market for Canadian corporate bonds, over a period of about 30 years spanning from August 1987 to December 2016. The examined time period is exceptionally long for the standards of the literature on Canadian financial markets. Our sample includes 2,424 bullet Canadian corporate bonds issued by 389 firms. Our analysis concludes that the momentum strategy is significantly profitable in the market for Canadian corporate bonds, as it yields gains that are comparable to those observed in the much larger market for US corporate bonds.

Cooper et al. (2004) find that momentum profits vary with the state of the market, and they explain their findings within the framework proposed by the theoretical works of Daniel et al. (1998) and Hong and Stein (1999). Our analysis reveals a strong and persistent market state effect also for Canadian corporate bonds. Conditioning on the market state doubles the returns on the momentum portfolio for holding periods ranging from one month to two years. Further, these gains are exclusive to periods following above-average market gains (i.e., in UP markets), as it is the case for US equities. The conditional momentum profits for Canadian bonds are sizeable, at about two third of the analogous gains for US equities, in UP markets.

Table 7: Unconditional Returns on the 6-month Formation Period Momentum Strategy for Top Bonds

Holding Period	N	Loser (P1)	Winner (P10)	Winner-Loser	Months
		Panel A: Holding period monthly returns ($R_{n,t}$)			
1	84	0.64	0.716	0.064	340
		(10.404)	**(8.177)**	(0.911)	
3	81	0.657	0.705	0.024	340
		(11.463)	**(8.192)**	(0.399)	
6	77	0.641	0.706	0.036	340
		(10.724)	**(8.299)**	(0.749)	
12	70	0.664	0.723	0.027	340
		(11.111)	**(9.144)**	(0.698)	
18	64	0.646	0.711	0.025	338
		(10.931)	**(9.114)**	(0.807)	
24	58	0.658	0.708	0.031	338
		(11.066)	**(9.509)**	(1.155)	
		Panel B: Holding period cummulative returns ($CR_{n,t}$)			
1	84	0.666	0.72	0.055	340
		(8.179)	**(7.800)**	(0.729)	
3	81	2.025	2.081	0.057	338
		(10.964)	**(10.041)**	(0.352)	
6	77	3.960	4.197	0.237	335
		(10.646)	**(10.175)**	(0.863)	
12	70	7.931	8.290	0.360	329
		(10.901)	**(10.247)**	(0.856)	
18	64	11.828	12.035	0.207	321
		(10.421)	**(9.420)**	(0.378)	
24	58	15.492	15.277	-0.214	315
		(9.476)	**(7.895)**	(-0.277)	

Panel A and Panel B report the average monthly and cummulative returns on the momentum portfolios for top bonds with holding periods of 1, 3, 6, 12, 18 and 24 months. Since the $CR_{n,t}$ series are the summation of overlapping returns, we employ a heteroskedasticity-and-autocorrelation consistent (HAC) estimator for the t-statistics reported in Panel B. The average number of bonds available in the monthly cross-section, denoted by N, is reported in Column 2. The number of months for which momentum returns are calculated is reported in the last column of each panel. The time period covered is from August 1987 to December 2016.

Previous research on the momentum effect for US corporate bonds has shown that momentum gains are driven by speculative-grade bonds. In contrast, high-grade bonds appear not to be associated with profitable momentum strategies. The lack of significant gains for investment grade bonds is confirmed by this study's results for the Canadian market. However, the conditional analysis highlights that the state of the market brings about sizeable momentum returns also for investment grade bonds, especially in the most recent years of the sample.

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Appendix: Market State

In this paper, we show that momentum gains are strongly market-state dependent, a result that corroborates the conclusions of Cooper et al. (2004) and extends its validity from the equity to the corporate bond market. In this study, the market is in the UP (DOWN) state in month t when the average of the monthly returns of the market aggregate portfolio, over the year preceding month t, is above or equal (below) the sample average of EW market portfolio monthly returns.

In conducting our empirical analysis, we strived to foster consistency with the literature by focusing on commonly studied momentum strategies and examining their conditional performance according to the methodologies proposed in preceding studies. While the conditional evaluation of the momentum effect on the basis of stock market variables (e.g., sentiment) can be conducted deploying the methodologies used in preceding literature, the use of bond market conditioning variables requires some market-specific adjustments. In particular, the approach proposed by Cooper et al. (2004), to categorize market states turns out being not applicable in our 1987-2016 sample.

