DEMATERIALISING CAPITAL IN FINANCIAL FIRMS: AN OPTION BASED APPROACH

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Abstracts

Risk management is at present essential to the banking business mainly as a discipline geared to the protection of depositors with a strong capital support. But risk management yields other benefits, offering a well-grounded procedure to allocate capital and to price banking products. Value at Risk (VAR) is by far the most common methodology for quantifying risk in banks' portfolios. In this paper we explore an alternative technique. Starting from a proposal by Merton and Perold an options based approach is suggested that - alternative to the VAR methodology – outlines a significant difference between cash and risk capital.

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KEYWORDS : Bank Capital, Option, Contingent Capital Instruments

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1. Introduction

If the underlying aim of the paper is to shed light on the pivotal role of capital in any kind of firm, it seems at the same time necessary and fundamental to start by stressing the deep conceptual link existing between the function carried out by capital and the need for protection which typically distinguishes any creditor. This suggests that the solvency and reliability of a firm can be achieved only when the total value of its Assets exceeds those of its Liabilities.
For a financial institution, the main role of capital is to provide protection against future losses, offering creditors a shelter in the event of default of the firm: therefore, it can be argued that capital carries out a role of "protection" against losses as its amount represents the maximum dimension of sustainable risk. This depends on the fact that larger amounts of capital, can reduce the probability of losses, which lead to a reduction of the asset value below those of liabilities, giving rise to insolvency conditions.
To enlarge upon this issue, we shall now consider the question in terms of how much capital is necessary, keeping in mind that there might be different stakeholders, whose interests and points of view may occasionally clash

- Bank supervision authorities, whose principal aim is to assure the stability of the financial system and to prevent the rise of crises in the bank industry will be focused on the determination and control of *systemic risk*, the possibility that the crisis of a single bank can be transmitted to other operators leading to a "domino" effect;

- Creditors and depositors of the financial institution, are interested in acquiring a "reasonable" safety on the possibility of receiving the flows produced by their investments; flows which should be unaffected by the variations of bank performances. Therefore, ceteris paribus, creditors and depositors are interested in an increase of the amount of capital held by the bank.

- The shareholders' target - on the other side – is to maximize the output of their investment, proportionally to the risk they were willing to assume when they entered the investment. According to this point of view, shareholders are interested in minimizing the amount of capital, because excessive levels of capital can diminish the level of profitability of their investment.

The existence of different perspectives makes the research of a satisfactory equilibrium among them essential and absolutely necessary if our aim is to understand how risk is split and divided among the different stakeholders, according to the idea that risk is faced not only by shareholders, but also by all the other subjects whose interests are tied to the perspectives of equilibrium of the firm[1].
In the following section of the paper, we shall attempt to present a different approach - proposed by R. Merton and A. Perold[2] - to understand the role of the principal stakeholders of the financial firm – i.e. creditors and shareholders – in sharing risk, relating it to the measurement of risk and to the different forms of capital that can be provided.

2. The theory of risk capital

The theory of risk capital in the financial firm, developed by Merton and Perold, analyses of the role of capital, referring to a financial institution, characterized by specific properties:

- Most of the passive holders of the financial institution - the depositors, if we consider a bank, insurance policies' underwriters if we

[1] It is important, first of all, for creditors that give the firm financial resources, but also for employees and all the community.
[2] Merton R.C., Perold A.F., (1993), *Theory Of Risk Capital*, In Financial Firms In Journal Of Applied Corporate Finance, Volume 6 N. 3.

consider an insurance firm - have a strongly credit-sensitive relationship with the financial institution; (..*Policyholders, depositors and swap counterparties.)*[3]. This means that for those clients the independence of their earnings from the firm's risk-yield conditions becomes important. The opposite occurs if we consider the shareholders' point of view: their earnings are positively correlated with the economic results of the firms that receive an earning dependent on the economic result of the firm; they are obviously compensated in connection to the greater risk assumed;

- The opacity towards both depositors and shareholders: information about Asset and Liability structures of financial institutions is only disclosed after a time lag. This increases information and agency costs for both funding and transaction activities; and this appears even more important if we consider that financial firms' financial structures suffer from high levels of liquidity, from which derive fast and continual changes. Moreover, monitoring becomes harder, as financial firms experience a strong trade-off among disclosure targets and strategic skills to compete, as information is perceived as a chief value driver;
- The existence of a highly competitive financial market, in which capital is lacking, whose cost influences financial firms' performances.

