

Basel II

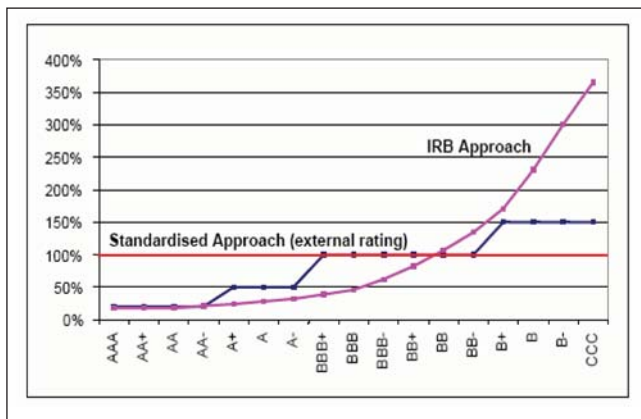
Competitive advantage

Mark Hodgson of Solens Consultants Ltd looks at the quantitative assessment of pricing, default and provisioning for structured trade finance transactions and the application of Basel II to attain competitive advantage.

The introduction of the new Basel II accord will undoubtedly produce new challenges for the banking products that serve the emerging markets. Whereas the accord recognises the effectiveness of security in the form of collateral and

whereby Monte Carlo simulation techniques have been utilised to produce risk profiles which can then provide the necessary input for determining the provisioning requirements as described under Basel II. The developed programme is

Figure 1: Risk weighting for corporates



other related trade documentation as a means of mitigating the level of capital at risk, there appears to be a significant limitation as to the availability of appropriate models which are flexible enough to meet the needs of not only trading companies, but also of emerging market commodity producers in their being able to access capital while lenders adhere to the principles of Basel II. Indeed, the introduction of internal Rating Basis (IRB) techniques to risk weight exposures for corporates having poor credit ratings indicates that the level of provisioning could rapidly increase, a point indicated by work undertaken by KfW (see Figure 1). The purpose of this article is to describe an approach

aimed at providing a contribution to the IRB approach that can be adopted by banks. The term 'baseline conditions' is a common phrase usually adopted to provide some form of benchmark for the subsequent cashflow model, which is then used to describe the capacity of the borrower to meet its financial obligations. However, there remains significant uncertainty as to the likelihood that such baseline conditions actually represent reality for the likely medium term, let alone the long term. It is the question of the variability of such baseline parameters that affects cashflow that provided the starting point for the development of the computer model that is

described in this article. By accepting that variability within practical limitations – as indicated from historic business practice – and further refining such cashflows to take account of the impact of country risk, it has proved possible to build an estimate of the probability of default for a given transaction. This probability of default can then be related to the comparable return to the investor. As a consequence, the risk-reward relationship can be defined for any transaction taking into account the most relevant risks, and, as a result, can enhance quantification of the pricing needed to meet investment expectations.

Enhancing competitiveness

The key objective of Basel II is to ensure that banks provide sufficient reserve capital to meet their lending requirements. A bank will gain competitive advantage if it is able to optimise the pricing of a transaction, the amount of capital lent and the required level of reserves accordingly used for provisioning.

This is the objective of the present paper, in which the relevant relationship between the return to the bank and the provisioning of a transaction can be quantified.

An indication of the type of relationship is shown in Figure 2. By quantifying the position of the return to the bank with respect to the capital provision, a lender will then be in a position to ensure optimisation of its lending at a specific pricing while ensuring that the requirements of Basel II can be duly observed. In this

way, the competitive position of the bank should be enhanced.

The following sections describe the development of the risk-reward associations involved and conclude with a risk adjusted return-capital provision relationship as deduced for a gold project. They also describe the basis for the computer programme used and the simulations conducted. The methods employed have been taken from a review of a number of works on credit models. Data used were sourced from real mine finance projects, the identity of which remain confidential. In summarising the key observations made, the reader's attention is drawn to:

- The risk-reward relationships given in Figures 5 and 6, which show how pricing can subsequently be optimised to ensure that it reflects the risks inherent in the transaction.
- The reward-provision relationships, as quantified in Figure 9, which shows optimum levels for the capital reserve and hence a measure of the maximum exposure the lender should consider.

