MOMENTUM AND SIZE EFFECTS IN THE COLOMBIAN STOCK MARKET

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MOMENTUM AND SIZE EFFECTS IN THE COLOMBIAN STOCK MARKET

ABSTRACT

This paper examines momentum and size effects after the merger of Colombia's local stock exchanges in 2001. We analyze performance of momentum portfolios under different settings and realistically, before and after transaction costs. In addition, we test the profitability of a size strategy and whether, controlling for market risk, returns are related to size. Results are consistent with momentum and size effects before transaction costs. Momentum effects seem stronger than size effects. We conclude that the profitability of the two strategies disappears when transaction costs are included. Consistent with the CAPM, size is found to be unrelated to returns.

1 INTRODUCTION

Momentum or the continuation of past returns in which a portfolio long on high past return stocks and short on low return stocks yields significant arbitrage returns is one of the most pervasive violations of weak market efficiency. Jegadeesh and Titman (1993) find strong evidence of momentum for the U.S. in that a winner portfolio consistently outperforms a loser portfolio in the mid-term, i.e., holding periods of three to twelve months. In a more recent paper, Jegadeesh et al. (2001) show that momentum is not a result specific of their initial sample (1965-1989) but it extends well into the nineties. Even after adjusting for risk a momentum strategy produces abnormal returns.

Since then, evidence of momentum has spread to other countries. Griffin et al. (2003) shows that for the U.S. and a set of 39 developed and developing countries for a sample that ends in December 2000, winner minus loser portfolio returns are on average positive, with Asian and by and large, emerging markets displaying the lowest momentum returns. Furthermore, momentum profits are shown to be uncorrelated across countries, and macroeconomic factors such as changes in unexpected and expected inflation, term spreads and changes in industrial production are a poor explanation for momentum returns. Li et al. (2008) find evidence of momentum in the United Kingdom. They show that by taking into account unsystematic risk (i.e. including a conditional volatility term in the mean equation) and leverage effects (or the asymmetric response of returns' variance to good and bad news) in standard asset pricing models of momentum portfolio returns, causes abnormal returns (or alphas) to vanish. Thus abnormal performance that previously seemed incommensurate to risk is shown to account for a conditional risk premium. Focusing on the Spanish stock market, Forner et al. (2003 and 2006) found some evidence in terms of abnormal returns for both momentum and contrarian strategies for a number of formation and holding periods. For instance, they document significant returns for a one year momentum and a 5 year contrarian strategy. Risk adjustments were unable to fully explain returns of these momentum and contrarian strategies. Momentum strategies, among several examined, are one of the most succesful in generating abnormal returns in a sample of emerging markets during 1985-1999 as reported by van der Hart et al. (2003). For Latin America, Muga and Santamaria (2007) report positive

returns for momentum strategies that invest both across countries and in individual countries such as Argentina, Brazil, Chile and Mexico for 1994-2005. They show that winner portfolios stochastically dominate loser portfolios providing evidence that momentum portfolios offer an adequate mix of risk and return in the period. By and large, they find that momentum seems less intense in developing rather than developed countries.

Finally, Lesmond et al. (2004) claim that previous momentum literature has disregarded the magnitude of transaction costs. Using several transaction costs estimates, albeit conservative, they find that any excess returns of a momentum strategy are not enough to compensate trading costs that might be as high as 6% per round trip. Results are consistent with binding bounds to arbitrage and after transaction costs market efficiency. An interesting research question is then to analyze if momentum profits are robust to trading costs in Colombia after the merger of its local exchanges.

In terms of a size effect, in which a portfolio of small companies consistently outperforms a portfolio of large companies, the international evidence is mixed. Banz (1981) finds that small stocks have higher abnormal average returns in the U.S. Fama et al. (1992) also find a size (e.g. the natural logarithm of the market value of equity) effect in the U.S. for the 1963-1990 period. However, Claessens et al. (1998) documents inconsistent size effects for a sample of emerging markets. For 8 out of 19 emerging countries any size effect is missing. Barry et al. (2002) do not find robust evidence of a size effect. They initially report evidence of a size effect for a sample of 35 emerging countries during the 1985-2000 period. However, after removal of extreme returns (i.e. outliers), that they claim can account up to 25% of the total return of a size strategy, excess returns disappear. Van der Hart et al. (2003) find, in fact, that a portfolio of large companies marginally outperforms a portfolio of small companies in 32 emerging markets for 1985-1999. Nonetheless, differences in performance of the two portfolios are not significant. Finally, Dissanaike (2002) argues that both the size and momentum effect are interrelated phenomena since momentum and size portfolios share similar characteristics in formation and holding periods. Using a sample of British equities and 24 to 48 month holding periods, he finds that both a small stock portfolio beats a large portfolio and a loser portfolio beats a portfolio of past winners. Finally, he discusses, using a regression model, the lack of explanatory

power of size on returns in the United Kingdom listing previous evidence portraying other factors as dominant and even the existence of a recent reverse size effect (in which large firms yielded higher returns than small firms).

Research has tended to focus, then, on studying momentum in equity markets abroad. In consequence, this article contributes to existing literature by describing and analyzing momentum strategies for the Colombian market in the period July 2001 to August 2009. The aim of this paper is to explore whether investors may be able to take advantage of relative simple investment strategies based on price continuation. Likewise the document strives to determine if there are seasonalities in momentum profits and how the current financial crisis (2007-2009) has impacted returns on this relative strength strategy. In addition, in a more realistic exercise, we consider momentum profits both before and after transaction costs (e.g. bid-ask spreads and commissions). In an emerging market it is difficult to let aside the effect of transaction costs on momentum strategies. The introduction of transaction costs may have a dramatic impact on the overall results. An additional objective of the paper is to examine the extent of a "size effect" in Colombia. This effect is a clear violation of semi-strong market efficiency. Previous literature for Colombia is somewhat inconclusive. On the one hand, Claessens et al. (1998) did not find evidence of a size effect for Colombia, from 1986 to 1993. On the other hand, Fama and French (1998) found both a reverse value and size effect for Colombian equities. On average, a portfolio of low book to market stocks beat a portfolio of high book to market stocks by a 17.47% margin (per annum) while a portfolio of large stocks beat a small stock portfolio by 20.54% during the 1988-1995 period.

The starting point of our sample coincides with the merger of the three former local exchanges "Bolsa de Bogota", "Bolsa de Medellin" and "Bolsa de Occidente" into the current Colombian stock exchange ("Bolsa de Valores de Colombia, BVC"). Previous research has shown an improvement in liquidity since the merger. Accordingly, one of the goals of this paper is to analyze, in this new setting and as the country becomes more integrated, if a size effect is still present in the Colombian stock market in a more recent period; whether a reverse size effect still prevails or it has reverted to a size effect as is more common in other markets (e.g. the U.S.).

A final goal of the paper is to indirectly assess the applicability of the Capital Asset Pricing Model (CAPM) in Colombia. The small number of stocks and consequently the low number of portfolios at hand precludes implementing more robust tests (e.g. Fama Mcbeth (1973) tests). In this regard we examine two issues. The first deals with the relationship between alphas, betas and future returns. According to the CAPM, one should expect, on average, a monothonic relationship for a series of portfolios built from low to high alphas and betas stocks and future returns. In other words, a high beta portfolio should, on average, outperform a low beta portfolio in a holding period. The second issue we examine is whether factors besides the market premium help explain stock returns for our sample. In particular, we explore if a size factor is priced in stock returns. We use four (both contemporaneous and lagged) proxies for size. Using four different proxies for size helps us to reach more robust and reliable conclusions.

2 DATA

We work with weekly prices in Colombian pesos, adjusted for dividends and splits, provided by Economatica. The estimation period covers data from July 2001 to August 2009 for a sample of sixteen representative stocks traded in the Colombian stock market. The starting point of our sample coincides with the merger of the three former local exchanges "Bolsa de Bogota", "Bolsa de Medellin" and "Bolsa de Occidente" into the current Colombian stock exchange ("Bolsa de Valores de Colombia, BVC"). Due to the short length of our sample, we decided to work with weekly instead of monthly data (as is more common in international studies). For some stocks the problem of missing data can be burdensome. To tackle this problem, we assume the same price of the previous day when there is no available price for a given day.[1] As the market index, this study uses the IGBC (a value weighted index of the (approximately) twenty most representative stocks by market capitalization) provided by Economatica and as the risk free rate, the DTF (*tasa de depósitos a término fijo*) taken from Colombia's Central Bank website.

