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An inquiry on cognitive biases in fruit growers' decision-making

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Abstract

Since its origins, the field of behavioural economics has explored many aspects of human beings' decision-making. Among these, particular attention has always been given to entrepreneurs and their exposure to cognitive biases, meaning systemic errors in taking decisions. As reported in literature, these biases do have a negative impact on firms' financial performance, especially when it comes to small businesses. This thesis' objective is to expand the current knowledge about SMEs entrepreneurs' rationality when making strategic decisions. Specifically, three cognitive biases have been discussed and investigated: overconfidence, the planning fallacy, and the status quo bias. The study developed around a questionnaire mainly based on Likert scale questions, assessing the presence and the intensity of such biases in the population of fruit growers in Piedmont, Italy, with a numeric score between 1 and 5. Moreover, this thesis also aimed to find statistically significant relationships between bias scores and four demographic variables: gender, age, educational level, and business size. Results showed that fruit growers are affected by overconfidence and planning fallacy, whereas they do not seem to suffer of status quo bias, appearing open to change. Furthermore, some significant relationships have been found between the three biases and the demographic variables: business of 41-80 hectares, considered as medium-large, resulted to be both more overconfident and less subjected to the status quo bias than micro businesses. In addition, education proved to have a positive impact on the planning fallacy, as university graduates resulted less biases in planning issues. As a result, despite cognitive biases remain difficult to eradicate, this work provides some applications for fruit growers to try to reduce the impact of these traps on their businesses.

1. Introduction

What is man?

Since the beginning of history, the human being has always defined itself as an animal. An animal, however, with a unique attribute: rationality.

Over time this aspect started to be central in humanity's view about the world order, elevating its superiority and asserting its dominance over the natural world. Once this difference with all other animals was acknowledged, the gap between us and nature grew, leading to the consequences we witness today.

But can we be certain about this facet of human nature? Is it true that we are rational? Tons of historians, psychologists, anthropologists, and economists have tried to answer this question.

Remarkably, the work done by the two Israeli psychologists Daniel Kahneman and Amos Tversky in the early 1970's has completely changed the beliefs that we had about ourselves. With their work they found out that the human being *is* indeed rational, simply not always. In fact, there are some conditions under which we behave as animals, without rational and structured reasoning but pushed by an old, strong, and irrational force.

This thesis aims to expand the current knowledge about humans' behaviour. In particular, the objective of this work is to investigate three cognitive biases involved in entrepreneurs' decision-making process: overconfidence, planning fallacy and status quo bias. Given the author's background, the research focuses on farmers, specifically on fruit growers.

The analysis was conducted through a questionnaire, administered to a sample of fruit growers in Piedmont, one of the most important regions for Italian agriculture, located in the north-west of the country.

After an introduction of what behavioural economics is, the three biases will be presented and discussed. Then, it will be explained how the questionnaire was created and the reasons behind every question, its suggested answers, and their framing.

In the fifth chapter sample characteristics will be described, as well as survey methodology.

Then, the statistical analysis will be presented together with its results. A discussion of these follows.

Finally, conclusions, limits and suggestions for further research will be discussed.

2. What is Behavioural Economics?

2.1 The concept of duality

In the introduction, the human being has been presented as a rational animal. Clearly, this is not always true. And it has always been known.

As pointed out by (Robinson, 2003)[1], the concept of "duality" finds its roots in ancient Greece, where philosophers used to discuss the contrast between "body" and "mind", two components of the human being. Dualism has different definitions depending on the specific aspect of the discussion: body and mind, material and immaterial, good and evil. The list can be as long as one wants. Furthermore, over time, this concept has evolved and has been influenced by many factors such as culture, religion, and scientific research.

Two interesting definitions are the ones given by the German philosopher Friederich Nietzsche and the Austrian psychologist and neurologist Sigmund Freud. The former, referring to ancient Greek tragedy, is about Apollonian and Dionysian. Apollonian symbolises logic and harmony whereas Dionysian stands for disorder and emotions (Apollonian and Dionysian, 2023)[2]. The latter progressed in the distinction between *conscious* and *unconscious*, i.e., the last step needed to reach the very basis of this work: Kahneman's research and the introduction of behavioural economics.

[1] Robinson, H. (2003, August 19). *Dualism.* Retrieved October 04, 2023, from Stanford Encyclopedia of Philosophy: https://plato.stanford.edu/entries/dualism/#HisDua

[2] *Apollonian and Dionysian*. (2023, September). Retrieved October 04, 2023, from Wikipedia, the free encyclopedia: https://en.wikipedia.org/wiki/Apollonian_and_Dionysian

2.2 The two systems

In the 1970's, Daniel Kahneman and Amos Tversky, two Israeli psychologists, discovered something that was destined to open a new era in the economics and psychology fields. In their research, they found out that people's decision-making is not as rational as one could believe. Whenever uncertainty is involved, some unconscious forces might deviate rational thinking in favour of an impulsive way of acting. This happens through what Kahneman and Tversky call System 1 and System 2. These two systems represent the two ways in which our brain can work.

System 1 has to do with fast, emotional, and impulsive decisions and valuations. It is what permits one to give rapid answers, somehow automatic, without a logical reasoning behind them. This is, in fact, the work of System 2. This system is responsible for logical thinking. It is slower, more energy intense, but more accurate when it comes to valuations and computations (Kahneman, Thinking, Fast and Slow, 2011)[3].

The famous ball and bat riddle helps in eliminating any doubt about this distinction. The riddle asks: if a ball and a bat together cost 1.10€ and the bat costs 1€ more than the ball, how much does the ball cost? System 1 is the one responsible for the quick answer of "10 cents". System 2 is the one which takes time to understand that the correct answer is 5 cents.

This 2-systems structure results, sometimes, in the so called "heuristics" and "biases" (Kahneman & Tversky, Judgment under Uncertainty: Heuristics and Biases, 1974)[4].

What are these two new elements?

[3] Kahneman, D. (2011). *Thinking, Fast and Slow.* Penguin Books.

[4] Kahneman, D., & Tversky, A. (1974). Judgment under Uncertainty: Heuristics and Biases. *Science*, 1124-1131.

Let us start with heuristics. (Ayaa, Peprah, Mensah, Owusu-Sekyere, & Daniel, 2022)[5] reported some definitions given in literature. The word "heuristic" firstly appears in ancient Greece with the meaning of "serving to discover". (Ahmad M. , 2021)[6] defines heuristics as instruments useful in the information search that modifying the representation of a problem make it easier to solve. (Skagerlund, Forsblad, Slovic, & Västfjäll, 2020)[7]'s definition focuses on the fact that when it comes to probability, heuristics usually tend to distort the correct solution and furthermore (Nadurak, 2020)[8] points out that heuristics work through what comes faster to the evaluator's mind. Putting together all these aspects one could have a complete image of what heuristics are.

(Ayaa, Peprah, Mensah, Owusu-Sekyere, & Daniel, 2022) did the same job also for biases. Within the definitions, it can be found that biases are systematic errors between the "correct" answer, i.e., the one given following a formal rule, and the one given by individuals (Montibeller & von Winterfeldt, 2018)[9]; (Zhang, Bij, & Song, 2020)[10] described them as: "*outcomes of the use of heuristic techniques",* underlying the link between the two phenomena. Finally, (Shah, Ahmad, &

[5] Ayaa, M. M., Peprah, W. K., Mensah, M. O., Owusu-Sekyere, A. B., & Daniel, B. (2022). Influence of Heuristic Techniques and Biases in Investment Decision-Making: A Conceptual Analysis and Directions for Future Research. *International Journal of Academic Research in Business and Social Sciences*, 1252-1267.

[6] Ahmad, M. (2021). Does underconfidence matter in short-term and long-term investment decisions? Evidence from an emerging market. *Management Decision*, 692-709.

[7] Skagerlund, K., Forsblad, M., Slovic, P., & Västfjäll, D. (2020). The Affect Heuristic and Risk Perception – Stability Across Elicitation Methods and Individual Cognitive Abilities. *Frontiers in Psychology*, 970.

[8] Nadurak, V. (2020). Why Moral Heuristics can Lead to Mistaken Moral Judgments. *KRITERION – Journal of Philosophy*, 99-113.

[9] Montibeller, G., & von Winterfeldt, D. (2018). Individual and Group Biases in Value and Uncertainty Judgments. In L. C. Dias, & A. Morton, *Elicitation* (pp. 377-392). Springer Cham.

[10] Zhang, H., Bij, H. v., & Song, M. (2020). Can cognitive biases be good for entrepreneurs? *International Journal of Entrepreneurial Behavior & Research*, 793-813.

Mahmood, 2018)[11] underlined the personal aspect of biases, suggesting that the basis of these mechanisms can be found in personal beliefs, which assist decision makers in their hard decisions.

Given these definitions and having defined what System 1 and System 2 are, a question arises: what happens when System 1 does the job of System 2? In other words, what happens when we make decisions without using the proper instrument?

System 1 is useful, and in some situations even necessary: it deals with all the problems that (Harari, 2015)[12] describes referring to when we were nothing more than hunter-gatherers. At the time, problems were limited and predominantly related to survival: finding something to eat, a safe place to sleep at night and protecting new generations. Each of these problems has something in common with the others: they all require a fast and somehow acceptable solution. A classic example is a dangerous situation. When it comes, you have only two options: the famous "fight or flight". System 1 is there to tell you which of the two is the right one.

Over time, humanity started to organize in structured organizations which we refer to as "societies". This change led to the raising of new problems: controlling such complicated organizations was not something we were made to do. New tools such as mathematics and statistics were necessary. Fortunately, one of the most important characteristics of the human being is the ability to adapt to new situations and create new instruments and ways to face problems. These were the perfect conditions for System 2 to develop.

The two systems on their own work pretty well. When a task is faced with the right system, we can be quite sure it will be completed appropriately. What still must

[11] Shah, S. Z., Ahmad, M., & Mahmood, F. (2018). Heuristic biases in investment decision-making and perceived market efficiency: A survey at the Pakistan stock exchange. *Qualitative Research in Financial Markets*, 85-110.

[12] Harari, Y. N. (2015). *Sapiens: A Brief History of Humankind.* Random House.

improve is the process of choosing which of the two systems to use. Since, as said beforehand, System 1 is automatic and more rooted in our minds, sometimes it happens that it does the work of System 2. In other words, it is the elder brother prevailing on the sibling. When it happens, we talk about cognitive biases and the resulting systematic (so predictable) errors.

2.3 Behavioural Economics

As pointed out by (Kenton, 2023)[13] , behavioural economics is the science that links individuals' economic decision-making and their psychology. It aims to understand how and why people's behaviour deviates from the predictions of classic economic models, and results in irrational actions and valuations. Behavioural economics considers many aspects of decision-making and has found plenty of factors influencing people's cognitive processes, such as biases, heuristics, and framing.

(Kenton, 2023) finds the origins of behavioural economics in the 18th century, when Adam Smith figured out that people tended to be overconfident about their ability to generate gains and not incur in losses (Smith, 1776)[14]. However, Kenton asserts that this field of economics started to receive more attention by the scientific community from the 1960's, when researchers identified some biases in information processing. After the first discoveries, it has become more and more an interesting and challenging area of study, given its potential implications and difficulties in asserting with certainty cognitive effects mechanisms and the reasons behind them. Acknowledging that people are not as rational as classic economic models assumed had a remarkable impact on how we should look at those theories, hence take our decisions. In fact, these models based their dynamics on the principles of rationality, which means that economic actors

[13] Kenton, W. (2023, January 16). *What Is Behavioral Economics? Theories, Goals, and Applications*. Retrieved October 05, 2023, from Investopedia: https://www.investopedia.com/terms/b/behavioraleconomics.asp

[14] Smith, A. (1776). *An inquiry into the nature and causes of the wealth of nations.* Indianapolis: Liberty Fund.

always carefully analyse every factor such as costs, benefits, and boundary conditions to maximise their satisfaction, usually summarized in the concept of "utility", through the utility function.

Starting from these new findings, (Kahneman & Tversky, Prospect Theory: An Analysis of Decision under Risk, 1979)[15] defined a new function describing how gains and losses are perceived, the "value function". This function is shown below in figure 1:

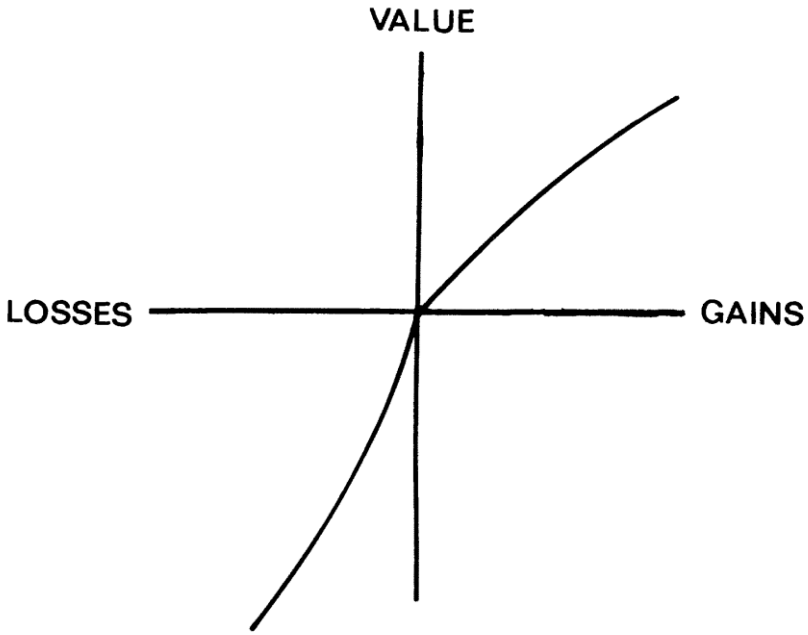

Figure 1: hypothetical value function

(original graph from Kahneman & Tversky article)

The value function has some interesting features. As one can see, the graph can be divided in two regions: the one of gains and the one of losses. Each of the two depicts how the value of a gain (or a loss) is perceived by an individual. What is remarkable here is the change that occurs at the origin of the axes. The line changes its steepness in the two regions, meaning that gains and losses are perceived differently. In particular, losses are more emotionally intense than gains

[15] Kahneman, D., & Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica*, 263-292.

as underlined by the greater slope of the curve in the left region. This results in individuals' loss aversion. It is important to underline that the steepness becomes smoother as gains and losses grow, a sign of a decreasing sensibility in absolute values, i.e., winning or losing is the game changing aspect, more than how much one gets or loses in absolute terms.

Prospect Theory put on the table new ideas and further stimulated research in behavioural economics. With these and other studies, five factors describing how individuals' behaviour is influenced have been found (Kenton, 2023):

I. *bounded rationality*: the effect of the limited knowledge and/or experience people have when taking a decision.

II. *choice architecture*: the effect of how the context of the choice is displayed on how the choice is done.

III. *cognitive biases*: see definitions above.

IV. *discrimination*: the effect that people's point of view over things, events or other people can have on how they look at other people, potentially discriminating against them because of their different opinions, based on their alternative views.

V. *herd mentality*: the tendency to follow others, even if the choice of the group is not the best one.

This thesis will focus on the cognitive biases aspect.

3. Investigated biases

3.1 Cognitive biases and Entrepreneurs

In the previous chapter it has been shown that cognitive biases and heuristics are widely spread in the population. They simply are a trait of human nature and, as such, part of each of us. Although it can be assumed to be impossible to completely eliminate their presence, exploring them would surely be useful for a deeper comprehension of how the human being's mind works.

What are these biases? How do they work? How many are they? One could go on forever with these questions. In fact, it is what the scientific community has been doing for the last 40 years. Still, behavioural economics is a subject which presents some difficulties given its psychological, hence difficult to measure, nature. However, a lot has been done over time. The literature can now classify plenty of different biases, each with its peculiarities, shades, and ways to interact with people's decisions and other biases.

An aspect of cognitive biases particularly interesting for this study is the difference in how distinct categories of individuals are affected by these systemic errors. If it is true that everybody experiences some distortions in their evaluations, estimates, and choices, it might be that the intensity of these distortions is not the same for each class of individuals. With this premise, the research can expand in three directions: identifying new biases, extending the current knowledge about the known ones (both adopting a "high" point of view, i.e., considering people as a unique category), or it can split the population base in many subpopulations (each with their characteristics, background, and problems to face) and make parallelisms between groups.

A typical distinction is based on people's job. In fact, it can be assumed on a certain degree that dissimilar roles and industries can significantly affect one's mental frameworks. After all, it is common sense to think that a banker and a painter see the world in two different ways. Their roles, responsibilities, and especially the

problems they have to face make people develop the frameworks through which they'll understand what is around them.

A particular case of interest are entrepreneurs. (Shefrin, 2010)[16] reports some aspects emphasized in literature: (Puri & Robinson, 2007)[17] focuses on some entrepreneurs' attitudes such as optimism and search for control. They found that this category is more risk-loving and sees a brighter future than others. Moreover, they discovered that these two aspects are divisible and with low correlation. (Wadhwa, Holly, Aggarwal, & Salkever, 2009)[18] supports these findings.

But entrepreneurs are not just optimistic individuals. They usually are also more confident than the rest of the population. A key point for this, according to (Weinstein, 1980)[19] and (Flynn, Slovic, & Mertz, 1994)[20], is control. Entrepreneurs appear in fact to seek non-pecuniary benefits in their activities, and having the power of controlling the environment in which they work and live seems to give them large satisfaction. After all, the freedom of choosing independently when, how, and with whom to work is one of the main reasons that independent workers and entrepreneurs always give when someone asks them why they chose that path.

The influence of overconfidence and optimism extends its domain over many other things. Referring to managers, (Ben-David, Graham, & Harvey, 2007)[21]

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[16] Shefrin, H. (2010). Behavioralizing Finance. *Foundations and Trends® in Finance*, 1-184.

[17] Puri, M., & Robinson, D. (2007). Optimism and economic choice. *Journal of Financial Economics*, 71-99.

[18] Wadhwa, V., Holly, K., Aggarwal, R., & Salkever, A. (2009). The Anatomy of an Entrepreneur: Family Background and Motivation. *SSRN Electronic Journal*.

[19] Weinstein, N. (1980). Unrealistic optimism about future life events. *Journal of Personality and Social Psychology*, 806-820.

[20] Flynn, J., Slovic, P., & Mertz, C. K. (1994). Gender, Race, and Perception of Environmental Health Risks. *Risk Analysis*, 1101-1108.

[21] Ben-David, I., Graham, J. R., & Harvey, C. R. (2007). Managerial overconfidence and corporate policies. *NBER WORKING PAPER SERIES*.

reported that overconfidence can have an impact on undertaken projects, but also on capital structure. An overconfident executive, in fact, is more prone to underestimate the risks involved in a project, thus the discount rate, having a direct impact on the computed NPV. Furthermore, overconfidence and unrealistic optimism might influence the perceived riskiness of debt. Underestimating this risk, these managers are more likely to get excessive debt, leading to a composition of the capital structure that might become dangerous and increase the company's cost of capital. Being aware of these biases would make executives critically analyse their reasoning, thus their decisions, necessary leading to a better decision-making process.

It is important to notice that managers, as intended in the article, differ in some respects from entrepreneurs. For example, managers, especially for large companies, usually are external agents whereas entrepreneurs are the "parents" of the businesses they run. Being external means having less emotional attachment to the business, thus dealing with it (at least theoretically) with more rationality. In addition, to reach top management positions in large companies a good background of experience and education is usually required, while entrepreneurs might become leaders of large businesses through their expertise, passion, and hard work. At the end of the day, they are somehow the two faces of the same coin.

However, they do share many behaviours and characteristics. After all, the problems they have to face are similar, thus similar frameworks might develop in their minds. For this reason, the findings reported above can be assumed to be true also for entrepreneurs, also of small and medium enterprises. An easy example can be found in SMEs' capital structures, too often unbalanced in favour of debt, cause of high riskiness, high cost of debt, and all related problems in the conduction of the business. This is particularly true for Italian small enterprises, a category which contains almost all agricultural companies, especially fruit growers, which most of the time conduct a family business, thus with a micro size.

Overconfidence and unrealistic optimism are two of the main biases influencing entrepreneurs, but not the only ones.

(Nuijten, Benschop, Rijsenbilt, & Wilmink, 2020)[22] extended the comprehension of these other biases involved in entrepreneurs of small and medium enterprises decision-making processes. In particular, they analysed 12 biases involved in 5 decision domains. These five areas were:

I. Strategy

II. Regulatory compliance

III. Human Resources

IV. Information Technology

V. Succession planning

For each of these decision areas they investigated 12 biases, how they influence choices in each domain, and with which intensity. With this work, they gave a guide of what SMEs entrepreneurs should consider when they think about the choices they have to make. Knowing which the most powerful biases involved in a specific context are can significantly improve the quality of the process followed to arrive to a final decision, and to critically analyse it afterwards.

Remarkably, the research has been one of the first to consider more than four biases at the same time. The list of biases analysed came from the work of (Zhang & Cueto, 2017)[23], who derived it from a review on SMEs literature. It was then modified a little to reach a higher level of accuracy. Some biases in the original list were in fact too close to others, thus creating ambiguity. These ones have been

[22] Nuijten, A., Benschop, N., Rijsenbilt, A., & Wilmink, K. (2020). Cognitive Biases in Critical Decisions Facing SME Entrepreneurs: An External Accountants' Perspective. *Administrative Sciences, 10*, 89-112.

[23] Zhang, S. X., & Cueto, J. (2017). The Study of Bias in Entrepreneurship. *Entrepreneurship Theory and Practice*, 419-454.

eliminated and substituted by others, referring to aspects that Nuijten and his team considered to be too important to not be present. From the original list the study did not include the *law of small numbers*, *self-serving attribution, similarity,* and *over-optimism.* They were deleted because of their resemblance with, respectively, *representativeness bias, confirmation bias* and *illusion of control,* again *confirmation bias and affect heuristic,* and *overconfidence.*

At their place, Nuijten included four biases that were not present in Zhang and Cueto's list. These were: *confirmation bias, groupthink, affect heuristic,* and *regret.* The first one aimed to substitute the similarity bias; the second, *groupthink*, had the objective to give a hint about an aspect of particular importance for entrepreneurs, i.e., the social context. Finally, *affect heuristic* and *regret* were added to emphasize the emotional face of entrepreneurs, who too often fail in being objective when it comes to value their companies and/or projects, simply because they fall in love with them and don't want to see what does not work, becoming "blind" at some degree. On the other hand, it happens that they suffer a bit of fear of missing out and jump into projects which should not be undertaken just to avoid regret in the future.

The final list of biases and a brief description of them coming from the article are reported below:

1. *Anchoring:* effect limiting rationality by fixing a value in the decision maker's mind, leading to a choice close to the initial value (called "anchor").

