

The disposition effect in bonds and stocks

New evidence from an emerging market

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The disposition effect in bonds and stocks. New evidence from an emerging market

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Abstract

This study examines whether the disposition effect holds in both stock and fixed income trades, for different types of investors (institutions, foreigners and, individuals) in an emerging market. Using a unique and proprietary database of the Colombian stock exchange, this paper broadly applies Odean's method (1998) to measure if investors are reluctant to realize losses. This is the first study to measure disposition effect in a fixed income market. In general, the results indicate a consistently higher disposition effect in stocks compared to bonds. Moreover, investors holding both bonds and stocks, present a positive relation between the degree of disposition effect in each market. In addition, I find a significant disposition effect in local individuals and institutions, in both fixed income and stocks markets, higher in the former group. On the contrary, foreign investors do not exhibit disposition effect in neither market.

Keywords: Disposition effect; behavioral finance; foreign investors; institutional investors; individual investors.

JEL classification: G11, G14, G40

1 Introduction

The classic financial models assume that investors behave under the premises of a utility maximizing agent, rational in processing information. However, the empirical evidence shows that, in contrast, the agents fall short of this ideal and exhibit behavioral biases that affect their decision making (e.g. [Bailey, Kumar, and Ng 2011](#); [Barber and Odean 2001](#); [Barberis and Huang 2001](#); [Kahneman and Tversky 1979](#)). One of the most studied bias is the well-known tendency of investors to sell stocks whose price has incremented while holding securities that have dropped in value. In other words, this bias, known as disposition effect, makes traders

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sell securities held for a profit at a quicker rate than those losing value (Odean, 1998).

The term "disposition effect" was coined by Shefrin and Statman (1985). The authors explain it in a theoretical framework consisting of four components: Prospect Theory, mental accounting, regret aversion, and self-control. Each of these components contributes something distinctive to the understanding of the bias. Since Shefrin and Statman (1985), a large range of academic research corroborate the presence of disposition effect in the decisions of investors, in both experimental and empirical settings. There is evidence in stock markets of Hungary (Ormos & Joó, 2014), Israel (Shapira & Venezia, 2001), Taiwan (Barber, Lee, Liu, and Odean 2007; Cheng, Lee, and Lin 2013) and United States (e.g. Garvey and Murphy 2004; Hur, Pritamani, and Sharma 2010; Odean 1998)¹. Besides stocks, there is also evidence of this bias in futures (Choe and Eom 2009; Frino, Johnstone, and Zheng 2004), stock options (Heath, Huddart, & Lang, 1999) and the housing market (Genesove & Mayer, 2001).

The disposition effect is a costly behavioral bias with a negative impact in investment performance. For example, Odean (1998) shows that, on average, for winners that are sold, the excess return over the following year is higher (2.4% above the market) than for losers that are not sold (1% below the market). According to the author, "investors who sell winners and hold losers because they expect the losers to outperform the winners in the future are, on average, mistaken" (p. 1790). Also, Seru, Shumway, and Stoffman (2009) find that returns are substantially higher in the lowest disposition quintile than in the highest quintile in the Finnish stock market. Similarly, Choe and Eom (2009) show a negative impact of this bias on the performance of institutions, foreigners and individuals in KOSPI futures markets.² In addition, Bailey et al. (2011) investigate the effects of behavioral biases on fund style and expenses choices of US individual investors. They find that investors with disposition effect tend to hold individual stocks and to avoid mutual funds and low expense index funds. Furthermore, when investing in mutual funds they tend to select high expense funds and time their buys and sells poorly, damaging portfolio's performance³. When these authors focus on retirement accounts, they find the same results.

Also, this is an interesting behavioral bias to study considering its effects on price formation and market efficiency. For instance, Grinblatt and Han (2005) document that the disposition effect creates a spread between a stock's fundamental value and its equilibrium price, and induces price underreaction to new information. Spread convergence, in turn, generates pre-

¹There is also experimental evidence from the Estonian (Talpsepp, 2011) and German (Weber & Camerer, 1998) stock markets and additional empirical evidence for Australian investors in IPO and index stocks (Brown, Chappel, da Silva Rosa, & Walter, 2006) and Chinese stock markets (Visaltanachoti, Lu, & Luo, 2007)

²Based on the performance implications of disposition effect, the investment companies should implement ways to detect disposition effect and reduce its influence on their portfolio managers (Cici, 2012).

³Cici (2012) show that "disposition-driven behavior affects the investment styles of mutual funds, causing the affected portfolios to have lower market betas and characteristics of value-oriented and short-term contrarian styles. Such impacts on mutual fund investment styles, although unintentional, could hurt investors by altering their asset allocations" (p. 818).

dictable returns (e.g. momentum). In the same way, [Frazzini \(2006\)](#) use data on mutual fund holdings to show that disposition effect causes underreaction to news announcements and, thereby return predictability and post-announcement price drift. In addition, [Hur et al. \(2010\)](#) show that the disposition effect in stocks with greater individuals' presence generates a stronger momentum since these investors are more prone to this bias.

The objective of this paper is to analyze whether the disposition effect holds for different types of investors (institutions, individuals and foreigners) in the Colombian stock and fixed income markets. To perform my analysis, I use a unique and proprietary transactional database provided by the *Bolsa de Valores de Colombia* (henceforth, BVC) -Colombian Stock Exchange-. The dataset contains for all trades an identifier for both buyer and seller for the period 2008-2016. Following the methodology of [Barber et al. \(2007\)](#),⁴ I quantify the degree of disposition effect for each particular investor. The data allow distinguishing between different types of investors (institutions, individuals and foreigners) and sub-types of institutions. Furthermore, I implement a regression analysis to study the relation between disposition effect and investor's characteristics like experience and sophistication.

The contribution of this research to the literature of disposition effect is two-fold. To start with, to the best of my knowledge, this is the first paper on the disposition effect in a fixed income market. The absence of empirical evidence in this type of market may be explained by the scarce availability of detailed data, since in most bond markets the largest portion of trading activity occurs over-the-counter ([Díaz & Escribano, 2017](#)). This study provides evidence of disposition effect by type of investor in an important emerging fixed income market, organized in a exchange. BVC holds the eight largest bond trading, measured in dollars, out of 48 exchanges with reported data in 2017. Moreover, it is the largest fixed-income exchange in the Western Hemisphere and the third in emerging markets ([World Federation of Exchanges, 2018](#))⁵. It is important to highlight that empirical studies on exchanges have advantages over OTC markets in terms of price formation, liquidity, and transparency ([Hendershott & Madhavan, 2015](#)). Second, this is the first study to test disposition effect across different markets for the same investor. As the database includes unique investors identifiers, it is possible to correlate measures of disposition across stocks and fixed income trades for the same agent. This analysis allows us to test whether this bias is in part investor-specific or if it is entirely market-dependent.

The main results can be summarized as follows: 1) the disposition effect is pervasive in both fixed income and stock markets, but it's lower in the former; 2) consistent with previous findings, the analysis by type of investors shows that individuals and institutions sell winners

⁴The methodology of [Barber et al. \(2007\)](#) follows Odean's method (1998) with one important difference. Odean (1998) calculated an investor's paper gains and paper losses only for days on which the investor made a sale, while Barber et al. (2007) do so every day. With this improvement in the method, I am able to compare the measure of disposition effect across investors holding differing portfolio sizes.

⁵Most of the trading of bonds worldwide takes place in OTC markets and only in a few countries, it is organized in exchanges.

at a faster rate than losers in both markets. Nonetheless, individuals exhibit a more pronounced disposition effect compared with the other types of investors. In contrast, foreigners show no evidence of this behavioral bias; 4) The analysis by sub-types of institutions suggests that Family Offices are the institutional investors with more propensity to the disposition effect in both samples. On the contrary, long term institutions and brokerage firms do not show evidence of this bias; 5) the cross-sectional study shows a negative relation between experience and disposition effect; 6) controlling by several investor's characteristics, there is a significant positive relationship between the disposition effect in the stock and treasury market for investors trading in both.

