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GOLD INVESTMENT AND FINANCIAL CRISIS: SOME THEORETICAL CONSIDERATIONS

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ABSTRACT

Due to its unique nature, gold has always been regarded as a safe asset. A drastic shift in recent years towards investment demand from jewellery demand reflects the concept that gold can be considered a safe haven asset in times of economic turmoil since investors construct their portfolios to include more gold as an alternative to riskier assets. This paper demonstrates the relevant theoretical dimensions of the gold investment during financial crises. Specifically, we exhibit how investor behaviour has the potential to support the safe haven property of gold. Evidence from this study shows that behavioural finance theories provide valuable contributions, and can aid in improving the understanding and the ability to make better decisions.

***JEL classification**: G01, G11, G40, G41.*
***Keywords**: Ellsberg paradox; gold; prospect theory.*

1. INTRODUCTION

According to the theory of conventional finance, the world and its participants are, for the most part, rational "wealth maximisers". The theory is based on rational and logic, where the main concept derives from portfolio theory, such as the capital asset pricing model (CAPM) (Lintner, 1965; Sharpe, 1964). The theory provides a theoretical foundation for the empirical analysis of gold hedging. This theory assumes that people, for the most part, behave rationally and predictably.

Nevertheless, as time goes on, academics in both finance and economics start to find behaviours and anomalies that could not be explained by the theories available at the time. While these theories could explain certain "idealised" events, the real world proves to be a very messy place in which market participants often behave very unpredictably. There are many instances where emotion and psychology influence investors' decision-making processes, causing them to behave in unpredictable or irrational ways. Therefore, behavioural finance, which is a relatively new field, seeks to combine behavioural and cognitive psychological theory with conventional economics and finance to provide elucidations for the reasons people make irrational

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financial decisions.[1] In other words, behavioural finance proposes psychology-based theories to explain asset pricing anomalies. Within behavioural finance, it is assumed that the information structures and the features of market participants systematically influence individuals' investment decisions and market outcomes.[2]

Numerous studies in the literature demonstrate systematic deviations from a rational, utility-maximising archetype of classical economics. This literature includes experimental evidence on such behaviour, building on insights from Ellsberg (1961), and including the well-known works of Tversky and Kahneman (1974), and Kahneman and Tversky (1979). The findings from the literature on behavioural economics demonstrate that individual preferences and behaviours may not be stable, but rather are contingent on factors both internal to the individual, such as visceral factors,[3] and external, such as the prevailing economic or financial market climate.

2. DECISION THEORY: ELLSBERG PARADOX

The Ellsberg paradox (Ellsberg, 1961) is a paradox in decision theory that displays and explains people's ambiguity aversion. Ellsberg (1961) demonstrates that seemingly rational people tend to "irrationally" avoid ambiguity. He conducts the following hypothetical experiment: You have two urns. The first urn contains 100 black and red balls but in unknown proportions. The second, which you can verify, contains exactly 50 black and 50 red balls. Whether betting on black or red, Ellsberg (1961) finds that a large number of people will choose to draw at random from urn two (where probabilities are known). From a probability viewpoint, such preferences are inconsistent, since they indicate the simultaneous belief that the probability of drawing either black or red from urn two is greater than from urn one. Therefore, such behaviour may be (mis)interpreted as "irrational". Once allowing for ambiguity aversion, however, the results can be construed as follows: Rather than divulging a seemingly irrational belief about the probability of drawing a particular ball from a

[1] Source: Investopedia homepage.

[2] The psychological foibles are not recognised in traditional models which assume that humans are rational beings or homo economicus (Economist, 2015). Thaler (2015) used a different term: econs. He states that "Compared to this fictional world of econs, humans do a lot of misbehaving, which means that economic models make a lot of bad predictions." Harvey and Liu (2014) argue that "Most of the empirical research in finance, whether published in academic journals or put into production as an active trading strategy by investment managers, is likely false." In reality, markets exhibit a herd mentality in which assets become fashionable. Investors pile in, driving prices higher and encouraging more investors to take part. This indicates that financial assets are not like other goods; demand tends to increase as the price rises.