2. *Availability heuristic:* heuristic that influences the decision by giving excessive weight to easily available information, such as recent or strongly emotional events.

3. *Confirmation bias:* tendency to search for the proof of their own ideas and not for the evidence of being wrong.

4. *Regret:* emotional force pushing individuals to consider past scenarios in a different way, usually with a better ending than the original.

5. *Escalation of commitment:* tendency of individuals to stick to an idea, a choice or a project just because it was chosen before, even if it is demonstrating negative outcomes. The longer the commitment, the harder letting go.

6. *Illusion of control:* overestimation of what people can control in the environment they operate.

7. *Overconfidence:* tendency to consider themselves better than what reality is in terms of ability, knowledge, ...

8. *Planning fallacy:* underestimation of the time and resources needed for a project.

9. *Representativeness bias:* wrong statistical thinking making people overestimate the accuracy of their predictions, often based on their limited experience or stereotypes.

10. *Status Quo bias:* change aversion, which translates into the systematic preference of the actual situation over new ones, even if these could be better for the decision-maker.

11. *Affect heuristic:* influence that emotions have on decisions, leading people to choose what "they like" the most with respect to what would be better for them.

12. *Groupthink:* tendency to follow the group. It is implicit in nature as a social animal.

To be able to identify and measure these biases, (Nuijten, Benschop, Rijsenbilt, & Wilmink, 2020) worked in collaboration with some accountants. In fact, these accountants used to cooperate and support SMEs entrepreneurs in their decisions. They had a cumulative experience of how entrepreneurs' minds work

able to describe accurately their cognitive processes. The evaluation was done throughout interviews and questionnaires administered to these accountants. In doing so, both qualitative and quantitative data have been collected. Questionnaires were useful to give a numerical measure of the intensity of the investigated biases, thanks to questions using the well-known Likert scale.

Likert questionnaires offer an easy instrument for both the researchers and the respondents. Their structure is so intuitive that everybody could fill a survey without any problem. In fact, for each asked question the answer is a valuation on a scale with discrete points. The most common form is the one which presents 5 options, but other forms such as the 1-7 are accepted and might be even more appropriate depending on the research's goal. In this type of answer, every number has a different meaning, spacing from an opposite to the other of the valuation requested, passing through the middle one, that stands for a neutral answer. Typical labels are "completely disagree" for number 1 and "completely agree" for the last option. Notice that the number of possible answers might be even, meaning that no neutral answer is available. This is done to push respondents to give a preference, and not "choosing not to choose" going for a neutral preference.

In this case, a 5 options Likert scale was adopted. Accountants had to value different aspects of entrepreneurs decision-making processes in the five domains presented above. Interviews have been conducted to get further information relative to the reasons behind these processes. After a pilot test with three accountants, not included in the main study, and some little changes in the structure of the questions and interviews, the real research started. The data obtained were then analysed through a deductive approach using thematic analysis.

This tool is one of the most used when qualitative data are to be analysed. Basically, it consists in finding patterns and meanings in the data, called "themes". In this process the experience and the ability of the researcher of "seeing through

things" is fundamental. It is, in some way, a subjective process (Villegas, s.d.)[24]. As such, it has some advantages and disadvantages. It is for sure a flexible tool, but this flexibility might be a double-edged sword. In fact, this characteristic needs to be managed carefully to avoid mistakes and/or significant losses in the interpretation power. Specifically, two ingredients are necessary to succeed: a certain experience in the use of the technique and a theoretical framework able to guide the researchers in their study. Their absence would possibly lead to a wrong analysis and hence wrong conclusions. On the other hand, the thematic analysis can be used for large data sets and, even if not in the most rigorous way, conclusions are based on data. Finally, to assess the relative importance of the twelve biases in the different domains, repeated measures ANOVAs were used (Nuijten, Benschop, Rijsenbilt, & Wilmink, 2020).

Table 1 presents the final results of the study:

[24] Villegas, F. (n.d.). *Thematic Analysis: What it is and How to Do It*. Retrieved 10 13, 2023, from QuestionPro: https://www.questionpro.com/blog/thematic-analysis/#:~:text=Thematic%20analysis%20is%20a%20method,making%20sense%20of%20the%20data.

Bias	Strategic Decision Domain	Regulatory Compliance Decision Domain	HR Decision Domain	IT Decision Domain	Succession Planning Decision Domain	Bias Mean Score (Scale 1–5)
Planning fallacy	2nd * 4.14 ^	5th 3.07	9th 3.14	1st 4.00	3rd 4.11	3.69
Escalation of commitment	4th 3.89	9th 2.46	3rd 3.71	2nd 3.82	4th 3.86	3.55
Status quo bias	3rd 4.00	8th 2.50	5th 3.57	4th 3.50	1st 4.18	3.55
Overconfidence	1st 4.32	6th 2.79	4th 3.64	3rd 3.64	7th 3.18	3.51
Availability heuristic	8th 3.50	3rd 3.32	1st 3.96	5th 3.46	6th 3.21	3.49
Affect heuristic	6th 3.75	12th 2.14	2nd 3.86	7th 3.32	2nd 4.14	3.44
Regret	7th 3.64	11th 2.32	9th 3.14	9th 3.14	5th 3.71	3.19
Confirmation bias	4th 3.89	10th 2.39	6th 3.50	11th 3.00	9th 2.93	3.14
Groupthink	12th 2.71	1st 3.43	11th 3.07	6th 3.43	8th 3.07	3.14
Illusion of control	9th 3.46	2nd 3.36	12th 3.04	12th 2.93	10th 2.79	3.11
Representativeness bias	11th 3.14	3rd 3.32	6th 3.50	9th 3.14	12th 2.07	3.04
Anchoring	10th 3.43	7th 2.64	8th 3.21	8th 3.29	11th 2.54	3.02
Domain mean score	3.66	2.81	3.45	3.39	3.32	3.32

Table 1 [25]

The table synthesises how the investigated biases influence each decision domain. Columns refer to the five areas, while rows stand for biases. The cells report the bias score, measuring the intensity of a bias on a 1-5 Likert scale in a specific decision domain. Moreover, aggregate information is given in the last column and in the last row, respectively indicating the mean score of a specific bias in all domains, and the overall score for each domain, giving the information of which areas are the most biased. Biases are sorted following a decreasing order, starting at the top with the *planning fallacy*, the strongest bias (generally speaking), followed by the *escalation of commitment* and the *status quo bias* both with a score of 3.55, and so on, arriving at the end to the *anchoring effect.*

[25] Nuijten, A., Benschop, N., Rijsenbilt, A., & Wilmink, K. (2020). Cognitive Biases in Critical Decisions Facing SME Entrepreneurs: An External Accountants' Perspective. *Administrative Sciences, 10*, 89-112.

These results contain a lot of information. Let us move a little bit deeper in the aspects that interest this thesis the most.

For simplicity's sake, this work does not include all 12 biases, but focuses only on what have been considered as the three most influential biases in the domain of interest. So, first of all: what is this domain? Since the objective of this study is to discover and analyse the biases involved in fruit growers' business and organization choices in the medium-long term, the strategy domain seems to be the most appropriate choice. Not only, according to the domain mean scores the strategic decisions appear to be the most biased ones within the five decision types analysed in the research just presented on page 16, making this domain of particular interest for further research.

Now that the domain has been identified, it remains to understand which biases should be the most interesting to study in the strategic choices of SMEs entrepreneurs. The three most important biases, in terms of influence, as already said, are the *planning fallacy, overconfidence,* and the *status quo bias.* What is remarkable here is that these three biases are also in the top 4 of the overall ranking (recall that *status quo* and *escalation of commitment* share the second place, having the same score). The combination of these two characteristics (strategy domain as the most influenced domain and the three biases highly influencing both in strategic decisions and generally speaking) gives solid basis for this decision and somehow justify the choice of simplification described at the beginning of the paragraph.

To have a clearer image of what concerns this study, ranks and scores of the selected biases from (Nuijten, Benschop, Rijsenbilt, & Wilmink, 2020) have been resumed in table 2:

	Strategy domain	Overall
Overconfidence	1st 4.32	4th 3.51
Planning Fallacy	2nd 4.14	1st 3.69
Status Quo Bias	3rd 4.00	3rd 3.55

Table 2

(Nuijten, Benschop, Rijsenbilt, & Wilmink, 2020) tested their results to analyse whether differences across domains were statistically significant. In doing so, repeated measures ANOVA have been used. The test was conducted against the null hypothesis of equality in the importance of biases between decision domains and valued through the p-value. A p-value lower than 0.05 meant statistical significance in the variations across decision areas.

Results are shown in table 3:

Bias	Does the Importance of the Bias Differ Significantly across Decision Domains?	Significance	Effect Size (Partial Eta-Squared)
Planning fallacy	Yes	$p = 0.012$ *	0.215
Escalation of commitment	Yes	$p = 0.001$ **	0.302
Status quo bias	Yes	$p = 0.000$ ***	0.359
Overconfidence	Yes	$p = 0.006$ **	0.241
Availability heuristic	No	$p > 0.2$	0.069
Affect heuristic	Yes	$p = 0.000$ **	0.424
Regret	Yes	$p = 0.028$ *	0.220
Confirmation bias	Yes	$p = 0.009$ **	0.227
Groupthink	No	$p > 0.2$	0.098
Illusion of control	No	$p > 0.2$	0.084
Representativeness bias	Yes	$p = 0.008$ **	0.230
Anchoring	No	$p = 0.109$	0.129

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, two-tailed.

Table 3[26]

[26] Nuijten, A., Benschop, N., Rijsenbilt, A., & Wilmink, K. (2020). Cognitive Biases in Critical Decisions Facing SME Entrepreneurs: An External Accountants' Perspective. *Administrative Sciences, 10*, 89-112.

Notice that 8 of the 12 investigated biases resulted to have statistically significant differences in the impact on the 5 decision domains. 4 out of 12, that is 33% of the total, resulted to be not significantly different across areas.

Since this thesis focuses on overconfidence, planning fallacy and status quo bias, let us have a closer look at these three. Each of them scored a p-value lower than 0.05, reaching the threshold of significance. Specifically, they scored, respectively, p-values of 0.006, 0.0012, 0.000, supporting a high level of significance.

3.2 Impact on SMEs' performance

The previous section described how entrepreneurs are biased and do not think as rationally as one could believe. However, there are several types of entrepreneurs. They differ in the sector they operate, the country, the region (it is known that also inside the same country there can be a huge variability in terms of culture and ways of acting), … the list could be extremely long.

A distinction of particular interest is the categorization by *size.* Different sizes mean different structures, organizations, and models. In big companies, roles and processes are more precisely defined: everybody knows what he must do, and the responsibilities related to his job. In SMEs, this might not happen. Actually, many times in small and medium enterprises roles are not clear as they should, and some activities are carried out by a small number of people able to deal with them, typically the entrepreneur himself and a bunch of trustees. This phenomenon is even larger when the size becomes "micro", as in the context of most fruit growers in Piedmont.

In their review, (Raveendra, Singh, Singh, & Santhosh, 2018)[27] pointed out some interesting aspects about irrational decision-making and the typical poor financial performance of SMEs. A first point regards the ability to sustain wrong decisions:

[27] Raveendra, P. V., Singh, J. E., Singh, P., & Santhosh, K. S. (2018). Bevioral finance and its impact on poor financial performance of SMES: A review. *International Journal of Mechanical Engineering and Technology (IJMET)*, 341-348.

having a big size means having a stronger structure, with (usually) higher reserves to cover wrong investments. SMEs typically do not have this advantage and must face harsher consequences when bad decisions are made, even leading to a disaster. Secondly, since too often roles are not properly divided, financial managers of small enterprises find themselves dealing with both short-term financial decisions concerning, for example, working capital, and long-term decisions with a strategic nature. The risk attached to this working model is extremely high and should be countered as much as possible. Acknowledging the impact of cognitive biases and heuristics is a first step to act more prudently and avoid big mistakes.

The quality of the decisions taken does not depend only on these factors. It is indeed directly related to the availability of data and the processes used to analyse it. Troubles come, as presented in (Gervais, 2010)[28], when - and it is a quite common scenario - SMEs managers make their decisions based on little or no data, whereas their large-organisation counterparts base their choices on more defined quantitative and qualitative processes. A key factor for this behaviour is the overconfidence typical of small entrepreneurs.

Other reasons can be found. (Kambwale, Chisoro, & Karodia, 2015)[29] stated that: *"major reasons for failure of SMEs are inappropriate financial management, poor planning, lack of capital and access to fund and insufficient training and education."* (Kalane, 2015)[30] supports these findings, insisting on cash flows, working capital and credit management, plus issues related to planning. (Hoque,

[28] Gervais, S. (2010). Behavioral Finance: Capital Budgeting and Other Investment Decisions. In J. R. Nofsinger, & H. K. Baker, *Behavioral Finance: Investors, Corporations, and Markets* (pp. 413-434). Wiley/Blackwell.

[29] Kambwale, J. N., Chisoro, C., & Karodia, A. M. (2015). Investigation into the Causes of Small and Medium Enterprise Failures in Windhoek , Namibia. *Arabian Journal of Business and Management Review*, 80-109.

[30] Kalane, L. (2015). *Reasons for Failure of SMEs in the Free State.* Bloemfontein: UFS BUSINESS SCHOOL.

2017)[31] added external emphasis on access to finance, underlying that in some regions micro enterprises finance themselves mainly through family and friends' loans as primary source of capital, plus microcredit coming after. Moreover, he pointed out the *mental accounting* bias that small entrepreneurs witness: they don't split correctly between their business and their family, using huge amounts of business earnings to face family's expenditures, having a negative impact on the financial status of the company.

Finally, (Ahmad & Seet, 2009)[32] found that too often preparatory research is not done and the consequent investments lack in quality.

Table 4 links some studies in literature investigating these themes.

[31] Hoque, M. Z. (2017). Mental budgeting and the financial management of small and medium entrepreneurs. *Cogent Economics & Finance*. Retrieved 11 22, 2023, from https://doi.org/10.1080/23322039.2017.1291474

[32] Ahmad, N. H., & Seet, P.-s. (2009). Dissecting Behaviours Associated with Business Failure: A Qualitative Study of SME Owners in Malaysia and Australia. *Asian Social Science*, 99-104.

Authors	Behavioral component of decision making	Authors	Reasons for sickness
Suresh	Emotional control	Jonisiu Ndinomwene Kambwale, Clever Chisoro, & Anis Mahomed Karodia	Inappropriate financial decision making, poor planning, lack of decision making skills
Kapse & Mamta Keswani and Dr Mahebaleshwara Bhatt HS and Daiva Jurevinciene, Olga Ivanova	Irrationality of decision making	Fatoki, 2014	lack of management experience, lack of functional skills, lack of finance and non-availability of logistic
Halaba & Ali Coskun	Heuristics	Kalane, 2015	Lack of knowledge of financial decision making skills, poor cash flow management, high competition, poor working capital management
Simon Gervais and Rahul Subash and Misal D M	Overconfidence	Vijayakumar & G Rajendra,	Financial, operational and managerial
Daniel Kahneman and Amos Tversky	Perception of decision problems	Ahmad, 2009	Lack of research before making an investment is one of the behavioral elements associated with business failure. Misinterpretation of market, locating the office at wrong place, inability to find suitable business partners
Abhijeet Chandra And Rahul Subash and Dr Vikram	Behavioral factors like greed and fear, cognitive dissonance and optimistic toward loss	Giardino, Wangm, & Abraham	Inconsistent decision making strategies

Table 4[33]

Please focus on the second and the last column, showing the link between the behavioural component of decision making and the reason for SMEs' sickness, confirming what said above.

[33] Raveendra, P. V., Singh, J. E., Singh, P., & Santhosh, K. S. (2018). Bevioral finance and its impact on poor financial performance of SMES: A review. *International Journal of Mechanical Engineering and Technology (IJMET)*, 341-348.

Finally, (Raveendra, Singh, Singh, & Santhosh, 2018) left a conceptual framework representing the mechanism with which biases interact with decision-making, degrading SMEs' financial performance:

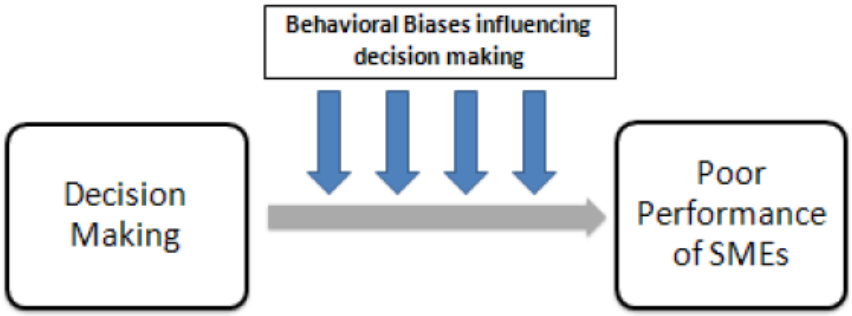


Figure 2[34]

This framework, even though very simple, gives an idea of where to intervene to stop, or at least limit, cognitive biases influence in entrepreneurs' choices.

After having described how entrepreneurs' decision-making is not as rational as believed, which are the most influential biases and heuristics in their cognitive processes and shared the results of one of the studies at the very basis of this work, it is now the moment of going deeper on the three biases that have been selected for this analysis. How do they work? How are they measured? Next section will answer these questions and give further information about each of the main characters of this thesis: overconfidence, planning fallacy and status quo bias.

[34] Raveendra, P. V., Singh, J. E., Singh, P., & Santhosh, K. S. (2018). Bevioral finance and its impact on poor financial performance of SMES: A review. *International Journal of Mechanical Engineering and Technology (IJMET)*, 341-348.

3.3 Overconfidence

3.3.1 Definition

Overconfidence has already been presented in the sections above as one of the most influential biases. It is not a case that to highlight its importance (Kahneman, Thinking, Fast and Slow, 2011)[35] referred to it as "*the most significant of the cognitive biases*".

(Moore, 2018)[36] says that overconfidence is one of the largest and omnipresent biases in the world. A classic example of excessive confidence is the famous "driver test", which asks people to state whether they are better or worse drivers than the average. Surprisingly, 93% of American drivers are convinced of being better than average in driving. It should be clear that this is statistically impossible (Svenson, 1981)[37].

So, what is overconfidence?

(Hayes, 2023)[38] reports: *"Overconfidence bias is a cognitive bias in which individuals tend to overestimate their abilities, knowledge, and skill in a particular area, leading them to make errors in judgment and decision making. This overestimation can manifest itself in various ways, such as an inflated sense of control, unrealistic optimism, or underestimating the risk involved in a situation".*

[35] Kahneman, D. (2011). *Thinking, Fast and Slow.* New York: Penguin Books.

[36] Moore, D. A. (2018, 01 22). Overconfidence. *Psychology Today*. Retrieved 10 17, 2023, from https://www.psychologytoday.com/us/blog/perfectly-confident/201801/overconfidence

[37] Svenson, O. (1981). Are we all less risky and more skillful than our fellow drivers? *Acta Psychologica*, 143-148.

[38] Hayes, A. (2023, 08 09). *What Is Overconfidence Bias? Can It Harm Your Investment Returns?* Retrieved 10 17, 2023, from Investopedia: https://www.investopedia.com/overconfidence-bias-7485796#citation-11

It is clear from this definition that overconfidence can (and it is what it does) reach its hands in an enormous number of directions, having an impact on almost every aspect of our lives. In fact, again (Moore, 2018) underlines the fact that overconfidence can have an impact also on how other biases affect people's choices. Specifically, he talks about the perception that individuals have about themselves, even when they are conscious of what cognitive biases are and how they work. This is remarkable since behavioural economics has been studied for decades and almost every student at business schools and management courses has at least a basic understanding of these mechanisms but, despite this, research continues to reveal the same biases not only in the general population, but also in managers and entrepreneurs. Why, with these premises, are decision makers still so irrational?

The reason lies right in overconfidence. People lack in honesty with themselves and think (unconsciously) that these biases do not affect them as others (Pronin, Lin, & Ross, 2002)[39]. In doing so, they do not recognize their vulnerability or do not understand how much they can be influenced. Notice that this is the exact definition of overconfidence.

There are many types of overconfidence out there. Among the best-known, (Hayes, 2023) reports:

- *Illusion of control:* as described beforehand, often people do not correctly evaluate the degree of control they have over situations, events, and the environment they operate in. This is a form of overconfidence because it is the sign that people do not understand their limits and believe they can go beyond them, choosing for things that are more or less clearly not under their influence.

- *Optimism bias:* tendency to see a brighter future for themselves if compared to others. It includes overestimating positive events and

[39] Pronin, E., Lin, D. Y., & Ross, L. (2002). The Bias Blind Spot: Perceptions of Bias in Self versus Others. *Personality and Social Psychology Bulletin*, 369-381.

underestimating negative events. Often overconfidence in proper capabilities lies at the origin of these positive expectations.

- *Miscalibration:* it is a trait of overconfidence related to what we think our abilities and knowledge are and what they are in reality. Miscalibration stands in the gap between the two.

Notice that both the *illusion of control* and the *optimism bias* are often considered as two distinct biases, since their presence is large, and their mechanisms can somehow be distinguished from the purest definition of "overconfidence".

(Michailova, 2010)[40] added a fourth trait of the bias, somehow related to the others, the *better than average effect.* As the name suggests, this effect is the consequence of people's miscalibration of their abilities resulting in the belief that they are better than the average in doing something. The driver test presented at the beginning of this section is a perfect example of "better than average" trait of overconfidence.

3.3.2 Influencing factors

Where does overconfidence come from? (Keasey & Watson, 1989)[41] identified four factors influencing the degree of overconfidence in individuals: *task complexity, amount of feedback, subjects' level of motivation,* and their *skills*.

Task complexity results in the so-called *"hard-easy effect"*, i.e., the relationship between the perceived difficulty of the task and the level of confidence in being able to complete it. This relationship can be translated in the tendency to overestimate the probability of success for tasks perceived as hard while underestimating the chances of success in solving relatively easy problems. This

[40] Michailova, J. (2010, 11 06). *Development of the overconfidence measurement instrument for the economic experiment.* Retrieved 10 17, 2023, from Munich Personal RePEc Archive: https://mpra.ub.uni-muenchen.de/26384/

[41] Keasey, K., & Watson, R. (1989). Consensus and accuracy in accounting studies of decision-making: A note on a new measure of consensus. *Accounting, Organizations and Society*, 337-345.

occurs, for example, when people are asked to answer questions of different difficulty, resulting overconfident in dealing with relatively hard questions and underconfident with relatively easy ones. Of course, skills interact influencing the subjective perception of how "hard" a task is.

For what concerns to motivation, according to (Bohner, Rank, Reinhard, Einwiller, & Erb, 1998)[42], being highly motivated increases the attention of individuals, leading to a minor degree of overconfidence. This happens because people are incentivized to have a better performance and act more rigorously. They switch on System 2, reducing the probability of incurring in systemic errors. Motivation can be given through different means and is strongly influenced by the reward. With respect to feedback, (Lichtenstein, 1982)[43] states that looking at results after the test is essential for training in improving calibration.