Panel A of Table 1 shows descriptive statistics of weekly logarithmic returns. For most assets average returns were positive, standard deviations ranged from a minimum of 3.8% to a maximum of 11.1% and skewness was mostly negative. Evidence of fat tails is provided by the high degree of kurtosis in the sample. Panel B of Table 1 shows descriptive statistics for market capitalization. Bancolombia (ordinary shares) had the highest market capitalization in the period while Coltejer had the lowest. A high degree of fluctuation in market value is observed using the standard deviation and the difference between the maximum and minimum of the variable. As shown in previous studies, small companies are riskier than large stocks (this is especially true for Coltejer, Fabricato, Pazrio and Tablemac).

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[1] We estimate weekly returns using daily data from Tuesday to Tuesday. Moreover, our choice of using weekly data was partially motivated as a way to ameliorate the effects of missing prices for some stocks.

Table 1. Descriptive statistics (2001-2009)

Panel A. Descriptive statistics (weekly returns)

Company	Mean	STD	Skewness	Kurtosis	Maximum	Minimum
Bogota	0.657%	4.082%	-1.597	17.948	16.855%	-34.249%
Cemargos	0.607%	5.004%	-0.714	16.370	32.065%	-39.360%
Chocolates	0.645%	4.136%	-0.434	13.651	19.539%	-31.366%
Colombia	0.724%	5.124%	-0.764	13.771	24.981%	-39.381%
Coltejer	0.044%	10.158%	-0.220	17.180	52.376%	-78.552%
Exito	0.421%	4.946%	-0.028	11.051	28.768%	-31.493%
Fabricato	0.039%	8.400%	0.278	10.344	38.366%	-48.696%
Grupoaval	0.458%	4.172%	0.172	8.922	18.084%	-25.428%
Gruposura	0.790%	5.832%	-2.284	26.413	19.968%	-57.235%
Inverargos	0.575%	4.778%	-1.143	14.714	19.163%	-38.908%
Mineros	1.080%	5.115%	1.169	13.219	36.482%	-30.613%
Pazrio	0.873%	11.160%	4.017	42.014	123.309%	-49.956%
Promigas	0.592%	3.807%	5.576	62.635	43.141%	-14.159%
Pvisa	0.709%	4.582%	-0.231	11.988	23.021%	-31.234%
Tablemac	0.028%	8.064%	-3.721	52.271	30.010%	-96.612%
Valbavaria	-0.280%	7.726%	0.587	10.867	49.802%	-41.994%

Panel B. Descriptive statistics (market capitalization, in COL$ millions)

Company	Mean	STD	Skewness	Kurtosis	Maximum	Minimum
Bogota	3,858,145	2,411,577	-0.013	1.369	7,561,182	424,842
Cemargos	3,730,086	4,090,892	0.422	1.303	11,401,556	80,489
Chocolates	3,596,258	2,886,465	-0.045	1.292	8,267,346	87,519
Colombia	6,239,855	4,626,730	0.061	1.296	14,511,773	414,355
Coltejer	68,242	151,694	2.078	5.374	479,274	1,037
Exito	1,809,002	1,373,574	0.583	1.815	4,736,574	416,236
Fabricato	188,666	118,355	0.855	3.120	564,617	30,398
Grupoaval	4,723,005	2,874,074	0.058	1.246	9,342,468	1,272,188
Gruposura	4,571,751	3,461,637	0.089	1.391	10,572,927	197,659
Inverargos	3,467,584	3,202,960	0.196	1.201	8,839,473	138,204
Mineros	288,128	275,237	0.387	1.600	955,159	5,259
Pazrio	492,138	442,099	0.456	1.900	1,483,450	2,376
Promigas	2,269,346	1,752,755	0.426	1.682	5,601,030	374,696
Pvisa	3,792,753	3,041,194	0.447	1.845	12,520,698	488,572
Tablemac	80,497	74,580	0.913	2.576	297,634	11,884
Valbavaria	640,828	332,402	0.015	2.348	1,590,081	83,331

Due to the presence of extreme values we decided to winsorize the data at the 0.5 and 99.5 percentiles. Before discussing the methodology for portfolio construction and performance of momentum and size strategies it is worth mentioning that results shown in the next sections are qualitatively similar if we use (unadjusted) closing prices, if weekly returns are calculated using daily data for any given trading day and if we decide not to winsorize the data.[2]

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[2] These results are available from the authors upon request.

3 MOMENTUM STRATEGY

A momentum strategy is developed following Jegadeesh and Titman (1993) seminal paper. Every K weeks, all stocks in the sample are sorted according to their means returns in this formation period and allocated to four portfolios, each one with four stocks. The first ("winner') portfolio consists of stocks with the highest average returns while the fourth ("loser") portfolio includes the ones with the lowest returns. Portfolios are value weighted in which case each stock is given a weight according to its market capitalization. We report results for value weighted portfolios; nonetheless results are qualitatively similar if portfolios are equally weighted. Next, returns are recorded for the four portfolios during the next K weeks (or holding period). A week later, all stocks are sorted again according to their returns in the last J weeks and allocated to portfolios of which we measure its performance during the following K weeks. For example, a $J = K = 26$ weeks strategy sorts all stocks on week t according to their average weekly returns from $t - 26$ to t and then invests from week $t + 1$ to $t + K + 1$. This process is repeated until the end of the sample.

Mean returns of the four portfolios are averaged across holding periods to assess statistical significance. Though in the literature there is some debate about the use of overlapping or non-overlapping windows, the use of overlapping windows increases the power of the tests (see Jegadeesh and Titman, 1993, p.68). A momentum strategy is a zero initial investment strategy, in which an investor holds a long position in the winner portfolio (P1) and a short one in the loser portfolio (P4). If momentum is present in the data, mean returns on this strategy should be reliably different from zero. For some, the practical content of our results can be questioned due to the infeasibility to short stocks in Colombia. However, returns on this strategy do provide valuable information on which stocks to avoid and their characteristics. In addition, as in van der Hart et al. (2003), excess returns of the winner minus loser portfolio can be understood as the excess returns following a strategy that overweights winners and underweights losers versus their benchmark weights (e.g. weights of the stocks in the IGBC).

Different momentum strategies can be set according to the formation and holding periods chosen. In particular, this study examines momentum strategies using quarterly (13

weeks), semesterly (26 weeks) and yearly (52 weeks) formation and holding periods. To further understand momentum returns, we recreate a momentum strategy that takes a long position in the winner portfolio and a short position in the index (IGBC). Positive momentum returns would provide evidence in favor of active portfolio management while negative returns would decidedly favor a passive investment approach. In addition to historical mean returns, we use alphas and betas from the CAPM model as sorting variables for portfolio construction. Alphas and betas are obtained during the J weeks of the formation period. Portfolio 1 includes now stocks with either the highest alphas or betas and portfolio 4 with the lowest ones. The goal of this analysis is to provide some evidence of the applicability of the CAPM model in the Colombian market. In particular, we examine the link between ex-ante alphas or betas and future (ex-post) mean portfolio returns.

