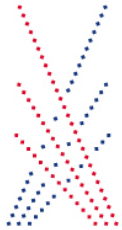

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Support and Prospect theories: a conceptual framework to analyse and mitigate cost underestimation arising from optimism bias in project planning

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Abstract

Optimism bias affects most estimation based human decisions, from daily activities to the appraisal of big infrastructure projects. Building upon the underlying constructs of this behaviour through the lenses of support and prospect theories, operationalised in the internal and external view in the project management context, has helped to formulate a conceptual framework. Relevant attributes from both views and relative theories were gathered, to provide a basis for future analysis and implementation of more accurate forecasting techniques. It has been found that this framework can promote an integration process between the two perspectives, currently deemed incompatible by the existing project management literature. Integration can be achieved by including subjective probabilities and unpacking techniques into case-based reasoning methods, thus creating a holistic view on forecasting. This has the potential to provide new insights on the issue of cost underestimation and effectiveness of forecasting techniques that may result in improved performance for project-based firms.

Word count: 5904

Introduction

Albert O. Hirshman in 1967, presented a principle known as the "Hiding Hand", suggesting that in planning ignorance is a positive thing, as, if decision makers would know the real costs and risks associated with a project, very few would decide to accept it and initiate the works. For this reason, a theoretical discussion that aims at building a conceptual framework able to be operationalised, leading eventually at mitigating the possible errors arising from cognitive biases may seem something of little relevance for people that endorse this idea.

However, as Flyvbjerg (2016) points out, in reality, ignorance does not benefit project success, rather it undermines it. In a scenario where real costs of a project are outweighed, benefits coming from the project at hand will be far more overvalued, and therefore, the combined influences of the two phenomena will lead to a compounded negative effect, as a consequence, also, of the initially high degree of uncertainty. Hence, the assumption that ignorance is bad for projects is made for the sake of this paper.

In order to begin the analysis, first, it will be introduced the concepts related to the decision-making process according to behavioural economics discipline, and afterwards, the idea of cognitive bias will be analysed to understand its potential impact on decision-making. After having assessed the importance of biases, a concept known as the "planning fallacy" (Flyvbjerg et al. 2010; Kahneman and Tversky, 1979) will be introduced to explain the phenomenon of cost overruns that affect many (if not most) nowadays' projects, by linking it to the concept of optimism bias. Planning fallacy draws from the idea that when something needs to be decided, an outside view on the issue should be adopted, thereby, comparing similar past endeavours and relative observable patterns to reach a more accurate estimate.

However, as Tetlock (2005) implies in its work on political judgement, all estimations should aim at balancing an internal and external view in order to be a useful tool for the decision-making process: with this in mind, another theory, known as support theory (Tversky and Koheler, 1994), will be introduced to understand how the use of subjective probabilities and unpacking can help in the process of making a decision during the initial phases of a project.

Functionally describing the problem is not the only objective of this paper; indeed, it will be investigated how to cross-fertilise the above-mentioned theories, belonging to the same theoretical background of behavioural economics, but emphasising two different sides of the problem, the inside and the outside view on forecasting.

Interestingly, in the academic literature (especially in the project management literature) these two sides are perceived to be incompatible (Flyvbjerg, 2018; Love and Dagbui, 2018) and the intense ongoing debate seems more oriented at discrediting each other's ideas rather than at finding a more effective solution able to increase the accuracy of estimates and forecasting techniques, ultimate goal of both research streams. In light of this, the paper wants to propose a conceptual framework, to be utilised as a ground for further future analyses and improvement of current forecasting methods that have been put in place by organisations in the construction industry (Mott MacDonald, 2002), academia (Flyvbjerg, 2004; Salling and Banister, 2009) and policy makers (Green Book, 2013) to mitigate the impact of optimism bias.

Ecological rationality, heuristics and cognitive biases: the architecture of mind

In order to begin with the analysis of the problem related to cost underestimation in projects, the first step that needs to be made relates to the understanding of the problem under the perspective given by behavioural economics on cognitive biases.

