

Underperformance of Individual Investors and Trading Intensity:

Evidence from Colombia

Abstract

We analyze all the stock transactions executed by the population of individual investors in the Colombian Stock Exchange between 2006 and 2016 (4,685,030 trades on behalf of 39,270 individual investors), and find that households underperformed the market on a *gross* return basis by between 4% and 4.3% per year (depending on whether alpha was estimated using the CAPM, the Fama-French or the Carhart model). The underperformance of households becomes even gloomier when transaction costs are considered. The average individual investor bias its portfolio towards small, low-beta, and value stocks, and turns over 8.6 percent of its portfolio monthly. The most active traders underperform the less active traders even on a *gross* return basis.

Keywords: Household finance, rational expectations, overconfidence, Colombia,

CAPM, Fama and French, Carhart

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Introduction

On aggregate, investors must earn the market return before costs, and for every investor overperforming the market, there must also be another investor underperforming it. The analyses of the performance of individual investors has been the subject of a number of studies in developed markets. However, we still know relatively little about the performance of households in emerging stock markets. Our aim is to shed light on the performance of individual investors in Colombia, a stock market that is characterized by an active investor community, illiquidity (except for the largest companies), relatively high transactions costs, corporate governance issues, and presumably higher information asymmetries than in developed markets.

We study the performance of individual investors in Colombia making use of a unique data set of transactions corresponding to 4,685,030 trades executed on behalf of 39,370 individual investors during the period 2006-2016. The database covers the complete trading history of all individual investors in Colombia during that period. This is an advantage of our study compared to other research whereby only a sample of traders (for example, traders belonging to a certain brokerage house) were used to examine the performance of individual investors. Our study also analyzes the performance of individual investors according to the intensity of their trading activity. The study allows to test the predictions of the rational expectations model proposed by Grossman and Stiglitz (1980) and compare them to those of a model in which investors suffer from overconfidence bias (Odean, 1998). For Daniel and Hirshleifer (2015, p. 1), “...Overconfidence means having mistaken valuations and believing in them too strongly”.

The data that we use has the following positive features: It contains all the transactions executed in a specific stock market (the Colombian Stock Exchange), it comprises a relatively long period of time (between January 2, 2006, and January 29, 2016), and it allows us to identify all the transactions made by each individual investor on the database. Pedraza, Pulga and Vasquez (2017) have already used this database to analyze the trading behavior and performance of foreign investors with different management styles (we comment more about this study later). And whereas their paper focuses on the trading behavior and performance of foreign institutional investors compared to domestic institutional

investors, our study concentrates on the trading behavior and performance of individual investors on an aggregate level and in relation to the intensity of their trading.

We find that households underperform the market on a *gross* return basis by between 4% and 4.3% per year (alphas vary only slightly depending on whether they were estimated using the CAPM, the Fama-French or the Carhart model). The underperformance of households becomes even more dismal when transaction costs are considered. The average individual investors bias its portfolio towards small, low-beta stocks, and turns over around 8.60 percent of its portfolio monthly. Also, the most active traders perform worse than less active traders even on a *gross* return basis.

Section 1 presents the literature review of the study, where rational expectations and behavioral finance models on the expected performance of individual investors are discussed, and the associated empirical evidence is presented. Section 2 examines the data and presents the methodology followed in the study, Section 3 presents the results of the paper, including some robustness checks, and Section 4 offers the conclusions, potential extensions and implications of the study.

1. Literature review

The study of the trading behavior and performance of individual investors has gained an increasing interest during the past two decades. In research conducted through the late 1990s, the study of investor performance concentrated mainly on the performance of institutional investors and, more specifically, equity mutual funds. At that time, data on mutual fund returns was readily available and economists were testing whether investors were unable to earn superior risk-adjusted returns after a reasonable accounting for transaction and opportunity costs (Barber and Odean, 2013). On the institutional side of the market, most studies of mutual funds conclude that the performance of the average fund lags that of the aggregate market, and that only little evidence exists supporting the proposition that those few mutual funds that do outperform exhibit persistence.