3.3.3 Implications

Since this bias is so spread among the population, it has several consequences in almost every context, from financial decisions to how people evaluate others. Here, particular attention will be given to economic and financial decisions.

The business world, given its uncertain nature, is the perfect place for overconfidence to prosper. Outcomes are always unknown and even after having seen the consequences of an action, it is almost impossible to know what could have happened if another choice was made. As such, different aspects of business are influenced by overconfidence, with all the resulting problems. In stock markets, overconfident investors find themselves with higher trading volumes, lack of appropriate asset diversification, underestimation of riskiness and

[42] Bohner, G., Rank, S., Reinhard, M.-A., Einwiller, S., & Erb, H.-P. (1998). Motivational determinants of systematic processing: Expectancy moderates effects of desired confidence on processing effort. *European Journal of Social Psychology*, 185-206.

[43] Lichtenstein, S. F. (1982). Calibration of Probabilities: The State of the Art to 1980. In D. S. Kahneman, *Judgment under Uncertainty: Heuristics and Biases* (pp. 306-334). Cambridge: Cambridge University Press.

undervaluation of facts proving something not in line with their original plan or estimation (Hayes, 2023)[44]. On the side of corporate decisions - in particular capital budgeting ones - (Oran & Perek, 2013)[45] reported that overconfidence (often in collaboration with optimism) can lead executives to bad estimates of risks, cash flows, thus discount rates and in the end NPVs, as already treated. These managers are also inclined to early investments, which sometimes can actually result in extremely good choices.

Surely, self-confidence and optimism are good things and can have a positive impact, especially in situations of difficulties, when pessimistic people leave the game. On the other hand, these aspects should never become extreme, or the consequent problems discussed above could go beyond the "security limits" after which rationality becomes only a memory and everything is chaos, governed by emotions and instincts.

Next paragraph provides some concepts about how to measure overconfidence, which are necessary to have quantitative data to be able to better understand the bias, and once a discrete level of consciousness is reached, to avoid - or at least limit - the chances of this to occur.

3.3.4 How to measure overconfidence

As one could have understood, cognitive biases are difficult to evaluate. As the name itself suggests, they are processes inside our mind and, as such, impossible to observe directly. This is a limitation that pertains to almost every aspect of psychology, in contraposition to natural science subjects. In fact, natural phenomena are often directly observable, hence measurable. Even if they were not, there is usually a mathematical theory there to help you in your job. Maybe it

[44] Hayes, A. (2023, 08 09). *What Is Overconfidence Bias? Can It Harm Your Investment Returns?* Retrieved 10 17, 2023, from Investopedia: https://www.investopedia.com/overconfidence-bias-7485796#citation-11

[45] Oran, J. S., & Perek, S. G. (2013). An Empirical Test of Optimism Bias in Capital Budgeting Decisions. *Journal of Modern Accounting and Auditing*, 287-296.

will not be perfect, maybe it will not work as well as you need, but in most cases, it will give you direction. All this is often extraneous to psychological facts: mental phenomena can be observed with electromagnetic resonance experiments and other neuroscience's tools, but when it comes to pure psychology everything becomes misty.

Each psychological phenomenon is different and has a different treatment when it has to be observed. Over time, several tests have been developed to analyse people's behaviour in different situations, contexts, and tasks. The variety among methods is huge: some approaches aim to measure biases directly, others look at them from other perspectives, as hidden spectators.

Of course, overconfidence measurement depends on which of the several typologies one wants to insist on. This thesis will put a particular emphasis on the miscalibration trait of overconfidence so only the main instruments referred to this aspect will be presented. With these premises in mind, let us dive deep in the methodologies.

According to (Michailova, 2010)[46], one of the most used methods to measure miscalibration is giving people a questionnaire built with some general knowledge questions. For each question, respondents must state the degree of confidence with which they think their answer is correct. (Mis)calibration is than computed as the difference between the average percentage confidence and the average number of correct answers: results less than 0 mean under-confidence (respondents think to be less correct than what they actually are, having a percentage of correct answers bigger than the average confidence percentage), results bigger than 0 signal the presence of overconfidence, and results equal to 0

[46] Michailova, J. (2010, 11 06). *Development of the overconfidence measurement instrument for the economic experiment.* Retrieved 10 17, 2023, from Munich Personal RePEc Archive: https://mpra.ub.uni-muenchen.de/26384/

witness perfect calibration. As presented by (Lichtenstein, 1982)[47], people tend, in general, to overrate their general knowledge and fall in the overconfidence bias. Notice that this test can measure overconfidence in both directions, thus giving information not only about the presence or not of the bias but also finding the opposite.

A second way to measure calibration is by using confidence intervals. A typical form is to provide a list of questions asking lower and upper bounds for unknown numerical answers so that the respondent is sure with a certain degree (for example, 90%) that the real answer lies between the given limits. Ideally, with a confidence level of, for example, 90%, 10% of real answers should fall outside the bounds. Evidence says the opposite as reported, again, by (Lichtenstein, 1982), proving another time people's miscalibration.

3.4 Planning Fallacy

3.4.1 Definition

After having described the "mother of all biases", its influencing factors, its implications and how to measure it, let us move to the second investigated bias of this work: the planning fallacy.

What is planning fallacy? (Nikolopoulou, What Is the Planning Fallacy? | Definition & Examples, 2023a)[48] defines it as a phenomenon related to estimation of resources. Specifically, we talk about planning fallacy when a decision maker underestimates the time needed to complete a task or a project or, more generally, the resources. But this bias can influence also other aspects of a planning process. In fact, the planning fallacy comes in two forms: the first one

[47] Lichtenstein, S. F. (1982). Calibration of Probabilities: The State of the Art to 1980. In D. S. Kahneman, *Judgment under Uncertainty: Heuristics and Biases* (pp. 306-334). Cambridge: Cambridge University Press.

[48] Nikolopoulou, K. (2023a, 08 11). *What Is the Planning Fallacy? | Definition & Examples*. Retrieved 10 24, 2023, from Scribbr: https://www.scribbr.com/fallacies/planning-fallacy/

related to underestimation of time, costs and risks involved in the project, the second related to the overestimation of results such as, for example, revenues.

Typical examples of planning fallacy are large scale projects, which usually take much longer and cost more than what predicted in budgeting decisions. When this is combined with public administration the effect is usually strengthened, especially in the Italian context. But this is not common only for large projects: (Buehler, Griffin, & Ross, 1984)[49] presented that people, in general, tend to be overoptimistic about the time they will need to complete a given task.

The choice of presenting the planning fallacy after overconfidence was not casual. Planning fallacy relates to the overconfidence bias as it can be seen somehow as a form of overconfidence. As pointed out by (Nikolopoulou, What Is the Planning Fallacy? | Definition & Examples, 2023a), a characteristic point of this fallacy is indeed that it occurs despite having already been witnessed by people, who continue to repeat the same mistakes over time, ignoring their past experience and thinking that they are not vulnerable anymore to this cognitive bias. This directly relates to overconfidence in the form of overestimation of own abilities: it is factual that people tend to not learn from all their mistakes, but keep thinking that they are better than average, not influenced by cognitive biases, and assume they act rationally, which is the very first step to fall into cognitive biases traps.

A simple model of how planning fallacy works and interacts with people's projects is shown in the following picture:

[49] Buehler, R., Griffin, D., & Ross, M. (1984). Exploring the "planning fallacy": Why people underestimate their task completion times. *Journal of Personality and Social Psychology*, 366-381.

Figure 3[50]

Even if it is clearly a simple framework and it might appear trivial, this model explains that plans will never consider all possible problems. It might be illness, delays due to some collaborators or whatever accident, but unforeseen events always are behind the door, ready to put chaos in all plans, even when they seem accurately done.

3.4.2 Influencing factors

Why does planning fallacy occur? Which characteristics of human nature are responsible for this bias to come up?

(Nikolopoulou, What Is the Planning Fallacy? | Definition & Examples, 2023a) finds four influencing factors for planning fallacy:

1. *Optimism bias:* main characteristics of this bias have already been described. What matters here is the importance of optimism in future estimates: when we make plans, we are more likely to be excessively optimistic about our capabilities and thus about the resources we will need to accomplish our tasks.

[50] Nikolopoulou, K. (2023a, 08 11). *What Is the Planning Fallacy? | Definition & Examples*. Retrieved 10 24, 2023, from Scribbr: https://www.scribbr.com/fallacies/planning-fallacy/

2. *Self-serving bias:* tendency to attribute own failures to external causes and own successes to inner abilities. It comes when people evaluate their performances afterwards, unconsciously taking merits for good outcomes and rejecting responsibilities for bad ones, independently from what is real and what is not.

3. *"Inside view":* it means focusing only on the main tasks of the specific objective we want to achieve, forgetting about the context. This attention to details is contraposed to the "outside view", i.e., "seeing the big picture".

4. *Social pressure:* feeling that optimistic plans have a better impact on the environment in which people work because they are somehow signals of quality and might impress others. It might be also seen on the other side, i.e., lowering expectations might put the planner in a bad light.

(Buehler, Griffin, & Ross, 1984)[51] found other two factors, more or less related with the ones mentioned above. The first of the two is what they call the "planning mode". The planning mode is a sort of mental status in which people enter when they estimate measures related to a future event, which is exactly the case of entrepreneurs trying to understand how many resources they will need in their projects. This mode, related to the "inside view" presented beforehand, consists of a focus primarily on the future, forgetting about past experiences. In fact, it has been found that individuals tend to think only about future steps, organizing the work in tasks, estimating times (here it is where the overconfidence comes), costs, benefits, and so on. In doing so, they do not consider past experience as a good predictor of future needs, and even if they do recall times when actual resources were larger than predicted ones, they tend to attribute delays and errors to external causes and to convince themselves that next time will be different. In this excessive orientation to the future people fail in evaluating similarities between

[51] Buehler, R., Griffin, D., & Ross, M. (1984). Exploring the "planning fallacy": Why people underestimate their task completion times. *Journal of Personality and Social Psychology*, 366-381.

past and present facts and tend to see actual problems as “unique” and, as such, not comparable with past ones. This is particularly true for entrepreneurs who by nature always look at the future and are more easily susceptible to the self-serving bias, as pointed out by (Holt, 1992)[52].

The second point concerns uncertainty. According to them, the planning fallacy is much stronger when the plan involves a certain degree of unknown variables and novelty, which is typical of entrepreneurs’ activity. These two factors might influence the perception of “uniqueness” of the current problem to face, empowering the tendency to ignore past experiences.

3.4.3 Implications

As it might be clear, the planning fallacy has its consequences every time that one puts themself in the condition of making an estimate. It usually leads to delays and problems on the economic aspect.

As stated by (Baron, 1998)[53], entrepreneurs are more likely to be vulnerable to planning fallacy effects than other people, so entrepreneurial businesses should be very careful about these dynamics in order to avoid bad outcomes in their projects. Notice that, as already stated in chapter 3 in the “Impact on SMEs’ performance” paragraph, planning mistakes are at very base of most of the problems that small and medium enterprises have. This should sound as a warning to entrepreneurs who are making or will make decisions about the future of their business.

[52] Holt, D. H. (1992). *Entrepreneurship: new venture creation.* Englewood Cliffs, N.J. : Prentice Hall.

[53] Baron, R. A. (1998). Cognitive mechanisms in entrepreneurship: Why and when enterpreneurs think differently than other people. *Journal of Business Venturing*, 275-294.

Some space should also be given to another relevant point reported by (Buehler, Griffin, & Ross, 1984)[54]: when planning, people tend to underestimate completion times of their projects but to overestimate completion times of others' activities. This is, again, a symptom of overconfidence of the type "better than average" (or at least "than others").

Notice that entrepreneurs are indeed more likely to be biased than others, but an important note from (Baron, 1998) must be reported: this difference in the realization of cognitive biases between entrepreneurs and people in general is actually influenced by the types of activities the two categories are involved in. Entrepreneurs deal everyday with uncertainty and unexpected problems which come up out of the blue, potentially involving big troubles in their operative activities. Even if a certain degree of this variability is explained by personal traits, an important part of it lies in the fact that entrepreneurs deal most of the time with scenarios in which these cognitive errors are expected to be maximised.

3.4.4 How to measure the planning fallacy

As for every bias, measuring the planning fallacy is not an easy task. Given the nature of this bias, it can be tested in two ways:

- Directly: measuring the difference between predicted amounts of time, monetary resources, etc. and effective values (i.e., the definition of planning fallacy).

- Using questions aimed at assessing the influence of past experience on new planning processes.

[54] Buehler, R., Griffin, D., & Ross, M. (1984). Exploring the "planning fallacy": Why people underestimate their task completion times. *Journal of Personality and Social Psychology*, 366-381.

Both the approaches might be used in different shapes such as interviews or questionnaires, as in (Nuijten, Benschop, Rijsenbilt, & Wilmink, 2020)[55], or just with Likert scale questions as done by (Keh, Der Foo, & Lim, 2002)[56].

3.5 Status Quo Bias

3.5.1 Definition

It is now the moment to present the third and last character of this work: the status quo bias. As the name suggests, this bias has to do with the present, in contrast with the planning fallacy.

Status quo bias first appeared in 1988, when (Samuelson & Zeckhauser, 1988)[57] presented the results of their study. They defined it as the preference for maintaining the current situation (i.e., the status quo) with respect to changing towards new alternatives. The reason for this must be seek in human nature: people do not like change. Change means uncertainty, and uncertainty means danger. This is the simple reason why people act preferring the current situation - even if not perfect - to an uncertain one, which might be less convenient. In other words, it is a matter of safety. This is why status quo bias is also referred to as an "emotional bias".

Examples of this bias can be easily found in almost every aspect of our lives, both privately and at work. Very common ones are the restaurants where people go, the dishes they eat there or the brand of some objects they use in their daily life.

[55] Nuijten, A., Benschop, N., Rijsenbilt, A., & Wilmink, K. (2020). Cognitive Biases in Critical Decisions Facing SME Entrepreneurs: An External Accountants' Perspective. *Administrative Sciences, 10*, 89-112.

[56] Keh, H. T., Der Foo, M., & Lim, B. C. (2002). Opportunity Evaluation under Risky Conditions: The Cognitive Processes of Entrepreneurs. *Entrepreneurship Theory and Practice*, 125-148.

[57] Samuelson, W., & Zeckhauser, R. (1988). Status Quo Bias in Decision Making. *Journal of Risk and Uncertainty*, 7-59.

At the end of the day, status quo bias is the incarnation of the larger concept of "comfort zone". This mental zone is literally the area in which we feel safe and ready to act, just because it extends itself until the boundaries of our knowledge and information: if we stay inside this zone, we know what could happen and most of the times also how to react; if we go beyond its limits, we enter in the dark world of uncertainty where everything can happen and we might not have the right instruments to face problems.

3.5.2 Influencing factors

As said above, the status quo bias is an emotional bias. There might be many reasons leading to the systemic preference of the current situation (sometimes even correctly), but (Nikolopoulou, What Is Status Quo Bias? | Definition & Examples, 2023b)[58] finds the three main ones in:

- *Loss aversion*: the fear of losing is at the very basis not only of the prospect theory, as presented in chapter 2, but also of the general concept of risk aversion, directly related to the status quo bias.

- *Regret avoidance*: tendency of people to avoid the feeling of regret. Key here is the fact that individuals tend to suffer more for negative outcomes coming from new actions than ones which are results of inaction. This often leads people to prefer to not act, avoiding the possibility of making the "wrong choice".

- *Mere-exposure effect:* likelihood to prefer things or people which are familiar to us. It is directly linked with habits: the more one sees something or someone (i.e., the more she is *exposed* to it), the more she becomes familiar with it, developing a preference for the status quo.

[58]Nikolopoulou, K. (2023b, 03 10). *What Is Status Quo Bias? | Definition & Examples*. Retrieved 10 26, 2023, from Scribbr: https://www.scribbr.com/research-bias/status-quo-bias/#:~:text=Example%3A%20Status%20quo%20bias%20You,be%20on%20the%20safe%20side.

(Godefroid, Plattfaut, & Niehaves, 2022)[59] reported other concepts related to the status quo bias:

- *Default bias:* tendency to choose the scenario set as "default" when evaluating different opportunities.

- *Inertia:* influence of organizations' characteristics such as size, systems, or processes on resistance to change.

- *Sunk cost:* inability to consider sunk costs as not relevant in decision making, proceeding on a line even if it proved to be wrong, just to justify the past investment in terms of money, time, or effort.

- *Innovation resistance:* related to inertia, it is the tendency to refuse change in its technological form.

Additional influence might be found in transaction and switching costs, which might be extra barriers to see change as a valid alternative, especially in uncertain conditions.

3.5.3 Implications

Everything is status quo.

There is no way to escape it. Even a new choice becomes status quo in the moment it is taken. Problems come when the status quo is systematically chosen between alternatives, valid or not. If it is true that preferring the current situation might lead to missing some trains, it might also be the best choice when the actual scenario is the optimal one, or alternatives are not valid. The following paragraph reports some consequences of sticking with the present.

[59] Godefroid, M.-E., Plattfaut, R., & Niehaves, B. (2022, 08 01). How to measure the status quo bias? A review of current literature. *Management Review Quarterly*.

As pointed out by (Nikolopoulou, What Is Status Quo Bias? | Definition & Examples, 2023b)[60] re-apply models which worked in the past can offer a certain degree of certainty and protection towards risks, especially at a psychological level. This is even truer when the process is complex and the quantity of information high: keeping a used framework helps keeping calm and not feeling overloaded. Of course, this might be dangerous when the context has changed, and ancient models may not work as well as they did in the past. The point here is finding the right balance, or the risk of being late with respect to current times would become concrete. Examples can be found in many companies which did not see the future coming and decided to stick with old models of their products or did not invest sufficiently in new technologies, such as Kodak did with digital cameras. Choosing the status quo means to close the doors to the future, keeping a bad attitude towards change and innovation.

This is one of the most important things when referring to entrepreneurs. Italian SMEs are typically involved in this type of mistake, since their models, practices, and horizons are usually old and limited. How can a business prosper if it is based on obsolete operational models? How can it be competitive if its competitors are always one step forward in the technologies they use? The answer is immediate: it cannot. This is one of the main reasons SMEs, as already treated in chapter 2, do not perform as well as they could. Notice that agriculture, because of its structure in Italy (it is composed mainly by micro sized enterprises) and some characteristics of agricultural entrepreneurs, is notably one of the most "innovation-averse" sectors in the economy.

[60] Nikolopoulou, K. (2023b, 03 10). *What Is Status Quo Bias? | Definition & Examples*. Retrieved 10 26, 2023, from Scribbr: https://www.scribbr.com/research-bias/status-quo-bias/#:~:text=Example%3A%20Status%20quo%20bias%20You,be%20on%20the%20safe%20side.

On the other hand, it must be reported that according to (Burmeister & Schade, 2007)[61] entrepreneurs (in general) are not as biased as one might believe. The evidence is that, generally speaking, they tend to be as biased as students and less than bankers, even if this is not an absolute truth and differences have been found across domains of experimentation.

For what concerns entrepreneurs, however, a key factor is experience. In fact, it has two effects on how they fall into the status quo bias. On one side it gives knowledge and expertise, hence credibility, on the other side, this knowledge might become a trap, leading to a view over the world too influenced by past experiences, thus leading to a biased view over the status quo.

3.5.4 How to measure Status Quo Bias

For the status quo bias, there are again two usual ways used in experiments:

- Likert scale questions
- Decisions problems

For the former, everything said for overconfidence and planning fallacy continues to be true. The latter is presented in (Samuelson & Zeckhauser, 1988)[62], where they asked respondents to answer some decision problems. These consisted of choosing between a fixed number of alternatives, each corresponding to a different scenario. Two approaches were used to frame the possible answers: a first one, the "neutral framing" in which all alternatives were presented in the same manner, without any label, and the "status quo framing", in which one of the options was pointed as the "default" one.

[61] Burmeister, K., & Schade, C. (2007). Are entrepreneurs' decisions more biased? An experimental investigation of the susceptibility to status quo bias. *Journal of Business Venturing*, 340-362.

[62] Samuelson, W., & Zeckhauser, R. (1988). Status Quo Bias in Decision Making. *Journal of Risk and Uncertainty*, 7-59.

For a clearer comprehension, an example of question from (Samuelson & Zeckhauser, 1988) is reported below:

2. You are a serious reader of the financial pages but until recently have had few funds to invest. That is when you inherited a large sum of money from your great uncle. You are considering different portfolios. Your choices are:

___ a) Invest in moderate-risk Co. A. Over a year's time, the stock has .5 chance of increasing 30% in value, a .2 chance of being unchanged, and a .3 chance of declining 20% in value.

___ b) Invest in high-risk Co. B. Over a year's time, the stock has a .4 chance of doubling in value, a .3 chance of being unchanged, and a .3 chance of declining 40% in value.

___ c) Invest in treasury bills. Over a year's time, these will yield a nearly certain return of 9%.

___ d) Invest in municipal bonds. Over a year's time, they will yield a tax-free return of 6%.

Figure 4: decision problem with neutral framing

___ a) Retain the investment in moderate-risk Company A. Over a year's time, the stock has a .5 chance of increasing 30% in value, a .2 chance of being unchanged, and a .3 chance of declining 20% in value.
___ b) Invest in high-risk Company B. Over a year's time, the stock has a .4 chance of doubling in value, a .3 chance of being unchanged, and a .3 chance of declining 40% in value.
___ c) Invest in treasury bills. Over a year's time, they will yield a nearly certain return of 9%.
___ d) Invest in municipal bonds. Over a year's time, these will yield a tax-free rate of return of 6%.

Figure 5: decision problem with status quo framing

The measure of the status quo bias lies in how respondents prefer the pre-selected option, when indicated. Evidence proved that the default option was generally preferred.

4. Questionnaire

At this stage, a general perspective of what is behavioural economics, how it works and how it influences entrepreneurs' behaviours – hence their business' performance – has been summarized.

All main biases have been presented, each with its peculiarities and its dangers. Among these, three biases have been selected to be further analysed in the specific domain of agriculture: overconfidence, planning fallacy and status quo bias, which constitute the specific focus of this thesis. Now, it is the moment to introduce the experimental aspect of this work.

While treating the different ways of how research can develop it has been said that it could dive deep into details of single cognitive biases referring to people as a general category, or it can explore different groups of individuals and investigate possible differences in which biases affect each group, with which intensity, and make comparisons between them. This work finds its roots in this last idea, and more precisely: analyse how a specific category relates with psychological mechanisms of behavioural economics. After an assessment of different possible categories to analyse, such as students, startup founders, C-level executives etc., the final decision has been made appointing farmers as the target group. Why farmers? For two very simple reasons: (1) the author's background and (2) the belonging of farmers to the wider category of entrepreneurs, a well-known and studied group in behavioural economics and finance.

