**An Investigation of Investor Risk Attitudes in Trinidad and Tobago**

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# Abstract

Mainstream finance theories as well as Prospect Theory (the dominant behavioural finance theory) maintain that investors are risk averse (they require a positive risk premium over the risk free rate to invest). According to Tversky and Kahneman’s (1979, 1992) Prospect Theory, investors are risk averse when faced with sure gains and risk seeking when faced with sure losses.

We are interested in determining whether domestic markets function as mainstream finance theory or Prospect Theory dictate. We test the Trinidad and Tobago Stock Exchange’s Composite Index (TTCI) to determine the nature of investor risk attitudes, and we conduct a survey of local professional investment managers, traders, portfolio managers and private investors to determine their risk attitudes and investment behaviour.

We conduct non-linear least squares regression of the TTCI monthly closing values for the period July 2006 to November 2010 using the following model:

* V(x)=maxi EU(XT)
* i=-(u-r)Vx / σ2  Vxx

Where:

i=TTCI indexlevels

V=indirect utility function or value function

U=direct utility function

x=initial wealth

XT=terminal wealth

σ2 = volatility of the index

u=rate of return on the index

r=risk free rate of return

The ratio of Vx/Vxx (which we call ) is the coefficient of risk attitude, such that a positive value indicates risk seeking behavior, and negative values indicate risk aversion.

In the empirical testing, we find that investors on the TTCI are overwhelmingly risk loving, and that risk loving attitudes increase as the investment time horizon lengthens, but at a decreasing rate. We conduct a survey of finance professionals and investors which confirmed the results of the empirical testing; the majority of investors are not risk averse. Less than half of the survey respondents to the survey classified themselves as risk averse, and most of those who did, revealed that their risk averse attitudes were mainly due to professional restrictions. As such, we are able to refute expected utility theory and Prospect Theory, since we found that on average, investors on the TTCI are risk loving.

1. **Introduction**

If investors and traders were all rational beings whose investing decisions were logically based on all the information available, then a particular event would precipitate predictable and unanimous reactions every time. But this assumes conditions that in reality almost never exist – rational human beings, perfect information and efficient markets.

In practice, trading is not a precise science - each event can have any number of interpretations for cause and effect, precipitating varied reactions and predictions, which effectively amount to sheer speculation, or ‘forecast’ error, where “permanent and widespread psychological biases affect both the subjective probability of future economic events and their retrospective interpretation” (Bovi, Economic versus psychological forecasting. Evidence from consumer confidence surveys 2009). Emotional and psychological factors often override rational expectations theory in financial decision making, affecting trading performance (Lo, Repin and Steenbarger 2005), and only if risk aversion is pegged at unrealistically high levels, does efficient markets hypothesis and rational expectations theory explain the volatility of the market overall (R. J. Shiller 2003). All economic actors are human beings, therefore all economic decisions are influenced by psychological factors, such that economics is ultimately a behavioural science.

Investor attitudes reside somewhere between the extremes of greed (displayed as risk loving behaviour, where a negative risk premium is acceptable) and fear (displayed as risk aversion, where positive risk premiums are demanded) and these attitudes appear to drive investment decision making.

In determining the true nature of investor attitudes in the Trinidad and Tobago equity market, the following steps are taken as discussed further in this paper:

1. We test the Trinidad and Tobago Composite Index (TTCI) to determine the risk attitudes of investors on that index.
2. We test these risk attitudes over time, and across different trading results – gains and losses - to determine whether risk attitudes change based on changes in wealth.
3. We conduct tests to determine whether risk preferences determine the index value (as expected utility theory holds), or whether the reverse is true.
4. We conduct a survey of finance professionals and investors in the Trinidad and Tobago market to verify the results found in the empirical testing.

To conduct the empirical testing to determine the nature of risk attitudes on the TTCI index, we use the standard portfolio model and assume exponential utility to arrive at the optimal portfolio. We find that contrary to conventional wisdom, investors generally display a risk loving attitude. Additionally, we find that the portfolio level determines risk appetite, whereas it is commonly accepted in mainstream finance literature that the reverse holds. We refute expected utility theory and Prospect Theory (discussed in the literature review which follows) having found that investors are risk loving, regardless of trading results (gains or losses).