Barber and Odean (2000) conducted a seminal study in which they analyzed the position statements and trading activity corresponding to 78,000 households at a large discount brokerage firm between 1991 and 1996. They found evidence suggesting that overconfidence leads to excessive trading. While Barber and Odean (2000) found that there is very little difference between the gross performance of households that trade frequently and those that trade infrequently,

they also determined the existence of a significant difference in returns when transaction costs (e.g., commissions, market impact, bid-ask spreads, and transaction taxes) are taken into account. More specifically, whereas households that trade frequently earned a net mean annual return of 11.4 percent, those investors that trade infrequently earned 18.5 percent. These results are consistent with models where trading originates from investor overconfidence, and are inconsistent with models in which trading arises from rational expectations. Barber and Odean (2000) also find that, after accounting for transaction costs, individual investors significantly underperform relevant benchmarks. They also conclude that: Households trade common stocks frequently, trading costs are high (around 3% in commissions and 1% in bid-ask spread), and households tilt their investments toward high-beta, small stocks.

Barber and Odean (2013) provide a synopsis of research on individual investors and their stock trading behavior and document that the behavior of individual investors detrimentally affect their financial well being because they: underperform standard benchmarks, suffer from the “disposition effect” (they tend to sell winning investments while holding on to their losing investments), are heavily influenced by past return performance and limited attention in their purchase decisions, avoid past behaviors that generated pain while repeating past behaviors that coincided with pleasure, and tend to hold undiversified stock portfolios.¹ The disposition effect is often cited as one of the main determinants of the performance recorded by individual investors.

Previously, Grossman and Stiglitz’s (1980) had developed a rational expectations model in which a group of investors choose to invest passively and others choose to acquire costly information. And while in equilibrium all investors have the same expected utility, active, informed investors earn higher pre-cost returns. These higher pre-cost returns are needed to compensate investors for the expenses associated to information gathering and processing, and are no longer abnormal when they are accurately accounted for. In a large, liquid market, information costs will probably explain only small abnormal returns.

According to Lee, Shleifer, and Thaler (1991) investor sentiment is normally attributed to individual, retail investors. Individual investors tend to place small trades, and their purchases and sales must be correlated if they are to substantially influence prices (Barber, Odean, and Zhu, 2009). These authors use transaction data and identify buyer- or seller-initiated trades to study the trading of individual investors. They find that individual investors herd, small trade

¹ The following authors have also offered reviews dedicated to behavioral economics and finance: Rabin (1998), Shiller (1999) Hirshleifer (2001), Daniel, Hirshleifer, and Teoh (2002), Barberis and Thaler (2003), Campbell (2006), Benartzi and Thaler (2007), and Subrahmanyam (2008).

order imbalances forecast future returns, small trade order imbalance is correlated with order imbalance based on trades (from retail brokers), and, over a weekly horizon, small trade order imbalance reliably predicts returns.

Barber, Lee, Liu and Odean (2009) analyze the performance of individual investors in Taiwan (the world's 12th largest stock market) using a unique and complete dataset, which contained the entire transaction data, the identity of each trader and underlying order data for the period 1995–1999. They find that trading in financial markets by individual investors causes economically large losses and that nearly all of the losses can be traced to their aggressive orders. They also construct portfolios that mimic the buying for and selling of each investor and find that while individuals lose, each group of institutional investors being analyzed (corporations, foreigners, dealers, and mutual funds) wins. Furthermore, most of the losses by individuals and the gains by institutions occur within a few weeks of trade.

In another important country study, Linnainmaa (2010) uses data from the Finnish Stock Exchange between 1998 and 2001 to identify whether an investor has placed a market or a limit order, a feature that was made possible by the characteristics of the Finnish dataset. Linnainmaa (2010) finds that individual investors underperform informed traders because they later select their limit orders. More specifically, the returns on individual investor trades that originate from limit orders lose 0.51% on the day following a trade and 3.3% over a 63 day-period. However, whereas individual investors in Finland lose money on executed limit orders, they make money on executed market orders. When gains and losses are combined, the profits are not statistically different from zero. However, the evidence from Taiwan, which has an electronic limit order market, differs from the evidence from Finland.

Most empirical research shows that individual investors behave differently from investors in rational expectations models. For example, many apparently uninformed investors trade speculatively, actively, and to their detriment, and most individual investors hold undiversified portfolios. Furthermore, when viewed as a group, individual investors make systematic (not random), buying and selling decisions. A salient finding in the literature consists in that most research concludes that the average long-run performance of individual investors is poor even before costs. However, and contrary to the long-run evidence, the returns obtained by individual investors over very short horizons (up to a week) seem to be fairly strong. For example, Kaniel, Saar, and Titman (2008) find that the stocks bought by individuals in the 10 days preceding an earnings announcement outperform, on average, by about 1.5% those sold in the two days around the earnings announcement.

