Rational Behavior, Uncertainty, and Economics

by

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Introduction

“Science is more than a body of knowledge. It’s a way of thinking, a way of skeptically interrogating the universe with a fine understanding of human fallibility.”

Carl Sagan, May 27, 1996

Economics is a social science, and as such faces a unique set of difficulties that are not prevalent in other ‘hard’ sciences such as Biology or Physics. There is a tension in economics with respect to theory that often centers on methodology. Ludwig Von Mises described economics as “the science of human action,” grappling with the desire for universal while contending with experiential bias and innumerable externalities; the ultimate goal being a realization, through logic, of \textit{a priori} trends and tendencies that we’ve known all along, but have never been able to explicate (Von Mises, 1960, p. 57). Meanwhile, Milton Friedman asserted that economics must strive to be fundamentally positive and empirical, with the foremost goal being, through the positive methodology, to solidify the predictive aspect of economics, and leave different schools to quarrel on an ideological plane and question the efficacy, not the validity, of the outcome.

When Friedman claims that economics strives to ‘positive,’ he references the aforementioned tension of methodology. In the philosophy of science, there are two general methodologies, which are mainly defined by their different goals. Normative methodology looks to analyze the world as it ought to be, and thus examines ideal conditions in order to provide prescriptions for the real world. An example would the economics of supply and demand, examined on an abstract level. Normative prescriptions would focus on the conditions required for equilibrium, and use those conditions to offer insight into how to improve the efficiency of real world systems.
Positive methodology is its opposite, and describes the world as it is. Abstraction is detrimental in positive methodology, generally, because simplification limits the explanatory power of positive analysis. Abstraction is only ‘generally’ detrimental to positive economics because some abstraction is necessary in order to approximate realistic behavior, and therefore limiting the abstraction required becomes crucial.

Mark Blaug, in his book *The Methodology of Economics*, stresses the importance of the goals of economics, and how changing philosophies on methodology effected the theories that followed; to paraphrase his title, he shows how philosophy has changed “how economists explain.” There is a divide between the philosophical underpinnings of economics and economics itself. It is essentially the conflict between the normative assertions of philosophers of social sciences, and philosophers of science in general, and the positive methodology of the economists themselves. In economics, generalization becomes necessary because subjective thought processes are difficult to analyze; however, the objective problems themselves can be identified. These objective problems can be viewed as a crucial motivation for scientific thought and development of theory, i.e. they create the goals that theorizing and modeling strive towards. These motivations, in an economic sense, would serve as constraints of the theory itself; in effect, the logic of the situation, presented by an objective problem, would dictate a certain course of action that is uniquely relevant to certain aspects of that situation. These theories could reasonably be considered valid, i.e. in adherence with a sort of rationality principle, if the situation doesn’t change.

However, it has begun to change. After World War II, economics began changing the questions it asked, and consequently began to examine new and
different areas. Economics has become incredibly influential in new and complex domains, and has begun to assess the affect of institutions and policy changes on agents, and how they behave when faced with change. The major difference between these questions and previous ones is that these questions actively contribute to real-world decisions. The information provided by models is no longer taken as a normative prescription, but is instead treated as a comparative metric of sorts. In these scenarios, the problems that agents face are complex, as are their reactions to changes in these scenarios. However, there still has to be some abstraction necessary, so that the behavior of the agent follows certain guidelines. The behavior of an agent is addressed by assumptions of rationality.

*A Dictionary of the Social Sciences* (1964) defines rationality as behavior “that is appropriate to the achievement of given goals [and] within the limits imposed by given conditions and constraints” (ed. Gould and Kolb, 1964, p. 573). Within economics, the neoclassical school specifies the goals and constraints by three central assumptions, which provide the generally accepted definition of rationality. First, agents have rational preferences between outcomes that are associated with certain values. Second, rational individuals maximize utility and rational firms maximize their profits. Third, the agent acts independently and utilizes complete and perfect information to make a decision.

There are multiple areas of interest here. First is the idea of complete and perfect information, two separate aspects of the nature of information. Complete information assumes that the agent has full knowledge of his choice set, his alternatives, his preferences, and all of the relevant information to make a decision. Essentially, the assumption of completeness deals with problems in the quantity of
information, so that the agent is not missing any relevant information that would influence his decision. *Perfect information* assumes that the agent has accurate information about all of his alternatives and the alternatives available to others. Therefore, while complete information deals with quantity, perfect information addresses the *quality* of information. With this information, the agent will rationally want to *maximize* his expected utility. Imagine a grocery store, with a rational agent shopping for cereal. He will know his preferences, via his indifference curves, for each cereal, and will have a reserve price that he would be willing to pay for each. By comparing the price of each cereal to his reserve price, the agent can calculate which cereal would give him the optimal expected utility. This is essentially the most units of enjoyment per income consumed.

What this establishes is a consistent and reasonable behavior for a rational agent within economic scenarios, which allows for his behavior to be predicted and quantified. By assuming that everyone will behave in a rational manner, many problem scenarios involving hundreds of people can be reduced to one individual who behaves rationally. Therefore, economic activity on a social scale can be reasonably understood through individual preferences and the rational actions based off of those preferences. Moreover, the assumptions that accompany neoclassical rational behavior eliminate constraints that would found within the agent or the agent’s perception of the environment. Only the objective characteristics of the problem scenario would be relevant to agent, because he has perfect and complete information about both the environment and his own preferences. Therefore, the rational agent will be able to respond to his objective environment in a consistent and calculable way.
These are the basic premises of neoclassical rational action. Winslow (1993) stresses that the key characteristics of hermeneutic reading are 1) “always remain[ing] open to the possibility that the author’s fundamental premises differ from [one’s] own,” and 2) “also remain[ing] open to the possibility that the author’s premises are better than one’s own” (Winslow, 1993, p. 91). This appeal is a restructuring of Gadamer’s principles of hermeneutic reading, adapted by Winslow. The premises of neoclassical economics can be characterized as rational behavior under conditions of assumed certainty of information. Moreover, it is assumed that in conditions of uncertainty, people essentially behave as though they had certain information, if they are behaving rationally. Therefore, they still judge the perceived characteristics as approximations of the objective characteristics of their environment, and their goals and behavior remain the same.

The basic premise of this thesis opposes this. In this thesis, the basic premise is that behavior in uncertainty greatly differs from behavior under certain conditions, and that this difference creates a different qualification of what is ‘rational, which is not represented within neoclassical economics. It will be argued that rational agents, when faced with uncertainty in the form of incomplete or imperfect information, adopt different behaviors and strategies to mitigate this uncertainty. Moreover, the strategies for coping with uncertainty depend on the nature of the uncertainty, i.e. whether it affects the quality or quantity of information known by the agent. In order to closely examine behavior under uncertainty, this thesis will first address early economics, specifically Adam Smith, followed by conditions of uncertainty in the quality of information found in the work of John Maynard Keynes, and finally will
examine Herbert Simon’s bounded rationality and its relationship with uncertainty in the quantity of information.

The first chapter, on Adam Smith and his work, is divided into two parts. The first will examine a moral characteristic within Smith’s system that has gone largely unheeded, but proves relevant to *The Wealth of Nations* and the pursuit of self-interest. This moral characteristic can be generalized as a sense of moral approbation, which could curb the influence of self-interest for it could be interpreted as ‘information’ about the character of a person, and could contribute or alter what is in one’s ultimate ‘self-interest.’ The second part will look into *The Wealth of Nations* itself, specifically Smith’s observations about behavior under conditions of uncertainty, and will demonstrate that Smith’s observations and conclusions on behavior in uncertainty are incongruent with neoclassical theory.

The second chapter will focus on John Maynard Keynes, specifically his *Treatise on Probability* and *General Theory of Employment Interest and Money*. The first section will define and explain Keynes’ notion of rational belief, which finds relevancy and application within the *General Theory*. The second section will examine Keynes’ inducement to invest in his *General Theory*, and how expectations embody situations of uncertainty in the quality of information. The final section will use Keynes’ *General Theory* in conjunction with his *Treatise* in order to derive some basic postulates about behavior under uncertainty, specifically with regard to the quality of information.

The final chapter will be dedicated to Herbert Simon and his concept of bounded rationality, which examines the cognitive limits of the agent, specifically with respect to computational ability and availability of information, including known
preferences. The first section will explain substantive rationality, the type commonly associated with neoclassical economics. The second section will discuss procedural rationality, the basis for Simon’s bounded rationality, and how it differs from substantive rationality and proves advantageous in complex problem situations. The final section will cover the empirical application of procedural rationality to complex problem scenarios, and its efficacy in explaining human behavior when faced with uncertainty in the quantity of information.
Chapter 1 – Adam Smith

“The overweening conceit which the greater part of men have of their own abilities, is an ancient evil remarked by the philosophers and moralists of all ages. Their absurd presumption in their own fortune, has been less taken notice of. It is, however, if possible, still more universal.” – Adam Smith

Adam Smith is the father of modern economics and his work *The Wealth of Nations* provided the first treatment of economics as a system; additionally, his system grounded the analysis of economics for centuries after. His prose often combines normative considerations, qualifications about how an economy ought to be, with empirical and experiential observation, on some occasions to augment his normative argument. However, in other sections these observations provide important caveats to his normative vision. Smith’s contribution to rationality is complex, but the most obvious contribution is the emphasis on the self-interest of each individual, and how the pursuit of self-interest is conducive to the aggregate growth of the commonwealth. This is commonly known as the *invisible hand*. Smith argues that the individual is “led by an invisible hand to promote an end which was in no part his intention” (*Smith, Wealth of Nations*, pg. 485). This end is ultimately the promotion of “public interest,” and “by pursuing his own interest [the individual] frequently promotes that of society more effectually than when he really intends to promote it” (Ibid. p. 484-5). Therefore, when left to pursue his own self-interest, the individual consequently contributes to society; moreover this contribution is largely beneficial. Rational individuals, as an abstraction of human behavior, would pursue the optimal outcome, and when combined with the later marginal revolution, could calculate the
maximization of their resources. This maximizing behavior, in Smith’s system, would simultaneously be maximizing the individual’s contribution to society. However, this is only one facet of Smith’s thought on rationality.

His training as a moral philosopher, explicit in *The Theory of Moral Sentiments*, provides an ethical structure that imposes limits to the pursuit of self-interest. This structure is implicit within *The Wealth of Nations*. The moral consideration was tossed aside by later economists, but complicates and nuances Smith’s ideas on behavior. While Smith does not use explicit economic terminology such as ‘rational behavior,’ he still hypothesizes on the goals of humanity within certain constraints, and his thought can be placed into economic terms with minimal meaning lost to interpretation. Additionally, within *The Wealth of Nations* itself, Smith’s experiential observations directly contradict what classical ‘rational behavior’ would predict. Section i will be devoted to *The Theory of Moral Sentiments* and sympathy, as well as possible implications of that sympathy on rationality, while Section ii will examine experiential contradictions within *The Wealth of Nations*; contradictions which both are at odds with traditional ‘rational behavior’ and offer insight into realistic actions that compromise the objective pursuit of self-interest.

### i. *The Theory of Moral Sentiments* and Sympathy

Smith was educated as a moral philosopher at Oxford College, before becoming a professor at the University of Glasgow in Scotland, where he also received his undergraduate degree. Henry Spiegel, in *The Growth of Economic Thought*, divided Smith’s “social science” into four parts: “natural theology – generally speaking, religion without revelation – ethics, jurisprudence, and ‘expediency,’ that is, politics and economics” (Spiegel, 1983, p. 224). This moral
training shaped the way that Smith viewed the world because of the interdisciplinary nature of his expertise. His diverse field of study would lead him to examine how multiple areas of human behavior could intersect and influence one another. Even the terminology of ‘political economy’ illustrates the innovative and synthetic approach Smith developed from his training in moral philosophy. This philosophy and his diverse academic background shaped his thoughts on economics.

His academic interests exposed him to a large number of influential thinkers and their theories, specifically the political liberalism of John Locke. One of Locke’s main assertions was that man’s happiness was his own affair, and this therefore grants man certain ‘inalienable rights.’ First, this gives sovereignty to the individual, which is very important when contrasted with the current of thought up to this point. Medieval thought considered personal ambition to be a sin, and the individual was often viewed not as its own unit, but rather as a part of the clergy or, in Hobbsian philosophy, part of the commonwealth. Locke’s sovereignty of the individual is the recognition of private motive as a serious force, and one that could lead to public good, and Smith’s structure of ‘the invisible hand’ clearly can be seen within Locke’s thought. Secondly, Locke’s concept of ‘natural liberty’ became a staple element of Smithian economics, stemming from Locke’s assertion that happiness is each individual’s personal affair. This pursuit of happiness of the individual also extends to “the being and welfare of a man’s children and friends,” indicating that a pursuit of one’s own happiness, universally, would lead to the increased good of all. Both of these contributions were crucial to Smith’s argument for both morality and laissez-faire economics; in Smith’s mind, combining these concepts with his own ethics of
self-reliance allowed for the selfish pursuits of individuals to aggregate into social advancement.

Smith’s philosophy is described as part of the ‘British Moralists,’ but his thought differs from other philosophers quite distinctly while maintaining certain aspects of each. Hutcheson, one of the other British Moralists, wished to examine the concept of ‘benevolence,’ where individuals derive pleasure from the “moral approval of actions which in no way relate to our natural good” (Tufts, The Individual and his Relation to Society, p. 19). Feelings define the individual and his ‘moral sense,’ which is the sense that Hutcheson argues inspires pleasure from witnessing these benevolent acts. Benevolence, according to Hutcheson, is a natural inclination, and while it may be contradicted by self-interest, it will never be subjected to selfish inclinations or produced by them. He argues that there is an innate love for all of humanity within each individual, akin to the love for a child, and this love is what creates social unity and collaborative action.

Hutcheson’s thought is directly opposed by Mandeville, who emphasizes not only man’s rampant egoism, but also the individual as a product of social forces, as opposed to a producer of them. There is no specific conception of morality here; instead individuals are purely motivated by the desire for ‘honor,’ where honor is often defined by the political and religious elite so that morality becomes an artificial, rather than an innate, construct. The motivation for man’s social nature stems from ‘intelligent self-interest,’ where each individual seeks to fulfill “the multiplicity of his desires” while eliminating “the continued opposition he meets within his endeavors to gratify them” (Ibid. p. 16). Mandeville takes Locke’s liberalism and injects his own cynicism by portraying each individual not only glorifying his own self-interest, but
also being driven by social factors beyond his control, as opposed to creating them. However, it is important to note that while Mandeville and Hutcheson vehemently disagree on the natural inclination of humankind towards benevolence, both still view the individual as the essential component of analysis. This stress of the individual once again illustrates the general shift in thought at this time away from treating society as the main unit of examination.

Smith’s moral philosophy is notable because of the synthesis he creates between these two conflicting currents of thought, which allows him to examine the individual as a unit while simultaneously recognizing his role and function within society. Screpanti and Zagmani summarized Smith’s views as compromise between the egoism of the individual and the free social order of government, embodied in Locke: “Smith simply aimed at demonstrating that individuals serve the collective interest precisely because they are guided by self-interest” (Screpanti & Zagmani, 2005, p. 56). This self-interest, and the contribution to the collective interest, is justified on an ethical level in *The Theory of Moral Sentiments*, specifically through Smith’s concept of *sympathy*.

Sympathy allows one to “conceive or to imagine that we are in” a situation of emotional gravity; moreover, that conception “excites some degree of the same emotion, in proportion to the dullness or vivacity of the conception” (Smith, *Sentiments*, p. 2). By making sympathy a universal phenomenon\(^1\), Smith creates a notion of morality that is at the same time ubiquitous in presence while being unique and subjective. Smith claims, “Whatever is the passion which arises from…the

\(^1\) *Sentiments* begins: “However selfish soever man may be supposed, there are evidently some principles in his nature, which interest him in the fortunes of others, and render their happiness
person principally concerned, an analogous emotion springs up, at the thought of his situation, in the breast of every attentive spectator” (Ibid.). Smith’s sympathy shows itself to be quite unique, as it encompasses both the idiosyncratic nature of personal emotion and the omnipresent empathy within humanity. The catholic nature of Smith’s sympathy makes it relevant to *The Wealth of Nations* and to Smith’s general thought, for the all-pervading presence of sympathy adds a constant consideration to any sort of behavior, whether it be economic or not.

