Appendix 2: Retrievability Bias in Explaining the Hurdle Rate Premium Puzzle

Mareike Hornung

Robert Luther

Peter Schuster

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1 Investment appraisal and setting the hurdle rate

Making correct investment decisions poses an important challenge for senior management. In particular, capital investments and consequently the appraisal of potential projects significantly affect a company's long-term performance and survival. The optimal decision, i.e. choosing the most profitable investment project, requires a non-distorted decision process with accurate data and rational decision-making. This paper revisits the phenomenon that "a hurdle rate in excess of the corporate cost of capital is often used to appraise divisional project proposals" (Harris, 2000, p. 91), and aims to provide a novel explanation based on managerial cognitive behaviour and corporate post-audit feedback processes.

Götze *et al.* (2015) model the ideal investment decision process and identify seven typical stages, of which Stages 5 and 7 of Figure 1 are particularly relevant to this study. Stage 5 refers to the investment appraisal methods applied and the acceptance decision made; Stage 7 refers to the monitoring and 'post audit' of projects and the resulting feedback and learning process. The setting of hurdle rate and the potential systematic error, as argued later in this paper, affect both stages.

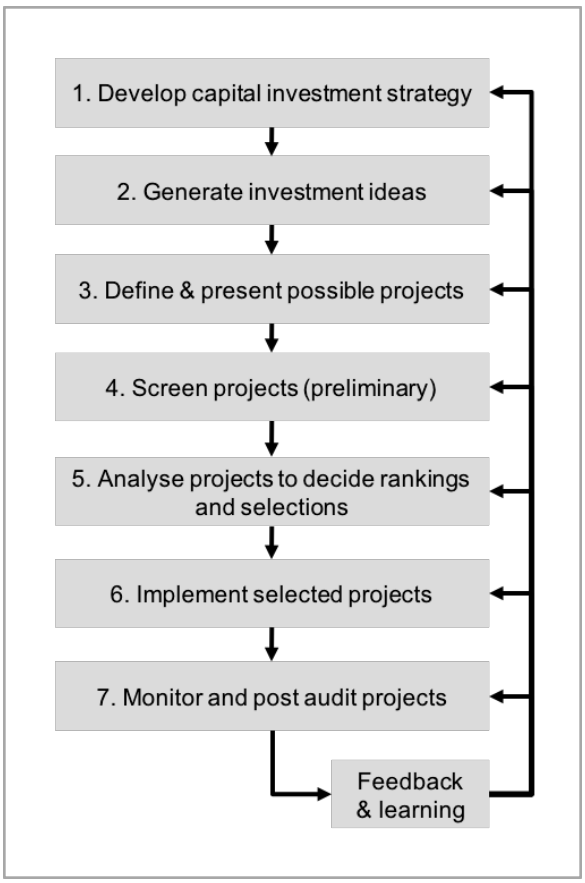

Figure 1 An investment decision process model based on Götze et al. (2015).

As regards Stage 5 of the process, discounted cash flow appraisal methods such as Net Present Value (NPV) and Internal Rate of Return (IRR) methods are widely recommended and used (see for example Haka, 2007; Meier and Tarhan, 2007; Pike, 1996). They require the following parameters: the discount rate and the project's forecast cash flow profile. The decisions about the parameters will affect the projected profitability of the considered investment projects and thereby the outcomes of the investment appraisal. This paper particularly focuses on the discount rate and what has become known as the Hurdle Rate Premium Puzzle.

The NPV and IRR methods are related. The former seeks to identify the 'value' that would be created, i.e. the present (discounted) value of all current and future cash flows. A project should be adopted if the NPV is positive, i.e. the project's rate of return exceeds the discount rate applied. Hence, the discount rate represents a minimum rate of return or hurdle rate. The IRR method calculates the rate that would lead to an NPV of zero, i.e. the rate of return of the investment project. A project should be supported if its IRR exceeds an appropriate hurdle rate. For both NPV and IRR methods the cost of capital typically serves as the hurdle rate. In our analysis, we will concentrate on the NPV method and assume a typical stream of cash flows;

that is, where initial outflows are followed by (mainly) inflows, so that the higher the discount rate, the lower the estimated NPV.

The values of the parameters utilised in investment appraisal derive from information in accounting records and knowledge and, in practice, from the decision-maker's memory and wider experience that can influence subjective parameter estimates (Luft and Shields, 2010). When making judgements the human cognitive system – exhibiting limited rationality – often uses decision rules that simplify a complex task and may incorporate cognitive biases, which will lead to suboptimal capital investment decisions. This paper examines one decision rule and reveals how its application under certain conditions can lead to suboptimal decision-making.

To detect a distortion in setting the hurdle rate, the rate actually chosen by the corporate decision-maker can be compared with an estimate of the optimal hurdle rate, i.e. an objectively appropriate one. Therefore, in Sections 1.1 and 1.2 we will discuss the determination of the hurdle rate in theory and in practice and consider the Hurdle Rate Premium Puzzle as practical phenomenon. Section 2 introduces the 'availability' decision rule and argues how this rule of thumb can lead to distorted judgement in the context of setting the hurdle rate. An illustrative example shows how a so-called heuristic might guide a corporate decision-maker's judgement and the bias that can result. The retrievability bias can systematically lead decision-makers to apply a discount rate higher than the cost of capital, and thus partially explains the boundedly rational hurdle rate premium.

1.1 Determination of the optimal hurdle rate

Discount rates play a major role in most investment appraisal methods. They are of crucial importance in enabling comparability of cash flows occurring at different points in time and permit comparisons between investment alternatives. They are applied to balance out differences in tied-up capital and in economic lives and reflect how much the future cash flows will be devalued.

