Project Finance Asset Risk Pricing Decisions:
Australian Evidence

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Abstract

Linking the loan risk premium to the borrower’s general creditworthiness has long been conventional lending practice. There is, however, an absence of traditional, ‘full faith and credit’ borrower guarantees when financing large capital projects. These projects have a unique reliance on asset risk identification, assessment, and management to support the lending decision as to whether, how much, and at what price debt financing will be provided. Even so, little has been done to explain the influence of the key project finance asset risks on the risk pricing decision. This is a critical deficiency given project finance’s emergence as a key financing instrument for large capital projects. This paper presents empirical data from a survey of Australian project lenders to address questions about the relative importance of the various project finance asset risks for the domestic project risk pricing decision and the degree of self-insight possessed by the project lenders when making this decision. The findings provide evidence that market risk is the most influential factor and accounts for more basis points in loan pricing. Operating, political/regulation, and sponsor risks are also important. Surprisingly, environmental risk carries relatively little weight in the domestic project finance loan pricing decision. Finally, Australian project lenders possess a mixed amount of self-insight when making the risk pricing decision.

Key words: Project finance, self-insight, risk pricing
1. Introduction

Project finance is a unique fund raising instrument for large capital intensive projects, such as the construction of airports, toll roads, telecommunication facilities, railways, and power stations. In contrast to other types of corporate loans, project finance is “the provision of funds for a single-purpose facility that generates the cashflows to repay the debt usually secured by the project assets and cashflows, not by the assets or general credit of the project’s sponsors” (Davis, 1996, p.6). Esty and Megginson (2003) push to a more specific definition noting that “project finance is defined by the creation of a legally independent project company financed with non-recourse debt for the purpose of investing in an industrial asset.” Key to both of these definitions is the primary reliance of project financing on the project’s own assets and cashflows which makes project finance asset risk pricing an even more critical component of the lending decision.

In spite of its practical importance, academic research into project finance is relatively sparse\(^2\). Shah and Thakor (1987) provide early academic justification as to why project finance works, in particular why project finance involves higher leverage than conventional leverage and why highly risky assets are project financed. Largely, this justification revolves around the better information available to the lenders in a project finance transaction and the consequential lowering of agency and bankruptcy costs. These advantages are expanded upon by both Brealey et al (1996) and Esty and Megginson (2003) who note the facilitating of low-cost re-contracting in the case of default.

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\(^{1}\) The authors wish to acknowledge the particularly helpful comments of two anonymous referees as well as those of participants at the 2000 and 2001 Australasian Banking and Finance Conferences.

\(^{2}\) Esty (2004) reports that although project finance totalled USD$217 billion in 2001, accounts for 10-15% of total capital investment in the US, and exceeds the amount of capital raised in IPOs or invested by venture capital firms, only one article on project finance had been published at that time in the top four leading finance journals and not more than 15 articles in all finance journals over the preceding 20 years. This situation is somewhat ameliorated by the Project Finance Web Portal (http://www.hbs.edu/projfinportal/) which contains references for books, articles and case studies as well as more than 900 links to related web sites.
Work into how the better information available to lenders in project finance impacts upon loan structure and ultimately, risk pricing is starting to emerge. Kleimeier and Megginson (2000) report that project finance loans differ fundamentally from conventional loans in their longer maturity, greater reliance on third-party guarantees, use of more syndicated loan participants, fewer loan covenants, greater use of fixed rate pricing, and greater likelihood of being extended to non-US borrowers, in riskier countries, and in tangible-asset-rich industries. As one of the defining features of project finance is the much higher leverage used, Esty (1999) has argued for varying costs of equity to reflect the widely differing debt levels over the life of the project and the consequential varying financial risk levels – a finding that should also impact upon project finance financial risk pricing. That sponsoring firms use project finance as a risk management tool (Esty 2002), also argues for more focus on just what risks are being managed and on just how important these risks are. In particular, he notes how lenders are increasingly demanding higher sponsor equity stakes in projects with higher levels of asset risk (variability in cashflows emanating from the assets) to lower the financial risk, and ultimately the total default risk of the project. To date, little work has been done to detail just how the individual project finance asset risks impact either singly or jointly on project finance asset risk pricing.

