LUISS

Department of Economics and Finance – Course in Economics and Business

Major in Management

The Sunk Cost Fallacy in Decision-Making: Psychological Mechanisms and Implications in Finance, Business, and Daily Life

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INTRODUCTION

Imagine this scenario: six months ago, you purchased a ticket for the concert of your favorite artist, and the day has finally arrived. However, during the day, you start feeling really sick and realize you have a high fever. Now you need to decide whether to go or not to the concert, and to do so, you make a cost-benefit analysis. According to economic theory, the decision should be based exclusively on two factors: the enjoyment you would derive from attending the concert against the benefit of staying home to recover.

From an economic perspective, a rational analysis would imply that decision should be made based only on the final payoff. This payoff combines the positive utility derived from attending the concert and the negative payoff stemming from the discomfort of being sick. If the result is positive, attending the concert would be the optimal choice, if not, staying home would be logical.

Yet, there is a psychological element that was overlooked in this analysis; many people, while making this type of evaluation, instead of making a purely rational decision, will add an extra factor generally expressed as "But I've already paid for the ticket", making them follow through with their original plan despite the circumstances. This is an example of the *Sunk Cost Fallacy*, in which non-recoverable costs already incurred, instead of being irrelevant to the present decision, end up influencing the choices people make, often leading to a result in contrast with economic logic.

The *sunk cost fallacy* is one of many cognitive biases that can affect the decision-making process. It shows us that people are not always rational agents as conventional economic theory suggests. The sunk cost fallacy has a significant impact on everyday life, but also in business, finance, and public policy.

The aim of this thesis is to explore the *sunk cost fallacy,* examining its psychological roots and its economic consequences. In particular, the focus will be on the psychological biases associated with this fallacy, and its application in both personal and professional decision-making. It will follow an analysis of case studies from the real world to assess the impact of the sunk cost fallacy, especially the negative impact it can have on financial

decisions. Finally, will be discussed strategies to mitigate the influence of the sunk cost fallacy in decision-making processes.

CHAPTER 1: THE SUNK COST FALLACY

The sunk cost fallacy is a psychological and economic phenomenon that influences the decision-making process, making people that have committed an investment towards a course of action stick to it despite it being unprofitable. This bias it's strictly linked to the concept of sunk costs, i.e. non-recoverable, past expenses. Even though economic logic suggests that these costs should not affect the decision-making process, reality shows that often people -irrationally- keep investing in unsuccessful operations to justify sunk costs.

1.1 Definition and impact of sunk costs

Sunk costs are expenses that have already been incurred and cannot be recovered through any future development or decision.
These costs can take many forms: monetary, temporal, effort, or psychological.
A typical example is the purchase of a ticket event: once purchased, the money spent is irremediably lost, regardless of the actual participation at the event.

In economic theory such costs should be ignored when making a decision, since they do not directly affect future marginal payoffs or marginal costs.
However, human behavior often violates this rational economic approach. This happens because people tend to view sunk costs as a kind of "investment" that they feel the need to justify, and in the attempt to do so, they fail to recognize when the abandonment of the project would be the most profitable choice.

1.2 Psychological mechanisms of the sunk cost fallacy

The sunk cost fallacy stems from several psychological mechanisms that influence the perception of risk and value. One of the most important is "loss aversion", a key concept of the Prospect Theory (Kahneman & Tversky, 1979). This mechanism makes people associate to a loss a higher level of discomfort with respect to the level of enjoyment associated to a gain of the same entity. As a consequence, sunk costs are perceived as a

loss that needs to be avoided or compensated – generally through the investment of more resources in the same project.

Another important psychological mechanism is the "escalation of commitment", a phenomenon where individuals that start a project, tend to justify further investments in order not to recognize the initial loss. This leads to a succession of irrational investments, strongly influenced by the desire for coherence, pride, and fear of other people's judgement. (Arkes, 1999)

Human behavior is subject to many of these psychological biases which generally prevail on the economic logic, leading individuals to fall straight into the trap of the sunk cost fallacy.

1.3 Economic and behavioral implications

The sunk cost fallacy has some important implications, not only in everyday life, but also in contexts like business, finance, and public policy.
For example, often businesses keep investing in unprofitable operations merely because they have already invested a lot of resources in them. This ends up in a greater loss than the one that would have resulted from the early abandonment of the project.
In the context of public policy, the sunk cost fallacy can lead to ineffective or harmful policies, like in the case of public projects that end up exceeding the initial budget, without providing the expected benefits. In order not to perceive the capital already invested as a loss, even more resources are invested, only worsening the final result.

The study of the sunk cost fallacy is a crucial step for the understanding of the deviations from the economic rational behavior. In the next chapters will follow an analysis of the decision-making process and how it is affected by some psychological biases.

CHAPTER 2: THEORETICAL FOUNDATIONS OF THE SUNK COST FALLACY

2.1. Expected Utility Theory (EUT)

To better understand why human beings, act in a way that goes against the economic rationality, it's crucial to explore theoretical basis of the decision-making process.