Coming from the agricultural context gave the author a deep knowledge and comprehension of the agricultural sector, its problems and people. This has been key in the process of creating the questionnaire to be administered to fruit growers. Given the specific knowledge about fruit growers habits and way of thinking, the research has been built around this specific subgroup of the wider category of agricultural entrepreneurs.

This belonging of farmers – and fruit growers, specifically – to the more general one of "entrepreneurs" leaves the possibility to make a direct comparison between the two. Are fruit growers more or less biased than entrepreneurs in general, at least according to the comprehension of entrepreneurs by academic literature? This is one of the questions that this work aims to answer.

To do so, a benchmark of entrepreneurs' behaviours is needed. Fortunately, researchers did this job. As presented in chapter 3, (Nuijten, Benschop, Rijsenbilt, & Wilmink, 2020)[63] analysed twelve cognitive biases involved in five decision domains typically faced by SMEs' entrepreneurs, that are: Strategy, Regulatory compliance, Human Resources, Information Technology, Succession planning. Strategic decision domain was selected, both because of its relative importance with respect to the other four domains (it resulted to be the most biased domain) and the original idea of the thesis itself. Please notice that since the two studies developed in different manners, the comparison can only be done at a qualitative level.

For simplicity's sake, only three of the twelve biases analysed have been selected for this work. This decision has been made upon the relative importance of biases within the strategic decision domain, in which overconfidence, planning fallacy and status quo bias ranked in the first four positions (see chapter 3 for further details).

After having explained the reasons behind the choice of the biases, they have been accurately discussed explaining their peculiarities, including how to measure them. Next session will expand this argument and explain the choices that back every question of the final questionnaire, their shape, and their framing.

[63] Nuijten, A., Benschop, N., Rijsenbilt, A., & Wilmink, K. (2020). Cognitive Biases in Critical Decisions Facing SME Entrepreneurs: An External Accountants' Perspective. *Administrative Sciences, 10*, 89-112.

The first step to consider is the result that the research aims to achieve. As said, this work found great inspiration in the study of (Nuijten, Benschop, Rijsenbilt, & Wilmink, 2020), and uses it as a benchmark. To be able to do a comparison, the same score form needed to be used. As in their research they calculated the score on a 1-5 basis, this was the starting point in the creation process of this questionnaire. Their approach was based on interviews and questionnaires, in which the Likert scale (already presented in chapter *3.1 - Cognitive biases and Entrepreneurs*) has been used to assess the intensity of each bias in each domain. With this structure, they were able to have a unique spectrum of values for each bias.

This questionnaire has been built around the same concept of 5-points Likert scale, enabling to have a direct comparison between this study's results and Nuijten's.

4.1 General structure

Before explaining the process behind each question, it is important to know the general structure of the survey. This will give a clearer view when single sections will be presented.

The questionnaire includes three sections:

1. Demographic data
2. Valuations
3. Multiple choice questions

In the first section, general data about the sample is collected.

In the second section, respondents are asked to answer 15 Likert scale questions, in which they must evaluate their degree of agreement with the proposed statement, referring to their past experience or future expectations.

Finally, multiple choice questions are asked to assess fruit growers' confidence in their general knowledge on agricultural topics.

More details will be presented in the following paragraphs.

4.2 Demographic questions

The questionnaire opens with a brief part collecting demographic data about the sample. Here, four questions have been asked as follows:

Age:

- 18 – 25
- 26 – 35
- 36 – 50
- 51 – 60
- 61+

Gender:

- Male
- Female
- Other

Education:

- Middle School
- High School Diploma
- University Degree
- Other: _____

Business size (surface):

- < 15 hectares (*small business, mainly family)*
- 15 – 40 hectares *(medium business)*
- 40 – 80 hectares *(large business)*
- > 80 hectares *(very large business)*

These basic data allow to have a general knowledge of the sample and understand its characteristics. All these variables can be used to explore differences between subcategories. Age, gender, education and business size can have a significant impact on how entrepreneurs manage their business and on how they are affected

by cognitive biases in their decision-making processes. To keep the identity of respondents hidden, no personal information has been required. Suggested answers have been displayed in categories in line with this anonymity principle.

4.3 Overconfidence questions

Let us now move to the core of the questionnaire: the measurement of cognitive biases. Within the 15 questions in Likert scale form of the second section aiming to measure the three selected biases, only three focus on overconfidence. To understand this choice, a step back is needed.

As presented in the "How to measure overconfidence" in chapter 3.3.4, overconfidence can be measured in different ways. This study mainly refers to the miscalibration aspect of overconfidence and, as such, gives a lot of importance to the measurement through confidence estimation and its relationship to correctness of given answers. This is indeed what is investigated in the last section of the questionnaire.

In the first part, however, some space has been given to three Likert-shaped questions. The reason for this peculiarity can be found in the willingness to have a larger comprehension of the overconfidence bias. In fact, these three questions measure some aspects other than miscalibration.

The first, reported below, evaluates fruit growers' expectations for the future. In other words, it looks at the optimism aspect of overconfidence.

1. ***In recent years, the agricultural sector has faced evident challenges that require a certain skill to be successfully addressed. How do you think you are "ready" to face them and adapt to future changes?***

0 0 0 0 0

Not at all Completely

In framing this question, particular emphasis has been placed on the word "ready". This had the objective to put the attention of the respondent on his capabilities,

and not only on future events outside of his control. This aspect is empowered using the word "skill" in the first sentence, assuming that fortune is not sufficient to face future problems. This is an alternative version of a question from the LOT-R test developed by (Scheier, Carver, & Bridges, 1994)[64], testing the optimism about future in general.

The second and third questions relate to the "better than average" effect, with a slight change. Instead of measuring farmers overconfidence with respect to "the average" of their sector, much emphasis has been placed on the comparison with technicians who support them in operational decisions, such as when to use plant protection products or when to start harvesting. There are two reasons behind this choice: firstly, the "better than average" typical questions (such as the driver one) refer to aspects of daily life in which the emotional side is not that strong. In other words, when asked whether they are better drivers or better entrepreneurs than average people may react in different ways: to admit to being a bad driver does not influence very much one's image, but what happens to a person if she admits to being an entrepreneur worse than average? The emotional answer is completely different. Since answers given by respondents are subjective, one should build questions taking care of these cognitive processes.

Secondly, in the agricultural sector, especially when it comes to small businesses, it is not uncommon to hear farmers disagree with experts. This phenomenon finds its roots in the different approach and experience the two groups have. On one side there are farmers with their practical expertise and on the other technical experts with their "theoretical knowledge", which does not always apply to reality, according to some fruit growers. The two questions below aim to evaluate this aspect.

[64] Scheier, M. F., Carver, C. S., & Bridges, M. W. (1994). Distinguishing optimism from neuroticism (and trait anxiety, self-mastery, and self-esteem): A reevaluation of the Life Orientation Test. *Journal of Personality and Social Psychology*, 1063-1078.

2. How often do you go against the advice of technicians because you find their instructions incomplete or too theoretical and not practical enough?

0 0 0 0 0

Almost never Very often

3. In general, who tends to be more accurate in assessing the actions to be taken for achieving a good production?

0 0 0 0 0

Farmers Technicians

To not interrupt the section made of questions in the Likert scale form, miscalibration questions have been put at the end of the questionnaire. This has been done based on the assumption that continuity makes a questionnaire easier to compile, thus reducing the risk of having people leaving the survey before having completed it.

In the final version, six questions are asked. Coming to their final form has been a challenging process, for many reasons: theme, shape, difficulty of each of them were crucial parameters in determining the significance of the measurement and should be thought accurately. To do so, a pilot test has been conducted. Details are provided in the following paragraph.

4.3.1 Pilot test

Pilot tests are small-size replicas of a true experiment. They are usually conducted to understand whether there are any problems in the structure of such research. In this case the pilot test has been done to value the validity of the first version of miscalibration questions, to understand whether the form, the themes and the difficulty of each question was in line with the objectives of the thesis.

A validation of these three parameters was in fact fundamental to arrive at a final version of the questionnaire. The importance of it lies in the fact that surveys

always face problems in the administration phase: reaching respondents is not an easy job, obtaining their answers is even more difficult. In other words, surveys have only one shot, and it must go well.

The first parameter, the form, finds its importance in the understanding of respondents about what they must do. “Confidence level” is a concept which people might not be confident with. Before administering the questionnaire to a large sample, one should be sure that respondents will understand this concept and will not give wrong answers.

When they want to measure miscalibration in a group of people, researchers usually make use of general knowledge questions. General themes, for their “not specific” nature, should give the same opportunity to answer correctly to almost everybody. They are, in this sense, inclusive. However, particular attention should be paid in the choice of themes. In fact, this aspect is fairly closed to the “difficulty” one since beyond the difficulty intrinsic in a question (and its answers) some themes might be easier or not depending on the characteristics of the sample. For example, think about questions related to history. Students would have a significant competitive advantage in answering such a survey with respect to people who have never studied these topics or have done it tens of years ago. If not properly done, one could confuse miscalibration with problems of cultural nature.

To solve this problem, questions have been based on the major theme related to the working activity of fruit growers, i.e., agriculture. If it might be true that, in general, farmers do not reflect the slice of population with most significant academic path, they should probably know facts around the industry they work in.

Last but not least, the difficulty. Difficulty of a question is related to both theme and suggested answers. If themes are responsible for what people might know or not, suggested answers are the ones making a question hard or not. A simple example might be found in a theme people have a general level of knowledge: if asked to state how many people died in World War II, one could expect that

nobody would answer with a number of the order of magnitude of thousands. In case of three suggested answers like the following ones:

a) 670.000

b) 1.000.000

c) 68.000.000

almost everybody would think about the last one, since the previous ones would be just too small to be real.

Now look at this second version:

a) 57.000.000

b) 68.000.000

c) 73.000.000

Changing suggestions and giving possible answers closer to the real value would definitely change the intrinsic difficulty of the question, for which people might have a general level of knowledge but not deep enough to clearly distinguish between similar values.

Keeping this in mind, a first version of the miscalibration questions have been written:

1. **What is the most cultivated fruit in Italy?**

   Peach | Pear | **Apple**

2. **How many varieties of apples are known in the world?**

   7.500 approx. | 9.000 approx. | 4.200 approx.

3. **What was the total production of apples in quintals in Piedmont in 2022?**

   22.562.421 | 10.736.135 | 37.046.890

4. **What was the percentage of the Italian GDP generated by the entire agri-food system in 2019?**

   7% | **15%** | 19%

5. **Which of these is the most important producer of apples in the world?**

   USA | Turkey | **China**

6. **What position does Italy hold in the ranking of the world's largest apple-producing countries?**

   6 | 3 | 9

7. **What was the employment rate in the agricultural sector in Italy in 2021?**

   3.4% | 9.8% | **4.1%**

As it can be seen, some attention has been given also to the placement of correct answers, avoiding too many repetitions which might unconsciously influence respondents' behaviour by making them think about the frequency of a specific answer.

For each question, respondents' confidence level was asked as follows:

How confident are you that your answer is correct? (33% - 100%)

Please notice that the meaning of "confidence level" and some instructions about what values could be given as an answer (33% if guessed, 100% if sure and something in between in other cases) were given in the introduction of the multiple-choice questions section, and in the interval proposed as mentioned above was just a brief reminder of what to answer.

The pilot test has been administered to a sample of 9 people. As the aim of this test was not to be statistically significant but just to understand whether there were huge mistakes in the formulation of questions or not, this number has been thought to be sufficient. Answers came from all types of categories in terms of

age, business size (measured with surface, in hectares), and educational degree. Unfortunately, no women were present at this stage. Overall, the significance of this sample relative to the objective can be assumed since no big differences are expected to be found in the level of difficulty in the answers or in the ability to correctly understand the questions with respect to gender.

The process of validation has been based on (Michailova, 2010)[65]. To determine which questions should be put in the final version of their survey, they computed the percentage of errors for each question and ranked questions for difficulty level with the criteria in table 5:

% error range	Difficulty level
0% - 33%	Easy
34% - 66%	Medium
67% - 100%	Difficult

Table 5

Starting from 50 questions, they selected 18 questions to build the final survey. To have a balanced questionnaire and eliminate the hard-easy effect, they chose to allocate equal space to every category, putting the constraint to have 6 questions for each difficulty level. In this thesis, this approach has been followed making some light adjustments to better adapt it to the specific case.

First of all, the sample and the control that researchers had over the sample were quite different. In their research, in fact, (Michailova, 2010) dealt with students,

[65] Michailova, J. (2010, 11 06). *Development of the overconfidence measurement instrument for the economic experiment.* Retrieved 10 17, 2023, from Munich Personal RePEc Archive: https://mpra.ub.uni-muenchen.de/26384/

which means having a high number of available people, all together, all able to dedicate some time to the questionnaire. This was not the case of this thesis, for which the sample was made of entrepreneurs who generally do not have time for this kind of things and cannot be found all at the same time at the same place. As such, the size of the sample has been reduced as well as the length of the questionnaire itself.

Secondly, given the reduced number of questions and respondents, also confidence level of answers - able to give some useful insights - have been considered. In fact, different combinations of correct answers and average confidence could reveal some useful insights about whether questions were answered using knowledge or by chance.

Results of the pilot test are reported below:

08/10/2023 19.03.49	Mela	100%	4200 circa	70%	22.562.421	70%	7%	50%	Cina	100%	6	70%	4.1%	70%
09/10/2023 20.01.15	Mela	100%	7500 circa	75%	37.046.890	75%	19%	100%	Cina	60%	9	70%	3.4%	65%
09/10/2023 20.05.02	Mela	100%	4200 circa	50%	10.736.135	100%	15%	50%	USA	50%	3	100%	3.4%	50%
09/10/2023 20.50.54	Mela	70%	4200 circa	60%	22.562.421	50%	15%	33%	Cina	100%	6	50%	4.1%	33%
09/10/2023 20.52.59	Mela	100%	4200 circa	50%	10.736.135	33%	7%	33%	Cina	100%	6	79%	3.4%	33%
09/10/2023 21.51.31	Mela	100%	7500 circa	33%	22.562.421	33%	15%	33%	Cina	100%	6	100%	4.1%	33%
10/10/2023 19.53.29	Mela	100%	4200 circa	33%	22.562.421	33%	15%	33%	Cina	100%	6	100%	4.1%	33%
10/10/2023 20.37.32	Mela	100%	7500 circa	70%	22.562.421	50%	15%	80%	Cina	100%	6	80%	4.1%	70%
11/10/2023 19.45.21	Mela	100%	7500 circa	33%	22.562.421	33%	15%	100%	USA	100%	3	100%	9.8%	33%
Errors	0		5		3		3		2		3		4	
Percentage error	0,00%		55,56%		33,33%		33,33%		22,22%		33,33%		44,44%	
Avarage confidence		97%		53%		53%		57%		90%		83%		47%
Difficulty	easy		medium		medium		medium		easy		medium		medium	

Table 6[66]

Among the seven questions, the first one resulted to be the easiest one, with a percentage error of 0%. This is an indication that the question was too easy. The 5th question, asking for the largest producer of apples in the world, also scored in the "easy" category. All the others resulted in the "medium" category of difficulty. As done by (Michailova, 2010), some adjustments have been made to reach a balanced composition:

[66] The questionnaire has been administered in Italian language.

- Question 1 has been eliminated because too easy.

- Question 2 has been moved to the “hard” category as the one with the largest number of errors.

- Question 6 has been reclassified as “easy” because of its confidence level: among the “medium” questions with the lowest percentage error (3,4, and 6, all with 33%) it was the one with the highest confidence, meaning that respondents were surer about their answers, while in the others they guessed more.

- Question 7 has been moved to the “hard” category as it got the second highest percentage error and a lower confidence than the other “medium” ones, signal of difficulty. A slight change has been made in the suggested answers, changing the value of 9.8% with 7.5%, closer to the correct answer of 4.1% to increase the hardness of the question.

Adjustments are resumed in the last row of the table 7:

08/10/2023 19.03.49	Mela	100%	4200 circa	70%	22.562.421	70%	7%	50%	Cina	100%	6	70%	4.1%	70%
09/10/2023 20.01.15	Mela	100%	7500 circa	75%	37.046.890	75%	19%	100%	Cina	60%	9	70%	3.4%	65%
09/10/2023 20.05.02	Mela	100%	4200 circa	50%	10.736.135	100%	15%	50%	USA	50%	3	100%	3.4%	50%
09/10/2023 20.50.54	Mela	70%	4200 circa	60%	22.562.421	50%	15%	33%	Cina	100%	6	50%	4.1%	33%
09/10/2023 20.52.59	Mela	100%	4200 circa	50%	10.736.135	33%	7%	33%	Cina	100%	6	79%	3.4%	33%
09/10/2023 21.51.31	Mela	100%	7500 circa	33%	22.562.421	33%	15%	33%	Cina	100%	6	100%	4.1%	33%
10/10/2023 19.53.29	Mela	100%	4200 circa	33%	22.562.421	33%	15%	33%	Cina	100%	6	100%	4.1%	33%
10/10/2023 20.37.32	Mela	100%	7500 circa	70%	22.562.421	50%	15%	80%	Cina	100%	6	80%	4.1%	70%
11/10/2023 19.45.21	Mela	100%	7500 circa	33%	22.562.421	33%	15%	100%	USA	100%	3	100%	9.8%	33%
Errors	0		5		3		3		2		3		4	
Percentage error	0,00%		55,56%		33,33%		33,33%		22,22%		33,33%		44,44%	
Avarage confidence		97%		53%		53%		57%		90%		83%		47%
Difficulty	easy		medium		medium		medium		easy		medium		medium	
Difficulty (adj.)	**extremely easy**		**hard**		**medium**		**medium**		**easy**		**easy**		**hard**	

Table 7

The final version of the questionnaire is reported below.

1. **How many varieties of apples are known in the world?**

   7.500 approx. | 9.000 approx. | 4.200 approx.

2. **What was the total production of apples in quintals in Piedmont in 2022?**

   22.562.421 | 10.736.135 | 37.046.890

3. **What was the percentage of the Italian GDP generated by the entire agri-food system in 2019?**

   7% | **15%** | 19%

4. **Which of these is the most important producer of apples in the world?**

   USA | Turkey | China

5. **What position does Italy hold in the ranking of the world's largest apple-producing countries?**

   3 | **6** | 9

6. **What was the employment rate in the agricultural sector in Italy in 2021?**

   3.4% | 7.5% | **4.1%**

4.3.2 Bias score recalibration

As one could have noticed, this two-way system to measure overconfidence would cause some confusion in the computation of the final score. In fact, Likert scale questions lead to scores from 1 to 5. On the other side, the system used to measure miscalibration leads to a different score. Miscalibration is indeed measured as:

bias score = average % confidence - % correct answers

As such, the resulting score would be a value between -0.67 and 1[67], where negative values stand for "negative bias" (in this case, under-confidence), 0 for neutrality and positive values highlight the presence of the investigated bias. Of course, the bigger the score, the higher the influence of the bias. To be able to compare and aggregate results, a recalibration of the score needs to be done.

The objective of the recalibration process is to "translate" values from the interval [-0.67,1] to the interval [1,5]. To do so, two steps are needed:

1. Shift to positive values.

2. Normalization to Likert scale values.

The first step implies to add a number greater than 0.67 to every bias score. This number has been decided to be 1 (e.g.: -0.67 becomes: -0.67 + 1 = 0.33).

The second step involves a normalization to translate values from the new interval to the final one. It is crucial to remember that the original interval is not symmetric: the negative region goes from -0.67 to 0 whereas the positive one contains values from 0 to 1. In translated terms, the interval can be split into the two regions [0.33, 1) and (1,2], with 1 as a limit number between the "negative" and "positive" zones. Since the final interval [1,5] is symmetric with respect to the central value of 3, two normalizations are needed. The final value of the overconfidence bias is then computed as the average between the scores in Likert scale questions and miscalibration.

4.4 Planning fallacy questions

Planning fallacy questions have been built around the definition of the bias itself and its related effects. Likert scale has been used to keep consistency between scores.

[67] Average % confidence cannot be below 33%, i.e., when all answers have been guessed.

Specifically, among the six questions, the first four refer directly to the definition of planning fallacy, i.e., the wrong estimation of resources needs or outcomes. Here execution times, costs, revenues and manpower needs were tested (manpower is highly variable in fruit harvesting activities). The same structure has been kept for each question to make this part easier to compile and not create misunderstandings. Questions are reported below:

1. **In past investments, how have the actual <u>times</u> varied compared to the estimated ones? (central response: actual time = estimated time)**

0	0	0	0	0
significantly shorter times				significantly longer times

2. **In past investments, how have the actual <u>costs</u> varied compared to the estimated ones? (central response: actual costs = estimated costs)**

0	0	0	0	0
significantly lower costs				significantly higher costs

3. **In past investments, how have the actual <u>revenues</u> varied compared to the estimated ones? (central response: actual revenues = estimated revenues)**

0	0	0	0	0
significantly lower revenues				significantly higher revenues

4. **Generally, do you find yourself with more or less manpower than necessary for the smooth execution of tasks?**

0	0	0	0	0
Less than				More than

necessary necessary

The 5th question has been built on a "higher" level. Since the planning fallacy leads to shortcomings, some problems usually arise. The objective now is to assess how strong these problems are. To be able to do so, it has been decided to frame the question using the general word "problems", leaving space to respondents' definition of those. This has been done because of the difficulty and risk attached to give a definition that could have been not right for every entrepreneur.

5. **During the project execution phase, do you tend to encounter more or fewer problems than those you had anticipated during the planning phase?**

0 0 0 0 0

Less problems More problems

The final question aims to measure the last characteristic of planning fallacy: the tendency to not consider past experience and evaluate every situation as a unicum. Key is the framing of the answers, giving a clear definition of what the question wants to assess and guiding respondents in their answers.

6. **How much do you tend to consider your past experience when evaluating a new investment?**

0 0 0 0 0

Not much,
every investment
is unique

A lot,
every investment
is comparable to others

4.5 Status Quo bias questions

Even though decision problems are surely a fascinating instrument to measure this bias, some problems could have arisen. In fact, not only is this measurement not on a 1 to 5 scale, but it does not detect the presence of the opposite bias. If it is easy to assess whether the *default option* is preferred over the alternatives, it is

not easy to assess if respondents are more or less likely to embrace change. As such, the Likert scale form resulted to be the best alternative.

Another problem lied in the questionnaire's simplicity and length. These were, in fact, two relevant constraints given the sample characteristics. Keeping a constant and linear structure was key to assure these qualities. Again, Likert scale perfectly fitted in these tasks.