According to standard economic models, when an individual needs to take a decision, relies on mathematical processes and calculations, generally defined as "perfect rationality" (Varian, 2010). In this way, people's rationality is assumed not to have limits or constraints from a mathematical capacity and context points of view. This definition of rationality, over time, proved itself to be hardly applicable in realistic and practical settings and for this reason, many economists, among whom Keynes and Savage, started to study the limits of rationality.

Herbert Simon (1955;1979), was the first to introduce the concept of bounded rationality, that, substituting the theory on perfect rationality of standard economics, was able to explain the reasons why the decision-making process of an economic actor may be influenced by boundaries on information, cognitive constraints (such as the partial inability of people to probabilistically assess events) and the complexity of situations, as in the case of modern construction projects (Simon, 1955; Pryke and Smith, 2012).

Bounded rationality, is a procedural rather than substantive type of rationality because does not rely on mathematical processes to make a decision and does not lead to optimal outcomes, taking into account also sub-optimal solutions (Baddeley, 2013). In this sense, decision makers do not take an optimal decision aimed at the utility maximisation (as predicted by the "perfect rationality" model), but a satisfactory one, which, as a consequence means that they do not possess perfect information on the decision to be made and they will try to act in the most reasonable way given the existing limits. Further to that, Simon (1979), specifies that the way in which economic actors will take decisions will be deeply affected by the above mentioned limits, becoming a distinctive trait of the final outcome in taking the decision. Examples of those constraints may be represented by the limit to assess and access every single possible option or the emotional involvement there could be in deciding in a given situation.

According to Gigerenzer and Selten (2002), bounded rationality aims to explain the underlying reasons behind certain behaviours and the consequent decisions resulting from them, by looking at an internal mind perspective, failing to explore the outside structure of the environments to analyse the in-mind behaviours. In response to this, the concept of ecological rationality has been suggested, defining a type of rationality that looks at the relationships of adaptiveness between cognitive and ecological structures. The latter refers not only to the structures present in the real world where people live but also to the human tasks and the relationships between the two structures.

Considering these assumptions behind ecological rationality, makes easier to understand why individuals are not able, most of the times, to take optimal decisions, as is, instead, predicted by standard economics. Indeed, according to behavioural economics, our mind is embedded with an "adaptive toolbox" that, thanks to the adoption of heuristics processes, a quick and instinctive decision-making technique that people use in situations of uncertainty, considers a relatively small amount of information when an individual has to choose between options and/or taking a decision (Gigerenzer and Selten, 2002; Baddeley, 2013).

To clarify this concept, Gigerenzer and Selten (2002), illustrate two different scenarios as in fig. 1:

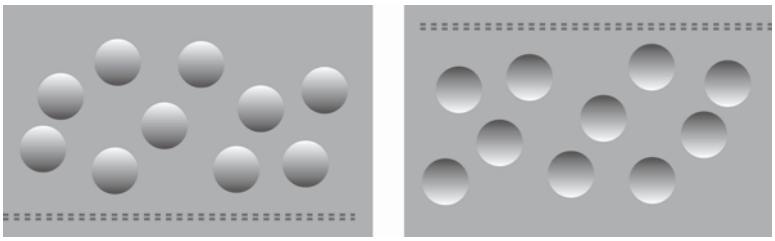

Fig. 1 Role of illusion in environment rationality (Gigerenzer and Selten, 2002)

In the first case, cognitive system deduces that the spheres are concaves and are directed in an opposite manner in relation to the viewer and in the second case spheres seem to be convex and orientated towards the observer. However, by turning the figure of 180 degrees, it can be noticed that the two figures are identical. This represents a quite useful analogy when compared to a decision-making context: perspectives are influenced by different environments or ecological structures, and a decision may be largely influenced by the context in which it needs to be made.

The ecological structure in which a decision is taken is not the only element which may lead to a misguided interpretation and assessment of reality. In personal judgements, as a matter of fact, data that are taken into consideration are subject to limited validity (Tversky and Kahneman, 1974) given by the constraints in having access to full information that are subsequently processed following the principles of intuition and reasoning of heuristics.