Classical Economic Theory suggests that individuals make decisions to maximize their utility, based on available information. However, this theory is applicable mainly for events with predictable outcomes, while it does not entirely account for situations involving uncertainty. The Expected Utility Theory (EUT) developed by Von Neumann and Morgenstern, follows the classical idea of utility maximization, but it is tailored to situations with uncertain outcomes. Under EUT, the decision-maker wants to maximize its expected payoff, which is determined by the state of nature, i.e. possibilities, occurrences, or constraints over which the player has no control. In this scenario the likelihood of the natural state—which, for the sake of simplicity, we'll assume may be represented in terms of objective probabilities—drives the decision maker's choice.

EUT provides a mathematical framework to evaluate choices based on the expected utility, calculated as the weighted average of all possible outcomes, with the weights being assigned by the probability of each outcome. (Von Neumann, 1944)

Let's make an example.

Suppose that an individual is faced with a game in which he needs to bet some dice on odd/even. If he guesses correctly wins 20$. Otherwise, he loses the same amount. We assume a fair dice, so that the probability of each event is 50%.

Assume that U(x) represents the utility for the player, and that he starts with an amount of money x_0.

The expected utility of this game, under the assumption of risk neutrality, is given by:

$$E[U(x)] = ½ (x_0 + \$20) + ½ (x_0 - \$20)$$

Resulting in: $E[U(x)] = x_0$

Let's now assume that the individual needs to purchase a ticket that costs 1$ before playing the lottery.
Under this assumption, according to expected theory, the expected utility would now be:

$$E[U(x)] = ½ ((x_0 - \$1) + \$20) + ½ ((x_0 - \$1) - \$20)$$

Resulting in: $$E[U(x)] = (x_0 - \$1)$$

As we can see, all actions are affected equally by cost of the ticket. Therefore, the player's best choice is not influenced by the introduction of a sunk cost —represented in this example by the price of the ticket. This is consistent with the classical economic idea that such costs should be ignored in the decision-making process since they do not directly affect future marginal payoffs.

However, this theoretical approach does not always align with real-world behavior. To better understand the psychological factors that drive decision-making in the presence of sunk costs, we must explore an alternative framework.

2.2 Prospect Theory

Until the late 1970s, Expected Utility Theory was the standard framework for analyzing decision-making processes in situations of uncertainty. However, the limitations of this model became clear. EUT assumes that human beings act is a rational way, which hardly happens. Recognizing these limitations, Daniel Kahneman and Amos Tversky introduced a new framework called *Prospect Theory* in 1979. (Kahneman & Tversky, 1979)

As the name suggests, *Prospect Theory* refers to the idea that the way in which individuals evaluate potential prospects is heavily influenced by the circumstances, the perspective from which they consider the situation and the framing of possible outcomes. According to this theory, the way choices are presented and perceived shapes risk-based

decision-making. As a result, people tend to overestimate certain elements, underestimate others, or fail to consider some factors entirely, depending on the circumstances.

Prospect Theory focuses on decision-making under risk, where decisions result in gains or losses. It highlights an important psychological insight: when presented with potential gains, people typically exhibit *loss aversion* – a tendency to prefer avoiding losses rather than acquiring something of the same value – whereas in a loss perspective people tend to exhibit a propensity for risk to avoid losses.
(EDWARDS, 1996)

To better understand these psychological mechanisms, consider the following scenarios:

Scenario 1: Potential Gains

A player is presented with two prospects:

- Prospect A: he gains $70 with a 100% probability.
- Prospect B: he has a chance to gain $100 with an 80% probability, but also a 20% chance of gaining $0.

The expected utility of prospect A (under EUT) is:

$$E[U(x)] = 1(\$70)$$

$$E[U(x)] = \$70$$

While the expected payoff of prospect B is:

$$E[U(x)] = 0.8(\$100) + 0.2(0)$$

$$E[U(x)] = \$80$$

In this situation, people tend to choose prospect A, even though prospect B offers a higher potential gain. This behavior is called *loss aversion*: individuals prefer the certainty of a smaller gain over the risk of gaining nothing, even if the expected value of prospect B is

higher. The certainty of not losing anything deeply influences the decision-making process, leading people to avoid the potential dissatisfaction associated with prospect B.

Scenario 2: Potential Losses

Now, the same player is faced with two different prospects:

- Prospect A: he loses of $70 with a 100% probability.
- Prospect B: he has a chance to lose $100 with an 80% probability, but also a 20% chance of losing $0.

The expected utility of prospect A (under EUT) is:

$$E[U(x)] = 1(-\$70)$$

$$E[U(x)] = -\$70$$

While the expected payoff of prospect B is:

$$E[U(x)] = 0.8(-\$100) + 0.2(0)$$

$$E[U(x)] = -\$80$$

In this case, most people will choose prospect B, even though they might lose a greater amount compared to prospect A. In scenarios like this -where people are presented with potential loss- individuals show a *propensity for risk*, that stems from the hope of avoiding any loss at all. People are drawn to the 20% probability of not losing anything, that generally outweighs the rational consideration of the higher potential loss.