All questions have been built around the influencing factors described in chapter 3, while keeping in mind in which ways change and innovation could influence fruit growers' activity. Some of them are more technical and some others more general, somehow related to wider themes. The six questions are reported below:

1. **Imagine you have the opportunity to plant a new orchard from scratch. How willing are you to choose a crop that you have never cultivated compared to one of the crops already present on your farm?**

   0 0 0 0 0

   Not willing at all — Completely willing

The first question aims to measure farmers' openness to new products and the influence of inertia and loss aversion in their valuations (both linked to the uncertainty of the depicted situation). Orchards are investments that might last 20-25 years, or even more for some crops. As such, fruit growers feel safer in cultivating crops they already know, because they know what to expect and how to get something from their efforts. Unfortunately, the market moves, and sometimes new horizons must be explored, even when it is scary.

2. **In recent years, there has been increasing talk about Agriculture 4.0 and the digitization of agriculture. What are your thoughts on this?**

   0 0 0 0 0

   Not convinced at all — It is the future of agriculture

Question 2 brings in technology, digitalization, and automation. It investigates the theme of innovation resistance. It is an open question asking for a feeling about something that is thought to be the future of sustainable and efficient agriculture.

3. **Imagine being offered the use of a new innovative machine for automated plant pruning. Even before seeing it in action, what would you expect?**

0 0 0 0 0

An acceptable job — A very poor job

Question 3 continues on the wave of innovation, this time referring to a specific application. Plant pruning is a key activity in the business of fruit growing. It puts the basis for the year's production and usually takes a significant amount of time to be completed. Automatise this task would be a big step for agriculture.

4. **In terms of irrigation, do you prefer 'drip' or 'surface' irrigation?**

0 0 0 0 0

Drip — Surface

"Drip" and "surface" irrigation are two ways to hydrate plants. The former consists in releasing water directly on the tree roots, making use of a system of pipes aligned with the line of plants, one for each line, and valves able to release water drops directly on the roots. It can be automated and regulated to have the right quantity of water per unit of time, giving extreme control on irrigation to the entrepreneur, making a more intelligent use of water resources, avoiding wastes, and saving useful time. The latter is the method coming from the past, simply consisting in flooding all the orchard with current water, starting from the higher part of the field and using the effect of gravity to move the water down to reach all parts of the orchard. Water needs are extremely higher, it cannot be automated, and it needs someone supervising the process.

This question lies on the inertia factor of the status quo bias: advantages of drip irrigation are strongly larger than ones of its competitor and denying them is a strong signal of innovation resistance and inertia.

5. **Imagine being offered to cultivate a new variety described as promising in several key aspects (colour, size, resistance, etc.), but nobody in your area cultivates it yet. How willing would you be to <u>consider</u> the offer?**

0 0 0 0 0

Not at all Completely

The 5th question recalls the 1st one. In this case, however, the degree of uncertainty is higher since the proposed crop is not spread locally. It asks to evaluate risks but also opportunities about something new that seems to be remunerating. Loss aversion and inertia have a role here.

6. **Which tools do you primarily use in managing your activities?**

0 0 0 0 0

Digital
(Excel, Google calendar, …)

Analogic
(paper, pen, agenda, …)

The final question refers to operational activities. It does not evaluate feelings or sensations but looks at daily used instruments, trying to understand the degree of digitalization of entrepreneurs' businesses, hence their openness to new instruments and change. Again, inertia and innovation resistance are challenged.

5. Empirical analysis

5.1 Demographic data

Let us start with giving information about the sample. After about one month of administration with the help of two Organizations of Producers in Piedmont, a total of 108 entrepreneurs answered the questionnaire.

Considering a total population of around 8000 fruit-growing businesses in Piedmont[68], this number translates in a level of confidence of 95% and a percentage margin of error of 9.4%, beyond the initial target of 90% and 10%.

Data about gender are resumed in figure 6:

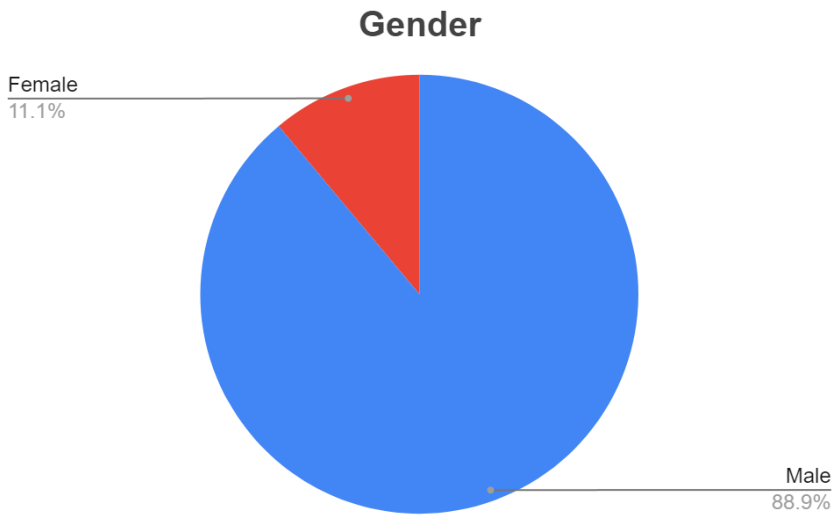


Figure 6

This numbers might appear strongly unbalanced but this is not completely the case. Agriculture is known to be one of those sectors run predominantly by men, thus this 11.1% of female is actually unexpectedly high.

[68] Source: *Coldiretti*, https://torino.coldiretti.it/news/i-frutticoltori-piemontesi-sono-sottopagati/

The distribution of age is characterised by a strong prevalence of adults with respect to young entrepreneurs. It is important to notice that almost half of the respondents are older than 50 years old. This supports the fact that agriculture not only is a business with prevalence of men, but also predominantly made of "aged" people. In fact, it is becoming harder and harder to see young people interested in agriculture. However, the distribution reminds a gaussian curve, which is what one could expect from a metric like age.

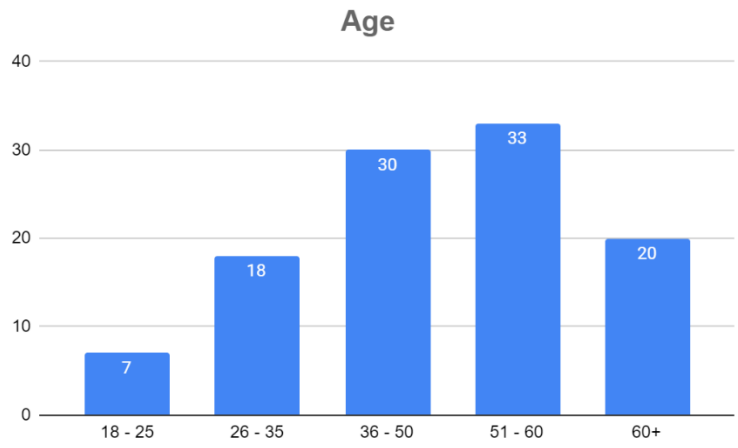


Figure 7

A still respectful part of the sample is made of people in the ranges of 26 – 35 and 36 – 50, which might be considered – especially the second group – as entrepreneurs with significant experience but still with the energy necessary to embrace change and innovation.

Education level is shown in figure 8:

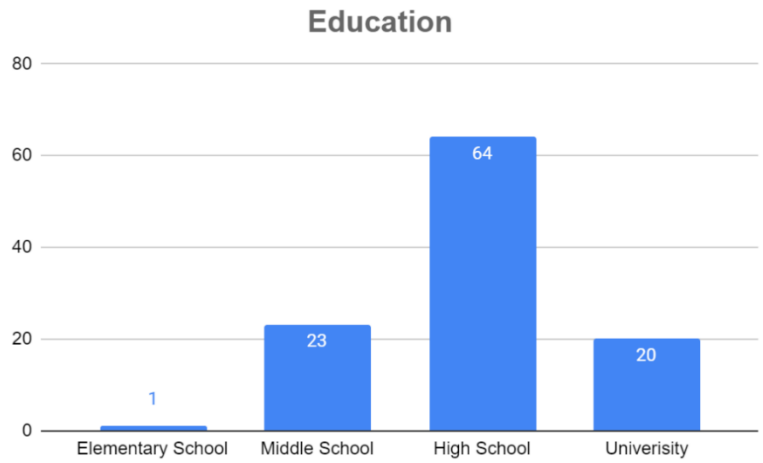


Figure 8

Most of the respondents received a high school diploma (around 60%), while the rest is evenly split between university graduates and ones who left school at 13. While the number of high school graduates is not unexpected, the number of respondents who attended university is significantly elevated. Only one respondent stopped his studies at the elementary school.

The last demographic variable is the business size, measured by its surface area and represented in figure 9. Here, about half of the businesses have a surface area between 15 and 40 hectares, which might be seen as a medium size. 31.5% of businesses have an extension of less than 15 hectares, relatable to an activity manageable almost entirely by family members; 13% of businesses fall in the range between 40 and 80 hectares (large businesses) and the remaining 6.5% extends on a surface of more than 80 hectares, classified here as “very large business”.

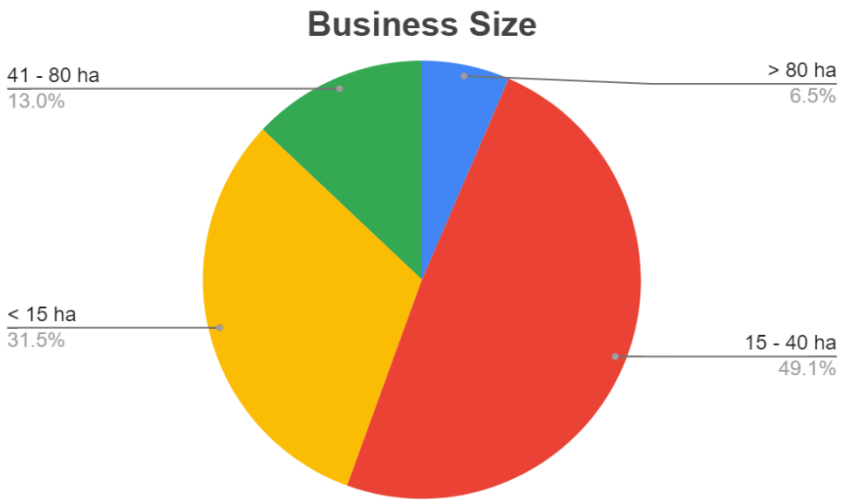


Figure 9

5.2 Descriptive Statistics

5.2.1 General results

In this section will be presented some descriptive statistics about the relationship between the sample characteristics and the three investigated biases, measured with a score in the continuous interval [1,5]. Statistical significance will be analysed later. Please notice that in this discussion, the unique observation concerning "Elementary School" will not be considered when referring to themes related to education, as it could mispresent the reality and easily deviate one's judgment.

Let us start with sharing the final scores and some metrics about them. Table 8 represents the minimum, maximum, mean and variance values for each of the three investigated biases:

Bias	Min	Max	Mean	Var	C.V.
Overconfidence	*2.16*	*3.98*	*3.10*	*0.17*	*0.13*
Planning Fallacy	*2.17*	*4.67*	*3.57*	*0.22*	*0.13*
Status Quo Bias	*1.00*	*4.33*	*2.55*	*0.46*	*0.27*

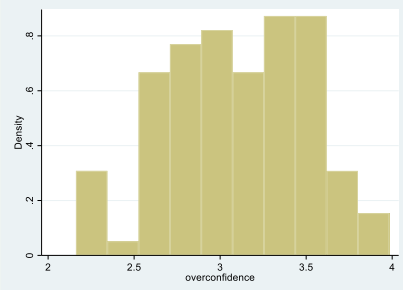
Table 8

As clear in the table, the status quo bias is the one witnessing the highest level of variability between the three. It is indeed the one with the lowest score (1.00, i.e., all answers equal to 1) and the second highest score (4.33), with a range extremely wide. This translates into the highest coefficient of variability, 0.27. Referring to a scale considering:

- Low variability: CV < 0.75
- Medium variability: 0.75 < CV < 1.33
- High variability: CV > 1.33

all the biases resulted in the class of "low variability", meaning that, despite some outliers, results do not vary that much.

Graphic representations of overconfidence, planning fallacy and status quo bias are reported below:

Variable	Histogram	Note
Overconfidence		Distribution approximately normal, centred around the mean value.

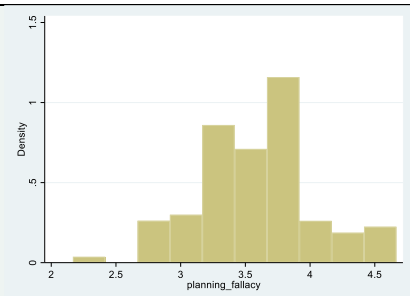
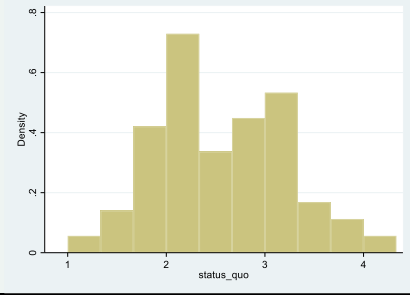
Planning fallacy		Nearly normal, a little shifted on the right, on the mean.
Status quo		Symmetric distribution with two peaks. It seems as there is a distinction on entrepreneurs open to change and others who are not.

Table 9

Let us now explore the single biases. While the overall overconfidence bias score resulted in a score of 3.10, it may be useful to dive in the data, represent the bias score with respect to demographic variables and split the overconfidence figure into its components. This process shows a first and gross analysis of the scores, able to make one recognizing big trends and differences across categories.

A first distinction should be made with respect to how the bias score is computed. In this study, the final overconfidence score is made of two components: a first one coming from the first three Likert scale questions (measuring fruit growers' feeling about the future, their "readiness" to face it, and the "better than average" effect, with respect to technicians instead of average) and a second one linked to the concept of miscalibration (average % confidence - % correct answers). Remarkably, the two components influence the final score in two opposite directions. Average scores are resumed in table 10:

Likert questions	**Miscalibration**	**Final score**
2.89	*3.31*	*3.10*

Table 10

Results show that overconfidence measured as pure miscalibration is appreciably higher than in the other form.

Putting the overconfidence bias in relation to demographic variables, some interesting insights come up:

1) As shown in figure 10, overconfidence presents slight changes with respect to age. A negative trend can somehow be detected, even if not that strong. Also, a small valley appears in the category of entrepreneurs between 26 and 35 years. This trend could be explained looking at different attitudes of people across their lives. In fact, it is not uncommon to see youngsters full of optimism and confidence in their future. On the other hand, having all the life in front of them means that the number of big challenges they already faced is probably low and they might not know what is waiting for them, thus underestimate the variability of the future. In addition, they might believe that what they have learnt in their studies is enough to face every difficulty. This sort of ignorance could be a reason for the higher confidence in themselves. However, reality usually does not make them wait long to tell them the truth.

Of course, this is not a general rule as one can come across elder people being too confident. In fact, as explained in the previous chapters, experience does have a role in the creation of overconfidence. The more one has witnessed in his life, the more he has convinced himself that he knows more than others. In this case, having faced problems for an entire life is what might make more experienced entrepreneurs believe that their abilities are better than what they really are.

Statistical significance tests in next chapter will give more insights and tell us whether age does have a meaningful impact on fruit growers' overconfidence or not.

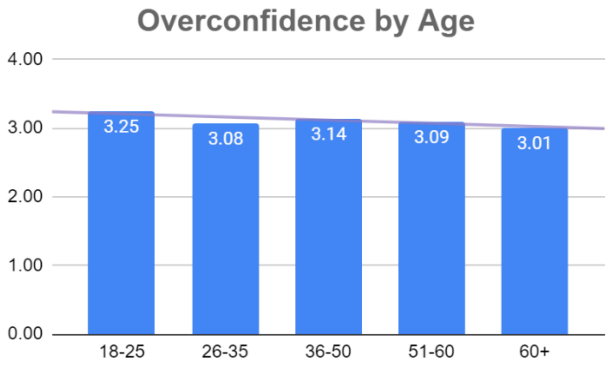


Figure 10

2) Education level (Appendix A, fig. 1) does not present such a relationship with overconfidence. Values lie almost on the same level among the four categories. There could have been a hypothetical negative trend linking overconfidence and educational level, as one could think that people who received a higher education should be more calibrated and careful about their judgments, but our data do not support this thesis.

3) The same applies for categorization by surface (Appendix A, fig. 2). However, a peak in the bias score has been observed in the business operating on a surface between 41 and 80 hectares, while no big difference can be detected between other groups.

4) Breaking down overconfidence, an interesting phenomenon occurs. Results (Appendix A, fig. 3) show that miscalibration has an opposite relationship with age with respect to overconfidence in general. According to the meaning of "miscalibration", this positive trend might indicate that elder fruit growers believe they have a better knowledge than younger ones. This finds a possible explanation in the paragraphs above. For what concerns education and surface nothing changes between overconfidence and miscalibration.

The same happens with Planning Fallacy. This time, however, the visible trend is generated by Education, even if it is not that strong. More than a trend, data suggest a difference in people who attended university and those who did not. This could be linked to what has been said referring to overconfidence. Attending

university is something that changes the way one thinks and can have an impact on subjects like the planning fallacy. Of course, a more detailed analysis of what universities respondents attended could give further knowledge and better explain the effect.

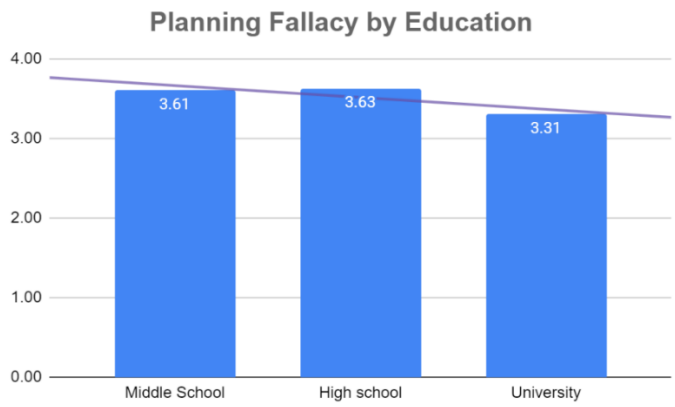


Figure 11

Instead, Age (Appendix A, fig.4) and Surface (Appendix A, fig.5) do not play a key role, with observations lying around their mean value. This seems to make sense as the planning fallacy is something related to the ability of predicting future outcomes, needs and understating how past experience can be exploited to one's advantage. These are personal abilities that should not be dependent on the size of the run business and might not change over time. This last point is true especially if considering the "past experience" aspect of the planning fallacy, which is exactly the inability to properly make use of expertise while making estimates.

The bias with the highest detected variability across categories is the Status Quo Bias. As it can be seen in the figures below, SQB seems to be influenced positively by age and negatively by the business surface, even if less strongly.

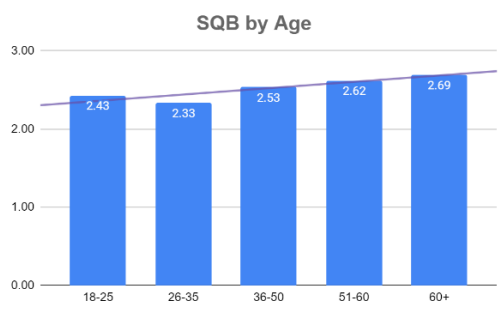


Figure 12

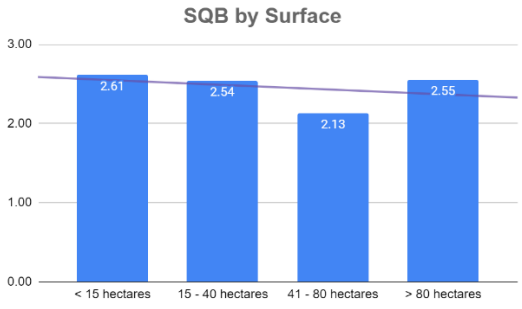


Figure 13

The first relation is quite easily explainable: as one grows his habits and beliefs become stronger and more difficult to eradicate. The status quo bias is the reason for the higher number of young people moving town than elder ones, or the higher dexterity of new generations with digital devices. It is something that has always been present in humankind's history, and probably always will.

The second relationship can be seen as the tendency of larger businesses to embrace with more easiness change and innovation than small ones. As reported in chapter 3, larger organizations usually have more money and are more ready to resist shocks such as the ones derived from wrong investment decisions, thus they are more prone to take some risk. On the other hand, too big organizations sometimes result in complicated processes, higher requirements and they can become slower than smaller ones in taking risky decisions, adopting a more risk-averse profile. With this lens, the low value corresponding to the surface of "41-80 hectares" (medium-large businesses) could find a possible explanation. Obviously, it is hard to determine whether this is true or not.

Education (Appendix A, fig. 6) seems to not be influencing, having only a small peak in the "high school" category. This goes against what is commonly perceived, i.e., a link between school attendance (especially in scientific majors) and openness to innovation.

What is remarkable here is that the Status Quo Bias resulted in values smaller than 3, i.e., indicating a certain openness to change. This was not expected and can have at least two explanations: (1) fruit growers might actually be more open to change than expected, (2) the test's questions could have not been sufficiently

able to detect the "true" value of the status quo bias for farmers. It is crucial to remember that behavioural economics still lacks in defined and completely reliable instruments. As a psychological subject, it is hard to prove a thesis and its findings should be considered most of the time as indications rather than absolute truths.

Some insights about the comparison between fruit growers' exposure to cognitive biases and the general category of entrepreneurs can be seen in (Appendix A, fig. 7,8 and 9). Please notice that the comparison is made between two studies which developed in two different manners: whereas in this work questions have been administered directly to entrepreneurs, in (Nuijten, Benschop, Rijsenbilt, & Wilmink, 2020)[69] the data were collected through accountants' experience. In reading the charts, please remember that the first line refers to this study, the second to Nuijten's scores in the domain of strategic decisions, and the last one to Nuijten's overall scores, considering all the five decision domains analysed in their study (Strategy, Regulatory compliance, Human Resource, Information Technology, Succession planning).

According to these numbers, overconfidence's impact on entrepreneurs' activities seems to be confirmed also in the subgroup of fruit growers, even if with a minor intensity. As already said, comparing directly these results is not completely accurate, but a possible reason for this value could lie in the fact that Italian agriculture is not witnessing good times. As a consequence of many economic and geopolitical events such as the increase in size – hence bargaining power – of the Large Organised Distribution which makes prices and charges the supply chain for costs (notice that farmers are often used as an example of perfect competition in microeconomics courses), the turbulent macroeconomic environment, or import bans such as the Russian one in 2014, it is not that strange that agricultural

[69] Nuijten, A., Benschop, N., Rijsenbilt, A., & Wilmink, K. (2020). Cognitive Biases in Critical Decisions Facing SME Entrepreneurs: An External Accountants' Perspective. *Administrative Sciences, 10*, 89-112.

entrepreneurs do not see the future with optimism and confidence as their counterpart.