Definitions used

There are a range of different measures for default and required provisioning stipulated under Basel II. For the purposes of this article, the key measures are:

- PD is the probability of default, as defined by the incidence of the borrower being unable to meet debt service obligations within a 12-month period.
- EAD is exposure at default, the exposure on the obligation at the time of default and expressed in a monetary amount.
- LGD is loss given default,

the fraction of the EAD that will not be recovered following a default and therefore expressed as a percentage.

It is the likely overall proportionate financial loss associated with the 'default'. In this paper, two measures will be used: the first will be that prior to the perfecting of security, mainly a reliance on conventional debt recovery processes or a 'default loss' (DL).

The second type of loss takes into consideration the potential for accessing tangible security (eg, contractual obligations, stocks etc), and is termed the 'secured loss' (SL), as would be the case for most structured trade-based transactions.

- EL is the expected loss, and is based on the envisaged likelihood of a default as expressed by PD. Hence the expected loss can be defined as (see Figures 3,4,5): $EL = LGD \cdot PD \cdot EAD$

- UL is the unexpected loss on the individual loan is usually expressed as the standard deviation of the credit (σ credit) of the overall advance amount (A). The definition quoted by the Deutsche Bundesbank is used here and is given as: UL (as a proportion) = σ credit = $LGD \cdot (PD \cdot (1-PD))$ Hence UL (as $\sqrt{\text{monetary value}}$) = σ credit $\cdot A$

Risk weightings, expressed as percentages, are applied to exposures in order to provide an appropriate level of provision in the event of a default. The higher the likelihood of default the higher the weighting. In the Consultative Document Overview (CP3) section on the treatment of unsecured claims and non-recognised collateral, senior claims on corporates, sovereigns and

banks not secured by recognised collateral will be assigned a 45% LGD. However, the recovery of defaulted exposures from emerging market countries can easily be zero.

Accordingly, LGDs of zero were applied in a number of the test runs. Given the fact that the accord places an emphasis on "slotting criteria" (paragraph 275) as opposed to the types of equations listed in the Appendix, an integration of LGD, EAD and PD principles for project and commodity finance (PF and CF, to use the Basel II acronyms) as well as structured trade finance (or STF, which is not mentioned as such) remains to be undertaken; hence the work described below.

Method used

Basel II, under the aegis of an IRB approach, provides for a range of interpretations for defining a case of default. In producing a measure for a default, the use of discounted cashflow or NPV can provide a useful first step and therefore a negative NPV for a cashflow can be taken as representing a default situation in the future.

A negative NPV therefore would take into account the possibility of a default situation being rectified by the continuation of the financial transaction in an attempt to achieve repayment in full.

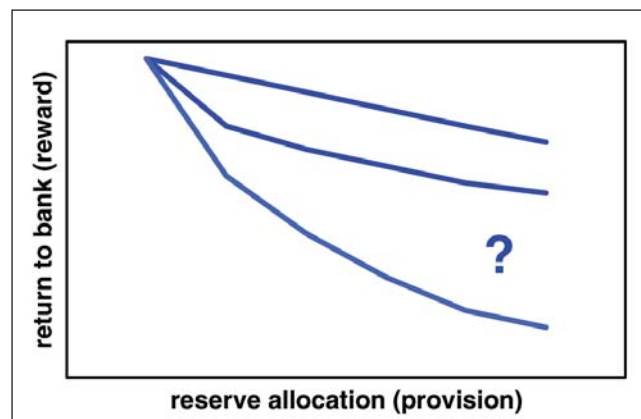
The other measure of default adopted, and on which this article focuses, was that based on the capacity of the borrower to repay within one year, a shortfall in debt service being sufficient to warrant a statement that a default has occurred.