2.2.1 Decision-making under risk

Kahneman and Tversky introduced a structured model that better analyzes decision-making under risk. They argued that the decision-making process is made of two fundamental phases: the editing phase and the evaluation phase. During the editing phase, there is a preliminary analysis of the prospects presented, through four sequential

operations: coding, combination, segregation, and cancellation. During the coding, the decision-maker establishes a point of reference, with respect to which all gains and losses will be evaluated. The combination is the aggregation of all the probabilities associated with identical outcomes. In the segregation, there is a separation of risky components of a prospect from non-risky ones. Lastly, the cancellation implies the elimination of components common to all the available prospects.

In the evaluation phase, the decision-maker evaluates (judges) the remaining prospects after the editing phase and chooses the one with the highest (expected) value.

The expected value of a modified prospect, denoted by V, is expressed on two scales: π and v.
π associates each probability p with a decision weight $\pi(p)$, which reflects the impact of that probability on the overall value of the prospect. The v scale assigns to each outcome x a subjective value v(x), which expresses how the individual perceives that outcome.

The formula used to compute V, for simple regular prospects of the form (x,p; y,q), is given by:

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

Where:
• x: an outcome that you might receive.
• p: the probability of receiving the outcome x.
• y: another possible outcome in the same prospect, which is different from x.
• q: the probability of receiving the outcome y.

This equation is applicable only in the case of normal prospects, that are neither strictly positive nor negative. If the prospect is strictly positive, all possible outcomes are gains (i.e., $x > y > 0$). If it is strictly negative, all possible outcomes are losses (i.e., $x < y < 0$). If the prospect is strictly positive or negative, during the editing phase it is divided into a risky component and a riskless one.

The formula to compute V in this case is:

$$V(x,p;y,q) = v(y) + \pi(p)[v(x) - v(y)]$$

(with $p + q \leq 1$)

Where:

• v(y): the subjective value of the outcome y.

• π(p): the decision weight associated with the probability p.

• [v(x) − v(y)]: the difference in subjective value between outcome x and outcome y.

• v(y): the value of the guaranteed outcome. It represents the riskless component.

• π(p)[v(x) − v(y)]: the value derived from the uncertain outcome, adjusted by its probability weight. It represents the risky component.

These formulas are not only the mathematical foundation for the evaluation of the prospects, but they also reflect the psychological mechanisms described by the Prospect Theory. In particular, the distinction between risky and riskless components and the way expected value is calculated, show that individual tend to perceive and evaluate risks in a non-linear way. This is further explained with the concepts of value function and weighting function. (s.d.)

The value function is a key element of Prospect Theory. It describes how people evaluate gains and losses with respect to a point of reference (established during the coding). The value function has three main characteristics:

1) It is defined as a deviation with respect to the point of reference.

2) It is concave for gains and convex for losses.

3) It is steeper for losses than for gains.

The last point shows that people, given a gain and a loss of the same entity, tend to perceive the discomfort associated with the loss as greater than the enjoyment linked to the gain, as shown in fig. 1. (htt)

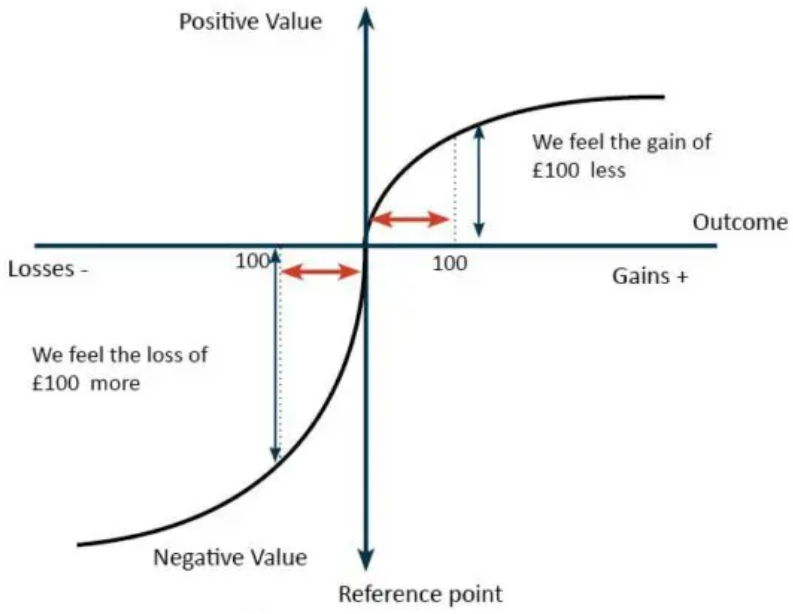

Figure 1: Value function.

Another crucial component of the theory is the weighting function, which represents the decisional weight associated with each probability. The decisional weights are not exactly the same as the probabilities because they do not follow classical probability axioms. They reflect how the probability of a result is perceived and considered by the decision maker, influencing the total expected value of the prospect. As shown in fig. 2 people tend to underestimate high probabilities, while they generally underestimate low probabilities.