The cost of capital approach is considered suitable for determining an appropriate discount rate. It is the minimum average rate of return needed to satisfy the requirements of the providers of funds and should recognise the effect of the project on the overall level of risk to the company's funders. It can be determined by the weighted average cost of capital (WACC) with the cost of debt derived from debt financing agreements, and the risk-adjusted company or project-specific cost of equity[1] based on the Capital Asset Pricing Model (CAPM). Using WACC as hurdle rate appears rational. Assuming that the projects being considered have the

[1] It builds on 'classical' research, for example originated by Sharpe (1964) and Lintner (1965), followed by publications of Black (1972), Black *et al.* (1972), Rubinstein (1973), Fama and MacBeth (1973), Black and Scholes (1973), Merton (1973), Ross (1976), and Ross (1977) and has been further developed for example by Dolde *et al.* (2012). It has seen serious criticism and justifications, for example by Jagannathan and Meier (2002), Wood and Leitch (2004) or Fama and French (2004).

same risk as the company's current projects on average, there is no better indicator of the company's future risk than the current cost of capital which reflects the expectations of creditors and shareholders given the current level of information.

It can be argued that companies utilizing the CAPM should conduct project-specific risk assessments and hence adjust the company WACC upwards or downwards to find the most appropriate hurdle rate – a key understanding of corporate finance theory since Modigliani and Miller (1958). The resulting tailored discount rates follow the logic that different projects or company divisions are associated with different levels of risk and therefore require adjustment.[2] However, a company's overall risk is the result of the individual capital investment projects' risks, and thus a company's WACC always represent the average project- (or division-)[3] specific hurdle rates.

In summary, the determination of a company-wide cost of capital – potentially adjusted for a project's specific risk – is a well-established, objective and accurate approach to approximate the optimal cost of capital (see for example Modigliani and Miller, 1958; Modigliani and Miller, 1965; Elton, 1970; Myers and Turnbull, 1977).

1.2 Determination of the hurdle rate in practice

Empirical research confirms that companies apply company-wide as well as project-specific discount rates – the majority applying a single company-wide discount rate only (see for example Meier and Tarhan, 2007; Graham and Harvey, 2001; Brounen *et al.*, 2004; Bruner *et al.*, 1998). In doing so, they typically use WACC.

Of particular relevance to this paper, the self-reported discount rate – and therefore the hurdle rate – often considerably exceeds the computed cost of capital (Brunzell *et al.*, 2013; Meier and Tarhan, 2007; Poterba and Summers, 1995; Gup and Norwood, 1982). Those studies contrast optimal and actual, i.e. self-reported, hurdle rates. Optimal rates were approximated by externally calculating WACC with data derived from the market and financial statements. This paradox that the self-reported hurdle rate exceeds the optimal one is known as the Hurdle Rate Premium puzzle. Evidence for this paradox is provided in studies of US companies by Meier and Tarhan (2007) and Poterba and Summers (1995) and in Nordic companies by Brunzell *et al.* (2013).

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[2] However, in practice there are problems in objectively determining an appropriate project-specific hurdle rate (see, for example, Titman and Martin, 2010). Moreover, conducting project-specific risk adjustments is questioned by corporate finance literature. For example, Reimann (1990) suggests establishing a regularly updated cost of capital based on CAPM principle, applied as a common hurdle rate. Risk adjustments should be made at the cash flow level. Risk adjustments can be made in various ways. This is not picked up in this paper; for empirical findings about different approaches applied see for example Lindblom *et al.* (2010).

[3] In the following, company WACC will be contrasted to project-specific cost of capital, but the same logic applies for divisional cost of capital.

A higher than optimal hurdle rate reduces profitability and implies a bias against lower-risk projects relative to riskier projects (Titman and Martin, 2010). It can also lead to a short-termism; companies may systematically favour projects with relatively high cash inflows in the close future by more strongly discounting cash flows that occur at a later point in time (Dobbs, 2009).

1.3 Existing explanations for the Hurdle Rate Premium

The Hurdle Rate Premium (HRP) has been known for many years and various explanations have been put forward.

Brunzell *et al.* (2013) empirically find that the sophistication of a company's investment appraisal method is inversely related to the hurdle rate premium (the more sophisticated the method, the lower the hurdle rate). Additionally, they find that short-term pressure felt by decision-makers has a positive impact on the hurdle rate (Brunzell *et al.*, 2013). Meier and Tarhan (2007) suggest that the growth potential and financial situation of a company are positively associated with the hurdle rate premium. However, these are merely statistical observations, and do not provide logical explanations for the paradox.

Titman and Martin (2010) note the potential scenario of capital rationing with mutually exclusive projects in which the hurdle rate might be raised to equal the opportunity cost, i.e. the rate of return of the next-best project, but this interesting concept does not provide a generic explanation for the HRP.

A relatively high hurdle rate might also be chosen to compensate for managerial overconfidence and overoptimism, which typically lead to inflated cash flow projections (see for example Gervais, 2010; Dobbs, 2009). This explanation could be valid where different level managers are involved in generating proposals from those making the investment decisions, since the higher level might want to adjust for biased behaviour below. However, instead of increasing the hurdle rate to correct for overconfidence and overoptimism, it would be more straightforward for the decision-maker to reduce the projected cash inflows across the project term; this would also avoid unintended compounding of the correction beyond the planning horizon.

Studies finding a hurdle rate premium (Meier and Tarhan, 2007; Poterba and Summers, 1995; Brunzell *et al.*, 2013) compare the (theoretically required) cost of capital to the hurdle rate self-reported by companies. There is, however, no argument in the HRP literature that the premium is only attributable to a conscious (upwards) adjustment of the cost of capital to derive a hurdle rate – the premium may also be applied without much thought or awareness.