The default situation will be referred to as a default loss

or DL event, for which the default exposure would be the EAD. The corresponding

level tested, it is frequently the case that as volatility increases, the tendency for a

Figure 2: Reward-provision relationship



exposure, after security has been taken into account, will be referred to here as EAD*. The resulting loss is termed a secured loss or SL. Monte Carlo simulations involve the sequential input of all the key variables which are made to vary between pre-established minima and maxima. The level of variation is referred to here as the volatility (denoted as σ). In most texts on the subject, such variables as metal price or process cost will tend to follow, or be considered to be governed by, a normal distribution. The following series of steps were used to develop the relationships between volatility and the defined default criteria:

- Load variables based on selected baseline criteria;
- Set initial volatility level;
- Calculate cashflow; record EAD and EAD*; repeat procedure for pre-selected number of trials;
- Determine PD based on recorded frequency of incidence of default;
- Increase volatility level and repeat steps three and four until trials at the 50% volatility level are complete. Once the series of trials is complete for each volatility

default will also increase. Concurrently, with the estimation of the probability of default, it is then possible to calculate an equivalent return based on the expected earnings from the transaction as compared with the likely loss. The occurrence of an expected loss (EL) in this case, has been taken to indicate a default (DL) situation. The equation subsequently used to relate EL to the return to the investor is that as given by Bessis, as follows: Risk adjusted return on capital (Raroc) = (expected earnings - EL) / CaR where CaR is the capital at risk.

In other definitions, this can be also be equated with the UL. In the case of the CaR, this was taken to being equivalent to the total sum of money drawn down multiplied by a factor usually reserved to the purpose, in this case the Cooke Ratio (normally 8%). As noted from the definition above, this can be different from the UL. Under such circumstances, the relationship between Raroc and the PD is a straight line having a positive gradient as the probability of

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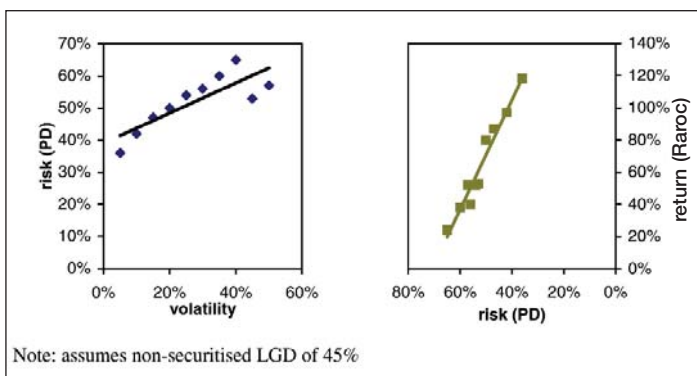
default decreases, for a constant Cooke Ratio. The position of this risk-reward line therefore summarises the overall effect of the key variables based on the chosen baseline criteria. The position of the line becomes particularly significant where it crosses the points at which Raroc

the respective mean and standard deviation parameters for such distributions, the main provisioning elements can then be produced as discussed below. An additional element of the provisioning requirement, relates to operational risk. Given the fact that most, if

taking place in the country. For example, if country risk has a material adverse effect on the ability of a borrower to perform under its financial obligations, the most likely impact would be a cessation of production of the commodity that could lead to a negative cashflow situation either on a temporary or permanent basis. Whereas country risk is presented in terms of risk ratings by the ratings agencies, it is possible to obtain quantitative measures of country risk from the public domain. Here, factors as used by the World Bank have been applied. These factors include financial, economic and political elements that together constitute an overall country rating. Values can then be assigned on their relevance to their impact on the borrower's operations. A weighted average of these factors can then be applied as a threshold risk value, above which an adverse country risk trigger event occurs and therefore impacts

follow a log-normal distribution. This again follows observations made by other authors. By applying a log-normal generator a series of random numbers can be generated which, depending on the level of the rating chosen, will either exceed or be less than a cut-off stipulated by the relevant country rating. In the event that the randomly generated variable exceeds the rating then production levels for the specified time period are deemed to be zero. Consequently, the lower the country rating, the lower will be the threshold at which such disruptions can occur and therefore it is possible to model the effect on cashflow which is commensurate with the level of country risk. The net impact of country risk is to produce points at the lower end of the risk-reward relationship. The benefit of this approach is that it is then possible to determine if the pricing of the transaction meets the expectations of the financing