(Dan Goldstein, 2022)

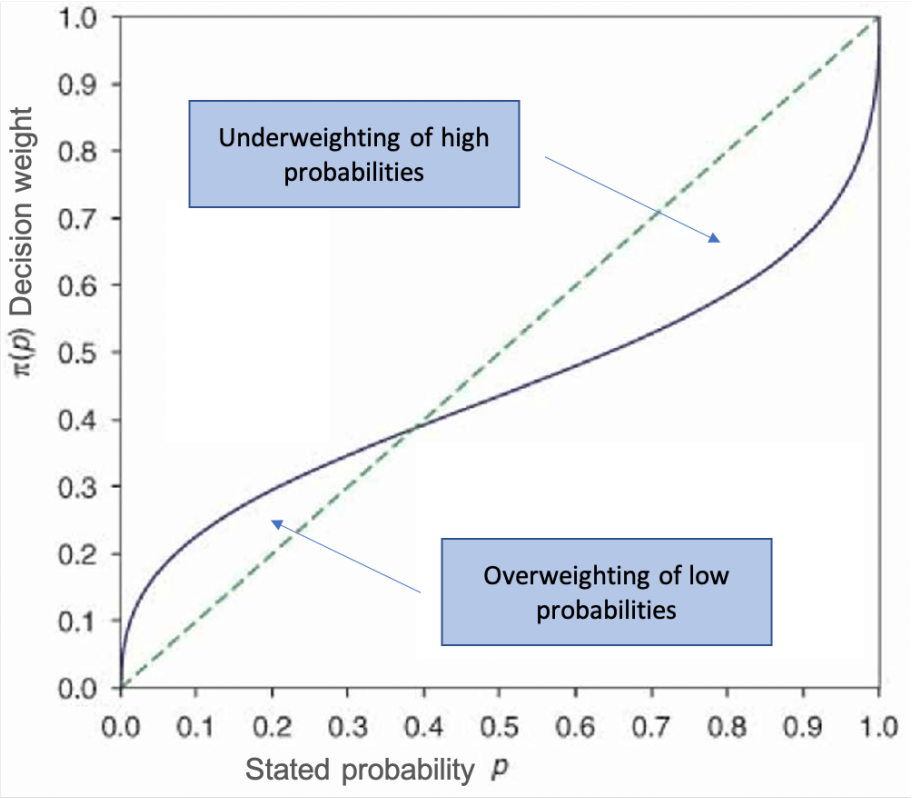

Figure 2:
weighting function.

In conclusion, the Prospect Theory provides a more accurate explanation of behaviors that are not aligned with the rational model proposed by classical economics and is particularly useful for analyzing scenarios with sunk costs. The value function, being concave for gains and convex for losses, shows how losses are perceived as more significant than equivalent gains. Sunk costs are treated as losses and, in the attempt to be minimized, they might negatively influence the decision to withdraw from an unprofitable investment. On the other hand, the weighting function explains how the probabilities of outcomes can be overestimated or underestimated, influencing the decision to continue investing even when it is not rational. These concepts show how psychological biases can influence economic behavior, distancing it from rationality.

2.3 Escalation of Commitment

A particularly relevant phenomenon that emerges when individuals continue to invest in a project or decision despite it being unprofitable, is the *Escalation of Commitment*. This behavior is a direct consequence of the trends described in Chapter 2, where the need to avoid losses and the willingness to justify past decisions lead to a succession of irrational investments.

Escalation of commitment (EoC), or commitment bias, is a psychological phenomenon that describes the tendency to remain committed to past behaviors, even if they have unprofitable outcomes.

Let's imagine this scenario. You are a first-year student of economics, and you are enthusiast about your major since this has always been your dream. During the second year, your brother starts his master's degree in quantum physics. Hearing him talking about the topic, you become curious about it and decide to dive deeper into it. After a few months you realize that you love this field and should have undertaken this course of study. You're tempted to change your major because you found something that you are more passionate about than economics. However, this prospect makes you particularly anxious. This change implies going against what you thought were your goals, beliefs, and even the idea you had of yourself. In addition to that, in the last years of college you couldn't stop talking about economics, and how sure you were that that was your future. The embarrassment and shame that you feel only imaging telling your parents and friends that you reconsidered your choice is enough. You tell yourself that you wouldn't be able to handle such uneasiness, so you continue with your economics studies, convincing yourself that it is what's best for you.

The reluctance to change path, even if we found something better or we are not enjoying the present one, is the result of commitment bias. The idea that our future choices must align with past beliefs and actions, limits our ability to make rational, optimal decisions.

In the context of the sunk cost fallacy, the EoC is an extreme response, where the decision-maker is unable to interrupt a failing course of action, worsening the situation with more irrational investments.
This bias is strictly related to the concept of loss aversion and to the psychological need to avoid the *cognitive dissonance* that would derive from the admission of an error.

Cognitive dissonance is a phenomenon whereby a person experiences tension or discomfort due to conflicting attitudes, beliefs, or behaviors. The existence of dissonance is psychologically uncomfortable, making people want to reduce it; the greater the dissonance, the greater the urge to eliminate it. Dissonance can be reduced by removing dissonant cognitions, adding new consonant cognitions, or reducing the importance of the dissonant cognitions. This can manifest itself as the avoidance of information that might increase the dissonance, or like a succession of behaviors that strengthen prior beliefs. (McLeod, 2018), (Lab, n.d.)