This paper investigates the project finance asset risk pricing decision for Australian domestic projects in order to better specify the contribution of each risk to the lenders’ required risk premium. This is a necessary first step to providing lenders and borrowers with a better appreciation of the cost effectiveness of alternative asset risk management strategies when structuring their project finance deals. Increased insight into how specific project risks impact on pricing and loan value will also be substantial value to banks making internal ratings based assessments of their project finance loan assets, as per the requirements of Basel II (Basel 2005). Adopting a human information processing perspective, the paper measures how changes in five key asset risks influence both the overall risk rating of a project and the risk premium charged on the project finance loan. Further, the paper reports on the general degree of ‘self-insight’ – defined as “an individual’s ability to express the relative emphasis he or she places on information cues
when generating judgments” (Mear and Firth, 1987, p.176) – displayed by Australian project finance lenders.

2. Literature review and research questions

2.1 Project finance asset risk importance

Research related to project finance asset risk importance can be drawn from the lending, export credit and project finance literature. The importance of borrower credit risks to loan rate premiums has been extensively addressed in the lending literature. Bates (1998) suggests that different loan rate premiums should be applied to different risk-profile customers determined by the probability of their default. This strong connection between risks and risk premiums is also found in Machauer and Weber's (1998) empirical study of the bank behaviour and internal ratings of borrowers. Their study was based on data from five leading German banks and credit files of two hundred small and medium-sized firms from the year 1992 to 1996. Using regression analysis, their research focused on identifying factors which explain (1) the interest rate premium firms have to pay, (2) the amount of collateral relative to the firm’s overall credit line, (3) the credit line relative to their balance-sheet total assets, and (4) the changes of interest rate premium from one credit analysis of the bank to the next.

Credit risk importance has also been studied in the context of the export credit decision. Using a methodology similar to this study, Ross and Pike (1997) found that individual export credit risks (ie., credit character, financial strength, country rating, and foreign exchange risk had both main and interaction effects on the credit assessment and structuring decision. That is, the total impact of each individual risk tended to vary according to the level of the other related risks – a finding

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3 While agreeing the primacy of risks to the project risk pricing decision, Ross and Nguyen (2000) suggest that other factors also impact on the project finance risk premium. In particular, they posit that the risk premium could be adjusted based on non-risk factors such the lender’s project financing experience, market
that suggests a substantial complexity to the credit risk assessment decision. A high degree of self-insight into the trade credit decision was also recorded in the experiment.

Risk importance has been highly acknowledged in the project financing literature (viz., Buljевич and Park, 1999; Davis, 1996; Holliwell, 1997; Nevitt and Fabozzi, 2000; Sapte, 1997; and Tinsley 2000). In this regard, Beidleman et al (1990) provide a systematic discussion of the types of risk faced in project finance by each phase of a project, and note which party is most likely to bear the risk. Domestic projects – according to most practitioner descriptions of project finance - primarily focus on market, operating, sponsor, political/regulation, and environmental risks for post completion projects. International projects carry additional asset risks such as country and currency risks and consequently, involve more risk management strategies than do. Esty and Megginson (2003) report that “in countries with strong creditor rights and reliable legal enforcement, lenders create smaller and more concentrated syndicates to facilitate monitoring and low cost contracting.” They also report that bank lenders also use official agency participation (viz., World Bank, EBRD, Eximbank) to lessen the political risk of expropriation. Hainz and Kleimeier (2004) explore more fully the political risk effects on international project finance, and find support for their hypothesis that project finance should be used more frequently for syndicated loans to borrowers from high political risk countries.

Specific work into the pricing of project finance loans was conducted by Kleimeier and Megginson (2000). They hypothesised spread to be a function of loan characteristics, namely; size, maturity, guarantee, currency risk, country risk, and collateralisable assets. They found that 1) loan size was not a significant factor in predicting the spread, 2) increasing maturity actually resulted in a lower spread (not a higher spread as was the case for most other loans), 3) third party guarantees substantially reduce the spread on project finance loans – much more so than other types of syndicated credits, 4) currency risk resulted (perversely) in a lower spread for project finance loans, 5) country risk did not significantly affect the spread, and 6) collateralisable assets actually
increased the spread for project finance loans instead of decreasing the spread as was the case for most other loan types. Interestingly, they found that project finance loans actually had lower credit spreads over LIBOR than did most comparable non-project finance loans, were significantly smaller than some other types of syndicated loans, and differ fundamentally from non-project finance syndicated loans. It is important to note that the OLS regression used by Kleimeier and Megginson was able to explain only 17% of the variance in loan pricing, and so a substantial amount of project specific risk (and other pricing factors) remain unexplained.4

In summary, there is support for the premise that project finance asset risks and risk premiums have a strong and positive correlation. However, the relationship of individual project finance asset risks to the project finance loan risk premium has not yet been fully explored. While the foregoing discussion provides a basic expectation that an increase in the level of project finance asset risks will increase the project risk premium charged, little can be said about how much the project risk premium will be raised by each individual risk.