Figure 3: Relationships between return, risk and volatility



equates to first, zero, and second, the hurdle rate as stipulated by the lending institution. These relationships are illustrated in Figure 3. The relationships are based on a real case involving the production and export of metalliferous ore.

not all STF and CF transactions, involve offshore accounts to mitigate the effects of transfer risk, the Basel II operational risk requirement was limited to: $\text{Operation risk provision} = \beta \cdot m \cdot A = 0.15 \cdot 0.035 \cdot A$. Where β , m are constants and A the amount of the advance. Whereas operational risk provides a relatively straightforward measure of the level of provisioning required under Basel II, the same cannot be said so readily for levels of EL. The Appendix gives the equations that have been applied which have been put forward under the Basel II accord.

Loss distribution functions

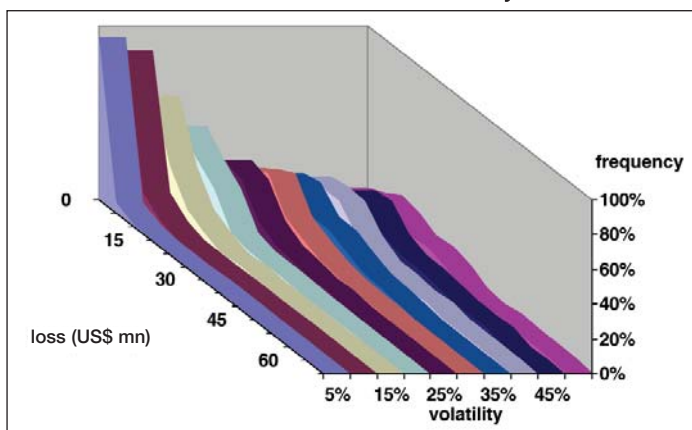
The programme has been designed not only to facilitate quantification of the risk-reward relationship but also to produce estimates of the provisioning required under Basel II. To that end, the losses likely to be incurred were compared with the provisioning estimates as currently stipulated under the latest Basel II documents released.

As the programme measures levels of cashflow and hence EADs directly, it is possible to collate losses into individual frequency clusters in a similar manner to the cashflows themselves. An example of the resulting loss distribution functions or LDFs is shown in Figure 4, for which beta distributions can be assigned. Based on

Pricing a transaction

The cashflow model which provides the basis for these determinations of PD incorporates factors such as production, throughput and commodity price which can be influenced by country risk. As a result, it then becomes possible to integrate, on a quantitative basis, the impact of adverse events arising from political, economic or financial factors

Figure 4: Loss distributions as observed for Au Project data



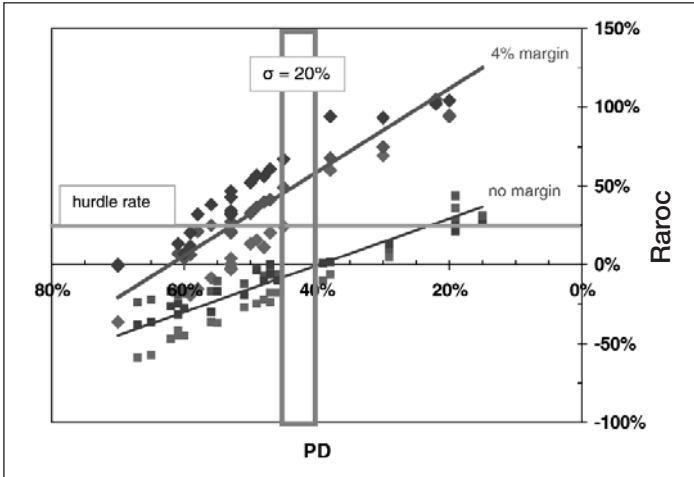
on key variables, such as production. It should be noted that this factor can be separated from other key variables such as taxation rate and royalty rate, which will have their own separate effects on the cashflow. The approach used in the programme is to assume that the impact of country risk on introducing a default will