[3] Visceral factors refer to a broad range of negative emotions (i.e., anger, fear), drive states (i.e., hunger, thirst), and feeling states (i.e., pain), that grab people's attention and motivate them to engage in specific behaviours (Loewenstein, 2000). Visceral factors could cause individuals to choose the option that offers instant gratification, but only when the matter in question is physically proximal to the decision maker (Loewenstein, 1996). Mischel (1974) demonstrates the impact of visceral factors on the impulsivity in children. In a series of experiments, when the children were asked to choose between an immediate, smaller reward, and a delayed, larger reward, the children find it harder to wait for the larger reward when either the immediate or the delayed reward is in the room with them. The fact that the physical presence of either the smaller, immediate reward or the larger, delayed reward triggers the children's visceral response and the immediate desire for that reward, even if it is smaller. Interestingly, merely showing a picture of the delayed reward does not trigger an impulsive choice, leading to the conclusion that the picture does not stimulate a visceral response.

particular urn, participants in the experiments are in fact divulging their preference for 'avoiding ambiguity'.

Based on his insights regarding ambiguity-aversion, Ellsberg (1961) presented the simplest decision rule that emphasises the degree of ambiguity of the available information:

$$max: \rho . est_x + (1 - \rho) min_x \quad (1)$$

where est_x is the expected payoff to asset x corresponding to a single estimated probability distribution, min_x is the minimum expected payoff to x over a range of probability distributions, and ρ represents the degree of confidence in a given state of information or ambiguity.

The decision rule is, in essence, a weighting scheme. Investors choose their optimal level of investment in each asset, x (which represents either gold or stock) in order to maximise the weighted sum of the expected payoff from x and the minimum expected payoff from x. The confidence coefficient ρ decreases in proportion to the ambiguity associated with the available information. Thus, in the case uncertainty or ambiguity is high, investors tend to give a larger weight to their "worst-case scenario" (min_x) in choosing their optimal portfolio of assets. Since gold is a physical asset, and its value is uncontingent on the decisions of a single government or central bank, it is sensible that investors view gold as the best alternative in a "worst-case scenario". Coates and Herbert (2008) demonstrate the neuroscientific basis for this relationship between uncertainty and a greater degree of caution. In times of greater market uncertainty or volatility, investors withdraw from risk, favouring a relatively safe asset, (i.e., those to which the minimum expected payoff will not be excessively negative).

To illustrate the manner in which the inclusion of ambiguity-aversion might be expected to affect investor choices in relation to the asset classes, Baur and McDermott (2013) assign values for est_x and min_x for each asset, and consider the manner in which the relative preference ordering between these assets would change for various levels of uncertainty (i.e., for different values of the confidence coefficient ρ). In the absence of uncertainty, the only salient considerations from an investor's point of view are the relative risk-return ratios of each asset. Baur and McDermott (2013) thus assign values for est_x based on each asset's average Sharpe ratio, which is higher for stocks than bonds, with gold provides the lowest value.

The min_x values represent the worst case scenario for each asset. The worst-case scenario for stocks would obviously be a total wipe-out of shareholder value. For bonds, theoretically, the worst case scenario would also be a total loss of value in the event of default, although a partial default might be more likely. Since gold is a physical asset, it is unlikely ever to see its value totally destroyed. Baur and McDermott (2013) therefore assign the largest negative value for min_x to stocks, and then bonds, while gold is considered to have the least negative worst case scenario.

Baur and McDermott (2013) then illustrate the relative preference ordering among stocks, bonds, and gold for different values of the uncertainty coefficient, based on the assigned est_x and min_x values. Under "normal" circumstances (i.e., in the case uncertainty is low), stocks are preferred over bonds or gold. As uncertainty increases, bonds and gold become more attractive, since both are viewed as relatively 'safe'

assets. For moderate degrees of uncertainty, bonds remain superior to gold. Eventually, for very high levels of uncertainty, gold is the dominant choice.

This characterisation of the relative preference ordering of stocks, bonds and gold under varying levels of uncertainty, is rational, given the differing features of these assets. In the case stock markets fall, investors seek protection from losses in the form of relatively safe assets. In this situation, government bonds represent an obvious choice, since they offer a fixed nominal return if held to maturity. Gold, on the other hand, is more volatile, hence, riskier, but protects from threats for which bonds do not. Gold protects investors against inflation, currency risk, and default risk. The latter property deserves further attention. Gold is a noncontingent asset since it carries no default risk, and its supply is not controlled by any single government or central bank, like hard currency and bonds. Eventually, it can be observed that the risk-return features of gold do not result in the inclusion of the asset in a mean-variance-efficient portfolio with stocks, bonds, and gold as available asset classes. Thus, to hold gold in a portfolio, investors must expect some form of compensation or protection that is not covered by the mean-variance optimisation framework. One obvious candidate is a relative safety when faced with ambiguous signals or uncertainty.