The chart in (Appendix A, fig. 7) shows the same differecences, with respect to the planning fallacy bias. Again, fruit growers seem to be less biased than the general category of entrepreneurs, even though they still lack in planning. To determine with more precision whether the planning fallacy is operating or not with a higher intensity, it would be advisable to classify what are the decisions that are taken in different industries and try to understand their difficulty: harder problems could in fact result in higher levels of planning fallacy, point that should be considered when making comparisons.

The bar graph in figure 14 is the most surprising. It is in fact the one showing the greatest difference in the findings of the two studies. This difference results in a "negative" score for fruit growers (i.e., indicating openness to change), which are usually thought to be a "close" category. Such a big difference requires further analysis to be explained.

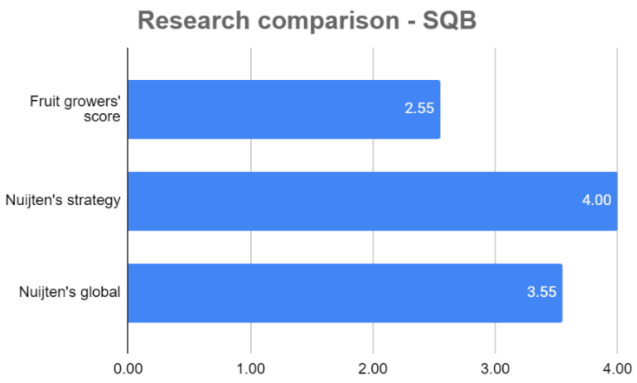


Figure 14

These numbers might be unprecise because of, for example, problems in the samples, or might depict a particular situation in the agriculture environment. Since last years have not been brilliant for the Italian agricultural sector, it could not be that impressive that farmers want something to change, starting from their businesses. On the other hand, assessing such a big difference and change of direction is quite strong and needs further evidence. Anyway, more details will be

provided in the final discussion of results, considering the statistical analysis and its outcomes.

However, should the results about the comparison between fruit growers and generic entrepreneurs be confusing or misleading, some useful insights about fruit growers' exposure to cognitive biases could be found in the mathematical models trying to explain the origination of those biases with respect to the four demographic variables considered.

5.2.2 Answers insights

Before moving to statistical significance tests, it might be useful to understand how fruit growers answered to the questionnaire, which where the more relevant questions and what can be understood from these. Before doing so, something about how answers have been registered and translated into the variables in the database should be said.

The questionnaire was administered through the platform Google Forms. This tool permits to extract data about the answers and work on them on the app Google Sheet. After some manipulation (inversion of scores, computation of bias scores, cleaning and creation of some dummy variables useful for some tests later explained), the final data has been uploaded into the software Stata. The list of all variables is reported below:

Variable(s)	Meaning
age, gender, education, size	Categorical variables. Levels implemented as numbers 1, 2, 3, … depending on their amounts for each variable.
readiness	How ready farmers feel to face the future.

tech_advice, tech_evaluation	How they follow technicians' advice/ how they believe in technicians' advice.
Time, costs, revenues, workforce, problems	Discrepancy between actual and expected values of themes on the left.
experience	How farmers take into account past experience in their choices.
newcrop_farm, newcrop_local	Openness to new crops never grown in the farm/locally.
agri40, pruning, irrigation, tools	Openness to innovation themes.
overconfidence, miscalibration planning_fallacy, status_quo,	Continuous variables measuring the bias scores.
oc_pres, pf_pres, sqb_pres	Binary variables stating the presence or not of a bias.
age_18-25, age_26-35, age_36-50, age_51-60, age_60+; edu_middle, edu_high, edu_uni, size_min15, size_16-40, size_41-80, size_80+	Binary variables stating the belonging to a specific level of the demographic categorical variables.

Analysing the answers to all questions with the help of histograms, some results have been found:

- In general, all the three biases appear to have a normal distribution. This is particularly true for the overconfidence and the planning fallacy: the former centred on the value of 3, the latter shifted a little on the right, with a median value around 3.5. It is interesting notice how miscalibration is almost completely skewed on the right, meaning that it is the main component moving overconfidence up in value. The status quo bias distribution, instead, seems to have to peaks, possibly meaning that there is a somehow remarkable difference in farmers' openness to change.

- Fruit growers feel "ready" to face what the future is preparing for them.

- They seem to follow experts' advice about operating activities, but not to believe that much in their evaluations, often thought to be "too theoretical". This is a stronger form of "better than average" overconfidence since average includes all people, while experts should be the most prepared on these specific themes.

- The planning fallacy has a significant impact on all the dimensions that have been tasted: costs, revenues, times, amount of workforce and general problems. The greatest impact has been found in costs, higher than expected in almost all the cases. Revenues follow.

- Past experience seems to be valuated as useful (mean 2.86).

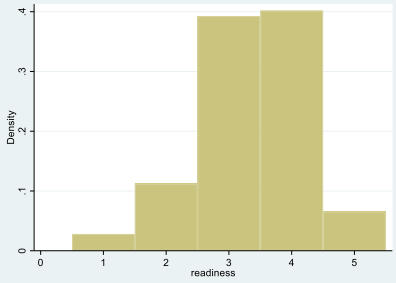
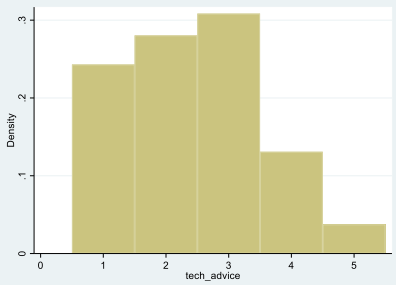
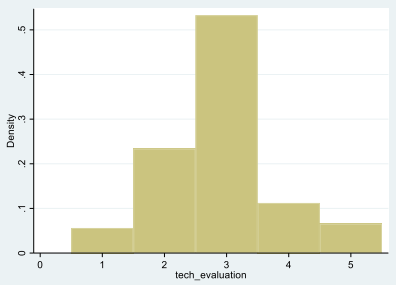
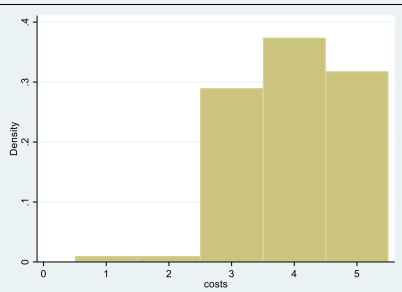
- Fruit growers *say* that they are open to plant new crops, both never had in their business or seen in their local area.

- Innovation and new technology appear to be welcomed by farmers, at least at a willing level. The more "advanced" the degree of innovation/technology the more variability increases in the answers, as one could expect. If "drip" irrigation looks as something entrepreneurs should strongly invest in, numbers change when talking about agriculture 4.0 and automatic pruning, where respondents do not agree as they did in

the previous questions. Please notice that these questions refer to hypothetical scenarios hence might be optimistic.

- There is a significant variability in the tools fruit growers use in managing their daily activities. This is a factual sign of some innovation resistance and inertia – stick to use a piece of paper instead of Excel to do large part of the work certainly does not find its motivation in efficiency.

Main results are displayed in table 9. The full table is consultable in the Appendix A.

Variable	Histogram	Note
Readiness		On average, fruit growers feel "ready" to face future threats. High concentration in values between 3 and 4 (average 3.34).
Tech_advice		Skewed on the left. It seems farmers follow technicians advise, even though not extremely convinced.
Tech_evaluation		Confirm of low convincement of technicians' reliability: they follow the advice but do not believe these are always the best choices ("3" is a neutral value but considering that technicians are the ones who are supposed to be best informed, this is interesting).
Costs		Strongly skewed on the right. Costs are almost always higher than expected.

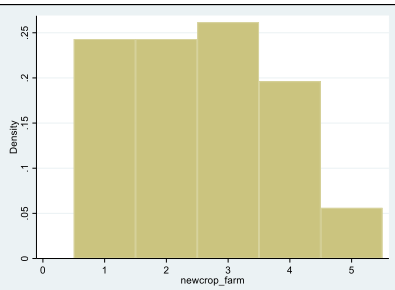
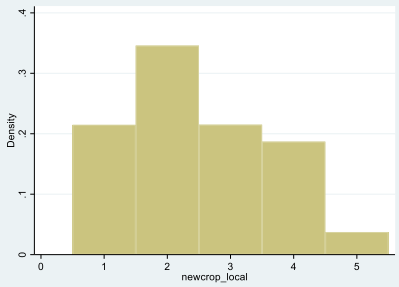
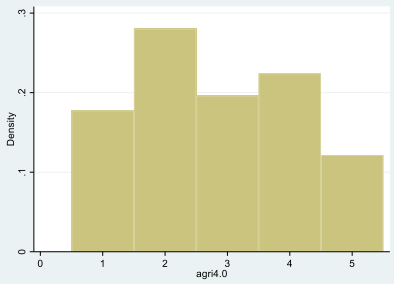
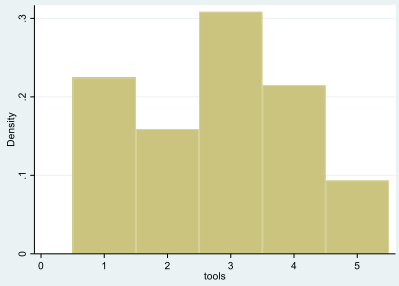
Newcrop_farm		Fruit growers say they are on average open to crops never had in their farm (mean 2.60).
Newcrop_local		Generally open to crops never grown in the area where respondents operate (mean 2.51). The distribution is more concentrated with respect to the previous question, even though a certain variability persists.
Agri4.0		Question with high variability and the highest mean score for SQB (2.85).
Tools		Answers are quite variable, centred on 3, with a mean of 2.81. There is a high variability in the instruments used by fruit growers to manage their administration processes (some people use digital tools, even though not excessively developed, some others have sticked to a completely analogical approach – pen and paper).

Table 11

5.2.3 Correlation analysis

It might be insightful to give a look at the correlation between variables and detect important relationships in their movements. It is crucial to remember that "correlation means not causation" and keep calm in front of high values. The correlation matrix obtained with Stata and colorized through Excel is reported below. In the matrix, green cells stand for positive correlation whereas red ones

indicate negative correlation. The intensity of the colour gives indication of the absolute value.

	readiness	tech_advice	tech_evaluation	time	costs	revenues	workforce	problems	experience	newcrop_farm	agri40	pruning	irrigation	newcrop_local	tools	miscalibration	overconfidence	planning_fallacy	status_quo
readiness	1.00																		
tech_advice	-0.24	1.00																	
tech_evaluation	-0.21	0.28	1.00																
time	0.01	-0.05	-0.02	1.00															
costs	-0.04	0.02	0.06	0.36	1.00														
revenues	-0.25	0.12	0.15	0.03	0.25	1.00													
workforce	-0.05	0.23	0.20	-0.11	-0.04	0.01	1.00												
problems	-0.26	0.18	0.23	0.08	0.25	0.14	0.13	1.00											
experience	-0.21	0.04	0.04	-0.02	0.24	-0.02	0.03	0.21	1.00										
newcrop_farm	-0.23	-0.06	-0.03	-0.02	-0.14	-0.08	0.10	0.16	0.30	1.00									
agri40	-0.27	0.06	0.18	-0.07	-0.10	0.16	0.26	0.21	-0.09	0.32	1.00								
pruning	0.02	0.28	0.19	-0.02	-0.03	0.14	0.20	0.06	-0.14	-0.06	0.23	1.00							
irrigation	-0.11	0.04	0.08	0.10	-0.04	-0.08	0.07	0.08	-0.09	0.14	0.22	-0.01	1.00						
newcrop_local	-0.38	0.15	0.04	0.17	-0.02	0.14	0.06	0.09	0.11	0.29	0.27	0.13	0.01	1.00					
tools	-0.20	0.16	0.23	-0.03	-0.06	-0.02	0.16	0.17	0.09	0.16	0.42	0.25	0.04	0.08	1.00				
miscalibration	0.00	0.12	-0.03	0.05	-0.04	-0.01	-0.10	-0.15	-0.08	0.06	-0.19	0.01	0.03	0.03	-0.13	1.00			
overconfidence	0.17	0.56	0.40	0.01	-0.02	0.02	0.09	-0.03	-0.10	-0.08	-0.14	0.21	0.03	-0.03	0.00	0.75	1.00		
planning_fallacy	-0.27	0.19	0.23	0.40	0.66	0.43	0.38	0.60	0.53	0.13	0.13	0.07	0.01	0.18	0.12	-0.11	-0.01	1.00	
status_quo	-0.35	0.19	0.21	0.03	-0.12	0.08	0.26	0.24	0.06	0.56	0.76	0.47	0.37	0.53	0.62	-0.06	-0.01	0.20	1.00

Table 12

Positive correlations do not offer great insights since the highest values refer to cognitive biases and their most important components in terms of score. It is not surprising that the overconfidence bias has a strong positive correlation with the variable *miscalibration* since this is, as said before, its strongest component. The same is valid for the other two biases, where their components positively relate with the biases themselves and their other components.

Negative correlations provide more material. The first thing that comes up is that all the major negative correlations are related to the variable *readiness*, measuring how entrepreneurs feel ready to face future threats and uncertainties. The strongest relation concerns the *readiness* and the variable *newcrop_local* (-0.48), i.e., the more they feel ready the more they are open to adopt crops never grown in their local area. This could be thought of as a signal of incoherence, as feeling "ready" should relate to possessing a good crops portfolio and not to considering changing it. The same applies to the variable *newcrop_farm*, with a correlation value of -0.23. A possible reason for this peculiarity could be found in what "ready" means for farmers: it might include the capability to rapidly adapt to new scenarios (obviously choosing for the best alternative), typical effect of overconfidence. In this case, it would be curious the low correlation between overconfidence and readiness (0.17), not large as one could expect.

The second highest value refers to the correlation between readiness and status quo bias. Again, the more ready farmers feel, the lower the status quo bias, i.e., the higher the degree of their openness to change.

It follows the relationship between *readiness* and *planning_fallacy* (-0.27) and its components *problems* (-0.26), *revenues* (-0.25), and *experience* (-0.21): entrepreneurs who feel ready are less likely to fall into the planning fallacy or one of its components. This might be a signal of "quality" of these entrepreneurs: having witnessed that historically they are not that wrong about their predictions makes them feeling ready to face they future since they tend to believe they will perform as well as they did in the past. Notice that overconfidence and planning fallacy (even though the fallacy can be considered a form of overconfidence) are not correlated (-0.01): it could be that "good entrepreneurs" are also quite calibrated in their confidence in themselves, enhancing their possibilities of doing well. On the other hand, correlations between readiness and costs/times (two of planning fallacy's most important components) are almost null.

5.3 Statistical significance models

In this section, statistical significance will be tested. Statistical significance is necessary to understand whether some effects, relationships or differences can be considered influent or not. These models provide quantitative results about the degree of confidence one can expect their results to be "true", starting from some initial parameters (such as confidence level) arbitrarily set. In this thesis, given the limited dimension of the sample, confidence level has been set to a value of 90%. The statistical analysis has been conducted through the software Stata and makes use of three basic models: t-test, ANOVA and linear regression. The first two aim to understand if differences between means in different groups (e.g.: male vs women) are statistically significant. Linear regression has the objective to estimate the impact of independent variables on the dependent one.

5.3.1 Means comparisons

T-tests are used to compare means of two groups. In this case, the only demographic variable with two subgroups was the gender, split into male and female. ANOVA is instead used when groups are three or more, such as with our variables age, education, and size.

T-tests and ANOVA Stata's output provide mean, standard deviation, significance statistic (Student's "t" for t-tests, Fisher's "F" for ANOVA) and their p-value, which gives immediate feedback on statistical significance. Results of these tests are shown below:

OVERCONFIDENCE				
	Mean	**Std. Dev.**	**Test statistic**	**P-value**
Gender				
Female	*3,0779*	*0,4646*		
Male	*3,1068*	*0,4004*		
			-0,2310	**0,8178**
Age				
18 - 25	*3,2477*	*0,5484*		
26 - 35	*3,0761*	*0,3854*		
36 - 50	*3,1392*	*0,3660*		
51 - 60	*3,1122*	*0,4429*		
60+	*3,0101*	*0,3825*		
			0,5600	**0,6929**
Education				
Middle School	*2,9779*	*0,4183*		
High School	*3,1624*	*0,3901*		
University	*3,0596*	*0,4200*		
			1,9300	**0,1507**
Size				
< 15 ha	*3,0025*	*0,4275*		
15 - 40 ha	*3,0970*	*0,3844*		
41 - 80 ha	*3,3869*	*0,2647*		
> 80 ha	*3,0626*	*0,5053*		
			3,1700	**0,0275**

Table 13

Notice that the only statically significant difference in means between groups for what concerns the overconfidence has been found in the demographic variable "size", with a p-value of 0.0275, thus not only significant at a 90% level of confidence (p-value < 0.10) but 95% (p-value < 0.05). A statically significant difference found with the ANOVA tells us that at least one of the groups has a

mean which significantly differs from the others. In mathematical terms, the null hypothesis H_0: $\mu_1 = \mu_2 = \mu_i = \mu_n$, where n is the number of groups, is rejected. To understand which of the group(s) has a different mean another test must be run. The choice fell on the Bonferroni test (proposed by Stata by default), which output is reported below:

Bonferroni test			
Row Mean - Col Mean	< 15 ha	15 - 40 ha	41 - 80 ha
15 - 40 ha	*0,0944* *1,0000*		
41 - 80 ha	*0,3843* *0,0170*	*0,2899* *0,0960*	
> 80 ha	*0,0600* *1,0000*	*-0,0344* *1,0000*	*-0,3243* *0,4690*

Table 14

Bonferroni's test makes comparisons between groups in pairs. Doing so, it can determine where the statically significant differences lie. The table must be read keeping in mind that results are showed in pairs of numbers: the top number refers to the statistic whereas the bottom number is the p-value of such statistic. In this case, p-values tell us that entrepreneurs managing businesses with a surface between 41 and 80 hectares are statistically different in their degree of overconfidence from entrepreneurs of small businesses (< 15 ha) and medium businesses (15 – 40 ha). To understand this difference, it is sufficient to look at the mean values reported in table 13: the category of 41-80 hectares has the highest overconfidence score (3.39); this means that, according to our data, in this range entrepreneurs are more likely to experience higher levels of overconfidence. This has already been hypothesized when representing bias scores with respect to demographic variables with bar charts in the paragraph 5.2.1 ("General results").

Table 15 presents the same analysis, with respect to the planning fallacy bias:

PLANNING FALLACY				
	Mean	**Std. Dev.**	**Test statistic**	**P-value**
Gender				
Female	*3,5556*	*0,5830*		
Male	*3,5666*	*0,4472*		
			-0,0778	**0,9382**
Age				
18 - 25	*3,4286*	*0,3170*		
26 - 35	*3,3688*	*0,5154*		
36 - 50	*3,5666*	*0,4905*		
51 - 60	*3,5104*	*0,4377*		
60+	*3,6333*	*0,4638*		
			0,4800	**0,7499**
Education				
Middle School	*3,6158*	*0,4247*		
High School	*3,6276*	*0,4967*		
University	*3,3083*	*0,2720*		
			4,0500	**0,0203**
Size				
< 15 ha	*3,5404*	*0,4188*		
15 - 40 ha	*3,5565*	*0,3935*		
41 - 80 ha	*3,5595*	*0,7413*		
> 80 ha	*3,7620*	*0,4892*		
			0,4600	**0,7132**

Table 15

In this case, the only significant difference in means between categories has been found in the education subgroups, while all the other categories' p-values are quite high.

The Bonferroni's pair comparison (table 16) clearly proves what has already been said in the presentation of general results: attending university (and studying, in general) is something that changes the way one looks at the world and their ability to understand it. Culture, combined with the understanding of how things can be complex (perfectly witnessed by university students), is the receipt to be more calibrated, more rational and avoid big mistakes – or at least helps.

Bonferroni test		
Row Mean - Col Mean	Middle School	High School
High School	*0,0118*	
	1,0000	
University	*-0,3075*	*-0,3192*
	0,0810	*0,0190*

Table 16

Table 17 displays results for the status quo bias.

STATUS QUO BIAS				
	Mean	**Std. Dev.**	**Test statistic**	**P-value**
Gender				
Female	*2,4584*	*0,6402*		
Male	*2,5421*	*0,6671*		
			-0,4111	**0,6818**
Age				
18 - 25	*2,4286*	*0,6517*		
26 - 35	*2,3333*	*0,7298*		
36 - 50	*2,5333*	*0,5927*		
51 - 60	*2,5677*	*0,6889*		
60+	*2,6917*	*0,6716*		
			0,7600	**0,5563**
Education				
Middle School	*2,4928*	*0,7256*		
High School	*2,5703*	*0,6950*		
University	*2,4584*	*0,4678*		
			0,2700	**0,7657**
Size				
< 15 ha	*2,7172*	*0,5613*		
15 - 40 ha	*2,5409*	*0,7249*		
41 - 80 ha	*2,1309*	*0,6103*		
> 80 ha	*2,4047*	*0,3314*		
			2,8000	**0,0436**

Table 17

Again, only one demographic variable seems to have an impact on the mean of its subgroups. In this case, it is the size of the business, with a p-value of 0.0436 (< 0.05, i.e., level of confidence at 95%). This ANOVA assesses the difference already spotted with bar charts in the category of size but discards the negative effect of age on the intensity of the status quo bias, which seemed to be stronger in elder

people from bar charts. Bonferroni's test (table 18) highlights again a difference between small and large businesses entrepreneurs: the latter appears to be less likely to fall into the status quo bias. Motivation for this could be found in the (theoretical) greater financial capacity of larger businesses to invest in new technologies, new systems, and crops. Following the future requires an effort, and this effort requires money, which small businesses might not have. In this case, it is curious not to see the same relationship with businesses greater than 80 hectares, which should dispose – in cash or potentially, through credit – of even larger amounts of capital.

Bonferroni test			
Row Mean - Col Mean	< 15 ha	15 - 40 ha	41 - 80 ha
15 - 40 ha	*-0,1763* *1,0000*		
41 - 80 ha	*-0,5864* *0,0320*	*-0,4100* *0,2220*	
> 80 ha	*-0,3125* *1,0000*	*-0,1361* *1,0000*	*0,2739* *1,0000*

Table 18

5.3.2 Linear regressions

Linear regression models aim to explain the relationship between one dependent variable and *n* factors influencing it. These factors are called "independent variables", as their level is not constrained. Linear regressions are just one type of these models, and the simplest. In fact, they operate using an approximation which is, as the name says itself, linear. Other models, more complex and – usually – more accurate can be created using successive orders of approximation. The choice of which level should be adopted depends on the phenomenon under investigation: some themes are modelled with sufficient precision with just a linear regression, some others (e.g.: thermodynamics) usually require greater detail.