To address this problem, the following research questions will be used to gauge the influence of each individual project finance asset risk on 1) overall project risk rating and 2) risk premium.

- **RQ1:** Which project financing risks are most important to the overall project risk rating?
- **RQ2:** Which project finance risks are most important to the risk premium?

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4 It is also possible that the various risk definitions used may not be fully capturing the specific risks indicated. For instance, defining currency risk as borrowing in a currency other than the borrower’s home currency could result in a project financing with less currency risk being shown as a project financing with more currency risk. This could happen in the case where US dollars are being used to finance a mine in Peru with predominantly US dollar denominated sales to international buyers who pay into offshore escrow accounts used to service the project finance loans. Borrowing in the domestic currency could involve a greater mismatch of cashflows and potentially result in greater currency risks.
2.2 Degree of self-insight into the risk pricing decision

Establishing the general amount of self-insight in the project finance asset risk pricing decision allows us to reflect on the average expertise of Australian project lenders. Lenders who are able to accurately gauge how they price their loans can focus more on the critical risks when explaining and promoting their pricing decisions. Research investigating self-insight has been conducted in accounting and auditing. A limited degree of self-insight was found in Ashton, 1974; Joyce, 1976; and Slovic et al, 1972; with perceived importance of relatively minor cues frequently overestimated and perceived importance of relatively major cues frequently underestimated. However, Mear and Firth (1987), Wright (1977), and Laswad and Roush (1996) found a considerable degree of self-insight in decision-makers. Wright’s empirical research was on “self-insight into the cognitive processing of financial information and showed an encouraging degree of self-insight, demonstrating that subjects participating in the experiment were able “to express indications of the relative cue importance which reflected the way they were using the information” (p. 323).

Mear and Firth (1987)’s empirical research on “cue usage and self-insight of financial analysts” showed that the subjective weight was distributed more constantly than the objective weights and the importance of some minor cues was overestimated. However, they noted that “these discrepancies between subjective and objective weights did not significantly affect the ability of the subjective weight models to either reproduce actual judgment evaluations or to predict the outputs of the individuals’ optimal regression policies” (p. 182). Mear and Firth, therefore, concluded that the subjects possessed a high degree of self-insight and were able to express indications of their relative cue importance. Laswad and Roush’s (1996) empirical study also came up with the same results suggesting a high level of self-insight into the judgement process conducted by financial controllers.

In summary, studies of self-insight into financial decisions have shown a fairly wide range of self-insight scores. The question of whether Australian project finance lending officers generally
possess a high or a low degree of self-insight when making project finance asset risk pricing decisions still remains unanswered. To address this deficiency, the following research question will be asked:

- **RQ3.** What is the degree of self-insight experienced by domestic project finance lenders generally when making the project finance asset risk pricing decision?

3. **Methodology**

3.1. **Method**

To address the above research questions, project finance lenders of commercial banks, superannuation funds, and consulting firms located in Sydney, Australia, were asked to participate in a within-subject, two level, five factor, one-half fractional factorial experiment ($2^{5-1}$). Each case comprised five project finance asset risks most frequently cited in the professional literature for domestic projects. Each participant indicated his/her judgement for each of the 16 hypothetical risk-pricing cases, which were structured by the Design of Experiment (DOE) program from the statistical software package MINITAB. Use of the fractional factorial design drops the required number of cases from 32 to 16 and so lessens fatigue among the respondents. However, this design is unable to capture the highest level interactions among the factors. Given that earlier experimental work with full factorial designs (Ross and Pike 1997; Wood and Ross 2006) was unable to detect higher than one or two level interactions, this loss of power was considered acceptable.

To classify treatment levels for the project risks, this experiment used a similar technique as that used by Ross and Pike (1997) and Wood and Ross (2006). Five project risk variables were given

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5 The DOE program generates a set of trials in which all relevant factors are varied systematically so that the maximum amount of information can be derived from the given number of observations.
two levels of treatment, namely “higher” meaning more risky than two of the last three project financing deals you priced and “lower” meaning less risky than two of the last three project financing deals you priced. This method aims to capture points on the risk range that were less extreme and simultaneously offered project lenders participating in the experiment more ground for judgment. To measure the overall risk rating given to each case by project lending officers participating in the survey, a common evaluation method used in various previous business studies (eg., Slovic et al, 1972; Laswad and Roush, 1996; Ross and Pike, 1997; and Wood and Ross 2006) was chosen. As such, each case was evaluated on a nine-point scale ranging from a score of one (“low risk”) to a score of nine (“high risk”). In addition, participants were asked to indicate their view of the appropriate required yield for each case presented by a basis points spread over the A$ BBSW. Data gathered from these responses were used to address research questions one and two.