Psychological or emotional factors are also likely to play a role in the choice of safe haven assets.[4] Gennaioli and Shleifer's (2010) "local thinking" model of investor decision-making emphasise the inherent cognitive limitations that individuals face with complex and uncertain choices. Initially, at least, only some decision-relevant data come to mind, with the most representative scenarios tend to dominate. Given time and sufficient information, decisions are made on the basis of the rational calculation of risk versus return. Nonetheless, under pressure, with high uncertainty, emotional or visceral factors tend to dominate decision making (Loewenstein, 2000).[5] Hence, in times of market panic, when investors consider gold as a potential investment, "what comes to mind" - based on what gold represents - is likely to be a robust and secure store of value. Peng et at. (2007) also argue that investors can only process a limited amount of information during a given period. This "limited attention" may result in different reactions of investors to large shocks than to small shocks.

Epstein and Schneider (2008) extend Ellsberg's (1961) decision rule to a dynamic context, using a model based on investors processing ambiguous news signals. For every market-related event, agents need to assess the relevant information against the criteria listed by Ellsberg (1961) (i.e., the amount, type, reliability and unanimity of information), in order to inform their degree of confidence in estimates of expected returns. The level of market uncertainty, and investor responses to it, thus, depends on the quality of the observed news signal.

Using the terminology of Epstein and Schneider (2008), Baur and McDermott (2013) differentiate between tangible and intangible news signals. Tangible news signals are a condition in which investors have the expertise or experience necessary to be confident in their interpretation of the signal. Such events include, inter alia, the

[4] Several studies witness a revival of interest in emotions among economists (Elster, 1998) and a quite dramatic burst of study on emotions by psychologists. Psychologists make tremendous strides in understanding a broad range of issues relating to emotion, including the role of emotion in decision making (Damasio, 1994), the neural bases of emotion (Panksepp, 1998) and the interaction of cognition and emotion (Zajonc, 1980).

[5] This study restricts attention to negative emotions since their effects resemble those of drive states and feeling states. The impacts of positive emotions are more subtle and complex.

release of financial or economic data, stock market corrections and earnings announcements. According to tangible news signals, investors update their beliefs in a standard Bayesian fashion (i.e., gaining confidence following good news, while losing confidence from bad news).

On the other hand, intangible signals generate uncertainty as a result of some combination of the novelty of the observation, or the investor's lack of experience or expertise in processing that type of news. Such events include speculation about a particular company or political development that are likely to have an impact on economic or financial activities. Unanticipated, or "black swan" events, might also be considered sources of intangible signals. By their nature, such events are rare in the extreme, with the result that investors have little experience and expertise to draw on in interpreting the implications of the event's occurrence.[6]

In the case of intangible signals, the associated uncertainty causes investors to take a worst-case scenario view. They, consequently overreact to intangible bad news signals and underreact to intangible good news signals.[7] This is because, as Epstein and Schneider (2008) elucidate, the worst-case scenario for an (ambiguous) bad news story from an investor's perspective is that the story is true, while the worst-case scenario for an (ambiguous) good news story is that the story is false. Similarly, Pastor and Veronesi (2012) demonstrate that policy changes with positive consequences for stock prices are widely anticipated, given the government's economic motivation. In contrast, negative policy announcements tend to contain a larger element of surprise. They emphasise that uncertainty generated by political decisions is due to a combination of the unpredictability of political choices and the further difficulty of assessing the economic implications of any changes in policy.

Baur and McDermott (2013) later illustrate the expected dynamics of uncertainty and its consequences for stock, bond, and gold around market shock. In period $t - 1$, there are rumours about a particular sector, company, or economy. These rumours generate uncertainty, leading some investors to become cautious and seek the relative safety of assets such as gold and bonds, and thus cause a drop in stock markets, and a rise in safe haven asset values.