The basic equation at the heart of a linear regression is:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \varepsilon$$

Where:

- Y is the dependent variable

- $X_1, X_2, \ldots, X_n$ are the independent variables

- β_0 is a constant term

- $\beta_1, \beta_2, \ldots \beta_n$ are the coefficients attached to the independent variables

- ε is the error linked to the approximation

In this case, the dependent variables will be the three bias scores while the independent variables the four demographic metrics.

The variety of models is not limited to the degree of approximation one wants to achieve. In the linear regression scope there are many options, each with its characteristics and sense. Here, particular emphasis has been given to a model composed by all the four demographic variables and all their levels, since a normal regression would not have been able to explore data at the granularity that we sought. All levels were important, since "education", for example, could have not been statistically significant as a hole but being graduated at university could. To do so, it was necessary to insert the factor "ibn." in the Stata command "regress", which specifies to include every level of a categorical variable in the regression. Hence, the final command was, for each bias, the following:

regress *bias_variable* ibn.gender ibn.age ibn.education ibn.size

Linear regression models of all the three biases are reported in table 19:

	Y = Overconfidence	Y = Planning Fallacy	Y = Status Quo
Female (vs Male)	*-0,0491**	*0,0290*	*-0,0893*
	*0,1258***	*0,1441*	*0,2069*
Age 18-25 vs 60+	*0,1593*	*-0,0590*	*-0,2607*
	0,1869	*0,2141*	*0,3074*
Age 26-35 vs 60+	*-0,0162*	*0,1377*	*-0,403*
	0,1409	*0,1614*	*0,2317*
Age 36-50 vs 60+	*0,0777*	*0,0122*	*-0,2368*
	0,1214	*0,1391*	*0,1997*
Age 51-60 vs 60+	*0,1234*	*-0,1116*	*-0,1863*
	0,1152	*0,1320*	*0,1894*
Education Middle vs University	*-0,1175*	*0,4107*	*-0,1085*
	0,1397	*0,1600*	*0,2297*
Education High vs University	*0,0540*	*0,3537*	*0,1267*
	0,1062	*0,1217*	*0,1747*
Size: 15- vs 80+	*-0,0085*	*-0,2543*	*0,3505*
	0,1698	*0,1946*	*0,2793*
Size: 16-40 vs 80+	*0,0999*	*-0,3015*	*0,1985*
	0,1650	*0,1890*	*0,2713*
Size: 41-80 vs 80+	*0,3756*	*-0,3324*	*-0,2442*
	0,1894	*0,2170*	*0,3115*
Constant	*2,9396*	*3,5442*	*2,5227*
	0,1955	*0,2239*	*0,3215*
# Observations	107	107	107
R2	0,1334	0,1195	0,1185

*Table 19; * = coefficient, ** = standard error*

Each column reports the value of the coefficient attached to each independent variable and its standard error. Please notice that in this model every coefficient refers to a "base level" of the same category, thus must be read in relative terms. For instance, the coefficient -0.0491 of female in the overconfidence column means that women overconfidence scores are inferior of 0.0491 compared to the ones of men. The same applies for all other variables, in which the last level (respectively *60+, university, and >80)* is omitted.

Values in red are the ones with a p-value < 0.10, indicating variables which have a statistically significant impact on the dependent variable. For what concerns overconfidence and planning fallacy, the results provided before with ANOVA are confirmed by the linear regression: a size of 41-80 hectares positively influences the overconfidence bias score, while being graduated at university reduces the

likelihood of being affected by the planning fallacy bias. The only result which was not confirmed was the impact of size (specifically 41-80 hectares) on the status quo bias score, which resulted to be influenced by the level 26-35 of the variable "age", instead. Notice that this relationship has not been found in any other test and model created, while the other two are supported by almost all of them (all consultable in the Appendix B).

The final row reports the value of the coefficient of determination, better known as "R-squared" indicator. R-squared is a "fit indicator": it gives feedback about how the model fits with the data. In particular, the coefficient of determination indicates the fraction of variation of the dependent variable that is "explained" by the independent variables. High values of R-squared mean high fit with the data, while low values indicate that the independent variables are not sufficient (or useless) to explain the output. Notice that although having a good value of fit is certainly good, this is not the primary objective of statistical and/or econometric analysis. In fact, high values can be obtained by inserting a lot of different variables in the regression model: they will explain most of the variability but will not make clear what relations are actually significant or not. In this case, a low number of variables has been used and the obtained values of R-squared were not that elevated. Looking at the other results, it is clear that this is due to the fact that some variables are significant while some others are almost surely not. Take gender as an example: no statistically significant differences were detected in any test. This might be due to a lack of dimension of female representatives in the sample or might mean that gender is not something that drastically influences rational investment decisions. Another example can be found in the variable age: although it was expected to notice some differences between young and elder entrepreneurs, this was not the case. This makes us think that if any important relationship has to be further explored, these would be the ones including education and size.

6. Conclusions

6.1 The bottom line

Cognitive biases are everywhere. As part of human nature, no one can escape from their hands and become a rational being in its purest form. Is therefore humankind doomed to act irrationally forever? Yes and no. If it is true that people will never get free from this burden, they certainly can do whatever is possible to limit damages.

In this thesis, it has been shown what cognitive biases are and how they influence people's actions, particularly of SMEs entrepreneurs. Even though research has reached a decent degree of understanding of such phenomena, there is still room for improvement, and deeper comprehension must be sought. This work had the objective to dive into a specific category of SMEs entrepreneurs - fruit growers - and try to detect, if any, differences in behaviours with their general category of belonging. The literature on these themes is large and much information can be found. Common findings are that SMEs are typically stuck in poor financial performance and more fragile in front of outcomes coming from bad decisions (Raveendra, Singh, Singh, & Santhosh, 2018)[70]. Business size plays a role in the capacity to absorb such shocks, as well as it does in the organization of operating activities, processes, and roles. Not only, small organizations usually lack in disposable tools and methodologies - or knowledge - to analyse data, hence do not take informed and data-driven decisions. Such decision-making models cannot work properly, and they do not, as supported by (Gervais, 2010)[71]. In this "rejection" of quantitative models appears the spectrum of overconfidence,

[70] Raveendra, P. V., Singh, J. E., Singh, P., & Santhosh, K. S. (2018). Bevioral finance and its impact on poor financial performance of SMES: A review. *International Journal of Mechanical Engineering and Technology (IJMET)*, 341-348.

[71] Gervais, S. (2010). Behavioral Finance: Capital Budgeting and Other Investment Decisions. In J. R. Nofsinger, & H. K. Baker, *Behavioral Finance: Investors, Corporations, and Markets* (pp. 413-434). Wiley/Blackwell.

whispering to SMEs entrepreneurs' ears that they do not need such instruments and can properly run their business just with their reasonings and intuition.

At the core of SMEs failures (Kambwale, Chisoro, & Karodia, 2015)[72] found "*inappropriate financial management, poor planning, lack of capital and access to fund and insufficient training and education",* supported by (Kalane, 2015)[73]. Moreover, (Ahmad & Seet, 2009)[74] stated that too less importance is usually given to preparatory research, leading to a lack in quality of all investments done on such weak basis. All these problems are somehow directly related to – among the others – the three biases studied in this work: overconfidence, planning fallacy, and status quo bias. The four demographic variables (gender, age, education, and size) help in finding explanations for such behaviours and find support in the existing literature.

Overconfidence permeates almost every aspect of people's lives, and entrepreneurs as a category are statistically more likely to develop this characteristic. Results of this work found that **fruit growers are generally overconfident**, even if less than the general category of SMEs entrepreneurs taken as benchmark from (Nuijten, Benschop, Rijsenbilt, & Wilmink, 2020)[75]. Considering the differences between the two studies (hence their numeric results), the expectation of finding overconfidence has been satisfied.

[72] Kambwale, J. N., Chisoro, C., & Karodia, A. M. (2015). Investigation into the Causes of Small and Medium Enterprise Failures in Windhoek , Namibia. *Arabian Journal of Business and Management Review*, 80-109.

[73] Kalane, L. (2015). *Reasons for Failure of SMEs in the Free State.* Bloemfontein: UFS BUSINESS SCHOOL.

[74] Ahmad, N. H., & Seet, P.-s. (2009). Dissecting Behaviours Associated with Business Failure: A Qualitative Study of SME Owners in Malaysia and Australia. *Asian Social Science*, 99-104.

[75] Nuijten, A., Benschop, N., Rijsenbilt, A., & Wilmink, K. (2020). Cognitive Biases in Critical Decisions Facing SME Entrepreneurs: An External Accountants' Perspective. *Administrative Sciences, 10*, 89-112.

Moreover, it has been demonstrated that, according to the data from the questionnaire:

*The **business size** (measured as surface) **influences the degree of overconfidence**: businesses considered as **large** (41-80 hectares) are related to **significant higher levels of overconfidence** with respect to **small businesses** (< 15 hectares) and **medium businesses** (15-40 ha). The difference with the other category of business size was not statistically significant, but still quite pronounced.*

A negative trend was also seen with respect to age: elder fruit growers seemed to be less likely to be overconfident than their younger counterparts, but this relationship did not find statistical evidence. Last, results showed how farmers' overconfidence comes up: while miscalibration is the crucial component in moving the bias score up, **farmers seem to be quite confident in their abilities as they follow technicians' advice, but do not seem to always believe in them**. Considering that these should be the most informed – hence reliable – professional figures in the sector, it is quite clear that fruit growers are victims of the "better than average" (in this case "than professionals"!) effect, typical trait of overconfidence.

As the major reason of SMEs poor financial performance, results about planning fallacy bias are of particular interest. Planning is not easy, as it deals with uncertainty, and nobody can see the future. This is why it is crucial to figure out where this bias lies and understand it as well as possible. **Fruit growers resulted to be influenced by the planning fallacy** too, with a mean bias score of 3.57 out of 5, not that far from Nuijten's one. Not only, data suggests that:

*The **planning fallacy** is **negatively related** to the **level of education** entrepreneurs received: specifically, **university graduates** proved to be **less biased** than both **middle school** and **high school graduates**. Moreover, although the planning fallacy influences almost all the aspects of the planning process, the **greatest impact** on fruit growers has been found in the matters of **costs** and **revenues** estimations.*

The greatest surprise came from the **status quo bias** results. Unexpectedly, **fruit growers scored negatively in this bias**, meaning that they are open to change and not excessively attached to the status quo. These results are upstream if compared to existing literature, which signals the status quo bias as a constant in almost every group of people, including entrepreneurs. This might be due to some characteristics of the questionnaire or might be an actual truth. Since literature seems to support the first view, evidence from this study is not enough to prove the opposite.

Nevertheless, data from the questionnaire:

- ***Proved*** *that* ***large*** *businesses (41-80 hectares) are* ***less affected*** *by the* ***status quo bias*** *than* ***small size*** *businesses (< 15 hectares).*
- ***Suggested*** *(not statistically significant) that* ***SQB intensity increases as age increases****.*

Single questions analysis gave some insights too: **automation and digitalisation are the two fields in which fruit growers scored the highest**. Despite the scores were still negative (i.e., generally indicating openness to change) a lot of variability has been found, **meaning that there is still a lot of diffidence towards these themes** – and it must be recalled that these questions were testing *hypothetical scenarios.*

6.2 Possible practical implications for fruit growers

What can fruit growers learn from these results? The objective is to eliminate as well as possible the irrationality and make better decisions. The starting point is the current comprehension of these biases and the results obtained with this work.

Among the influencing factors of overconfidence found by (Keasey & Watson, 1989)[76] reported in chapter 3.3.2, some leave some room to try to reduce their impact. In particular, some work can be done on what they call *skills* and *motivation*. Skills – and culture, knowledge, in general – are responsible for how entrepreneurs can face their activities. Being prepared helps in solving problems, using the right tools, and making the correct comparisons. Skills are what turn overconfidence in just confidence, thus must be sought. Also, being skilled will help when it comes to planning issues, statistically reduced by the degree of education. For what concerns motivation, the real matter lies in *consciousness:* knowing what cognitive biases are, how easily people are subjected to them, and being focused on the activity they are doing will enable fruit growers to avoid their traps.

For what concerns the planning fallacy, (Nikolopoulou, What Is the Planning Fallacy? | Definition & Examples, 2023a)[77] and (Buehler, Griffin, & Ross, 1984)[78] found six influencing factors. Among these, the "*planning mode*" is probably the one on which entrepreneurs should work as a priority. Fruit growers should make their plans avoiding entering in the planning mode and trying to see "the big picture", including both past experience in their valuations and tools to face uncertainty, such as hypothetical scenarios weighting.

[76] Keasey, K., & Watson, R. (1989). Consensus and accuracy in accounting studies of decision-making: A note on a new measure of consensus. *Accounting, Organizations and Society*, 337-345.

[77] Nikolopoulou, K. (2023a, 08 11). *What Is the Planning Fallacy? | Definition & Examples*. Retrieved 10 24, 2023, from Scribbr: https://www.scribbr.com/fallacies/planning-fallacy/

[78] Buehler, R., Griffin, D., & Ross, M. (1984). Exploring the "planning fallacy": Why people underestimate their task completion times. *Journal of Personality and Social Psychology*, 366-381.

Finally, the Status Quo Bias finds its roots in many emotions, including *loss aversion, regret avoidance, inertia,* and *innovation resistance* (Nikolopoulou, What Is Status Quo Bias? | Definition & Examples, 2023b)[79], (Godefroid, Plattfaut, & Niehaves, 2022)[80]. Since this an emotional bias, it might be hard to counter it. In this case, the advice is to care less about social pressure and regret and do what business sense and *data* suggest doing. Innovation is not a threat, but an opportunity: if one does not follow the future, the world will leave them behind.

At the end of the day, it all comes down to a single principle: constantly asking ourselves whether our decisions are as rational as they could or not. Paying attention to how we take our decisions, what might influence them, and what information we have at the moment of the valuation, is key. In a sentence: study, be informed, open the horizons on what innovations around the world can help agriculture, and be conscious.

[79] Nikolopoulou, K. (2023b, 03 10). *What Is Status Quo Bias? | Definition & Examples*. Retrieved 10 26, 2023, from Scribbr: https://www.scribbr.com/research-bias/status-quo-bias/#:~:text=Example%3A%20Status%20quo%20bias%20You,be%20on%20the%20safe%20side.

[80] Godefroid, M.-E., Plattfaut, R., & Niehaves, B. (2022, 08 01). How to measure the status quo bias? A review of current literature. *Management Review Quarterly*.

7. Limitations and further research

As every study, this thesis is based on some assumptions and hence has some limitations. While the initial part of literature review has been conducted as rigorously as possible, constraints have been relaxed a bit in the building of the questionnaire. Since it was meant to be administered to a population of fruit growers, it has been decided to make the questionnaire thematic: all questions were related to the agriculture field. This choice has been justified by the aim to reach full equality in the compilation possibility of such questionnaire: some themes might create disparities in how people know them and, as such, mislead results confusing some cognitive biases with lack of culture. This was particularly true for the section of miscalibration, based indeed on the concepts of confidence level and correctness of answers. While this choice made the study consistent with itself, it mined the possibility to make direct comparisons with other studies. A parallelism with (Nuijten, Benschop, Rijsenbilt, & Wilmink, 2020) was however made, but only at a qualitative level. Moreover, even though the size of the sample was larger than expected, 108 answers still remain a limited number. The statistically significance had to be lowered from the usual values of 95% confidence level and 5% margin error to values of, respectively, 95% and 9.4%.

The field of behavioural economics has made great improvements since its origin, but there is still a lot to do. Priority is to create tests and instruments able to measure biases in the same way, in every context and category of people analysed. This would be the only way to finally have results directly comparable and classifiable. In the specific domain of SMEs entrepreneurs, and in particular in the agricultural sector, future research could start from this thesis and further explore overconfidence, planning fallacy and status quo, their relationships with some demographic variables (confirming or discarding what has been find here, statistically and not), their impact on revenues and profits (here omitted for privacy reasons). Furthermore, some work could be done applying the same approach of this thesis to some or all the other biases from (Nuijten, Benschop, Rijsenbilt, & Wilmink, 2020)'s list, comparing between what are the most

important biases in SMEs entrepreneurs and farmers, maybe discovering some interesting differences. Some improvements should be made on the standardisation of the instruments used, for example, using decision scenarios in the determination of the Status Quo Bias instead of direct questions. This would allow to observe the SQB directly in action instead of asking entrepreneurs to evaluate their degree of openness and probably make more accurate observations about this specific bias, which resulted anomalous. However, if done in a multiple biases comparison scenario as in this case, this implies the ideation of a system of conversion from these results to a common metric, such as the 1-5 Likert scale used in this thesis.

Another possible improvement can be found in the extension of such analysis to other categories of agricultural entrepreneurs other than fruit growers, such as breeders or cereal growers. Expanding the basis of the survey would give a better description of the agricultural world, in all its shades. In this direction, studies could be directed both on specific subcategories of agricultural entrepreneurs (as done here) or including all categories at once.

Finally, this study was limited in its geographical extension. The survey was administered only to farmers in Piedmont, which even though represents one of the major regions for fruit growing activities in Italy, clearly does not make this study statistically significant on a national level. Enlarge the geographical boundaries of this work would firstly enable to reach a higher number of respondents and, secondly, give a more comprehensive idea of how agricultural entrepreneurs are affected by cognitive biases in Italy.

Questions are unlimited: it remains only to begin.