institution. It can then be readily seen that by increasing the margin, the risk-reward line will be translated vertically and so it is then possible to produce an estimate of the minimum remuneration that would be expected in order for the lender to have a return that is in line with the risk. By comparing the trends

with the likely volatility assumed for credit purposes as well as the hurdle rate for a return on the investment, the minimum pricing needed for the transaction could be defined. The process is shown in Figures 5 and 6.

forward. Blue denotes Raroc based on an 8% Cooke ratio; green, Raroc based on perfection of security (SL); red, no perfection of security (DL)

Figure 5: Risk-reward relationships: Ni Project (LGD=45%)



From a general overview of the literature it has been assumed that typical volatility levels adopted by banks are around 20%. The equivalent PD range for this volatility level is subsequently indicated by the grey bar in Figures 5 and 6 for the mine project tested.

The hurdle rate is shown by an orange line (taken to be around 25%, based on informal market discussions had by the author).

Three valuations of the Raroc were applied, one set as based on the Cooke Ratio, the second set for non-securitised events (DL), the third set after security has been perfected (SL). The lines represent the linear regressions obtained for no margin (blue) and a 4% margin (green). Of particular significance is the position of the lines when a 0% LGD is assumed (Figure 6) as opposed to a 45% LGD (Figure 5). It could well be argued that Figure 6 represents a more conservative and practical view of the risk reward especially for countries where tangible collateral is the only feasible way

Provisioning estimates

Mean EADs and subsequently LGDs were determined from the LDFs and their associated beta distributions. A comparison of the losses estimated with the Basel II capital requirements is shown in Figure 7 for the gold project (DL data are given in red, SL data in green).

Conditions: country risk factor included; margin present; non-securitised LGD of 45%

Figure 7 serves to illustrate how all the Basel II capital provision estimates are consistently smaller than the estimates for the projected overall losses. This observation would be in line with other work done on Basel II capital requirements, albeit in banking areas outside PF, STF and CF. As would be expected, Figure 7 shows that the level of provisioning increases proportionately with the level of drawdown. The blue curve represents the so-called capital ratio (the average amount provisioned as a proportion of the amount drawn down), which would

be equitable with the Cooke Ratio.

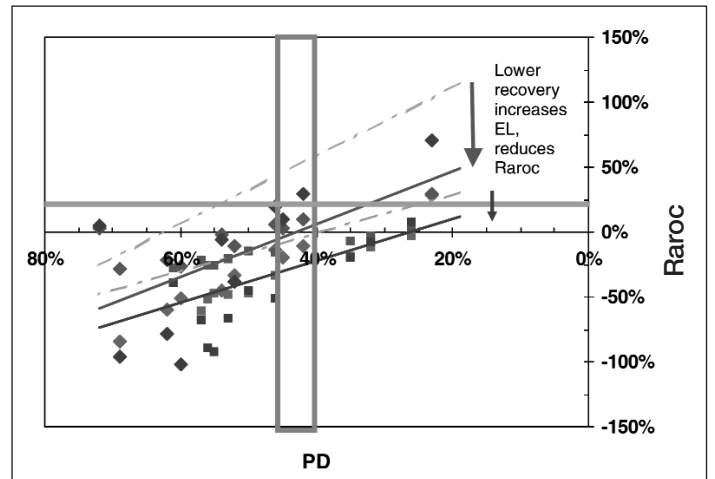
As shown, the values obtained ranged from 5-14%, indicating that the usual 8% figure might be considered as being too optimistic for the presented case.