The notion of sympathy that Smith puts forth allows for a laissez-faire system precisely because he envisions “sympathy” as a universal characteristic of humanity. Smith believes that “man naturally desires…not only praise, but praiseworthiness...he dreads, not only blame, but blameworthiness,” in essence creating a positive emotional feedback loop for humanity. He continues, “praise and blame express what actually are; praiseworthiness and blameworthiness, what naturally ought to be, the sentiments of other people with regard to our character and conduct” (Ibid. p. 105). This desire for approbation, combined with an aversion of denouncement, allows for Smith’s sympathy to guide humanity on the aggregate towards a higher social standard of conduct. In effect, Smith’s system removes the rebuttal of questionable morality from his laissez-faire argument before it even begins by combining a positive measure of morality, praise or blame, with a normative standard that it holds itself to, praise or blame “worthiness.” Within this system of

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1 “That thing which, though he derives nothing from it, except the pleasure of seeing it.” (Smith, 1892, p. 1)
2 “That thing which, thought it should be praised by nobody, is, however, the natural and proper object of praise” (Smith, 1892, p. 95)
3 “That thing which, though it should be blamed by nobody, is, however, the natural and proper object of blame” (Smith, 1892, p. 95)
morals, laissez-faire would be logically preferable, and would indeed appear to be the optimal system not only for economic reasons, but also for moral reasons.

By allowing people to judge for themselves the propriety of other’s actions, and by removing economic policies that create rewards for ‘impropriety,’ i.e. mercantilist policies, Smith envisions a world where men are judged for their moral actions, and where their economic success or failure would be inextricably tied to that judgment, reflected by “the certain propensity in human nature…to barter, truck, and exchange” with another (Smith, Nations, p. 14). Here, judgment can serve to limit the gains of untrustworthy people precisely because humanity is willing to barter with everyone, and can therefore make economic decisions partially based off of moral impressions.

The manipulation of public policy by manufacturers via the mercantilist system is condemnable, in Smith’s view, not merely from an economic view, but also in a moral sense. The violation of this morality should be punished, and the punishment could be carried out by a laissez-faire system. The violation of the social norms that Smith identifies could manifest in an aversion to “truck, barter, and exchange” with those who practiced bad business. The freedom to choose contains within it the freedom to change, and that change would incorporate an economic punishment for a moral violation that would serve to advance both spheres on the aggregate. By punishing a merchant for bad ethics, it encourages ethical business practices so as to avoid further punishments due to morality. And, by encouraging the proper business practices through the positive moral feedback loop, the system encourages positive economic growth by allowing self-interest to still reign supreme, driving up aggregate wealth while maintaining an aversion for that which stymies it,
both morally and economically. This is Smith’s normative system working within itself on both an economic and social level.

The main issue with Smith’s sympathy, specifically with respect to it affecting and guiding self-interest, is the difference between Smith’s time and now. Smith’s system of morality works in his time because of the nature of business in the eighteenth century. There is a higher level of accountability and a direct relationship between merchants that has diminished as society progresses, and as a consequence of this, Smith’s moral structure diminishes with it. In his time, self-interest could feasibly work as an invisible hand because individuals would still be constrained by morality and the direct consequences of violating that morality. However, as business and investment decisions have become increasingly mercurial and distant, the opinions of others are less directly detrimental. This sympathy is important to consider in situations of direct exchange, and could offer constraints to behavior that classical rationality does not consider in direct exchanges, but that Smith had in mind at all times.

Imagine an employee working in a small store in a small town, with the owner constantly moving in and out of the shop. He could steal things, or scrape a little money off of the top, or simply slack off, but if he were caught or fired, he would be hard pressed to find a job in the town after that. Now constrain transport as well, so that this employee cannot relocate without a large amount of effort and money. In this situation, he ought to be a good employee, not only because it would be in his best interest, but also because his interest is directly affected by others’ view on his moral character. But, removing those constraints, e.g. giving the employee a car and a cell phone, completely changes the incentive structure. Now New York City isn’t so far
away, and he doesn’t really need the owner’s referral to get a job. His morality doesn’t constrain his self-interest, and in fact something things that would be considered morally reprehensible may also represent his ‘best interest’ simply because the repercussions have faded. To complete the example, now assume the owner of the store sells it to a large corporation. Now instead of direct accountability to an owner, this employee now is under middle management, and possibly the manager that doesn’t really care all too much, as it’s a small town. Once again, the moral component of his behavior has drastically shifted. Sure, he may still work hard to get promoted, but the moral component of that decision is seriously diminished. While this is a simple example, there are still instances within economics that could have intrinsic moral considerations that could alter the behavior of an agent. A brief example could be comparing moral incentives within a third world village and a town in Middle America; the repercussions of moral accountability drastically change between the two.

Thus, Smith’s *Theory of Moral Sentiments* is significant in two ways. The first is purely within his own time and his own thought, where sympathy is a constant force that influences every individual, albeit to different degrees. Because of the desire for approbation that stems from sympathy, Smith’s laissez-faire economic system gains a moral reinforcement that ensures, philosophically, that humanity is moving towards a greater aggregate moral plane, not solely an economic one. The second area of significance centers on Smith’s morality in practical application and in the lens of modern conceptions of rationality. Morality and the adherence to an ethical standard is far less significant on average in current times than it was in Smith’s time, and this diminished moral presence, considering its relationship with
self-interest in Smith’s view, could seriously alter just how important self-interest is in the grand scheme of things. Specifically, the diminished approbation and moral feedback loop could negate self-interest’s eventual march towards the good of all of society, simply because that innate check and balance system has been altered.

Additionally, the notion of sympathy and approbation could have applications within modern economics in situations where direct and personal accountability carry more significant consequences. In these sorts of scenarios, such as economic exchanges in developing nations, modeling behavior ought to consider the self-interest of morality, and the repercussions of violating the perceived moral code. Smith’s self-interest and invisible hand are important for economic action, but his work in the *Theory of Moral Sentiments* augments his actual notions for rationality in the *Wealth of Nations*.

However, within certain sections, Smith uses experiential knowledge and observation to comment on what he views as common behavior, and behavior that is not congruent with the neoclassical notions of rationality which he provided the basis for.

**ii. Contradictory Behavior in *The Wealth of Nations***

Adam Smith’s pursuit of self-interest formed the basis for the economic conception of behavior, both in a positive and normative sense. Clearly, Smith’s ‘perfect liberty’ and laissez-faire system was not actually present in society, but it offered a view of how an economy ought to be. This view, centered on the pursuit of selfish interests leading to aggregate gain, can be seen within the neoclassical definition of rationality, where an agent acts to maximize his expected utility by calculating his preferences against given alternatives. While his normative system provided this foundation for abstract analysis, Smith’s experiential observations of behavior differ significantly from the classical axiom that he inspired.
In Chapter X of Book I in the *Wealth of Nations*, Smith addresses the variations between wages and profit amongst “different employments of labour and stock”, in order to explain the differences in recompense between various employments. When addressing the “Nature of the Employments themselves”\(^4\) Smith simultaneously writes about perceived universal characteristics of men at that time. He first details “the five…principal circumstances which…make up for a small pecuniary gain in some employments, and counterbalance a great one in others” (Ibid. p. 115). When Smith embarks on a characteristic digression during his exposition of the fifth principle, “the probability or improbability of success” in employments, he begins to reveal his assumptions about the rational processes of men in his time. These behaviors are not rational in an objective sense; rather, Smith is examining how people rationalize, or perhaps justify, their behavior when self-interest would suggest they ought to pursue something entirely different.

Smith uses the field of law as his first example, beginning by stating “the probability that any particular person shall ever be qualified for the employment to which he is educated, is very different in different occupations. Success is…very uncertain in the liberal professions” (Ibid. p. 122). Smith argues that the field of law is one of those uncertain liberal professions, and that lawyers, because of their terrible odds of success – “it is at least twenty to one if ever [a lawyer] makes such proficiency as will enable him to live by the business” – face a large amount of upfront risk by deciding that they wish to pursue law (Ibid. p. 122). Therefore, Smith argues that they ought to be reimbursed for that risk, or rather that their wages ought to reward that high risk with a reciprocally high wage, writing, “the counselor at

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\(^4\) *Wealth of Nations*, Book I, Chapter X, Part I
law...ought to receive the retribution, not only of his own so tedious and expensive education, but of that of more than twenty others who are never likely to make anything by it” (Ibid. p. 122). Smith concludes:

Compute in any particular place, what is likely to be annually gained, and what is likely to be annually spent...with regard to all the counselors and students of law...and you will find that their annual gains bear but a very small proportion to their annual expence...the lottery of the law, therefore, is very far from being a perfectly fair lottery; and [it]...is, in the point of pecuniary gain, evidently under-recompensed (Smith, 1994, p. 123).

However, in spite of this, Smith observes that there is teeming mass of aspiring individuals training for professions such as law, so that “all the most generous and liberal spirits are eager to crowd into them” (Ibid.). Neoclassical rational behavior, or even merely the pursuit of self-interest, would suggest that many would be dissuaded from these professions, not “eager to crowd into them,” because of the terrible odds and poor remuneration. A rational agent, when deciding what to do, would be able to calculate the probability of success within that field balanced against the utility of expected income that would accompany it. He would conclude that the expected value of a career in law, from the perspective of a student, would be meager, and, if he were risk-averse, would avoid that profession. In fact, if there is overcrowding within the field, the probability of success may be even further diminished than what Smith observed, leading to an even lower chance of success and a much higher level of risk. Why, then, do so many do exactly what they ought not to do, if they had their best interests in mind?
In his answer, Smith indicates a certain conception of rational action, but not in the neoclassical sense illustrated above, i.e. optimizing behavior. Smith points to two factors which cause this overcrowding: “first, the desire of the reputation which attends upon superior excellence in any of them; and secondly, the *natural confidence* which *every man has* more or less, not only in his own abilities, but in his own good fortune” (Ibid. p. 123; emph add.). While this is not as formulaic as modern definitions of rationality, Smith still emphasizes an aspect of the decision-making process in uncertainty and a generalization of the thoughts that accompany it. Specifically, there are two parts that influence this decision, and suggest motivations contrary to neoclassical rational behavior.

The first is the desire for merit, which could be viewed in a similar manner to the desire for approbation within *Sentiments*. Smith stresses the importance of “public admiration which attends upon such distinguished abilities” as a key contributive factor in the decision to pursue such a risky field (Ibid.). This is problematic for traditional conceptions of rationality, as clearly an agent in this scenario would be gaining utility from a reward that is simply incalculable, or at the very least resistant to quantification. The excellence in such a distinguished profession offers a “decisive mark of what is called genius or superior talents,” and the public recognition of it “makes always a part of their reward” (Ibid.). This reward and the desire for approbation detailed in *Sentiments* can both be classified under the pursuit of self-interest, but this self-interest differs from the neoclassical economic conception of it. Self-interest here is all encompassing, and as such includes considerations of merit, morality, and social standing that would directly contradict neoclassical theory. This is mainly because the ‘value’ that one would derive from approbation or public
admiration would vary wildly, and moreover cannot be assumed to fluctuate in a statistically normal distribution. Different societies would admire different professions, and the valuation of public opinion within the agent could also vary. However, Smith’s second reason illustrates an even greater departure from classical rationality.

Smith argues that the other motivation for pursuing a risky field such as law is a sort of arrogance, or in his words “the natural confidence which every man has more or less, not only in his own abilities, but in his own good fortune” (Ibid.). This is not congruent with rational action as it is neoclassically defined. Over-confidence in abilities is inconsistent with the notion of accurately assessing the probability of success in the pursuit of different alternatives. Furthermore, a natural confidence in good fortune suggests a problematic approach to risk and a persistent characteristic that accompanies choice in uncertainty. Smith comments, “the overweening conceit which the greater part of men have of their own abilities, is an ancient evil…their absurd presumption in their own good fortune, has been less taken notice of. It is, however…still more universal” (Ibid. p. 124). Smith is arguing here that men do not quantify, or do not value, risk as they ought to. Smith’s claims here do not apply solely to lawyers, proven by language such as ‘natural confidence,’ ‘every man,’ and ‘still more universal.’ Smith has moved beyond specific analysis, or rather used it as a springboard into a far deeper examination of what influences decisions under uncertainty.

The undervaluation of expected risk is a phenomenon that Smith stresses again and again; in his words, “the chance of gain is by every man more or less overvalued, and the chance of loss is by most men undervalued, and by scarce any
man…valued for more than its worth” (Ibid. p. 124; emph. add). Smith turns to insurance, in a case of classic inductive reasoning, to validate his point:

That the chance of loss is frequently undervalued…we may learn from the very moderate profit of insurers. In order to make insurance…a trade at all, the common premium must be sufficient to compensate the common losses, to pay the expense of management, and to afford such a profit as might have been drawn from…any common trade. The person who pays no more than this, evidently pays no more than the real value of risk, or the lowest price at which he can reasonable expect to insure it…Moderate, however, as the premium of insurance commonly is, many people despise the risk too much to care to pay it (Smith, 1994, p. 125; emphasis added).

When Smith argues, “many people despise the risk,” this is not him arguing that people are behaving as though they are risk averse. In fact, it is the exact opposite. The loathing that Smith focuses on is an aversion to paying for risk, or properly valuing it.

Smith argues that this insurance is actuarially fair, or at least quite close, but due to the previous ‘overweening conceit’ in their own good fortune, most people don’t care to pay for it. Neoclassical rationality, and rational behavior, would argue that, because agents are risk-averse, they would naturally derive more utility from insurance, especially the insurance scheme that Smith details. However, the behavior that Smith sees and emphasizes time and time again is the complete opposite: real people often do not pay for insurance because they believe in their own good luck. This belief can and should be interpreted in a more formal manner: Smith observes
that people do not properly value risk in situations of uncertainty, and therefore do not behave as though they have performed the calculations assumed by neoclassical rationality. Smith claims, “the neglect of insurance upon shipping…is, in most cases, the effect of no such nice calculation, but of mere thoughtless rashness and presumptuous contempt of risk” (Ibid. p. 125; emph. add). Again, the contempt of risk here is the exact opposite of behavior that is considered ‘risk-averse’ within economics. Smith’s presumptuous contempt of risk is rather contempt of the concept of risk, a refusal to properly acknowledge its existence and gravity.

The importance of these passages is twofold. First, it is important within Adam Smith’s system itself. The considerations of merits and approbation as rewards are an aspect of Smith’s system that are resistant to quantification, and can only be assumed as having some important influence. These evaluative rewards, Smith shows, can alter the decisions that people make, and possibly induce them to pursue riskier behavior or avenues of employment than they ought not to pursue. Additionally, the use of terminology such as ‘universal’ and ‘natural confidence’ suggests a prevalence of risk-ignorant behavior in Smith’s society. If Smith is to be taken at his word, then his system within *The Wealth of Nations* assumes this sort of behavior as the norm. More importantly, Smith never directly refutes this behavior in his normative prescriptions or his system of laissez-faire economics; there are no assumptions that every man suddenly learns how to properly evaluate risk, or experiences a sudden dose of humility. Therefore it is reasonable to conclude that this contemptuous treatment of risk is assumed to be present within Smith’s economic system. In essence, Smith observes that people have an unusually high tolerance for
risk in situations of uncertainty, and that this high tolerance appears to stem from ignorance, rather than from rational calculation.