Results for a momentum strategy based on past returns, assuming no transaction costs, are shown in panel A of Table 2. The table shows mean yearly returns for winner (W), loser (L) and momentum (M) portfolios. Interestingly, all winner and loser portfolios had positive and significant average returns. Winner portfolio returns fluctuated from 27 to 34% per annum while loser portfolios ranged from 19 to 26% per year. Moreover, momentum returns fluctuated from as low as 1.5% to a maximum of 15.4% per year. Momentum was stronger using a 26-week formation period and 13-week holding period. By and large, using semesterly formation periods and semesterly or perhaps yearly formation periods helped to increase momentum returns. Our results show evidence of positive and significant momentum returns (before transactions costs), and coincide with extant evidence for other countries (Griffin et al. (2003) for the U.S. and a set of 39 developed and developing countries for a sample that ends in December 2000, Forner et al. (2003) for Spain and more recently, Muga and Santamaria (2007) for Argentina, Brazil, Chile and Mexico). Panel B of Table 2 shows returns differences between the winner portfolio and the market index. For quarterly formation periods, a winner portfolio is unable to beat the index, indeed, the index outperforms by 6.1% a winner portfolio using quarterly formation and holding periods. Moreover, most of the differences are not statistically significant. The winner portfolios outperform by a relative small margin the market using semesterly and yearly formation and holding periods. However, this margin is very likely to disappear as bid-ask spreads and other transaction costs come into play. All in all, the evidence does

not favor active portfolio management that seeks to invest in the most recent winners instead of tracking the index.

Table 2. Yearly average returns of several momentum strategies (2001-2009)

Panel A. Momentum strategy returns based on sorts of historical returns (without transaction costs)

Holding Period (K)

Formation Period (J)	Winner Portfolio			Loser Portfolio			Momentum Portfolio		
	13	26	52	13	26	52	13	26	52
13	27.56%***	31.10%***	32.14%***	26.10%***	22.29%***	22.692%**	1.46%	8.81%***	9.44%***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	* [0.000]	[0.614]	[0.001]	[0.000]
26	34.37%***	33.21%***	33.85%***	19.01%***	20.87%***	23.415%**	15.37%***	12.34%***	10.44%***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	* [0.000]	[0.000]	[0.000]	[0.000]
52	34.08%***	34.40%***	31.13%***	25.43%***	25.66%***	26.076%**	8.65%***	8.73%***	5.06%***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	* [0.000]	[0.008]	[0.000]	[0.002]

Panel B. Excess returns of winner portfolio over IGBC index (without transaction costs)

Holding Period (K)

Formation Period (J)	Momentum Portfolio		
	13	26	52
13	-6.07%***	-0.90%	0.18%
	[0.001]	[0.472]	[0.821]
26	2.64%	2.05%	2.50%***
	[0.180]	[0.111]	[0.001]
52	1.39%	3.08%***	0.63%
	[0.420]	[0.008]	[0.423]

Panel C. Momentum strategy returns based on sorts of alphas and betas from the CAPM model (without transaction costs).

Sorting variables	J = K = 26 weeks					J = K = 52 weeks				
	P1	P2	P3	P4	P1 – P4	P1	P2	P3	P4	P1 – P4
Historical returns	33.2%***	31.4%***	28.8%***	20.9%***	12.3%+++	31.1%***	32.2%***	29.2%***	26.1%***	5.1%+++
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.002]
Alpha	29.9%***	31.8%***	31.5%***	20.0%***	9.9%+++	24.0%***	30.1%***	34.7%***	24.3%***	-0.3%
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.851]
Beta	34.7%***	27.2%***	29.6%***	26.1%***	8.7%+++	34.3%***	26.5%***	30.2%***	27.7%***	6.6%+++
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]

Note: The table reports yearly average returns. Formation and holding periods are expressed in weeks. ***, ** and * denote statistical significance at the 1, 5 and 10% levels respectively.
P1 = Portfolio 1 ("winners") and P4 = Portfolio 4 ("losers"). +++, ++ and + denote statistical significance for momentum returns (P1-P4) at the 1, 5 and 10% levels. P-values are reported in brackets.

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Yearly returns for the four portfolios and two strategies based on sorts of alphas and betas are shown in panel C of Table 2. The panel highlights three interesting findings. First, all portfolios had positive and significant returns. Even the loser portfolio (low alpha or low beta) had a good performance with returns fluctuating from 20 to 27% a year. Second, momentum returns for the alpha and beta strategies were mostly positive and significant, as the CAPM predicts. Finally, contradicting the CAPM, average returns did not linearly increase on alpha or beta. For alphas, we find an inverse U-shape relation while for betas there is no such clear cut pattern although it seems to resemble a U-shape (except for P4).

3.1 Seasonality of momentum returns

Table 3 shows mean monthly returns for 26 and 52 weeks (left and right hand side of the table) formation and holding periods for the four portfolios. For semesterly formation periods and focusing on portfolios 1 and 4, October and July were the months with the highest mean returns respectively, while February and March turned out to be the least profitable. In quarterly terms, on average, an investor would have fared better during the fourth quarter investing in a past winner portfolio and during the third quarter investing in a past losers portfolio. For a yearly strategy, October had the highest returns for both portfolio 1 and 4 and June the lowest ones. All in all, the fourth quarter was the most profitable for both strategies.

Table 3. Average momentum returns per month (2001-2009)

| | J = K = 26 weeks | | | | | J = K = 52 weeks | | | | |
Month	P1	P2	P3	P4	P1 - P4	P1	P2	P3	P4	P1 - P4
Jan	21.1%**	24.2%***	23.4%***	2.7%	18.4% [0.17]	34.6%***	30.2%***	25.5%***	31.9%***	2.7% [0.63]
Feb	21.0%**	30.4%***	24.7%***	4.1%	16.9% [0.19]	30.2%***	28.0%***	23.1%***	28.8%***	1.4% [0.82]
Mar	28.4%***	29.2%***	25.2%***	0.6%	27.9%++ [0.02]	30.7%***	24.0%***	27.6%***	25.2%***	5.4% [0.28]
Apr	34.7%***	30.3%***	16.6%***	6.5%	28.2%+++ [0.01]	32.1%***	33.2%***	31.4%***	27.9%***	4.2% [0.16]
May	31.6%***	22.6%**	16.7%**	6.4%	25.2%+++ [0.00]	26.2%***	32.4%***	27.2%***	18.6%**	7.6% [0.14]
Jun	40.8%***	41.4%***	29.7%***	37.9%***	2.9% [0.71]	22.0%***	32.0%***	29.1%***	17.6%**	4.4% [0.48]
Jul	43.0%***	45.4%***	39.4%***	45.3%***	-2.3% [0.71]	30.1%***	33.8%***	33.4%***	22.9%***	7.2% [0.19]
Aug	36.3%***	29.3%***	33.4%***	40.3%***	-4.0% [0.56]	31.7%***	35.9%***	31.7%***	20.1%**	11.6%+ [0.08]
Sep	34.5%***	31.5%***	37.3%***	38.0%***	-3.5% [0.53]	36.0%***	35.2%***	34.6%***	30.3%***	5.7% [0.36]
Oct	45.6%***	40.0%***	34.1%***	27.0%**	18.6%++ [0.03]	38.0%***	39.2%***	34.1%***	33.5%***	4.6% [0.47]
Nov	42.7%***	36.5%***	37.6%***	26.8%***	15.9%+ [0.10]	30.8%***	30.3%***	22.4%***	25.3%***	5.5% [0.36]
Dec	21.8%**	17.7%**	28.5%***	19.4%***	2.4% [0.83]	31.0%***	31.3%***	28.6%***	32.2%***	-1.2% [0.83]

Note: The table reports yearly average returns per month. The left panel uses semesterly formation and holding periods while the right panel uses yearly periods. ***, ** and * denote statistical significance at the 1, 5 and 10% levels respectively. P1 = Portfolio 1 ("winners") and P4 = Portfolio 4 ("losers"). +++, ++ and + denote statistical significance for momentum returns (P1-P4) at the 1, 5 and 10% levels. P-values are reported in brackets.

Using semesterly data, momentum returns, on average, were negative during the third quarter.The highest momentum return occurred during the first quarter. In particular, April was the most profitable month for a momentum strategy with a yearly average return of 28.2% (or 2.1% per month) followed by March (27.9%). We hypothesize that price continuation during these 2 months is stronger for a winner portfolio since this period

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coincides with dividend announcements for companies and perhaps the market is overly optimistic about future performance. The market eventually corrects itself at a yearly horizon in which no evidence of momentum is found for these two months. Jegadeesh et al. (1993 and 2001) using U.S. data report positive momentum returns for all months except January. We do not find the same pattern in the data. There are both positive (e.g. March, April, May, October and November) and negative (e.g. July, August and September, though none is statistically different from zero) momentum profits. Using semesterly data as well, Forner et al. (2006) find that in Spain a momentum strategy is more profitable in December and during the last seven months of the year. In Colombia, the opposite seems to be the case; a momentum strategy performs better during the first semester of the year and December is not particularly profitable. Moreover, as in the Spanish case, we do not find a negative seasonality in January.