The most related study is [Barber et al. \(2007\)](#), who analyze the disposition effect in the context of the Taiwanese stock market for five years ending in 1999. They also have investor identifiers and classification of investors. The authors find that individuals, corporations, and dealers are reluctant to realize losses, while mutual funds and foreigners are not. I have some important differences. First, besides studying the disposition effect in a stock market, I also provide evidence of this bias in a fixed income market. Second, our analysis focus on a longer time period and in a more detailed classification of institutional investors. Specifically, I am able to document the results for four important actors in the market: pension funds, insurance companies, brokerage firms, and family offices. Third, I also study the relationship between disposition effect and investor's characteristics such as sophistication and experience.

The remainder of this paper is organized as follows. The next section describes the most important related literature. I highlight the seminal works on the subject and establish our hypotheses based on the previous empirical evidence. Section 3 describes the data employed and provides some descriptive statistics by type of investor. Section 4 introduces the methodology used to calculate the disposition effect and the model employed to analyze the relationship between the characteristics of investors and disposition effect. Section 5 presents the results for both fixed income and stock markets. Finally, section 6 summarizes the main conclusions.

2 Disposition effect and empirical evidence

The seminal work in the empirical analysis of the disposition effect is the article of [Shefrin and Statman \(1985\)](#). Using monthly data on US mutual fund stocks from 1961 to 1981, they report that investors "sell winners too early and ride losers too long", naming this finding 'disposition effect'. To explain this behavioral tendency, the authors start with the Prospect Theory⁶ but complement it with insights from three behavioral biases: mental accounting, regret aversion, and self-control problems. Prospect theory is the descriptive framework of choice under uncertainty developed by [Kahneman and Tversky \(1979\)](#). Unlike the classical

⁶[Barberis and Xiong \(2009\)](#) show with a different theoretical model that the link between the Prospect Theory and the disposition effect is not always present. In particular, the prospect theory does not explain the disposition effect in cases when the number of trading periods is low and when expected risky asset returns are high.

utility functions, in Prospect Theory the utility function is defined on gains and losses relative to a reference point and is concave (convex) in the domain of gains (losses). This S-shaped function is also steeper for losses than for gains. This theory predicts that since the decision maker classifies outcomes as gains or losses relative to the reference point, she behaves as risk-averse when facing expected gains but as risk-seeker in the loss domain. Consequently, if investors behave under these premises, they tend to take more risk following losses (by holding onto their losses) but reduce risk exposure after gains (by selling their winners).

Three other behavioral biases contribute to Prospect Theory in explaining disposition effect. Mental accounting refers to the tendency to separate gambles into different accounts based on a variety of subjective criteria, thereby neglecting potential dependencies (Thaler, 1985). An investor committing this bias tends to break financial decision-making into smaller and tractable mental accounts. In this setting, having to close a mental account at loss is “the major obstacle standing in the way of loss realization” (Shefrin & Statman, 1985, p. 781)⁷. On the other hand, investors affected by regret aversion tend to avoid making a decision worrying that in hindsight an alternative choice would have fared better than the chosen one. While closing a stock account at loss induces regret, when the stock rebound, closing it at a gain not so much. Thus, avoiding regret might lead to realize gains too early and to postpone realizing losses. Finally, the absence of self-control causes people to fail in achieving long-term objectives due to a lack of discipline in the short term. In particular, realizing a loss is painful in the short term, but usually pays off in the long-run whenever an underperforming asset is sold. However, investors with low self-control behave more impatiently and rush to cash in gains and, at the same time, lack the willpower to cut losses.

Starting with Shefrin and Statman (1985), several researchers have demonstrated the presence of disposition effect using different investor databases. One of the prominent works is Odean (1998) who analyzes the trading records of 10,000 accounts at a US discount brokerage from 1987 through 1993. He finds that investors realize their gains more readily than their losses -except in December when tax-motivated selling prevails- and this is not explained by rebalancing trades or transaction costs. Weber and Camerer (1998) also confirm the existence of the disposition effect through an experimental setting in Germany. They analyze an investment experiment consisting of six securities with predetermined prices, finding that more than 70% of their participants are prone to the disposition effect. Grinblatt and Keloharju (2001) employ logit regressions to show that Finnish investors are less likely to sell a stock held for a capital loss. They report the disposition effect for five investor categories: non-financial corporations, financial and insurance companies, households and government and non-profit institutions. Brown et al. (2006) analyze daily Australian Stock Exchange data for investors in IPOs and index stocks from 1995 to 2000. They find that the disposition effect is pervasive across investor classes. Studies have also found evidence of this behavioral bias in trading company stock options (Heath et al., 1999), real estate (Genesove & Mayer, 2001) and futures

⁷In fact, Thaler (1999) highlights that a realized loss is more painful than a paper loss as a result of the combination of utility function of Kahneman and Tversky (1979) and mental accounting principles.

(Choe and Eom 2009; Frino et al. 2004).

Several studies have focused on identifying differences in the disposition effect in terms of types of investors. Except for a few studies, the general finding suggests that both institutions and individuals are prone to the disposition effect and that this bias is stronger for the latter group. In addition, foreign institutions seem to be the less affected group. This is usually explained as that "institutional investors generally take larger positions than individuals, have more resources to spend on research, and in many cases, view investment as a full-time career" (Grinblatt & Keloharju, 2000, p. 55). Consequently, it is reasonable to view institutions as more sophisticated than amateurs and, accordingly, less prone to behavioral biases (Cici, 2012). Besides, as the foreign group in Colombia includes mostly institutions (Agudelo, Byder, & Yepes-Henao, 2019), the previous argument also explains why foreigners exhibit less propensity to the disposition effect.

In this regard, Shapira and Venezia (2001) analyze the records of all investment transactions of about 4,000 Israeli investors during 1994. They show that both institutional and individual investors exhibit the disposition effect, although the effect is stronger for the last group. Frino et al. (2004) show evidence of disposition effect for both on-floor professional futures traders and a matched sample of non-local professional traders. The tests suggest that the disposition effect is stronger in locals than in non-locals. Barber et al. (2007) implement a study in the Taiwanese stock market and find that individuals, corporations, and dealers are reluctant to realize losses, while mutual funds and foreigners are not. Using a proprietary database of currency trades, OConnell and Teo (2009) find that institutional investors, unlike individuals, are not prone to the disposition effect. In the KOSPI futures market, Choe and Eom (2009) show that individual investors are much more susceptible to the disposition effect than institutional and foreign investors. Talpsepp (2011) documents that contrary to individuals and institutions, foreign investors seem to exhibit a reverse disposition effect in the Estonian stock market. Based on the prevalent evidence, this work test the following hypotheses:

H₁: Both institutional and individual traders are reluctant to realize their losses in both stocks and fixed income. However, the disposition effect is stronger for individual traders.

H₂: Foreign traders exhibit less disposition effect than the two local groups, both in stocks and fixed income.

There is also evidence showing the relation between disposition and investor's characteristics. According to Cici (2012), professional investors have constant connection with sophisticated tools and continually trade securities in the markets. The experience acquired through constant trading probably makes professionals more skilled and more likely to prevent behavioral biases than the common amateur. In fact, Dhar and Zhu (2006) find empirical evidence that individuals employed in professional occupations exhibit a lower disposition bias. In ad-

dition, [Goo, Chen, Chang, and Yeh \(2010\)](#) show that investors holding college or advanced degrees have a lower disposition effect. Similarly, [Talpssepp \(2011\)](#) finds that experience and investor sophistication does seem to reduce the disposition effect bias even when controlling for different demographic and market wide variables. Similar results are found by [Da Costa Jr, Goulart, Cupertino, Macedo Jr, and Da Silva \(2013\)](#), who document that though both experienced investors and undergraduate students show the disposition effect, the more experienced traders are less affected. Following these results I establish the following hypothesis:

H₃: Experienced and sophisticated investors have a lower disposition effect.

