Behavioural Finance: Beginnings and Applications

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Abstract

The essay traces the beginning of behavioural finance by examining the development of expected utility model. Expected utility model is based on the assumptions of time consistent preferences of utility. However, experimental results in psychology regarding choice under risk and uncertainty shows well-defined deviations from the predictions of expected utility model. It was found that there were systematic biases and heuristics that economic decision makers use to make choices. In the next section, the essay describes some of these heuristics and how they modify the assumptions of utility model. Applications of behavioural understanding in finance is briefly discussed to show the widespread prevalence of behavioural heuristics in and beyond finance. The essay concludes by arguing that accommodating the behavioural variable is necessary to make neoclassical model more relevant to the real world.

Keywords: Behavioural finance, Psychology, Economics, Rationality

1. Introduction

'The economist may attempt to ignore psychology, but it is sheer impossibility for him to ignore human nature, for his science is a science of human behaviour'.

- J.M. Clark, Economics and Modern Psychology (1918)

From the time of Adam Smith in the eighteenth century, modern economics has evolved as a field of enquiry grappling with the question of how individuals make choices and decisions. Smith himself dealt intensely with human nature in both his works, *The Theory of Moral Sentiments* (1759) and *Wealth of Nations* (1776). In his former work, Smith describes human beings as possessing dual psychological characteristics of passion and rationality. In fact, he understands the process of making choices as a conflict between the deep passions of one part of our selves and the 'impartial spectator' in the other. This dualism and preoccupation with psychology is remarkably similar to what Daniel Kahneman (2011) argues in his work *Thinking, Fast and Slow*. However, by the time Smith was writing *Wealth of Nations*, the idea of 'dual selves' had simplified into a monolithic rational economic actor driven by an urge to maximise his self-interest. Rational decision making has been the keystone of economics ever since. The assumptions of utility and time consistent preference have been at the centre of our understanding of choices and decision making by an economic actor. In other words, the supremely rational 'economic man' has birthed both normative and descriptive understanding of how economic actors make decisions. In the process of this simplification, we have relegated the other part of the economic actor- irrational, greedy, fearful, regretful, sad, happy, generous, selfless and ecstatic- to the back stage.

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Nevertheless, the irrational ever-present self has played havoc with our elegant assumptions, overturning predictions, upending expectations and driving deviance. In other words, in the journey from the classical to the neo-classical economics and beyond, it was only a matter of time, before the irrational self would be noticed and accommodated in our understanding of the economic world. The insertion of 'behavioural' explicitly in economics and the experiments in psychology that studied decision making over the last forty years, have given a much-needed new direction in our understanding of choice and decision making under various circumstances. This is not to say that neoclassical economics is overlooked; in fact, the assumptions of neoclassical economics have had to accommodate and understand the behavioural strand to make the explanatory and predictive value of its models more effective. Behavioural economics has been both an important deviation from as well as a continuation of the neoclassical tradition. The new ideas and concepts speak to the old ones, each side lights up the other and the new evidence and arguments have made us understand the complex economic world we build through our choices.

Behavioural finance is a branch of inquiry that uses insights from psychology to inform decision making in finance. Shefrin (2005) defines behavioural finance as 'the study of how psychological phenomena impact financial behaviour'. Today, it is a fledgling field of enquiry with a wide range of applications in not just financial behaviour, but in decision making across areas like education, health and political choices. This spilling out of psychology into various disciplines of finance has created many opinions among academics. Forbes (2009), in the preface of his book *Behavioural Finance* trenchantly remarked that 'behavioural finance has now branched out far from its original founding fathers' intentions'. To some extent, it is true that researchers have created their own behavioural tradition by focussing on a range of questions and methods, making this a rapidly evolving field of inquiry.

The story of behavioural economics and finance is the theme of this essay. The first part of the essay draws from the assumptions and arguments of classical and neoclassical economics and shows the observed deviations. In the second part, the essay attempts to explain the deviations using well-documented behavioural phenomena. The last part of the essay discusses some applications of behavioural understanding in finance and beyond.

2. The Beginning

Traditional finance, like neoclassical economics, relied on the 'economic man' who was perfectly rational, to study how financial decisions were made in markets. This was done with the help of a number of theoretical models that were taken as approximations of reality under the given conditions. Models had both explanatory and predictive value. However, the models of traditional finance sometimes failed to explain or anticipate the given behaviour of economic actors. This failure of traditional finance led to the opening of two main branches of enquiry—the economics of decisions under uncertainty (that eventually became behavioural economics) and the economics of information.

In order to understand behavioural finance, it is necessary to dwell on behavioural economics since it is here that wide applications of psychology to economic decision making began to be studied experimentally. Economists have varied opinions on whether behavioural economics is a field within economics or is part of mainstream economics. Richard Thaler, considered as the founding father of behavioural economics, calls it 'a moderate agnostic approach to studying financial markets' (Thaler 1999). It is interesting to note that the founders of classical economic thinking such as Adam Smith, did not differentiate the psychological aspects of human behaviour as something to be examined separately. In fact, some of their concerns were directly dealing with the capricious nature of human minds and how to effectively guide them to economic thinking. For instance, what we describe as economic thinking today, were studied under the rubric of 'moral sciences' or 'political economy' in the eighteenth century. Later, how did the focus of intellectual inquiry in economics change? What were the compulsions that drove the infusion of psychology back into economics? What are the consequences of these developments to economics as we know of it today? These are some questions that this essay deals with.