There exist great variation in performance across individual investors, and this cross-sectional variation in performance can be traced to cognitive abilities (Korniotis and Kumar, 2009a conclude that smarter investors outperform others by about 3.6% per year), IQ (Grinblatt, Keloharju, and Linnainmaa, 2010, determine that in Finland the spread in returns earned by low versus high IQ investors is a significant 2.2% per year), experience (Campbell, Ramadorai and Ranish, 2014, document that both investment experience and feedback from investment returns affect investor behavior, performance, and favored stock styles), age (Korniotis and Kumar, 2009b, find that investment performance declines with age), optimism (Kaplanski, Levy, Veld, and Veld-Merkoulova, 2015, find that individuals having a more positive sentiment also have higher return expectations and a higher intention to buy stocks), and gender (Barber and Odean, 2001, find that men perform worse than women and link these results to the fact that men trade more often than women because they are more prone to overconfidence). The cross-sectional variation in performance has also been linked to investment skill, investment style, and location.

A few notable studies find evidence that individual investors overperform the market. For example, Ivkovich, Sialm and Weisbenner (2005) find evidence that individual investors that have relatively concentrated portfolios outperform those individuals that are more diversified. Ivkovich and Weisbenner (2005) show that individuals outperform the market when they buy the stocks of companies that are close to their homes (compared to the stocks of far-away companies). Finally, and as commented before, Kaniel, Saar and Titman (2005) find that stocks that are heavily purchased by individuals in one month generate positive excess returns in the subsequent month. A criticism to the previous findings consists in that, given the low diversification of many of the accounts of these studies; one would expect substantial cross-sectional variation in performance by chance (even if there are no differences in skill, Barber and Odean, 2013).

We still know little about the performance of individual investors in emerging markets (with the exception of Taiwan, which is nonetheless a relatively large market within the emerging markets, and one where day-trading is very prominent). Also, is this performance affected by the intensity of trading activity? These are the questions that we try to answer in this study, focusing in the case of Colombia.

2. Data and Methodology

The dataset that we use was provided by the Colombian Stock Exchange and contains all the stock transactions executed between January 2, 2006, and January 29, 2016.² The dataset includes the date and time of each transaction, the transaction price, the number of shares traded, the name of the company, whether the order was a buy or a sell trade, a stock identifier, and a broker ID. As commented by Pedraza, Pulga, and Vasquez (2017), who used this data to compare the performance of domestic versus foreign institutional investors in Colombia, a key aspect of the dataset, and one that is very relevant for us, is that every purchase and sell record has a distinctive investor ID number that allows the identification of each transaction executed on behalf of each investor throughout the whole sample period. It is important to point out here that most of the existent empirical literature often proxies the transactions performed by individual investors as those that correspond to small trades. However, we have the advantage that we can identify whether a transaction corresponds to an individual or to an institutional investor because we have a distinctive investor ID.

The initial dataset includes all the buy and sell stock trades, and excludes repurchase agreements and shares tendered for short sales.^{3 4} We also excluded stocks for which there were a total of less than one thousand transactions during the sample period, investors that transacted less than 20 times during the whole sample period, as well as transactions that were below 154,500 Colombian Pesos (between around USD 500 and USD 750, depending on the exchange rate of the respective date). Stocks that did not trade during three months or more were also excluded. Finally, we excluded those investors that did not perform trades for periods of at least 24 months. We are left with 39,370 individual investors. Also, stock prices were adjusted for splits and other corporate events that affected their nominal value.

We do not know the exact portfolio that each investor has in the data set. Therefore, and similar to the procedure followed by Pedraza, Pulga and Vasquez (2017), we created investor portfolios assuming a zero initial holding condition

² We would like to thank Adriana Cardenas and other members of the Colombian Stock Exchange Research Committee for kindly providing the data.

³ Short-sales were allowed in the Colombian Stock Exchange during the period of analysis. However, investors had to close short positions by the end of each trading day, and therefore we were not able to use short sale information in our study, as this information is not observable in the database.