Secondly, when contrasted to neoclassical assumptions of rational behavior, Smith's universal observations contradict them on fundamental levels. First, the derivation of some sort of utility or reward from subjective evaluations such as ‘merit’ or ‘approbation’ contradicts the assumption that only external, environmental factors will influence a rational agent’s decision. Either these people behave irrationally, or there is a different sort of rationality at work here. Additionally, the contempt of risk is contradictory to neoclassical rational behavior on an essential level. Rational agents, classically, are assumed to know the probability distributions for all of the alternatives available to them, and then perform calculations to determine which alternative is the best or ‘optimal’ choice. Smith observes no such calculation, in fact he argues “the neglect of insurance upon shipping…is…the effect of no such nice calculation” (Ibid. p.125). There are no considerations of probability distributions, either because people do not care or because they can’t conceptualize risk because of their presumed good fortune. Either way, Smith’s experiential observations stand in direct contrast to the ‘rational behavior’ that he is considered to have fathered, metaphorically.

Smith’s thought illustrates a far more nuanced and sophisticated approach to behavior than the neoclassical ‘rational agent,’ and this is evident throughout his entire body of work. First, within his *Theory of Moral Sentiments*, Smith details a desire for approbation and an adherence to moral code. This could influence decisions so that they are not the product of pure economic self-interest, but also can embody a moral component. These moral considerations would be more important in Smith’s
time because of the limitations on transportation and the importance of referral, as well as the long-term and direct nature of many business relationships at that time. However, they could still find application within modern economics, specifically when considering more agrarian societies such as economic exchange within developing nations.

Additionally, Smith’s observations of behavior under uncertainty in *The Wealth of Nations* directly contradict the neoclassical notion of ‘rational behavior,’ which is considered risk-averse and the result of careful calculation of expected utility. Instead, Smith observes that many act as though they despise the concept of risk, so that they never actually care to consider it, and that this stems from their “overweening conceit” in their own good fortune, which Smith additionally claims is “universal.” All of these indicate a void between the neoclassical definition of rational action and its application to realistic human behavior. This incongruence is significant enough to be found even with the founder of economics’ *magnum opus*, which mostly functions as a normative and abstract systemization of economics.
Chapter 2 - John Maynard Keynes

“I also want to emphasize strongly the point about economics being a moral science...it deals with introspection and with values. I might have added that it deals with motives, expectations, psychological uncertainties. One has to be constantly on guard against treating the material as constant and homogenous. It is as though the fall of the apple...depends on the apple’s motives, on whether it is worth while falling to the ground, and whether the ground wanted the apple to fall, and on mistaken calculations on the part of the apple as to how far it was from the centre of the earth”

- John Maynard Keynes, July 16, 1938

Keynes’ thoughts on rationality ultimately are grounded in considerations of the fallibility of information for an agent. In the neoclassical theory of rational action, there are multiple assumptions that increase the logical tractability of the theory, i.e. allow it to be predictable and, more importantly, calculable. Keynes disagrees with this approach and he “accuses classical economic theory of being...one of these pretty, polite techniques which tries to deal with the present by abstracting from the fact that we know very little about the future” (Keynes, 1937, p. 115). This accusation is not unfounded, but rather is justified throughout Keynes’ body of work, beginning with his thoughts on rational belief in The Treatise on Probability and finding economic application within The General Theory of Employment Interest and Money. Keynes’ main concern is with uncertainty that cannot be avoided, which he claims agents would rationally acknowledge. Therefore, Keynes is opposed to the perfect information assumption that accompanies neoclassical ‘rational action.’ Keynes has a different view of what probability actually is, which he details in his Treatise, and this view of probability is also apparent in his discussion of investment, the inducement to invest, and expectations in Chs. 11 and 12 of his General Theory. This different view of probability, which Keynes defines as “degrees of rational belief,” resonates
throughout his entire work and moreover expands what is considered ‘rational’ to a domain beyond the neoclassical conception.

Additionally, when considering Smith’s experiential observations on behavior, a comparison between the two reveals far more agreement than would be expected. The ‘optimism’ that one finds in Smith’s agent, i.e. the presumptuous belief in one’s own good fortune, is also present in Keynes’ treatment of investment, specifically the convention that “we have tacitly agreed, as a rule, to fall back [upon]” (Keynes, *General Theory*, p. 152). Keynes expands upon Smith’s observations, but this is an unintentional expansion; Keynes and Smith identify a similar, perhaps even the same, behavior under uncertainty, but Keynes expands and diverges from Smith as a consequence of his theory on probability and rational belief. Keynes’ continuity of thought is comparable to how the moral structure within Smith’s *Theory of Moral Sentiments* is assumed to be present in his economic system in *The Wealth of Nations*, with the major exception being that Keynes’ previous work reexamined what it meant to be ‘rational,’ not moral. Therefore, the two main areas of examination for Keynes, insofar as rationality is concerned, are his conception of probability and then its presence within his *General Theory*, specifically referring to investment, expectations, and uncertainty. Much of what Keynes’ writing centers on the idea of ‘irreducible uncertainty,’ essentially matters about which “there is no scientific basis on which to form any calculable probability…we simply do not know” (Keynes, 1937, p. 114). This notion of uncertainty represents a basic premise throughout all of Keynes’ literature, and it establishes how he treats expectations and how he defines ‘rational’ behavior in economic agents.
In this chapter, it is first necessary to understand Keynes’ ideas on probability and degrees of rational belief, as well as the notion of ‘weight,’ which is another aspect of probability. This will be discussed in Section i. Next, Section ii will examine the inducement to invest in the *General Theory*, specifically the consideration of expectations that arise as a consequence of Keynes’ marginal efficiency of capital, which allows for predictions on the future based on uncertain information to seriously affect the greater economy. Finally, Section iii will take a close look at the behavior which Keynes details, and develop premises for how rational behavior differs in conditions of true uncertainty.

i. Rational Belief

Keynes’ notion of rational belief and probability differ from the classical definitions, and these differences are a consequence of the quality of information available to an agent. Neoclassical rational action includes the assumptions of perfect information and complete information. Complete information assumes that the agent has all information about the preferences, strategies, alternatives, and payoffs associated with those strategies. Essentially, complete information deals with the *quantity* of information available to the agent. Perfect information assesses the *quality* of the information, and assumes that the agent knows all of the information relevant to the decision, including probability distributions, his own preferences, etc., and that all of that information is *correct*. This is quite important, as the perfect information assumption creates a scenario where the agent firmly believes that his information is correct and accurate in an objective sense, and eliminates the possibility of fallibility.

While Keynes agreed that economic agents act rationally, one of the main divisions between his thought and the classics’ is the *type* of information an agent
could possibly have. Keynes believed that there was an “irreducible uncertainty” that could never be quantified and was simply the consequence of an unknowable future. For Keynes, the unrealistic assumption of perfect information, even as a generalization, cannot stand as an accurate representation of how economic agents act when faced with uncertainty. The limitations on information are constraints that necessarily affect considerations of the future, albeit in different degrees, so that “changing views about the future are capable of influencing the quantity of employment and not merely its direction” (Keynes, *General Theory*, p. xxii). Because uncertainty affects the quality of information within each agent, an agent could have a ‘rational process’ for coping with acknowledged uncertainty in situations where he cannot derive a complete or accurate probability distribution. The normal assumption, through perfect information, claims that agents will simply treat uncertainty as equivalent to risk, as opposed to altering their behavior to compensate for the uncertain quality of information, or even assessing its reliability. Moreover, an agent’s behavior under this type of uncertainty could be quite different from behavior with risk.

This difference between risk and uncertainty is quite important, and was first noted by economist Frank Knight (1921). Risk, in this sense, is something that is both quantifiable to a degree and a phenomenon that can be mitigated, while uncertainty represents that which cannot possibly be calculated. Knight refers to risk as “a measurable uncertainty,” while uncertainty is immeasurable and restricted “to cases of the non-quantitative type” (*Risk, Uncertainty, and Profit*, p. 19). It amounts to the difference between a weather forecast for the day and the weather on a walk, to borrow an example from Keynes. A weather forecast gives the probability of
rain for the day at 45%; this is risk, specifically the risk of rain at some point during the day. But, say the walk is only 15 minutes both ways, amounting to 30 total minutes of possible rainfall. Even if one attempts to calculate the ‘risk’ of rain during the walk, his forecast will have almost no predictive capacity compared to someone who hasn’t seen the weather report – it amounts to anyone’s guess, i.e. uncertainty. Essentially, by reducing all decisions to a matter of probabilities, uncertainty is universally replaced by risk. The reduction of uncertainty to risk and the assumption of perfect information are not supposed to be supremely realistic representations of human action; rather they are generalizations that contribute to the analysis of what markets would look like under perfect conditions, forming a logical possibility on normative grounds.

*The Treatise on Probability* can be seen as a way to assess the fallibility of information in a way that is ‘logical,’ or rational. Throughout the *Treatise*, Keynes focuses on how we assess the quality of information, and in doing so makes a distinct departure from the classic and generally accepted view on probability, known as the frequency theory. This theory “holds that the probability of an event, under given conditions, is the relative frequency with which it occurs under these conditions,” which is important to understand. The frequency theory claims that any and all probabilities represent how often an event will happen in certain conditions, and as such implies a level of certainty that Keynes rejects. Keynes asserts that probability is not mathematically oriented, but rather represents a barometer of rational confidence in a proposition. By rejecting the frequency theory, Keynes immediately distances himself from classic “quantifiable” probability and concerns himself with what being “probable” actually means.
Keynes’ view on probability is complex and nuanced, but mainly defines probability as “the degree of belief which it is rational to entertain in given conditions” (Keynes, *Treatise*, p. 4). This means that the assessment of probability, and our corresponding belief in it, is independent of the objective truth content. Probability is not merely a mathematical representation of belief, but is also a measurement of why, rationally, that belief exists. Even though Keynes acknowledges that his definition of “probability may be called subjective” due to this reliance on belief and rational behavior, he stresses that “in the sense important to logic…a proposition is not probable because we think it so…Facts are given which determine our knowledge; [and] what is probable or improbable…has been fixed objectively, and is independent of our opinion” (Ibid.). Therefore there is a distinction between rational belief and mere belief; the logic and critical thought behind a decision are what qualify it as rational, while the eventual validity of a proposition is inconsequential.

This is very important when considering the previous neoclassical assumption of perfect information. In that assumption, probability is an accurate and complete assessment of the world around the agent, and therefore focuses on the truth content of the information, i.e. its accuracy and objectivity. Keynes views information in a very different and far more realistic way. Rational belief, and consequently rational behavior, does not and moreover should not be determined by the ultimate validity of that decision. Humans are constantly gathering more information, processing it, and using it to make decisions at the time. Keynes does not judge rationality on the ‘perfect’ nature of the information used, because it simply doesn’t matter. Keynes
views rational belief as an assessment of the quality of information, and therefore probability represents the degree of confidence that one can have in a belief logically.

It is actually similar, structurally, to Smith’s views on approbation within *The Theory of Moral Sentiments*. Approbation for Smith is not determined by the objective virtue within an action, but is rather determined by the ability to understand why that action was taken, and whether or not it was moral. The ability to sympathize with a situation is the ability to imagine oneself directly in it and then judge the actions accordingly. Rational belief functions in a similar manner. A belief is not ‘rational’ because it was right; in fact, it could be quite irrational if the methods used to justify it are questionable or instinctual. Rational belief is therefore determined by the logical justification of the belief, using the information and knowledge available to the agent as the standard of judgment.

A brief example would be different types of belief in the Big Bang Theory. Two people both believe in the Big Bang Theory, but believe it for very different reasons. The first person saw the Big Bang Theory in a dream or prophetic vision, and therefore believes it because of intuition or divine revelation, and believes it wholeheartedly. The other person read a few articles on the recent discovery at Harvard, researched gravitational waves, asked his friend who is a Physics major about it, and concluded that while the Big Bang Theory is likely, there are other possible explanations for how the universe was created. Both can be right, objectively, but only the second person can be considered rational in Keynes’ mind. This is because that person acquired knowledge, assessed the quality of that information, and then determined that rationally the Big Bang Theory is likely. The first person just had an interesting dream, or is a prophet of the Lord. Probability, and
the rational nature of it, is embodied by this second person, the one who gathers information and logically justifies their conclusion.

The measurement of rational belief is the result of comparing indirect and direct knowledge. Direct knowledge is essentially anything experiential; Keynes defines it as “objects of direct acquaintance,” which is subdivided into three categories: Experience, Understanding, and Perception (Ibid. p. 11). This sort of knowledge is considered certain, so that when one sees a yellow wall, and then sees a yellow legal pad, they can confirm that both are certainly yellow. By using experiential and direct knowledge, that person is certain that both the legal pad and the wall are yellow. Indirect knowledge stems from propositions, which Keynes defines as “objects of knowledge and belief;” this knowledge is gained “through perceiving the probability-relation of the proposition, about which we seek knowledge, to other propositions” (Ibid.). Keynes is essentially stating that indirect knowledge is that which is gained through argument, and can never be demonstratively certain, but will always be in relation to other evidence that is certain. Indirect knowledge is the most important part in determining probability, for it is through deciphering the quality of indirect knowledge that one can come to a rational conclusion. Recall the two people contemplating the beginnings of the universe. The second person read multiple articles, he asked his friend who specializes in that field to clarify concepts, and his conclusion came from the logical assessment that the information he gathered was relatively valid information. That logical assessment represents Keynes’ “perceiving the probability-relation,” so that not all indirect knowledge is considered equal. Wikipedia is considerably more reliable than a random blog, but is not as reliable as an article in Nature. Thus, it
would be quite irrational to judge the information from a blog as superior to the published article in *Nature*, even though one never saw the experiment or phenomenon take place.

Recall that probability is not merely the presence of rational belief, but is a *degree* of rational belief. These degrees are a consequence of assessing the indirect knowledge of a claim, so that the article from *Nature* would justify a greater degree of rational belief than a blog post. The degrees of rational belief encapsulate one of the main departures from neoclassical theory because Keynes’ concept includes the possibility and assessment of fallacious information in a way that neoclassical rational action does not. Because the quality of information is assumed perfect in the neoclassical structure, there is no need to doubt this quality. However, in conditions of uncertainty, human behavior often indicates a value judgment on the quality of information, one that is simply not acknowledged by the neoclassical assumptions. Empirical evidence can be found within Corner et al.’s paper “Conservatism in Belief Revision and Participant Skepticism” (2010), where they find that “people’s beliefs…are revised less than they should be…[because] participants do not perceive information provided to them…as coming from a fully reliable source” (Corner et al, 2010, p. 1). Other psychological papers, including Edwards (1968) and Kahneman and Tversky (1973), find similar results, i.e. that actual revision of belief does not mirror normative prescriptions, implying a hypothesis that assessing the quality of information under uncertainty can lead to behavior that is incongruent with modeled behavior.

The departure from modeled behavior would be considered ‘irrational’ to neoclassical economics; Keynes would argue that this behavior is actually quite
rational. The subjects in the experiment do not know where their information is coming from, or how it was gathered; therefore they cannot assign a high level of rational belief to it, leading to conservative revisions that are inconsistent with predicted behavior. Rational belief is significant because Keynes’ inducement to invest is partially a function of expectations, which are predictions for the future. These are obviously limited, and there is no certainty in the predictions, therefore when deciding to invest, rational belief would represent a major component in the decision-making process. The treatment of probability as assessing the fallibility of information could alter rates of investment in ways that models could not explain because they do not incorporate value judgments on information. Now it is time to examine exactly how expectations of the future and valuations of informational quality affect investment, and consequently the greater economy.

ii. Investment and Expectations

Rational belief is applied within Keynes’ inducement to invest, specifically through the marginal efficiency of capital. It represents the relationship between the prospective yield of an investment and its supply price, the price necessary to have a manufacturer sell one more unit of that asset. Keynes stresses that the marginal efficiency of capital is “defined in terms of the expectation of yield and of the current supply price” of an investment” (Keynes, General Theory, p. 136, emph. orig.). This role of expectations as determinate of the marginal efficiency of capital creates the necessity for forecasts of the future to be made by investors on the yields of an asset. The purchase of an investment is essentially a purchase of the prospective, or future, returns that the investor “expects to obtain from selling its output, after deducting the
running expenses of obtaining that output, during the life of the asset” (Ibid. p. 135).
The summation of the annuities of this investment are called “the prospective yield of
the investment,” essentially functioning as the asset’s value over time (Ibid. emph.
orig.). Expectations of this nature involve forecasts of the future, meaning the
conjectures should involve rational belief in the form of propositions on the future.