The origin and early development of modern economics is verily a battle of ideas. These ideas were as much about philosophy of inquiry (what we commonly refer to as research methodology today) as it was about choices and human behaviour. When it began as a branch of social inquiry, economics was very close to 'moral sciences' and 'political economy', eschewing the orthodoxy it was to develop a little later. For example, Adam Smith (1759) was talking about the philosophical and psychological

aspects of choice in *The Theory of Moral Sentiments.* It was an era just after renaissance in Europe, when scholars were debating both human nature and the nature of philosophical inquiry. On human nature, the most common description was that 'man was by nature lazy and indolent, improvident and wasteful, and it was only by the force of circumstances that he could be made to behave economically or carefully to adjust his means to his ends' (Hayek 1946). On the objective of philosophical inquiry, one dominant view was described by Rousseau (1754) that 'the best use one can make of philosophy is to have it destroy the evils it has given birth to…It is true we would not know anything then, but we would agree upon that in good faith, and in our search for truth, we would have taken all the steps from error to ignorance'.

The philosophy of inquiry in economics was also deeply influenced by the idea of science as a method of producing a 'new organisation of experience of the external world' away from 'sense qualities' (Hayek 1941). In the scientific paradigm, what people felt and knew from their sensory perception did not form part of reality. A particular form of reasoning that excluded sensory perceptions and emotions was preferred over the more extroverted behavioural aspects even in the analysis of social behaviour. This had consequences for the way economic thinking was structured. Thus 'human drama, the greed, eccentricity or caprice of market participants' were safely relegated and in its place, the deductive method of reasoning refuting hypothesis was born.

The scientific nature of reasoning was based on conjectures and potential refutability of data. In his essay, 'The Methodology of Positive Economics', Milton Friedman elucidates the scientific method of reasoning with refutable hypothesis. He argues that, '… a hypothesis is important if it 'explains' much by little…if it abstracts from the mass of complex and detailed circumstances and permits valid predictions on the basis of them alone. To be important, therefore, a hypothesis must be descriptively false in its assumptions' (Friedman 1953: 14). The application of scientific method to study markets had interesting results. One such consequence was the development of price allocation mechanism. Price allocation mechanism was a method that aggregated information and required individual economic actors to have far less mental agility than any other competing allocative mechanism. This mechanism was called 'economy of knowledge' with which the market operated (Hayek 1945). Economics was being

established as a field of enquiry that centred on efficiency of allocation of information through markets where the economic man made perfectly rational decisions based on the information given.

As Elster (1986) has argued, the central tenet of rationality that drove the economic man was the need for consistency of beliefs and desires that it provided. The challenge to this rational belief was that economic actors were as much motivated by greed and spite while making decisions as much by the price allocation. There were circumstances where being perfectly rational was self-defeating because of institutional imperfections. Separating irrationality from these circumstances remain challenging to this day.

This new orthodoxy based upon price allocation and the economic man made economics more 'introverted' and led to the evolution of stylised facts. Rabin (2002) characterises economic man as having at least four important characteristics. According to him, economic man has well-defined preferences. Secondly, these preferences are based on choices on expected outcomes. Thirdly, the economic man always attempts to maximise his well-being or utility based on these expected outcomes. Finally, while evaluating future outcomes, an economic man discounts expected pay-offs by geometrically increasing amounts to obtain their present value.

The classical assumptions of the market as an institution are also relevant to this discussion. There were three main assumptions regarding markets. Firstly, there was the presence of many buyers and sellers that prevented any individual or groups from influencing prices. Secondly, an economic actor's expectation of returns was based on full use of available information. And finally, there was only minimal amount of friction distorting the demand-supply equilibrium. These assumptions about the economic man and the market are the keystones in understanding basic theoretical models of classical economics which was expected to have the two qualities all branches of scientific inquiry have- explanatory and predictive value.

3. Fundamental Concepts in Economic Decision Making

'Mathematical truths make little sense to the mind…Most results in probability are entirely counterintuitive'.

- Nassim Nicholas Taleb, *Fooled by Randomness* (2005)

The most important theoretical model of neoclassical economics is the utility model of choice. Discounted utility model was proposed by Paul Samuelson (1937) and expected utility model by Neuman and Morgenstern (1947). Both these models are based out of Bayesian method of calculating probability. The probability of an event occurring in the future is at the heart of calculating expected outcome of an event and the utility attributed to it. Yet, there are mathematical models that use rationality to show that being rational would sometimes be counterproductive in real life situations. Box 1 discusses St Petersburg paradox in this context (refer box 1). However, probability, risk, utility and time consistent preference continue to be the four fundamental concepts in understanding human decision making.

This section of the essay sketches the relation between these concepts and how they affect our understanding of choices. In the first part of this section, Bayes' theorem of posterior probability is discussed that helps to understand the conditional probability of an event, given the probability of another event. In the second part. Samuelson's discounted utility model is discussed. This model gives an account of how future utilities are discounted at a constant rate. In the third part, expected utility theory is explained along with risk aversion. A clear understanding of the assumptions and implications of assumptions of neoclassical model would help in anticipating why deviations from rational choices were observed later through experimental psychology.