These results not only add weight to the growing acceptance that traditional finance theories and assumptions are fundamentally flawed, but they also serve to refute behavioural finance’s Prospect Theory.

1. **Literature Review**

The dominant theories of finance (expected utility theory, rational expectations theory and efficient markets hypothesis) hold that that market participants are risk averse, that they accurately take all available information into account when arriving at a decision and taking action, and that overall, market efficiency and rationality prevail. As such, it is assumed that arbitrage or profit opportunities, where they exist, are fleeting as their exploitation restores equilibrium. Indeed, price changes are unforecastable if there is perfect information, efficient markets, and if future price changes fully and accurately reflect all available information and expectations of all market participants (Samuelson 1965). These theories and assumptions have been universally accepted in academia and widely adopted by finance professionals for decades, not because they are flawless, but because nothing thus far can replace them. But the kinks in the armour are deepening.

The June 28th 2010 “Investment Guide” edition of Forbes magazine[[1]](#footnote-1) contained an article entitled “Your own worst enemy”, written by David K. Randall about a University of California finance professor called Terrance Odean, who studied investor behavior under Daniel Kahneman (Randall 2010) . What this article did, was to simply bring into mainstream media what the behavioural finance academic community had been discussing for (at least) three decades. The article explained that the way human beings process information, causes us to make fundamental errors in the interpretation of information, and hence, in decision making. The implications of these well-accepted phenomena in psychology are ripe with contradictions to mainstream finance theories – investors are generally not objective or rational, information (perfect or otherwise) is not always used appropriately or interpreted correctly, and investors tend to be risk seeking rather than risk averse.

It is widely accepted and empirically demonstrated that rational expectations theory and the efficient markets hypothesis generally do not hold, for various reasons discussed later, hence the growing acceptance of behavioral finance theories (J. R. Ritter 2003) .

The psychological factors which interfere with rational thinking include cognitive biases such as heuristics, overconfidence, mental accounting, framing, representativeness, conservatism and disposition effect (J. R. Ritter 2003), and overall emotional reactivity (Lo, Repin and Steenbarger 2005). There are also other factors which skew decisions, such as misevaluations of financial assets (J. R. Ritter 2003), lack of understanding and miscalculation of basic financial measures, such as volatility (Goldstein and Taleb 2007), and the effect of word of mouth and media driven feedback (R. J. Shiller 2003).

Behavioural finance has countered these obvious deficiencies of traditional finance theories in explaining the way markets behave, by incorporating the effects of human psychology and behavior on financial markets.

**Prospect Theory**

In response to the growing acceptance that traditional finance theories are flawed, behavioural finance has emerged as a marriage between psychology and finance, and the most widely-known behavioural finance theory, Kahneman and Tversky’s Prospect Theory [ (Kahneman and Tversky, Prospect Theory: An Analysis of Decision Under Risk 1979), (Tversky and Kahneman, Advances in Prospect Theory: Cumulative Representation of Uncertainty 1992)], seeks to replace expected utility theory. Prospect theory asserts that individuals are ‘loss averse’ or more sensitive to losses than to gains, they prefer certain outcomes versus probable ones (called the certainty effect), and are risk averse in the face of sure gains and risk seeking in the face of sure losses (Kahneman and Tversky, Prospect Theory: An Analysis of Decision Under Risk 1979).

Indeed, prospect theory, its improvements and derivations empirically demonstrate that framing effects, nonlinear preferences, source dependence, risk seeking and loss aversion for example, repeatedly override any rational choices (Tversky and Kahneman, Advances in Prospect Theory: Cumulative Representation of Uncertainty 1992). Further work found that the utility derived by the investor from gains or losses in wealth not only depends on his existing stock of wealth as asserted in prospect theory, but on his past investment outcomes (called the ‘house money’ effect) such that current losses intensify the pain of earlier losses, or are cushioned by prior gains (Barberis, Huang and Santos 1999).

Prospect theory does not suggest what the market’s reaction to or interpretation of a specific economic event would be, since it argues that a person’s risk attitude in any given situation depends on that individual’s specific economic situation (or his *interpretation* of same) such that if the event is viewed positively, then the individual would tend to be risk averse, and vice versa (Bovi, Economic versus psychological forecasting. Evidence from consumer confidence surveys 2009), and even these predictions of individuals’ behavior are counterintuitive (Alghalith, The Limitations of Prospect Theory and the Expected Utility Theory: A New Theory 2010). This means that each person’s risk attitude is dynamic and unique, *even* if the conditions for individuals were identical since is depends on *perception* of one’s circumstances and of the event. This in itself makes for very difficult generalization and forecasting.