What distinguishes Risk Capital (CAR) from other forms of capital are the peculiarities of financial aspects of a financial firm's balance sheet, as most of the risky assets are financed by the issue of lower risk liabilities, such as deposits. It therefore follows that the economic risk, must be borne by the other firm's stakeholders: for instance the economic risk a bank incurs when financing risky assets with deposits, is borne both by the shareholders and by the liabilities holders, whose earnings are tied up with those of the firm. Finally, if we suppose the existence of other

3Merton R. C., Perold A.F. (1993).

forms of deposits insurance, risk will be suffered as well by public authorities[4].

The issues of free-risk liabilities are essential to the exercise of the monetary function, therefore the capital management process, in order to assure a default-free funding, needs to consider on one side the issue of subordinated loans and other risky titles assuring different rights to the shareholders, and on the other more innovative instruments such as insurance policies and contingent capital instruments.

It should be underlined that each alternative has to be taken by the financial firm in accordance with the (supervising authority's) rules, as well as with corporate governance and profitability ties.

It is therefore evident that the importance of the risk capital for a financial firm is defined *"...as the smallest amount that can be invested to insure the value of the firm's net assets against a loss in value relative to a free-risk investment"*[5]. According to this definition the Risk Capital of a long position on a Bond[6], is given by the value of a put option on the same title with a strike price equal to the forward value of the title[7].

3. The option based approach as a measure of the risk sharing between bank stakeholders

The aim of this section is to find an application of the conceptual framework proposed by Merton and Perold, for the measurement of bank risk capital.

The purpose is to apply the Option Based Approach, as an alternative to the VAR methodologies, for the determination of the correct measure of capital, stressing the advantages arising from highlighting the separation

[4] And, in this way, by all the community.

[5] Merton R.C., Perold A.F.(1993)

6 Perold A.F., (2001)

[7] The forward price is the current price plus interest calculated at the free-risk rate minus any coupons paid in the interim.

of the different roles assumed by principal stakeholders in the coverage of firm's risk.

Value at Risk (VAR) is the prevailing method used to estimate a bank's risk capital. Briefly, a confidence interval is chosen around the distribution of the bank's asset portfolio returns and then the required capital is calculated according to an "acceptable" probability of default. The larger the variance of the distribution and the lower the cut-off probability of default, the larger will be the amount of capital required.

Even the setting of a very low probability of default – in other words high level of protection- won't exclude the event of bankruptcy, and that means that depositors will, in any case, bear some risk.

According to the VAR methodology[8], we will consider a bank with a 100 ML € of asset portfolio, whose returns are normally distributed, with an annual expected return of 10 percent and with a yearly standard deviation of 10 percent. According to this hypothesis it is possible to quantify the measure of capital, assuming that the interval of confidence chosen is of 99 percent.

It will result that that:

$$Z = \frac{X - m}{s} \qquad (1)$$

and the value of the variable Z, corresponding to a 99 percent confidence interval, is equal to 2,33

$$-2{,}33 = \frac{X - 10\%}{10\%} \Rightarrow X = -13{,}30\% \qquad (2)$$

this implies that the measure of capital necessary to protect the value of the assets from a default with 1 percent probability is equal to € 13,3 MLs.

[8] For further investigations see: Leone P. (1999).

The Balance sheet of the bank will be therefore equal to:

(Chart 1) €

Assets		***Liabilities***	
Portfolio	100.000.000	Deposits	86.700.000
		Capital	13.300.000
Total	100.000.000		100.000.000

In this case the portfolio of investments of the bank is financed both by the depositors and by the shareholders; the risk is mainly borne by the shareholders with € 13,3 MLs of capital that cover the potential losses with a 99% confidence interval, while the depositors bear only the most extreme risks with a probability smaller than 1 percent.
According to this methodology of measurement both the shareholders and the depositors suffer the bank's risk[9], and it is not possible to come to a clear distinction between the resources designated to finance the operational funding (cash capital) and those destined to retain losses (risk capital).