Considering the structural differences between the the fixed income and the stock market, I expect a stronger disposition effect in stocks compared to bonds. There is anecdotal evidence driving this rationale. First of all, fixed income securities do not get as much individual investor attention as the stock market does, primarily because bonds do not offer so many opportunities of news-motivated speculation as stocks. Following previous findings of disposition effect in individuals, this lower participation of amateurs should reduce the overall disposition effect in bonds markets. Second, institutions tend to dominate the fixed income market and they often have rigid investment policies that prevent them to pursue short-term gains. For instance, long-term investors typically hold bonds to maturity or rebalance to maintain a target average duration paying little attention to short-term changes in the interest rates. Third, investors in fixed income markets tend to be larger than those in stocks. In particular, to trade in Colombian treasury market, the investor must accomplish with minimum purchase requirements. Generally, larger investors are more sophisticated ([Dhar and Zhu \(2006\)](#), [Calvet, Campbell, and Sodini \(2009\)](#), [Cronqvist and Siegel \(2014\)](#)) and, as seen before, less prone to behavioral biases. Based on these arguments I propose the following hypothesis:

H₄: The disposition effect is lower in fixed income than in stocks.

In summary, the previous literature shows the disposition effect as a behavioral bias affecting the behavior of investors in several markets and many countries. The underlying theoretical framework of this anomaly explains it as a composition of investor-specific behavioral biases. As the database provides a unique investor's identifier it is possible to relate the disposition effect in stocks and fixed income securities for the same agent trading in both markets. With this, I can examine whether the disposition effect is in part investor-specific or if, on the contrary, depends entirely on the security market. For this purpose, I also test the following hypothesis:

H₅: The disposition effect is related across stocks and fixed income, for investors that trade in both markets.

3 Data description

This study focuses on both fixed income and stock markets in Colombia. According to the annual statistics of the World Federation of Exchanges, in 2017 Colombia had the eight largest bond trading value out of 48 exchanges, the first in the Western Hemisphere and the third in emerging markets. Public debt has the largest share. In fact, according to [BVC \(2018\)](#), just 5% of traded volume was on private debt in 2017. As for the stock market, Colombia had the 4th largest Latin American stock exchange and the 13th of Emerging Economies in terms of domestic market capitalization ([World Federation of Exchanges, 2018](#)). The COLCAP index is the official reference indicator for this market and reflects changes in the prices of the most liquid issuers registered in the exchange.

The selected sample focuses on the most liquid securities of both markets: Colombian government peso-denominated treasury bonds (TES)⁸ and stocks belonging to COLCAP. The transactional database employed was provided by BVC. It contains the complete history of transactional records for the fixed income and stock market from January 2008 through November 2016. The trading data include: a) security identifier, b) investor unique identifier, c) execution price, d) the number of securities traded d) date and time of transaction, e) buy-sell indicator and, f) broker code. The BVC's database also includes the classification of investors in three categories, i.e. individuals, foreigners, and institutions. The latter is in turn classified as Brokerage Firms, Family Offices, Long Term institutions (Pension Funds and Insurance Companies) and Funds (mutual and employee funds)⁹.

Tables 1 and 2 present the number of traders and the total value of buys and sells for each investor group in the stock and treasury bond markets, respectively, during the 2008-2016 period. Column 5 of both tables shows that individual investors account for roughly 90%-97% of the total number of traders in the equity market, while in the public debt market they are lesser and more variable share (28% - 80%). The number of individual investors in the stock market has significantly diminished between 2013 and 2016 in the stock market (see column 2 of table 1). In particular, in 2013 the number of individual investors fell around 19% respect to 2012, due to a generalized loss of confidence after the collapse of the biggest brokerage firm of the country (*Interbolsa*) in 2012¹⁰. In 2014 and 2015, the fall in the oil price discouraged more

⁸TES securities are fixed-rate bonds with annual coupons. Following [Díaz and Escibano \(2017\)](#), I exclude the trading activity of TES with less than a year from its expiration. Over this period the uncertainty about the price is significantly reduced and the security has similar characteristics of Money Market instruments.

⁹I eliminate American Depository Receipts (ADRs) group. Four Colombian stocks are listed as ADRs type II or III on the NYSE. Most trades classified as such are either part of arbitrage strategies between the underlying local stock and the ADR itself or intended to move capital between the two exchanges. Following [Agudelo et al. \(2019\)](#), since I am unable to classify those trades as belonging to institutions, foreigners, or locals, I omit them from this analysis. They represent only 4.8% of the trading value in the stock market. I also eliminate institutions (133 in the treasury market, 197 in the stock market) such as banks, leasing companies, cooperatives, fiduciaries and factoring, considering that their investment objectives are different in nature from the other.

¹⁰The Interbolsa crisis was a corruption scandal that culminated with the collapse of this brokerage firm,

individuals, especially by sinking the price of the stock of the oil state company "Ecopetrol", the most actively traded share in the COLCAP Index. The decreasing number of individual investors have also affected the treasury bond market. Indeed, in 2012 the number of investors dropped by almost half compared to 2011 and this decreasing trend continued till 2016.

In terms of traded value, institutional investors contribute 40% in the stock market and more than 90% in the treasury bond market. Considering that individuals tend to hold smaller portfolios than institutions, this predominance of institutional investors in the public debt market is probably explained, not just for preferences, but also for the minimum amount requirements to trade TES¹¹. Interestingly, foreign investors reflect a growing share of the trade in both markets in the studied period. They went from 4.5% to 26.4% of the traded value of the stock market and from 1% to 35% of the participation of traders in the government bond market. This might be explained in part by the following events in the Colombian financial market during the sample period: 1) investment grade recovery of Colombian sovereign debt in June, 2011 (Fitch Ratings, 2011)¹², 2) simplification and reduction of taxes on foreign portfolio investments through the Law 1607 of December, 2012 and, 3) inclusion of new Colombian public debt securities in JP Morgan's GBI-EM index family, the most important benchmark indexes among those that follow the public debt in local currency of emerging markets (Cardozo, Hincapie, & Rojas, 2014)¹³.

then the largest player in both fixed income and stock markets, which handled about a third of trading value in the stock market (El Espectador, 2012).

¹¹BVC establishes minimum purchase quantities of TES, differing according to the nature of the security. As reference, for the most traded varieties the minimum tradable principal is 500 millions of COP (about 166.000 USD at the end of 2016).

¹²In 1999, Colombia lost the investment grade rating for its sovereign debt, as a result of the financial crisis.

¹³On March 19, 2014 JP Morgan announced the increase of Colombia's participation in the GBI-EM Global Diversified Index (from 3.2% to 8%), in the GBI-EM Global (from 1.81% to 5.60%) and in the GBI-EM Global Diversified 15% IG (from 3.07% to 8.26%) (Cardozo et al., 2014).