Heuristics, as it represents the process leading to a decision where there is no complete information and therefore some level of uncertainty, may present some gaps, labelled by the literature as cognitive biases. Many academics have studied the relationship between heuristics and biases, among which, the largest and more comprehensive studies have been made by Kahneman and Tversky (2000), which identified various types of heuristics with related biases. A detailed discussion of the types of heuristics and cognitive bias that may result from the inefficiencies of the decision making process is outside the purpose of this paper.

All in all, ecological rationality, heuristics and consequent biases that may arise from using this intuitive decision-making tool, represent, in the most realistic way, the architecture of human mind when a decision needs to be made. Is under these set of assumptions, that the issue of optimism bias and cost underestimation in projects will be addressed, with the aim to create a ground for comparison and cross-fertilisation of theories arising from this framework that grew into the formalisation of different (some would say opposite) perspectives.

The anatomy of cost underestimation: prospect theory and the planning fallacy

After having discussed a possible framework regarding rationality in environmental decisions, by highlighting the fact that some biases may arise in a contextual decision-making event and that those can be exacerbated by uncertain information about the future and imprecise knowledge of the present, it will be now examined how this "architecture" can influence people into taking different decisions. In particular, by looking at non-maximising behaviours, it will be introduced Kahneman and Tversky's (1979) prospect theory. This theory has been proposed to explain non-maximising behaviours that expected utility theory is not able to consider. Prospect theory was elaborated as a result of empirical experimentations based on actual decision-making scenarios that people had to face, the nature of those choices were initially related only to the gambling field, but its applicability to other fields such as social sciences, economics and international relations, made it become a prominent and widely recognised theory able to explain an abundance of phenomena. The two academics believe that decision-making process represents the result of two sequential phases: the editing phase and the evaluation phase.

During the first phase, the individual simplifies the decision according to the context in order to create easier prospects as a matter of preliminary analysis. In the second phase, those prospects are evaluated and the one having the highest payoff is chosen (Kahneman and Tversky, 1996; Baddeley, 2013). The perception of changes, according to them, can influence the final decision but, at the same time, is highly dependent on the status quo (or reference point) of the decision-maker, so that in the case of loss aversion, the decision-maker will overestimate losses and underestimate gains (fig. 2, next page). This theory, as mentioned above, is not only related to the phenomenon of loss aversion but also to other phenomena such as the one known as planning fallacy. In this case, according to theory, most of times reference point does not refer to a status quo or a previous situation but on a distorted image of the future (Buheler et al., 1994).

The first definition of the planning fallacy was provided by Kahneman and Tversky (1979), to describe the phenomenon according to which people underestimate the time necessary to complete a future task, disregarding past undertakings of the same or similar tasks. With this definition, the two scholars did not want to invalidate the principle of realism in relation to similar past undertakings completed, but they wanted to stress the role that optimism can play in task estimation time (Gilovich et al., 2002).

In order to assess whether or not an estimation has been influenced by the planning fallacy two issues are likely to occur: first, the estimated time to complete a task will result to be more optimistic than the average of the distribution of past completion time for similar tasks. Moreover, the estimated time to complete the task will be lower than the actual time to complete it (Buehler et al. 2010). In the literature, a large number of experimental studies have been devoted to find out the impact of planning fallacy in personal time predictions to complete a task. Keeping in mind the two main issues that describe planning fallacy as mentioned above, the studies conducted by Buehler and other scholars in the realm of individuals' task estimation times, were able to show how across different categories of tasks these two characteristics were consistently observed (Buehler et al. 1994; 1997; 2010).

Further to this, the tendency to underestimate tasks completion time has not only been studied for personal time predictions, but also in work and academic related undertakings, touching the fields of large scale projects, software development, information communication

technology projects and entrepreneurship (Bruzelius et al. 2002; Cassar, 2010; Lefley, 2013; Min and Arkes, 2012; Pezzo et al., 2006; Phychyl et al. 2000; Shmueli et al. 2016).