The link between Escalation of Commitment and cognitive biases such as cognitive dissonance highlights how deeply rooted these mechanisms are in decision-making. To fully understand this dynamic, it is necessary to examine the psychological processes underlying it, which make it difficult to abandon a failed path, even when rationality would suggest otherwise.

2.3.1 Mechanisms at the base of EoC

The Escalation of Commitment is a complex phenomenon that stems from several psychological and social mechanisms which strongly influence decision making. One of the most important is self-justification. Self-justification is an application of cognitive dissonance, where decision-makers become entrapped in a losing course of action to justify their original decision. The pressure to commit to the original choice increases as an individual seeks to justify the correctness of the original decision (Brockner, 1992). (Association, Cognitive dissonance: Reexamining a pivotal theory in psychology , 2019)

There are 3 main factors that drive the need for justifications that are: the extent of responsibility for losses, the ego-defensiveness, and the involvement of others in the situation. The first two are positively correlated to the pressure for justification, while the last one is negatively correlated.

Those elements are not only the result of internal psychological mechanisms, but they are also deeply affected by the cultural context.

To analyze the link between culture and EoC, it is useful to recall Hofstede's cultural dimension theory.

Hofstede identifies 6 cultural dimensions: masculinity, individualism, uncertainty avoidance, power distance, long-term orientation, and lastly, indulgence.

For our analysis, we will focus mainly on the first three.

Masculinity vs femininity

In cultures with a high masculinity index, independence, self-affirmation, and success are key values. Given the importance of independence and performance in these contexts, the extent of responsibility for losses tends to be very high. In addition to that, in masculine societies success is acclaimed, which exponentially increases the ego of the decision-makers. Accordingly, due to the centrality of independence and self-affirmation, involvement of others will be limited, increasing even more the need for justification. It turns out that masculine cultures will likely showcase a higher propensity for the escalation of commitment.

On the other hand, feminine cultures, where the focus is on equality and quality of life, might display a lower inclination to EoC, given that sharing and care values prevail on personal-affirmation and success.

Individualism vs. collectivism

Individualism is another cultural dimension that affects EoC. In individual cultures, identity is strongly linked to the individual and the ability to take care of themselves or their families. The strong importance attributed to personal responsibility for decisions, and the weight that the correctness of such decisions has in social status, increase the risk for Escalation of Commitment.

Uncertainty avoidance

Lastly, uncertainty avoidance plays a central role. Cultures with low uncertainty avoidance tolerate better risk and ambiguity, showcasing a behavior more flexible and less prone to the Escalation of Commitment. In these cultures, decision-makers are more open to change direction, when a decision ends up being unsuccessful. On the other side, in cultures with high levels of uncertainty avoidance -where stability and security are primary- EoC might be more common. This is due to the preference of decision makers to stick to a course of action, rather than face the unknown of a change. (Geiger, Robertson, & Irwin, 1998)

(Geiger, 1998)

CHAPTER 3: CASE STUDIES

In economic and psychological theory, the *sunk cost fallacy* emerges as a fundamental concept for understanding irrational decisions that, despite signs of failure, continue to require additional resources. This section explores emblematic cases that illustrate how this phenomenon had a significant impact in real-world contexts, analyzing the ***Concorde***, the ***Vietnam War***, and the ***Beagle 2.*** These examples demonstrate how decisions influenced by sunk costs and an escalation of commitment can lead to lasting negative consequences.

3.1 The Concorde Fallacy

The **Concorde supersonic airliner** is probably the most famous example of escalation of commitment and sunk cost fallacy, to the point that "Concorde Fallacy" has become a metaphor for when individuals continue to invest resources into a project even when the costs outweigh the benefits.

The Concorde Fallacy derives from the Concorde project, the supersonic aircraft designed by France and the United Kingdom, which despite the huge costs and the evidence of an economic failure, was carried on until its conclusion.

3.1.1 The Context of the Concorde Fallacy

The Concorde was an ambitious project started in the 1960s with the objective to revolutionize the history of civil aviation by creating the first commercial jet to exceed the speed of sound. Despite the initial enthusiasm, a lot of technical and economical problems emerged soon. In a few years, costs increased way above the £70 million estimated, reaching approximately £1.3 billion.

Despite the negative financial projections and several warnings about the economic sustainability of the project, the governments of France and the United Kingdom continued to invest in the project. The main justification for moving forward was that too much money had already been spent to abandon the project without completing it. This is a typical example of sunk cost fallacy, where future decisions are influenced by sunk costs.

3.1.2 Escalation of Commitment and sunk cost fallacy

The Escalation of Commitment manifested itself when governments decided to carry on with the project, despite the signs of a likely economic failure. The logic behind this behavior was based on a "self-justification" mechanism: abandoning the Concorde project would have meant admitting that the entire project had been an error, with negative consequences for the national reputation and carriers of the decision-makers involved.

The sunk cost fallacy was particularly evident in the governments' determination to complete the Concorde. Despite evidence that the aircraft could never be profitable, the project was carried out to avoid that the investments already made would be wasted. This mentality ignored the fact that the money already spent was irrecoverable and that further investments would only worsen the losses.