Box 1

St Petersburg Paradox and the Real World of Irrationality

Throughout history, there have been abstract mathematical puzzles that have had direct impact in the real world. One typical example is what we know today as St Petersburg Paradox, a mathematical conundrum concerning probability and decision making. This paradox was first framed by Nicolaus Bernouilli, an eighteenth century Swiss mathematician, and first solved by his brother Daniel Bernouilli. Nicolaus wrote in a letter to his friend Pierre Reymond de Montmort in 1713, about a lottery game that leads to a random variable with infinite expected value (pay-offs). He described a situation where calculation of expected pay-off alone, leads to a game situation which no rational person would be willing to take. In a paper presented to the Imperial Academy of Sciences, St Petersburg, Russia, Daniel gave one of its possible solutions. Thus, the paradox came to be referred to as St Petersburg Paradox.

Bernoulli's paradox can be framed as follows. A game of chance (or lottery) is called 'fair' if each player's expected net profit is zero. Assume a game where player A agrees to pay player B whenever a fair coin toss leads to 'heads'. The payment is as follows: $ 2 if heads appears on the first toss, $ 4 if first head appears on the second toss, $8 if first head appear on the third toss and so on. This leads to a simple formula of payment of $ 2^n if the first head appears on toss n. In this game, what should be the expected pay-off to player B and the entrance fee charged by player A to make the game fair?

Let Y be the expected pay-off to player B. Then, Y is a discrete random variable with probability distribution p (Y) as follows

Value of Y	2	4	8	…∞
p(Y)	½	¼	1/8	∞

Expected pay-off, E (Y)= 2.1/2+4.1/4+8.1/8+…∞

This is a typical casino-gambler situation in which no finite entrance fee can make the game fair. Player B is certain to win only a finite amount, so paying an infinite amount as entrance fee makes the game unfair. Hence no rational player will be willing to enter the game. This is the paradox.

Nicolaus himself attempted a solution to his puzzle. He assumed the probability of large values of Y to be zero from the assumption that they are not likely to occur. He truncated the series of probability distribution by valuing n=25, arguing that E(Y)=24. However, he was not satisfied with his own solution. A number of mathematicians attempted various solutions. Daniel Bernouilli presented his solution in 1731 in which he gave the idea of 'marginal utility of money' in solving expected pay-off. Daniel argued that money should be valued at its 'marginal utility' because the more an economic actor has money, the less he wants of it more. He concluded that marginal utility of $n is log n, arriving at n=4.

Many mathematicians have used different assumptions to arrive at a maximum value of entrance fee for this game over the centuries. The interesting fact is that a number of real world situations come under the category of this paradox. The game show 'Who wants to be a millionaire' and sports player's pay-out in proportion to scores played in a season are common examples.

The trend of investing in 'growth stocks' in financial markets is an example of St Petersburg paradox at work in the world of financial markets. Growth companies are those that are growing at a rate faster than the overall economy. In 1999, Wall Street reported a phenomenal rise in investment of 'growth stocks' causing analysts to call it 'irrational exuberance'. Thus, Bernouilli's paradox continue to play out in different ways around us.

i. Bayesian model of conditional probability

Bayes' Theorem is a way to think about probability. Reverend Thomas Bayes of Tunbridge Wells in Kent, United Kingdom, was a well-known mathematician of his times and a member of the Royal Society. In his compelling biography, Bellhouse (2004) recounts how after his death in 1761, Bayes' friend Richard Price published all his collected works in 1763. This included his celebrated 'theorem for posterity'.

Bayes begins his reasoning from understanding the conditional probability of an event, given the occurrence of another event. For a considered event x, let x take the form of X and for a considered event y, let y take the form of Y. The conjunction of the considered events be denoted by Pr [x|y]. Given the state of affairs, the conditional probability that x=X and y=Y is given by

$$\Pr[x|y] = \frac{\Pr[x \cap y]}{\Pr[y]} \quad (1)$$

From equation (1), conditional probability gives those states when state y leads to state x. x∩y gives the property of X taking the value x when Y takes the value y.

From equation (1), there are three properties of probabilities that we can derive.

(i) For any given chance x=X, the occurring is bound between impossibility and certainty, i.e., 0≤Pr[x]≤1

(ii) If x and y are exclusive events, then the probability of either of them occurring is the sum of both the events

(iii) The joint probability of x and y occurring is the probability of the state of the world given the event multiplied by the unconditional probability of that event.

Property (iii) can be mathematically derived as follows.

$$\Pr[x \cap y] = \Pr[x|y] \Pr[y] = \Pr[y|x] \Pr[x] \quad (2)$$

From (2),

$$\Pr[x|y] = \frac{\Pr[y|x] \Pr[x]}{\Pr[y]} \quad (3)$$

$$\frac{\Pr[x|y]}{\Pr[x]} = \frac{\Pr[y|x]}{\Pr[y]} \quad (4)$$

$$\Pr[y|x] = \frac{\Pr[x|y] \Pr[y]}{\Pr[x]} \quad (5)$$

From equation (5),

Pr [y] — prior probability of the state of the world y

$\frac{\Pr[x|y]}{\Pr[x]}$ — relative likelihood of the event, given the state

Pr [y|x] — posterior probability of the given state y

ii. Samuelson's discounted utility

Paul Samuelson (1937) gave a model of discounted utility and consumption preference over time. Let U be the utility measure, c be the consumption measure, t be the time and δ be the discount rate that gives the pure rate of time preference. According to Samuelson, a sequence of consumption (c_1, c_2, …, cn) is preferred over (c_1^1, c_2^2, …, c_n^n) if and only if

$$\sum_{t=1}^{T} U\,(c_t)\,\delta^t > \sum_{t=1}^{T} U\,(c_t^1)\,\delta^t \quad ; \quad 0<\delta<1 \qquad (6)$$

From (6), the first derivative of utility with respect to consumption is positive and the second derivative is negative. In other words, utility increases with consumption at a decreasing rate.