Appendix A

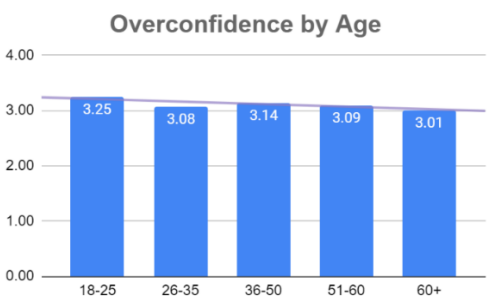


Fig. 1

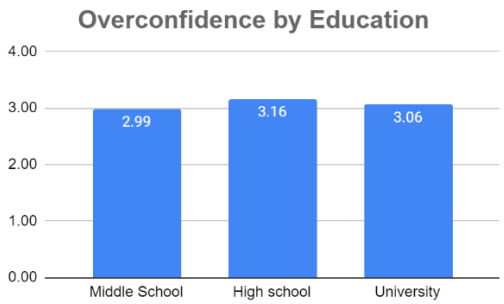


Fig. 2

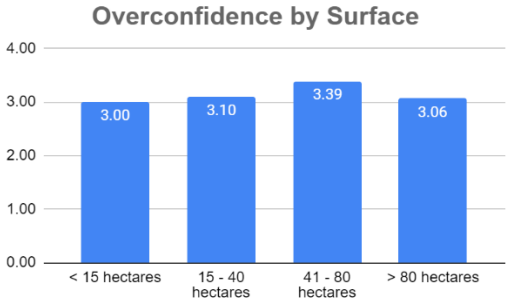


Fig. 3

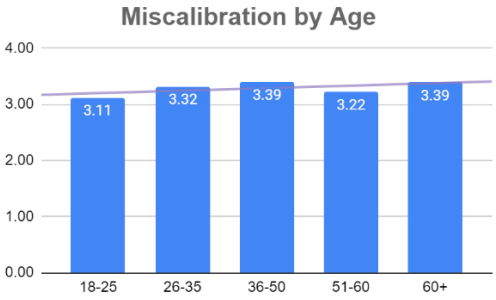


Fig. 4

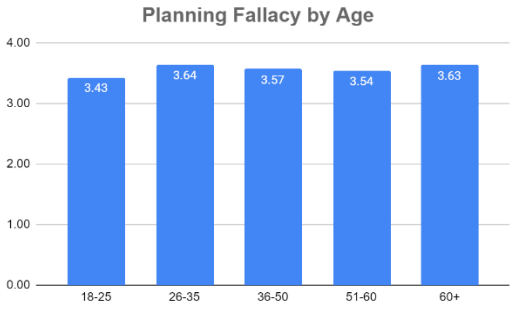


Fig. 5

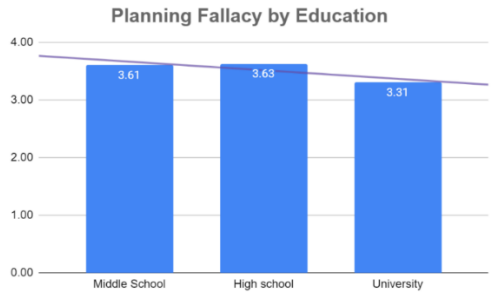


Fig. 6

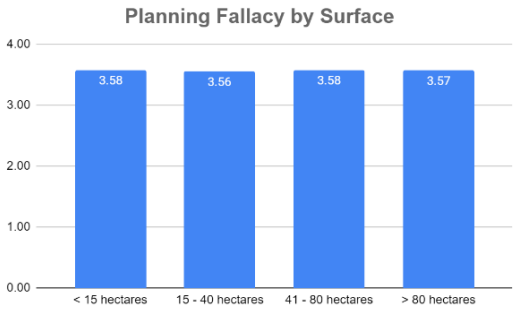


Fig. 7

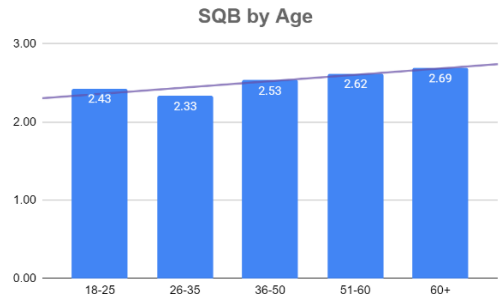


Fig. 8

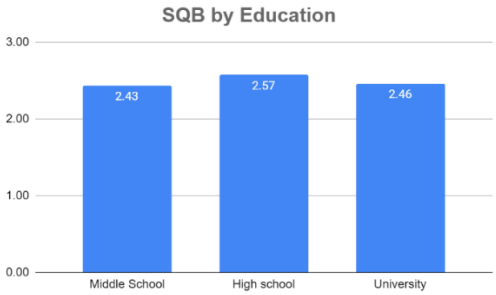


Fig. 9

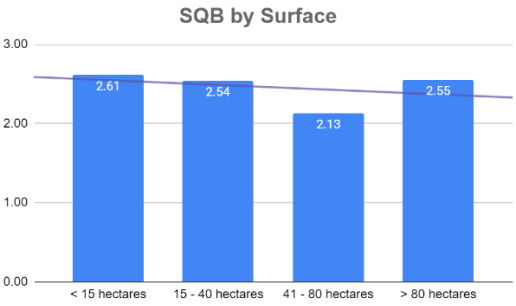


Fig. 10

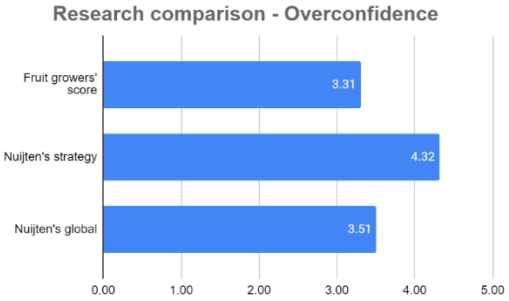


Fig. 11

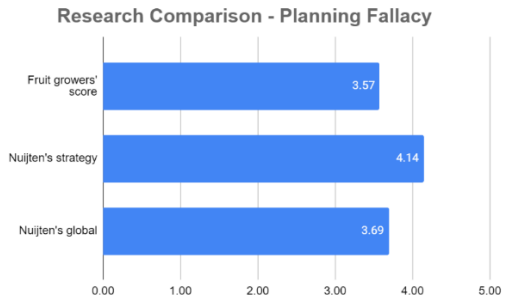


Fig. 12

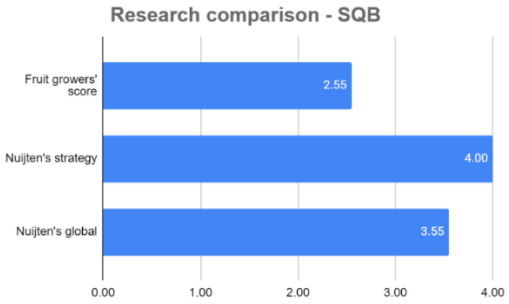
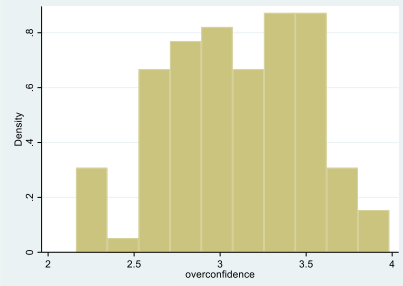
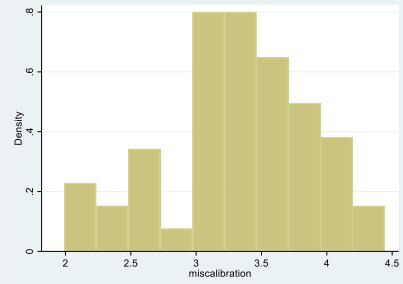
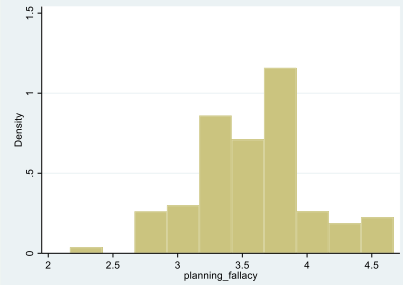
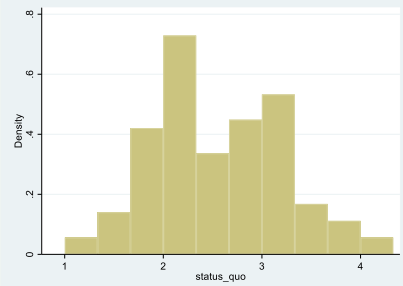
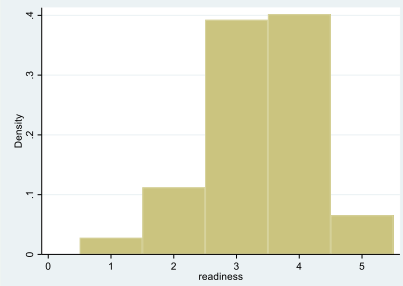
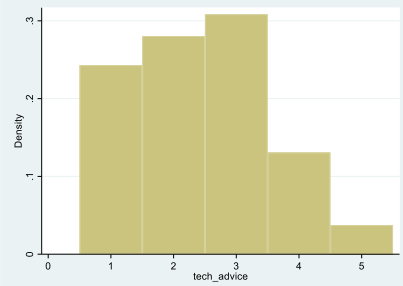
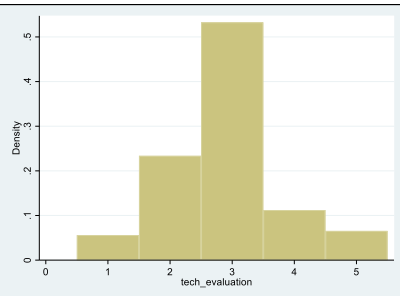
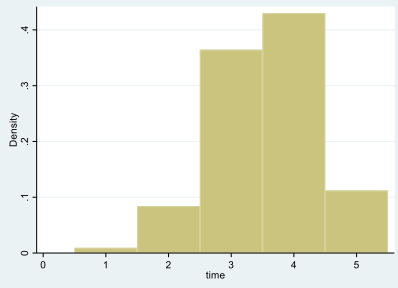
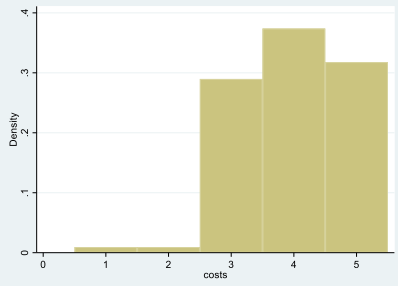
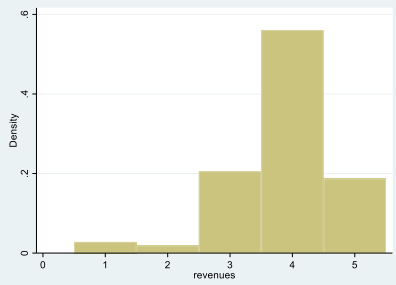
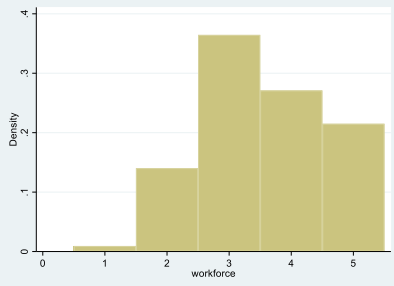
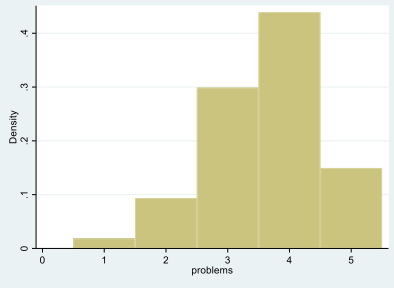
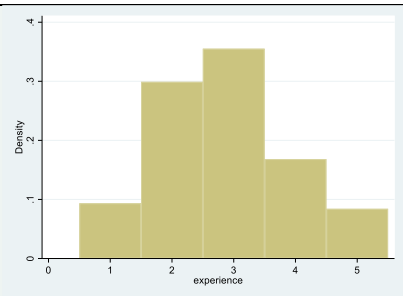
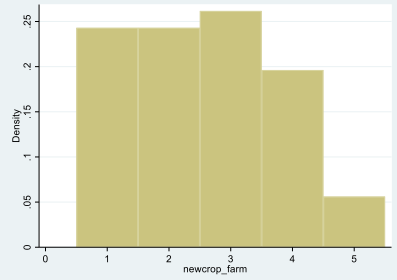
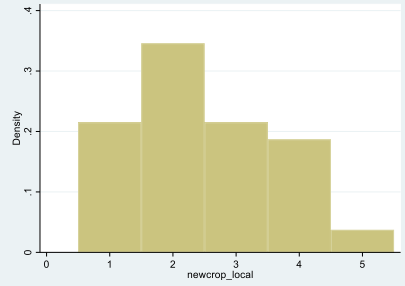
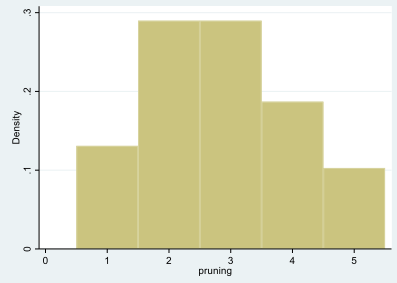
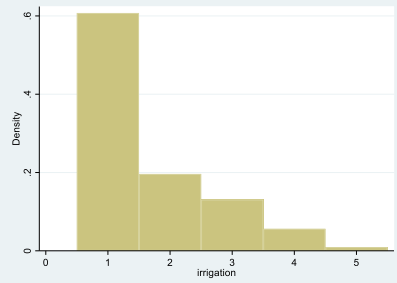
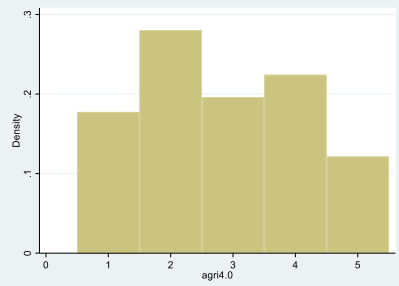
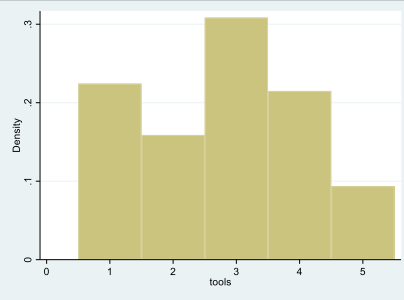


Fig. 13

Variable	Histogram	Note
Overconfidence		Mean 3.10. Distribution approximately normal.
Miscalibration		Little skewed, more density in the positive zone. Miscalibration mean higher than overconfidence's and less variable, meaning this is the component moving the bias score up.
Planning fallacy		Nearly normal, a little shifted on the right. Mean 3.57.
Status quo		Symmetric distribution with mean 2.55 and two peaks. It seems as there is a distinction on entrepreneurs open to change and others who are not.
Readiness		On average, fruit growers feel "ready" to face future threats. High concentration in values between 3 and 4 (average 3.34).
Tech_advice		Skewed on the left. It seems farmers follow technicians advise, even though not extremely convinced.

Tech_evaluation		Confirm of low convincement of technicians' reliability: they follow the advice but do not believe these are always the best choices ("3" is a neutral value but considering that technicians are the ones who are supposed to be best informed, this is interesting).
Time		High concentration around 3-4. Fruit growers underestimate needed times for their projects.
Costs		Strongly skewed on the right. Costs are almost always higher than expected.
Revenues		Skewed on the right, similar to the costs' one, but less dispersed: the delta between expected and actual revenues is perceived more homogeneously.
Workforce		Similar to costs, even though bias scores are lower. Workforce tends to be underestimated on average, despite some variability in the answers.
Problems		"Problems" are almost always more than expected.

Experience		Experience is perceived as a useful source of information. This does not mean it is properly used though. A certain number of respondents (area on the right) consider past investments as not so useful to make comparisons.
Newcrop_farm		Fruit growers say they are on average open to crops never had in their farm (mean 2.60).
Newcrop_local		Generally open to crops never grown in the area where respondents operate (mean 2.51). The distribution is more concentrated with respect to the previous question, even though a certain variability persists.
Pruning		On average open to new technology for automation. However, a significant part does not believe in this kind of innovation.
Irrigation		Almost everybody is convinced drip irrigation is better. Expected: preferring the surface method is actually a signal of underdevelopment).
Agri4.0		Question with high variability and the highest mean score for SQB (2.85).

Tools		Answers are quite variable, centred on 3, with a mean of 2.81. There is a high variability in the instruments used by fruit growers to manage their administration processes (some people use digital tools, even though not excessively developed, some others have sticked to a completely analogical approach – pen and paper).

Appendix B

```
. regress overconfidence age gender education size, level(90)
```

Source	SS	df	MS	Number of obs	=	107
				F(4, 102)	=	1.11
Model	.730992037	4	.182748009	Prob > F	=	0.3537
Residual	16.7190133	102	.163911895	R-squared	=	0.0419
				Adj R-squared	=	0.0043
Total	17.4500053	106	.164622691	Root MSE	=	.40486

overconfid~e	Coef.	Std. Err.	t	P>|t|	[90% Conf.	Interval]
age	-.0197696	.0379135	-0.52	0.603	-.0827034	.0431641
gender	.0119016	.1248381	0.10	0.924	-.1953209	.219124
education	.0279471	.0687547	0.41	0.685	-.0861808	.142075
size	.0851352	.0474516	1.79	0.076	.0063688	.1639016
_cons	2.938253	.278082	10.57	0.000	2.476656	3.39985

Linear regression model including all the categorical variables as a hole, overconfidence. Only the variable "size" is significant.

```
. regress planning_fallacy age gender education size, level(90)
```

Source	SS	df	MS	Number of obs	=	107
				F(4, 102)	=	1.42
Model	1.1881911	4	.297047776	Prob > F	=	0.2330
Residual	21.3533963	102	.209347022	R-squared	=	0.0527
				Adj R-squared	=	0.0156
Total	22.5415874	106	.212656485	Root MSE	=	.45754

planning_f~y	Coef.	Std. Err.	t	P>|t|	[90% Conf.	Interval]
age	-.0246051	.0428472	-0.57	0.567	-.0957284	.0465182
gender	-.0221093	.1410832	-0.16	0.876	-.2562975	.2120788
education	-.1689684	.0777017	-2.17	0.032	-.2979477	-.039989
size	.0470185	.0536265	0.88	0.383	-.0419977	.1360347
_cons	3.909386	.3142687	12.44	0.000	3.387722	4.43105

Linear regression model including all the categorical variables as a hole, planning fallacy. Only the variable education is significant.

```
. regress status_quo age gender education size, level(90)
```

Source	SS	df	MS	Number of obs	=	107
				F(4, 102)	=	2.06
Model	3.47343665	4	.868359162	Prob > F	=	0.0911
Residual	42.935706	102	.420938294	R-squared	=	0.0748
				Adj R-squared	=	0.0386
Total	46.4091426	106	.4378221	Root MSE	=	.6488

status_quo	Coef.	Std. Err.	t	P>|t|	[90% Conf.	Interval]
age	.0871271	.0607572	1.43	0.155	-.0137256	.1879799
gender	.1352715	.2000557	0.68	0.500	-.196807	.46735
education	.0671146	.1101808	0.61	0.544	-.1157779	.2500071
size	-.1702651	.0760423	-2.24	0.027	-.2964899	-.0440402
_cons	2.318874	.4456326	5.20	0.000	1.579155	3.058593

Linear regression model including all the categorical variables as a hole, status quo bias. Only the variable size is significant.

```
. regress overconfidence size_4180 size_min15 age_1825, level(90)
```

Source	SS	df	MS	Number of obs	=	107
				F(3, 103)	=	3.38
Model	1.56556338	3	.521854461	Prob > F	=	0.0210
Residual	15.8844419	103	.154217883	R-squared	=	0.0897
				Adj R-squared	=	0.0632
Total	17.4500053	106	.164622691	Root MSE	=	.39271

overconfid~e	Coef.	Std. Err.	t	P>|t|	[90% Conf.	Interval]
size_4180	.2974713	.1166437	2.55	0.012	.1038681	.4910744
size_min15	-.0779303	.0865289	-0.90	0.370	-.2215494	.0656889
age_1825	.1247427	.1561042	0.80	0.426	-.1343563	.3838416
_cons	3.080476	.053047	58.07	0.000	2.992429	3.168522

Model created including only the most significant levels of the categorical variables on overconfidence. Only the variable "size" at the level "41-80 ha" is significant.

```
. regress planning_fallacy edu_high edu_uni size_1640, level(90)
```

Source	SS	df	MS	Number of obs	=	107
				F(3, 103)	=	2.71
Model	1.64751423	3	.54917141	Prob > F	=	0.0491
Residual	20.8940731	103	.202855079	R-squared	=	0.0731
				Adj R-squared	=	0.0461
Total	22.5415874	106	.212656485	Root MSE	=	.45039

planning_f~y	Coef.	Std. Err.	t	P>|t|	[90% Conf.	Interval]
edu_high	.0078876	.110182	0.07	0.943	-.1749906	.1907658
edu_uni	-.3118583	.1384063	-2.25	0.026	-.5415826	-.082134
size_1640	-.0276138	.0877148	-0.31	0.754	-.1732013	.1179736
_cons	3.632635	.1080299	33.63	0.000	3.453328	3.811941

Model created including only the most significant levels of the categorical variables on planning fallacy. Only the variable "education" at the level "university" is significant.

```
. regress status_quo age_2635 age_60 size_min15 size_4180, level(90)
```

Source	SS	df	MS	Number of obs	=	107
				F(4, 102)	=	2.68
Model	4.41229496	4	1.10307374	Prob > F	=	0.0358
Residual	41.9968476	102	.4117338	R-squared	=	0.0951
				Adj R-squared	=	0.0596
Total	46.4091426	106	.4378221	Root MSE	=	.64166

status_quo	Coef.	Std. Err.	t	P>|t|	[90% Conf.	Interval]
age_2635	-.1533781	.1716277	-0.89	0.374	-.438268	.1315119
age_60	.1749367	.1631529	1.07	0.286	-.0958857	.4457591
size_min15	.1757617	.140327	1.25	0.213	-.0571712	.4086946
size_4180	-.3973498	.1905485	-2.09	0.040	-.713647	-.0810526
_cons	2.523587	.0968792	26.05	0.000	2.362774	2.6844

Model created including only the most significant levels of the categorical variables on the status quo bias. Only the variable "size" at the level "41-80 ha" is significant.

```
. logit oc_pres age gender education size, level(90)

Iteration 0:   log likelihood = -72.470854
Iteration 1:   log likelihood = -69.248225
Iteration 2:   log likelihood =  -69.23168
Iteration 3:   log likelihood =  -69.23168

Logistic regression                             Number of obs     =        107
                                                LR chi2(4)        =       6.48
                                                Prob > chi2       =     0.1662
Log likelihood =  -69.23168                     Pseudo R2         =     0.0447
```

oc_pres	Coef.	Std. Err.	z	P>|z|	[90% Conf.	Interval]
age	-.301085	.20309	-1.48	0.138	-.6351383	.0329683
gender	-.5376239	.6738967	-0.80	0.425	-1.646085	.5708375
education	-.1950098	.3529819	-0.55	0.581	-.7756133	.3855938
size	.4377468	.2564341	1.71	0.088	.0159502	.8595434
_cons	1.408778	1.477133	0.95	0.340	-1.020889	3.838445

Logistic regression with binary variables assessing the presence or not of the bias, overconfidence. Only the variable "size" is significant.

```
note: 4.size omitted because of collinearity
Iteration 0:   log likelihood = -72.470854
Iteration 1:   log likelihood = -66.271459
Iteration 2:   log likelihood = -66.005763
Iteration 3:   log likelihood = -66.002502
Iteration 4:   log likelihood =   -66.0025

Logistic regression                             Number of obs     =        107
                                                LR chi2(3)        =      12.94
                                                Prob > chi2       =     0.0048
Log likelihood =   -66.0025                     Pseudo R2         =     0.0893
```

oc_pres	Coef.	Std. Err.	z	P>|z|	[90% Conf.	Interval]
size						
<15	-.0176996	.8410669	-0.02	0.983	-1.401131	1.365732
15-40	.7884574	.8146388	0.97	0.333	-.5515042	2.128419
41-80	2.85263	1.288509	2.21	0.027	.7332214	4.972038
>80	0	(omitted)				
_cons	-.2876821	.7637626	-0.38	0.706	-1.54396	.9685956

Detail of the logistic regression into the significant variable for overconfidence, size. Only the variable "size" at the level "41-80 ha" is significant.

```
. logit pf_pres age gender education size, level(90)

Iteration 0:   log likelihood = -28.440288
Iteration 1:   log likelihood = -28.149206
Iteration 2:   log likelihood = -28.144429
Iteration 3:   log likelihood = -28.144428

Logistic regression                             Number of obs     =        107
                                                LR chi2(4)        =       0.59
                                                Prob > chi2       =     0.9640
Log likelihood = -28.144428                     Pseudo R2         =     0.0104
```

pf_pres	Coef.	Std. Err.	z	P>|z|	[90% Conf.	Interval]
age	.0221885	.3533892	0.06	0.950	-.559085	.6034619
gender	.0445308	1.133311	0.04	0.969	-1.8196	1.908662
education	-.394711	.6425327	-0.61	0.539	-1.451583	.6621613
size	.1276284	.4583171	0.28	0.781	-.6262362	.8814929
_cons	2.963957	2.631284	1.13	0.260	-1.36412	7.292033

Logistic regression with binary variables assessing the presence or not of the bias, planning fallacy. None of the variables are significant.

```
. logit sqb_pres age gender education size, level(90)

Iteration 0:   log likelihood = -64.403348
Iteration 1:   log likelihood = -59.770772
Iteration 2:   log likelihood = -59.658891
Iteration 3:   log likelihood = -59.658806
Iteration 4:   log likelihood = -59.658806

Logistic regression                             Number of obs     =        107
                                                LR chi2(4)        =       9.49
                                                Prob > chi2       =     0.0500
Log likelihood = -59.658806                     Pseudo R2         =     0.0737
```

sqb_pres	Coef.	Std. Err.	z	P>|z|	[90% Conf.	Interval]
age	.3690861	.2310826	1.60	0.110	-.011011	.7491831
gender	.4729328	.7499335	0.63	0.528	-.760598	1.706464
education	.2939412	.3847353	0.76	0.445	-.338892	.9267744
size	-.6720275	.3052894	-2.20	0.028	-1.174184	-.1698712
_cons	-1.93517	1.676447	-1.15	0.248	-4.69268	.8223393

Logistic regression with binary variables assessing the presence or not of the bias, overconfidence. Only the variable "size" at the level "41-80 ha" is significant.

```
. logit sqb_pres ibn.size, level(90)

note: 4.size != 0 predicts failure perfectly
      4.size dropped and 7 obs not used

note: 3.size omitted because of collinearity
Iteration 0:   log likelihood = -61.910066
Iteration 1:   log likelihood = -60.359346
Iteration 2:   log likelihood = -60.327497
Iteration 3:   log likelihood =  -60.32748
Iteration 4:   log likelihood =  -60.32748

Logistic regression                             Number of obs     =        100
                                                LR chi2(2)        =       3.17
                                                Prob > chi2       =     0.2054
Log likelihood =  -60.32748                     Pseudo R2         =     0.0256
```

sqb_pres	Coef.	Std. Err.	z	P>|z|	[90% Conf.	Interval]
size						
<15	1.360977	.8427671	1.61	0.106	-.025252	2.747205
15-40	.9534303	.8202807	1.16	0.245	-.3958113	2.302672
41-80	0	(omitted)				
>80	0	(empty)				
_cons	-1.791759	.7637626	-2.35	0.019	-3.048037	-.5354818

Detail of the logistic regression into the significant variable for the status quo bias, size. The size level ">80 hectares" perfectly predicts failure (all 7 observations reported a failure).

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