Transposed to a project management context, the planning fallacy is epitomised by the optimism bias, a cognitive bias arising from the deceptive formulation of project appraisals, given the delusional optimism in regards to the attributes of the iron triangle (cost, quality and time) from one side and an excessive optimism in terms of stakeholders' capabilities during the project life cycle, from the other. Planners and project promoters, indeed, tend to overvalue positive outcomes, to oversimplify project activities and not to focus on potential risks. As a consequence, promoters will tend to undertake projects that are unlikely to have the benefits planned at the appraisal stage that in many cases will lead to a situation of cost overruns (Flyvbjerg et al. 2010; Meyer, 2014; Weyer, 2011).

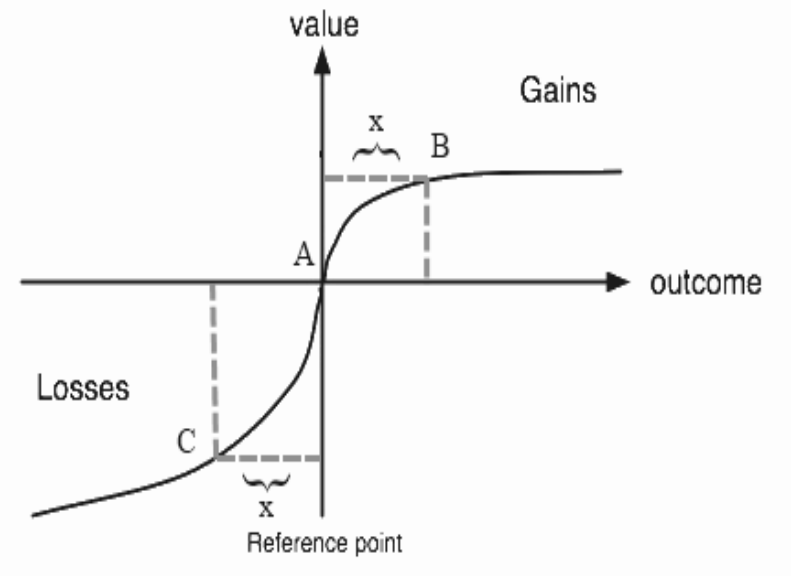

Fig. 2 Value function: overweight losses and underweight gains (adapted from Baddeley, 2013)

Cost overruns as pointed out by Flyvbjerg et al. (2003; 2005), Kahneman and Tversky (1996) and Holm and Buhl (2002), may happen for different reasons. The one just explained, refers to what is recognised as being the psychological explanation; this, together with the technical one, encompassing the inadequateness of tools and forecasting systems in general, but as well "honest" mistakes by cost and risk specialists, represent the internal explanations for cost overruns.

In the literature, moreover, also external explanations have been detected, namely, those associated with economic and political motives, such as strategical misrepresentation and deliberate underestimation of costs and risks. These kind of distortions are deliberate, entailing a fully rational process and as Flyvbjerg (2008) suggests, a variety of measures can be enforced in order to mitigate those intentional misrepresentations by putting in place a system of rigorous accountability for projects' stakeholders and elaborating a set of

procedures entailing incentives to get more precise estimates, for example. However, given the deliberate nature of those situations, external explanations are out of the purpose of this paper. In Table 1 next page, explanations for cost overruns are summarised.

As mentioned earlier for external explanations, also internal ones cannot be completely eliminated but they can be mitigated. For this reason, practitioners and academics are working towards the establishment of new forecasting techniques, not only by looking at the internal mechanisms of the project but also outside of it. In the next section, the differentiation between the inside and outside view on forecasting will be introduced. From this discussion, will be formalised a conceptual framework able to gather relevant attributes from both perspectives in order to provide a more effective basis to analyse and subsequently implement more precise forecasting techniques in project management.

Table 1 *Possible reasons for cost overruns (by author)*

Internal		External	
Technical	**Psychological**	**Economical**	**Political**
• *Mistakes on forecasts* • *Honest errors* • *Inadequacy of business case* • *Inadequacy of project schedule*	• *Planning fallacy* • *Excessive risk-taking conducts* • *Delusional optimism vs uncertainty*	• *Intentional underestimations on accountability of resources and misrepresentations activities*	• *Use of strategies in order to underestimate costs and make a project happen (e.g. political pressure)*

The adoption of an outside view on project cost forecasting

In general, when a person needs to make a prediction related to time or cost decisions, there is a natural tendency to concentrate on the given project by gathering information, developing different scenarios and ground those forecasts on single or few analogies (Lovallo et al., 2012). Therefore, people are inclined to examine the uniqueness of the endeavour or task they have to perform, rather than look for distributional similarities of precedent projects (Lovallo and Kahneman, 2003). This phenomenon was labelled by psychologists as the "inside view". According to many academics, among which Buehler et al. (1994), inside view, triggers events that make optimism bias arise most of the times, as decision-makers, by focusing on the uniqueness of the project, tend to be overconfident and more optimists than they should be.