⁴ When the price of a stock changes more than 10% relative to its reference price, the Colombian Stock Exchange suspends trading in that stock for 30 minutes. Also, all transactions in the exchange are suspended until the next trading day if the COLCAP index declines more than 10% during a trading session. The COLCAP is a value-weighted index. As of the first quarter of 2018, it included 25 companies, the largest of which was Ecopetrol (12.70% of the total market capitalization of the index), followed by Bancolombia (12.13%).

for each investor the first date that he or she appears in the dataset. We then added daily stock holdings to each investor over time. For each investor we identified negative holdings at the end of the whole period of the dataset, and add that value to the zero initial holdings in order to account for the short-sell ban. Errors in our measure from differences in initial conditions would decline over time if portfolio turnover is large enough and considering that the sample period spans 10 years. Finally, we obtained stocks returns, share prices, trading volume, and bid-ask spreads from Bloomberg, Datastream and the Colombian Stock Exchange.

We measure investor turnover as the maximum between the sum of monthly buys and sells by an investor, divided by the value of the portfolio.

We calculate three measures of risk-adjusted performance. First, we calculate alpha starting with the CAPM Model (Jensen's alpha). We estimate the following monthly time-series regression in which we regress the monthly excess return earned by each individual investor ($r - r_f$) on the market excess return.

$$r - r_f = \alpha + \beta_1(r_m - r_f) + \varepsilon$$

Where r_f is the risk-free-rate, and $(r_m - r_f)$ is the market excess return.

Second, we employ an intercept test using the three-factor model developed by Fama and French (1993), also known as the three-factor alpha. Thus, to evaluate the performance of individuals in aggregate, we estimate the following monthly time-series regression:

$$r - r_f = \alpha + \beta_1(r_m - r_f) + \beta_2(SMB) + \beta_3(HML) + \varepsilon$$

Where, as before, r_f is the risk-free-rate, $(r_m - r_f)$ is the market excess return, SMB is calculated as the return on a value-weighted portfolio of small stocks minus the return on a value-weighted portfolio of large stocks, and HML is calculated as the return on a value-weighted portfolio of high book-to-market stocks minus the return on a value-weighted portfolio of low book-to-market stocks. Barber and Odean (2000) argue that one should place particular attention on the Fama-French intercept tests, considering that individual investors tend to bias their portfolios toward small stocks, and that the three factor model offers a reasonable adjustment for this small stock bias.

The third intercept test is performed using the Carhart four-factor model. This intercept is known as the four-factor alpha. The Carhart four-factor model adds a momentum factor to the three-factor model of Fama and French.

Momentum (*WML*) is the tendency for stock prices to continue to rise when a stock price is increasing and to continue to decrease when stock prices are declining. Momentum is calculated constructing a zero-cost portfolio that is long the previous 12-month return winner stocks and short the previous 12-month loser stocks. It is the monthly premium on winners minus losers.

$$(r - r_f) = \alpha + \beta_1(r_m - r_f) + \beta_2(SMB) + \beta_3(HML) + \beta_4(WML) + \varepsilon$$

The portfolios for the factors (i.e., market, *SMB*, *HML* and *WML*) for Colombia were calculated by Pedraza, Pulga, and Vasquez (2017), who kindly provided these data to us. The risk-free-rate that we employed is the one-month Colombian T-bill rate.

3. Results

We first comment on a few characteristics and statistics of the Colombian Stock Exchange. During the sample period 2006-2016, the aggregate stock market capitalization of Colombia ranged between a minimum of 34% of GDP in 2005 and a maximum of 73% in 2012 (ending at 35% in 2015), and the number of listed firms started in a total of 68 in 2005 and ended in 65 in 2015. According to evidence presented by Pedraza, Pulga and Vasquez (2017), between 2006 and 2010 domestic individual investors accounted for 46% of all stock transactions (in total value) in the Colombian Stock Exchange, and for 27% between 2011 and 2016.⁵ The decline between the two sub-periods could be attributed to the effects of the global financial crisis of 2008-09 on subsequent years, which might have affected individual investors harshly than institutional investors, and the negative effects of the bankruptcy of Interbolsa, the largest stock brokerage in Colombia and responsible for handling around 25% of all the transactions of the Colombian Stock Exchange, in late 2012 (OECD, 2017). This brokerage firm had close to 20,000 clients and its demise affected the confidence of investors in the system.