Table 1: Equity market: Descriptive statistics by type of trader

Year	Number of traders	Value of buys	Value of sells	% of total traders	(% of total value)	
					Buys	Sells
Individual investors						
2008	91474	11554.73	12831.65	96.15	48.52	53.88
2009	107665	9307.51	10332.74	96.62	38.01	42.19
2010	112544	14381.44	14998.91	95.56	39.61	41.32
2011	120183	13160.25	14747.55	94.96	33.70	37.76
2012	132994	11261.86	14161.40	95.19	25.59	32.18
2013	107756	7200.30	8514.30	94.38	18.92	22.38
2014	87508	6629.35	7717.72	93.44	17.20	20.02
2015	47738	4614.50	4845.28	91.28	14.97	15.72
2016	43767	4430.15	5543.59	90.86	15.19	19.01
Institutional investors						
2008	3070	10449.08	9117.00	3.23	43.88	38.28
2009	3149	13145.41	11536.51	2.83	53.68	47.11
2010	4340	16946.73	18596.30	3.68	46.68	51.22
2011	5088	19035.83	20434.84	4.02	48.74	52.32
2012	5192	21389.66	22187.67	3.72	48.60	50.41
2013	4802	20601.80	19327.30	4.21	54.14	50.79
2014	4490	18480.75	19870.67	4.79	47.95	51.55
2015	3030	13140.58	15422.78	5.79	42.63	50.04
2016	2892	15969.54	15966.35	6.00	54.75	54.74
Foreign investors						
2008	591	1076.15	1017.22	0.62	4.52	4.27
2009	614	1068.41	1186.82	0.55	4.36	4.85
2010	885	3072.00	1499.64	0.75	8.46	4.13
2011	1283	4103.63	2195.64	1.01	10.51	5.62
2012	1527	8685.20	4841.37	1.09	19.73	11.00
2013	1603	9278.82	7634.98	1.40	24.39	20.07
2014	1639	11244.38	9314.61	1.75	29.17	24.17
2015	1520	11039.34	9499.30	2.91	35.82	30.82
2016	1501	7688.60	6838.75	3.12	26.36	23.45
All investors						
2008	95141	23813.62	23813.62	100.00	100.00	100.00
2009	111435	24489.30	24489.26	100.00	100.00	100.00
2010	117776	36303.14	36303.28	100.00	100.00	100.00
2011	126561	39056.01	39056.01	100.00	100.00	100.00
2012	139721	44012.90	44012.90	100.00	100.00	100.00
2013	114170	38050.81	38050.81	100.00	100.00	100.00
2014	93651	38543.28	38543.28	100.00	100.00	100.00
2015	52300	30823.16	30823.16	100.00	100.00	100.00
2016	48171	29165.87	29165.87	100.00	100.00	100.00

This table contains the number of traders and value of buys and sells by type of investor between 2008 and 2016. Data are from the Colombian Stock Exchange for stock transactions.

Table 2: Fixed income market: Descriptive statistics by type of trade

Year	Number of traders	Value of buys	Value of sells	% of total traders	% of total values Buys	% of total values Sells
Individual investors						
2008	7376	10985.21	10831.69	79.68	5.08	5.01
2009	5447	23113.48	23066.60	74.82	4.76	4.75
2010	5996	23431.09	23051.80	74.32	3.74	3.68
2011	5074	18593.97	18970.64	72.02	3.06	3.12
2012	2755	13961.01	14286.07	67.13	2.25	2.30
2013	1550	16275.65	16481.39	55.52	2.69	2.73
2014	1203	13961.27	13994.91	45.14	2.56	2.56
2015	768	14548.81	14591.77	35.56	3.07	3.07
2016	518	8966.62	9013.69	28.52	2.10	2.11
Institutional investors						
2008	1791	201506.00	200008.45	19.35	93.19	92.50
2009	1749	456210.92	455654.94	24.02	94.01	93.89
2010	1978	596577.96	599098.01	24.52	95.34	95.74
2011	1865	580402.42	581939.51	26.47	95.50	95.75
2012	1213	600448.82	600406.72	29.56	96.60	96.59
2013	992	575135.28	579275.23	35.53	95.18	95.87
2014	935	504967.01	519411.17	35.08	92.55	95.19
2015	809	438312.94	446793.55	37.45	92.37	94.15
2016	648	391811.37	401879.76	35.68	91.61	93.96
Foreign investors						
2008	90	3739.45	5390.52	0.97	1.73	2.49
2009	84	5972.08	6574.93	1.15	1.23	1.35
2010	94	5729.12	3588.36	1.17	0.92	0.57
2011	106	8745.44	6831.69	1.50	1.44	1.12
2012	136	7163.12	6880.17	3.31	1.15	1.11
2013	250	12827.21	8481.52	8.95	2.12	1.40
2014	527	26712.87	12235.07	19.77	4.90	2.24
2015	583	21669.57	13146.00	26.99	4.57	2.77
2016	650	26939.29	16823.82	35.79	6.30	3.93
All investors						
2008	9257	216230.66	216230.66	100.00	100.00	100.00
2009	7280	485296.48	485296.48	100.00	100.00	100.00
2010	8068	625738.17	625738.17	100.00	100.00	100.00
2011	7045	607741.84	607741.84	100.00	100.00	100.00
2012	4104	621572.96	621572.96	100.00	100.00	100.00
2013	2792	604238.15	604238.15	100.00	100.00	100.00
2014	2665	545641.15	545641.15	100.00	100.00	100.00
2015	2160	474531.32	474531.32	100.00	100.00	100.00
2016	1816	427717.28	427717.28	100.00	100.00	100.00

This table contains the number of traders and value of buys and sells by type of investor between 2008 and 2016. Data are from the Colombian Stock Exchange for fixed income transactions.

4 Methodology

4.1 Measuring the disposition effect

To test whether investors are reluctant to realize their losses, I need to calculate the extent to which investors sell losers and winners, relative to the possibilities to sell each. Comparing these proportions I am able to estimate the extent of disposition effect for each investor. Specifically, I use the measure of Barber et al. (2007), to obtain a daily hazard rate of realization of gains and losses by trader:

$$PGR_{jit} = \frac{RG_{jit}}{RG_{jit} + PG_{jit}} \quad (1)$$

$$PLR_{jit} = \frac{RL_{jit}}{RL_{jit} + PL_{jit}} \quad (2)$$

where PGR_{jit} (PLR_{jit}) is the proportion of gains (losses) realized by the investor j on stock i on day t , and RG_{jit} (RL_{jit}) is the value of realized gains (losses). PG_{jit} (paper gains) and PL_{jit} (paper losses) refer to the value of unrealized gains or losses. A positive and significant difference between these proportions ($PGR - PLR$) indicates the presence of disposition effect.

To calculate measures (1) and (2), there are three cases to consider. First, on days with no sales, paper positions are recorded based on the comparison between a reference price (defined below) and the maximum and minimum prices for the day. If the reference price is lower (higher) than the minimum (maximum) of the day, a paper gain (loss) is recorded. If the reference price is in the range of prices of the day, the position is undetermined. The value of the paper position is recorded as the shares held times the prior's day closing price. Second, if a position is sold on a day, the realized positions are calculated as the number of shares sold times the sale price. A realized gain (loss) is recorded when the sale price is higher (lower) than the reference price. The position is undetermined when the reference and sale prices are equal. Finally, on days when investors sell part but not all of their outstanding positions, I record both paper and realized values. The shares sold are recorded as a realized gain, realized loss, or indeterminate in the same manner as of complete sales. The paper positions are recorded using the sales price of shares sold.

The reference price attempts to approximate the one subjectively used by the investor to classify a position as a winner or loser. This reference price differs among the studies. For example, Odean (1998), Grinblatt and Keloharju (2001) and Barber et al. (2007) calculate the reference price as the average of the prices at which the contributing stock purchases took place, weighted by the number of purchased shares. On the other hand, Frazzini (2006) employs a First In, First Out (FIFO) accounting method as the main reference price and several alternative prices as robustness test¹⁴. Given the methodological differences from pre-

¹⁴The author uses also the last buying price, last trading price, averages prices, and LIFO and FIFO accounting approaches for robustness. LIFO (last in, first out) and HIFO (highest in, first out) are distribution methods used to manage assumptions of costs related to inventory, stock repurchases (if purchased at different

vious studies and the absence of any theories supporting one particular method (Cici, 2012), this study employs the average price of purchases as reference point -following Barber et al. (2007)- and the last buying price as robustness test (see Appendix A for more details).

I slightly modify the methodology of Barber et al. (2007) to measure the disposition effect in the fixed income market. The database provides both the dirty price and rate to which the bond was traded. However, given the time-varying effect of the coupon payments on the dirty price of bonds' accumulated interest and the convergence of prices to the nominal value upon maturity, I consider the trading rate (YTM) as a more appropriate reference point¹⁵. Specifically, I compare the current rates of bonds to the weighted average of past trading rates to determine whether the investor is trading at a gain or at a loss. In this case, if the current rate is higher (lower) than the reference rate, the position is counted as a loss (gain). As before, there are two types of gains and losses. If the investor trades at a gain (loss), it is counted as a realized gain (loss). If the investor holds the positions, it is counted as a paper gain (loss) if the current rate is lower (higher) the reference rate. The realized and paper gains and losses are computed using the dirty price, as explained before.