Comparing yearly and semesterly momentum returns, by and large, momentum returns tend to decline, the longer the formation period. Though there is evidence of yearly momentum for all months except December, most of these returns were not significant. This might be explained by evidence of reversal of a loser portfolio performance; a portfolio that tends to yield better using a yearly formation period. This fact is especially evident for the first semester of the year. For instance, the loser portfolio yielded just 2.7% a year during January using semesterly data strategy 1 and 31.9% using yearly data.

Figure 1 complements Table 3 and shows momentum portfolios and IGBC returns. There are large swings in both momentum and IGBC returns from month to month, though IGBC's returns seem to fluctuate more than momentum portfolios' returns. Comparing the 26-week strategy and the market index, it is straightforward to see that index dominates during January, April, June, July, August, September and decidedly during the last two months of the year. From a practical perspective this result can be seen as an incentive to hold a more diversified portfolio during each of these months.[3]

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[3] It is convenient to remember that the index includes roughly twenty stocks while momentum value-weighted portfolios just include four stocks.

Figure 1. Momentum portfolios and IGBC returns per month (2001-2009)
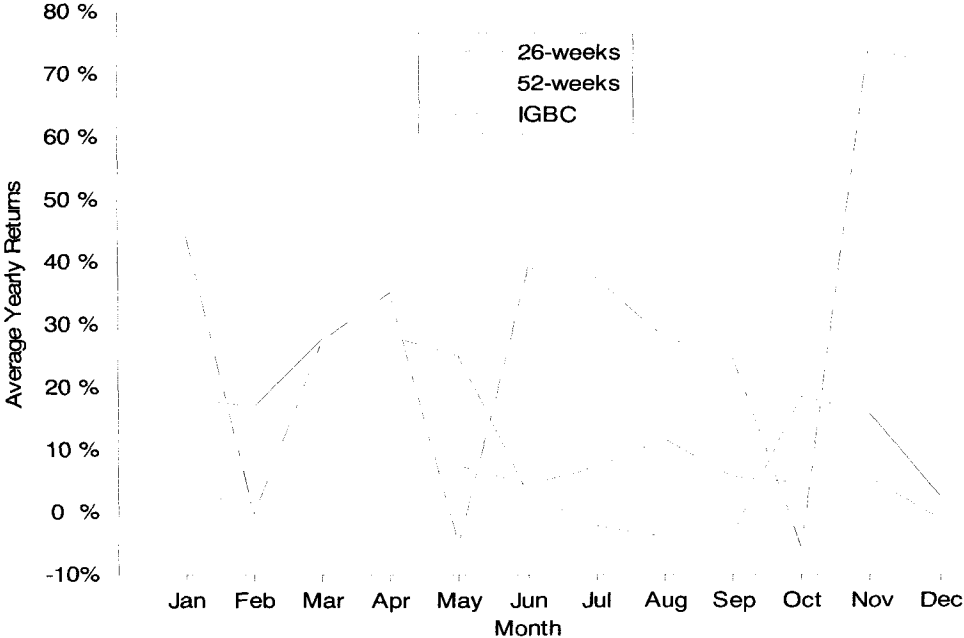
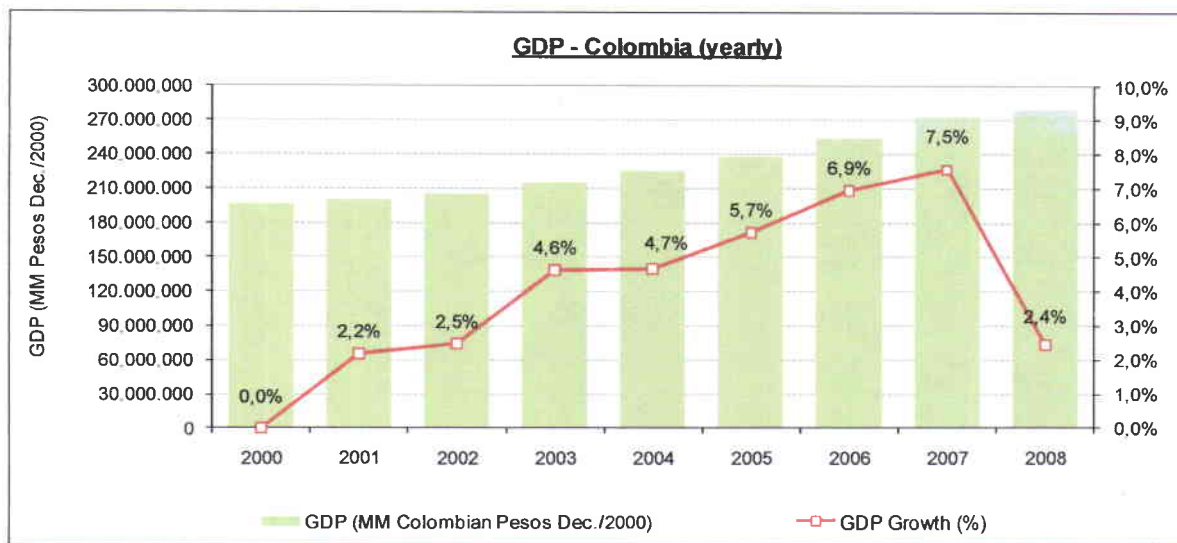## 3.2   Momentum returns and the current financial crisis

Chordia et al. (2002) argue that macroeconomic variables can impact momentum returns. Moreover, Cooper et al. (2004) find that higher momentum returns coincide with higher overall market returns and viceversa. In short, both studies assert that momentum returns are stronger during economic booms. In this section we briefly try to assess if momentum profits might have been negatively affected by the financial crisis that for many began in 2007 and had its peak in the third quarter of 2008. Looking at quarterly real economic growth, Colombia's GDP grew in the third quarter of 2008 (when compared to the same quarter of the prior year) by 2.84% while in the fourth quarter; growth changed its trend and GDP ended with negative growth of 1.07% (see Figure 2). Overall, Colombia's economy slowed down considerably during 2008. From a yearly growth rate of 7.5% in 2007, the economy went to a more modest growth rate of 2.4% in 2008 (see Figure 3). Colombia's stock market suffered from the effects of the unwinding of the housing bubble in the U.S. and the subsequent global liquidity crisis. The bankruptcy filing of Lehman Brothers by mid-September of 2008 had a somewhat lagged effect in the Colombian stock market. In particular, the IGBC remained relatively stable during September of that year but suffered a drop of 22% in October 2008.

Figure 2. Colombian quarterly GDP growth (2000-I to 2009-II)
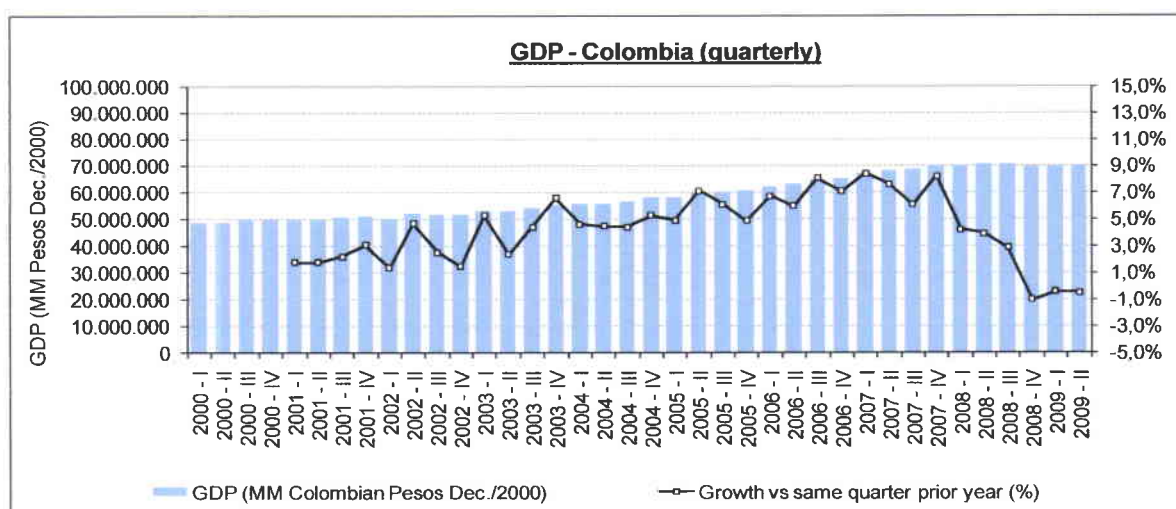
Note: Data from DANE (Departamento Administrativo Nacional de Estadística), Colombian National Statistics Administrative Department.