For a given month t, Cooper et al. (2004) define the UP and DOWN states on the basis of the average market return over the three-year preceding month t. The market is in the UP state if the three-year average is nonnegative, whereas the DOWN state occurs when the average is negative. The authors also show that using the one-year and the three-year market averages yield consistent results on the market state dependence of the momentum effect. For the time period examined in this study, which covers almost three decades, there are very few periods in which the average return on the EW corporate bond market index return is negative.

Further, no month is categorized as a DOWN state if we use the sign of the three-year

average market return to define UP and DOWN states, as done in Cooper et al. (2004). When using the sign of the one-year average, we would still get a very unbalanced sub-samples, with 336 and 5 UP and DOWN periods, respectively. Using the sign of the one-year or three-year median of the returns yielded by the EW index to separate the UP and DOWN states yield similarly unbalanced samples.

To evaluate the implications of this study's departure from the approach proposed in Cooper et al. (2004) to classify market states, we examine the state dependence of the benchmark equity momentum portfolio, which is available on Kenneth French's webpage.[25] Table A1 reports the stratified averages of the stock market momentum factor according to four definitions of the UP and DOWN market states. What we find is that the methodology employed in this study makes harder to detect state dependence of the momentum factor. Presently, comparing the sample average of the return on the EW market index and the one-year average returns of the market portfolio to define the market states, as done in this study, yields a smaller spread between equity momentum in the UP vs. DOWN market states than the corresponding spread when the definition of UP and DOWN markets proposed in Cooper et al. (2004) is used. The annualized equity momentum gains stand at 10.43% and 1.41%, respectively in the UP and DOWN states, as defined in this study, over the 1987-2016 sample. These rates correspond to a spread of 9.03%.[26] Over the same period, the corresponding returns for the UP and DOWN states, where these are defined as in Cooper et al. (2004), are 8.52% and -24.95%, with a spread equal to 33.47%, again in annualized percent terms.[27]

[25] We use the methodology of Stambaugh et al. (2012), and condition the returns on the momentum factor on the month preceding the holding period monthly return.

[26] Correspondingly, for 1929-2016 sample, equity momentum gains are 10.35% and 3.41% respectively using this study's definition of UP and DOWN states. The spread is 6.94%.

[27] The stratified momentum returns when the UP and DOWN states are defined as in Cooper et al. (2004) are 9.54% and -18.79% respectively, in the UP and DOWN states, over the 1929-2016 sample. The spread

Further, we also find that the use of the one-year average market return to define the market state makes harder to detect state dependence, with respect to the use of the three-year average, employed in Cooper et al. (2004).[28] To illustrate, we consider the returns on the momentum equity factor in UP and DOWN states where the market states are defined comparing the sample average of the EW market index with the three-year versus the one-year average return on the same aggregate portfolio. Using the three-year average market return yields a spread between the average momentum gains in the UP vs. DOWN market states that is about 88% larger than the spread obtained using the one-year market return series, over the 1987-2016 sample.[29]

Summarizing, the use of the sample average of the return on the EW market index as a threshold for the one-year market return, to discriminate UP from DOWN markets, makes harder to provide evidence of state dependence for momentum than the sign of the (one or three-year) average of the EW market index return.

is 28.32%.

[28] As noted Cooper et al. (2004), the use of the market return average over longer vs. shorter time periods identifies market states that are more (less) extreme. However, using longer time periods also decrease the number of observations.

[29] For the 1929-2016 sample using the three-year average market returns yields a UP-minus-DOWN effect that is about 45% larger than that obtained relying on the one-year market average return.

Table A1: State Dependence of the Stock Market Momentum Factor

	1-year		3-year	
Avg. ret. EW index	UP	DOWN	UP	DOWN
	10.43	1.41	13.63	-3.31
Sign ret. EW index	UP	DOWN	UP	DOWN
	12.84	-13.04	8.52	-24.95

Note: The table reports the stratified average returns on the equity market momentum factor, as obtained from Professor French's website. Stratification is according to the UP and DOWN market states that are defined, in the first row, by comparing the one-year average (first column) and three-year average (second column) return on the EW market portfolio with the sample average of the monthly returns on the same index. In the second row, the UP and DOWN market states are defined by the sign of the one-year average (first column) and three-year average (second column) of the monthly returns on the EW index. In this appendix, the monthly returns are gauged by the returns on the CRSP EW market portfolio for US equities.