3.1.3 Consequences and lessons

The Concorde officially entered service in 1976, after 12 years of experimentation, but it never obtained the hoped-for success. It was an engineering masterpiece, with a flight capability never seen before. However, shortly after its launch, the project showed significant economic limitations. The Concorde had exorbitant maintenance, management, and fuel costs, resulting in high flight prices with a very low request rate. In 2003, after 27 years of economic losses, the Concorde was withdrawn from service.
The case of the Concorde Fallacy highlights the threats of the sunk cost fallacy and Escalation of Commitment, demonstrating how decisions made based on sunk costs may lead to important economic losses, and that failing to acknowledge when a project is destined to fail can have serious economic and reputational consequences. (Blasingame, 2011), (Arkes, 1999)

3.2 The Vietnam War

The Vietnam war is a vivid reminder of the dangers of Escalation of Commitment combined and the sunk cost fallacy in the military context.
This conflict is a prominent example of how decision-makers may continue to allocate resources for a failing operation, due to the need to justify previous investments.

3.2.1 The context of the Vietnam war

The Vietnam War, started in 1955 and terminated in 1975, began as part of the American policy of containing communism during the Cold War. In the early 1960s, the United States began providing military support to the South Vietnam government to counter the advance of communist forces in the North. However, it was soon evident that the war was becoming increasingly expensive both in economic and human term, without bringing concrete results.

As the war progressed, it became apparent that victory was unlikely. However, instead of withdrawing, the US administration decided to intensify its engagement, increasing the number of troops and the level of military involvement. This decision was strongly influenced by the sunk cost fallacy: the initial commitment of troops and resources, made American leaders reluctant to abandon the war, fearing that admitting defeat would mean that all those sacrifices had been in vain.

3.2.2 Escalation of Commitment and decision-making

In the Vietnam war the sunk cost fallacy played a crucial role in shaping decision making. The initial investment of troops and resources created a sense of commitment to the war, even when it became increasingly complex, and the desired results seemed unattainable. The fear of appearing weak or wasting the investments already made influenced policymakers to continue the war, often against increasing evidence that alternative tactics may have been more effective.

The escalation of commitment in Vietnam is the result of several psychological and political factors. Self-justification played a central role: past decisions created a sense of obligation to persist in the American leaders' mind. In addition to this there was a strong

political and social pressure to appear strong against communism, reinforcing the image of invincibility of United States.

Another key aspect was the illusion of control: US policymakers thought they would have been able to change the course of action through a greater military commitment, ignoring the actual circumstances. Even when the war became increasingly costly and victory was impossible, the escalation didn't stop, leading to further -avoidable- human and material losses.

3.2.3 The consequences

The Vietnam war ended with the withdrawal of American troops in 1973, and the fall of Saigon in 1975 marked the end of the war with the victory of North Vietnam. The consequences were devastating: Over 58,000 American soldiers died, and between 500,000 and 2 million Vietnamese civilians were killed.
This conflict caused an enormous damage to the image of Unites States. The country lost his role of invincible defender of freedom, which was not compatible with the suffered defeat, which left an indelible mark on American society and United States foreign policy.

The Vietnam War shows how escalation of commitment, and the sunk cost fallacy can impact large-scale decisions with devastating consequences. It highlights the challenges of untangling from a deeply committed path, when the desire to save past investments and the fear of admitting an error are in contrast with the objective best choice. (GeoPop, n.d.)

3.3 The Beagle 2

A significant and less known example of escalation of commitment in the context of space missions is represented by the Beagle 2, a probe designed to explore the surface of Mars. Beagle 2, integrated onto the European Space Agency's (ESA) Mars Express mission, was launched on June 2nd of 2003, with the ambitious goal of searching for traces of life

on Mars. However, the mission failed when the probe failed to establish communications with Earth after its landing on the Red Planet.

3.3.1 The roots of escalation

The escalation of commitment in this context manifested itself through a series of decisions that, despite numerous warning signs, carried the project forward. The mission was under severe economic and technical pressure, and many experts raised doubts about its feasibility. “According to the official report of the Commission of Inquiry set up by the British Minister of Science Lord Sainsbury and the Director General of the European Space Agency (ESA) Jean-Jacques Dordain, the Martian mission Beagle 2 should never have received the green light from ESA.” (scienze, 2005)

Some critical errors were made, compromising the feasibility of the project from the beginning. Initially the probe Beagle 2 was considered only as a scientific instrument of Mars Express, rather than a spaceship itself, therefore not enough resources were committed to it. Not having managed it as a spaceship led to several budget and design problems. (Agency, 2003)

Despite these critical issues, the project team, driven by national pride and the hope of achieving scientific success, continued to invest significant resources in the mission.

One of the main reasons why the project was not abandoned was the need to justify the decisions and investments already made. Beagle 2 represented a unique opportunity for Britain to establish itself as a leader in space research, and the failure of such an important mission would have been a major shock to the country's reputation. This led the project managers to ignore or minimize the risks, deciding to proceed with the launch anyway.

3.3.2 Psychological and social factors

The psychological mechanisms behind this escalation included self-justification; decision-makers were attempting to protect their image and their careers by carrying on with the project. Despite growing signs of failure, social and national pressure to demonstrate the value of the British space program helped perpetuate the escalation.