Keynes confirms that the marginal efficiency of capital depends “on changes
in expectation, because it is chiefly this dependence which renders the marginal
efficiency of capital subject to…somewhat violent fluctuations,” mainly due to the
“significance of…changes…on the readiness to produce new assets through their
reaction on the marginal efficiency of capital” (Ibid. p. 143-4, 142). This means that
expectations of the future are capable of actively augmenting the volatility of the
market, which is a clear departure from classical theory. In classical theory,
investment is modeled as a function of income and the interest rate, \( r \). No forecasts of
the future are necessary in this function; the rate of interest is the sole determinate of
investments insofar as policy interventions are concerned. But the inducement to
investment is partially determined by this marginal efficiency of capital, also known
as the investment demand-schedule\(^6\): “It follows that the inducement to invest
depends partly on the investment demand-schedule and partly on the rate of interest”
(Ibid. p. 137). This inducement to invest is what will convince the rational agent to
invest, and will therefore determine the aggregate investment of a nation. Keynes
writes:

\(^5\) Defined by Keynes as: “the price that would just induce a manufacturere to produce an additional
unit of such assets.” (Keynes, General Theory, p.135)
\(^6\) i.e. the two are synonymous
The physical conditions of the supply in the capital-goods industries, the state of confidence concerning the prospective yield, the psychological attitude to liquidity, and the quantity of money…determine, between them, the rate of new investment (Ibid. p. 248).

Keynes’ system explicitly includes a component on ‘the state of confidence’ and the ‘psychological attitude to liquidity.’ Both are important terms to remember, and they no doubt include his system of rational belief from his Treatise on Probability. The significance of this is quite radical, mainly because “neither the knowledge of an asset’s prospective yield nor the knowledge of the marginal efficiency of the asset enables us to deduce either the rate of interest or the present value of the asset,” which severs Keynes’ investment theory from neoclassical theory at the root. (Ibid. p. 136)

It is important to remember the classical model of investment is solely the function of the interest rate and income. This is because the assumption of perfect information requires no evaluation of the quality of the information gathered. It’s perfect. The significance of this is magnified by economic’s stance in the world today as a predictive and positive science. It is one which contributes to monumental policy decisions and provides the empirical evidence for the efficacy of one policy to another. Its influence is quite large, to be honest. However, there is a need for realism, specifically in the assumptions made. Keynes writes, “The fact that the assumptions of the static state often underlie present-day economic theory, imports into it a large element of unreality” (Ibid. p. 146). These models influence important decisions and form the crux of policy debate. Keynes’ inducement to invest includes far more
realistic premises on what determine the rate of investment, namely the dynamic component of the inducement to invest. Essentially, in Keynes’ mind, there is a fundamentally speculative component of investment that must be accounted for.

Envision an investor, anyone interested in buying a stock. Up to this point, we have seen that at the start, he feels pretty comfortable. He has all of the information he needs to make a decision, and the interest rate is enticing, so he invests. Life is good. Now eliminate the perfect status of that information, or rather, make it more realistic. Now that investor doesn’t know if his information is objectively correct. Sure, he watches Mad Money every day, but that only goes so far. Does he take that information seriously, or does he watch another show to learn more? How does he decide which opinion is better, when they disagree? These are the areas of rational belief, and precisely why Keynes’ *Treatise on Probability* is essential to envisioning his view on rational economic behavior. Furthermore, they are premises that more accurately represent the conditions of investment and the expansion of rational behavior towards realism would enhance the positive and predictive powers of economics.

Now let’s return to the marginal efficiency of capital compared to the classical rate of investment, which is solely determined by income and interest rate. Keynes writes, “The schedule of the marginal efficiency of capital is of fundamental importance because it is mainly through this factor (much more than through the rate of interest) that the *expectation of the future* influences the present” (Ibid. p. 145, emphasis added). “It is by reason,” he continues, “of the existence of durable equipment that the economic future is linked to the present;” therefore, it follows “that the expectation of the future should affect the present through the demand price
for durable equipment” (Ibid. p. 146). The fact that equipment purchased with capital, functioning as an investment, both has to compete with newer equipment and faces the risk of obsolescence via technological advancement over the course of it’s ‘life,’ makes expectations of the future not only a prudent, but also a crucial facet of investment. Again, these are conditions of uncertainty that the classical model does not recognize, but adhere to reality in a more significant manner.

Keynes subdivides expectations on prospective yield into two categories: i) “existing facts which we can assume to be known more or less for certain,” and ii) “future events which can only be forecasted with more or less confidence,” which he defines as being “the state of long-term expectations” (Ibid. p. 147-8, emphasis original). Implicit in both of these categories is Keynes’ notion of probability and knowledge from his earlier Treatise on Probability. Specifically, the notion of ‘more or less confidence’ carries with it his earlier qualifications of ‘degrees of rational belief,’ where rationality is determined not by the ultimate outcome, but rather the logical processes that led to belief. This is also why he immediately dismisses “matters which are very uncertain” in the General Theory, claiming, “it would be foolish, in forming our expectations, to attach great weight” to them (Ibid. p. 148). This reveals one of Keynes’ true premises, as Keynes’ agent is explicitly calculating the quality of the information, a calculation that is assumed away within the neoclassical assumption of perfect information.

The Treatise resonates throughout Keynes’ consideration of expectations in the General Theory, which is why he emphasizes “to a considerable degree…facts about which we feel somewhat confident, even though they may be less decisively relevant to the issue than other facts about which our knowledge is vague and scanty”
(Ibid.). The appeal to his previous system of ‘rational belief’ is important to consider throughout the chapter; in a manner similar to Smith’s *Theory of Moral Sentiments*, Keynes’ conception of probability shapes the standards by which he judges expectations. This is why “the state of long term expectations…does not solely depend…on the most probable forecast we can make,” but also depends “on the confidence with which we can make this forecast” (Ibid., emphasis original). Keynes’ ‘rational belief’ and ‘degrees of confidence’ give shape and function to the *state of confidence*, which “is relevant because it is one of the major factors determining…the investment demand-schedule” (Ibid. p. 149). Therefore, when examining expectations, he is not considering them solely in a vacuum, but also considering their effect on the investment demand-schedule, and consequently the investment demand-schedule’s effect on the inducement to invest. For comparison, the neoclassical assumptions turn these states of confidence into pure probability calculations which reduce uncertainty into actuarial risk, while Keynes stresses that, “if we speak frankly…our basis of knowledge for estimating the yield ten years hence of a railway [or] a copper mine…amounts to little and sometimes to nothing” (Ibid. p.149-50).

Return to our investor. Now he’s getting pretty worried about his information, and about other people’s too. He isn’t sure of the *quality* of information: he can’t tell if a stock is doing well objectively, or because a bunch of people like him listened to the man on the television. He begins to get nervous, and this is not because of the interest rate. In fact, it doesn’t matter what the interest rate is doing while he is having this crisis. Keynes writes, “the stimulating effect of the expectation of higher prices is due, not to it’s raising the rate of interest…but to it’s raising the marginal efficiency of…capital,” while if the interest rate “were to rise *pari passu* with the marginal
efficiency of capital, there would be no stimulating effect from the expectation of rising prices” (Ibid. p. 142-3). There is an aspect that is influencing this investor, and it is not calculable in the neoclassical sense. The individual investor needs some sort of reason to overcome this fear, and be convinced to invest.

In the absence of such knowledge, and therefore the basis for calculation, some other motivation must induce the individual to accept this uncertainty. The neoclassical rational actor would purchase a stock because he had calculated it as the optimal choice. Liquidity, with his perfect information, doesn’t really matter; everything is reduced to actuarial risk. He will ultimately select the right stock, if he is indeed rational. But Keynes’ notions on what constitutes ‘rationality’ are quite different. In order to overcome this disconnect, “in practice we have tacitly agreed, as a rule, to fall back on what is, in truth, a convention...assuming that the existing state of affairs will continue indefinitely, except insofar as we have specific reasons to expect change” (Ibid. p. 152). This points to a very volatile influence on investment, and one that would not appear ‘rational’ within Keynes’ philosophical structure. However, Keynes concedes, “the above conventional method of calculation will be compatible with a considerable measure of continuity...so long as we can rely on the maintenance of the convention.” (Ibid. p. 152, emphasis original) The successful maintenance of this convention is what facilitates investment, “thus investment becomes reasonably ‘safe’ for the individual investor over short periods, and hence over a succession of short periods however many, if he can fairly rely on there being no breakdown in the convention” (Ibid. p. 153).

This convention is one way of dealing with uncertainty. Up to this point, we have discussed how Keynes’ notions on rational belief within The Treatise on
Probability have been found within his General Theory, indicating a possibility for the valuation of the quality of data. This valuation has been shown to be mainly in expectations, which ultimately determine the rate of new investment for a nation. And it has been contrasted with neoclassical assumptions on perfect information, and offered increased adherence to reality. This contrast has been important, but is going to become less relevant because of the distinction between risk and uncertainty. Perfect information removes the possibility for pure uncertainty, and therefore is relevant to the next section only insofar as to how it is not applicable on a fundamental level. However, uncertainty, it has been shown, exerts a clear influence on Keynes’ system of economics.

iii. Uncertainty

The convention that Keynes refers to is a way for an investor to cope with uncertainty. This means that, when faced with imperfect information and considerations of uncertainty, this convention is what makes it ‘safe’ for the investor because the convention is accompanied by the liquidity of investment. Keynes argues that the reliance on convention is what transforms “investments which are ‘fixed’ for the community…[into] ‘liquid’ for the individual” (Ibid.). This liquidity is the main way that investors deal with uncertainty, and it essentially opens avenues for an agent to mitigate uncertainty to a certain degree, in practice. However, it is not liquid in the same sense of money being liquid; it is merely “having an opportunity to revise [a] judgment and change [an] investment, before there has been time for too much to happen.” (Ibid.)

For example, this is the difference between buying a tractor for a farming company and buying stock in that farming company, which they then use to buy (or
rent) a tractor. When the investor has to buy the actual tractor, there is far more uncertainty to be considered, and he needs to judge the quality of his information carefully. What if oil prices rise, or a new model comes out that cuts fuel consumption by 50%? What about an electric tractor, accompanied by tax credits? Moreover, as newer models come out, his investment decreases in value. The incentive to fix that tractor diminishes over time, as does its resale value. When he buys a stock, the tractor is the company’s purchase and the company’s prerogative, and if their fleet malfunctions, our investor can simply move his money to a different company. This is precisely how the liquid character of the stock market facilitates investment.

Due to “the separation between ownership and management…and with the development of organized investment markets,” a system forms centered on “frequently attempting to revalue an investment to which we are committed” (Ibid. p. 151). “Thus,” Keynes writes, “certain classes of investment are governed by the average expectation of those who deal on the Stock Exchange…rather than by the genuine expectations of the professional entrepreneur” (Ibid.). This means our average-Joe investor has suddenly become relatively important. His decisions, including his possibly rational assessment of his information, will be part of the constant reassessment of investments that occur daily, with our nervous investor’s influence resting partially on his rational abilities to process the information that he’s given. Keynes claims, “The daily revaluations of the Stock Exchange…inevitably exert a decisive influence on the rate of current investment” (Ibid.). This is problematic, because our investor still has a considerable amount of uncertainty, and
a lot of reason to be cautious, which does not bode well for the rate of current investment.

One of the ways our investor will try to mitigate this uncertainty is through the aforementioned convention: “assuming that the existing state of affairs will continue indefinitely, except insofar as we have specific reasons to expect change” (Ibid. p. 152). This is also known as the efficient market hypothesis, and represents a major tenet of neoclassical thought, but it is essentially explained by the previous assumptions of perfect and complete information. If a rational agent behaves accordingly, he will on the average select the best stock, so that markets will always tend to equilibrium. Keynes objects to this convention on multiple levels, and believes that it represents an ‘optimistic’ outlook, to put it politely. His first objection:

This [convention] does not mean that we really believe that the existing state of affairs will continue indefinitely. We know from extensive experience that this is most unlikely. The actual results of an investment over a long term of years very seldom agree with expectations (Ibid.).

Keynes’ objection finds it theoretical basis within his Treatise on Probability and ‘rational belief.’ ‘Extensive experience’ takes the place of direct knowledge, that which is certain. Therefore, if an individual is rational and knows from experience that the state of affairs will not continue indefinitely, it would be irrational for him to abandon that evidence in favor of the convention. This effectively eliminates the argument that markets are self-correcting because individuals will behave rationally, and as such their decisions always optimize and trend investment towards its natural equilibrium. Under Keynes’ conditions for rational behavior, the individual would
have to acknowledge that the decision to rely on this convention is irrational. This is mainly a consequence of the individual simultaneously recognizing the uncertainty that he faces. Keynes argues that a rational agent, when faced with this uncertainty, would see from past experience that ‘rational belief’ in the state of affairs continuing indefinitely would be fallacious.

Keynes’ second objection:

Nor can we rationalize our behavior by arguing that to a man in a state of ignorance errors in either direction are equally probable, so that there remains a mean actuarial expectation based on equi-probabilities. For it can easily be shown that the assumption of arithmetically equal probabilities based on a state of ignorance leads to absurdities (Ibid.). This objection would refute the argument that people will subconsciously act as though they have performed some sort of calculation when confronted with ignorance. But recall the discussion of conservatism and belief revision covered in Section i, including the experimental evidence that accompanied it. Behavior, in those papers, did not indicate an equal trend, but rather a conservative reevaluation of probabilities. This does not verify a hypothesis that every rational agent conservatively revalues their probabilities, but it does reject the hypothesis that “in a state of ignorance errors in either direction are equally probable” (Ibid.). Moreover, the state of ignorance would technically be impossible within the neoclassic framework, as the rational agent would have perfect and complete information. However, the assumptions are obviously not realistic, and as a failsafe of sorts, the justification for them, when compared to actual human behavior, relies heavily on the notion that errors of any sort are equally probable when considering ignorance. Thus,
people behaving as if they were calculating these probabilities can still be ignorant, but from an aggregate standpoint it all evens out. But, again, the realism of this assertion is quite questionable. The ‘absurdities’ provide enough reasonable doubt by themselves, but they would be further exacerbated by the realistic assumption that people aren’t holistically ignorant, or certainly not all ignorant to the same degree.

In light of these two objections, Keynes claims that the convention must be viewed differently. He writes:

We are assuming, in effect, that the existing market valuation, however arrived at, is uniquely correct in relation to our existing knowledge of the facts which will influence the yield of the investment, and that it will only change in proportion to changes in this knowledge; though, philosophically speaking, it cannot be uniquely correct, since our existing knowledge does not provide a sufficient basis for a calculated mathematical expectation (Keynes, *General Theory*, p. 152).

Keynes is essentially stating that people, when faced with uncertainty, do not reduce it to pure calculable risk, but perform a mental compromise within their rational sense. This convention is the explanation for the liquidity of investment: “For, assuming the convention holds good…thus investment becomes reasonably ‘safe’ for the investor over short periods, and hence over a succession of short periods” (Ibid.). Therefore, in order to believe in this convention up to this point, one would have to accept a proposition, one that grounds the neoclassical tradition, as irrational when considered with *The Treatise on Probability*. 
Instead, a rational individual would have to use the information available to him, and rely on induction, or “direct judgments of irrelevance” (Keynes, Treatise, p. 294). By considering these direct judgments of irrelevance, one can arrive at the first basic premise on behavior under uncertainty within Keynes’ General Theory. Keynes argues that “the principle judgment of this kind...[is] the Principle of the Uniformity of Nature,” where “we judge that mere position in time and space cannot possibly affect, as a determining cause, any other characters; and this belief appears so strong and certain...that the judgment by which we arrive at it seems perhaps to be direct.” (Ibid.) Essentially, this principle involves treating interpretations of past experience as direct, i.e. certain, knowledge, so that our experiences may serve as these direct judgments of irrelevance, which are “certain properties of objects which we rule out from the beginning as wholly or largely independent to all, or to some, other properties” (Ibid.). This principle is simply the removal of irrelevant information, where the relevancy is determined by an agent’s past experience. This experiential component is very important on its own, but even more so when applied to this ‘convention’ of the market, which closely resembles the aforementioned Principle.