Mainstream finance theories as well as Prospect Theory assume that investors are risk averse, regardless of wealth, and here we discuss some of the scientific evidence refuting the assumption of risk aversion.

**Risk Aversion**

There is abundant literature highlighting the human behavioural contradictions to the assumption of risk aversion. Some of the most common contradictions to the assumption of risk aversion are nicely summarized by Andrew Lo in his 2004 article published in the 30th Anniversary edition of the Journal of Portfolio management; “They include: overconfidence ( (Slovic, Fischhoff and Lichenstein 1980); (Barber and Odean 2001); (Gervais and Odean 2001)), overreaction (De Bondt and Thaler 1990), loss aversion ( (Kahneman and Tversky, Prospect Theory: An Analysis of Decision Under Risk 1979); (Shefrin and Statman 1985); (Odean 1998)), herding (Huberman and Regev 2001), psychological accounting (Tversky and Kahneman, The Framing of Decisions and the Psychology of Choice 1981), miscalibration of probabilities (Lichtenstein, Fischhoff and Phillips 1982), hyperbolic discounting (Liabson 1997) and regret ( (Bell 1982); (Clarke, Krase and Statman 1994))” (A. Lo, The Adaptive Markets Hypothesis 2004).

“Memorability” and “imaginability” cause biases in the way information is perceived, and overconfidence is an aspect of heuristics which causes us to underestimate how little we know and how much more information is needed to properly assess the risks we face, and to overestimate the precision of our estimates (Slovic, Fischhoff and Lichenstein 1980). In addition, experts are equally prone to overconfidence as are lay persons, thereby amplifying the risks we all face when inappropriate policy decisions are made as a result. The attribution bias causes most people to overestimate (underestimate) the degree to which we are responsible for our successes (failures), and this leads to overconfidence in one’s abilities, such that successful traders (though not the *most* successful) were found to be the most overconfident (Gervais and Odean 2001).

**Trinidad and Tobago**

Financial markets in the Caribbean have not benefitted from the extensive research performed on their metropolitan counterparts, and as such they may not be as well understood from a scientific perspective.

The Trinidad and Tobago equity market is known to be underdeveloped; narrow, thin and inefficient (Singh 1995), as a limited number of entities are publicly traded (Bourne 1998). Ownership is highly concentrated in the hands of a few, as roughly 70% of shares on the Trinidad and Tobago Stock Exchange are held by institutional investors and are not actively traded (Nicholls, Leon and Sergeant 1996). Returns on the TTCI are found to be highly non-normal, and compared to the Jamaican and Barbados stock exchanges, presents the highest return and the lowest risk (as measured by the standard deviation) and, consequently, the largest Sharpe ratio (Watson 2008).

It is intuitive that mainstream finance theories ought not to apply in such a market where, for example, the forces which restore equilibrium do not exist (such as the capacity to engage in short selling, and the restrictions on daily price movement). We however note that the assumption of a risk averse investor is upheld by expected utility theory regardless of market conditions, and test the TTCI for investor risk attitudes.

1. **Description of the data**

**The Trinidad and Tobago Composite Index (TTCI)**

To test the Trinidad and Tobago stock market as discussed earlier, the month-end closing values on the TTCI for the period January 2000 to December 2010 were used, and the monthly return therefore was calculated using a simple percentage change of ‘t’ over ‘t-1’. In addition, we calculated a quarterly return, being the percentage change of time ‘t’ over ‘t-3’. The variance of the return (which is calculated for each monthly data point, for the past quarter or three data points) is used as the measure of volatility, where n=3. The average 91-day TTD treasury bill rate is used as the risk free rate, to calculate the quarterly risk premiums. Risk premium is calculated for each data point as the quarterly return minus the risk free rate.

The original data was segmented according to periods of positive quarterly returns and those of negative quarterly returns, and for each, the value of was calculated as discussed in the Theory section. We see in Figure 1 below, the graphical depiction of the index’s movements from January 2000 to December 2010, just to give an idea of the overall trend, which incidentally began an upward climb in 2010.