Internal view, therefore, is highly correlated with the phenomenon of planning fallacy described in the last section and, for this reason, many pieces of research have been devoted to find a way to mitigate cognitive biases by adopting a different perspective that, through the use of distributional similarities, both from an historical and statistical point of view, can make forecasts and appraisal of projects more precise (Flyvbjerg, 2013). This perspective came to be known as the "outside view" on forecasting and when linked to a project management context, it refers to the adoption of specific past projects as a base for the appraisal part of a reference class. Therefore, unlike the inside view, the outside one focuses

on the common characteristics of the project at hand with past ones, allowing planners to avoid thinking just to the particular project at hand and analyse it from a similarity distribution point of view. Given the experience-oriented nature of construction industry, this view is gaining always more and more recognition, and governments have started to release guidelines and policies indicating how to adopt the outside view on forecasting in the most effective way according to the latest developments in the topic's research.

Outside view, in fact, can be implemented through the adoption of a variety of methods, the best known of which is the reference class forecasting (RCF), belonging to the family of the so-called case-based reasoning methods (CBR). Such a method considers and weights the result of past tasks in projects to elaborate a more precise forecast of the project at hand (Flyvbjerg, 2008; Ji et al., 2011). This technique has been developed as a consequence of the theory of optimism bias by Khaneman and Tversky (1996) and consists of three main phases.

The first phase is to identify the most relevant reference class, in which dissimilarities are taken into account in order to identify the reference class that presents the highest correlation to the task into consideration. An important thing to bear in mind while performing this step is to account for a relatively large sample of projects in order to have a result that is statistically meaningful, at the same time the reference class should not be excessively large, otherwise, the comparability of data between projects could be contaminated.

The second phase of RCF, is the establishment of a probability distribution, in order to have a maximum, minimum, median points and, if any, clusters of data. As a matter of fact, some authors such as Ji et al. (2011) have noticed that this phase may present a lot of challenges. One of those is represented by the level of competence of project appraisers to correctly establish the position of the project at hand on the distribution chosen and as a consequence, assessing the reliability of the prediction when computing the correlation with historical data.

To answer this problem, the Green Book (2013) suggests some standard mitigation and contributory factors to optimism bias divided by different categories of projects, embedding some pre-set probabilities in the calculations. It will be analysed, in the next section, with the help of the so-called "support theory" if the use of objective probabilities can represent a correct tool to utilise in the context of cost forecasting for projects to help reducing biases arising from cost underestimation. The third and last phase of RCF, finally, encompasses the placement and comparison of the project with the reference class; generally, in most construction projects, the placement assumption is very close to the median point (Flyvbjerg, 2008).

Overall, RCF technique may present some limitations, such as the hard accessibility of precise and reliable cost data, projects pertaining to different areas grouped in the same cluster (as happens in Flyvbjerg database) and the variability of the sample given the geographical location of the various projects (Salling and Banister, 2009). However, this technique has been proved to be effective with an overwhelming level of statistical significance (Flyvbjerg, 2018). Many efforts have been made in order to further develop these techniques, even though, most of them emphasise the importance of taking an outside view on the project at hand, risking to potentially overlook at the uniqueness of every project, and exclude some categories of projects, such as the vanguard ones (Frederiksen and Davies, 2008). This conduct may eventually lead to reduce the pivotal activity of initial cost forecast of a project to a mere statistical and distributional exercise. For this reason, the paper wants to explore the possibility to adopt a framework able to have a more holistic approach, grounded

on the same theories of the two perspectives introduced in this section, that perhaps, rather than being opposite perspectives represent two faces of the same coin.