The adjustment of hurdle rates due to the explanations above mostly require conscious adjustment, they may not fully solve the puzzle. In the following section we argue that the premium may arise due to unconscious intuitive judgements and cognitive biases; that is, it may be caused by decision-makers using simplified decision rules, so-called heuristics, to facilitate decision-making (Tversky and Kahneman, 1974, Kahneman, 2003, Dobbs, 2009). This would imply, though none of the approaches outlined above has extensively dealt with this aspect, that distorted judgement may be an explanation. The hurdle rate premium could, at least partly, be attributed to limited (bounded) rational behaviour in that cognitive reasoning systematically and unconsciously guides decision-makers to make suboptimal decisions.

2 The relevance of cognitive biases to explain the Hurdle Rate Premium

Despite normative views that the optimal hurdle rate for appraising projects should equal the cost of capital, empirical surveys of practice do not confirm this. The arguments outlined in 1.3 above may provide partial explanations for the HRP but we maintain it has another explanation, based on decision-makers' bounded rationality and biased intuitive judgements.

Intuition may be involved whenever judgements are incorporated in the decision process thereby influencing the decision: When a manager determines the discount rate or hurdle rate for evaluating an investment project, he or she may subjectively use different sources of information including his or her[4] own experience, thereby deviating from the 'optimal' process. The optimal process or outcome may be disputed but the tendency to set hurdle rates higher than can be explained by standard corporate finance theory, has been shown.

As indicated above, a decision-maker's memory, knowledge and experience almost always play a role in the process of searching and selecting the information from accounting records and knowledge (Luft and Shields, 2010). This may vary between a fairly objective, 'close to optimal' choice of the hurdle rate where only few or no pieces of information are subjectively searched and selected on the one hand, and a highly subjective choice of the hurdle rate on the other hand. Even the 'close to optimal' case implies some subjective considerations.

2.1 The heuristics and biases concept – some background

From psychology-based research it is known that in decision situations under uncertainty, decision-makers often use 'heuristics' or 'heuristic principles' when their complex task is to make a judgement (and eventually make a decision) where a probability or value has to be estimated or predicted (Tversky and Kahneman, 1974). Heuristics are often described as decision shortcuts, rules of thumb or simple decision rules. Generally, a decision-maker –

[4] For simplicity, in future, the male pronoun is used but this is not intended to imply any significance.

deliberately or (more typically) unconsciously[5] – simplifies the problem (i.e. uses simpler judgemental operations) in order to solve it. This can be due to various reasons such as limited information, time constraints and bounded cognitive capacity to store, retrieve and process information. As a consequence, the decision-maker forfeits an optimal result, which otherwise – if at all – might only be reached by a thorough and rational analysis, and accepts a satisfying and sufficing non-optimal decision instead. This bounded-rational behaviour is known as 'satisficing' (Simon, 1955).

To arrive at a judgement about an event that the decision-maker has limited information about, and that is not available to perception, the heuristic serves to search and choose the informational sources and information to utilise (Hastie and Dawes, 2010). Brunswik's Lens Model provides a framework for judgement (Brunswik, 1952; Cooksey, 2001). The hurdle rate is the to-be-judged criterion for which a judgement, i.e. an estimate, has to be made. The decision-maker uses the cues (the 'lens' that connects the environment with internal psychological processes) that are available to him or her such as information in accounting records, knowledge about how hurdle rates should be set and also from memory and wider experience (Luft and Shields, 2010). Cues may be unconscious, interrelated and interdependent and involve 'limited ecological validity' due to uncertainty in the environment and limited time (Brunswik, 1952; Hastie and Dawes, 2010). The decision-maker then processes the cues' information and makes an inference as to what the criterion should be, i.e. he makes an estimate of the criterion (the hurdle rate) and thus arrives at a judgement (Hastie and Dawes, 2010). Heuristics can be described as the way cues are combined and processed.

Generally, heuristics can be very helpful tools; intuitive thinking is not wrong in general but deemed to be skilled and successful (Kahneman, 2003). Heuristics save time and simplify a problem and may lead to generally good judgements (Gigerenzer and Brighton, 2009), unless – consciously or unconsciously – a cognitive bias occurs, that can result in severe and systematic decision distortions. Setting the hurdle rate might be such a complex decision task. The following example will illustrate where subjective judgement represented by a heuristic is involved in setting the hurdle rate. It will be shown how a heuristic might influence a manager's judgement and the bias that can result.

2.2 Example

Consider a situation where a decision-maker such as a manager or a CFO of a large[6] company, who is responsible for making capital investment decisions, has data about previous investment

[5] For a discussion on the extent to which heuristics are deliberate or unconscious processes, see for example Sloman (2002).

[6] Decision-makers in large companies might have a more significant level of experience due to high investment volume, a high number of projects and standardised processes. Moreover, there can be more than one manager deciding on projects (e.g. each one responsible for another field) so that the "knowledge pool" and feedback to investments might be greater and better.

projects and their outcomes, as well as about the cash flow projections of a potential investment project. The manager is well-educated in corporate finance, experienced in his job and has decided upon, and can recall, a number of investment projects of similar nature (e.g. with respect to the project's features and investment frequency). The company routinely applies a project-specific discount rate based on company WACC adjusted for project-specific risk.

Imagine the manager's task is to determine the discount rate and thus the NPV to appraise a potential investment opportunity. Being experienced in his job, he is not inclined to conduct an explicit detailed analysis of the project's risk; instead, he usually intuitively considers all risks associated and prefers a prompt decision. "With today's dynamic business environment, executives must have cost-effective and user-friendly analysis techniques that they can apply easily but not mechanically, which are embedded in their everyday thought processes." (Harris, 2000, p.103). As stated the manager has decided upon several projects of similar nature in the past and *ex post* considered whether parameters such as the cash flows and the level of risk had been correctly estimated.