Figure 1

1. **The Dynamic Portfolio Model**

**Theory**

We consider a standard investment model, which includes a risky asset or portfolio, and a risk-free asset. In this paper, we assume that the index values are substitutable for the prices of the risky asset in both models.

We use a standard Brownian Motion {*W1s, W2s, Fs*} t ≤ s ≤ T on the probability space (Ω, *Fs*, P), where {*Fs*} t ≤ s ≤ T is the augmentation of filtration. Similar to previous models, we consider a risky asset, a risk free asset, and a random external economic factor.

The risky free asset price process is given by 0 = where is the rate of return.

The risky asset price is given by

(1)

Where is the average rate of return on the risky asset / portfolio, and is the volatility of such return.

The wealth process is given by

, (2)

Where is the initial wealth, is the risky portfolio process with .

The trading strategy is admissible ( that is, )

The investor’s objective is to maximize the expected utility of the terminal wealth

(3)

Where is the value function, and is a continuous bounded utility function.

Under regular conditions, the value function satisfies the Hamilton-Jacobi-Bellman Partial Differential Equation (HJB-PDE)

(4)

Where the subscripts and denote the first and second partial derivative, respectively.

Hence the optimal portfolio is given by

= (5)

Therefore the optimal portfolio depends on the parameters and preferences which we call . According to the traditional expected utility theory and Prospect theory, the agent is risk averse (seeking) if is negative (positive). Thus a diminishing (increasing) marginal utility is synonymous with risk aversion (risk seeking).

**Estimating Equations**

We use the theoretical foundations in the previous section to derive estimating equations which we use to test some finance and behavioural finance theories and assumptions. Using (5) and letting be the measure of risk preferences, we obtain the following estimating equations:

(6)

(7)

(8)

Where is the parameter that will be estimated, while and are observed data, and is the estimation error. These equations can be estimated using a non-linear regression. Equations (6) and (7) attempt to measure the relationship between the value of the portfolio and preferences, and hence the direction of influence is not known a priori. It is worth emphasizing that much of the theoretical and empirical literature assumes that preferences determine the value of the portfolio (a fundamental postulate of expected utility theory) and thus they preclude the possibility that the portfolio can determine preferences. Consequently, we can test this dominant theory by independently estimating (6) and (7). (8) provides an estimate for the average value of via the parameter . A negative (positive) value for and hence implies risk aversion (seeking), since by the assumption of a positive marginal utility of wealth.

**Empirical Results**

We test the TTCI using the model discussed earlier to determine the nature of investor risk attitudes, and the effect of risk attitudes (the index) on the index (risk attitudes).

1. First regression using equation (6), to determine whether changes to the TTCI index, has any impact on risk attitude as shown by the values for .

Table 1



1. Second regression using equation (7), to determine whether changes in risk attitudes, have an impact on the TTCI index, as shown by values for .

Table 2



We found to be highly insignificant, but highly significant. This result has a very important implication since it reveals that contrary to mainstream theory, preferences of investors on the TTCI index are dependent on the value of the index, but that the converse is not true. This result is consistent with a recent theoretical contribution (Alghalith, A New Stochastic Factor Model: General Explicit Solutions 2009) which shows that, under the correct assumptions, the optimal portfolio does not depend on preferences.

It is worth emphasizing that (8) offers a better alternative to prospect theory in several ways. First, it is more flexible than prospect theory since it does not a priori assume that the value of the portfolio induces risk aversion/seeking. Secondly, according to prospect theory, a change in the sign of the returns/wealth changes preferences, but a (very large) change in the magnitude of gains/losses does not change the sign of preferences. Clearly, this is unrealistic. Therefore, according to our model, a change in the sign of preferences does not necessarily imply a change in the sign of wealth/return and vice versa. Moreover, unlike prospect theory, our model does not a priori preclude linear preferences.

1. Sixth regression using equation (8), to determine the value of , and therefore the nature of the risk attitudes on the TTCI index. A negative indicates risk aversion, while a positive indicates a risk loving attitude.

Table 3



We find that investors on the TTCI are overwhelmingly risk loving, as indicated by the positive values for shown in Table 3. We segmented the data into periods of only positive monthly returns, and negative monthly returns. As we see in Table 3, even when returns are negative, investors are risk loving, which directly contradicts expected utility theory and prospect theory. We also examined the data series for which revealed that for periods of quarterly positive returns, is positive throughout – indicating a risk loving attitude when faced with gains, contrary to prospect theory and expected utility theory. Also, 83% of the series for quarterly negative returns was positive, again indicating a prevalence of risk loving attitudes, even in the face of losses.