Table 1 shows the descriptive statistics of our database. A total of 4,685,030 trades were executed on behalf of 39,370 individuals. The mean number of trades is 133.64, and the median is 45. The number of trades is strongly skewed

⁵ Domestic institutions (corporations, pension funds, mutual funds, brokerage firms, and others) were responsible for 50% of all the transactions (in total value) between 2006 and 2010, and 27% between 2011 and 2016. Finally, foreign investors accounted for 4% and 17% of all the transactions in the periods 2006-2010 and 2011-2016, respectively. The participation of individual investors among foreign investors was negligible.

to the right, similar to the cases of volume and trade size. This skewed to the right behavior has also been documented by Barber and Odean (2000) for the U.S., and by Barber, Lee, Liu and Odean (2009) for the case of Taiwan, among other studies, wherein a small percentage of all the households is responsible for a large fraction of all the trades and volume executed. Mean commissions were 2.47% (median was 2.19%). Mean commission decline as the volume increases, as the commissions charged by brokerage houses decrease when the total volume traded by the investor increases. Monthly mean turnover is 8.60, a number that is slightly higher than the figure reported by Barber and Odean (2000), which was around 6.0.

Results for the panel regressions on the three measures of risk-adjusted performance (CAPM, Fama and French or 3-factor model, and Carhart or 4-factor model) are presented in Table 2. Whereas Panel A of the table presents the results for the gross return performance of individual investors in aggregate, Panel B shows the net returns results. Results from the three models clearly indicate that households underperform, even in terms of gross returns (recall that, in turn, Barber and Odean, 2000, had found that there was very little difference between the gross performance of individual investors that traded frequently and those that traded infrequently). The alphas range from -0.33% per month to -0.36% per month on a gross return basis, and the underperformance is even worse when transaction costs are included. The six alphas are statistically significant at 1%. The underperformance by individual investors represents between 4% and 4.3% on an annualized basis. These results certainly indicate that individual investors in Colombia would have earned higher returns if they had invested in the aggregate stock market. Finally, we also found that only 6.73% of the population of households was able to earn a positive alpha net of transaction costs.

We now turn to the analysis of the coefficient estimates on the market, size, book-to-market, and momentum factors. On aggregate, individual investors tend to bias their portfolios toward small stocks, as suggested by the positive and small coefficients on *SMB* for both the three and four-factor models (results significant at the 1% level). Furthermore, the market beta for stocks held by households is less than one, which is intriguing and suggests that individual investors hold a portfolio of stocks that differs in some respects from the market portfolio. Individual investors in Colombia have a slightly negative exposure to the *HML* factor, and a slight tilt toward momentum (*WML*), both coefficients being significant at the 1% level in all specifications. We can compare these results to those presented by Pedraza, Pulga, and Vasquez (2017) for institutional investors in Colombia. The exposure of these investors (both domestic and foreign) to the factors on the CAPM and the Carhart model (the two models that they use) show, as opposed to our case, are higher,

although still lower than one, exposure to the market factor, and a small and negative exposure of institutional investors to the *SMB* factor, consistent with institutional investors tilting their portfolios toward larger companies.

3.1. Performance and trading

In the rational expectations model proposed by Grossman and Stiglitz (1980) investors will trade until the marginal benefit of transacting equates to or exceeds the marginal costs of the trade, including information costs. According to this model, active and passive investors have the same expected utility. On the other hand, in models in which investors suffer from overconfidence, investors will trade excessively, and trading, at the margin, will decrease their expected utility (see, for example, the model proposed by Odean, 1998). The overconfidence bias is suffered by investors that are absolutely confident of their decisions, leading to overestimations or exaggerations (for a review of the overconfidence bias, see Daniel and Hirshleifer, 2015).

As explained by Barber and Odean (2000), in the model developed by Grossman and Stiglitz, active traders must earn higher expected gross returns to compensate their higher trading costs. Furthermore, this model predicts that the gross risk-adjusted return performance of the most active investors will be higher than that of investors having low turnover, but both types of investors will have similar net risk-adjusted returns. On the other hand, the overconfidence model predicts that the net return performance of investors with high turnover will be lower than that of investors with low turnover, while making no prediction about the differences in gross returns.