This judgment, i.e. relying on the Principle of the Uniformity of Nature, is analogous to “assuming, in effect, that the existing market valuation, however arrived at, is uniquely correct in relation to our existing knowledge of the facts which will influence the yield of the investment, and that it will only change in proportion to changes in this knowledge” (Keynes, General Theory, p. 152). Basically, the relationship between our knowledge and the existing market valuation, i.e. how it is “uniquely correct,” is a relationship that could only be formed through induction and direct knowledge, according to Keynes’ Treatise. Furthermore, the changes “in
proportion to changes in this knowledge” represent the direct and ‘certain’ treatment of experience as knowledge (Ibid.). So, in the case of this induction, investors are essentially relying on a convention of the Principle of the Uniformity of Nature. This is the first premise one can derive from Keynes’ theory of investment on behavior under uncertainty. When individuals are faced with recognized inadequate information – “philosophically speaking, [the existing market valuation] cannot be uniquely correct” – and uncertainty, they tend to fall back on the assumption of the uniformity of nature. (Ibid.) The significance of this is that the investor recognizes the uncertainty he faces, and furthermore recognizes the convention as an imperfect mechanism, or as Keynes writes, “based…upon imperfect analogy,” but nevertheless relies on his own experience as direct and correct in order to process uncertainty (Keynes, Treatise, p. 294).

Keynes cautions that “these judgments of irrelevance are not free from difficulty, and we must be suspicious of using them” (Keynes, Treatise, p. 295). This suspicion is clearly not present within the convention, and therefore it becomes problematic. “It is not surprising,” Keynes notes, “that a convention, in an absolute view of things so arbitrary, should have its weak points” (Keynes, General Theory, p. 153). However, Keynes still admits, “The use of inductive methods can be justified if they are applied to what we have reason to suppose [is] a finite system,” but the initial caution cannot and should not be completely dismissed (Keynes, Treatise, p. 295). This principle of the Uniformity of Nature assumes that past experiences cannot be based “upon imperfect analogy,” but this is only in assessments of irrelevance (Ibid. p. 294). When these assessments are applied to an investment decision, i.e. the convention, suddenly an agent’s past experience becomes crucial in determining
behavior when confronted with uncertainty, because the agent will use his past experience to value the relevance of some information over others. Moreover, each agent will have had different experiences, and therefore could value the same information in a totally different way. Therefore, each agent’s unique and subjective history is essential in determining behavior under uncertainty, which is the first premise of behavior under uncertainty that can be synthesized from General Theory.

The second premise is centered on how an investor would determine the value of one investment over another. Essentially, what sort of comparative metric would an individual use in conditions of uncertainty. Let’s return to the investor. He’s decided, for good or for ill that his past experiences mean something, and now he’s convinced himself to invest. Now he must decide where he wants to invest, which stocks seems better to him based off of what he knows. But there is a problem. Because he is following this convention, he now must also believe that everyone is following this convention. He recognizes, as Keynes puts it, “the precariousness” of this structure of investment, and it worries him; moreover, there are multiple “factors which accentuate this precariousness” and heighten his worry (Keynes, General Theory, p. 153).

Firstly, the liquid nature of investments leads to a “gradual increase in the proportion of the equity...owned by persons who do not manage and have no special knowledge of the circumstances,” and that consequently “the element of real knowledge in the valuation of investments by those who own them...has seriously declined” (Ibid.). Secondly, “day-to-day fluctuations in the profits of existing investments...have an altogether excessive, and even an absurd, influence on the market,” even though these profits are “obviously of an ephemeral and non-
significant character” (Ibid. p.153-4). Both of these factors seriously cripple the two major aspects of neoclassical ‘rational expectations,’ the first on the grounds of clearly pervasive imperfect information, and perhaps even ignorance, and the second on the grounds of simply how far into the future a ‘rational’ individual calculates. Imperfect information, which Keynes implies is normal, is that decline of the ‘element of real knowledge,’ and represents another consideration of uncertainty for our investor. He does not necessarily know all that much about the companies he’s investing in, and even if he does, his small stock purchase wouldn’t warrant a seat on the board. The second aspect is the length of time an investor would expect to hold an investment, which alters how it is valued. The neoclassical assumption would be that our investor cares about the long-term profitability of the stock, but Keynes argues the opposite. Investment decisions are not illiquid, and this alters the incentive to invest because one can focus on short-term profitability. Therefore, for our investor, he can’t just concern himself with his decision, but must consider others’ as well. From a theoretical standpoint, this is important because it shows that, when considering conditions of uncertainty, the absence of perfect information is a crucial facet in influencing an agent’s strategies and behavior, and consequently incentivizes the prediction of short-term profit fluctuations over long-term prospective yield because he lacks the quality of information necessary to properly forecast so far into the future.

This leads to a third concern, that the convention is in fact “the outcome of the mass psychology of a large number of ignorant individuals” that is “liable to change violently as the result of a sudden fluctuation of opinion” (Ibid. p. 154). “Thus,” Keynes continues, the “investor is forced to concern himself with the anticipation of
impending changes, in the news or in the atmosphere, of the kind by which experience shows that the mass psychology of the market is most influenced” (Ibid.). So, to recap, our investor now recognizes that his past experiences are going to assist him in valuing stocks by observing how the markets react to news and atmosphere. Therefore, he has the ability to make judgments of irrelevancy; he can eliminate certain information, e.g. baking and driving, because he will conclude that they are not relevant based off of his past experience. The investor is now making evaluative judgments of the different types of information he has. He believes that his past can facilitate his judgment, by following Bloomberg and reading the Business section of Times to hypothesize how stocks fluctuate. He must value certain information as more relevant, and therefore cannot examine this choice solely from the aspect of probability, or rather the probability of success in an investment. He is weighing information differently in order to lessen the uncertainty he faces, so that he considers not only the probability, but also the confidence in that probability.

What this implies is that when considering past experiences, the ‘degree of rational belief’ matters as well as an assessment of ‘weight.’ Weight is essentially the amount of relevant information to a decision, and therefore serves as a way to further distinguish the quality of information. Keynes asserts at the beginning of chapter 12 that “It is reasonable…to be guided to a considerable degree by the facts about which we feel somewhat confident, even though they may be less decisively relevant to the issue than other facts about which our knowledge is vague and scanty” (Ibid. p. 148). So, when our investor is performing evaluative comparisons between stocks, he is sifting through his available information in order to determine what is relevant. He then must assess whether or not he can feel *confident* in the conclusions which he
draws from that information. Did he only see a phenomenon happen once, or does a certain stock seem to drop every few months? Do political scandals affect stock prices, and if so, are there specific types that cause greater damage? How many scandals has he seen?

These are all considerations of weight, and the greater the amount of evidence, the more confidence our investor can have in his conclusions. This is why Keynes stresses, “It would be foolish, in forming our expectations, to attach *great weight* to matters which are very uncertain” (Ibid., emphasis added). This *weight* is essentially a relation “between the *absolute* amounts of relevant knowledge and of relative ignorance” (Keynes, *Treatise*, p. 78). This weight functions as an additional consideration that qualifies decisions under uncertainty, as it represents the barometer of confidence for forecasts by balancing ‘absolute’ amounts of relevancy and irrelevancy. Therefore, the second premise is essentially that, when performing judgments of relevancy in conditions of uncertainty, our investor cares not only about the predicted outcome based on his experience, but also the confidence that he can ascribe to that prediction by assessing its weight.

The third and final premise has to do with the confidence aspect of this decision, i.e. whether our investor believes that his conclusions are right, and whether they’ll lead to successful investment. Keynes defines this type of decision as *speculation*, which is “the activity of forecasting the psychology of the market” (Keynes, *General Theory*, p. 158). Speculation is important because of its volatile role within investment, and is contrasted with *enterprise*, “the activity of forecasting the prospective yield of assets over their whole life” (Ibid.). The main issue with speculation, as compared to enterprise, is the speculative aspect of investment is
“unduly interested in discovering what average opinion believes average opinion to be,” a huge departure from what neoclassical rational action would prescribe.

This departure is again a consequence of uncertainty, via the liquid individual nature of investment. The liquidity of individual investment offers a way out for our investor, so that he may “flatter himself that his commitment is ‘liquid,’ ...[which] calms his nerves and makes him much more willing to run a risk” (Ibid. p. 160). Our investor has managed to convince himself, because of the liquid status of investment, that he can focus on “favorable changes in the conventional basis of valuation,” i.e. short-term stock fluctuations, without having to worry about the long-term commitment to the investment. He’s doing pretty well again, and simply needs to try and forecast what other people will forecast about what everyone thinks about the stock market, and use that to make his decision. While it seems complicated, he is more comfortable with the associated risk because he can pull out his money or reinvest as soon as one investment begins to go sour. So even though he needs to try and predict what “the average opinion expects the average opinion to be,” he can still reverse his decision while avoiding major consequences.

However, there is an issue here. Remember that our investor is attempting to determine “the outcome of the mass psychology of a large number of ignorant individuals,” which Keynes warns “is liable to change violently as the result of a sudden fluctuation of opinion” (Ibid. p. 154). So our investor’s confidence in his information is not all that matters. Because his information is being used to assess this ‘mass psychology,’ suddenly our investor’s confidence is inextricably linked to the confidence of everyone participating in this system, if he is indeed speculating. He therefore realizes that “there is [an] instability due to the characteristic of human
nature that a large proportion of our positive activities depend on spontaneous optimism rather than on mathematical expectation, whether moral or hedonistic or economic” (Ibid. p. 161). This is quite significant, as it suggests that our investors’ confidence in his own predictions is now partially a result of this optimism which he senses in others. This has large ramifications insofar as theory is concerned.

Keynes argues that individual decisions to invest are partly “a result of animal spirits – of a spontaneous urge to action rather than inaction, and not as the outcome of a weighted average of quantitative benefits multiplied by quantitative probabilities” (Ibid.). Up to this point, our investor has begun to mitigate certain aspects of uncertainty, in an attempt to convince himself to invest in the stock market. However, his past experiences can only take him so far, and there is a limit to his rational confidence. Therefore, a crucial facet in the inducement to invest is this ‘optimism’ and the drive to action, what Keynes calls ‘animal spirits.’ He claims, “individual initiative will only be adequate when reasonable calculation is supplemented and supported by animal spirits, so that the thought of ultimate loss…is put aside as a healthy man puts aside the expectation of death” (Ibid. p. 162). What this means is that, for the individual investor, there is an inducement to invest which is largely not predicted by neoclassical ‘rational behavior.’ Our investor must decide that he simply wants to invest his money, accept a given amount of uncertainty, and then attempt to make the best decision with imperfect information and his gut feeling. This is Keynes’ third and final premise: that behavior under uncertainty is partially determined by confidence, which is independent from the rate of interest, $r$.

Keynes argues, “In estimating the prospects of investment, we must have regard…to the nerves and hysteria…of those upon whose spontaneous activity it
largely depends” (Ibid.). This urge of spontaneous activity is the state of confidence, essentially the belief that an investment will be fruitful, at least in the short term. It is partially a consequence of the liquidity of investment, and therefore decreasing confidence will result in a greater demand for liquidity. This confidence does not need to be grounded in actual facts, or even in professional opinion, but is rather the product of the ‘mass psychology…of ignorant individuals’ who exert their decisive influence on the rate of current investment partially because of their fluctuating confidence. Therefore, when faced with uncertainty, our investor will also decide whether or not he is confident, and whether other participants seem to be confident or optimistic before committing to any sort of investment. If so, he will decide to invest. If not, he will postpone his investment, as he is nervous about even the short-term fluctuations in value; instead, he would prefer to hoard money as an “alternative way in which to hold his savings” (Ibid. p. 160). Therefore, as confidence decreases, the demand for liquidity increases; moreover, as confidence decreases, the rate of current investment suffers in a way that does not depend solely on the rate of interest, $r$. This is the third and final premise from Keynes’ *General Theory*.

It is important to note that this confidence is not the *sole* determinate of the rate of current investment. Rather, Keynes argues, “we are merely reminding ourselves that human decisions affecting the future…cannot depend on strict mathematical expectation, since the basis for such calculations does not exist” (Ibid. p. 162-3). These considerations are important because they simply had not been properly acknowledged before, and instead had been assumed away by perfect information and neoclassical ‘rational behavior.’ Once more, Keynes’ thoughts on investment reference his philosophy within the *Treatise* and illustrate how rational
thought can be applied. While “it is our innate urge to activity” that ultimately spurs
the individual to invest, those decisions rely on “our rational selves choosing between
the alternatives as best we are able, calculating where we can, but often falling back
for our motive on whim or sentiment or chance” (Ibid.). Rational belief, in Keynes’
views on investment, facilitate the decision making process in the face of uncertainty
as best it can, and this is why the logical grounds of his definition on probability are
so important. By focusing on the evidence examined, i.e. the quality of information,
Keynes’ probability offers a useful structure for behavior under uncertainty because
of its reliance on ‘degrees of rational belief.’ These decisions are not wholly
irrational, and that is an important qualification. However, they are also not wholly
rational, and this is a consideration that is at serious odds with the neoclassical
assumption of rational behavior.

When applied to actual investment decisions, or to policy interventions, it
should be clear that the nature of investment is far more complicated than simply a
matter of efficient markets and perfect information. The premises that can be
synthesized from Keynes’ General Theory with the aid of his Treatise on Probability
are: 1) an agent’s past experiences tend to exert a decisive influence on his future
behavior, specifically with investment, because people tend to assume the Principle of
the Uniformity of Nature, 2) an agent values both the probable outcome and the
confidence, or weight, which he can ascribe to that outcome, and 3) this confidence is
not solely the result of comparative analysis, but is also the result of the general state
of confidence, and when this suffers, the agent will demand liquidity in lieu of real
assets. These premises all apply to conditions of uncertainty, meaning that the agent
does not have a complete probability distribution required to make these decisions
mathematically. But, more importantly, they highlight a major weakness within the neoclassical structure of ‘rational behavior,’ namely the assumption of perfect information.

Keynes demonstrates that, specifically for uncertainty, there are different qualifications for what makes an agent ‘rational,’ and even those are not enough to fully induce him to invest. The potential for expansion of this is enormous, as Keynes basically offers testable hypotheses for behavior in uncertain conditions. These can be empirically validated and explored, but illustrate an adherence to reality that appears, on a theoretical level, far greater than the neoclassical system. Therefore, the expansion of these premises, in considerations of uncertainty in the quality of information, represent a large area of research that could greatly augment the predictive and explanatory powers of economics via a revised conception of what is ‘rational’ for both an agent and his behavior.
Chapter 3 – Herbert Simon

“The attempt to predict and prescribe human economic behavior by deductive inference from a small set of unchallengeable premises must fail and has failed” – Herbert Simon (1976)

Herbert Simon’s contribution to science looms large over other contemporaries, stretching over multiple disciplines, including artificial intelligence, general computer science, cognitive psychology, and economics. His work on bounded rationality represents one of the primary attempts to critically examine and revise the classic conception of rationality on both a formal and empirical level. He is mainly critical of optimizing behavior by economic agents, and the assumptions that accompany it; however, at times, Simon is admittedly overenthusiastic about the universal applicability of his bounded rationality and ‘satisficing.’

Simon’s work mainly focuses on the assumption of complete information and the processes used in incomplete information problem scenarios. Therefore, his uncertainty is quite different from Keynes’ conditions of uncertainty in the previous chapter. Essentially, Keynes’ uncertainty had to do with the quality of information, while Simon mainly examines the quantity of information by limiting the computational ability of an agent. This essentially limits the amount of preferences known to the agent, or eliminates them, and then examines the decision-making processes of gathering and analyzing information used to reach a solution.