If we assume that the entire amount of deposits is due after one year, depositors will recover all their money on condition that the assets value will be larger or at least equal to the nominal value of the deposits increased by interest. If this fails to happen - asset value turns out to be smaller - depositors will lose the difference between the deposits increased by interest and the asset value, as shown in (graph 1):

Moving from the VAR methodology to Merton's approach, we shall now think of the pay-off of the depositors as the sale of a put option

[9] In this example no deposit insurance form is considered.

from the depositors to the bank's shareholders. Depositors will invest the return of the sale at a free-risk rate (frr).
The strike price of the put option is equal to the nominal value of deposits increased by the interest calculated at frr.
According to these foundations we can argue that the capital value can be defined as the value of the portfolio minus the difference between the nominal value of the deposits and the value of the option, according to the expression (3):

$$(3) \quad C = A - (D - O_p)$$

Where:

C: Capital Value;
A: Portfolio Value;
D: Nominal Value of Deposits;
O_p: Put Option Value;

The balance sheet scheme showed in chart 1, becomes:

(Chart 2) Ml €

Assets		***Liabilities***	
Portfolio	100,00	Deposits	86,7 - Op
		Capital	13,3 + Op
Total	100,00		100,00

For the fixing of the Put option value, we will refer to the Black-Scholes[10] formula, hypothesizing the followings data:

Free Risk rate (frr) (%)	5
Strike price	(€ 86,7 ML * 1,05) =

[10] Black F., Sholes M. (1973).

	= € 91,035 ML
Yearly volatility (%)	10
Time to maturity (years)	1
Portfolio value	€ 100 ML

Following our assumption, the value of the Put Option is equal to €312.493,30; and the balance sheet becomes:

(Chart 3) €

Assets		***Liabilities***	
Portfolio	100.000.000,00	Deposits	86.387.507,00
		Capital	13.612.493,00
Total	100.000.000,00		100.000.000,00

In other terms:
(Chart 4) €

Assets		***Liabilities***	
Portfolio	100.000.000,00	Deposits	86.700.000,00
		Capital	13.300.000,00
Total (on-balance)	100.000.000,00		100.000.000,00
Put Option	312.493,30		312.493,30
Total (on + off balance)	100.312.493,30		100.312.493,30

The examples shown allow us to stress how the functional dematerialization of capital works: the bank gets free-risk funding, buying from the depositors a put option and selling it to the shareholders; the shareholders will exercise the option if, at the expiry date, the portfolio value is lower than the value of the deposits increased by the interests accrued at the frr, transferring the bank's assets to the

creditors at a price equal to the repayment value of the debt, getting rid of any contractual obligation towards the depositors.

Therefore, the put option can be seen as an insurance contract "sold" by the depositors to the bank, in which the insured event consists of the possibility that the value at the maturity of the assets can be lower than the liabilities' value.

It is worth pointing out that insurance can be sold to the bank even by a third party; for instance a subordinate stockholder or an insurance firm, that offers protection against the entire risk suffered by the bank, making deposits and equity totally neutral to risk.

Under those assumptions, the total amount of capital - or the value of the insurance - can be measured following the previous example, and therefore referring to the value of a Put Option sold by the subordinate stockholder to the bank, with a strike price that is equal to the bank's portfolio future value at frr, with a time to maturity equal to protection period needed.

The effect of insurance on the bank's assets at maturity is shown in graph 2:

The value of the option can be measured according to the following data:

Free Risk rate (%)	5
Strike price	(€ 100,00 ML * 1,05) = = € 105,00 ML
Yearly volatility (%)	10
Time to maturity (years)	1
Portfolio value	€ 100 ML

The value of the option is equal to € 3.925.199,62; since this measure of capital allows the bank to neutralize shareholders and depositors' risk at maturity, we can read that value as the total amount of Risk Capital for the bank.

The balance sheet becomes:

(Chart 5) €

Assets		Liabilities	
Portfolio	100.000.000,00	Deposits (risk-free)	86.700.000,00
		Capital (risk-free)	13.300.000,00
Total on balance	100.000.000,00		100.000.000,00
Put Option	3.925.199,62	RISK CAPITAL	3.925.199,62
Total on + off balance	103.925.199,62		103.925.199,62

If the protection role is carried out directly by depositors and shareholders instead of by the third party, the balance sheet becomes :
(Chart 6) €

Assets		Liabilities	
Portfolio	100.000.000,00	Deposits (risk-free)	86.700.000,00
		Capital (risk-free)	13.300.000,00
Total on balance	100.000.000,00		100.000.000,00
Depositors (risk capital)	312.493,30		
Shareholders (risk Capital)	3.612.706,32	RISK CAPITAL	3.925.199,62
Total on + off balance	103.925.199,62		103.925.199,62

In this last assumption, depositors assume a part of the risk and they sell the put option to the Bank, while, the remaining part of risk capital, is subscribed by the shareholders at a value equal to the difference between total Risk capital and the option value sold by the depositors.

