Risk Management in the Chilean Financial Market
The VaR Revolution

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I) Introduction

Almost a decade ago a major change in the risk management industry was in its way: the well known international bank J.P. Morgan was about to release for the general public through the internet a full technical document describing with great detail a simple technique to measure market risks for trading portfolios: the Value at Risk (VaR) technique (JP Morgan, 1995). The document soon became an industry standard, and the techniques described on it fully addressed the quantitative recommendations issued by the group of thirty (Group of Thirty, 1993). These recommendations were trying to protect an industry that was being challenged by major financial scandals most of them involving derivatives. Most of the financial problems that some very reputable institutions experienced during these years were related to lack of appropriate risk disclosures, lack of involvement of senior management, and poor internal procedures and risk management controls.

The Basle reform of January 1996 (Basle 1996) captured the major concerns of regulators and senior management, and introduced the VaR technique to measure market risk and established regulatory capital to be allocated based on this calculation.

Seven years after what has happened in Chile? How is the actual level of risk management techniques in the Chilean financial sector, and what is the level of compliance with the best practices recommended by regulators and international practitioners?

The main goal of this document is to provide a general overview of the Chilean banking industry in terms of its risk management practices.

II) Trends in the International Financial Market

In January 1996, the Basle committee of Banking supervision issued the Market Risk Amendment, due to apply a year after to all G10 central banks and to the supervisory institutions of commercial banks.

This was the first major change to the 1988 Capital Accord, which was the prevailing framework to deal with risk, and its focus was mainly credit risk. The Amendment established, among other recommendations, that regulatory capital should be assigned to prevent unforeseen movements in interest rates and market prices that could affect on balance sheet and off-balance sheet positions of the bank.

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The Accord suggested for larger institutions, that capital should be assigned on a regular basis according to the market risk of the trading portfolio, and this should be measured with a Value at Risk technique. Banks should use VaR to define the capital charge for general market risk. In order to control the accuracy of the VaR estimates, banks are also required to perform a backtesting process, where VaR estimates are compared with effective (unrealized) losses and confirm their statistical accuracy. If VaR is estimated at a 99%, then losses above the VaR value should on average occur once in 100 days.

The Amendment also defines a set of qualitative requirements that incorporated the best practices for risk management[2]. In general terms it establishes the need for ongoing improvements in risk control and risk disclosures, focuses on more technical measurement of market risks (daily mark to market of the portfolios and measuring risks through VaR techniques), and stresses the development of a risk management culture with strong involvement of senior management.

By the early 90´s, the international financial market has become extremely complex, and technology has empowered the largest money banks to increase the volumes of trading to unsuspected amounts. At the same time, major financial disasters[3] have shown a lack of control of risks involved in these trading activities.

III) Measuring risks in Chile: the VaR approach

The Value at Risk approach to measure market risk is very simple: it measures the worst case scenario of a portfolio loss, for a certain confidence interval and a defined time horizon.

For example, if a portfolio has a VaR of 2% of its notional, it means that this is the maximum loss it could face in one week, given the potential changes in market prices, with for example a 99% of probability. In other words, losses larger than 2% of its notional in one week might occur, but with a small probability (1%).

Analytically, the definition of risk can become very simple and tractable tool.

Let $\mathbf{V_0}$ be the current market value of a portfolio. In a short period of time, say 1 day or 1 month, the market value of the portfolio will have a, random, value of $\mathbf{V_1}$. We can therefore define the profit and loss value of the portfolio as

$$\mathbf{P\&L = V_1 - V_0}. \qquad (1)$$

[2] These best practices were previously discussed among bankers, consultants, supervisors, and practitioners in what was known as the Group of 30 recommendations: a set of 20 recommendations issued in 1993 for dealers and end-users of derivatives, and 4 recommendations for legislators, supervisors and regulators.
[3] See Jorion (1997) for a discussion on major financial disasters of the 90´s.

This loss is a random variable, so we could try to estimate its minimum value with a given probability. That is exactly the definition of VaR: the maximum potential loss for a given horizon and a confidence interval.