Simon’s work is very important, but does not delegitimize the optimizing agent, classically considered ‘rational;’ instead, each notion of rationality has its own domain where it would be most applicable, and these applications of both neoclassical and bounded rationality will be identified throughout the chapter. The
main contributions of Simon’s bounded rationality, also referred to as *procedural rationality*, are the identification and differentiation of problems within economics, a critical examination of optimizing behavior, and an interdisciplinary solution to the questions of uncertainty of alternatives that allows for far greater realism in modeling complex behavior.

Section i. will discuss what Simon calls *substantive rationality*, which represents the neoclassical assumptions within a rational agent and assumptions about his environment. Section ii. will then contrast substantive rationality against his alternative, *procedural rationality*. And finally, Section iii. will discuss the empirical results and applicability of procedural rationality.

**i. Substantive Rationality**

Within the social sciences, rationality refers to a style of behavior of an agent that is both goal-oriented and within a given set of constraints. Neoclassical economics generally assumes the agent’s goal is simply to maximize the expected value of utility, also known as ‘optimizing behavior.’ The agent also has a feasible choice set, with a fixed number of *a priori* known alternatives, and is often assumed to have complete information about three primary categories: 1) the constraints he faces, 2) the complete feasible choice set, and 3) each specific alternative, including information on the consequences of each. This complete choice set allows the agent to know his preferences, including in strict rationality situations, his indifference curves. These allow him to calculate the expected utility of whatever he is choosing. *Complete* information is quite different from perfect information: complete information merely states that the agent has all of the information necessary to make a decision based on known preferences. Essentially, the agent has enough information
to compare his alternatives to his preferences, and therefore can make the optimal decision because he knows every alternative and its outcome.

What all of these assumptions accomplish is a formalization of behavior, which reduces economic decision to a simple, mathematically tractable action. This action is quantifiable, logical, and predictable, and as such is highly useful for theoretical and normative applications within economics. Most importantly, this notion of rationality, which Simon terms *substantive rationality*, allows for one optimal solution to the problem of rational choice. Because the individual knows his preferences and all of his alternatives, he will naturally make the optimal decision.

Imagine a thesis student is looking for a book in a library, on a specific topic – let's say, fungi. This student is happy right now, because he can go on Amazon and figure out which books would be the most contributive, because he would know their utility. He could calculate the optimal choice, which would lead to the best books for his thesis.

The main objective, inferred from the nature of the assumptions, is an acceptable departure from adherence to reality in order to establish a logically and mathematically predictable model of behavior that can be tested, in principle, against human behavior. The main issues with this entire structure of rational behavior and substantive rationality revolve around its relative simplicity. Simon notes that, “the assumption of substantive rationality…freed economics from any dependence on psychology,” which from a formal perspective is an important freedom (Simon, *From Substantive to Procedural Rationality*, p. 131). The freedom from considerations of psychology heavily contributes to the theoretical power of substantive rationality and allows for its ubiquitous application without fear of subjective bias. Basically, this
rational behavior gives the agent a specific goal, i.e. selects the optimal choice, and assumes away possible contributions from psychology in complex problem situations. By assuming the information is complete, they are giving a large amount of information to an agent and then assuming that he processes all of it in order to reach the optimal decision, all in relatively short order.

While substantive rationality relies on abstraction, there are certain environments that induce behavior similar to modeled behavior, also referred to as situations with strong validation. Armen Alchian’s paper, “Uncertainty, Evolution, and Economic Theory” (1950), argues that certain competitive markets, where firms compete in a quasi-Darwinian environment with survival of the fittest, lead to only profit-maximizing firms ‘surviving,’ i.e. achieving success. He argues, “the existence of uncertainty and incomplete information…motivates and rationalizes a type of adaptive imitative behavior; …it does not base its aggregate description on individual optimal action, yet it is capable of incorporating such activity where justified” (Alchian, 1950, p. 221; emphasis added). Essentially, the justification in this specific scenario was the behavior which competitive firms utilized to ‘survive,’ where profit-maximizing behavior became analogous to evolutionary adaptive advantage. What this example illustrates is a necessary process of validation, which can negate the non-realism of the assumptions that accompany neoclassical rational action. If the environmental conditions, like in Alchian’s argument of the firm or the agent’s learning process, maintain a strong resemblance to the ‘non-realistic’ assumptions, then the application of substantive rationality is valid. The example of validation in this paper would be that in competitive markets, even with incomplete information and uncertainty, firms survive as though they are profit-maximizing, but “the
economist need not assume that each participant is aware of, or acts according to, his cost and demand situation” (Ibid.). This validation is what Alchian means when he uses the phrase “where justified;” his is essentially saying that the conditions in competitive markets force firms into a Darwinian ‘survival of the fittest’ scenario, and profit-maximizing behavior is akin to an evolutionary advantage. Therefore, optimizing behavior can be assumed even though the individual is not actually optimizing anything. This is known as strong validation.

However, not all scenarios have strong validation, e.g. not all economic environments could be classified as ‘Darwinian.’ Substantive rationality models behavior in a way that eliminates the constraints that pertain to the agent, namely the constraints within the agent, e.g. computational limitations, and perceived constraints, which would be a consequence of incomplete information. Computational limitations and the perception of constraints are closely related due to the fact that many incorrect perceptions of the characteristics of the choice situation would be a direct result of the agent’s computational capacity. This is all nullified by the assumption of complete information, where the agent has a full choice set and information for all of his alternatives. Our thesis student is still happy, because he knows which books to buy. This is a simple scenario, and this departure from realism is acceptable in simple situations. Many simple situations embody the aforementioned strong validity, as exemplified by Alchian’s example, and were the main focus of economics up to World War II. Therefore, in our analysis up to this point the student can make the optimal choice. But it also does not adhere to reality very closely, and this is problematic.
After WWII, and partially as a consequence of Keynes’ *General Theory*, economics began to examine areas where realism was crucial, and where many of the assumptions of substantive rationality were in direct opposition to common knowledge of the choice situations. Our student was useful in order to show how he would behave rationally when given complete information, but this scenario lacks the strong validation of Alchian’s paper. Without complete information, the student now has to look up something about the books he wants, i.e. gather information. He doesn’t know what his preferences are exactly, but he knows that he needs books on fungi. Let’s say, specifically, growth rates of different mushrooms under certain environmental conditions. How many books will he look up? How closely will he read the abstracts? These are questions which procedural rationality looks to answer. The student is now in a complex decision scenario, and he has a problem with the quantity of the information he has.

In the transition from normative to positive economics, and in an effort to positively contribute to business and public policy decisions, models began to grapple with real-world scenarios accompanied by instances of imperfect competition, uncertainty, and decision-making with limited resources, including information. These are all complex scenarios, and generally resistant to ‘strong validation. Consequently, substantive rationality encountered criticism because of the non-realistic nature of its assumptions and the void it illustrated between theory and the real world. Simon’s work with procedural and later bounded rationality had empirical success in industrial organization, focusing on complex situations involving uncertainty, imperfect information, and *satisficing*. Section ii. will examine the development of procedural rationality, its link to satisficing, and what distinguishes it
from substantive rationality. Section iii. will examine areas of empirical success that involve the application of satisficing and bounded\textsuperscript{7} rationality, mainly in areas with weak validation.

ii. Procedural Rationality and Decision Making

The different concepts of rationality originate from two opposite schools of thought on the firm: situational determinism and economic behavioralism, terms first coined by Latsis (1972). The main difference between the two is that economic behavioralism requires “as an essential component a psychological theory of rational choice” (Simon, *From Substantive to Procedural Rationality*, p. 129). This essential component is what distinguishes procedural rationality from its substantive relative, but it is important to note that procedural rationality “is not merely an adaptation of [substantive rationality, but]…a distinct concept that has its own independent origins within psychology” (Ibid. p. 129-30). What this really represents is how procedural rationality is fundamentally different from substantive rationality, and that this difference is a consequence of its genesis within psychology, and the different questions each discipline looked to answer.

Economics looked to first assess conditions for equilibrium via linear algebra, differential calculus, and conditions of certainty, in order to more fully understand how agents behave with set resources. Recall that “rationality,” broadly speaking, is goal-oriented behavior within set constraints. The goal of a rational agent, as specified by neoclassical economics, is to maximize his expected utility value. Moreover, Simon claims, “a theory of rational behavior may be concerned with the rationality of individuals or the rationality of organizations. In fact the two are not

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\textsuperscript{7} i.e. procedural rationality, as the two are very closely related.
wholly distinct” (Simon, *Theories of Bounded Rationality*, p. 161). This is reference to J. Marschak’s paper “Elements for a Theory of Teams” (1955), which claims, “a team is efficient if the net score is maximized” (Marschak, 1955, p. 129). Basically, these teams are analogous to individuals because even thought there are multiple parties involved, “each executive of a business firm” makes the final decision (Ibid.). This executive bases his decision “not only on those facts known to all...[but] also his special or local information,” and therefore an organization, in this case a team, functions in a similar way to the individual (Ibid.). Thus, when considering substantive and procedural rationality, these implications apply to both individual agents and firms. The goal for firms, in neoclassical theory, is that they are *profit maximizing*.

Psychology, on the other hand, looked to examine rational behavior in terms of the thought process that generated it, and, moreover, focused on non-trivial situations where “the substantively rational response...is not instantly obvious” (Simon, *Procedural Rationality*, p. 132). In these situations, the subject must gather information and process it before determining a reasonable course of action, i.e. a solution, and procedural rationality mainly concerns itself with this entire process of discovering a solution. Non-trivial situations are an example of weak validation, where the conditions of the environment require gather and processing data. Psychology defines rational behavior as “the outcome of appropriate deliberation” (Ibid. p. 131). Therefore, while relevant cognitive psychological research falls into

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8 This information is essentially information that only the decision-maker would have to know, e.g. an admiral knowing specific strategies that his corporals do not, even though they share their information with him, See: Marschak (1955), Section 3 - Information

9 “When psychologists use the term 'rational,' it is usually procedural rationality they have in mind.” (Simon, *Procedural Rationality*, p. 131)
three main categories – learning, problem solving, and concept attainment – procedural rationality and the research associated with it represents a unification of these three areas.

These categories of research could also be viewed as components in the process of making a decision, where each require a certain amount of cognitive effort. Learning, problem solving, and concept attainment do not represent instinctual or simple tasks, but instead require a certain amount of processing and time. As soon as the assumption of complete information is removed, the agent now needs to gather information in order to determine his preferences and make a decision, and the same can be said for a firm. Each of these concepts, when taken as parts of making a decision in economic terms, can be viewed as a type of cost or constraint, requiring resources, e.g. time, interns, money, in order to gather information and develop alternatives, and agents could employ different methods to reach their solution. These are conditions of uncertainty pertaining to the quantity of data.

Recall the thesis student, who was happily ordering his books, fully confident that he has selected the best books available to him. He was aware of his full choice set, analyzed each alternative, and came to the conclusion to order five books out of the one hundred search results. Now take away his complete information, as was done earlier. The student cannot know \emph{a priori} which books would be helpful for his thesis, so he would have to search through each one. He would have to read each abstract, determine some system for what qualified as ‘relevant’ or helpful to his research, and then weigh the specific (albeit simplified) concepts in each book against the others in order to determine which ones would be the most useful. These processes take time, and require focus; they are not instantaneous. These processes are the primary
concern of procedural rationality, so that boundedly rational behavior, which is a direct disciple of procedural rationality, differs greatly from neoclassical rational behavior. Simon characterizes the difference as “a basic shift in scientific style, from an emphasis on deductive reasoning within a tight system of axioms [i.e. substantive rationality] to an emphasis on detailed empirical exploration of the complex algorithm of human thought [i.e. procedural and bounded rationality]” (Ibid. p. 147). This is the difference, respectively, between our thesis student when he was happy and our thesis student now that has to actually search for the right books, and is therefore less happy. It also illustrates that procedural rationality will mainly focus on the thought process as the main determinate of rational action, as opposed to the outcome. In this way, Simon can be seen as similar to Keynes, but the distinct difference still remains that Keynes’ uncertainty revolved around the quality of information, while Simon is mainly concerned with the quantity and an agent’s ability to process it.

The main metric of comparison is that of computational efficiency, using computational mathematics. This computational consideration is very important when comparing procedural rationality to substantive rationality. Because computational efficiency is a primary concern, the solutions become slightly less determinate of the ‘value’ for one method compared to the other. The fact of the matter is some problems require computation that is realistically unfeasible, even if it is theoretically possible. When considering any sort of time constraint on the decision, the search for the optimal solution becomes unnecessary, and this irrelevancy is exacerbated in situations where cognition is similarly limited. Therefore, the solution arrived at does not represent the optimal solution, but rather the *satisfactory* one, because procedural
rationality is “concerned with the rate at which an approximation can be expected to improve as a function of computational effort” (Simon, *Theories of Bounded Rationality*, p. 164). This distinction between optimal and satisfactory is a crucial one, as it represents a major change in the goals of the agent, which is itself one of the two primary aspects of rationality, the other being constraints faced by the agent.

An agent’s problem is bipartite: the agent must find a good, or the best, strategy as a rational actor, and he must compose a set of accurate evaluations about his set of alternatives which are immediately available to him. Classical reasoning, as embodied by substantive rationality, sees these problems as indistinguishable. It does not matter if the agent has a grand scheme in mind or simply makes one small decision after the other, either way he will optimize and select the best strategy. He has unlimited computational power, and is essentially only limited by the availability of data. However, evaluating every option takes time, and moreover requires mental effort to process each alternative and its consequence, i.e. the process of computation. Procedural rationality says that he will, instead of finding the best option, set *aspiration levels*, or conditions of acceptability, and then consider alternatives until he finds one which satisfies his requirements. That process, which sounds much more analogous to the rational human thought process, is called *satisficing*.

Satisficing is another of Simon’s most important contributions to economics and procedural rationality. As the term implies, satisficing is the process of finding a satisfactory course of action by considering a selection of alternatives, comparing them to specific aspiration levels, and ending once a satisfactory option has been discovered. Satisficing offers a few key advantages to optimizing, which make it invaluable for complex situations. The thesis student needs to search for his books,
and look through his results. He probably will not read every abstract, as that would require much more time and effort than he’s willing to commit at this point. So, instead, he could set aspiration levels, looking for books with a chapter discussing his topic. He looks on the first page of results, and lets assume it displays twenty-five search results per page; after reading the abstracts, he selects five books that satisfy his requirements. The student faces a problem with uncertainty of his alternatives, or a partial choice set. This is a situation of incomplete information, where the student doesn’t know exactly what his options are, and therefore must determine what they are before he can assess their relevancy. This problem centers on the quantity of information available to the agent *a priori*, and procedural rationality has a few key advantages when assessing a complex scenario such as this.

First, it is far less computationally intensive when considering large situations with unknown alternatives. Simon uses an example of chess, which has $10^{120}$ different unique outcomes but is also a game of perfect information, to show satisficing in practice. Simon comments on the professional chess player’s skills:

> He compensates for his limited computational capacity by searching very selectively through the immense tree of move possibilities, …stores in [his] long-term memory a large collection of common patterns…together with procedures for exploiting the relations that appear in these patterns, …[and] forms and modifies his aspirations for a position, so that he can decide when a particular move is ‘good enough’ (satisfices), and can end his search (Simon, *From Substantive to Procedural Rationality*, p. 136).
This is a perfect illustration of satificing at work – “the expert chess player’s heuristics for selective search and his encyclopedic knowledge of significant patterns are at the core of his procedural rationality” (Ibid.). The chess player is able to utilize his incomplete information on strategies, which is still significant, in order to refine his search, decrease time dedicated to calculating options, and select a satisfactory move with relative ease. Simon’s example also demonstrates the dynamic nature of procedural rationality in the modification of the chess player’s aspirations, another of the aforementioned ‘key advantages.’