Figure 3. Colombian yearly GDP growth (2000 to 2008)

Note: Data from DANE (Departamento Administrattivo Nacional de Estadística), Colombian National Statistics Administrative Department

To isolate the impact of the current financial crisis, we restrict our sample from July, 2001 to September, 2008 a period of relative calm in the stock market. Table 4 shows results for winner, loser and momentum portfolios and could be compared to panel A of Table 2.

Table 4. Average momentum returns (July 2001-September 2008)

	Holding Period (K)								
Formation	Winner Portfolio			Loser Portfolio			Momentum Portfolio		
Period (J)	13	26	52	13	26	52	13	26	52
13	29.93%***	35.07%***	37.91%***	28.30%***	26.64%***	27.40%***	1.63%	8.43%***	10.51%***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.611]	[0.003]	[0.000]
26	37.30%***	36.91%***	40.39%***	21.02%***	24.94%***	28.68%***	16.28%***	11.97%***	11.71%***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
52	36.20%***	38.25%***	36.16%***	31.12%***	35.45%***	35.59%***	5.08%	2.81%	0.57%
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.153]	[0.245]	[0.725]

Note: The table reports yearly average returns. Formation and holding periods are expressed in weeks. ***, ** and * denote statistical significance at the 1, 5 and 10% levels respectively. P-values are reported in brackets.

Performance of both winner and loser portfolios was better for this period of relative calm. In addition, momentum returns using quarterly and semesterly formation periods remained significant and very similar to those reported in panel A of Table 2.

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For instance, the 26-week formation and holding period strategy continued to yield close to 1% per month. Momentum returns decline as the formation period lengthens (to a year); none of the spreads now is statistically significant. In sum, except for yearly formation periods, in which momentum returns actually increase in a period that includes the crisis, momentum returns seem little affected by the current financial turmoil. This result is consistent with Griffin et al. (2003) who argue that risk-based explanations would predict that momentum portfolios should fare badly during recessions or bad stock market conditions. However, their paper finds that this does not seem to be the case, momentum profits are still positive during stock markets busts or recessions.[4]

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[4] In unreported results, we tried to find if momentum profits diminished due to the liquidity drain (as reported in Agudelo, 2009) in the market since the start of trading of Ecopetrol, the largest oil company in Colombia in November 2007. This stock concentrated the bulk of trading in the country. In similar results to those of this section, for quarterly and semesterly formation periods, momentum profits in the pre-Ecopetrol period were similar to those for the whole sample. For yearly formation periods, momentum profits were actually lower in the sub-period.

3.3   Momentum returns and transaction costs

Thus far our calculations have not taken into account transaction costs. Lesmond et al. (2004) claim that momentum strategies in the U.S. require a considerable amount of trading in high cost stocks practically vanishing abnormal returns previously reported. In addition, one has to remember that a momentum investor faces transaction costs of four trades: buying and selling stocks in P1 and P4, a fact that seriously endangers "paper profits". Following Agudelo (2009), we consider two liquidity cost measures based on intraday prices to assess if momentum profits in the Colombian market remain. Both measures assume that any purchase of stocks has a minimal impact on prices (i.e. only small orders are considered). The first measure is the quoted bid-ask spread which can be calculated as follows

$$\text{Quoted bid-ask spread}_t = \frac{\text{Bid Price}_t - \text{Ask Price}_t}{\text{Average Price}_t} \qquad (1)$$

Where the average price (or bid-ask midpoint) is just the mean between the bid and ask price at moment *t*. If all transactions occur either at the bid or ask price, the quoted bid-ask spread would be a proper measure of liquidity costs. However, in Colombia's stock market, on occasion, market or limit orders might not be bounded by bid and ask levels. To account for this, the literature suggests a second measure; the effective bid-ask spread, which can be estimated for transaction *i* as

$$\text{Effective bid-ask spread}_i = 2 \times \frac{\text{Transaction price}_i - \text{Average Price}_i}{\text{Average Price}_i} \qquad (2)$$

An advantage of this last measure is that it takes into account more precisely the dynamic process of trading, allowing for sweeping orders, limit orders that might not be settled at bid-ask prices and for the effect of incoming orders that lower the bid-ask spread. We do

not have access to the time series of these two indicators, thus we *approximate* these transaction costs by averages reported by Agudelo (2009, table 5).[5]

Table 5. Transactions costs and commissions

Company	quoted bid-ask spread	effective bid-ask spread	commission roundtrip	Total Costs 1 quoted spread + commission	Total Costs 2 effective spread + commission
Bogota	2.27%	1.20%	0.60%	2.87%	1.80%
Cemargos	1.18%	0.58%	0.60%	1.78%	1.18%
Chocolates	2.11%	1.03%	0.60%	2.71%	1.63%
Colombia	1.20%	0.59%	0.60%	1.80%	1.19%
Coltejer	2.71%	1.56%	0.60%	3.31%	2.16%
Exito	1.92%	1.00%	0.60%	2.52%	1.60%
Fabricato	1.15%	0.70%	0.60%	1.75%	1.30%
Grupoaval	1.85%	0.88%	0.60%	2.45%	1.48%
Gruposura	0.86%	0.42%	0.60%	1.46%	1.02%
Inverargos	1.36%	0.71%	0.60%	1.96%	1.31%
Mineros	4.57%	2.25%	0.60%	5.17%	2.85%
Pazrio	2.41%	1.32%	0.60%	3.01%	1.92%
Promigas	8.15%	5.94%	0.60%	8.75%	6.54%
Pvisa	0.88%	0.44%	0.60%	1.48%	1.04%
Tablemac	1.24%	0.72%	0.60%	1.84%	1.32%
Valbavaria	5.96%	3.59%	0.60%	6.56%	4.19%

Note: Bid-ask spreads taken from Agudelo (2009, table 5).

For our sixteen stocks quoted bid-ask spreads varied from 0.86% to 8.15% with an average of 2.49%. Effective bid-ask spreads were lower ranging from 0.42% to 5.94% and with an average value of 1.43%. A momentum strategy incurs in transaction costs both at the long and short end of the trade. For a given window or investment period of length of K weeks, we estimate average weekly returns for a momentum strategy, $\bar{R}_{mom_K}$, as follows

$$\bar{R}_{mom_K} = \frac{w_W{}^t R_{WK} - w_W{}^t TC_W - w_L{}^t R_{LK} - w_L{}^t TC_L}{K} \qquad (3)$$

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[5] Agudelo kindly provided us data of spreads from December 2007 to May 2008 (a fraction of our sample period) for the stocks in his sample and those of Banco de Bogota, Coltejer, Grupo Aval and Valbavaria. This information on bid-ask spreads is not widely available in Colombia. Indeed, the exchange only keeps records of the last six months of trading.

Where w is a 4x1 vector of portfolio weights either for the winner or loser portfolio, t stands for transpose, R_K denotes a vector of returns of stocks in period K and TC stands for a transaction cost vector (4x1) with bid ask-spreads for the assets in the portfolio plus commissions that we assume at 0.60% (both bid-ask spreads and commisions are round-trip). Mind that transaction costs for the short portion of the portfolio $\left(w_L{}'TC_L\right)$ substract rather than add returns to the strategy as if one estimates after transaction costs momentum returns simply as $W - L$. From these average weekly returns, it is straightforward to estimate yearly averages which are included in the next table.