There are two central assumptions that come out of equation (6). The first is 'preference independence' that states that if two consumption streams share common elements, then they can be distinguished by their uncommon elements alone. The second assumption is 'stationarity' that states if the first n elements of a consumption streams are common, then the difference in utility can be evaluated using their remaining elements alone. It is this assumption that has given rise to the concept of constant discount rate (refer box 2).

Box 2

At the Heart of Expected Utility Model

At the heart of expected utility model is the idea of intertemporal preference. It is interesting to see how this idea travels the path of time through several minds to become what we know of it today.

Economics has always been interested in the question of how an economic actor values consumption over time. This evaluation is at the heart of expected utility that determines choice in a given situation. Nearly all major economic theoreticians confronted this question at some point in their career. Adam Smith was one of the prominent thinkers who dealt with the question of intertemporal choice. In his work *The Theory of Moral Sentiments* published in 1759, he studied human beings as a combination of passionate economic actor and an impartial spectator. The impartial spectator assumed many roles throughout decision making

process, acting as the rational individual and conscience-keeper, encouraging the passionate economic actor to choose long term choices over short-term preferences. This dual perspective of psychology is remarkably similar to what behavioural economists argue today. William Jevons (1871) in *The Theory of Political Economy* postulated that preference for present over future consumption diminishes over time. His introduction of marginal utility transformed classical economics into its neoclassical variant. Irving Fisher (1930) in *The Theory of Interest* provided a model to understand how economic actors chose their preference of consumption over different time periods at a given rate of interest through the 'indifference curve'. Finally, Paul Samuelson in a seven-page paper 'A Note on the Measurement of Utility' in 1937 gave the economic world the discounted utility model. What is interesting about Samuelson's paper is that the last two pages were devoted to the limitations of the model in real world applications due to discounting fallacies that economic actors have. Decades later, Thaler (1981) found experimental evidence of discounting future preferences more than the expected rate and called it 'hyperbolic discounting'.

iii. Expected utility and risk aversion

Neuman and Morgenstern (1947) presented a model of expected utility theory explaining normatively how a rational economic actor should behave about choosing alternatives. It was not presented as a descriptive theory that explains how economic actors and their actual decision making. The assumptions of this model were four abilities of the economic actor — to rank alternatives, ignore irrelevant alternatives, continuously rank outcomes where outcomes are continuous and focus on outcomes and not how the information is presented. Expected utility theory provided a rule for evaluating risky outcomes from the perspective of the economic man.

Let the uncertain event or lottery be x. Utility (U) is the weighted average of outcomes of the lottery.

$$U(x)= L (o_i, p_i) = L (o_1,o_2,\ldots o_n ; p_1 .p_2, \ldots p_n) \quad (7)$$

From equation (7), o is the possible outcomes that occur with probabilities p_i. i could take values from 1 to n.

The important insight from equation (7) is that any intermediate outcome between 1 and n will have the same reference point with respect to the best outcome at o_n and the worst at o_1. In other words, it is possible to build a cardinal ordering (ranking) of anticipated outcomes when preference for outcome is expressed as weights in a lottery. Furthermore, not only the preferred outcome, but the willingness to pay for this outcome can be derived out of ranking.

Two important observations regarding probability weights are in order here. The first is that probability weights are subjective probabilities. It is possible that certain choices are truly uncertain as opposed to merely being risky. The second point is that expected utility is not just our preference over different levels of consumption alone, it is also the revealed preference for risk. Economic actors dislike risk, all other things being equal. A lottery is a 'fair bet' when it offers an expected value equal to cost. For a given level of wealth w, an economic actor prefers the least risky way of attaining it. Utility function to evaluate prospects of a lottery would be as follows.

Let w be a given level of wealth, p(w) be its expected utility and R_A be the risk aversion. At any given point, $\frac{\partial p(w)}{\partial W}>0$ and $\frac{\delta p(w)}{\delta W}<0$. This means that expected utility for wealth w increases but at a decreasing rate because of marginal diminishing utility.

$$R_A = -w \frac{\frac{\partial p}{\partial W}}{\frac{\delta p}{\delta W}} \quad (8)$$

From (8), it is clear that, since the economic actor is risk averse, he is unwilling to pay the expected value of 'x' for a prospect unless the maximum pay-off of at least x is certain. It is also clear that an economic actor is likely to give greater value to bad outcomes deviating from mere probability weights alone.