If we fix the confidence level, let´s say at **α= 99%**, then VaR of the portfolio can be calculated by solving the following equation:

$$\Pr(\text{P \& L} \geq \text{VaR}) = \alpha \qquad (2)$$

If we know the probability density function of P&L, **f(·)**, a simple integration of this function will provide VaR.

$$\int_{-\infty}^{VaR} f(x)dx = 1-\alpha \qquad (3)$$

Alternatively, if we can obtain the cumulative distribution function **F(·)** of the random variable **P&L** for a given horizon of time, then VaR of the portfolio is just the inverse of the function valued at one minus the confidence level chosen:

$$VaR = F^{-1}(1-\alpha) \qquad (4)$$

This equation can be typically solved directly assuming a specific cumulative distribution function, or by simulation.

Normal markets and linear portfolios

When markets are considered normal and portfolios are linear in its risk factors, then function **F** becomes the normal cumulative function. Under these circumstances, we can simply solve VaR by recognizing that equation (4) can be written as,

$$VaR = \mu_{P\&L} - k_\alpha \cdot \sigma_{P\&L} \qquad (5)$$

that is, if we fix the level of confidence at α, we can always find the corresponding percentile of the distribution of P&L, by subtracting a certain number of standard deviation to the expected value of P&L . In this case, the exact number of standard deviations chosen depends on α, and is obtained through the inverse of the standard normal cumulative function, N(·):

$$k_\alpha = N^{-1}(1-\alpha) \qquad (6)$$

In other words, when markets are normal and portfolios are linear, to obtain the maximum loss, given a certain level of confidence, the only information required, besides the k_α parameter, is the expected value of the P&L function for the time horizon considered, and its standard deviation.

Typically, the expected value of the P&L of a trading portfolio in a short horizon is assumed to be zero. Under normal market circumstances, we could expect that this should be appropriate given market efficiency arguments. For longer term horizons, the VaR calculation should consider the drifts associated to the stochastic processes for the underlying risk factors, including its mean reversion dynamics.

Estimating the volatility of the portfolio

The market value of the portfolio **V**, can be defined by a known fixed set of market prices known as risk factors[4]. These risk factors in Chile are typically exchange rates, and interest rates.

Our assumption that portfolios are linear, means that we can decompose the change in portfolio value into a linear combination of several portfolio exposures in these risk factors times the change of risk factor prices.

That is, if V can be defined as a function of n risk factors,

$$V = V(f_1, f_2, \cdots, f_n) \qquad (7)$$

then P&L can be estimated through a first order Taylor expansion around each of the risk factors. Moreover, given that we also assume that markets are normal, this means that relative changes in market prices tend to a normal distribution[5] Therefore, differentiating equation (7), we can obtain:

$$\begin{aligned} &P\,\&\,L \approx w_1 \cdot x_1 + w_2 \cdot x_2 + \cdots + w_n \cdot x_n \\ &x_i \rightarrow N(\mu_i; \sigma_i^2) \end{aligned} \qquad (8)$$

where $x_i \equiv \frac{\Delta f_i}{f_i}$ and, $w_i \equiv V \cdot \left(\frac{\partial V}{\partial f_i} \cdot \frac{f_i}{V} \right) = V \cdot e_i$. The term e_i represents a risk factor elasticity measuring the percentage impact on the portfolio market value, when factor i changes in 1%.

From equation (8) it is simple to deduce that P&L variance can be written as

$$\sigma_{P\&L}^2 = \sum_1^n \sum_1^n w_i w_j \sigma_{ij} \text{ , where } \sigma_{ij} \equiv Cov(x_i, x_j) \qquad (9)$$

Finally, equation (9) can be written in a more compact manner using matrix notation:

[4] The procedure of decomposing the portfolio exposures to the different risk factors is known as "mapping".
[5] The exact assumption is that log returns rather than relative returns are normally distributed, but for short term returns, that is daily or weekly returns, both are very similar.

$$\sigma_{P\&L} = \sqrt{w^T \cdot \Sigma \cdot w} \qquad (10)$$

where this time **w** is nx1 vector and **Σ** is the nxn variance covariance matrix of the risk factors.

VaR can easily be obtained by replacing equation (10) into equation (5).