4.2 Investors' characteristics and disposition effect

I am also interested in the relationship between disposition effect and characteristics of investors. In particular, existing studies indicate that experience and sophistication seem to attenuate, or even eliminate, this behavioral bias (e.g. Da Costa Jr et al. (2013), Cici (2012), Talpsepp (2011), Seru et al. (2009), Dhar and Zhu (2006)). Those studies argue that sophisticated and experienced investors are more skilled, have a better understanding of the market and, consequently, are more likely to avoid behavioral biases than the average investor.

I follow Seru et al. (2009) to measure investing experience with the cumulative number of trades that an investor has placed¹⁶. Following these authors, I also approximate the sophistication measure with the number of distinct securities traded by an investor over the sample period. As additional proxies for sophistication, I also include the number of different securities traded in a day and a dummy variable to indicate whether an investor ever trades both bonds and stocks, considering that these investors are likely to be more familiar with financial markets.

Using investor-level cross-sectional regressions I investigate whether more experienced and sophisticated investors are less prone to disposition effect, controlling by some additional variables. I estimate the following equations by market and type of investor (individuals, institutions, and foreigners).

prices), and various other accounting purposes.

¹⁵Anecdotally, two expert traders in the Colombian fixed income acknowledge using purchase rates as the reference point in fixed income market.

¹⁶Talpsepp (2011) and Feng and Seasholes (2005) also employ the trades made since the beginning of the data-set.

$$DE_j = \alpha + \beta X_j + \epsilon_j \quad (3)$$

DE_j is the disposition effect measure of agent j and the vector X_j includes different measures of investor’s characteristics such as experience (cumulative trades), sophistication (number of different securities in the sample, average number of different securities traded per day and dummy variable indicating if the investor trades in both bonds and stock) and transactional activity (average number of trades per day). This vector also includes dummy variables to indicate the sub-type of investors in the case of institutions (long term institutions, funds, family offices, and brokerage firms). The detailed information of these variables is shown in Appendix B.

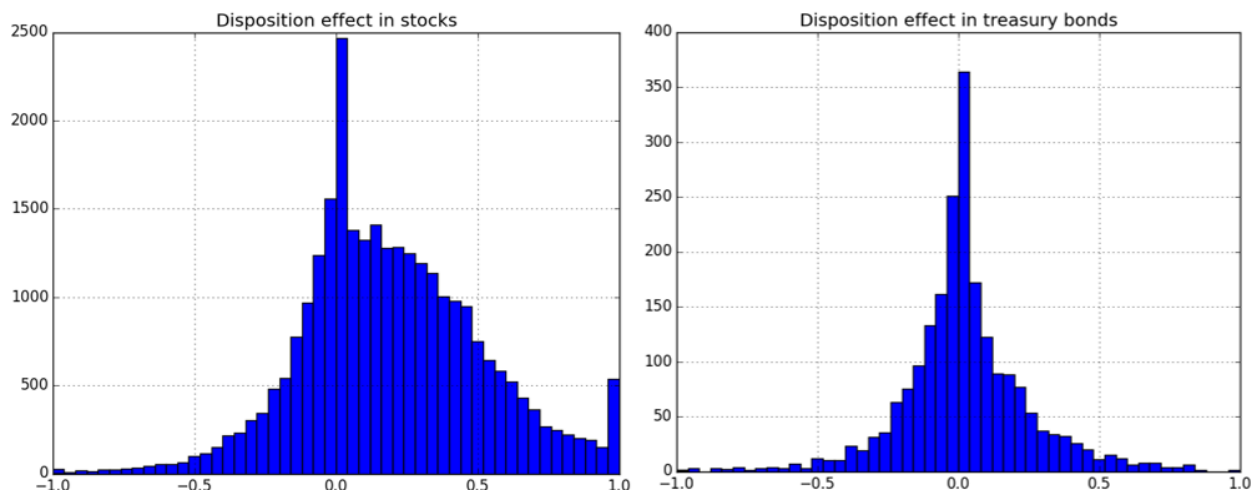
5 Results

In this section, I begin by presenting the results of disposition effect by types of investors in both, fixed income and stock markets. I also analyze the disposition effect by type of institutions (i.e. long term institutions, brokerage firms, funds, and family offices). In section 5.2, I discuss the results on disposition effect by percentiles of trading activity. In section 5.3, I examine the relationship between disposition effect and the investor’s experience and sophistication. Finally, section 5.4 presents the comparison of disposition effect across stock and bond markets for investors that trade in both.

5.1 Disposition effect in treasury and stock markets

To formally test if institutions, individuals and foreigners exhibit disposition effect, I calculate PGR_j and PLR_j for each investor and then average across investors in a group. Then, I perform a cross-sectional t-test analysis between these measures to determine if the difference ($PGR - PLR$) is positive and significant among groups. Figure 1 shows the empirical distribution of this difference in both markets, widely distributed with a minimum of -1 and a maximum of 1. The distributions display a thicker right tail and is much more evident for the stock market. This is preliminary evidence for the existence of disposition effect in both, treasury and stocks markets, and indicates that the average level is higher for the later.

Figure 1: Distribution of disposition effect measure (PGR-PLR)



The figure shows the empirical distributions of disposition effect in stocks and treasury markets. The measure of disposition effect is the difference of each investor’s PGR and PLR, as defined in Section 4.

Table 3 present the results in both markets by type of investor. In Panel A and B, I present the proportion of realized gains (*PGR*) and losses (*PLR*) and the disposition effect measure ($PGR - PLR$) in the treasury and stock market, respectively. In average, including all investors there is a positive and statistically significant difference $PGR - PLR$ in fixed income (p-value<0.05) and stock (p-value<0.01) markets, being considerably higher in the second case¹⁷. The results by type of investor indicate that both institutions and individuals are reluctant to realize their losses in both markets. Nonetheless, the bias is stronger for individuals, who are around 4% more likely to realize gains than losses in the treasury market versus 2% for institutions. This difference is statistically significant at the 1% level in the stock market (19.3% vs 17.9%). In contrast, foreign institutions do not show statistically significant evidence of disposition effect in either market.

These findings support the hypotheses H_1 and H_2 established in section 2. In particular, I expected that both institutional and individual traders were reluctant to realize their losses, being this effect stronger for the latter. In turn, I expected that foreign traders do not exhibit disposition effect. These results are also consistent with most previous findings showing that individual investors are much susceptible to the disposition effect than institutions, while foreigners are the group least affected by this bias (e.g. Shapira and Venezia (2001); Grinblatt and Keloharju (2001); Frino et al. (2004); Choe and Eom (2009); Talpsepp (2011)).

The lower disposition effect in institutions (or non-existent in foreign institutions) can be attributed to the skills acquired through their continuing trading and constant connection with sophisticated investment tools, which help them to avoid this behavioral bias (Cici, 2012). It

¹⁷Using as the reference point the last buying price, does not alter any of the main results (see Appendix A for more details).

Table 3: Disposition effect across investors in TES and stock markets

Mean PGR, PLR	All	Foreigners	Individuals	Institutions	Ind vs Inst
Panel A: Treasury Market					
Sample	2143	365	736	1042	
PGR (%)	40.96	15.89	52.4	41.65	10.75***
PLR (%)	38.85	18.1	48.46	39.34	9.12***
PGR-PLR	2.10**	-2.21	3.94***	2.32*	1.62
Panel B: Stock Market					
Sample	28139	1382	23644	3113	
PGR (%)	69.76	25.29	74.05	57.47	16.58***
PLR (%)	50.29	23.71	54.76	39.49	15.27***
PGR-PLR	19.46***	1.58	19.29***	17.98***	1.31***
stocks vs TES	17.36***	3.79***	15.35***	15.66***	

This table contains the proportion of realized gains and losses for type of investor. I calculate the mean difference across investors within a particular investor group. Statistical significance is based on the mean difference between PGR and PLR and the cross-sectional standard deviation of the difference. The symbols ***,** mean reliable different from zero at the 1% and 5% significance level, respectively.

can be also explained by the stop-loss rules usually taken by these type of investors. In fact, [Fischbacher, Hoffmann, and Schudy \(2017\)](#) show through a laboratory experiment¹⁸ that the ex-ante commitment to automatically selling at a loss causally reduces the disposition effect. [Weber and Camerer \(1998\)](#) also find evidence supporting the hypothesis that the disposition effect is smaller when assets are automatically sold than when selling is deliberate.