At period *t*, the relevant news is released. In the case of a tangible signal representing either good or bad news about the company or economy under pressure, i.e., the release of financial or economic data; the uncertainty dissipates, and investor caution is likely to be reversed. In this circumstance, markets reverse their previous day's movements; stocks regain their previous losses, while safe haven assets reverse any gains.

Nevertheless, the announcement may take the form of an intangible signal, such as a central bank intervention in an attempt to restore market confidence or an unexpected earnings announcement by a company. The intangible signal may

[6] "Black swan" events - the unknown unknowns that nobody predicted - characterised by Taleb (2010) as events that carry extreme effects. The events are outliers in the sense that they lie outside the realm of regular expectations and are essentially unpredictable a priori. For this reason, "black swan" events, which never been factored into models of risk (because nobody believes, or imagines, that such an event would ever take place), are the type of events that force agents to re-assess their world view, thus generating large uncertainties.

[7] There is a relationship between tangible and intangible signals and tangible and intangible assets. Baur and McDermott (2013) predict and demonstrate empirically that intangible signals tend to lead to the tangible assets purchase (gold) while tangible signals lead to the acquisition of intangible assets (stocks).

represent good news, e.g., a decision in politics such as the Irish government's announcement in 2008 of a blanket bank guarantee, or a central bank's decision to reduce interest rates or to pursue quantitative easing. Nevertheless, such good news is likely to have been anticipated by markets. Therefore, the impact will be muted (Pastor & Veronesi, 2012).

The intangible signal could also represent bad news. Market participants may be disappointed by political indecision or inaction, as typified by the repeated failed efforts to produce a political solution to the Euro debt crisis. Alternatively, indeed, the announcement and the associated action may be unanticipated, such as the decision to allow the Lehman Brothers to collapse.

The unexpected nature of the bad news signal represents a market shock in which stock markets start to fall. Moreover, such ambiguous bad news signals generate substantial uncertainty. Investors overreact to the ambiguity, focusing on worst-case scenarios and downside risks, resulting in a crisis of confidence. The perceived shift in their environment forces investors to accept that they face the Knightian uncertainty.[8] As a consequence, investors question the validity or applicability of their mathematical models that are based on quantifiable uncertainty.

As described in the previous statement, the increase in the level of uncertainty causes investors to be very cautious, disengaging from long-term commitments and risks. Such trends lead to an intensification of the crisis and a contagion effect, or a classic flight-to-safety (Caballero & Krishnamurthy, 2008). This highly stylised illustration is suggestive of how a shock can be transformed into a crisis, through the mechanism of increased uncertainty.

3. PROSPECT THEORY

Psychologists working in the field of behavioural decision-making produce much evidence that people do not behave as if they have von Neumann-Morgenstern (1944) preferences, but rather systematically behave in a different manner. Notably, behavioural psychologists have the advanced theory that addresses the causes and effects associated with these systematic departures. The behavioural counterpart to von Neumann-Morgenstern's (1944) theory is known as the prospect theory.

The focus of a safe haven asset at times of market turmoil implies that investors behave differently in normal times and extreme adverse market conditions. The prospect theory proposes an almost natural framework for such an analysis since it explicitly analyses gains and losses. The theory, proposed by Kahneman and Tversky (1979) initially, and later refined by Tversky and Kahneman (1992), explains that investors evaluate gamble by thinking about gains and losses rather than the final wealth levels and that they evaluate these losses and gains using certain heuristics. The model is descriptive, i.e., it attempts to model real-life choices rather than optimal decisions.

Conventionally, the net effect of the gains and losses involved with each choice is combined to present an overall evaluation of whether a choice is desirable.

[8] Knight (1921) distinguishes between economic risk and uncertainty. Situations with risk are those where the outcomes are unknown but governed by probability distributions known at the outset. He argues that these situations, where decision-making rules such as maximising expected utility can be applied, differ from "uncertain" where the outcomes are likewise random, but governed by an unknown probability model. He argues that uncertainty gives rise to economic profits that perfect competition could not eliminate. Although most economists acknowledge Knight's distinction between risk and uncertainty, the distinction has not resulted in much theoretical modelling or empirical work.