ANOVA was used to measure the relative importance of the five project finance risks in relation to overall risk level and risk margin. F and P values along with judgement means were computed. Two indications of the relative importance of each individual risk on the risk pricing decision were also calculated. The first indication was the magnitude of effect based upon the degree to which the mean judgement shifted as the levels of a factor varied (Slovic et al, 1972, p. 293). The second indication was $\omega^2$, measuring the attribution of each of the main effects to the response variation (Hays, 1973, p. 513).

After judging the individual pricing cases, the participants were asked to allocate 100 points across the five project financing risks in proportion to their perceived relative importance of each risk in formulating their decisions. These subjective weights were then compared with the objective weights representing actual judgments made by the project lenders to gauge the average degree of self-insight into the project finance risk pricing decision. This data was then used to address research question three.

The project risks were presented to the experiment’s subjects in the case format shown in Table 1. Presentation of the cases was made randomly to avoid presentation bias.
3.2. Sampling and data collection procedures

The experimental subjects of this study were project lenders working for commercial banks, superannuation funds, and consulting organisations in Sydney, Australia. These organisations are actively involved in project finance and advisory work. The participants were asked to work independently. They were also assured that they were not being evaluated by their employers. Confidentiality and anonymity of the responses were maintained by having the completed questionnaires returned in unmarked envelopes. No names of the participants or their organisations were shown on the survey questionnaire or envelopes.\(^6\) The experiment considered each participant as an independent individual without taking factors associated with their firms into account. All the responses were then combined to provide the final results. The participants’ average age and work experience are 38 and 8 years, respectively.

Based on the *International Project Finance Directory*, names and contact phone numbers of organisations involved in project finance were gathered. A short fax was then sent to these organisations. It contained a brief introduction of the researchers’ position, descriptions of the research experiment, and a note letting these organisations know that they would be contacted shortly. Two days later, various phone calls were made to these organisations to ask for their participation in the experiment. If they voluntarily agreed, short meetings were arranged to deliver the survey questionnaire. Alternatively, a package of the survey questionnaire was posted to them if they preferred. The package included (1) a cover letter together with a plain language statement for participants outlined by the researchers’ Human Research Ethics Committee and (2) a survey

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\(^6\) It is noted that having the subjects making judgments anonymously, and without performance-contingent compensation, could result in them exerting less effort in the experimental setting than they would in an environment with explicit incentives. As such, this possibility is acknowledged as a limitation in design.
containing the hypothetical cases and related questions. Each participant was given a return postage paid envelope to reduce unnecessary inconvenience and to ensure the confidentiality of their answers. Of the 54 questionnaires delivered in person and posted, 25 (46%) were completed and returned.7

3.3. Experimental validity

Before delivering the survey package, the instrument was piloted with three senior project lenders to remove ambiguities, gauge the time required to complete it, and to ensure that the exercise was a valid replication of the project finance risk pricing decision. Additionally, the project lenders participating in the experiment were asked about (1) the confidence they had in their decisions; and (2) how likely they would be to change their decisions if provided with more information. In the first case, the project lenders generally were confident of their decisions (mean = 5.9, S.D. = 1.65 on the nine-point scale anchored by 1 = "not very confident" and 9 = "very confident"). In the second case, the project lenders indicated that they were, to some extent, likely to change their decisions if more information was available (mean = 6.58, S. D. = 1.77 on a nine-point scale anchored by 1 = "not very much" and 9 = "very much").

Viewing these two measures of experimental validity, together with recollections from the pilot study, suggests that the risk pricing cases used in this experiment provided the right kind of information needed to make the decisions, but probably less than that desired by the participants. However, moving toward greater complexity in order to overcome the artificiality of the experiment and to reflect the multitude of possible variations of the decision would not prove to be feasible. It would create numerous risk pricing cases and subsequently lengthen the experiment's

7 Twenty-five respondents is a relatively small number of respondents and so raises concern over whether these results can capture significant differences in factor importance or fairly represent standard Australian lending practices. In this regard, the use of a repeated measures design ensured that the study had sufficient power to detect significant main effects and managerially relevant interactions. It was also considered that these respondents – being practiced in the task of making project finance asset risk pricing decisions and
duration, causing various difficulties both in attracting participants and in obtaining high quality responses from them. This lack of information is expected to create certain difficulties for the participants when making the risk pricing decision. Their risk judgments to a degree had to rely on various assumptions made in these hypothetical cases. The pricing decision therefore would be systematically more specified and the risk margin given each case would not be exactly identical to that in a real project. Nevertheless, these adverse effects have been minimised due to the two following reasons.