The analytical examples used in the paper allow us to draw some conclusions:

a) Both shareholders and depositors subscribe two kinds of Liabilities: cash capital necessary for the operational funding and risk capital necessary for the hedging of losses; in the example depositors subscribed €86.700.000,00 of cash capital and € 312.493,30 of risk capital, while the shareholders subscribed €13.300.000,00 of cash capital and € 3.612.706,32 of risk capital;

b) It is possible to measure risk capital effectively and to split its value in two different parts, the first which refers to shareholders and the second to depositors, allowing us to point out the effective part of risk undertaken by each of the stakeholders analysed.

Stakeholders' net position is equivalent to the amount obtained using the VAR methodology: depositors invested as deposits 86.700.000,00 € and received from the option sale 312.493,30 €, with a net position towards the Bank equal to 86.387.506,70 €; shareholders subscribed both cash capital for 13.300.000,00 € and risk capital for 3.925.199,62 €s, minus the option value, that represents the risk insurance, with a net position equal to 13.612.493,30 €; the sum of the two net positions is equivalent to the portfolio investments value.

Results can be summarized as follows:

(Chart 7) €

Cash capital expenditures		Source of Cash Capital	
Portfolio	96.074.800,38	Cash Capital (Shareholders)	9.687.293,68
		Cash Capital (Depositants)	86.387.506,70
Total (A)	96.074.800,38		96.074.800,38
Risk capital expenditures		Source of Risk Capital	
Insurance	3.925.199,62	Risk Capital (Depositants)	312.493,30
		Risk Capital (Shareholders)	3.612.706,32
Total (B)	3.925.199,62		3.925.199,62
TOTAL (A+B)	100.000.000,00		100.000.000,00

4. Implications of the Option Based approach and alternative risk transfer instruments

Merton and Perold's model offers a significant insight into the potential of an effective integration of financial and insurance markets, offering new capital instruments for potential losses hedging.
Risk hedging through insurance contracts achieves a double purpose[11]:

- It permits the transfer of risk to a third party, replacing an uncertain loss with a certain cost (the premium);
- It offers firms future funding to cover the costs deriving from future losses.

[11] Doherty N. A.(1997).

In a traditional insurance contract, the first aim (the component of risk transfer) is to stabilize earnings, while the second (the financial aspect) is to stabilize cash-flows.
It is worth stressing the fundamental role of the financial aspects when facing risks characterized by low probability with a high level of potential losses.
When analysing the effects for a bank if an "extreme event" were to occur, we have to consider the economic implications and the financial aspects separately.
The economic consequences of the event can be absorbed through the bank's self financing in the long term, while, from a financial perspective, losses can bring financial stress in terms of capital absorption[12].
The example underlines the attractiveness, for financial firms, of financial instruments that offer methods of financial funding, without the necessity of risk transfer.
Those instruments, generally called *"contingent or committed capital"*, may supply cash capital, under pre-established conditions, at a future date in the case of the trigger event occurring.

It is important to point out that contingent capital facilities are not insurance products, but products structured and priced through the use of a combination of insurance and capital markets techniques. Those instruments allow firms to raise equity or debt upon the occurrence of a pre-agreed event. The providers of this capital do not stand the risk of the event: they simply finance the loss once the event has occurred[13].

A contingent capital instrument is an option, and the firm that owns those options has the right to sell its own securities - that may take the form of equity, debt or a hybrid of the two - at a fixed price for a fixed period of time: this allows the firm to raise new capital.

[12] Culp C.L. (2002).
[13] Nieman D. B. (1999)

The underwriter of a contingent capital option is obliged to buy the securities, only under the will of the option owner, if all the conditions of the agreement are met.

5. Characteristics of contingent capital instruments

Contingent or committed capital instruments are characterized by great flexibility and adaptability to the counterparties' needs; therefore it becomes difficult to manage a standardization of different contracts types. It could be useful to underline the different variables that distinguish a Contingent Capital instrument:

- Option period: The option period establishes the time in which the option can be exercised, and like an American Option, It should be long enough to allow for the occurrence of the trigger event and for management to take the decision whether to exercise the Contingent Capital option or not;

- Holding period: The holding period refers to the time gap, generally beginning with the exercise of the option, and ending with the date of redemption; during which the underwriter holds the issued securities;

- Trigger events: the trigger is the event that makes the option active, so that the owner can exercise it. It can include economic indicators such as inflation, gross domestic product, or financial market indicators. Generally it is possible to include also a second trigger, as a moral hazard mitigation technique. In this case the trigger has to be a variable that is not under the direct control of the contingent capital purchaser.