I measure the disposition effect by sub-types of institutions in table 4. The findings indicate that the institutions with more propensity to this behavioral bias in both markets are the Family Offices¹⁹. This bias is especially pronounced in the stock market, as indicated by the mean t-test (mean difference 16.04, p-value<0.01). On the contrary, brokerage companies and long-term institutions do not show evidence of disposition effect in either market. In the last case, this may be consistent with the fact that life insurers and pension funds have a relatively long investment horizon and their behaviour is more likely to be driven by the characteristics of their liabilities than by speculation ([De Haan & Kakes, 2011](#)). Besides, funds only exhibit disposition effect in the stock market. The empirical evidence presents mixed results for funds. For example, [Cici \(2012\)](#) find that a sizable fraction of US equity mutual fund exhibits disposition effect²⁰. However, [Barber et al. \(2007\)](#) find no evidence of disposition effect for mutual

¹⁸The authors implement three treatments in the laboratory experiment: a no limit treatment, a limit treatment, and a reminder treatment. In the first one, investors can only actively buy and sell assets. In the second one, investors can additionally use automatic selling devices (stop-loss and take-gain orders). Finally, in the reminder treatment investors state price limits for which they plan to sell the assets and are informed if one of these limits is hit, but they still have to decide on whether or not to realize the trade. [Fischbacher et al. \(2017\)](#) find that investors' disposition effects are significantly lower in the second treatment.

¹⁹This institutional group has some similarities to individual investors in that they hold actively traded portfolios managed by professionals on behalf of wealthy individuals or families ([Agudelo et al., 2019](#)).

²⁰The author presents a stronger presence of the disposition effect in the trades of mutual funds run by

funds in Taiwan.

Table 4: PGR and PLR across different types of institutions

	Funds	Long term	SBC	Family Offices
Panel A: Treasury Market				
PGR (%)	39.44	19.98	10.94	50.92
PLR (%)	38.27	20.76	12.26	46.99
PGR - PLR	1.17	-0.78	-1.32	3.93**
Panel B: Stock Market				
PGR (%)	44.97	19.13	35.29	59.59
PLR (%)	31.86	17.13	28.67	39.62
PGR - PLR	13.11***	2.00	6.62	19.97***
T-statistic (stocks vs TES)	11.94***	2.78	7.94***	16.04***

This table contains the proportion of realized gains and losses for type of institution. The categories include: Brokerage Firms, Family Offices, Long-Term institutions (Pension Funds and Insurance Companies) and Funds (Mutual Funds and other managed portfolios). Statistical significance is based on the mean difference between PGR and PLR and the cross-sectional standard deviation of the difference. The symbols ***,** mean reliable different from zero at the 1% and 5% significance level, respectively.

Interestingly, as expected in H_4 , I find that both institutions and individuals exhibit disposition effect, but this bias is weaker in the treasury market. This finding is supported by the mean t-test analysis applied to the difference between the disposition effect measures in both markets. I find that the difference is statistically significant for all type of investors (see table 3) and also for sub-types of institutions, excepting long term firms (see table 4). This important finding may be explained by the reasons stated in H_4 : first, the Colombian treasury market have a smaller proportion of individuals than the stock market (34.34% vs 84.03%, respectively). This single fact decrease the overall disposition effect in TES. Second, the investment behavior of institutional investors, the dominant group in the treasury market (11.06% in stocks vs 48.63% in TES), may be driven by policies that constraints speculation, and thereby reduce the propensity to the disposition effect. Third, in average, the investors in the treasury market hold larger portfolios than those in the stock market²¹. According to previous findings (e.g Choe and Eom (2009), Dhar and Zhu (2006)), larger investors then to be more sophisticated and, consequently, more likely to avoid behavioral biases including the disposition effect.

teams of portfolio managers as opposed to those run by a single portfolio manager.

²¹The daily average traded value by trader in the stock market is around 36.325, 259.271 and 307.260 USD for individuals, institutions and foreigners, respectively. In the treasury market these values are considerably bigger: 1.019.758, 9.189.491 and 3.515.168 USD, in the same order.

5.2 Disposition effect and trading activity

I am interested in analyzing if the transactional activity, measured by daily average number of trades and traded value, influences the degree of investors' disposition effect. For each type of investor, I create two groups according to the top and bottom decile of the corresponding empirical distribution of trading activity. Tables 5 and 6 summarize the results for both, the daily average number of trades and the traded value, respectively.

According to table 5, the most active investors exhibit less disposition effect than those in the bottom decile of trading activity in the stock market. This finding is supported by the mean t-test analysis applied to the difference between the disposition effect in the bottom and the top decile groups. The results indicates that the differences are statistically significant at the 1% level for all the types of investors. This difference is larger for foreigners, where the bottom decile group is around 25% more likely to be affected by this bias than the group in the top decile. Interestingly, although foreigners as a group do not exhibit disposition effect (see table 3), the bottom decile group shows a statistically significant bias. On the other hand, individuals are the investors with more propensity to disposition effect in both groups of trading activity in the stock market.

Table 5: Disposition effect by number of trades

	Stock Market			Treasury Market		
	Foreigners	Individuals	Institutions	Foreigners	Individuals	Institutions
Panel A: Bottom decile						
PGR (%)	68.61	78.05	71.83	19.57	68.66	70.38
PLR (%)	47.01	54.71	49.21	20.70	60.63	63.31
PGR - PLR	21.60***	23.34***	22.62***	-1.13	8.03	7.07*
Panel B: Top decile						
PGR (%)	14.70	59.71	30.86	11.81	26.95	13.20
PLR (%)	17.60	44.57	23.18	12.10	28.15	13.09
PGR - PLR	-2.90	15.13***	7.68***	-0.29	-1.20	0.11
Bottom vs top	24.5***	8.21***	14.94***	-0.84	9.23**	6.96**

This table contains the proportions of realized and losses for the investors whose trading activity (measured as average number of trades per day) is above (below) the 90th (10th) percentile of the respective group's empirical distribution. The results are shown by type of institution in both fixed income and stock markets. Statistical significance is based on the mean difference between PGR and PLR and the cross-sectional standard deviation of the difference. ***, **, * denotes significance at the levels 1%, 5% and 10%, respectively.

Similarly, in the treasury market, institutions and individuals exhibit less disposition effect in the top decile groups, as indicated by the mean t-test analysis (significant at the 5% level). In this case, individuals exhibit the largest difference between both groups. However, in this market, the number of trades does not seem to affect the lack of disposition effect in foreign investors. Surprisingly, contrary to the results in the stock market, individuals in the top decile of the trading activity, are the investors less affected by the disposition effect.

Similar results are found with traded value. According to table 6, with one exception, all the groups of investors in the top decile of traded value, have a lower disposition effect than the bottom decile group in both, stock and treasury markets. The differences between bottom and top groups are statistically significant at 1% level. In the stock market, the most pronounced difference is exhibited by institutions: the top decile group has around 5.8% less propensity to disposition effect than the bottom decile group. Besides, individuals continue to be the group more likely to be affected by the disposition effect in both groups of trading activity in both markets.