The dynamic, adaptive nature of procedural rationality allows it, via aspiration levels, to respond to changes in the environment in a far more flexible manner than the neoclassical theory of rationality. Optimization and substantive rationality require a radical simplification of the world until the agent can computationally process it; satificing and procedural rationality simplify in a different direction, so that the model maintains far more realistic detail, but searches for a satisfactory solution, as opposed to an ‘optimal’ one. This is why the thesis student is a suitable analogy: when faced with unknown alternatives, he will try and find a satisfactory book instead of the optimal one. So, our student, when using procedural rationality and confronted with incomplete information, will be able to respond to changes in his environment and utilize his knowledge on his topic in order to determine his aspiration levels. He doesn’t know everything on fungi, but he most likely has some specialized knowledge on the general topic; therefore, he will set aspiration levels and select books that are deemed satisfactory. Additionally, it does not matter if the search returned two or three hundred results; our student would still search for satisfactory
books, rather than optimal ones. If he were to attempt to select the optimal books, even with complete information, his computational ability would have to be immense.

However, our thesis student’s search structure is slightly more complex than it initially appears. He is somehow determining that 25 books is a good number, rather than 30. This is a question of design, which is “concerned with the discovery and elaboration of alternatives” (Simon, *Theories of Bounded Rationality*, p. 172).

Evaluations of design are not among complete designs, but rather serve to guide the search or “the elaboration of the design itself,” and provide a basis for deciding in which direction a design ought to be elaborated (Ibid.). Satisficing procedures can easily incorporate optimization within its structure, e.g. programming an optimal amount of search time, because at an early point in the search, the student simplifies his problem. He calculates how much time he wants to spend reading abstracts, and how many he should read before determining satisfactory options. It is possible to fix aspiration levels optimally using computational mathematics and the theory of approximation, so that the levels dynamically respond to the relationship between the expected improvement per unit of time searching and the incremental cost of searching. Of course, for this to be practically effective, one must also value the alternatives in units comparable to units measuring search cost, so that the marginal productivity of a search can be estimated. But this required specification is actually quite useful in retrospect, because the marginal productivity of a search would vary from situation to situation, and therefore the ‘value’ of time and effort would fluctuate depending on the nature of the problem and the environment.

To hearken back to the chess example, efficient design would be a player looking for a *single* checkmate strategy, not all checkmate strategies. More complex
designs would require more complex search structures, but this is actually how optimizing behavior can be included within procedural rationality. In the early stages of a complex search, the environment could be reduced and simplified into abstracted detail, so that optimization can be used in these primary stages to provide an optimal ‘blueprint’ of sorts. The chess player would decide that he only wanted to consider 30 moves, instead of 100, because of his experience. His knowledge allows him to approximate an optimal amount of searching in order to reach a satisfactory decision, based on the amount of specialized knowledge he has.

As detail and other variables are gradually reintroduced, the search design can utilize satisficing and procedural rationality in order to refine the search further, based off of earlier approximation. So, within those 30 alternatives, the chess player can adjust his aspiration level to determine which strategy would be most successful. In fact, theoretically, optimizing, using an approximated and simplified world, and satisficing are quite similar; the acknowledgment of optimization as an approximation would effectively mean it provides a satisfactory solution to some problems. However, the two previous examples highlight the practical differences between the two, mainly due to the inclusive nature of satisficing and procedural rationality, which are mainly defined by the quantity of information. Therefore, this incorporation of optimizing within procedural rationality is simply applying it to an initially trivial problem, e.g. how much time one spends on it, and as such represents a case of strong validity. Simon writes, “Even a satisfier will exhibit such a preference [of maximization] whenever the difference in rewards between the two arrangements is sufficiently large and evident” (Simon, *Rationality as Process and as Product of Thought*, p. 6). However, as the search becomes more complex and more
details are introduced, actual neoclassical rational action would essentially assume those complexities away. Procedural rationality and satisficing create a computational simplicity that allow it to be applied to complex problems of human decision-making, and as such offer great predictive and explanatory power when applied to situations with weak validity.

In summation, procedural rationality and the process of satisficing offer multiple advantages in comparison to classical, or substantive, rationality. Because of its independent generation within psychology, it focuses on the decision-making structure of rationality and the cognitive abilities of the agent. This offers two main benefits: first, it allows for far more detail to remain in the environment and second, it focuses on the critical component of computational ability within an agent, which is a facet essentially assumed away by substantive rationality. Furthermore, procedural rationality allows for dynamic considerations and inclusive theoretical design that differentiates it from its substantive cousin, while still allowing for simplification and optimization as part of the process.

iii. Application within Economics

Procedural and bounded rationality offer distinct benefits in certain problem scenarios. Simon argues, “Procedural rationality takes on importance for economics in those situations where the ‘real world’ out there cannot be equated with the world as perceived and calculated by the economic agent” (Simon, On How to Decide What to Do, p. 504). Procedural rationality displays empirical successes in experimental situations, but those situations are specified. It is important to recall how situations have either strong or weak ‘validation,’ where the approximations and assumptions of substantive rationality more accurately resemble certain scenarios in positive
economics. The empirical success of procedural rationality is often in scenarios with weak validation and large amounts of complexity, because procedural rationality examines ‘non-trivial’ situations where the substantively rational decision was not immediately obvious.

Procedural rationality must be considered because the questions economics asks have been changing. Simon argues that there has been a “shift from a highly quantitative analysis, in which equilibration at the margin plays a central role, to a much more qualitative institutional analysis, in which discrete structural alternatives are compared” (Simon, *Rationality as a Product and Process of Thought*, p. 6). This essentially means that questions began to examine how different policies affected behavior, as opposed to examining the optimal outcome of that behavior. In complex decision situations, substantive rationality, in the form of Subjective Expected value of Utility (SEU), lacks explanatory power because of its reliance on the goal of optimization or profit maximization.

In imperfect competition, the market has only a few (or one) producers, and this leads to an issue of market power, where price can be influenced by manipulating supply or demand. In a perfectly competitive market, firms have no ability to raise market price over their marginal cost, and are assumed to have zero market power. Thus, in perfectly competitive markets, firms are known as price takers. But, imperfect competition has few producers to supply the entirety of demand, meaning that consumers have limited (if any) alternative options, depending on whether the market is a monopolistic or oligopolistic structure. Therefore, a firm with market power in an oligopoly can influence the price of a commodity by altering its quantity, because its quantity represents a large portion of the aggregate supply. But, because
all of the firms in this market are price makers, they must balance their ability to affect the price with their expectations on what their competitors will do.

Antoine Cournot (1838) first identified this problem in *Recherches sur les Principes Mathematiques de la Theorie des Richesses*, and observed that in this situation of imperfect competition, in his case a duopoly, profit maximization cannot be clearly defined because “the choice that would be substantively rational for each actor depends on the choices made by the other actors; none can choose without making assumptions about how others will choose” (Simon, *From Substantive to Procedural Rationality*, p. 140). Cournot’s solution essentially argued that, because “each [producer] independently will seek to make [their] income as large as possible,” therefore each producer takes the competitor’s output as given, and alters their own output so as to maximize their own profits (Cournot, *Researches*, p. 79; emph. orig.). The equilibrium here “is therefore stable; i.e. if either of the producers, misled as to his true interest, leave it temporarily, he will be brought back to by a series of reactions” (Ibid. p. 81).

This solution, while being ‘optimized’ and reaching equilibrium, is not grounded in optimizing behavior, but in the “assumption about the procedure each actor would follow,” so that only by considering the decision-making process can one conjecture a feasible equilibrium (Simon, *From Substantive to Procedural Rationality*, p. 140). Simon notes that other proposed solutions of imperfect competition “rest on postulates about the decision process, in particular, about the information each decision-maker will take into account, and the assumptions he will make about the reactions of the others to his behavior” (Ibid.). Cournot’s solution also invites a consideration of game theory because of the duopolistic structure of this
market. It has already been noted that firms and individuals, insofar as procedural rationality is concerned, may be considered as similar if not analogous. Therefore, the decisions that these two producers must make are partially in response to their competition, which they recognize as rational. The “study of mathematical models of conflict…between intelligent rational decision makers” is what is commonly referred to as game theory (Myerson, 1991, p. 1). Procedural rationality has also demonstrated success and applicability within game theory.

In *A Comparison of Game Theory and Learning Theory* (1956), Simon identifies similarities between rational behavior as predicted by Estes’ formula and rational behavior described by game theory, specifically the minimaxing of regret. These similarities illustrate that, if an agent is assumed to have an incomplete choice set, he could rationally decide to maximize something other than expected payoff, which represents the substantively rational and neoclassical choice. The type of experiment is known as a *partial reinforcement* experiment and involves two alternatives, each with a reward that is assigned a probability of being chosen. Each trial randomly chooses an alternative to reward based on the assigned probabilities, and the participant ‘earns’ the reward by guessing the correct alternative. The Estes theory predicts the frequency, approaching a limit as the number of trials increase, of selecting the first alternative, or “the frequency…with which the first alternative will be chosen in preference to the second” in the experiment (Simon, 1956, p. 267). The response was that “a rational individual would first estimate, by experimenting, which of the two alternatives had the greatest probability of reward, and would subsequently always select the reward which would not be predicted by the Estes theory” (Ibid. p. 267-8). Essentially, the argument was that a rational individual
would attempt to maximize his expected payoff, which would be the alternative not endorsed by this theory.

M. W. Flood (1954), when given this objection, argued that the agent in a real-world scenario would not completely know the payoffs; therefore, the agent could have a different perception of the perceived payoff, or ‘payoff matrix,’ that could rationalize his behavior. Simon interprets this defense as assuming “the subject is trying to maximize something other than expected payoff” (Ibid. p. 268). Simon hypothesizes that instead of maximizing expected payoff, the agent is attempting to minimize regret. Regret, in game theory, is “the difference between the actual payoff for a given pair of strategies and the payoff that could have been realized, if the strategy actually employed by nature had been anticipated,” and is connected to the Estes theorem because both explain behavior in the same way (Ibid. p. 270). Simon argues that the given probabilities in Estes’ theory, designated $\pi_1$ and $\pi_2^{10}$ represent “the conditional probabilities of persistent behavior,” where the subject chooses the same alternative as he had in the previous trial, while $(1 - \pi_1)$ and $(1 - \pi_2)$ are the “corresponding conditional probabilities of a shift in behavior,” where the subject alters his choice from the previous trial (Ibid. p. 269). In a neoclassical assumption of rationality, the agent would have complete information, and would therefore know the reward probabilities. If one was higher than the other, e.g. $\pi_1 > \pi_2$, the rational decision would be to always select the first alternative, which is inconsistent with Estes’ theorem.

However, Flood’s (1954) objection was precisely that the agent did not know the probabilities, and therefore may have a goal other than maximizing expected
payoff. Simon argues that one such goal could easily be minimizing regret. Essentially, the agent still has the opportunity to shift or persist in his behavior, but does not know the probabilities of reward. Therefore, if he persists, he is rewarded with the probability of whichever alternative he selected previously. However, if he shifts, his reward is either 1 for guessing correctly, or 0 for guessing incorrectly. If he is attempting to minimize regret, he will subtract the largest element, i.e. prospective payoff, from the other in order to calculate what the prospective regret would be for each choice of persistence or shifting. Simon shows that in this game of minimizing regret, the agent would persist with the probability $\pi$ and shift with the probability $(1 - \pi)$, and that therefore “behavior predicted by Estes’ theory is identical with that…exhibited by a rational subject intent on minimaxing $^1$ regret” (Ibid. p. 271).

The perceptive limitations of the agent are what justify his rational pursuit of minimizing regret in lieu of maximizing expected payoff. Remember that Simon dealt with issues related to the quantity of information. In this case, and feasibly in the previous case of imperfect competition, realistic scenarios involve uncertainty in the available alternatives and their consequences, requiring a satisfactory goal as opposed to an optimal one. In the game theory paper, the agent is faced with an incomplete choice set, specifically with respect to the objective probabilities of reward, and therefore decides pursue the satisfactory goal of limiting regret. In the imperfect competition example, each producer takes its competition’s output as given in order to calculate its own output, even though in a complex world the producer would doubtlessly recognize that the competition’s output is likely to change. Once again,

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$^2$ The subscript numbers refer to the corresponding alternative, e.g. $\pi_1$ is the probability of alternative 1 being chosen in a random trial.
there is a limitation on the quantity of information the producer can possibly have, represented here by not constantly updating reports on the output of the competition. Both of these illustrate the “distinctions between subjective rationality (i.e., behavior that is rational given the perceptual and evaluational premises of the subject), and objective rationality (behavior that is rational as viewed by the experimenter)” (Ibid. p. 271). What this really represents is the explanatory power of procedural rationality in a complex scenario. A subject in a complex scenario must not only have data available to him, but he must also process it and, from his analysis, determine what his goals are. These goals are what define what it is ‘rational’ for him to do, as rationality is broadly defined as goal-oriented behavior within given constraints. The development and identification of those goals are one of the primary objectives of an agent in a complex scenario, so that “if anything was learned…by the subjects, …it was the appropriate perceptual model and not the appropriate behavior once that model was assumed” (Ibid. p. 272). This is why procedural rationality is applicable in these sorts of complex decision scenarios: the limited choice set available to the agent would create a need for him to alter his goals in order to cope with the uncertainty pertaining to the quantity of his information.

This uncertainty is another facet which substantive rationality treats with care and distance, e.g. the perfect information assumption in Section i. Realistically, many do not have accurate probability distributions about their future, and even when presented with data that could facilitate such a distribution, many people would not care to or be able to calculate such a distribution. Examples of agent uncertainty can

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11 This is minimizing the maximum loss scenario, essentially minimizing the effect of the worst-case scenario
be found within “experimental tests of SEU maximization, of Bayesian strategies for sequential decisions, and of other models of rational choice under uncertainty,” where simple and transparent games show behavior consistent with SEU theory; however, the introduction of complexity, or “the smallest departures from this simplicity and transparency,” leads to behavior completely inconsistent with Bayesian and SEU theory (Simon, Procedural Rationality, p. 134).

Kahneman and Tversky, in their paper “Psychology of Prediction” (1973), observe “intuitive predictions are insensitive to the reliability of the evidence or to the prior probability of the outcome,” which leads to “the experience of unjustified confidence in predictions and the prevalence of fallacious intuitions concerning statistical regression.” (Kahneman and Tversky, 1973, p. 1) Their findings, in layman’s terms, indicate that subjects in this experiment over-valued new evidence, regardless of how reliable it was, and disregarded prior probabilities. Meanwhile, Edwards’ paper “Conservatism in Belief Revision and Participant Skepticism” (1968) shows that subjects exhibited the opposite behavior, and that “participants do not perceive information provided to them…as coming from a fully reliable source…[leading] to a more conservative belief revision.” (Edwards, 1968, p. 17)

What these two papers really illustrate is empirical evidence of behavior that directly contradicts Bayesian computation and substantive rationality in the face of uncertainty. People, understandably, do not have the computational power or view the effort as too costly when considering uncertainty, and consequently “either overrespond to new evidence or ignore it.” (Simon, From Substantive to Procedural

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12 Essentially, this is the computational ability assumed by substantive rationality, where agents combine new information with old in order to update their probability predictions. Thus, predictions do
Neoclassical rational action would assume complete information; therefore the subjects would have no doubt in the reliability of the information they were given, and may simply consider the new evidence in conjunction with the old. Moreover, they would be easily able to process all of this information without any regard to computational limitations. The results of the two previous papers indicate that people do not apply Bayesian considerations to probabilities, leading to one of two conclusions: 1) People behave irrationally when presented with uncertainty, or 2) They behave rationally, but interpret and process the problem in a different way than conventionally assumed.