Enhancing the positive impact of the outside view with attributes of the inside view: support theory and subjective probabilities

As mentioned earlier, the outside view presents many positive features and is able to mitigate some aspects of the planning fallacy by considering similar past decisions or endeavours. In fact, by considering a probabilistic rather than deterministic approach on estimations is able to give a more complete picture on the different scenarios that are likely to happen given past similar events (Buheler et al., 1994). Applying this perspective to cost forecasting techniques, has been showed to be effective in partially mitigating, in absolute value, the optimism bias usually arising when appraisers make cost estimations for projects. However, academics and practitioners that are usually favourable towards this approach, disregard an important matter: adopting an inside view when making forecast of any kind does not always produce an outcome of planning fallacy (Kruger and Evans, 2004), indeed, in some cases, the opposite may be true. In fact, it may happen that by adopting a perspective that is "too external" and does not enter in the known details of the task or project that needs to be estimated can result in an increase of the planning fallacy, as appraisers perspective may be diverted excessively from thinking about the specific endeavour.

From a theoretical perspective, it is possible to find a ground able to explain the above-mentioned supposition in another work based on decision-making analysis and judgement capabilities in the behavioural economics literature, the support theory (Tversky and Koheler, 1994). The starting assumption of this theory, is the fact that when a person is asked to make a decision, it will base this according to subjective probabilities, or in other words, the degree of belief and the relative quantification that can be expressed both in form of direct judgment or as a choice between different events (Kahneman and Tversky, 1983). The decision will be, therefore, dependent on many variables, such as past experience, different opinions or simple intuition. There will be, on the other hand, also other factors at play during this decision, and this theory, by recognising the nonextensionality of subjective judgements postulates that probabilities associated with those judgements are not linked to events but to the way the events are described. Following this logic, the resulting probabilities' outcomes, will not be equal to the probability that the event occurs, as predicted by probability theory (Fischoff et al., 1978) but will be assessed in terms of the support corresponding to a specific hypothesis derived from the description of the event of the judging probability.

As a consequence, the main assumption of this theory is that unpacking an event into subcategories is able, in general, to positively influence its support: for example, if the event to be considered is "a building collapse", and two subcategories are "building collapses because of foundation failure" and "building collapses because load is heavier than expected", then the support relative to the two disjoint events will be equal or greater than the support relative to the event that does not have further cause description. This principle, as Tversky and Koheler (1994) mention, is not only related to probability judgement but is something that can be applied at a greater level as a founding characteristic of human judgement.

Before exploring further how the attributes of the support theory are able to enrich the analysis on cost forecasting, a clear differentiation between the concepts of unpacking and decomposing a task or project should be outlined. Following what Kruger and Evans (2004)

report, when practically operating on a task and the requirement is to decompose it, next step is to actually divide the task into subcomponents and to make separate forecasts for each of them that will be subsequently aggregated (not important the actor that performs the aggregation task). Unpacking, on the other hand, requires only to break down the task in a figurative way, altering the description or representation of it in order to enhance the accessibility to the parts that constitute the whole task, so that the forecaster is able to elaborate a single judgement and not numerous as in the case of decomposition.

In light of this, unpacking (and relative support theory) rather than decomposition principle has been chosen in order to create the conceptual framework of this paper, because it yields to a single judgement elaborated by the same person that is required to complete the estimation task, as it happens in reality when appraising for a project.

As a result of these speculations, support theory may be presented as a possible route to follow in order to address the issue related to the underestimation of time and cost arising from the planning fallacy, as it accounts for factors that are oriented towards the inside view rather than focusing solely on the outside view. Further to this, unpacking is able to give a more specific perspective of the task at hand and in the case of projects, could give to forecasters the opportunity to gain better and more specific insights by focusing on how to divide into subcategories the estimation to be performed rather than just focusing on similar past projects. Indeed, unpacking a determined project or task, by offering a different outlook, may remind forecasters of possibilities they would have not accounted for and at the same time, may give importance to the various milestones to be achieved in order to conclude the endeavour in a way that a more precise snapshot of the object of the estimation can be built in the forecaster mind before performing the appraisal.