To test these two competing models, we follow a procedure similar to that employed by Barber and Odean (2000), dividing the sample of investors into quintiles based on mean monthly turnover. We then proceeded to estimate the parameters of the CAPM, Fama and French's three-factor model, and Carhart's four-factor model for each turnover by quintile. Results are shown in Table 3 (once again, whereas Panel A of the table presents the results for the gross return performance of individual investors in aggregate, Panel B shows the net returns results). First of all, it is salient to observe that the gross return performance, which is negative for each quintile, deteriorates monotonically as one moves from the lowest to the highest trading turnover quintile of investors by turnover, regardless of the model used to measure performance. Whereas low trading intensity quintiles underperform by between 0.26% and 0.29% per month, high trading intensity quintiles do so by between 0.40% and 0.42%. The difference in gross return performance between high turnover and low turnover investors ranges from 1.5% to 1.7% (on an annualized basis), depending on the model. These results are

clearly at odds with the prediction of the model of Grossman and Stiglitz (1980) and can be accommodated to the model proposed by Odean (1998). In short, those households who traded the most were not only unable to earn higher gross returns, they underperformed investors who traded less on a gross return basis. The coefficient estimates reveal that high turnover households tilt their portfolios more heavily toward low-beta and momentum stocks and less heavily toward value stocks, than do the low turnover households.

Finally, and as a robustness check to our main results, we used volume traded (in COP, or Colombian Pesos) as an alternative measure of trading activity, and we also divided the sample by quintiles based on trading commissions spent by investors. Once again, we estimated alphas for the CAPM, the Fama and French 3-factor model, and the Carhart 4-factor model (results are available upon request). In the case of volume, and similar to the case of number of trades that we used as the base case before, we found that alpha is negative for each quintile, and declines as one moves from the lowest to the highest quintiles by volume, on both a gross and a net return basis, and regardless of the model. A similar result is found when we construct the quintiles based on trading commissions spent.

These results reinforce the message that higher levels of trading activity are associated with inferior performance, even on a gross return basis. Individual investors are at an informational disadvantage compared to other investors (e.g. institutional investors) and may also suffer from behavioral biases, such as overconfidence. These features may well explain the inferior performance of households that has been documented in most of the literature. It could be contended that information asymmetries are more prevalent and severe in an emerging and relatively small stock market such as Colombia's, than in developed stock markets. This argument, combined with lower levels of liquidity and higher transaction costs on average in emerging markets, may well predict that the underperformance of individual investors in emerging markets should be expected to be worse than the underperformance of households in developed markets, and that higher levels of trading activity by individual investors would be penalized, on average, with lower gross and net returns. For instance, in the case of the Colombian stock market, Karolyi (2015) finds that while this market fares relatively well in terms of legal investor protection, it still suffers from market capacity constraints, operational inefficiencies and corporate opacity.

4. Conclusions, possible extensions and implications

In this study, we have determined that individual investors in Colombia underperformed the market on a gross return basis by between 4% and 4.3% per year (depending on whether alpha was estimated using the CAPM, the Fama-French or the Carhart model) between 2006 and 2016. These findings are even more disappointing to households when one considers that the COLCAP index declined by 5.8% per year during the period of study. These results were obtained after analyzing all the stock transactions executed by the universe of individual investors in the Colombian Stock Exchange. The underperformance of households becomes even bleaker when transaction costs are considered. We also found that the average individual investor bias its portfolio towards small, low-beta, and value stocks, and turns over around 8.6 percent of its portfolio monthly. Finally, we also determined that the most active traders (measuring trading activity by either number of trades or volume) underperformed the less active traders even on a gross return basis.

Our results are in conflict with Grossman and Stiglitz's (1980) rational expectations model, but can be consistent with models in which investors suffer from overconfidence. And it could be argued that overconfidence is penalized harsher (in terms of lower gross and net returns) in emerging markets (which tend to be characterized by illiquidity, higher transaction costs, information asymmetries, and corporate governance issues), compared to the case of trading in developed capital markets, where most of the studies on the performance of individual investors have been undertaken.

We could extend this study by analyzing whether individual investors that place limit orders underperform informed traders, following the study by Linnainmaa (2010) on the Finish Stock Exchange. In the case of the Bogota Stock Exchange, and before February, 2009, the market functioned as a continuous trading system from 8:00 to 13:00 on weekdays and investors were only permitted to place limit orders. However, after February 9, 2009, a new trading platform was introduced, allowing market and stop orders, and a batch auction was introduced during the last five minutes of each trading day (Pedraza, Pulga, and Vasquez, 2017). These features of the Colombian stock market allow us to conduct this study. Also, we could analyze whether individual investors that have relatively concentrated portfolios outperform those individuals that are more diversified, following the study by Ivkovich, Sialm and Weisbenner (2005).