Let us assume that the project-specific risk premium applied for all similar projects in the past has been the same due to a similar level of riskiness. Also that the decisions to invest turned out to be reasonable *ex post* since the cost of capital applied as hurdle rate for these projects appeared to be a good approximation – except for one project: One of the comparable projects, on which the manager participated in the investment decision, failed and led to a loss in company value. The (relatively unlikely or not anticipated) worst case 'state of nature' happened and the cash flows failed to materialise as expected. Thus, as regards the project's risk assessment, the hurdle rate chosen for the initial appraisal still seemed objectively justifiable. An 'outlier' outcome of low probability (such as a plant burning down) may have occurred but was not present in the decision-maker's mind; the event had never occurred and its probability was underestimated. From the subjective point of view of the manager, this scenario can lead to a different risk assessment *ex post* and biased judgement in a similar future situation as will be explained in the next section.

2.3 The retrievability bias and its surprising effect

The 'availability heuristic' is a simple decision rule that may be applied by the manager in such a situation. It implies that, when a decision is to be made about the probability of an event, an individual 'searches' the memory and concludes that those events which come to mind more easily appear to be more frequent and therefore probable (Tversky and Kahneman, 1974; Kahneman, 2003).

Assuming that the managerial decision-maker is not inclined to conduct an explicit thorough analysis but feels able to evaluate the risks informally in his mind, he may unwittingly

employ the availability heuristic in making a judgement about the appropriate hurdle rate. He must judge which hurdle rate (i.e. higher, lower, or equal to the WACC and by what amount) appears to be the adequate one given uncertainty about the future and thus which one ensures a good decision about the project's value. In practice, board decision-making plays an important role. However, boards consist of individuals each having been involved in good or bad prior decisions so the process described, though incomplete, remains valid.

In this process, the availability heuristic suggests the following reasoning for an *unbiased* mind: The decision-maker recalls all projects of similar nature from the past and assesses the extent to which the appraisals – including the assessments of risk and the applied hurdle rate – were appropriate. "Decision makers use their own experience, and evaluate new opportunities by comparing them with a reference point from personal knowledge." (Emmanuel *et al*., 2010, p. 481). He might conclude that for projects, except one, his judgement of the risks and his resulting decision, i.e. the selected hurdle rate, was appropriate; and thus this hurdle rate seems *ceteris paribus* to be a good starting point for a rate to be applied to the current project. However, some minor amendment of the hurdle rate might seem necessary due to his experience with the incorrect decision that was made because he underestimated risk (e.g. the risk of fire) and thus the hurdle rate applied by the company seemed too low. For appraising future similar projects the hurdle rate should be slightly revised upwards correcting for the neglected type of risk.

One *bias* that can occur due to the availability heuristic is the so-called 'bias due to the retrievability of instances' developed by Tversky and Kahneman (1974): When some events are more vivid than others or have occurred recently, they can more easily be recalled from memory and thus appear more frequent and therefore probable than others. Other events might have occurred equally frequently in the past but, as they are less vivid in the decision-maker's memory or occurred a longer time ago, they appear less likely (see Tversky and Kahneman, 1974; Bazerman and Moore, 2013). This bias will occur if the manager's decision is overly influenced by the very salient exceptional project (such as a production site fire). That event can make him believe that his assessment of the project's risk and thus his determination of the project's hurdle rate may have been inappropriate; it led the company to experience a loss in value, and should have been set significantly higher.

We assume that organisations do generally have widely accepted perceptions about whether or not individual past investment decisions were good decisions, satisfactory decisions or bad decisions. Given the assumption that an investment is perceived to be regrettable and to have 'failed', there will be formal and informal, or even unconscious, individual and group thinking about what was the reason for the failure or what had been incorrect in the appraisal process.

There are two broad causes for the failure of an investment project: cash flows that turn out to be worse than forecast, and a risk assessment that may result in inappropriately low risk-adjusted cost of capital, i.e. actual risk-adjusted costs of capital that exceed expectations. As regards the risk assessment of a project as the cause of failure, the following two categories have been identified:

Category I: The appraisal process was correct and all the risks were adequately recognised (including the level of uncertainty about cash flows), but the actual 'state of nature' turned out to be bad. Enterprises will inevitably have projects that go wrong despite correct quantification of risk, and they need to accept some failures; if they set the hurdle rate so high that no projects ever failed, this would also screen out many good projects.

Category II: In the appraisal process, risk was not adequately recognised with regard to:

- The cash flows were over-optimistic given the facts that were known at the time; thus there was a greater organisational information risk (related to the reliability of the forecasting) than recognised.
- The project had inherent flaws that were not known at the time of the appraisal; thus the project information risk was not adequately recognised.
- The costs of capital were underestimated at the time (procedural risk), or they increased more than was anticipated (information risk).
- The operating (internal) environment deteriorated more than was anticipated (e.g. key staff left, the factory was flooded); thus the operating risks were not adequately recognised.
- The external environment changed more than was anticipated; thus the business risk was not adequately recognised.

In all of the above Category II issues, the hurdle rate applied is likely to be seen to have been inappropriate. For example, not recognising over-optimistic cash flows or not recognising potential changes in the market (external environment) represents an underestimation of risk. The firm's policy and the decision-maker's motivation may now increase efforts that all Category II reasons will be eliminated in a subsequent appraisal to improve decision-making. Learning from, and adjusting to the inappropriate appraisal components will be central to a project review; and a flawed investment appraisal that led to project failure represents a salient event to the decision-maker.

To a different decision-maker it may not be obvious whether the project failure was a 'poor draw' from the correctly specified distribution (Category I) of the project's outcomes, or whether there was a cash flow error or a risk was inadequately recognised (Category II).

Conceivably, a decision-maker may realise that risk had been adequately recognised (Category I) and thus it was not their mistake and should not influence their future judgement. Despite this reservation, there may still be a high enough proportion of projects that are perceived to be in Category II for the retrievability bias to irrationally upwardly skew hurdle rates:

The bias arises if, due to the 'painful' experience of a project failure in general or of a false appraisal, the perceived risk and thus hurdle rates for the subsequent projects under consideration are set higher than appropriate and what the 'availability' rule of thumb suggests. In other words, prior mistakes are overcompensated. The systematic setting of inappropriately high hurdle rates gives distorted estimates of projects' profitability and leads to underinvestment. The feedback to the decision-maker due to false project appraisal will be discussed in the next section.