Table 6. Average momentum returns including transaction costs (2001-2009)

Panel A. Quoted bid-ask spread plus commissions

	Holding Period (K)								
Formation	Winner Portfolio			Loser Portfolio			Momentum Portfolio		
Period (J)	13	26	52	13	26	52	13	26	52
13	16.52%***	25.63%***	29.42%***	11.75%***	15.07%***	19.04%***	-23.94%***	-3.89%	3.07%*
	[0.000]	[0.000]	[0.000]	[0.001]	[0.000]	[0.000]	[0.000]	[0.126]	[0.095]
26	23.99%***	28.02%***	31.31%***	5.28%	14.02%***	20.01%***	-8.74%**	0.30%	4.49%**
	[0.000]	[0.000]	[0.000]	[0.145]	[0.000]	[0.000]	[0.013]	[0.913]	[0.019]
52	23.83%***	29.32%***	28.70%***	11.96%***	18.92%***	22.72%***	-15.06%***	-3.09%	-0.73%
	[0.000]	[0.000]	[0.000]	[0.001]	[0.000]	[0.000]	[0.000]	[0.182]	[0.647]

Panel B. Effective bid-ask spread plus commissions

	Holding Period (K)								
Formation	Winner Portfolio			Loser Portfolio			Momentum Portfolio		
Period (J)	13	26	52	13	26	52	13	26	52
13	20.20%***	27.46%***	30.33%***	16.53%***	17.48%***	20.25%***	-15.47%***	0.35%	5.20%***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.891]	[0.005]
26	27.48%***	29.77%***	32.17%***	9.97%***	16.37%***	21.17%***	-0.56%	4.39%	6.51%***
	[0.000]	[0.000]	[0.000]	[0.006]	[0.000]	[0.000]	[0.874]	[0.113]	[0.001]
52	27.31%***	31.05%***	29.55%***	16.60%***	21.24%***	23.87%***	-6.94%**	0.96%	1.27%
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.034]	[0.676]	[0.426]

Note: The table reports yearly average returns. Formation and holding periods are expressed in weeks. Momentum portfolio returns are calculated according to equation (3). ***, ** and * denote statistical significance at the 1, 5 and 10% levels respectively. P-values are reported in brackets.

Table 6 shows average yearly returns for a momentum strategy after transaction costs. As expected, returns for the strategies decrease. For instance, using the quoted bid-ask spread, returns for a winner portfolio decrease (as compared to panel A of Table 2) roughly by a minimum of 1.7% to a maximum of 11% a year. For quarterly holding periods a momentum strategy entails negative returns (due to the higher impact of transaction costs) while for semesterly periods a momentum strategy produces returns not distinguishable from zero. Our findings do not conform to those of Muga et al. (2007) for a quarterly holding period. Momentum strategies on their sample produced a quarterly return of 4.62% that even after taking into account approximate trading costs amounting to 3% (bid-ask spread of 1.2%, round trip commision of 0.8% and 1% of price impact costs), yield a positive return. In our case, quarterly holding period returns were not enough to compensate transaction costs. After transaction costs, this strategy can yield negative returns of up to 2% per month.

Only for yearly holding periods a momentum strategy is consistent with positive returns ranging from 1.2% to 6.5%. Again, lower transaction costs might explain this result. As for formation periods, returns tend to be higher for semesterly periods, in a similar fashion to that reported in Table 2. In sum, under most specifications, momentum profits after transaction costs are negative or close to zero. Only for longer holding period the impact of trading costs diminishes and momentum strategies become profitable by a modest margin.

Our results support after transaction costs semi-strong market efficiency in the Colombian market.

4   SIZE EFFECT

Table 7 reports returns for a strategy that goes long on small capitalization stocks and short on large stocks. In the first panel, transaction costs are omitted. Initially, both small and large stock portfolios had positive and significant returns. Most returns on arbitrage portfolios are not significant. Large capitalization stocks outperform small stocks for quarterly holding periods. At longer holding periods (e.g. yearly) there is evidence of a size effect in which small stocks outperform by roughly 5 to 7% a year. In this regard, our results do not match those of Fama et al. (1998) who using a yearly holding period found a reverse size effect, before transaction costs, for Colombian equities during 1988-1995. We believe that the merger of the exchanges, improvements in liquidity and the increased access to the market by foreign investors have increased financial integration with other countries in which the size effect is prevalent. In addition, the market seems to recognize that small stocks would tend to command higher returns at least in the long run due to their riskier nature.

Table 7. Returns to a size strategy including transaction costs (2001-2009)

Panel A. No transaction costs

	Holding Period (K)								
Formation	Small Portfolio			Large Portfolio			SMB Portfolio		
Period (J)	13	26	52	13	26	52	13	26	52
13	25.87%***	27.22%***	31.132%***	30.69%***	29.14%***	28.78%***	-4.82%	-1.92%	2.35%
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.275]	[0.524]	[0.211]
26	28.96%***	30.63%***	33.833%***	31.13%***	29.29%***	28.92%***	-2.16%	1.35%	4.92%***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.630]	[0.651]	[0.007]
52	33.92%***	34.27%***	35.286%***	30.73%***	28.93%***	28.35%***	3.19%	5.34%*	6.94%***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.491]	[0.078]	[0.000]

Panel B. Quoted bid-ask spread plus commissions

Formation	Small Portfolio			Large Portfolio			SMB Portfolio		
Period (J)	13	26	52	13	26	52	13	26	52
13	12.44%**	20.47%***	27.79%***	22.62%***	25.08%***	26.72%***	-26.32%***	-12.73%***	-3.05%
	[0.011]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.103]
26	15.42%***	23.82%***	30.45%***	23.09%***	25.24%***	26.87%***	-23.75%***	-9.51%***	-0.51%
	[0.002]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.001]	[0.775]
52	20.25%***	27.38%***	31.87%***	22.76%***	24.92%***	26.32%***	-18.45%***	-5.56%*	1.49%
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.065]	[0.427]

Panel C. Effective bid-ask spread plus commissions

Formation	Small Portfolio			Large Portfolio			SMB Portfolio		
Period (J)	13	26	52	13	26	52	13	26	52
13	17.68%***	23.11%***	29.104%** *	25.49%***	26.52%***	27.46%***	-18.22%***	-8.64%***	-0.99%
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.004]	[0.595]
26	20.72%***	26.50%***	31.790%** *	25.93%***	26.68%***	27.60%***	-15.60%***	-5.40%*	1.56%
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.001]	[0.070]	[0.386]
52	25.62%***	30.10%***	33.227%** *	25.58%***	26.34%***	27.04%***	-10.27%**	-1.43%	3.57%*
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.027]	[0.637]	[0.058]

Note: The table reports yearly average returns. Formation and holding periods are expressed in weeks. SMB ("small minus big") portfolio returns are calculated according to equation (3), in which the "winner" and "loser" portfolios now become the "small" and "big" portfolios respectively. ***, ** and * denote statistical significance at the 1, 5 and 10% levels respectively. P-values are reported in brackets.

Using our first measure of the bid-ask spread a small-size strategy turns decidedly unprofitable. Only for yearly formation and holding periods this strategy produces positive returns (though insignificant). Our second measure of the bid ask spread paints a similar picture in regards to a size strategy: returns are mostly negative following this approach. Only for yearly holding periods this strategy produces significant, but modest, positive returns.