Overall, testing of the data for the TTCI showed that investors are overwhelmingly risk loving regardless of whether the index is delivering gains or losses. The results show that investors, when making a decision based on daily, monthly or quarterly return, adopt a risk-loving approach in general, as reflected by the consistently positive coefficients in the third regression, as shown in Table 3 above. These results directly contradict Prospect theory, which states that when faced with losses, investors tend to take on more risk, and display risk-loving behavior. The results also directly contradict mainstream finance theories such as expected utility theory, which assume a risk-averse investor.

**Survey of Trinidad and Tobago Investors**

In addition to the empirical testing, a survey of Trinidad and Tobago investors was conducted, to verify the findings of the empirical tests.

The short survey asked multiple choice questions to determine the respondents’ risk attitudes, behaviours and decision-making process. The survey population of 36 consisted mainly of acquaintances in the financial sector (portfolio managers, investment managers, traders, investment analysts) and private investors who invest in Trinidad and Tobago securities, who agreed to participate under the condition of anonymity. The survey was conducted in early 2011.

The results of the simple survey are reported as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | In general, you consider yourself to be | Risk Averse | 48% |
| Not risk averse | 52% |
| 2 | On average, when faced with losses, you | Adopt a risk-loving attitude | 19% |
| Adopt a risk-averse attitude | 23% |
| Exit loss-making trades | 52% |
| Increase investment in loss-making trades | 6% |
| 3 | Which one has the most influence on your investment decisions? | Macroeconomic and financial data | 52% |
| Overall market sentiment / risk attitude | 27% |
| Your own risk attitude | 21% |
| 4 | Which ONE is generally more significant in influencing overall market movements? | Macroeconomic / financial data | 27% |
| Overall market sentiment / risk attitude | 73% |

Contrary to Prospect Theory and expected utility theory, but consistent with the findings of the empirical testing just discussed, less than half of the survey respondents classified themselves as risk averse, and most of those who did, revealed that their risk averse attitudes were mainly a reflection of professional restrictions.

Also in direct contradiction to Prospect Theory, over half of the respondents stated that on average, they exit loss-making trades, while Prospect Theory holds that investors are loss-averse and tend not to realize losses by exiting loss-making trades.

Interestingly, a whopping 73% of investors acknowledge that overall market sentiment / risk attitude is more significant in influencing market movements, but still over half of them believe that macroeconomic and financial data has the most influence on their investment decisions. Case of irrationality in point!

Essentially therefore, the survey confirmed the empirical results.

# Conclusion

Overall we found that investors are overwhelmingly risk loving across all market directions, and increasingly so over time. These results resoundingly refute prospect theory since investors were found to be risk seeking both in the face of gains and losses. These findings are also consistent with the work done by psychologists and behavioural finance researchers who have found that psychological and behavioural biases exist, which make investors interpret information in a manner which gives rise to risk seeking behavior (A. Lo, The Adaptive Markets Hypothesis 2004) as discussed earlier.

Secondly, we found that contrary to mainstream theory, preferences of investors on both indices are dependent on the value of the index, but that the converse is not true. Of note is the fact that equation (8) presents some advantages over Prospect Theory; it does not a priori assume that the value of the portfolio induces risk aversion/seeking. Also, according to our model, a change in the sign of preferences does not necessarily imply a change in the sign of wealth/return, and vice versa, and our model does not a priori preclude linear preferences.

The importance of these findings cannot be understated, since a risk loving investor would have major implications for the way we formulate market outlooks and make investment decisions.

Additionally, these results imply that if we can find a consistently accurate way to assess investors’ risk attitudes, we should be able to determine the effect of an event, and the future direction of the index. Work of this nature already conducted holds promise, showing that certain indicators of risk appetite increase prior to and therefore lead stock market crises (Coudert and Gex 2008). Testing other indices in other markets would be the next step in determining whether these findings are universal.

Most importantly, we were able to quantify preferences; that is, based on historical data, we generated a data series for and thus we can forecast the future value of and hence the direction and value of the index.

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