Nevertheless, Kahneman and Tversky (1979) present a concept that contends that people value gains and losses differently, being more sensitive to losses than gains, and, as such, will base decisions on perceived gains rather than on perceived losses.[9] Duxbury and Summers (2004), in their survey study, suggest that there exists a general prevalence of loss aversion rather than risk aversion among financial agents. Thus, if a person is given two equal choices, the first choice expressed in terms of possible gains, and the second choice in possible losses, people would choose the former, even in the case they achieve the same economic end result. In this context, Ang et al. (2005), in particular, contend that investors tend to engage in abrupt switches between assets, indicating that extreme price movements can be rather informative.

According to the prospect theory, losses have a more emotional impact than an equivalent amount of gains. For instance, in a traditional way of thinking, the amount of utility acquired by receiving RM50 should be equal to a circumstance in which an investor gains RM100, and then loses RM50. In both situations, the end result is a nett gain of RM50. Nonetheless, despite the fact that the investor still ends up with an RM50 gain in either case, most investors view a single gain of RM50 more favourably than gaining RM100 and then losing RM50.

The prospect theory predicts that people process these gains and losses using a value function that is concave for gains, and convex for losses. Kahneman and Tversky (1979) conduct a series of studies that involve making judgements about two financial decisions that involve prospective losses and gains. The following questions are used in their study:

1. Investors have \$1,000 and must pick one of the following choices:
   Choice *A*: They have a 50% chance of gaining \$1,000 and a 50% chance of gaining \$0.
   Choice *B*: They have a 100% chance of gaining \$500.
2. Investors have \$2,000 and must pick one of the following options:
   Choice *A*: They have a 50% chance of losing \$1,000 and 50% of losing \$0.
   Choice *B*: They have a 100% chance of losing \$500.

Logically, investors would pick either *A* or *B* in both situations. Investors choosing *B* would be more risk-averse than those choosing *A* (risk-seeking). Nevertheless, the findings of this study show that an overwhelming majority of investors chose *B* for question 1 and *A* for question 2. The implication is that investors are willing to settle for a reasonable level of gains (even if they have a reasonable chance of earning more), but are willing to engage in risk-seeking behaviours in which they can limit their losses. In other words, losses are weighted more heavily than an equivalent amount of gains.

The formula that Kahneman and Tversky (1979) assume for the evaluation phase is as follows:

$$U = \sum_{i=1}^{n} w(p_i)v(x_i) \qquad (2)$$

where U is the overall or expected utility of the outcomes to the individual making the decision; x_1, x_2,…, x_n represent the potential outcomes; and p_1, p_2,…, p_n their

[9] Investors are loss averse, that is, they dislike losses by a factor of 2.25 as compared to their liking of gains.

respective probabilities. *v* is a so-called value function that assigns a value to an outcome. The value function (sketched in Figure 1) that passes through the reference point is *S*-shaped and asymmetrical. The function *w* is a probability weighting function and expresses that people tend to underreact to medium and large probabilities, but overreact to small probability events.

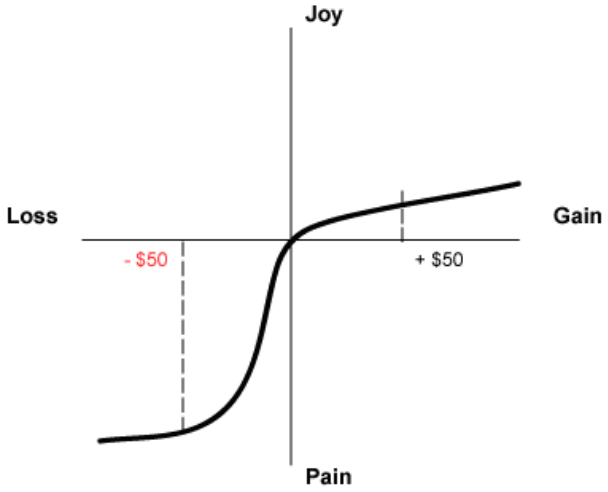

Figure 1: A hypothetical value function.
Source: Investopedia homepage.

The value function in Figure 1 is a representation of the difference in utility (amount of joy or pain) that is achieved as a result of a certain amount of gain or loss. The most evident feature is how a loss creates a greater feeling of pain if compared to the joy generated by an equivalent gain. For instance, the absolute joy felt in finding $50 is a lot less than the absolute pain caused by losing $50.