In results not shown for brevity, we evaluate the profitability of a reverse size strategy (long on large stocks and short on small stocks) and find similar results; transaction costs erode

any profitability of such size-based strategy.[6] In addition, we compare returns originating from this strategy in the pre-crisis period (see section 3.2.) and the overall period. Returns from a size strategy are larger in the former period. However, after transaction costs, our previous results hold. Most spreads are negative or not significant. Only for yearly holding periods after costs returns are significant and ammount to a maximum of 5.8% per year. Barry et al. (2002) argue that extreme returns (i.e. outliers) are prevalent in emerging markets and consequently, inferences on return anomalies might be altered if outliers are not dealt with. Hence, they examine the degree to which extreme returns affect the size effect. In particular, they delete returns falling in the 1% lower and upper tails of the distribution. After deletion of outliers any remaining size effect vanishes; it seems than an important portion of this effect is explained by outliers. We analyze if by excluding returns falling in the 1 and 99 percentiles, our inferences change. In short, same results obtain for momentum and size effects; deleting outliers does not change our main conclusions.[7]

Thus far one can conclude that returns (both before and after transaction costs) derived from a momentum strategy are larger than those following a size strategy (see tables 2, 6 and 7). However, none of the two strategies is able to deliver economical and statistically significant returns after transaction costs. These results are robust to two ways of dealing with extreme returns: winsorizing or deleting them. On the whole, our results strongly agree with both weak and semi-strong market efficiency. In the next section we evaluate if perhaps a size factor, controlling for systematic risk, helps explain returns for the stocks in the sample. In the U.S., since Fama's (1992) work, the use of a size factor has almost become standard practice.

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[6] Due to transaction costs the profitability of the two strategies is not necessarily symmetrical.
[7] Returns to a reverse size strategy as well as returns in the pre-crisis period and returns on both momentum and size strategies after deletion of outliers are available from the authors upon request.

4.1 Are returns related to size?

We conduct a regression analysis to verify the existence of a size effect within the framework of the CAPM model and more specifically, to examine if returns are related to size. After controlling for market risk, is size priced? According to the CAPM, the short answer should be "no". For each of the sixteen stocks in the sample, we regress stock returns on Colombia's market index and a size proxy. The model is

$$R_{it} - Rf_t = \alpha_i + \beta_i(Rm_t - Rf_t) + \gamma_i Size_{it} + \varepsilon_{it} \tag{4}$$

Where R_{it} is the return for stock i for week t, R_f is the weekly risk free rate, α is the intercept, β represents the beta coefficient of the CAPM model accounting for market or systematic risk and γ is the sensitivity of returns to our size proxy; becoming the coefficient of interest. We allow for conditional heteroskedasticity by applying a Generalized AutoRegressive Conditional Heteroskedaticity or GARCH (1, 1) model. In this case the variance of returns $\left(\sigma_t^2\right)$ is given by:

$$\sigma_t^2 = a_0 + a_1\varepsilon_{t-1}^2 + a_2\sigma_{t-1}^2 \tag{5}$$

Four proxies are used to account for size.[8] The first one is an absolute size variable in which for each stock the logarithm of the total market value of equity in week t is recorded (as in Dissainake 2002) while the second is a relative size variable in which we divide market value at time t over the sum of market capitalization of all stocks in the sample at t. The third and fourth proxies are lagged one-period values of the absolute and relative size variables (the last one as in Claessens et al. 1998). By using lagged variables, we try to assess the predictive power of different proxies to forecast futures returns, controlling by systematic risk. For each of the four specifications and for each stock, we estimate the CAPM model. Next, a likelihood ratio test is performed to assess the diference between the restricted (CAPM) and unrestricted (CAPM plus size proxy) models. This provides

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[8] The short sample period and the limited number of stocks in the sample prevent us to reliably use for Colombia a more traditional size proxy as the difference of returns of a portfolio of small and large stocks. For a similar argument, see Fama et al. (1998), p.1997.

further evidence of the significance or not of a size proxy. The test is distributed χ^2 with one degree of freedom.

Table 8 shows coefficient and p-values for our regression analysis. CAPM's betas were similar across different specifications ranging from a low of 0.09 to a high of 1.22 and in most cases being significant at the 1% level. Alphas were seldomly significant and in most cases, low capitalization stocks were the ones with significant alphas. For contemporaneous size proxies, coefficients were "small" and in a majority of cases not different from zero. In addition, most of the likelihood ratio tests did not reject the null, providing support for the CAPM model (i.e. restricted model). As for adjusted R^2, coefficients go as low as 1% to a maximum of 72%. By and large, the model has a difficult time explaining small stock returns (e.g. Coltejer, Tablemac, Fabricato and Mineros). For lagged one period proxies, the evidence of a size effect, controlling for systematic risk, is weak. Coefficients are of the same magnitude as in the contemporaneous case and again the likelihood test is unable to reject the null. Looking at the last specification we see slightly stronger evidence in favor of a size factor; coefficients tend to be larger and in six out of 16 cases coefficients are significant (in all cases with a negative sign). Nevertheless, a lagged relative market capitalization size proxy does not add explanatory power as evidenced by 10 out the 16 likelihood ratio tests.[9]

The result of the non-significance of a size effect after controlling for market risk is similar to that reported by Claessens et al´s (1998) at the World Bank. They used a sample of 22 Colombian stocks for 1986-1993 and founf that after controlling for market risk and other factors (such as earnings to price ratio, price to book ratio, dividend yield, turnover and exchange rate fluctuations), size had no explanatory power for returns on the firms in the period.

The non-existence of a size effect coincides with our univariate results reported in Table 7 as well as with van der Hart et al. (2003) who test a size strategy for emerging markets

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[9] Diagnostic tests to assess GARCH effects (Engle LM test), stationarity (Augmented Dickey Fuller test) and autocorrelation (Ljung Box test) of the residuals are available from the authors upon request. In an overwhelming majority of cases, diagnostic tests supported a GARCH (1, 1) specification.

using diversified but country neutral portfolios[10] and find that returns are unrelated to size. In sum, we find that if any size effect exists it is ultimately subsumed by a "market effect", as the CAPM predicts.

Table 8. Estimation of the CAPM model plus size proxy

Shares	Panel A. Ln (Market Equity) (t)					Panel B. Relative Capitalization (t)				
	a	b	g	p-lratio	Adjusted R^2	a	b	g	p-lratio	Adjusted R^2
Bogota	0.044 [0.318]	0.665*** [0.000]	-0.001 [0.334]	0.255	0.402	-0.006 [0.278]	0.662*** [0.000]	0.061 [0.170]	0.072*	0.402
Cemargos	0.002 [0.914]	0.955*** [0.000]	-0.000 [0.934]	0.923	0.627	0.001 [0.587]	0.954*** [0.000]	-0.009 [0.746]	0.713	0.627
Chocolates	0.011 [0.635]	0.672*** [0.000]	-0.000 [0.712]	0.683	0.419	0.003 [0.381]	0.672*** [0.000]	-0.003 [0.928]	0.930	0.419
Colombia	0.033 [0.289]	1.075*** [0.000]	-0.001 [0.309]	0.326	0.701	-0.002 [0.775]	1.073*** [0.000]	0.024 [0.666]	0.682	0.700
Coltejer	-0.001 [0.979]	0.546*** [0.000]	-0.000 [0.954]	0.925	0.085	-0.004 [0.381]	0.546*** [0.000]	-0.054 [0.979]	0.962	0.085
Éxito	-0.125** [0.034]	0.748*** [0.000]	0.004** [0.034]	0.024**	0.353	0.005 [0.287]	0.737*** [0.000]	-0.095 [0.259]	0.241	0.346
Fabricato	-0.293** [0.021]	1.042*** [0.000]	0.011** [0.025]	0.022**	0.199	-0.013** [0.049]	1.017*** [0.000]	0.824 [0.269]	0.219	0.197
Grupoaval	-0.044 [0.473]	0.592*** [0.000]	0.002 [0.467]	0.344	0.363	0.002 [0.649]	0.592*** [0.000]	-0.008 [0.748]	0.688	0.361
Gruposura	0.027 [0.365]	1.229*** [0.000]	-0.001 [0.406]	0.380	0.723	0.006 [0.261]	1.232*** [0.000]	-0.037 [0.440]	0.465	0.723
Inverargos	-0.008 [0.730]	1.010*** [0.000]	0.000 [0.704]	0.673	0.660	-0.001 [0.770]	1.009*** [0.000]	0.024 [0.551]	0.539	0.661
Mineros	0.043 [0.190]	0.456*** [0.000]	-0.001 [0.269]	0.227	0.126	0.009** [0.043]	0.456*** [0.000]	-0.440 [0.557]	0.505	0.125
Pazrio	-0.034 [0.488]	0.865*** [0.000]	0.001 [0.526]	0.295	0.160	-0.013* [0.085]	0.880*** [0.000]	1.093 [0.116]	0.024**	0.166
Promigas	-0.001 [0.980]	0.090** [0.014]	0.000 [0.929]	0.916	0.011	0.004 [0.539]	0.090** [0.015]	-0.021 [0.827]	0.809	0.011
Pvisa	-0.089** [0.033]	0.770*** [0.000]	0.003** [0.030]	0.010***	0.461	-0.015* [0.083]	0.774*** [0.000]	0.190** [0.038]	0.013**	0.462
Tablemac	-0.112 [0.107]	0.837*** [0.000]	0.004 [0.122]	0.082*	0.188	-0.004 [0.432]	0.823*** [0.000]	-0.241 [0.894]	0.914	0.178
Valbavaria	-0.434*** [0.000]	0.720*** [0.000]	0.016*** [0.000]	0.000***	0.164	-0.011* [0.088]	0.713*** [0.000]	0.139 [0.541]	0.483	0.144

Note: Standard errors of the coefficients were obtained through residual bootstrap using 10,000 simulations. ***, ** and * denote statistical significance at the 1, 5 and 10% levels respectively. P-lratio corresponds to the p-value of the likelihood ratio test. P-values for coefficients are reported in brackets.