According to Wyman (World Economic Forum, 2016), over the last decade, retail investors were attracted to invest in the Bogota Stock Exchange through the launching of a number of "democratization" programs aimed at incorporating new investors to the stock market. For example, in 2007, Ecopetrol, the largest oil company in Colombia, sold stocks through an IPO to almost half a million new investors. A new IPO to small investors followed in 2011. While

programs such as Ecopetrol's were successfully in attracting interest from individual investors, they also caused the portfolios of many of these investors to be undiversified. When oil prices declined in late 2014 and the stock prices of oil companies suffered as a result, investors experienced a loss of confidence in the market.

To restore investor confidence in the stock market, the offering of broad financial education programs for small investors will be of utmost importance, as well as the reinforcement of regulation and the improvement of corporate governance standards. Regarding this latest issue, Wyman (World Economic Forum, 2016) comments that the Colombian stock exchange still faces a number of challenges that may be restraining the disposition to invest in the exchange (most notably, there exists a need to reinforce the protection of the rights of minority shareholders so that issuers can entice interest from a wide range of investors), notwithstanding important efforts that have already been made to improve corporate governance practices in Colombia (see OECD, 2017). Furthermore, there exists a need to improve liquidity so that transaction costs can be reduced, new investors be attracted, and systemic and liquidity risks decreased. The strengthening of the private pension system accompanied by an increased interest from foreign investors, as well as new democratization programs, will certainly help a long way to increase liquidity.

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Table 1
Descriptive statistics

The sample of individual investors at the Colombian Stock Exchange from 2006 to 2016 records 4,685,030 trades of 39,370 individuals. Trades is the number of transactions, either buys or sells, during the period performed by each investor. Volume is the monetary amount traded by investor, expressed in Million COP. Trade size is expressed in Million COP. Commissions are calculated as the total commission expense divided by the total volume traded by investor, and is expressed in percentage. Monthly turnover is calculated as the maximum of monthly buys or sells divided by the value of shares held during the month

	Mean	25th Percentile	Median	75th percentile	Sd	Observations
Trades	133.64	28	45	93	671.13	4,685,030
Volume	4,800	352	788	2,150	42,700	4,685,030
Trade size	35.91	12.57	17.51	23.11	63.62	4,685,030
Commissions	2.47	1.83	2.19	2.85	1.05	4,685,030
Monthly turnover	8.60	6.52	8.28	10.17	3.13	4,685,030

Table 2
Individual investors performance

This table reports estimates of the CAPM, the Fama and French 3-factor model and the Carhart 4-factor model for individual investors at the Colombian Stock Exchange from 2006 to 2016. The dependent variables are the gross and net returns in excess of the one-month Colombian T-bill rate. Market is the return in excess of the Colombian market index (COLCAP) relative to the one-month T-bill rate. SMB is the return on a portfolio of small cap stocks minus big cap stocks. HML is the return on a portfolio long in high book-to-market ratio and short in low book-to-market ratio. WML is the return on a portfolio long on winner stocks during the previous 12 months and short on losers shares during the same period. Note: t-statistics in parentheses. */**/** indicate that the coefficient estimates are significantly different from zero at the 10%, 5%, 1%.

	Gross risk-adjusted return			Net risk-adjusted return		
	CAPM	3-Factor	4-Factor	CAPM	3-Factor	4-Factor
Market	0.350*** (1061.30)	0.379*** (1018.98)	0.387*** (1015.35)	0.350*** (1050.81)	0.378*** (1004.79)	0.386*** (1001.12)
SMB		0.114*** (170.66)	0.128*** (186.88)		0.112*** (166.13)	0.126*** (182.10)
HML		-0.0443*** (-67.57)	-0.0444*** (-67.73)		-0.0422*** (-63.60)	-0.0423*** (-63.75)
WML			0.0570*** (94.96)			0.0568*** (93.36)
Constant	-0.00355*** (-187.60)	-0.00326*** (-172.18)	-0.00339*** (-178.75)	-0.00373*** (-195.51)	-0.00345*** (-179.81)	-0.00358*** (-186.24)
Observations	4,406,933	4,406,933	4,406,933	4,406,933	4,406,933	4,406,933
Investors	39,370	39,370	39,370	39,370	39,370	39,370
R-squared	0.2046	0.2100	0.2116	0.2004	0.2055	0.2071
FE	Investor	Investor	Investor	NA	Investor	Investor

Table 3
Individual investors performance by trades

This table reports estimates of the CAPM, the Fama and French 3-factor model and the Carhart 4-factor model for individual investors at the Colombian Stock Exchange from 2006 to 2016 sorted by quantiles of trades. Panel A exhibits the coefficient estimates on gross excess returns and Panel B on net excess returns. Market is the return in excess of the Colombian market index (COLCAP) relative to the one-month T-bill rate. SMB is the return on a portfolio of small cap stocks minus big cap stocks. HML is the return on a portfolio long in high book-to-market ratio and short in low book-to-market ratio. WML is the return on a portfolio long on winner stocks during the previous 12 months and short on losers shares during the same period. Note: t-statistics in parentheses. */**/** indicate that the coefficient estimates are significantly different from zero at the 10%, 5%, 1%.