These models that incorporated constant discounting rates and expected utility by the application of probability have ruled financial economics for the best part of the twentieth century. Some of the cardinal models that predict stock prices, guide investment decisions and explain market phenomena have taken these assumptions as starting points to build models (refer box 3). Expected utility model began to be widely used through its various applications. It gave way to some central assumptions regarding investment preference in finance, articulated by Friedman and Savage (1948).

They were

(i) Investors prefer larger certain outcomes to smaller outcomes
(ii) Low income investors tend to buy more insurance
(iii) Low income investors simultaneously buy more lottery
(iv) The lotteries that low income investors buy often have more than one prize

It was only in the early 1970s that psychological experiments that studied decision making under risk and ambiguity began to provide well documented deviations from the assumptions of traditional finance. What these experiments were and how the new results affected traditional finance forms the next section of the essay.

Box 3

The Two Musketeers of Traditional Finance

Two of the most prominent theoretical models of traditional finance have been anchored in the assumptions of expected utility model. They are Modern Portfolio Theory (MPT) of Harry Markowitz and Efficient Market Hypothesis (EMH) of Eugene Fama. Both of them were awarded the Nobel Memorial Prize in Economic Sciences.

Harry Markowitz published his paper 'Portfolio Selection' in *The Journal of Finance* in 1952. In this paper, he proposed a model that explained how risk-averse investors could optimize their earnings by diversifying their investment portfolio. The assumptions of the model were derived from expected utility theory especially the characteristics of a rational economic actor who expects higher economic returns. According to Markowitz, optimal portfolio can be selected from calculating an efficient frontier by analysing risk-return preferences of the economic actor. This model is also known widely as mean variance hypothesis. The different versions of Capital Asset Pricing Models (CAPM) developed by William Sharpe (1964) Fischer Black (1972) and Black *et al* (1972) built on MPT to discover the rate of return for assets in portfolios.

Eugene Fama, published his paper 'Efficient Capital Markets: A Review of Theory and Empirical Work' in *The Journal of Finance* in 1970. The paper began with two assumptions- that economic actors are rational and that they have rational expectations. In this paper,

Fama proposed two concepts- market efficiency and joint-hypothesis problem. Market efficiency is the mechanism through which information is factored in price. Fama proposed three forms of market efficiency in which information was factored into prices to varying degrees. Joint hypothesis problem stated that it was impossible to test market efficiency other than through some other market pricing model. This was due to the fact that when a model yields results that are significantly different from actual results, it is impossible to ascertain whether there is imperfection in the market or in the model.

4. Questioning Expected Utility: Prospect Theory

'Models fail because they fail to incorporate the inter-relationships that exist in the real world.'

- Myron Scholes as quoted in *Capital Ideas Evolving (*Bernstein 2011)

In finance, variations from expected utility rule have been observed while making decisions under risk and uncertainty. For example, factors like habit formation that attune people to specific consumption levels and socially shared benchmarks of expectations in life were found to affect investment decisions. A program of research on heuristics and bias began in the 1969 annual meeting of Mathematical Psychological Society and American Psychological Association. A survey questionnaire was posed to the eighty four participants who participated in this meeting. The questions ranged from statistical significance of samples and robustness of statistical estimates to replicability of research results. Even though the participants were specialists in statistical tools and techniques, a general tendency to make incorrect assessment of probability was observed.

A large number of experiments in the following years gave evidence of how individuals made decisions in risky and uncertain situations. Many anomalies from expected utility were found due to the mental shortcuts and biases with which economic actors approached problems. There was a psychological aversion to risk and loss that modified our rational behaviour in investment decisions. What was illuminating was that these biases that led to seemingly non-rational choices were systematic. Behaviour had never been integrated before as a variable in economic decision making.

The excessive reliance on pure theory or empirical statistics led to misconceptions about how decisions were actually made by overlooking neurological limitations, psychological factors and social conditioning. Incorporating behavioural factors could describe the characteristics of economic actors more precisely, identify and correct biases in value estimates, identify parameters that predict decision making impairments and help in evaluating outcomes.

The importance and the need to have different evaluation models for outcomes cannot be overstated. Evaluating outcomes is at the heart of expected utility theory. How an economic actor evaluates future outcomes is mentally linked to past experiences. Evaluation of the past is done from memories that are created in the mind, and edited each time an individual retrieves them. Psychological studies on risk evaluation reveal that the way individuals forge memories is based on 'peak moments' and 'end of the event', regardless of the duration of event. In a situation that inflicted pain (medical treatment), people evaluated how bad the experience was based on their worst day and the end of the treatment. This meant that individuals preferred long-duration procedures with less pain over short-duration treatments with short intervals of high intensity pain.

Such mental frames have impact over future evaluations. Decision under risk and ambiguity can lead to economic actors making very different choices given equivalent probabilities of two different outcomes. When anticipation and experience diverge, economic actors have trouble in evaluating future value of outcomes. In this scenario, they use mental shortcuts called 'heuristics' to arrive at a decision.

Prospect theory (Kahneman & Tversky 1979) was a descriptive theory of how choices were actually made in circumstances of risk. This model was based on the assumption that contradictions in expected utility theory could be explained if an economic actor was thought of as having an ordered mental frame where choices were structured. Outcomes were not just preferentially ordered, but given subjective values by economic actors.

Consider a prospect of an outcome. Let one possible outcome be x with a probability of occurring p. Let a second possible outcome be y with a probability of occurring q. According to prospect theory, outcomes give rise to value v(.) for economic actors and probabilities have weights π(,) attached to them.