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[10] The general idea of country neutral portfolios is as follows: for each country they classify stocks into winner and losers and allocate the top or bottom 15% of stocks into winner and loser portfolios. Then, these stocks are combined into geographically diversified portfolios in which international stocks are equally weighted.

Table 8. Estimation of the CAPM model plus size proxy

Shares	Panel C. Ln (Market Equity) (t-1)					Panel D. Relative Capitalization (t-1)				
	a	b	g	p-lratio	Adjusted R^2	a	b	g	p-lratio	Adjusted R^2
Bogota	0.019 [0.409]	0.666*** [0.000]	-0.001 [0.443]	0.228	0.405	0.000 [0.946]	0.667*** [0.000]	0.009 [0.845]	0.794	0.398
Cemargos	0.001 [0.931]	0.955*** [0.000]	-0.000 [0.955]	0.950	0.627	0.002 [0.335]	0.952*** [0.000]	-0.020 [0.454]	0.389	0.627
Chocolates	0.003 [0.870]	0.673*** [0.000]	-0.000 [0.976]	0.973	0.419	0.005* [0.079]	0.673*** [0.000]	-0.037 [0.290]	0.303	0.420
Colombia	0.017 [0.391]	1.075*** [0.000]	-0.001 [0.428]	0.464	0.700	0.025*** [0.001]	1.086*** [0.000]	-0.154*** [0.002]	0.005***	0.704
Coltejer	0.014 [0.745]	0.543*** [0.000]	-0.001 [0.683]	0.507	0.086	-0.003 [0.473]	0.546*** [0.000]	-0.406 [0.843]	0.720	0.085
Éxito	-0.002 [0.941]	0.742*** [0.000]	0.000 [0.943]	0.937	0.344	0.014*** [0.006]	0.732*** [0.000]	-0.245*** [0.004]	0.002***	0.357
Fabricato	-0.023 [0.717]	1.026*** [0.000]	0.001 [0.796]	0.897	0.194	-0.002 [0.731]	1.029*** [0.000]	-0.586 [0.432]	0.376	0.197
Grupoaval	-0.011 [0.707]	0.592*** [0.000]	0.000 [0.690]	0.602	0.362	0.005 [0.265]	0.594*** [0.000]	-0.025 [0.309]	0.202	0.363
Gruposura	0.010 [0.613]	1.228*** [0.000]	-0.000 [0.683]	0.658	0.723	0.018*** [0.001]	1.237*** [0.000]	-0.138*** [0.004]	0.006***	0.724
Inverargos	-0.003 [0.841]	1.010*** [0.000]	0.000 [0.805]	0.793	0.660	0.002 [0.493]	1.008*** [0.000]	-0.017 [0.676]	0.662	0.660
Mineros	0.059** [0.026]	0.454*** [0.000]	-0.002** [0.048]	0.083*	0.129	0.014*** [0.002]	0.457*** [0.000]	-1.324* [0.073]	0.044**	0.131
Pazrio	-0.020 [0.637]	0.861*** [0.000]	0.001 [0.690]	0.562	0.158	-0.005 [0.547]	0.857*** [0.000]	0.138 [0.843]	0.763	0.158
Promigas	0.020 [0.367]	0.090** [0.015]	-0.001 [0.427]	0.600	0.012	0.015*** [0.008]	0.095*** [0.009]	-0.207** [0.025]	0.015**	0.026
Pvisa	-0.071*** [0.005]	0.772*** [0.000]	0.003*** [0.004]	0.040**	0.459	0.003 [0.744]	0.771*** [0.000]	-0.005 [0.956]	0.949	0.458
Tablemac	-0.045 [0.325]	0.830*** [0.000]	0.002 [0.377]	0.517	0.180	0.007 [0.160]	0.837*** [0.000]	-5.603*** [0.003]	0.017**	0.178
Valbavaria	-0.122** [0.035]	0.725*** [0.000]	0.004* [0.050]	0.023**	0.151	-0.004 [0.496]	0.716*** [0.000]	-0.161 [0.476]	0.410	0.147

Note: Standard errors of the coefficients were obtained through residual bootstrap using 10,000 simulations. ***, ** and * denote statistical significance at the 1, 5 and 10% levels respectively. P-lratio corresponds to the p-value of the likelihood ratio test. P-values for coefficients are reported in brackets.

5   CONCLUDING REMARKS

We contribute to the literature by examining the extent of momentum and size effects in Colombia after the merger of the three local exchanges in 2001; a merger that has brought improvements in liquidity and market efficiency. Previous literature only studied the pre-merger period. We explore the profitability of both momentum and size strategies, under different settings: in the pre-financial crisis period (July 2001-September 2008) and the whole sample period (2001-2009), removing or not extreme returns and more importantly, before and after transaction costs. By and large, results remain the same if we exclude from our sample the crisis period (post October 2008) and extreme observations. However, transaction costs dramatically change the profitability of momentum and size strategies. Before transaction costs, momentum and size strategies are generally profitable. For instance, a strategy that is long in recently high return stocks and short on recently low return stocks and uses semesterly formation and holding periods yields on average 1% per month. Comparing momentum and size strategies returns it seems that the former are higher than the latter. Nonetheless, after transaction costs that include bid-ask spreads and commissions, both strategies become unprofitable. Only for longer holding periods in which transaction costs have naturally a lower impact on returns, we observe significant but modest yields. These results are consistent with after transaction costs market efficiency in Colombia's stock market and complement evidence, in terms of market efficiency, provided by Berggrun and Jaramillo (2009) for Colombian pension funds.

It is important to mention that the Colombian stock exchange is only 8 years old and still shows some of the typical limitations or problems related to emerging markets, principally in terms of volume, liquidity and market size and depth. Because of that we decided to work with weekly data instead of monthly data. Although we select sixteen of the most liquid Colombian stocks, in some cases, we needed to complete missing price data with prior information.

Even after transaction costs, the returns of practically all the "winner" and "loser" portfolios based on the past returns performance are positive and significant. For the "winner"

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portfolios considering a 26-week formation period we obtain yearly average returns of 24%, 28% and 31% for holding periods of 13, 26 and 52 weeks respectively. For the "loser" portfolios considering a 52-week formation period we obtain yearly average returns of 12%, 19% and 23% for holding periods of 13, 26 and 52 weeks respectively. These results indicate that the Colombian stock market has been very profitable since the creation of the national stock exchange "BVC" in July 2001.

We also assess the applicability of the CAPM model in Colombia. Initially we see that high alpha or beta portfolios outperform low alpha or beta portfolios in a holding period, in line with the model's predictions. However, the relationship between alphas and betas in a formation period and returns in a holding period is not strictly linear. In addition, we examine if returns are related to size. Consistent with the CAPM, size (proxied in several ways) is not significant in explaining returns for the stocks in the sample but the lack of fit of the model (especially for small stocks) warrants further examination. Perhaps as in Fama et al. (1992 and 1998) a distress factor might be helpful in explaining returns in the Colombian market. This is left to future research.

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