2.4 Systematisation of scenarios, outcomes and feedback

Figure 2 systematises and graphically depicts the problem by identifying eight cases, their decision outcomes and interpretations by the decision-maker. In Cases A, B, F and H decision mistakes were not made because even with the appropriate hurdle rate, the decision (accept or reject project) would have been the same. Cases D and E represent appropriate risk assessments and settings of the hurdle rate and are therefore not considered further.

In Case A, the decision-maker has – based upon their risk assessment – set the hurdle rate too high but the project nevertheless is accepted and will not lead to a loss in company value, i.e. with hindsight, it will be seen to be 'good'. This implies that the projected cash flows must have been sufficiently high to compensate the inappropriately high hurdle rate effect. Error does not result from the hurdle rate being set too high in this case. The same logic applies to Case F which was correctly accepted, due to strong positive cash flows, despite an underestimation of risk and an inappropriately low hurdle rate.

With regard to the feedback provided to the decision-maker we should now consider the investment decision-making process and its final step (see Stage 7 in Figure 1): the follow-up monitoring phase of a project and in particular of the cash flows and the risk assessment (target-actual comparison and resulting analyses) followed by feedback and learning. This stage is illustrated in the right column in Figure 2. If a routine mechanism is established which *ex post* explicitly analyses projects that have been accepted (i.e. the cash flows and whether the risks were adequately considered and thus the reasons why a project may not have turned out as projected) then decision-makers will get feedback on projects that have been accepted, such as Cases A, D, F and G. The analysis will reveal that the cash flows had been estimated too high, too low or appropriately and what risks were considered adequately or not and why (cf. Category II). In doing so, a false appraisal of the hurdle rate in Cases A and F will become

evident (green feedback fields). However, the decision-maker is unlikely to perceive the non-appropriate risk assessment and hurdle rate as significant because the decision would not have been altered using the 'correct' rate.

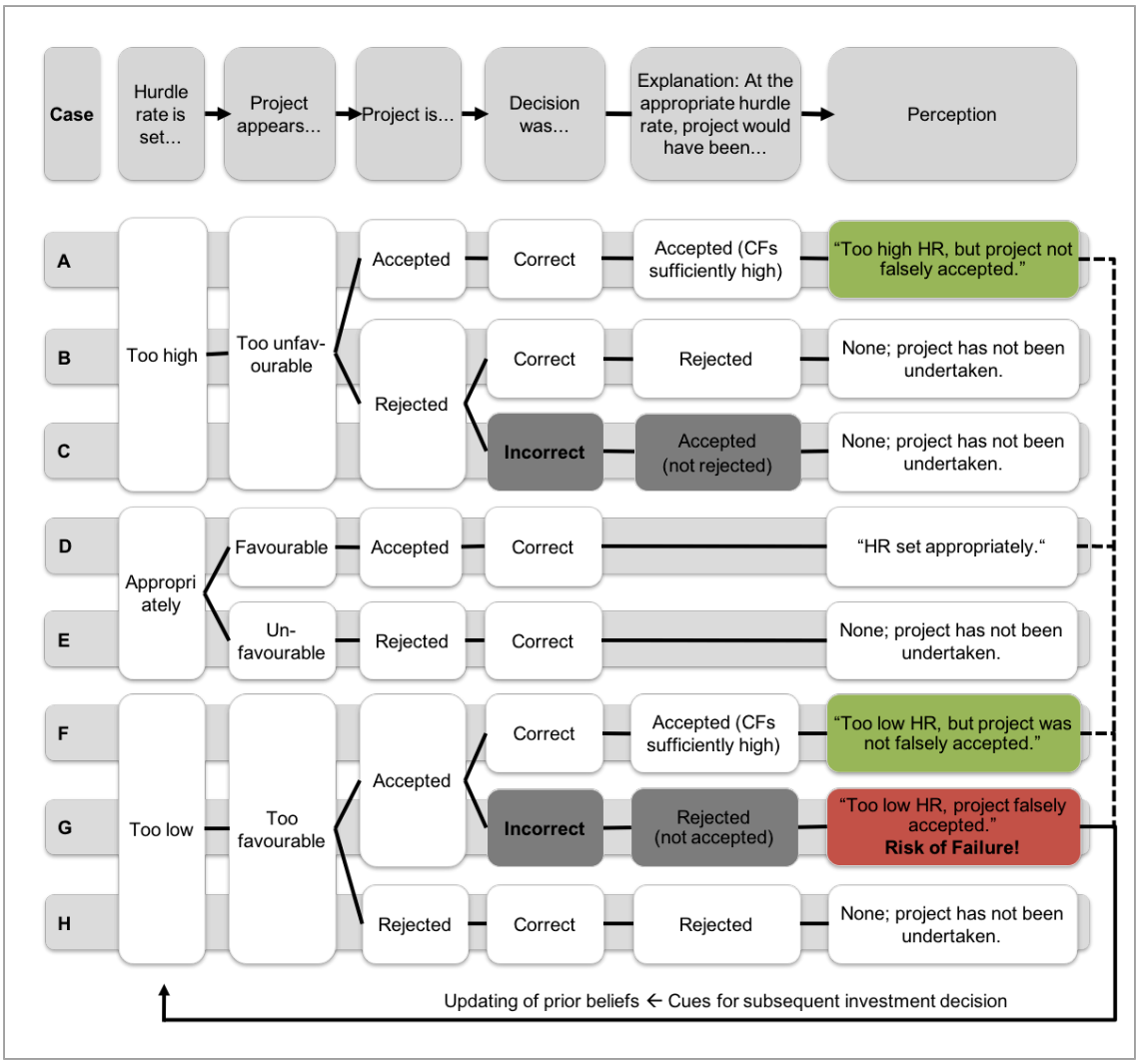

Figure 2 Decision-maker's perception of the setting of the hurdle rate (HR)