Some authors have indicated that Basel II does not sufficiently recognise collateralised lending. In analysing the difference between the loss and the Basel II capital requirement, provision is made within the Basel II framework for adjustments to be made to account for different levels of maturity, among others. Modification to the maturity adjustment factor resulted in a narrowing of the reported difference. Amendment to the relevant coefficient used in the definition of the coefficient, b, (as defined in the Appendix) further resulted in the reduction in the observed difference, however for the sake of consistency with the Basel II formulae, the original

on capital with respect to the risk entailed. Here, the Raroc would be defined as the net earnings after taking into account expected losses as a proportion of the actual provisioning required, based on either an unperfected or perfected security position. In this way, such a measure would then be useful in providing a means of optimising the return on risk based on appropriate Basel II provisioning. This is shown in Figure 8.

Figure 8 shows a reproduction of Figure 6 with the original risk-reward lines for the 0% LGD indicated as the dotted black and blue lines. The improved Raroc values (shown in green for SL, red for DL events) arise due to the lower level of provisioning compared with that implied from a consideration of projected loss. This highlights the need to consider the utilisation of capital from the aspect of provisioning alone as opposed to taking a conservative view on likely

Figure 6: Risk-reward relationships: Ni Project (LGD=0%)

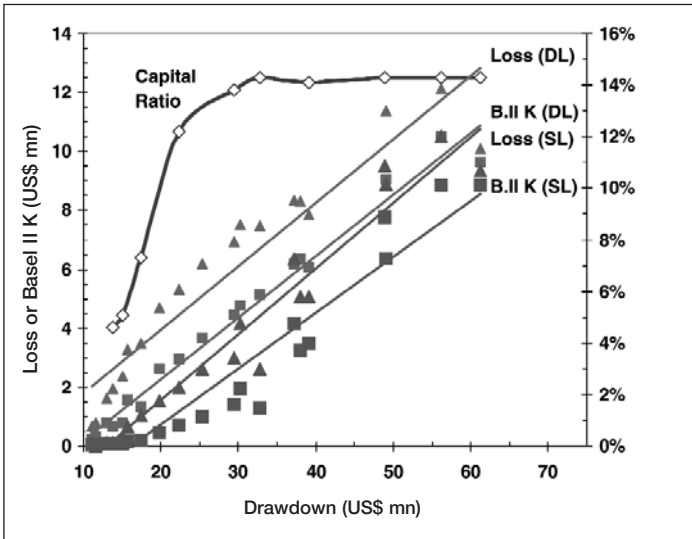


constants were maintained, although there may well be reasonable grounds for their amendment in the future due to the requirements of specialised collateralised lending (as in the case of STF). As a result of the adjustments, it is then possible to produce a revised estimate for returns

losses. Figures 5, 6 and 8 serve to illustrate the impact of pricing and associated Raroc definitions on the resulting risk-reward relationships. As noted earlier, the competitiveness of a bank will be measured by not only ensuring that the risk-reward balance is acceptable, but also by the optimum

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Figure 7:
Calculated losses, Basel II provisions vs project advances



utilisation of its capital. In Basel II terms, this amounts to ensuring that the Raroc remains positive for the provisioned amount. This is the basis of the Raroc-Basel II provisioning curves shown in Figure 9.

Here, the Raroc is based on estimates for UL as opposed to provisioning amounts, thereby providing a conservative view of the risk involved.

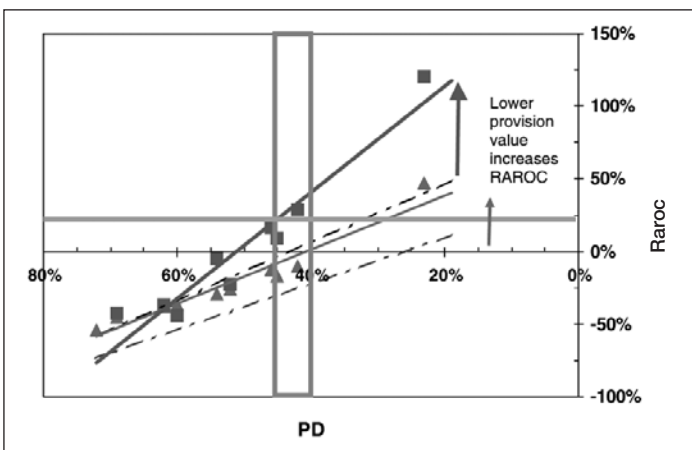
As shown in Figure 9, the double headed green arrow indicates the impact of the pricing range on the maximum amount of capital provision that ensures a Raroc in excess of the hurdle rate. The graph shows that the optimum provisioning level would be US\$5 million-9 million given the arbitrary hurdle rate of 25%. Above US\$9 million, the