Value of a prospect is given as

$$V= \pi(p)\, v(x) + \pi(q)\, v(y) \quad (9)$$

There are four important inferences from equation (9).

(i) Values are functions of outcomes and weights are functions of probabilities.
(ii) Outcomes are gains and losses relative to some reference and nominal levels of wealth as claimed by expected utility theory.
(iii) Losses hurt more than gains please investors because of the subjective weights attached. Therefore, outcomes with very low probability are heavily over-weighted.
(iv) At some level of certainty, the weighting given by prospect theory converges with its true probability to an outcome

The assumptions of prospect theory vary from expected utility theory by modifying three assumptions. Firstly, the weight function of prospect theory helps in clarifying choices vis-à-vis certainty and uncertainty, sensitivity to changes in probability and assesses the degree of bias. The second point is the idea of relative reference point that prospect theory proposes. Economic actors compare choices with respect to status quo, outcomes of other choices and with respect to expectation. This assumption eschews the possibility of having time consistent preferences that have the same best and worst case reference points. Finally, the change in reference points themselves can be explained by temporal discounting as opposed to fixed discounting proposed by expected utility model. Temporal discounting is done because of learning, changes in goals or a combination of goals, expectancy and experience.

5. Heuristics and Bias

Visceral emotions like animal spirits, greed, fear, regret and rejoicing in addition to social beliefs give economic actors preferences that were not entirely rational. It was well-documented observations of such influences in experiments that led to the development of behavioural finance. For instance, behavioural patterns of investment in financial markets indicate ‘herding’ (doing what others do) and avoiding of ‘sin’ stocks (like that of tobacco companies) that may be profitable. There were a number of scholars who combined their understanding of various disciplines like psychology, statistics and neurobiology who studied the behavioural aspects of decision making

(refer box 4). Mental shortcuts and systematic bias of various kinds were reported from these studies.

Box 4

The Amazing Duos of Behavioural Economics

Behavioural Economics has been a multidisciplinary field of research that has encouraged group thinking and work, perhaps because of the necessity of collaboration from different subjects and the influence of experiments in questioning assumptions. A team of two scientists, rather than the lonely traveller, have brought out some of the pioneering insights to the discipline.

Daniel Kahneman and Amos Tversky, were the original amazing duo whose paper 'Prospect Theory: An Analysis of Decision under Risk' published in *Econometrica* in 1979 critiqued the expected utility model of decision under risk and presented an alternative descriptive model called 'Prospect theory'. With a simple, but elegant equation, the psychological aversion to risk and losses were quantified in this model using assumptions that were observed in experiments. This paper laid the foundation of behavioural economics and fetched Kahneman the Nobel Memorial Prize for Economics in 2002, six years after Tversky's death.

Sarah Lichtenstein and Paul Slovic conducted experiments that showed reversal of preferences challenging the assumption of consistent preference of expected utility model. In their findings published in *Journal of Experimental Psychology* in 1971, they demonstrated reversal of preferences between bids and choices in gambling.

Charles Plott and Vernon Smith worked their 'induced value methodology' to understand simple predictable behaviour that deviated from applications of Bayesian or regression analysis. Their argument was that findings of experiments in isolated conditions including laboratory, had applications in richer and real environment. Eventually, Vernon Smith consolidated their arguments in his 1976 paper 'Experimental Economics: Induced Value Theory' in *The American Economic Review.*

Richard Thaler and Cass Sunstein broke the ideological grounds in behavioural economics with their paper 'Libertarian Paternalism' in *The American Economic Review* in 2003. Following this, they explained the political justification for choice architecture, a

framework that can help people make more rational choices by guiding decisions through 'nudges'. The idea of choice architecture was presented in their book *Nudge: Improving Decisions about Health, Wealth and Happiness* in 2008 in which a wide array of applications of behavioural economics is given.

Sendhil Mullainathan and Eldar Shafir bring psychology and economics to understand a fundamental concept called scarcity. In their book, *Scarcity: The True Cost of not Having Enough* published in 2013, the duo examines the idea of scarcity and its impact on daily lives with lively examples and explain the persistence of poverty by analysing poverty reinforcing habits of the poor.

Justin Hastings and Jesse Shapiro provided a test of fungibility of money based on parallel shifts in prices of different quality grades of the same product. Analysing consumer choice in such scenario using panel microdata, they explained psychological choices that goes against the rational inference that money is fungible. These findings were published in *Quarterly Journal of Economics* in 2013 as 'Fungibility and Consumer Choice: Evidence from Commodity Price Shocks'.

Behavioural economics and finance owe their foundation to the understanding of these mental frames. This section discusses some of the most common concepts that behavioural finance has introduced to economic thinking.

i. Hyperbolic discounting: Present over future

One of the first set of experiments that questioned expected utility was by attacking the idea of time-consistent discounting rates. Thaler (1981) found out that economic actors displayed asymmetric response to gains and losses. Expected utility theory states that the means of eliciting choice should not affect choice itself, i.e.,

Delay premium = Speed up costs.

In other words, the willingness to avoid delay in losses (delay premium) should equal the willingness to speed up attaining gains (speed up costs). But this was not to be so. Thaler found that the willingness to delay losses was much higher than the speed up costs for gains. Thaler also found that economic actors made high discount rates at short time horizons and the discounting declined as time horizons became larger.