Table 6: Disposition effect by traded value

	Stock Market			Fixed income market		
	Foreigners	Individuals	Institutions	Foreigners	Individuals	Institutions
Panel A: Bottom decile						
PGR (%)	23.02	58.01	28.71	15.35	61.42	41.17
PLR (%)	18.19	42.98	20.61	19.91	53.75	39.63
PGR - PLR	4.84***	15.04***	8.10***	-4.57	7.68***	1.54***
Panel B: Top decile						
PGR (%)	7.54	46.24	12.99	12.74	25.52	5.50
PLR (%)	7.03	33.76	10.66	10.37	22.17	5.76
PGR - PLR	0.51***	12.48***	2.32***	2.36***	3.35***	-0.26
Bottom vs top	4.33***	2.56***	5.78***	-6.93***	4.33***	1.8***

This table contains the proportions of realized and losses for the investors whose trading activity (measured as average traded value per day) is above (below) the 90th (10th) percentile of the respective group's empirical distribution. The results are shown by type of institution in both fixed income and stock markets. Statistical significance is based on the mean difference between PGR and PLR and the cross-sectional standard deviation of the difference. ***, **, * denotes significance at the levels 1%, 5% and 10%, respectively.

In general, these findings are in line with the results of [Choe and Eom \(2009\)](#). The authors argue that as investors repeat the same activity constantly, they become more familiar with the objectives and do better than less active investors. Therefore, the disposition effect drops substantially in the top decile of number of trades. Also, according to these authors, it is widely accepted that sophisticated investors have a larger trading volume and value than amateurs. Consequently, it is expected that the disposition effect monotonically decreases with trading activity.

5.3 Characterizing the disposition effect

To examine the characteristics of an investor reluctant to realize his losses, I estimate cross-sectional regressions for the disposition effect measure by type of investors. Specifically, I include proxies for experience and investor sophistication and add some variables reflecting trading activity and dummies for types of institutions. The variables are described in Appendix B. As explained in H_3 , I initially expect a lower disposition effect for more experienced

and sophisticated investors.

Table 7 shows the cross-sectional regression estimates for the stock market. I find that more experienced individuals and institutions, trading several stocks in a day and holding treasuries, tend to exhibit a lower disposition effect. The relation between these three variables and the disposition effect keeps also negative for foreigners but the coefficients are not statistically significant. On the other hand, I find a positive relationship between the number of different stocks and disposition effect. This is an unexpected result, but may be reasonable as a greater exposure to stocks could increase the disposition effect of an investor who already has this bias.

In terms of trading activity, the results suggest that foreign investors with more propensity to disposition effect are in the bottom decile of the empirical distribution and institutions in the top decile of trading activity are less prone to this bias. This is consistent with the findings in section 5.2. Surprisingly, I do not find this feature significantly related to the disposition effect of individual investors. The reason is that, when the daily average of different stocks traded is included, the significance of trading activity dummies disappears.

Table 7: Investor characteristics and disposition effect in stock market

Dependent variable: Disposition effect	Foreigner (1)	Individuals (2)	Institutions	
			(3)	(4)
Experience	-1.246*	-0.015***		-2.709***
Number of different stocks	0.343***	0.002***		0.206***
Daily average of different stocks traded	-0.453	-0.147***		-3.583***
Treasury dummy =YES	-1.141	-0.032***		-3.708**
Trading activity=bottom	17.535***	0.004		-1.499
Trading activity=top	-1.356	0.016		-4.581**
Dummy type inst=Funds			8.89***	3.008
Dummy type inst=Brokerage firms			4.62	11.478***
Dummy type inst=Family Offices			15.31**	3.799*
R^2	0.09	0.01	0.01	0.04
N	1382	23078	2994	2994

This table presents the results of cross-sectional regression estimates by type of investor in which the disposition effect measure is the dependent variable. Independent variables are defined in Appendix B, and a constant term is included but not reported. I exclude institutions such as banks, leasing companies, cooperatives, fiduciaries and factoring, considering that their investment objectives are different in nature from the other. The data are from Colombian Stock Exchange for the 2008–2016 period. White-corrected standard errors in the presence of heteroskedasticity. ***, **, * denotes significance at the levels 1%, 5% and 10%, respectively.

I include two regressions for institutional investors. Regression (3) indicates consistent results with section 5.1. In particular, when differentiating by type of institutions, I find that funds and family offices have more propensity to disposition effect than long term institutions (omitted group on the regression). However, when including other control variables

-especially experience-, brokerage firms exhibit the largest significant difference with respect to long-term institutions.

Table 8 contains the cross-sectional regressions in the treasury bond market. As in the stock market, investor’s experience has a negative relation with disposition effect for individuals and institutions. I do not find any variable significantly related to the foreigners’ disposition effect, probably because of the lower levels of this bias in bonds. In terms of sub-types of institutional investors, the regression (3) indicates that family offices have more propensity to the disposition effect compared to pension funds. Brokerage firms and family offices do not exhibit significant differences respect to this omitted group. These results are consistent with table 4. Similar to stocks, the inclusion of investor’s experience in regression (4), makes the difference between family offices and pension funds no longer significant.

Table 8: Investor characteristics and disposition effect in treasury market

Dependent variable: Disposition effect	Foreigner (1)	Individuals (2)	Institutions (3) (4)	
Experience	0.855	-1.333*		-2.24**
Number of different stocks	0.259	0.624**		0.079*
Daily average of different stocks traded	-1.892	-5.43		1.347
Stocks dummy =YES	-0.57	-2.839		0.362
Trading activity=bottom	1.224	1.634		-0.614
Trading activity=top	1.976	-2.04		4.67
Dummy type inst=Funds			1.11	0.651
Dummy type inst=Brokerage firms			-1.28	0.681
Dummy type inst=Family Offices			4.47**	1.867
R ²	0.01	0.02	0.001	0.03
N	365	736	909	909

This table presents the results of cross-sectional regression estimates by type of investor in which the disposition effect measure is the dependent variable. Independent variables are defined in Appendix B, and a constant term is included but not reported. I exclude institutions such as banks, leasing companies, cooperatives, fiduciaries and factoring, considering that their investment objectives are different in nature from the other. The data are from Colombian Stock Exchange for the 2008–2016 period. White-corrected standard errors in the presence of heteroskedasticity. ***, **, * denotes significance at the levels 1%, 5% and 10%, respectively.

In general, except for foreigners, experience seems to reduce the disposition effect of all types of investors in both markets. Proxy variables of sophistication like daily average of different stocks traded and the dummy indicating TES holdings, attenuate the disposition effect for individuals and institutions in the stock market. These results are consistent with the hypothesis H_3 established in section 2 and the conclusions of [Feng and Seasholes \(2005\)](#), [Dhar and Zhu \(2006\)](#), [Cici \(2012\)](#) and [Da Costa Jr et al. \(2013\)](#) regarding the effect of investor’s experience and sophistication in the disposition effect.

5.4 Disposition effect across markets

As indicated in H_5 , I expect a priori that investors trading stocks and TES, exhibit a consistent reluctance to realize losses in both markets. In the sample, I find 1024 investors with both stocks and TES holdings. Table 9 shows that the average disposition effect for these traders in the treasury market (2.31%) is similar to the average in the whole sample (2.10%, see table 3). However, in the stock market, these investors have a lower average disposition effect compared with the whole sample (11.29% vs 19.46%, respectively). The pattern is also observed by type of investor, where foreigners, individuals, and institutions exhibit a disposition effect 2.64%, 5.39% and 7.47% lower than the whole sample, respectively. This finding is consistent with the results shown in section 5.3, where investors with holdings in both markets, presumably more sophisticated, exhibit a lower bias.

Table 9: Average disposition effect for investors trading in treasury and stocks markets

	All	Foreigners	Individuals	Institutions
Sample	1024	89	424	511
Disposition effect in treasury market	2.31	-1.79	2.56	2.42
Disposition effect in stocks market	11.29	-1.06	13.90	10.51

This table presents the measure of disposition effect for investors trading in both treasury and stocks markets. This measure is the difference between PGR and PLR as defined in section 4. The data are from Colombian Stock Exchange for the 2008–2016 period.