Firstly, a wide range of assumptions and explanations were given in the first page of the experiment to assist the participants in understanding these hypothetical risk-pricing cases. A clear description for each risk was also given to avoid the possibility of misunderstandings due to the use of different terms or definitions in each organisation. Missing information, which would normally be available in actual projects such as locations, sectors, and timing, was overcome by suggesting the participants use the three last project-financing deals priced as a benchmark for these hypothetical risk pricing cases. These assumptions are highly essential in helping the participants to capture the situation and price more accurately. As a result, while real project financing cases could not be replicated and a certain variation in basis points might occur, the risk margin given to the hypothetical cases still reflected the magnitude of risk observed by the project lenders in those cases.

Secondly, the participants involved in this experiment were project finance lenders with substantial experience in project finance (an average of 8.3 years). They therefore are expected to have had little difficulty in understanding the project finance cases as well as in absorbing the necessary assumptions needed to make the risk pricing decision for each case.

located in some of Australia’s largest project finance lenders and opinion leaders – would adequately capture standard Australian lending practice.
4. Results and discussion

4.1. Project finance risk importance

The study’s findings in respect to project finance risk importance are set out in Table 2. Part One of Table 2 presents the main effects\(^8\) of the five project-financing risks on the overall risk rating, as measured by "risk level". "Risk level" was calculated based on the one-nine risk scale and presents the project lenders' judgements of the projects' overall riskiness. All main effects are significant at .01.

Insert Table 2 here

Measurement of individual risk importance to overall risk rating using magnitude of effect was based on variations in mean judgements of the projects' overall riskiness when the risk level given to the individual risk changed from “lower” to “higher”. As shown in Table Two, the overall riskiness score for projects rose by 2.45 points when market risk shifted from a lower level to a higher level. Similarly, 1.58, 1.52, and 1.10 point increases in the mean judgements of the projects' overall riskiness were recorded when operating, sponsors, and political/ regulation risk, respectively, increased. A marginal increase of 0.58 was observed when environmental risk increased. Taken together, the magnitude of effect shows that market risk accounted for 34% of the deviation in the mean overall riskiness judgments, followed by operating, sponsors, and political/ regulation/political risks with 22%, 21%, and 15% respectively. Changes in the risk level of environmental risk had the least impact, accounting for only 8%.

\(^8\) Surprisingly, only one interaction effect was found to be significant at p <.05 and this interaction had an effect size of less than .03. As interactions had such little effect on the decision, impact calculations were based on main effects only.
Measurement of individual risk importance to overall risk rating using effect attribution was based on the relative impact of each risk\(^9\) on the project lenders' assessment of the projects' overall riskiness. It is achieved by computing the degree to which each risk influences the project lenders' judgements of the projects' riskiness by choosing any value in the one-nine risk scale. It shows that 46% of the decisions were contributed to by market risk, 21% by operating risk, 20% sponsors risk, and 10% by regulation/political risk. Once again, environmental risk had the least impact on the projects' overall riskiness judgment, accounting for only 3%.

In addressing RQ1 as to which project finance risks are most important to the overall risk rating, these two measures provide very strong evidence that market risk is most important when determining overall risk rating, followed by operating, sponsors, regulation/political risks, with environmental risk being the least important.

Part Two of Table 2 presents the main effects of the five project financing risks on the risk margin, as measured by the basis point spread over the A$ BBSW. Similar to the main effects measured by "risk level", these main effects are all significant at p<.01.

Measurement of individual risk importance to risk margin using magnitude of effect was based on the mean variations in the required spread when the risk level given to the individual risk changed from “lower” to “higher”. As shown in Part 2 of Table 2, when these five risks all moved from “lower” risk to “higher” risk, the mean required yield rose by 152.90 basis points (bps). More particularly, an increase of 50.50 bps was caused by the movement of market risk, 32.10 bps by operating risk, 30.20 bps by sponsors risk, 25.20 bps by political/regulation, and 14.90 bps by environmental risks. This measurement is important since it clearly demonstrates how sensitive the risk margin is to changes in the risk levels of these five project financing risks. Altogether, as the magnitude of effect shows, market risk accounted for 33% of the change in the required risk

\(^9\) Since the interaction effects were very small, this calculation is dominated by main effects.
margin, followed by operating risk 21%, sponsors risk 20%, regulation/political risk 16%, and environmental risk 10%.