Moreover, if we assume that the expected change in P&L is zero, then it is easy to show that

$$VaR = -\sqrt{v^T \cdot \Omega \cdot v} \qquad (11)$$

where,

$$v_i = V \cdot k_\alpha \cdot e_i \cdot \sigma_i \qquad (12)$$

is the VaR associated with the risk factor i, and Ω is the correlation matrix.

This calculation is very simple: the only requirement is to map the current portfolio in the n risk factors, then calculate individual value at risk for each of the risk factors using equation (12), and then correlate these individual VaRs as shown in equation (11) to obtain the final portfolio VaR. This method is known as parametric VaR.

The parametric method requires statistics (volatilities and correlations) on the different risk factors. The challenge here is particularly on the interest rates markets to have access to enough historical data on term structures.

In Chile, this is definitely a problem where zero curves are non standard, and where publicly available term structures are poor and usually based on yield rates and concentrated on few government bonds.

The use of the parametric method requires that interest risk factors should be defined as instruments (and statistics become bond yields) rather than zero rates, and therefore the mapping procedure must occur at the instrument level rather than at the cash flow level.

Alternatively, banks must develop a more sophisticated technology to generate zero rates from yield rates. The standard bootstrapping method in this case will not work properly, given that up to last year the most important government bonds had annuities rather than bullet structures. This means that other methods such as Nelson-Siegel (1987), or Svensson (1995) should be used.

Simulation methods

When markets are non normal or when portfolios are not linear, then parametric VaR might be inappropriate. In these cases, then equation (4) is directly estimated through historical simulations or Montecarlo simulations.

Historical simulations uses historical data as if the historical returns could represent possible price scenarios for the current portfolio. This approach uses historical returns to generate potential P&L scenarios. These scenarios are then sorted and an empirical distribution is built. VaR is then deduced directly by choosing the P&L limit such that α % of the scenarios generated are to the right of that limit.

Other simulations methods (such as Montecarlo simulation) can generate thousands of random scenarios through a specific probability distribution and then proceed in a similar manner to obtain VaR of the portfolio.

The advantage of simulations is that they do not rely on the normal distribution assumption. However, it has a computational disadvantage: it requires to value the current portfolio in each of the historical observations. In case of non-linear portfolios, that is portfolios containing options, the simulation method has to perform a full valuation procedure rather than the valuation through the Taylor expansion presented in equation (8).

The standard risk factors in Chile tend to behave in normal fashion, and there are no important options trading activities in the financial market. The exception are mortgage bonds that have an implicit optionality that could be exercised depending on the level of market interest rates. If the pre-payment possibilities of these bonds are limited, VaR in the Chilean financial market should be using the parametric approach.

IV) Risk Management and Best Practices in Chile

In order to measure the level of actual development of the risk management standards in the local market, we had access to 17 of the largest financial institutions, representing more than 95% of the total assets of the banking industry, and almost 92% of total capital of the banking industry as of July 2003. Nine institutions were left out of the interviews: two of them local banks that just started their operations, and seven foreign branches of international banks that have a small size operation in the local financial market.

A set of interviews was conducted between August and September 2003, trying to identify quantitative and qualitative risk management best practices in the financial industry.

The results of the survey are presented as a percentage associated for each bank to one of the 10 risk management principles defined. The percentage represents a general appreciation on the level of how well is the principle implemented in the organization based on the quantitative survey and the qualitative discussion with the risk management team. The percentage level chosen were discrete values, starting with the lowest which is 0%, meaning that the there is no compliance to the risk management principle. A score of 25%

means that compliance is insufficient. This could be because the organization is just strating to address the issue, or because it is not yet a priority. The third level is 50%, representing a fair compliance to the principle, but with still an important space to cover. 75% represents the following level, and means that the organization is almost complying with the best practice principle, and minor issues are still pending. Finally a 100% represents a total compliance with the principle.

The results are averaged for all 17 banks interviewed, and discussed for each of the 10 risk management principles in the next paragraphs.

Principle 1: *Senior management involvement developing a risk culture, and encouraging the implementation of best practices in risk management, and helping defining the appropriate organization.*

This is a very basic principle, that reflects in which manner the organization is reacting to the regulatory environment, and internalizing the risk management function as a strategic one for the mission of the bank.