Table A2: Conditional Momentum Portfolio Returns for the US and Canadian Corporate Bonds

Holding Period / N (UP/DOWN)		LONG UP	LONG DOWN	LONG UP-DOWN	SHORT UP	SHORT DOWN	SHORT UP-DOWN	LONG-SHORT UP	LONG-SHORT DOWN	LONG-SHORT UP-DOWN
					Panel A: TRACE Sample 2002-2014					
1	58	1.429	0.716	(1.700)	0.71	0.786	(-0.213)	0.719	-0.07	**(2.014)**
	78	**(3.862)**	**(3.090)**		**(4.223)**	**(2.175)**		**(2.478)**	(-0.271)	
3	58	3.936	2.158	**(2.060)**	2.110	2.402	(-0.320)	1.825	-0.244	**(2.576)**
	76	**(5.490)**	**(4.056)**		**(6.183)**	**(2.745)**		**(2.980)**	(-0.456)	
6	57	7.334	4.252	**(1.941)**	3.861	5.115	(-0.540)	3.473	-0.864	**(2.273)**
	74	**(5.562)**	**(3.541)**		**(5.817)**	**(2.179)**		**(2.686)**	(-0.645)	
12	57	12.636	9.232	(1.220)	7.226	11.924	(-0.919)	5.409	-2.692	**(1.929)**
	68	**(5.053)**	**(3.815)**		**(7.599)**	**(2.211)**		**(2.478)**	(-0.839)	
18	57	16.103	12.774	(0.935)	10.885	19.668	(-1.282)	5.218	-6.894	**(2.236)**
	62	**(4.573)**	**(3.086)**		**(7.816)**	**(2.720)**		**(1.766)**	**(-1.964)**	
24	55	21.345	15.272	(1.228)	14.107	26.974	(-1.329)	7.239	-11.702	**(2.729)**
	58	**(5.713)**	**(2.665)**		**(9.573)**	**(2.705)**		**(2.596)**	**(-2.235)**	
					Panel B: Canadian 2002-2014 Subsample					
1	38	0.705	0.631	(0.267)	0.355	0.485	(-0.934)	0.35	0.146	(0.757)
	104	**(2.829)**	**(4.573)**		**(6.376)**	**(3.795)**		(1.502)	(1.134)	
3	38	2.178	1.827	(0.636)	1.02	1.535	(-1.411)	1.158	0.292	**(1.710)**
	104	**(4.620)**	**(5.765)**		**(7.100)**	**(4.523)**		**(2.797)**	(0.939)	
6	38	4.72	3.352	(1.529)	1.946	3.29	(-1.661)	2.774	0.063	**(3.077)**
	104	**(6.963)**	**(4.838)**		**(7.059)**	**(4.222)**		**(4.455)**	(0.098)	
12	38	8.314	6.971	(0.851)	3.817	7.09	**(-2.134)**	4.496	-0.118	**(2.836)**
	104	**(5.456)**	**(5.918)**		**(14.486)**	**(4.618)**		**(3.261)**	(-0.137)	
18	43	12.442	10.614	(0.594)	6.418	10.586	(-1.602)	6.023	0.028	**(2.430)**
	99	**(4.284)**	**(5.840)**		**(6.619)**	**(4.185)**		**(2.790)**	(0.021)	
24	45	17.373	13.422	(1.097)	8.993	14.886	(-1.658)	8.381	-1.464	**(2.949)**
	97	**(5.354)**	**(5.644)**		**(7.550)**	**(4.154)**		**(3.855)**	(-0.576)	

The table reports market-state stratified averages, and their statistics, as estimated by Equation 2 for the TRACE sample (Panel A) and the Canadian corporate bond subsample (Panel B). Each panel tabulates the conditional mean returns and their t-statistics for the winner and loser portfolios, as well as for the resulting momentum strategy in UP and DOWN markets. The portfolio holding periods are of 1, 3, 6, 12, 18 and 24 months. Each UP-DOWN column reports the t-statistics of the γ coefficient from Equation 3. This coefficient evaluates whether the stratified returns are statistically different across the market states. Panel B reports the analogous results for the Canadian subsample. The time period covered is from August 2002 to December 2014.

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