With this in mind, it becomes clear that, if the main attribute of support theory (i.e. unpacking), would be integrated with the outside view on forecasting, some of the shortcomings of this technique would be mitigated. When considering the case of RCF, as mentioned before, one of the weaknesses of this method is related to the possible mistakes deriving from the wrong positioning of the project in its reference class (and the selection of the reference class itself): if the appraiser, before conducting the analysis on the selection of the reference class and the relative position of the project in it, would unpack the project at hand, this action may unveil characteristics of the project that were not considered before, resulting in an overall improvement of the quality of the appraisal. As a consequence, it may help in enhancing the value of comparability between the project at hand and past project, which is a fundamental issue when it comes about the adoption of an outside view on cost forecasting model (Lovallo et al., 2012).

Also, another relevant attribute of support theory in the context of cost forecasting, is the fact that it entails the use of subjective probabilities: earlier on, it was discussed that in order to reduce optimism bias the Green Book (2013) suggests that some contributory and mitigating factors can be used in order to consider if the optimism bias final calculation on the project at hand can be reduced. However, contributory factors constitute a standardised measure given by policymakers not aimed at being changed and therefore represents an objective probability (they are expressed under the form of a pre-set description that cannot be changed by the forecaster without altering the final result of the calculations). Differently, unpacking, is based on subjective probabilities, so that the application of it on forecasting may have the opportunity to make estimations more reliable, as, with the possibility to manipulate the

probabilities related to the contributory factors, it may focus on aspects of the project at hand that would be overlooked by using standard measures.

Moreover, It has been showed that support theory, through unpacking, has the potential to improve forecasts accuracy and as a consequence reduce the impact of optimism bias; unpacking, indeed, has revealed itself to be more effective when performed on complex tasks (Kruger and Evans, 2004), and this is the reason why it may seem particularly suitable to be adopted in the appraisal of projects' cost and schedule.
The above discussion, suggests therefore that, integrating some attributes of the inside view on the outside view on forecasting, would have a beneficial impact in relation to the reliability of the final estimates and that, the issue of the planning fallacy, may be analysed by looking at it from a more comprehensive perspective.

Integrating different perspectives on cost forecasting: theoretical implications

Prospect theory and support theory have a different interpretation on how to overcome the planning fallacy, this, however, does not mean that the two explanations are mutually exclusive. On the contrary, they both contribute in giving more insights helpful to clarify the issue, by analysing from one side the importance of comparing the task of estimation at hand with similar past cases adopting a probabilistic mind set and from the other side it offers the opportunity to increase the awareness on the components that constitute the task. Interpreting the theories in this way gives the opportunity to look at the issue of the planning fallacy in a more holistic way, opening new routes of exploration both at a general level and at more specific cases such as the one of cost forecasting for projects.

In this setting, the conceptual framework that this paper wants to propose, can be introduced: Analysing the problem of cost underestimation and its corollary of making more accurate estimates, should not be aimed at fragmenting it into two different and incompatible perspectives, as currently presented in the literature (especially in the project management literature); it should, as a matter of fact, be focused on adopting a more holistic approach that capitalising on the positive features of the two different perspectives is able to reach the final goal of both, improving the precision of forecasts.

As can be observed in fig. 3, next page, a process of integration (Phase B), both at a practical and at a theoretical level is promoted in order to create new knowledge on this field and create a set of techniques, methods, approaches and regulations. Those should be able to consider a "holistic" view on cost forecasting rather than two scattered perspectives that even though providing relevant insights, have been proved to have many limitations, as previously discussed in the paper.

This framework may help in devising, what are the strengths and weakness of each perspective to operationalise them into the cost forecasting techniques that are currently being used to make them more precise and effective decision-making tools. The framework is intended, therefore, to provide a ground for analysis as prompted by Semiatycki (2008; 2009) in blending different approaches to develop innovative techniques to collect and analyse data from various sources able to contribute to an advance in the understanding of the mitigation of optimism bias in the project management context. A critical assessment of those techniques, however, is outside the scope of this paper but will be the subject of further research on this topic.