Scientists and engineers involved, found themselves in a situation where the abandonment of the project would have been seen as an admission of failure, on both a personal and national level.

3.3.3 The consequences

The failure of the mission was recognized when the Beagle 2 couldn't establish contacts with Earth after the presumed landing on Mars. Years later it was found that the probe actually landed on Mars, but during the landing it failed to fully deploy its solar panels, thus preventing communication. This underlines the complexity of such operations and the consequent necessity of rational decision making, to avoid serious consequences.

The case of Beagle 2 shows how the escalation of commitment can present itself even in highly technological and scientific contexts. The desire for success and to justify previous choices and investments, can lead anyone to sustain projects with low success probabilities, rather than evaluating in a critical way the situation and the potential withdrawn from the project.

CHAPTER 4: THE SUNK COST FALLACY IN FINANCIAL INVESTMENTS AND APPROACHES TO MITIGATE IT

In the realm of finance, where data-driven decision-making is essential, psychological biases often damage rational investment strategies. One most influential cognitive bias is thec, which induces investors to continue investing in losing assets merely because of the resources already spent. This chapter explores the impact of the sunk cost fallacy in financial decision-making, examining common investor behaviors like *holding onto losing stocks* and d*oubling down on investments.* The chapter will also introduce other biases such as *anchoring* and *the disposition effect*, which further complicate financial decisions. Lastly, we will explore strategies to mitigate these biases, encouraging more rational decision-making in financial, corporate, and private contexts.

4.1 Sunk cost fallacy in finance

The sunk cost fallacy in finance arises when investors allow past investments, which are non-recoverable, to affect their current and future decisions. Instead of making choices based on potential future returns, decisions are influenced by the desire to not waste previously invested resources. This often leads to suboptimal financial outcomes, as resources are continuously devoted to unprofitable investments.

4.2 Common investor behaviors driven by sunk cost fallacy

A frequent mistake investor make is the tendency to *hold onto losing stocks* in the hope of recovering losses. Investors often are tied to the original purchase price of a stock, and they refuse to sell it until the stock price rises at least to that level. This behavior is irrational because the future value of the stock should be the only element taken into consideration, not the price paid for it. The correct approach would be to evaluate the profitability of the stock based on available information. If outlooks are unfavorable, it would be more rational to sell the stock, even at a loss, and reinvest in another asset.

Another manifestation of the sunk cost fallacy in finance is the tendency to d*ouble down on losing investments.* This occurs when investors, instead of cutting their losses, decide to invest more money in a failing asset, hoping to recover their losses. This behavior is driven by mechanisms such loss aversion and overconfidence, where the investor believes that the additional investment will eventually fix the situation. However, this often leads to even greater losses, given that the problems for which the investment is at loss are not affected by the investor's behavior. (Finance, s.d.), (Gunia B. C., 2009)

4.3 Anchoring and the Disposition Effect

The sunk cost fallacy is a significant driver of irrational financial decisions, but there also are other cognitive biases, such as anchoring and the disposition effect, that further aggravate the problem.

4.3.1 Anchoring

*Anchoring i*s a bias where individuals rely heavily on an initial piece of information -the "anchor"- when making decisions. This often manifests when an investor fixates on the original purchase price of a stock, making it the starting point for future decisions. This often leads the investor to not sell a stock that has decreased in value until it returns to the original purchase price, despite evidence that the company's prospects have worsened.

However, anchoring is not confined to financial decisions; it also occurs in everyday situations. For example, when negotiating the price of a car, the initial price quoted by the seller can serve as an anchor, influencing the buyer's perception of the car's value. Even if the buyer manages to negotiate a lower price, their sense of getting a good deal is due to the original asking price, which may not reflect the car's actual value. To avoid a situation like this, the buyer should research the car's average market value beforehand and use that information as the basis for negotiation, rather than relying on the seller's initial price.

Anchoring creates a distorted reference point which prevents people from making rational decisions based on the real information available. (Staff, 2024)

4.3.2 The Disposition Effect

The Disposition Effect is another behavior that stems from loss aversion, where investors tend to sell winning investments too soon and hold onto losing investments for too long. This occurs because investors are impatient to realize gains quickly for fear of potential losses, while they delay selling stocks at loss in the hope that these investments will recover. This behavior is a direct consequence of loss aversion whereby people perceive as more intense losses, than gains of the same size. The disposition effect deteriorates gains as winning stocks are sold before they fully mature, and losing ones are kept until they drag down the overall returns. (Kaustia, 2010)

4.4 Mitigating sunk cost fallacy and related biases in finance

To contrast the sunk cost fallacy and other cognitive biases like anchoring and the disposition effect, it is important to use a many-sided approach. Investors and financial advisors can implement several strategies to promote rational decision making.

An effective approach is engaging in pre-commitment strategies. They can help investors make rational decisions by setting predetermined rules for selling assets. Being based on performance criteria, this method reduces emotional interference and can prevent the escalation of commitment.