Individual risk importance to risk margin using effect attribution was computed as the proportion of risk margin attributed to each risk. Table 2 shows that 48% of the risk margin change was determined by market risk, 19% by operating risk, 17% sponsors risk, 12% by political/ regulation risk, and 4% by environmental risk.

In addressing RQ2 as to which project finance risks are most important to the required risk premium, the above measures provide very strong evidence that market risk was the most influential factor, followed by operating, sponsors, regulation/political, and environmental risks.

It should be noted that there is very little difference in the risk importance findings for each of the five project financing risks for both overall risk rating and required risk premium. In fact, these two dependent variables (ie. risk level and risk margin) were highly correlated with \( r = 0.68 \). This strong, positive correlation is consistent with the cited literature which suggests that loan risk premiums ought to be linked to the risks taken by the lenders. Still, given that the subjects made judgments for both dimension concurrently, the high degree of correlation may be due – at least in part – to the research design and so should be treated cautiously.

If reliance can be placed on this high correlation between assessed risk and risk margin, more consideration can be directed to how each individual risk is priced into the risk premium by the lender. Lenders and borrowers looking to increase loan value by reducing specific risk premiums could cost on a risk-by-risk basis various risk management options. For example, long-term take-or-pay contracts could be valued according to the present value of the market risk premium savings they bring to the project borrower. Price concessions valued at several million dollars could be ‘money well spent’ if they result in a 50bps saving on a 20 year, $500 million loan facility. Likewise, spending hundreds of thousands more on pollution control could provide an
immediate present value increase in wealth to the project sponsors if the environmental risk premium can be dropped by 15 bps on a $1 billion loan facility.

4.2. The degree of self-insight

The study’s findings with respect to Australian project finance lender self-insight are presented in Table 3. Several broad statements can be drawn from this data.

Insert Table 3 here

First, the self-reported project financing risk weightings are consistent with the conclusion drawn earlier on the relative ranking of the five project financing risks. The subjective assessments of individual risk importance also show market risk as the most important factor in the risk pricing decision (30% weighting), followed by operating risk (22%), sponsors risk (19%), political/regulation risk (18%), and environmental risks (11%). However, the relatively high standard deviation for market risk (10.39%) and its wide range of reported weighting (8-65%) indicates that not all of the project lenders surveyed perceived market risk to be the most important factor.

Second, average subjective weights were distributed much more evenly across the five project finance risks than the objective weights. For instance, the difference between the most important risk (market risk) and the least important risk (environmental risk) observed in the subjective weights was 19% in comparison to that of 43% and 44% recorded in the objective weights for risk level and for risk margin, respectively. However, within the objective weight distribution, the weight given to each risk measured by both risk level and risk margin was almost identical, confirming a high level of correlation between these two measurements.

Comparison of the subjective weights and the objective weights measured by risk level shows that the relative importance of several risks were mis-estimated by the project lenders. Subjectively,
environmental risk and political/regulation risk were considered to be relatively more important, accounting for 11% and 18% respectively. However, the objective measurement shows that their actual impacts on the project lenders’ risk pricing decisions were less, accounting for only 3% and 10%, respectively. Hence, it can be stated that environmental risk and regulation/political risk were, on average, overestimated by the project lenders. Market risk, on the other hand, produced much greater influence on the risk pricing decision-making process than the project lenders generally thought. The difference between its subjective and objective weight (16%) was substantial. More insightful judgements were found for operating and sponsor risks with only a 1% average variation.

Comparison of the subjective weights and the objective weights measured by risk margin demonstrates that the relative importance of the five project financing risks was, to some extent, misjudged by the project lenders. Overall, the result was consistent with the previous finding using the risk level measurement. Environmental risk and political/ regulation risk were overestimated by 7% and 6%, respectively. It again shows that the project lenders, while concerned about these risks in general, did not place a lot of emphasis on them when it came to setting the risk premium. In contrast, market risk had much more impact on the project lenders’ decision than they generally perceived. In fact, its importance of market risk was underestimated by 18%. Once again, more consistency has been found in the estimation of operating and sponsors risks with a variation of only 2% and 3%, respectively.

In addressing RQ3 as to the degree of self-insight experienced by project lenders generally when making the risk pricing decision, the above data provide mixed results. Insight as to the relative importance of the moderate weight risks (operating and sponsor) was relatively accurate while insight into the full importance of market risk or the lesser importance of political/regulation and environmental risks was, on average, low.