Thirdly, the discounting rates also depended on whether the choices were presented as one-off or bundled in a series. Choices that were fragmented or bundled induced higher discounting than one-off choices. The implication of this study was that rather than a constant exponential discounting function, economic actors preferred more immediate, less valuable choices through the process of 'hyperbolic' discounting. The inability of economic actor to rely on the marginal utility of each of the choices for a period is because of inconsistency of preference for each time frame. Laibson (1997) in another study found that large prospective gains are not discounted as heavily as smaller ones. He named this magnitude effect. Changes in the way economic actors used discounting rates was the first salvo from the armour of behavioural finance.

ii. Representativeness bias: Like goes with like

Representativeness bias refers to the way people make subjective probability judgments based on similarity to stereotypes. Baker and Nofsinger (2010: 259) define it as '…a tendency to assess similarity of outcomes, instances and categories on relatively salient and even superficial features, and then to use these assessments and similarity as a basis of judgment'. Tversky and Kahneman (1974) proposed that representativeness bias was a direct contradiction of various laws of statistics while making judgments on probability. One was base rate neglect which meant economic actors often ignored prior probabilities relying on the representativeness of the event alone. There was also insensitivity to sample size as well as predictability. The final feature was misinterpreting chance and randomness. Two typical examples were 'law of small numbers' by which economic actors put too much faith in the representativeness of a small number of observations. Another example was gambler's fallacy. Gambler's fallacy was a common example where people who played lottery expected bad luck to reverse quickly. Ignoring 'regression to the mean' was another feature of representativeness bias. Regression to the mean law in statistics state that exceptional events are followed by a series of normal events. The belief in 'hot hands' or extrapolation bias in basketball and gambling are examples in which economic actors expect exceptional events to be followed by exceptional events. Tversky and Kahneman (1971) had earlier formulated that extrapolation bias was common where economic actors believed that past performance was a good proxy to future outcomes. Illusion of validity was also commonly seen in decision making under

risk in which confidence was seen as a function of representativeness. In reality, confidence is a function of a series of related inputs.

There are some real-life examples of representativeness seen in financial markets. One assumption that 'good stocks are from good companies' is a product of representativeness bias. The rationale against this type of reasoning is that if good management practices were relevant to prices of stock, it would already be reflected in the market price. Another example is the assumption that 'growth stocks are better than value stocks'. Lakonishok, Shleifer and Vishny (1994) found out that economic actors value growth stocks over value stocks. But value stocks were found to consistently outperform growth stocks. The belief in 'hot hands' was also seen in economic investors choosing stocks that had stronger analyst's recommendation. 'Chartism' was another instance of representativeness bias. Chartism is a process by which future price movements of stocks are done by relying on past prices.

iii. Familiarity Bias: Invest in what you know

Familiarity bias refers to the revealed preference for familiar assets in the presence of higher returns and lower risks from less familiar assets (Baker & Nofsinger 2010: 277). Familiarity bias leads to lack of diversification in portfolio. This is because past returns are taken as proxy for future outcomes by investors. Bias in investment toward local firms and home-based firms are common examples of familiarity bias operating in the markets. There are a number of explanations why familiarity bias operates. Markets are often not fully integrated due to transaction costs that are visible in the form of explicit barriers like different tax rates in different jurisdictions, laws limiting asset liquidity and currency conversion fees. There are also implicit barriers like appropriation of risks in distant markets, risk in currency, asymmetric information and presence of different corporate governance standards. Economic and cultural difference also lead to high risk perception of foreign assets and holdings. Patriotism and social identification contribute to investing in home-grown firms where higher returns and low risks are present in other alternatives abroad.

iv. Limited attention: Dichotic listening

Most investors use only a subset of information available to them to make economic decisions. There is well documented evidence for low attention of economic actors in the markets. The customary Friday announcement of bad news ensures that negative

information is given when investors have limited attention. Kahneman and Tversky (1973) observed 'dichotic listening' when individuals were subjected to competing stimuli. This was due to salience of information and processing ease of the information. A stimulus is more salient when it is more prominent and people easily perceive them. Processing ease refers to a phenomenon by which some information is processed more easily than the others.

v. Loss aversion

Kahneman and Tversky (1979) found that economic actors were more averse to losses with respect to an arbitrary reference than gains. The psychological perception of losses is twice as hard as gains give happiness. Therefore, people are more willing to take risks to avoid loss than to ensure gains. Related to loss aversion is endowment effect and status quo bias. Loss aversion also explains why economic actors respond to penalty frames than rewards.

vi. Mental accounting

Mental accounting is a set of cognitive operations by which economic actors organise and evaluate their financial choices. Thaler (1985) observed that despite the awareness that money is fungible, economic actors divide transactions into separate mental accounts and treat pay-offs differently across these accounts. The three stages of mental accounting are perceiving outcomes, bracketing choices and committing resources to these outcomes. Consumer choices and saving patterns are greatly influenced by the mental accounts that economic actors keep.

vii. Endowment effect

Thaler (1980) observed asymmetry in willing to sell what economic actors possess with the corresponding willingness to buy them. He articulated that there is a 'tendency for (economic) agents to want more to sell a good that they have than what they would be willing to pay to buy them'.