likelihood is that the bank's reserve would be compromised. Summarising, the green line shows the best balance between return and the capital reserve so that the bank can determine the optimum level of its commitment to the transaction presented.

Conclusion

The main reason for the development of the programme was the identification of a need for a tool which could complement the development of a STF transaction in a way which would provide immediate feedback to business managers so that they would not only have an appreciation of the key variables that quantitatively influence cashflow, but also would

Figure 8: Risk-reward relationships: Ni Project (LGD = 0%):
Basel provisioning basis



provide a means for a more rigorous estimation for an appropriate pricing.

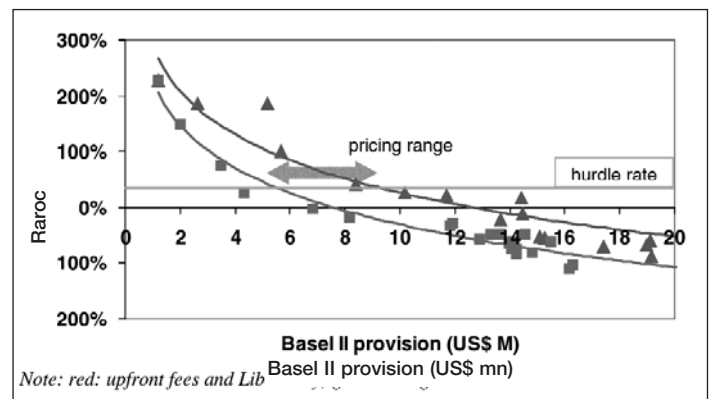
The whole purpose of structured trade transactions is to mitigate, to the furthest extent possible, the level of country risk.

It therefore follows that the pricing of such transactions needs to be fundamentally based on a quantitative estimate of the real risks that are involved, as opposed to a more general country risk margin.

In this way, this tool should provide a means by which

structured trade transactions not only provide a cost-effective means of raising capital in countries perceived as having high levels of risk, but also can demonstrate that the transaction satisfactorily takes into account those risk elements and manages them in a manner to produce a level of provisioning which is commensurate with Basel II. In this way, the tool can aid the lender to achieve competitive advantage through optimisation of its pricing and the provisioning relative to the risk assumed.

Figure 9: Risk-Basel II provision relationship: Au Project



Abbreviations Used

- A Advance made to Borrower
 - ASA Alternative Standardized Approach
 - b Maturity adjustment
 - CaR Capital at Risk
 - CF Commodity Finance
 - DL Default Loss
 - EAD Exposure at Default; EAD* the EAD after security is perfected
 - EL Expected Loss
 - EXP Natural exponential
 - IRB Internal Ratings-Based approach
 - LDF Loss Distribution Function
 - LGD Loss given default; LGD* the LGD after security is perfected
 - ln Natural logarithm
 - K Capital requirement as required under Basel II
 - M Effective maturity
 - m Coefficient used in calculation of operational risk provision
 - OpR Operational Risk
 - PD Probability of Default
 - PF Project Finance
 - RB Retail Banking
 - S Revenue (turnover) of SME
 - SL Secured Loss
 - SME Small or Medium Sized Entity
 - STF Structured Trade Finance
 - UL Unexpected Loss
-
- β beta for operational risk
 - λ (for determination of K)
 - Φ Normal Distribution
 - Φ^{-1} Inverse Normal Distribution
 - ρ Correlation (for determination of K)
 - σ Volatility: standard deviation associated with losses in general
 - σ_{credit} Standard deviation associated with unexpected loss

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