When evaluating a similar project next time, this analysis with its insights on the (inappropriate) risk assessment and thus setting of the hurdle rate (should and) probably will be taken into account by the decision-maker. The bottom arrow of Figure 2 represents learning about one's ability and updating one's prior idea about the appropriate risk and hurdle rate when new information arrives (see Gervais, 2010). New information comes particularly from post audit feedback on projects that get adopted (A, D, F and G); this will affect the decision-maker's subsequent estimates of the most appropriate hurdle rates. We note that the feedback that managers get can be of low quality as it is imprecise and slow, and investment decisions are

made infrequently and irregularly, which complicates learning (Gervais, 2010). Knight (1921) cautions that "in business management no two instances, perhaps, are ever very closely alike, in any objective, describable sense." However, we can assume that experienced decision-makers have capacity to integrate new information and compare it to previous situations so that learning does happen. A formal or an informal post audit of projects may provide information about the mistakes in the appraisal; realising that the initial risk assessment was insufficient may happen consciously but, more importantly, also unconsciously.

As indicated above, the essential point is that the feedback on some investment decisions, such as G, which 'go wrong' might be more salient and vivid than on others such as A and F which turn out as successes; this is elaborated in the following paragraphs.

With regard to Case B (H): The project's risk is not adequately recognised and may be underestimated (overestimated); thus the hurdle rate is set too high (low) and the project is rejected due to a negative NPV, but the erroneous rate is not obvious; the decision-maker will not be aware of the false setting of the rate, because companies seldom organise follow-up monitoring on projects that have been rejected. The decision-maker is thus not in a position to use this information when assessing the next project. Furthermore, even if *ex post* reviews were carried out on B and H, they would show that despite the inappropriate hurdle rates the appraisal outcomes were, in fact, the right ones.

Our model contains two scenarios for incorrect accept-reject decisions: First, a false positive case can be illustrated by the fire example in Section 2.2, is represented by Case G in Figure 2. The project was not rejected but with an appropriate rate it would have been rejected. The hurdle rate was set too low, which resulted in insufficient discounting of future cash flows. This can result in accepting a project which is later seen to generate a negative NPV. The poor decision evidenced by a poor outcome is likely to be a salient event (red feedback field in Figure 2) and can generate the previously described retrievability bias and an incorrectly raised hurdle rate in future appraisals.

Secondly, a false negative case is given in Case C of Figure 2. The project risk is overestimated, the hurdle rate therefore set too high, and the project is rejected due to a negative estimated NPV. With an appropriate (lower) hurdle rate, the appraisal would have correctly shown a positive NPV for the proposed project and the project might have turned out to be successful *ex post*. However, the decision-maker will not realise the false decision because the project will not be undertaken. The decision-maker is unlikely to get feedback on the mistaken risk assessment and having set the hurdle rate too high and so does not learn from the experience. This case illustrates the long-term consequences of setting the hurdle rate too high; projects are falsely rejected resulting in underinvestment. Moreover, and as indicated above,

risky projects are systematically preferred to low-risk projects (Titman and Martin, 2010) and a short-term bias is induced (Dobbs, 2009).

Figure 2 summarises the different combinations of 'too high/too low' and 'accept/reject project' and shows the cases in which feedback is provided to the decision-maker on the project appraisal that may influence the setting of the hurdle rate. As indicated above, perception and cognitive processes, reinforced by the one-sidedness of the post-audit process in concentrating only on adopted proposals, will impact the decision-maker's judgement and subjective reasoning when evaluating future projects. As Case G is a much more salient event, the false risk assessment and thus inappropriate setting of the hurdle rate (too low) will influence the judgement more severely than Cases A (too high, but project succeeded nevertheless) and F (too low, but project succeeded nevertheless).

Furthermore, we can assume that projects which proved to be successful are subjected to investigations less frequently and thoroughly than those, which fail. I.e. cash flows and discount rates might not always be evaluated in a detailed and comprehensive way for positive NPV projects *ex post*. If so, then Cases A and F will result in even less feedback to the appraisal including the risk assessment than will Case G and the argument is strengthened further.

Our analysis to this point has referred to the determination of absolute profitability of an investment project. However, relative profitability, i.e. the comparison of different (mutually exclusive) projects will reveal the same systematisation of cases and errors as derived from the original example. Due to a suboptimal setting of the hurdle rate (too low or too high), the project which appears relatively profitable is not necessarily the objectively more profitable one.

2.5 Discussion

The two extremes of *ex post* feedback – on the one hand, no (or lax) follow-up in the case of non-adopted or successful proposals and, on the other, a thorough follow-up mechanism on bad investments – give different levels of information to the decision-maker. A rigorous follow-up monitoring of all proposals could uncover the false setting of hurdle rates. However, these procedures might still not overcome the disproportionate effect that an accepted project's failure has on the decision-maker's intuition and the retrievability bias may persist. Failure of the project in general, and the failure of a project due to a false appraisal as regards the setting of the hurdle rate, as in Case G, remain the most influential events and will be more available in memory for the next project decision when events like these are retrieved. It will serve as a strong cue to influence cognitive reasoning and thereby the judgement.

Because of humans' retrievability bias, the event 'hurdle rate has been set too low' – additionally associated with a negative affect – stays in memory more easily. The event

‘(possible) failure’ is likely to come to mind more easily and thus a higher hurdle rate appears to be more suitable, and is therefore more ‘probable’, than the truly appropriate one. To the decision-maker, it seems it might help to avoid a decision mistake and wrong acceptance of a project, and will thus influence judgement. In other words if, next time, information on which hurdle rate to set is retrieved from memory, the setting of an underestimation of risk (and thus a too low rate) leading to an error, will be the cue that is intuitively more promising. Hence, the decision-maker will tend to revise the previous hurdle rate upwards but would not systematically set a hurdle rate too low; this explanation is in accordance with empirical findings relating to the hurdle rate premium.