Another useful strategy is regular portfolio reviews. Routine reviews that focus on current market conditions and future prospects rather than past investments, can help investors remain objective with their investments. This process encourages a forward-looking attitude, where the logic behind each investment is continually re-evaluated to check whether it still aligns with the investor's financial goals.

Furthermore, it's crucial to educate investors about cognitive biases, such as the sunk cost fallacy, Anchoring, and The Disposition effect. Proper education can teach them to

recognize these patterns in their own behavior. By understanding these biases, investors can develop strategies to counter them, like the development of a data-driven decision framework or consultation with a financial advisor.

These strategies can help investors to maintain a more rational approach toward their investments, which ultimately leads to more profitable financial outcomes.

4.5 General tools to contrast the sunk cost fallacy in decision-making

As the sunk cost fallacy also affects several other contexts, it is useful to analyze general tools and strategies that help mitigate it in various decision-making scenarios. These instruments are useful to overcome the influence of past investments on current decisions, in both private life, business and public policy.

One of the most effective methods is the use of structured decision-making frameworks, such as cost-benefit analysis or decision trees. These structures can help individuals and organizations evaluate choices based on current and future prospects rather than past investments. By providing the possible outcomes and associated probabilities, these frameworks provide a logical structure for decisions, helping to ensure they are the result of a rational analysis and are not affected by emotional attachment.

It can also be beneficial to seek external feedback. People who are not emotionally invested in the decisions can provide a more objective perspective and may find easier to recognize when sunk costs are incorrectly influencing the process. This external input can favor a more detached and impartial evaluation of the available options, hopefly leading to the most rational choice.

are made collectively, the presence of multiple individuals can significantly reduce the influence of the sunk cost fallacy. The involvement of various perspectives helps to minimize the impact of any single person's emotional attachment, as the decision-makers can hold each other accountable and provide balanced, objective insights."

Another useful strategy to mitigate the sunk cost fallacy is the involvement of multiple individuals in the decision-making process. The involvement of various perspectives helps to minimize the impact of any single person's emotional attachment, as the decision-makers can hold each other accountable, ensuring that choices are made more objectively. Furthermore, spreading he responsibility of the decision across a larger group of people can help reduce the extent of responsibility for losses and ego-defensiveness, two of the main drivers of self-justification and escalation of commitment.

To prevent EoC, it is useful to have separate individuals make initial decisions and subsequent resource allocation.

Lastly, planned, controlled, and reasoned decision-making is vital to reduce impulsive actions driven by cognitive biases. Taking time to consider whether a decision is based on rational analysis or emotional attachment to past investments can prevent costly mistakes.

CONCLUSION

The analysis carried out in this thesis has highlighted how the phenomenon of *Sunk Cost Fallacy* represents a central element in the understanding of human behavior in complex decision-making contexts. Although classical economic theory suggests that rational decisions should be based solely on future costs and benefits, empirical and psychological evidence shows that individuals often fail to ignore sunk costs of the past. This divergence between economic rationality and real behavior emphasizes the strength of cognitive distortions and their influence on daily and professional decisions.

Through the analysis of some fundamental economic theories like the *Expected Utility Theory* and *Prospect theory*, it has been possible to better understand the psychological mechanisms underlying the sunk cost fallacy. Kahneman and Tversky's Prospect Theory highlights how the perception of risks and benefits is strongly influenced by the context and the way in which information is presented. This is crucial for the comprehension of the process behind what apparently are irrational decisions.

This thesis shows how the phenomenon of escalation of commitment, strictly linked to the sunk cost fallacy, plays a crucial role in perpetuating bad decisions. This phenomenon, that was explored trough the analysis of emblematic cases such as the Concorde Fallacy and the Vietnam war, highlights how the desire to justify past decisions and to avoid the discomfort of admitting mistakes, might lead to a spiral of irrational investments. The fear of facing failure pushes decision-makers to continue on an unsuccessful path, even when evidence suggests that abandoning the project would be the most profitable choice.

The analysis continued with a focus on the financial context, where decisions should be led by data and rational previsions. Especially in this context, the sunk cost fallacy can play a crucial role; the investors -influenced by the tendency to avoid losses- often maintain failing investments or, even worse, they increase the size of dedicated resourced in the attempt to recover past losses. This tendency is further aggravated by other cognitive biases like anchoring and the disposition effect, compromising the rationality of financial decision-making.

Some of the possible strategies to mitigate the effect of sunk costs and other cognitive biases were then explored. The adoption of structured decision-making instruments helps reduce the emotional influence on the decisions. Pre-commitment strategies can help in the financial context, promoting more rational choices based on objective criteria. Then it followed a series of recommendations applicable in various areas, from private life to business and public policy.

One of the main objectives of this thesis was to underline the importance of a correct education around cognitive biases. The understanding of human psychological tendencies and the consequent adaption of a rational approach based on objective data are crucial steps to combat the sunk cost fallacy and optimize resources.

In conclusion, the sunk cost fallacy is a phenomenon that influences several contexts and that, if not correctly addressed and managed, might lead to unprofitable choices with negative psychological and economic consequences. Recognizing the presence of this cognitive distortion is crucial to mitigate its impact and improve the quality of decisions, allowing individuals to achieve more satisfactory results in both the professional and personal sphere.

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