By applying procedural rationality to these findings, a reasonable hypothesis could be that, when presented with uncertainty and changing probability, agents proceed to judge the veracity of new information contrasted to old information, and then update their behavior based off of this decision. Uncertainty, when treated as reducible or purely calculable as it is in substantive rationality, then becomes incorporated into models which offer insight on how agents respond to policies, new products, etc. But if actual behavior treats uncertainty in an entirely different way, these compromises, which seemed small theoretically, suddenly gain far more gravity when others use the models to interpret or predict how people behave in the real world. Ignorance, stemming from uncertainty, prevents substantive rationality from functioning as it was theorized to, so that even when an agent uses optimization to make a ‘good’ decision, this is not the same as the optimal decision. As soon as models and economics becomes interested in the procedures used to make decisions,

“not depend on new evidence only, but on prior probabilities as well.” (Simon, Substantive to Procedural, p. 134)
substantive rationality contradicts itself at an incredibly fundamental level, which is quite problematic.

One of the hypothesized explanations for the incongruity between Bayesian strategies and empirical behavior is computational limitations, but these limitations are really part of a larger aspect of procedural rationality that is arguably its greatest asset: decisions and behavior with limited resources. These resources are not concrete, but are rather mental faculties and informational deficits that could strictly constrain the possibilities available and the methods used to obtain them. A brief example would be that of chess. Chess is a game of perfect information, where every possible move is visible, so that all choices are available to the agent. However, even with this perfect information, chess players still rely on satisficing procedures augmented by specialized experiential knowledge in order to select a ‘good’ move, simply because considering and calculating every choice would be too mentally straining. Maximization is difficult and inefficient in this scenario.

Thus, chess illustrates a complex problem which is facilitated by specialized information and past experiences, and where the computation of all the ‘perfect information’ available would be a hindrance as opposed to an advantage. Business, and the practices associated with it, could be viewed in a similar manner. Experience in business could facilitate solving similar problems that appear at a later time, such as managerial or organizational issues, so that an ‘experienced’ businessman could easily be regarded as having a distinct advantage to a well-educated new recruit. In fact, many business practices exhibit far more procedural rationality, while minimizing reliance on any sort of substantive rationality. Businesses don’t look to equate marginal cost to marginal revenue, but instead look for ways to innovate and
construct procedures that facilitate problem-solving, including the generation and aggregation of data. Simon argues that modern decisions are concerned not with theoretical maximization, but with “efficient procedures for computing actual solutions to concrete problems.” (Ibid. p.139)

A fantastic example of these efficient procedures is found within Kuehn and Hamburger’s paper “A Heuristic Program for Locating Warehouses” (1963). The main object of their study was “to determine the geographical pattern of warehouse locations which will be most profitable to the company by equating the marginal cost of warehouse operation with the transportation cost savings and incremental profits resulting from more rapid delivery.” (Kuehn and Hamburger, 1963, p. 643) Their approach displays an elegant combination of optimization and satisficing, and illustrates the inclusive nature of procedural rationality from the previous section. Optimization is used to maximize warehouses to the distribution network without increasing total cost, similar to the ‘blueprint’ concept. Satisficing is used after this in modifying solutions by dropping individual warehouse or shifting their locations while examining the profit implications for each. As detail is increased, in this case by focusing on the profit implications of individual warehouse instead of general warehouse feasibility, the search process offers far more significant and meaningful results.

This paper was highlights the efficacy of heuristics in comparison to pure linear programming, which would exhibit more of substantively rational approach by calculating every option. There were two main advantages: “(1) computational simplicity, which results in substantial reductions in solution times and permits the treatment of large-scale problems, and (2) flexibility with respect to the underlying
cost functions, eliminating the need for restrictive assumptions.” (Ibid. p. 656) Again, the application of this sort with procedural rationality, where large and complex problems can be considered while limiting simplification, improving resource use, and increasing the realistic contributive content of solutions, illustrates the serious advantages which procedural rationality and satisficing can offer for theory and modeling.

Herbert Simon’s work with bounded rationality has been shown to be incredibly important, but it does have limitations. In situations with strong validation, where the environment reasonably mirrors the restrictive assumptions, substantive rationality provides a far simpler avenue of calculating an optimal solution, or even one that is reasonably good enough. Furthermore, in abstract situations, procedural rationality almost seems unnecessary when judged by its own standards, for substantive rationality would simply require less effort because of the lack of specificity. Finally, procedural rationality still implies that all of the information is objectively available, or rather limits the amount of uncertainty in the quality of information. The unpredictability of large-scale events, akin to aggregate shocks in an insurance scheme, is not seriously considered, and this highlights the difference between uncertainty in Simon’s work and Keynes’. Additionally, there are aspects of rational behavior which may rely on more social convention than procedural rationality is willing to concede. However, Herbert Simon’s work and contribution is a serious improvement in multiple problem areas of economics, and also exhibits far more of a positive flexibility which could make it an invaluable modeling tool. As economics continues to assess the effect of institutions on economic behavior, and as technological progress continues to alter and augment the constraints and decision-
making process of a rational agent, procedural rationality offers an adaptive and innovative solution with great potential for complex problems, as well as explanatory power for how agents, and subsequently people, make decisions when faced with realistic complications.

Conclusion

“Too large a proportion of recent ‘mathematical’ economics are merely concocted, as imprecise as the initial assumptions they rely on, which allow the author to lose sight of the complexities and interdependencies of the real world in a maze of pretentious and unhelpful symbols” – John Maynard Keynes, The General Theory of Employment Interest and Money, p. 298

The foundational premise of this thesis was that behavior in conditions of uncertainty differs from behavior in certain conditions. These certain conditions are often a consequence of assumptions meant to abstract and simplify behavior into a predictable and quantifiable form. As economics begins to examine scenarios that are increasingly complicated, and where agents would encounter informational and computational issues, the need for expansion of rational choice becomes increasingly necessary. The three economists surveyed here all point to observed and marked differences in the behavior of people in real-world scenarios of uncertainty. There are multiple other developments that possibly exacerbate the distance between assumptions of rational behavior and realistic behavior.

First, the increasing reliance on technology brings actually increases the need for computational concerns and a focus on how people develop their preferences. As searches become more specialized and applications offer suggestions based off of previous preferences, an agent’s preferences would become dynamic. An agent may no longer search, but rely on algorithms to suggest products to them that may not
utilize linear programming, and therefore would not resemble optimal behavior. Moreover, misinformation and imperfect information is exacerbated by the rapid spread of information via social media such as Facebook and Twitter. Therefore, news doesn’t even need to be true, the agent simply needs to perceive it as true, and this could alter his preferences or behavior. The Internet is the most revolutionary informational sharing tool since the development of the printing press, and its development and influence offer a massive amount of information almost immediately. However, the computational ability to process all of this information, as well as assess its relevance and its validity, becomes increasingly important in how agents form their preferences. Procedural rationality could offer insight into the adaptive strategies humans, and therefore agents, would develop to cope with this increasing amount of information available.

Second, the increasing speculative aspect of investment banking relies heavily upon expectations, and therefore Keynes’ system of analysis becomes much more relevant. Speculation has exponentially increased, and has increased partially as a consequence of the development of the Internet, which served as a catalyst for technological growth. The expectations of the future are becoming increasingly relevant, as is amateur participation in the market via applications such as E Trade. Participants in the stock market have far easier access and reduced trading penalties than previous generations, and this would lead to an issue of uncertainty with the quality of information on two levels. First, clearly there is pervasive imperfect information via the casual investor who now has a larger ‘market share,’ which leads to an issue of the quality of information used to make decisions of investment. Second, this casual investor also has a day-job, and may have taken Econ 101 in
college, but ended up majoring in Philosophy. He doesn’t have the nearly as much information as professional investors do, but he receives some from his E Trade app. So he needs to decide between trusting this information or supplementing with other sources, whose validity he not only has to confirm but then compare against his other sources.

The final development has to do with economics itself, and its role within society. It is difficult to decide whether Keynes’ *General Theory*, the Great Depression, the Cold War, capitalism, World War II, or globalization provided the catalyst amongst a myriad of other possibilities, but the fact remains that economics, specifically in the past fifty years, has had a rapidly increasing influence on many other fields. It forms the cornerstones of political debates and its influence can be seen on the front page of any newspaper. Additionally, again consider the Internet’s contribution to economics, specifically with data. The aggregation of data has become far easier, results are quickly disseminated, and amount of analytical data has increased at a staggering rate. However, the answers demanded from economics have also changed, or rather what their answers represent. The questions now ask about how things affect behavior, and how people react to certain changes. This is distinct from what sort of behavior and policies lead to an efficient economy. People demand real-answers, and in order to account for the dynamic nature of the questions, rationality needs to be further expanded. This is not something that is immediate; in fact, with the increased prevalence of experimental economics, immediate results seem contrary to what economics is equipped to produce. However, the increasing amount of data facilitates research into how to modify and augment traditional models of rational behavior. In the introduction, the opening quotation claimed
science is “a way of thinking, a way of skeptically interrogating the universe with a fine understanding of human fallibility.” Neoclassical rational behavior has received theoretical skepticism, but is in dire need of empirical skepticism.

It would be difficult and rash to completely dismiss the neoclassical conception of rational behavior. It is a good theory, and has resisted an immense amount of criticism and reexamination. However, it imposes limitations that have become increasingly more significant as economics and civilization change and progress. The three authors primarily demonstrate observations of behavior that gain an additional amount of relevancy when compared to the current society.

Adam Smith’s moral structure adds an important qualification to his pursuit of self-interest. Even though Smith emphasizes self-interest, this self-interest can be partially curbed or influenced by the desire for approbation. However, this sympathy relies upon direct contact, in a time where direct relationships were necessary. This direct relationship has becomes the progressive minority, as more people gain the ability to participate in ‘social’ or business domains without having to physically know each other. Therefore, this sympathy, which could influence self-interest, becomes an increasingly irrelevant concern for the majority of economic exchange. But Smith’s emphasis on the pursuit of self-interest as the primary goal of the individual was partially grounded in this moral structure, which has become mostly insignificant. It is an important qualification for the pursuit of self-interest, and consequently the optimal choice, which has been forgotten but should be considered. Additionally, situations of moral considerations could be relevant in examinations of developing nations, specifically when observing the behavior of people in small villages. Because of the limitations on transport and small, tight-knit society, moral
violations could carry more significant consequences, which could alter what an agent’s ‘optimal’ choice in that society.

Adam Smith’s observations on behavior in *The Wealth of Nations* are especially interesting, primarily because they contradict traditional rational behavior. The neglect of shipping insurance by merchants goes directly against predicted behavior, where agents would be assumed to calculate the higher expected utility from purchasing insurance and proceed to make that choice. Smith claims that individuals in his society have contempt for risk, where they despise the notion of it and consequently ignore it. Smith blames this contempt on the universal assumption of good fortune, which he qualifies as a ‘natural characteristic’ of every man. However, this behavior has similarities with Keynes’ observations on investment, albeit with different explanations. Keynes discusses animal spirits as factor that induces the individual investor. Keynes writes, “a large proportion of our positive activities depend on spontaneous optimism rather than on mathematical behavior” (Keynes, *General Theory*, p. 161). ‘Spontaneous optimism’ can easily be seen as analogous to Smith’s assertion of every man’s “absurd presumption in [his] own good fortune” (Smith, *Wealth of Nations*, p. 124). These are very similar observations on human behavior, and both are in conditions of uncertainty. Smith and Keynes both identify a problem in behavior, where people do not behave as they ‘ought’ to when they are given uncertain circumstances. Instead, they adopt some sort of strategy that can be interpreted as optimism or belief in good luck, but is not confirmed as such. These explanations could be incomplete, but the trend of behavior is apparent. Therefore, Smith’s relevancy also stems from these observations, which are mainly
significant because they are consistent with Keynes’ observations, even though the two are separated by centuries of development in society, technology, and economics.

John Maynard Keynes had more complex views on behavior in uncertainty than his ‘spontaneous optimism’ quotation suggests. His work on probability actually examines the way that people approach assessing the quality of information, which they express through probability. *Treatise on Probability* offers a starting point for attempting to understand what evaluative processes people use for information under more realistic assumptions. Keynes correctly notes that probability, while often expressed numerically, colloquially indicates more than a quantifiable estimate, but also represents some level of confidence that, while not quantifiable, is an important criterion.

Additionally, Keynes’ *Treatise on Probability* enhances and nuances concepts in his *General Theory* in a way similar to Smith’s two works. By applying principles and conceptions from the *Treatise* into Keynes’ discussion of expectations and their influence on the inducement to invest, a few basic premises can by synthesized on behavior under uncertainty, specifically with respect to quality of information. These are: 1) an agent’s past experiences tend to exert a decisive influence on his future behavior, specifically with investment, because people tend to assume the Principle of the Uniformity of Nature, 2) an agent values both the probable outcome and the confidence, or weight, which he can ascribe to that outcome, and 3) this confidence is not solely the result of comparative analysis, but is also the result of the general state of confidence, and when this suffers, the agent will demand liquidity in lieu of real assets. With the new data available to economists, these premises could be empirically tested and further developed. They offer a starting point, not a definitive
model, but the scientific process involves identifying the area of examination and forming a hypothesis. These premises can serve as the initial hypotheses, and represent an area where the neoclassical theory of rational choice could be tested against alternatives.

Finally, Herbert Simon’s work on bounded rationality examined uncertainty in the quantity of information, as well as the agent’s ability to process it. The primary significance of Simon’s work is that it represents one of the successful departures from the neoclassical theory of rational choice. It has demonstrated its applicability within complex problem situations, and the approach of procedural rationality offers unique explanatory power for increasingly realistic situations. Still, even though Simon’s work is important and often considered theoretically, its adoption is still slow. However, when considering the development of the Internet, Simon’s bounded rationality should become increasingly relevant. The incompleteness of preferences, the need to search for data, and the search for satisfactory options are important areas that the Internet looks to facilitate. However, the search methods and algorithms could seriously differ from the assumed behavior of neoclassical rational choice. Moreover, the adaptive nature of humanity is pretty much disregarded by economics, but adaptation to the increased presence of the Internet could alter the way that human beings approach problems and their subsequent goals. Procedural rationality is a far more inclusive structure in these scenarios, as it offers insight into the way that decisions are made more so than the eventual outcome. Therefore, when the previous point is considered alongside the recognition that economics now increasingly examines institutional effects on behavior, it becomes apparent that procedural
rationality not only has potential for expansion, but also more accurately represents the type of problems facing the modern individual.

In conclusion, a reexamination of the neoclassical theory of rational action is necessary because analysis has begun to shift focus from outcomes to reactions. These two are quite different, and the distinction highlights the weakness of specific assumptions employed to increase the logical tractability of neoclassical ‘rational behavior.’ Because of new concerns arising from economics’ role in society, the development of technology, and increased prevalence of speculative markets, the accepted notion of what is ‘rational’ must be examined and expanded. Informational concerns and situations of uncertainty are realistic phenomena, and as society progresses the consequences of abstraction from these phenomena become increasingly exacerbated. Behavior under uncertainty can still be rational, and most likely is. However, the rational strategies for dealing with uncertainty appear to be quite different from the traditional assumptions of rationality.

Finally, it is important to consider that these complications and weaknesses are the product of months of searching, reading, and learning. They are not common knowledge. The caveats that accompany the assumptions, the warnings of abstraction and whatnot, are lost to the general public and to the individual as they are overloaded with empirical data, statistics, and projections for what the world will look like tomorrow. These abstractions and gaps matter because they are lost or forgotten by many, and those same people then log onto their E Trade app to trade stocks, listen to political debates on opposing economic plans, or try to read the New York Times to understand exactly what a stimulus is supposed to do. This is why abstractions, and the constant critical reexamination of them, matter. Behavior, in the face of
uncertainty, is likely to change and adapt in dynamic ways that are impossible to instantly hypothesize. But the pursuit matters, and the skepticism matters, because these theories and models influence every day life in a way that would be difficult to conceive thirty years prior. Simon claims, “Economics…is a description and explanation of human institutions, whose theory is no more likely to remain invariant over time than the theory of bridge design” (Simon, Procedural Rationality, p.146). A critical expansion of what defines rational choice, specifically in conditions of uncertainty, are of fundamental importance for economics as a social science, and as a contributor to the development of society on the whole.
Works Cited


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