These findings are important. To the extent that Australian project lenders do not fully recognise their actual risk pricing behaviour, they may be mispricing project loans and so losing otherwise
good value investments and accepting lower value investments. Further, to the extent that they do not fully recognise the importance of market risk in their project risk pricing decision, they may be disregarding risk-reduction strategies that could add substantial value to their project loans. Likewise, over-estimation of the importance of political/regulation and environmental risks may result in too much risk mitigation in these areas. A move by Australian project lenders to openly consider and evaluate their project risk pricing behaviour could lead to more value creating behaviour.

5. Conclusions

This paper provides important first steps towards a better understanding of the project finance asset risk pricing decision. The relative ranking of key project finance asset risks in overall asset risk rating and their importance to risk premium setting has been established for domestic project finance loans in Australia – a market in which project finance is becoming increasingly important. Likewise, first measures of the average amount of self-insight shown by Australian project finance lenders have been taken. Taken together, these findings suggest that 1) valuable new pricing and risk management practices could be developed to better reflect the importance of key project finance asset risks and 2) project finance lenders ought to ensure that their actual pricing decisions are consistent with their risk pricing intentions.

As an exploratory study into asset risk pricing for project finance loans, this paper complements Esty’s (1999) work in the area of project finance equity risk pricing as well as Kleimeier and Megginson’s (2000) work into the influence of project finance loan characteristics on loan pricing. By providing a domestic project finance asset risk pricing base, it also complements work by Esty and Megginson (2003) and Hainz and Kleimeier (2004) on specific foreign asset risk pricing factors.
Of course, as with any new set of findings there are limitations in application and new research opportunities. The use of experimentation in this study to provide powerful new findings also brings with it the limitations associated with the restricted generalisation of the findings to levels and risks other than those used in the experiment. New research using actual project finance asset risk pricing data and correlational studies could support a broader application of the findings. Likewise, detailed case studies could provide greater project finance asset risk pricing model validation as pricing behaviour is studied in greater depth. Likewise, this study’s use of human information processing could be potentially replaced with artificial intelligence models that reduce the influences of biases in human decision making and provide greater reliability in pricing and risk management. Work developing such models could also afford project finance lenders new insight into their lending decisions.

In addition to the limitations occasioned by the choice of research method, there are also the limitations caused by the actual empirical setting. This study looked at Australian lenders and Australian domestic project financings. Non-Australian lenders with other experience bases and pressures would likely generate different project finance risk importance scores. For instance, it is noted that the importance of political/ regulation risk measured in this experiment was relatively small in comparison to the importance placed on it in both the academic and in professional project finance literature. This could be due to the hypothetical cases being domestic, and the experiment being conducted in Australia where the political environment is stable and familiar to the Australian project lenders. It is likely that a much higher level of importance would be attached to political risk by Australian lenders for projects conducted in developing countries where political violence, nationalisation and expropriation of the property, or foreign exchange transfer blockage and currency inconvertibility often occur. This suggests that the findings of this study are systemically limited to similar risk environments. New and different risk weights would attach to different risk environments.

In conclusion, this paper ought to be viewed as providing an essential beginning towards a scientific and validated review of project finance asset risk pricing. Extending this work into other
markets and project lenders, increasing its depth and breadth through the use of alternative methods, and placing the influence of asset risk into proper context with financial risk and non-risk factors affecting project finance risk pricing are all dimensions of the project financing risk pricing decision that need development. In any regard, it is clear from this work that individual risks directly affect the pricing decision and that work ought to be directed towards determining how to optimise value in project finance asset risk pricing and risk management.

References


Table 1: PROJECT FINANCING RISK HYPOTHETICAL CASE

<table>
<thead>
<tr>
<th>ORDER</th>
<th>PROJECT FINANCE RISKS</th>
<th>RISK LEVEL</th>
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<tr>
<td>1</td>
<td>Environmental Risk</td>
<td>Lower</td>
</tr>
<tr>
<td>2</td>
<td>Market Risk</td>
<td>Higher</td>
</tr>
<tr>
<td>3</td>
<td>Operating Risk</td>
<td>Higher</td>
</tr>
<tr>
<td>4</td>
<td>Sponsor Risk</td>
<td>Higher</td>
</tr>
<tr>
<td>5</td>
<td>Political/ Regulation Risk</td>
<td>Higher</td>
</tr>
</tbody>
</table>

**Rating:** (low risk) 1  2  3  4  5  6  7  8  9 (high risk)

**Premium:** $ A BBSW + ______________ basis points (bps)
Table 2. EFFECTS OF INDIVIDUAL RISKS ON THE RISK PRICING DECISION