To assess the hypothesis H_5 , I initially evaluate the strength and direction of association that exists between the disposition effect measures in stocks and bonds for these investors. Table 10 contains the Pearson correlation coefficient and its respective p-value by type of investor. In general, the coefficients show a weak but significant positive association (10.89%, p-value<0.01) between the disposition effect in stocks and bonds. Within each group, the correlation is positive and significant at the 5% level, except for institutions, whose correlation is marginally significant at 10%.

Table 10: Pearson’s correlation of disposition effect for investors trading in treasury and stocks markets

	All	Foreigners	Individuals	Institutions
Pearson’s correlation	10.89%	24.05%	10.01%	8.42%
P-value	0.0005	0.0232	0.0394	0.0572

This table presents the Pearson’s correlation coefficient, between the disposition effect in bonds and stocks for 1024 investors trading in both, treasury and stocks markets. Its value can range from -1 for a perfect negative linear relationship to +1 for a perfect positive linear relationship. A value of 0 indicates no relationship.

To have a better approximation of the relation between the disposition effect in both markets for the same investors, I complement the analysis by estimating cross-sectional regressions.

Table 11 presents the results for two regressions using the disposition effect in stocks as dependent variable. Interestingly, the first regression shows a positive and significant relationship between the disposition effect in both markets, controlling by type of institutions. Thus, as expected in H_5 , investors with higher disposition effect in the treasury market tend to have more propensity to this bias in the stock market. As shown before, the results also suggest that foreigners and institutions have less propensity to this bias than individuals (omitted group) in the stock market.

In the second regression, I include the additional control variables employed in section 4.2 for the stock market. The disposition effect in TES continues to be positive and significant. Besides, even for this presumably most sophisticated investors, the experience in the stock market seems to reduce the propensity to this bias as in section 4.2. Furthermore, for this sample of investors, there is no significant difference between individuals and institutions. On the contrary, foreigners exhibit a significantly lower disposition effect than individual investors.

Table 11: Disposition effect for investors trading in treasury and stocks markets

Dependent variable: DE in stocks	(1)	(2)
DE in TES	0.105***	0.083**
Experience		-2.701***
Number of different stocks		0.113
Daily average of different stocks		-0.923
Trading activity = bottom		7.012
Trading activity = Top		-3.232
Investor type=foreigners	-13.723***	-10.773***
Investor type=Institutions	-3.314**	-1.003
R^2	0.04	0.09
N	1,024	1,024

This table presents the results of cross-sectional regression estimates for investors trading in both, treasury and stocks markets. The disposition effect in stocks is the dependent variable. Independent variables are defined in Appendix B, and a constant term is included but not reported. The data are from Colombian Stock Exchange for the 2008–2016 period. White-corrected standard errors in the presence of heteroskedasticity. ***, **, * denotes significance at the levels 1%, 5% and

In summary, these findings provide evidence in favor of H_5 . In particular, we find a significant positive relationship between the disposition effect in the stock and bond market for investors trading in both. These results suggest that the disposition effect is not only market-dependent, but explained in part by investor-specific features.

6 Conclusions

In this research, I study the disposition effect in three types of investors -individuals, institutions and foreigners- in the Colombian treasury bond and stock markets. Using a unique and proprietary database, the paper provides the first evidence of this behavioral bias in a fixed income market. In addition, this is also the first study testing the disposition effect across different markets for the same investor. The general finding indicates that the disposition effect is pervasive in both markets, but is considerably weaker in the TES. Furthermore, for investors trading bonds and stocks, the disposition effect in both markets has a significant positive relationship.

The analysis by type of investors suggests that both, institutional and individual investors are reluctant to realize their losses and this effect is stronger for individuals in both markets. In contrast, foreign traders do not show evidence of this behavioral bias in either market. Besides, family offices is the sub-group of institutions with most tendency of disposition effect, while long term institutions and brokerage firms do not show evidence of this bias. In addition, investor's characteristics like experience and sophistication seem to attenuate the disposition effect, especially in the stock market.

A bias that is so widespread across diverse markets has the potential to affect market efficiency and investor performance as shown by previous literature. Certainly, these results have implications for institutional investors, and for individuals and their investment advisors. Measures should be designed and implemented to mitigate it. In addition, future work might study the extent to which the disposition effect affects price formation and market anomalies in the in the context of Colombian fixed income and stocks markets. Besides, it is important to have an estimation of the incurred losses in both markets as a consequence of this bias.

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APPENDIX A

Essential to the computation of PGR and PLR is the proxy for the reference price, which investors compare against the current stock price to determine whether a stock position represents a gain or a loss (Cici, 2012). Given the methodological differences from previous studies and the absence of any theories supporting one particular method, for robustness, I also employ the reference point as the last buying price following Frazzini (2006).

Table 12 contains the results by type of investor for fixed income and stock markets. Consistent with previous analysis (see section 5.1) and previous empirical evidence, individuals and institutions sell winners at a faster rate than losers in both markets, being this effect stronger for the former. Likewise, foreign investors do not prefer to sell winners rather than losers. Furthermore, this bias is more pervasive in the stock market.

Table 12: Disposition effect across investors (robustness test)

Mean PGR and PLR	All investors	Foreigners	Individuals	Institutions
Panel A: Fixed Income market				
PGR (%)	40.37	14.90	51.98	41.18
PLR (%)	36.58	16.52	46.61	36.59
PGR-PLR	3.79***	-1.62	5.38***	4.58***
Panel B: Stock market				
PGR (%)	63.78	23.18	67.86	50.86
PLR (%)	48.20	21.91	51.22	36.94
PGR-PLR	15.58***	1.27	16.64***	13.92***

This table contains the proportion of realized gains and losses for type of investor. I calculate the mean difference across investors within a particular investor group. Statistical significance is based on the mean difference between PGR and PLR and the cross-sectional standard deviation of the difference. The symbols ***, ** mean reliable different from zero at the 1% and 5% significance level, respectively.

I also employ the last purchase price to test the results by type of institutions in both markets. Table 13 shows the results. Again, I find that Family Offices are reluctant to realize losses in both markets, while long-term institutions and brokerage firms do not show evidence of this bias.

Table 13: PGR and PLR across different types of institutions (robustness test)

	Funds	Long term	SBC	Family Offices
Panel A: Fixed Income Market				
PGR (%)	40.40	22.03	14.19	49.28
PLR (%)	36.85	18.23	13.13	43.74
PGR - PLR	3.55	3.81	1.06	5.54***
Panel B: Stock Market				
PGR (%)	40.46	17.30	30.96	52.80
PLR (%)	31.73	16.69	28.51	38.05
PGR - PLR	8.74***	0.62	2.45	14.75***

This table contains the proportion of realized gains and losses for type of institution. The categories include: Brokerage Firms, Family Offices, Long-Term institutions (Pension Funds and Insurance Companies) and Funds (Mutual Funds and other managed portfolios). Statistical significance is based on the mean difference between PGR and PLR and the cross-sectional standard deviation of the difference. The symbols ***,** mean reliable different from zero at the 1% and 5% significance level, respectively.

APPENDIX B

Table 14: Control variables of regression analysis

Variable	Description
Experience	Natural logarithm of the cumulative number of trades of investor j in the whole sample
Number of different stocks	Different stocks held by investor j in the whole sample
Daily average of different stocks	Daily average of different stocks traded by investor j
Treasury (stock) dummy	Dummy variable indicating if investor j trades in the treasury (stock) market
Trading activity	Dummy variable that equals "Top decile" ("Bottom decile") if the trading activity of agent j is above (below) the 90th (10th) percentile of the respective empirical distribution
Type inst	Dummy variable that indicates the type of institutional investor. Apply only to regression of institutional traders

This table presents the description of the control variables considered in the regression analysis defined in section 4.2, equations (1), (2). The institutional group includes Brokerage Firms, Family Offices, Long-Term Institutions, and Funds.