- Type of securities: The security underlying the contingent capital option can be any of the securities that a firm uses to raise capital, for example common equity, preferred equity or senior debt. Generally if the target of the purchaser is to demonstrate financial strength to

Supervision Authorities, the security chosen will be an instrument that can be qualified as regulatory capital, such as subordinated debt.

- Redemption alternatives: The purpose of the option underwriter is to offer contingent capital facilities, and not to acquire a strategic shareholding of the firm, therefore contingent capital instruments include an exit strategy for the option underwriter. The alternatives could consist of having a security that: a) forces payback of the capital, b) is easily converted into a liquid asset c) provides a share of future profits of a specified line of business[14];

- Cost: The cost of a contingent capital option is made up of two components: a) the option premium, b) the financing rate on the security if the option is exercised.

6. Conclusion

Risk management is at present essential to the banking business mainly as a discipline geared to the protection of depositors with a strong capital support. But risk management yields other benefits, offering a well-grounded procedure to allocate capital and to price banking products. Value at Risk (VAR) is by far the most common methodology for quantifying risk in banks' portfolios. In this paper we explore an alternative technique. Starting from a proposal by Merton and Perold (1993) an options based approach is suggested that - alternative to the VAR methodology – outlines a significant difference between cash and risk capital.
According to these results, we tried to merge those considerations with the use of new capital instruments, based on an insurance perspective of capital management, such as contingent capital options. Those instruments have the advantage of being very flexible and of reducing the total cost of capital, through the combination of financial and

[14] Culp C. L. (2002).

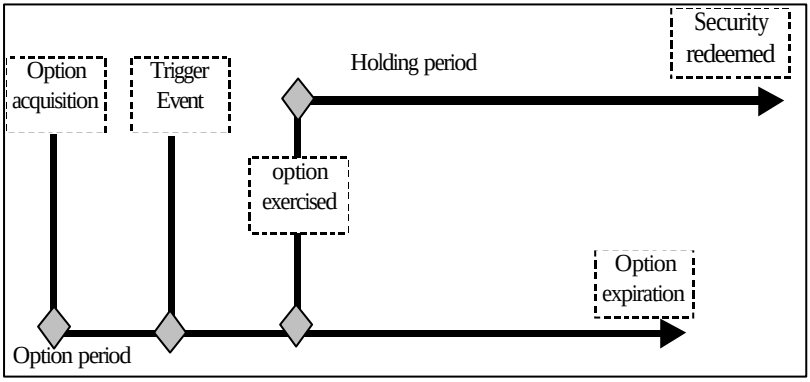
insurance methodologies. A Financial Firm can therefore use Contingent Capital Instruments to assure the availability of Cash Capital, at a lower cost if compared to that of traditional capital instruments[15].
We would like to conclude with some issues that could be the basis for further research.
In primis, it is worth underlining the elements that can work as obstacles to the development of alternative capital instruments:

- The existing trade off among standardization and flexibility, which typically distinguishes those instruments, makes the realization of the risk pooling function- which appears to be a fundamental condition of the efficiency of the market- more difficult;
- If the contingent capital option underwriter is not "reliable" enough, the bank could experience the transformation of the originally transferred risk into a counterparty risk;
- Limitations as to the use of those instruments could derive from the rules defined by the New Basel Capital Accord (Basel 2)[16], which limits the benefits, in terms of reduction of the capital needs, arising from insurance coverages to the operational risks area.

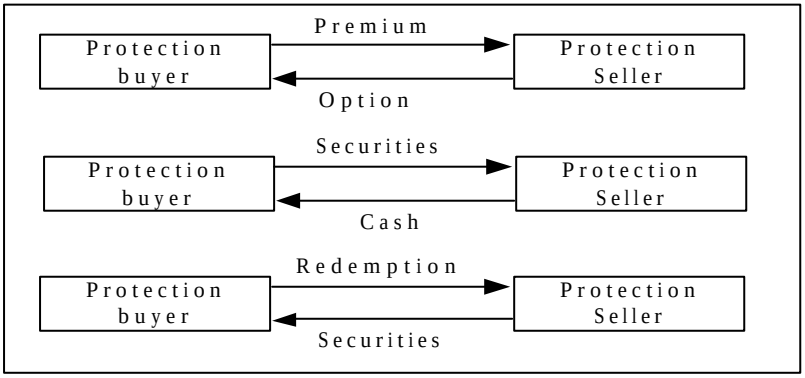
It is not difficult to imagine a future scenario in which the illustrated obstacles will be reduced, and in which financial firms will intensify the benefits arising from the use of alternative risk transfer instruments in risk management activities.