viii. Other heuristics

A number of other heuristics operate while economic actors make decisions under risk and uncertainty. Inertia is a situation in which economic actors fail to update their economic conditions despite there being potential gains to them. This is due to

conservatism. Self- deception is another case of heuristics. Deviations from rationality arise from economic individual's desire for a positive self-image affecting their reasoning and decision making. Behavioural economist term this as self-deception. Biased self-attribution is another instance where deviation from rational expectations is clearly evident. Biased self-attribution refers to the tendency by which economic actors attribute successful outcomes from their decisions to their own actions and bad outcomes to external factors. Affect heuristic is an example of systematic bias in economic actor. Slovic (1987) found that people allow their initial emotional reactions or feelings towards a decision to influence their subsequent evaluation of its risks and benefits.

6. Applications: The Coming of Choice Architecture

The understanding of heuristics and bias in economic actors and incorporating these variables in investment decisions have benefitted traditional finance and transformed it into behavioural finance. From capital budgeting, initial public offering, mergers and acquisitions, dividend policy decisions to leadership, organisational culture and corporate governance standards have all been influenced by the advent of the behavioural variable. This section of the essay briefly discusses three instances where behavioural applications have modified traditional finance and one instance (pension participation) beyond finance.

i. Capital budgeting and investment decisions

Corporate budgeting is a method by which corporations invest their capital. This is done by computing actual financial cost based on net present value. Net present value and internal rate of return are the two concepts used widely in traditional finance. However, behavioural finance looks beyond cost-related factors into the manager making these decisions (biases and heuristics). In reality, a manager's traits like optimism and overconfidence lead to erroneous evaluations of costs and returns. Behavioural fallacies lead managers to overestimate precision of information and their ability to control risks.

ii. Dividend policy decisions

Dividend policy decisions are important in a firm's stock values even if dividend as a form of payment to shareholder's is not as gainful as capital stocks. Yet, dividend

policy has continued for the last four hundred years as the primary method of payment in what is known as the 'dividend puzzle'. It is found that dividend payment is the preferred method of payment by large established firms with low risk. Dividend volatility is generally less than stock price volatility. Dividend is also an inefficient way to distribute cash to shareholders because of the presence of double taxation. Yet, stock price reaction to dividend announcement tends to be positive. Behavioural explanations for this paradox include inertia based explanations, mental accounting of shareholders and problems with self-control. Dividend payment (a series of small gains) is preferred over one big gain through capital stocks.

iii. Asset allocation and trading

Another area where behavioural explanations are required to account for less-than rational decisions of the investment managers is the allocation of portfolio. Individual investors do not have time-consistent preferences and the presence of default bias and extrapolation bias is strong. Even in trading portfolio, the main objective is how to rebalance the portfolio over time. Inertia operates in this situation, often preventing investors in making well-defined rational investment decisions.

iv. Pension Participation

Outside the field of behavioural finance, there are numerous applications of the behavioural variable in public policy. Pension participation is an example. Many countries with developed markets have attempted social security and well-defined benefit plans and contribution plans in the realm of pensions. There are a number of decisions awaiting the participant of a pension programme. This includes decisions like whether to participate, how much to contribute, where to allocate assets, how to rebalance allocation and how to handle the sum post retirement. Default option has a major impact in the way the programme design in perceived among participants. For instance, it has been found that default setting like 'voluntary opt-in' has a more positive impact on enrolment than an 'opt-out' arrangement on participation level. At the stage of enrolment, status-quo bias, peer effect and choice overload operate making 'opt-in' default setting to ensure better participation. At the next stage of deciding contribution level, strong default bias and reinforcement learning heuristic operates through which individuals increase weights on strategies where they had previously experienced success.

7. Mainstreaming the Irrelevant

For most part of its development, economic theory has relied on constrained optimisation scenarios where resources are always scarce with competing uses. It assumes that rational expectations and decisions of economic participants lead to equilibrium conditions. Although such simplified assumptions about human behaviour has helped in understanding market mechanisms to a large extent, economic theory based on model thinking has been deficient because of its inability to correspond to reality. A regular economic actor differs significantly from the representative agent in economic model. He has limited information, will power and rational abilities. The 'supposedly irrelevant factors' of human behaviour thus become essential in analysing financial markets (Thaler 2015). Practitioners like traders and stock brokers have long known how investors make decisions based on biased judgments and justify poor choices. Nevertheless, academics continue to be sceptical about the findings of these 'irrational' aspects of decision making. Economists and psychologists who began collecting 'facts' based on observation, experiment or questionnaire for the last forty years have found empirical evidence to understand this human element. In this endeavour, a large set of studies have been devoted to uncovering anomalies through the understanding of heuristics. Another group of scholars have attempted to study fundamental questions like how people perceive money and how they utilise it. We can enrich our understanding of financial markets by adding the human element to it. Gradually, economics could move towards a paradigmatic shift in methodology by paying attention to the behavioural variable. As Richard Thaler (1999) hopes for in his essay 'The end of behavioural finance', what other kind of finance is there? The application of cognitive psychology informs and enriches the way economists perceive economic actors and markets as institutions. Behavioural finance has the potential to give academics and practitioners better explanatory and predictive components to the fundamental question- how people make choices in markets.

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