Strategies do exist for correcting cognitive biases, i.e. debiasing, include motivational, cognitive and technological strategies or decision aids (see for example Larrick, 2004). Moreover, awareness of potential biases and the situations where they can occur is the most important requirement for correcting biases (see for example Kahneman, 2003; Milkman *et al.*, 2009). However, this debiasing process can be long and requires constant review and vigilance in the decision process, particularly the more complex the context, and is up to the individual decision-maker (Bazerman and Moore, 2013). Thus, even though an individual is aware of a cognitive bias, efforts are needed to correct it. A well-structured investment appraisal process with a post audit stage can serve as a good starting point for developing decision aids providing awareness. However, the biases inherent in the setting of the hurdle rate may not be easily corrected and are therefore still be observable in practice.

3. Conclusion and Outlook

Our analysis requires empirical testing to validate the relevance of the retrievability bias in the setting of the hurdle rate. Experiments could address the effect of past experience of failed investment projects, and of the review process, on future risk assessments and thus the hurdle rate decisions. A first testable hypothesis may be:

> *H1: The more failures of investment projects a decision-maker has experienced, the higher the risk premium incorporated into the hurdle rates applied in future project appraisals.*

The failure of an investment project could result from either false investment appraisal or from one of the anticipated states of nature (independent of the appraisal). The awareness of a false appraisal assumes that some kind of review or post audit of the project has been performed – either formally or informally/unconsciously. Thus, we could consider the effect of a formal versus a subjective informal review of the failed investment appraisal:

H2a: The more incorrect assessments of investment projects' risks (disclosed in a formal post-audit process) a decision-maker has made, the higher the risk premium incorporated into the hurdle rates applied in future project appraisals.

H2b: The more incorrect assessments of investment projects' risks a decision-maker has perceived, the higher the risk premium incorporated into the hurdle rates applied in future project appraisals.

Further potential avenues to explore in this context, but which we will not lay out as formal hypotheses include: There may be a relationship between the level of detail of a company's review process and its impact on hurdle rate premia. More sophisticated review processes will disclose more details and thus more mistakes in the appraisal, which in turn could affect the decision-maker's risk and hurdle rate assessment. Secondly, given that the more investment appraisals an individual has been involved in, i.e. the higher a decision-maker's work experience in this field, the more failed investment projects s/he may have experienced. Thus one might investigate associations between HRPs and demographic variables such as age, years of work experience, or personality traits such as confidence of attitudes to risk.

To conclude, the determination of parameters in investment appraisal, particularly estimating a project's risk and thus setting the hurdle rate, necessarily involves a certain degree of subjectivity. From this it follows that heuristics, which to some extent rely on intuition, may guide a decision-maker's judgement, and cognitive biases can systematically distort decisions. This paper shows the effect of the retrievability bias on the judgement of experienced managerial decision-makers. It provides a reasoned explanation of how managers deciding on investment projects may be biased in tending to systematically set hurdle rates higher than suggested by theory. While we are not claiming to provide a complete explanation of the paradox, we believe that cognitive biases and the noise in feedback on adopted investment proposals play a systematic part in explaining why hurdle rates are set above the rationally advocated discount rate, and we thus help solve the Hurdle Rate Premium Puzzle. The policy implications of this study are that corporate success could be enhanced, firstly, by making executives aware of the premium phenomenon and of its behavioural causes; and, secondly, by widening the scope of the post-audit programme to include significant rejected investment proposals, and communicating the opportunity cost of 'false negative' decisions on proposals not adopted.

References

Ackert, L.F. and Deaves, R. (2010), *Behavioral finance - psychology, decision-making, and markets,* South-Western, Cengage Learning, Mason, USA.

Bazerman, M.H. and Moore, D.A. (2013), *Judgment in managerial decision making,* John Wiley & Sons, Hoboken.

Black, F. (1972), "Capital market equilibrium with restricted borrowing", *The Journal of Business,* 45**,** 3, 444-455.

Black, F. *et al.* (1972), "The capital asset pricing model: Some empirical tests", Jensen, M.C., *Studies in the theory of capital markets*, Praeger, New York, 79-121.

Black, F. and Scholes, M. (1973), "The pricing of options and corporate liabilities", *Journal of Political Economy,* 81**,** 3, 637-654.

Brounen, D. *et al.* (2004), "Corporate finance in europe: Confronting theory with practice", *Financial Management***,** Winter, 71-101.

Bruner, R.F. *et al.* (1998), "Best practices in estimating the cost of capital: Survey and synthesis", *Financial Practice and Education,* 8**,** Spring/Summer, 13-28.

Brunswik, E. (1952), "The conceptual framework of psychology", Neurath, O., Carnap, R. and Morris, C., *International encyclopedia of unified science*, The University of Chicago Press, Chicago, London, Toronto.

Brunzell, T. *et al.* (2013), "Determinants of capital budgeting methods and hurdle rates in nordic firms", *Accounting & Finance,* 53**,** 1, 85-110.

Cooksey, R.W. (2001), "Brunswik's the conceptual framework of psychology: Then and now", Hammond, K.R. and Stewart, T.R., *The essential brunswik: Beginnings, explications, applications*, Oxford University Press, Oxford et al., 225-237.

Dobbs, I.M. (2009), "How bad can short termism be? - a study of the consequences of high hurdle discount rates and low payback thresholds", *Management Accounting,* 20, 117-128.

Dolde, W. *et al.* (2012), "Should managers estimate cost of equity using a two-factor international CAPM?", *Managerial Finance,* 38**,** 8, 708-728.