<table>
<thead>
<tr>
<th>PROJECT FINANCE RISKS</th>
<th>F-</th>
<th>P</th>
<th>Judgement Mean</th>
<th>Magnitude of Effect</th>
<th>Effect Attribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low Risk: -1</td>
<td>High Risk: +1</td>
<td>Difference a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Risk</td>
<td>201.62</td>
<td>0.000</td>
<td>4.77</td>
<td>6.35</td>
<td>1.58</td>
</tr>
<tr>
<td>Environment Risk</td>
<td>27.17</td>
<td>0.000</td>
<td>5.27</td>
<td>5.85</td>
<td>.58</td>
</tr>
<tr>
<td>Political/Reg. Risk</td>
<td>97.72</td>
<td>0.000</td>
<td>5.01</td>
<td>6.11</td>
<td>1.10</td>
</tr>
<tr>
<td>Market Risk</td>
<td>438.46</td>
<td>0.000</td>
<td>4.39</td>
<td>6.72</td>
<td>2.34</td>
</tr>
<tr>
<td>Sponsors Risk</td>
<td>186.60</td>
<td>0.000</td>
<td>4.80</td>
<td>6.32</td>
<td>1.52</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>7.23</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Part 2: MAIN EFFECTS MEASURED BY RISK MARGIN (N=24)

<table>
<thead>
<tr>
<th>OPERATING RISKS</th>
<th>F-</th>
<th>P</th>
<th>Judgement Mean</th>
<th>Magnitude of Effect</th>
<th>Effect Attribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment Risk</td>
<td>16.99</td>
<td>0.000</td>
<td>170.10</td>
<td>185.00</td>
<td>14.90</td>
</tr>
<tr>
<td>Market Risk</td>
<td>48.88</td>
<td>0.000</td>
<td>164.90</td>
<td>190.10</td>
<td>25.20</td>
</tr>
<tr>
<td>Sponsors Risk</td>
<td>195.63</td>
<td>0.000</td>
<td>152.30</td>
<td>202.80</td>
<td>50.50</td>
</tr>
<tr>
<td>Total</td>
<td>69.68</td>
<td>0.000</td>
<td>162.40</td>
<td>192.60</td>
<td>30.20</td>
</tr>
</tbody>
</table>

a) The difference is the degree to which the mean judgement changes as the level of factor(X) changes = Judgement Mean of X at Higher Risk - Judgement Mean of X at Lower Risk
b) Magnitude of Effect for factor X = Sum of Difference \( \omega^2 (X) \)
c) Effect Attribution of factor X expressed by % = \( \frac{\text{Sum (} \omega^2 \text{ of main effects + } \omega^2 \text{ of interactions)}}{\text{SSx} - [\text{d.f. (x)} \times \text{MSE}]} \) (Hay W., 1973)
Table 3. PROJECT FINANCE RISK WEIGHTING

<table>
<thead>
<tr>
<th>METHOD</th>
<th>PROJECT FINANCE RISKS</th>
<th>OPERATING RISK</th>
<th>ENVIRONMENTAL RISK</th>
<th>POLITICAL/REG. RISK</th>
<th>MARKET RISK</th>
<th>SPONSORS RISK</th>
<th>SUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBJECTIVE WEIGHTS (N=25)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (S)</td>
<td>22%</td>
<td>11%</td>
<td>18%</td>
<td>30%</td>
<td>19%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>S.D</td>
<td>7.22</td>
<td>4.16</td>
<td>6.35</td>
<td>10.39</td>
<td>9.92</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range (L-H)</td>
<td>(10-40%)</td>
<td>(0-20%)</td>
<td>(9-30%)</td>
<td>(8-65%)</td>
<td>(10-60%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMPARISON OF SUBJECTIVE AND OBJECTIVE WEIGHTS (Response is Risk Level, N=25)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effect Attribution (O)</td>
<td>21%</td>
<td>3%</td>
<td>10%</td>
<td>46%</td>
<td>20%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Difference (S-O)</td>
<td>1%</td>
<td>8%</td>
<td>8%</td>
<td>-16%</td>
<td>-1%</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>COMPARISON OF SUBJECTIVE AND OBJECTIVE WEIGHTS (Response is Risk Margin, N=24)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effect Attribution (O)</td>
<td>19%</td>
<td>4%</td>
<td>12%</td>
<td>48%</td>
<td>17%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Difference (S-O)</td>
<td>3%</td>
<td>7%</td>
<td>6%</td>
<td>-18%</td>
<td>2%</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

* Calculation of effect attribution was based solely on the main effects since two-level interactions were very small