Trades	CAPM		3-Factor				4-Factor				
	Alpha	Market	Alpha	Market	SMB	HML	Alpha	Market	SMB	HML	WML
Panel A. Gross risk-adjusted returns											
Group 1 - Low	-0.00294*** (-66.52)	0.400*** (515.30)	-0.00262*** (-59.34)	0.428*** (487.25)	0.118*** (75.31)	-0.0623*** (-39.89)	-0.00274*** (-61.71)	0.437*** (480.84)	0.131*** (81.48)	-0.0622*** (-39.71)	0.0519*** (36.67)
Group 2	-0.00328*** (-73.46)	0.378*** (483.54)	-0.00299*** (-66.73)	0.407*** (460.95)	0.116*** (73.31)	-0.0501*** (-32.10)	-0.00311*** (-69.31)	0.415*** (457.60)	0.129*** (79.63)	-0.0500*** (-32.08)	0.0530*** (37.29)
Group 3	-0.00353*** (-82.82)	0.353*** (475.04)	-0.00323*** (-75.70)	0.383*** (457.26)	0.119*** (78.82)	-0.0458*** (-31.02)	-0.00335*** (-78.50)	0.390*** (455.09)	0.132*** (85.63)	-0.0459*** (-31.07)	0.0548*** (40.53)
Group 4	-0.00378*** (-94.45)	0.331*** (476.52)	-0.00350*** (-87.49)	0.359*** (459.27)	0.111*** (78.40)	-0.0404*** (-29.39)	-0.00363*** (-90.59)	0.367*** (458.51)	0.124*** (86.05)	-0.0406*** (-29.57)	0.0570*** (45.11)
Group 5 - High	-0.00422*** (-108.24)	0.292*** (433.97)	-0.00395*** (-101.33)	0.321*** (426.20)	0.112*** (81.43)	-0.0255*** (-19.30)	-0.00411*** (-105.27)	0.331*** (429.48)	0.127*** (91.24)	-0.0261*** (-19.76)	0.0703*** (57.32)
Panel B. Net risk-adjusted returns											
Group 1 - Low	-0.00316*** (-70.85)	0.400*** (508.42)	-0.00286*** (-63.86)	0.427*** (480.29)	0.116*** (73.13)	-0.0604*** (-38.22)	-0.00297*** (-66.38)	0.435*** (475.37)	0.129*** (79.3)	-0.0601*** (-38.04)	0.0512*** (35.88)
Group 2	-0.00348*** (-76.93)	0.378*** (476.46)	-0.00319*** (-70.38)	0.406*** (453.87)	0.114*** (71.2)	-0.0480*** (-30.33)	-0.00331*** (-72.90)	0.414*** (450.51)	0.127*** (77.4)	-0.0479*** (-30.31)	0.0527*** (36.54)
Group 3	-0.00371*** (-86.03)	0.353*** (468.78)	-0.00341*** (-79.09)	0.382*** (450.91)	0.117*** (76.83)	-0.0441*** (-29.49)	-0.00354*** (-81.81)	0.390*** (448.68)	0.130*** (83.49)	-0.0441*** (-29.54)	0.0542*** (39.62)
Group 4	-0.00394*** (-97.40)	0.331*** (470.41)	-0.00367*** (-90.62)	0.358*** (453.13)	0.109*** (76.38)	-0.0380*** (-27.35)	-0.00380*** (-93.66)	0.366*** (452.37)	0.122*** (83.93)	-0.0382*** (-27.52)	0.0569*** (44.47)
Group 5 - High	-0.00436*** (-110.39)	0.292*** (428.77)	-0.00409*** (-103.64)	0.321*** (420.92)	0.110*** (79.53)	-0.0232*** (-17.38)	-0.00425*** (-107.56)	0.331*** (424.27)	0.126*** (89.33)	-0.0238*** (-17.84)	0.0709*** (57.12)