Elton, E.J. (1970), "Capital rationing and external discount rates", *The Journal of Finance,* 25**,** 3, 537-584.

Emmanuel, C., Harris, E. and Komakech, S., (2010), "Towards a better understanding of capital investment decisions", *Journal of Accounting and Organizational Change,* 6, 4, pp. 477 - 504

Fama, E.F. and French, K.R. (2004), "The capital asset pricing model: Theory and evidence", *The Journal of Economic Perspectives,* 18**,** 3, 25-46.

Fama, E.F. and Macbeth, J.D. (1973), "Risk, return and equilibrium: Empirical tests", *Journal of Political Economy,* 81**,** 3, 607-636.

Forbes, W. (2009), *Behavioural finance,* John Wiley & Sons, Chichester.

Gervais, S. (2010), "Capital budgeting and other investment decisions", Baker, H.K. and Nofsinger, J.R., *Behavioral finance: Investors, corporations and markets*, John Wiley & Sons, Inc., Hoboken, New Jersey, 413-434.

Gigerenzer, G. and Brighton, H. (2009), "Homo heuristicus: Why biased minds make better inferences", *Topics in Cognitive Science,* 1, 107-143.

Götze, U. et al. (2015), Investment appraisal. Methods and models, Springer, Berlin et al.

Graham, J.R. and Harvey, C.R. (2001), "The theory and practice of corporate finance: Evidence from field", *Journal of Financial Economics,* 60, 187-243.

Gup, B. and Norwood, S. (1982), "Divisional cost of capital: A practical approach", *Financial Management,* Spring, pp. 20 - 24.

Haka, S.F. (2007), "A review of the literature on capital budgeting and investment appraisal: Past, present, and future musings", Chapman, C.S., Hopwood, A. and Shields, M.D., *Handbook of management accounting research vol. 2*, Elsevier, Amsterdam et al., 697-728.

Harris, E. (2000), "Strategic investment decision-making: Managerial judgement on project risk and return", *Journal of Applied Accounting Research,* 5, 3, pp. 87 - 109

Hastie, R. and Dawes, R.M. (2010), *Rational choice in an uncertain world,* Sage, Los Angeles et al.

Jagannathan, R. and Meier, I. (2002), "Do we need CAPM for capital budgeting?", *NBER working paper series.*

Kahneman, D. (2003), "A perspective on judgment and choice", *American Psychologist,* 58**,** 9, 697-720.

Knight, F.H. (1921), *Risk, uncertainty, and profit,* Houghton Mifflin, Boston.

Larrick, R.P. (2004), "Debiasing", Koehler, D.J. and Harvey, N., *Blackwell handbook of judgment and decision making*, Blackwell Publishing, Malden, Oxford, Victoria.

Lindblom, T. *et al.* (2010), "Investment appraisal techniques and the adoption of quantitative risk measures – evidence from swedish 500 largest firms", *16th International Working Seminar on Production Economics*, 1-5 March 2010, 297-308.

Lintner, J. (1965), "The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets", *Review of Economics and Statistics,* 47**,** 1, 13-37.

Luft, J. and Shields, M.D. (2010), *Psychology models of management accounting,* Now Publishers, Hanover.

Meier, I. and Tarhan, V. (2007), "Corporate investment decision practices and the hurdle rate premium puzzle", working paper.

Merton, R.C. (1973), "An intertemporal capital asset pricing model", *Econometrica,* 41**,** 5, 867-887.

Milkman, K.L. *et al.* (2009), "How can decision making be improved?", *Perspectives on Psychological Science,* 4**,** 4, 379-383.

Modigliani, F. and Miller, M.H. (1958), "The cost of capital, corporation finance and the theory of investment", *The American Economic Review,* 48**,** 3, 261-297.

Modigliani, F. and Miller, M.H. (1965), "The cost of capital, corporation finance, and the theory of investment: Reply", *The American Economic Review,* 55**,** 3, 524-527.

Myers, S.C. and Turnbull, S.M. (1977), "Capital budgeting and the capital asset pricing model: Good news and bad news", *The Journal of Finance,* 32**,** 2, 321-333.

Pike, R. (1996), "A longitudinal survey on capital budgeting practices", *Journal of Business Finance and Accounting,* 23**,** 1, 79-92.

Poterba, J. and Summers, L. (1995), "A CEO survey of us companies' time horizon and hurdle rates", *Sloan Management Review*, 43-53.

Reimann, B.C. (1990), "Why bother with risk-adjusted hurdle rates?", *Long Range Planning,* 23**,** 3, 57-65.

Ross, S.A. (1976), "The arbitrage theory of capital asset pricing", *Journal of Economic Theory,* 13, 341-360.

Ross, S.A. (1977), "The current status of the capital asset pricing model (CAPM)", *The Journal of Finance,* 33**,** 3, 885-901.

Rubinstein, M. (1973), "A mean-variance synthesis of corporate financial theory", *The Journal of Finance,* 28**,** March, 167-182.

Sharpe, W.F. (1964), "Capital asset prices: A theory of market equilibrium under conditions of risk", *The Journal of Finance,* 19**,** 3, 425-442.

Simon, H.A. (1955), "A behavioral model of rational choice", *Quarterly Journal of Economics,* 69, 99-118.

Sloman, S.A. (2002), "Two systems of reasoning", Gilovich, T., Griffin, D. and Kahneman, D., *Heuristics and biases: The psychology of intuitive judgment*, 379-396.

Titman, S. and Martin, J.D. (2010), Valuation, Pearson, Boston.

Tversky, A. and Kahneman, D. (1974), "Judgment under uncertainty: Heuristics and biases", Science, 185, 1124-1131.

Wood, J.S. and Leitch, G. (2004), "Interactions of corporate financing and investment decisions: The financing present value ("FPV") approach to evaluating investment projects that change capital structure", *Managerial Finance,* 30**,** 2, 16-37.