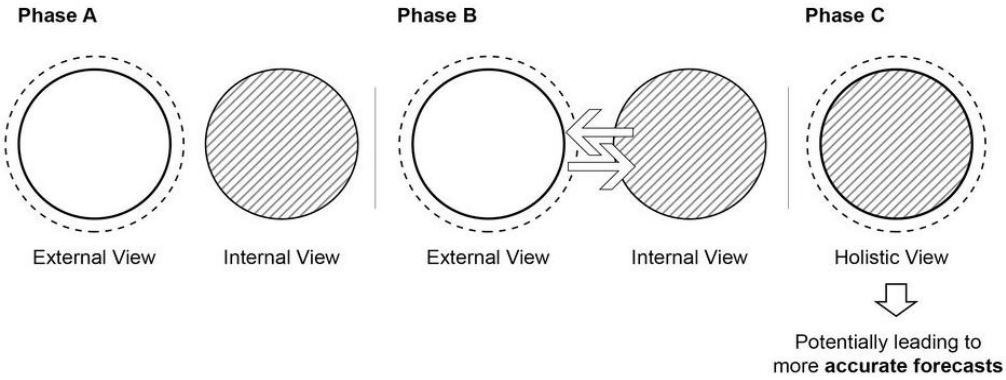

Fig. 3 *Integration of the External and Internal view to create a Holistic View on forecasting (by author)*

Conclusions

This paper main objective was to introduce a new conceptual framework in order to analyse the problem of cost underestimation and forecast accuracy during the phase of project planning. To formalise the framework, first it was elaborated a context that through the decisional theories of behavioural economics was able to explain the existence of cognitive bias in projects. This background was used to pave the way for the psychological reason behind cost overruns, present the planning fallacy and look into a possible explanation of it thanks to the prospect theory. After that, a perspective that looked at the appraisal of projects as a distributional historical analysis of past project characteristics, the outside view, was analysed to find out its main positive and negative features.

As opposed to the outside view, the inside view on forecasting was explored, to understand whether or not some attributes offered by the support theory and its main assumption related to unpacking may provide new insights on how to mitigate the issue of cost underestimation. It has been found that according to the literature, unpacking a task, or, in other words, figuratively breaking down a task and manipulating the description or representation of it, has the potential to reduce the planning fallacy, and make estimates more accurate. Also, thanks to the use of subjective probabilities, it may unveil contributory risks that are not part of the standardised measures found, for example, in the Green Book (2013) and therefore helping in getting more reliable estimates.

In light of this findings, it was proposed that, in order to gain new insights and to approach the problem of cost underestimation, an holistic view rather than inside or outside view on forecasting should be adopted, creating a conceptual framework that integrates the two perspectives considering the two theories described in the paper.

Further to this, some limitations on how to operationalise this integration may be devised: first of all, in practice, no forecasting technique embedding internal and external view has ever been put in practice for more than one project, an example of it is the Salling model (Salling and Banister, 2009) that considers distributional and deterministic calculations (no

mentioning of unpacking though), therefore there might be resistance from practitioners to adopt it. In order to solve this issue, the necessity to make more research on the topic and to empirically provide a practical ground for the validity of this framework should be carried out.

Also, the proposed framework is based on behavioural economics constructs, which, acknowledging the limits of human rationality also make a point on the difficulty to study patterns related to human behaviour: every forecaster and every decision-maker will adopt different behaviours in different circumstances. However, if specific patterns are isolated for study, they may lead to the formulation of techniques that even if not able to solve completely the issue of optimism bias (something that is unfortunately impossible to achieve) may help in mitigating it in a more efficient way. In this sense, the advice is to devote more research efforts in exploring appropriate and innovative laboratory and out of laboratory simulations able to mimic in the best possible way what happens in reality.

Finally, during the course of this paper, it has been mentioned many times how the two theories and the two perspectives presented differ from each other's; however, it should be highlighted that they both emphasise how at the base of the inaccuracies in estimations, human behaviour and judgement plays a central role. This, therefore, constitutes an appropriate ground in order to analyse, further, in future researches, how cross-fertilising and integrating those two theories may offer an enhanced "toolbox" for project appraisers to get better estimates.

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