As a result, when multiple gain/loss events occur, each event is valued separately, and then pooled to create a cumulative feeling. For instance, according to the value function, if you find $50, but then lose it soon after, this will lead to an overall effect of -40 units of utility (finding the $50 causes +10 points of utility (joy), however losing the $50 causes -50 points of utility (pain)).

Baur and Lucey (2009) provide evidence that the utility of an investor increases if he/she adds a safe haven asset to his/her portfolio. They commence with an example of a hedge in normal conditions and then modify the model with a focus on extreme market conditions. They assume a gamble with equal probabilities (50:50) in which an investor can gain $1500 or lose $1000 of his/her portfolio. Adding an asset with a hedge characteristic, but not a safe haven, yields potential gains of $1400, and losses of -$800. Thus, the hedge is effective, on average (i.e., decreases potential losses). The addition of such an asset would yield higher utility within prospect theory based on the final wealth level.

Baur and Lucey (2009) then modify the example and assume that the gains are $1500 with a probability of 0.9, and the losses are -$1000 with a probability of 0.1. Using the assumption that a hedge is only efficient, on average, but not necessarily in extreme market conditions with low probabilities (e.g., 10%), adding a hedge to a portfolio with the above payoffs could yield $1400 and -$1000 with the probabilities of 0.9 and 0.1, respectively. In this case, the hedge is assumed to decrease gains and

is thus ineffective in extreme market conditions. Adding a safe haven asset to the portfolio, in contrast, could yield a payoff of $1400 and -$800 with the probabilities of 0.9 and 0.1, respectively. At this point, the safe haven asset is effective in times of market turmoil, since the utility levels are greater with the safe haven asset.

4. CONCLUSION

The main concept of hedging is derived from the portfolio theory: CAPM (Lintner, 1965; Mossin, 1966; Sharpe, 1964, 1970; Treynor, 1961, 1962). The CAPM lumps all sources of risk into one unified set. Nevertheless, the theory discusses the issue under a stable condition that does not change over time. That is, the CAPM is limited in usefulness as a tool for investment analysis since it neglects to account for behavioural factors (see Appendix).

The models that break traditional assumptions by incorporating human behaviours into investment decisions are the Ellsberg paradox (Ellsberg, 1961) and the prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1974, 1992). The Ellsberg paradox deals not only with risk aversion but with ambiguity aversion as well. The main idea behind this paradox is about ambiguity or uncertainty aversion; more specifically, it describes a preference or an attitude for known risk over unknown risk. The prospect theory, on the other hand, is somewhat abstract, but it is useful in tackling some of the long-standing puzzles in financial markets, where the main idea is about loss aversion. The theory could also be seen as a behavioural foundation of the CAPM. Utilising both theories allows the researcher to investigate the safe haven issue empirically, since they gauge the time-varying of stock return and return volatility, particularly during extreme conditions where visceral factors such as emotion can be quantified.

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APPENDIX

Table 1: Theoretical model framework.

Theory	Dependent Variable	Independent Variable	Idea
CAPM	The risk premium on the asset (expected return of asset *i* minus rate of risk-free investment).	Market risk premium (expected return rate of a market benchmark minus rate of risk-free investment), beta (sensitivity of the return on asset *i* to the particular factor).	• Investors require higher levels of expected returns of asset *i* to compensate them for higher expected risk; if not, the investment should not be undertaken.
Ellsberg Paradox	Safe haven asset	Visceral factor that is, short-term but powerful psychological, emotional and sentiment factor. For example fear and panic.	• Displaying and explaining people's ambiguity aversion. • People often make irrational decisions in the face of better logic simply because unambiguous situations are easier to quantify. • Often cited as evidence for unknowable ambiguity versus computable risk.
Prospect Theory	Risk propensity (risk-seeking or risk-averse)	Domain[10] (gains or losses relative to a reference point[11])	• Investors are risk-averse if facing potential gains, and risk-seeking if confronted with potential losses. • Investors are more sensitive to losses than gains. Thus, decisions are based on perceived gains rather than perceived losses.[12]

[10] Domain refers to whether an action takes place in the perceived realm of gains or losses.
[11] Reference point is the current steady state to which a person has become accustomed.
[12] If one is given two equal choices, possible gains and possible losses, one will choose the former, even when they achieve the same economic end result.