[15] Resti A. (2002)
[16] Basel Committee on Banking Supervision (2001), Working Paper on the Regulatory Treatment of Operational Risk.

(Graph 3) - Timeline for contingent capital option -



(Graph 4) - Typical structure of Contingent Capital operation -



Appendix I

Swiss Re's CLOCS (Committed Long-Term Capital Solution)[17]

In 2000, Swiss Re, one of the reinsurance market leader companies, dealt a Contingent Capital contract with Royal Bank of Canada (RBC), in which Swiss Re would make available C$ 200 million (€ 126 million) to Royal Bank of Scotland in exchange for preferred stock. The triggering event is tied to Bank 's loan portfolio and it is activated when the bank incurs exceptional credit losses that are in high-loss layers but that are not so high as to expose the firm to default risk. The C$ 200 million would result in Swiss Re owning about 1 percent of the firm's total equity if the option is exercised, so Swiss Re did not need to worry about having to "run the company" one day.

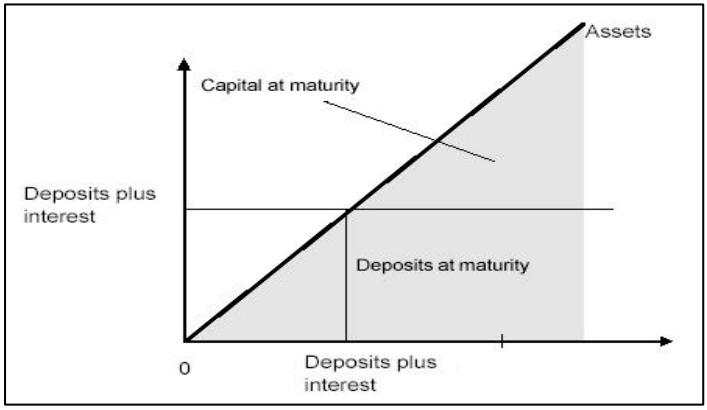
Apart from the obvious advantage of helping RBC secure funding on preloss terms, the committed capital facility helps RBC in several other specific ways. First, it helps RBC lower the cost of funding its loan-loss reserves.

As RBC executive David McKay indicated, "It costs the same to fund your reserves whether they're geared for the first amount of credit loss at the last amount of loss..... What is different is the probability of using the first loss amount versus the last loss amount. Keeping capital on the balance sheet for a last loss amount is not very efficient."

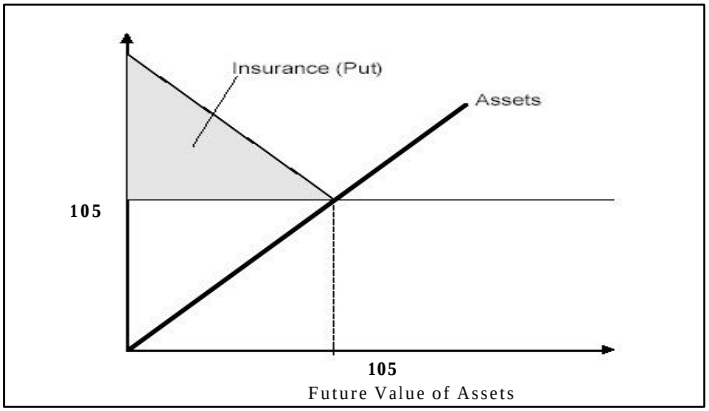
By covering the upper layers of RBC's loans improves its financial ratios. Swapping balance sheet reserves for contingent capital increase RBC's return on equity, for example. In addition, early indications are that AAA – Contingent capital provided by Swiss Re will be regarded as an acceptable substitute for Tier I capital under the Basel Accord by the BIS.

[17] Extracted from: Culp C.L. (2002), "The ART of Risk Management" Wiley-Finance.

(Graph 1) - *Cash Flows at Maturity* -



(Graph 2) - *Effect of Insurance on Assets at Maturity* -



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