Only 5 banks among the 17 interviewed were considered as complying 100% with this principle. The rest of the banks were considered half way or below 50%. Although the majority of the banks mentioned risk management as critical in their mission statement, this was not totally consistent with the amount of time senior management spent in strategic discussions with the head of the risk management team, or in the role of senior management promoting a cultural change in the organization. Another observations was the relative relevance of the risk management group inside the bank that could be appreciated for these 5 financial institutions and the difference we could notice in terms of seniority of the management team, office space, and infrastructure, among others.

Table 1. Compliance with Risk Management Principle 1: Senior Management Involvement

Number of Banks and compliance score					Total
0%	25%	50%	75%	100%	54,4%
2	3	7	0	5	17

Source: Elaborated upon survey

It is important to notice that the top 5 banks scored in senior management involvement, are also the banks that started the earliest in implementing Value at Risk calculations in their trading portfolios. This suggests a level of maturity of the organization in this area.

Principle 2: *Risk management head with strong political weight in the organization, independent (specially from the risk taking group) and with a clear role of developing risk policies, and monitoring compliance of these policies.*

This principle states the requirement of the bank to have an appropriate risk management leader, with enough seniority that can face the leader of the risk taking group, usually the head of the treasury, with a mandate to develop policies, and with enough authority to enforce them.

This principle reflects upon the quality of the design of the risk management organization, its role, and its seniority in the bank.

We measured the compliance to this best practice, by asking the role of the head of the risk management team, her counterparties inside the organization, how policies are designed and enforced, and independent specially from the treasury area is the risk management position.

The results are presented in Table 2:

Table 2. Compliance with Risk Management Principle 2:
Seniority and Independence of Risk Management Leader

Number of Banks and compliance score					Total
0%	25%	50%	75%	100%	47,1%
4	4	4	0	5	17

Source: Elaborated upon survey

Results here are very correlated with the previous principle of senior management involvement: the same 5 banks that comply 100% in Principle 2 also comply with Principle 1.

The major problem we encountered was the lack of independence between the risk management team and the treasury group. Often times, the risk manager is actually a position that depends functionally from the head of the treasury. In other cases, the head of the risk management unit is a junior analyst, or a mid manager , and the strategic decision maker is often far from the technical details and shares responsibilities with other areas, such as credit risk. In three cases the risk management area is brand new, and the head of the area is just starting the process of developing risk management policies.

Principle 3: *Sound conceptual risk measurement system based on VaR, implemented with integrity in the risk management of the bank.*

This principle states that in order to measure the market risk of the trading portfolios, then bank should use a methodology based on VaR. Furthermore, this measurement should be used properly inside the institution to make decisions related to risk management policies.

In our survey, we asked if VaR was calculated, and what method was used to estimate this potential loss. We also asked other technical details such as the confidence interval and the time horizon used, the type of statistics used, and the number of risk factors identified.

Only two banks recognized they are not currently performing VaR calculations, and five banks mentioned they are in the process of building the measurement. These are smaller institutions or recently created banks. The rest of the banks have a VaR

calculator, but its level of sophistication varies with the size of the bank, and how long the risk management team has been developing this measurement.

Table 3. Compliance with Risk Management Principle 3:
VaR system implemented with integrity

Number of Banks and compliance score					Total
0%	25%	50%	75%	100%	52,9%
2	5	3	3	4	17

Source: Elaborated upon survey

Most of the banks are calculating parametric VaR, and four banks use historical simulation as well. The number of risk factors used varies from 15, to 120, although the majority uses between 50 and 60.

As we mentioned, five banks are in the process of building or implementing the VaR calculator, therefore it is not still fully integrated in the decision making process.

On the other hand, the level of sophistication of the risk measurement model can still be improved in 6 institutions to deal with a more integrated tool to the risk management and decision making platform. In particular, some of these institutions could improve on having a more flexible calculator, and others are in the process of standardizing the set of risk reports required by the bank. This is a learning process where the banks need to invest time and resources to make the VaR calculator development an efficient risk communicator.

It is our impression that some banks are behind in the learning curve, but in general all of them are moving into the right direction to increase the integration of the VaR calculator with the risk management process.

Principle 4: *Daily mark to market valuation of the market risk exposed portfolios, and daily risk measurement.*

This best practice establishes the frequency of the risk calculations to daily, as well as the valuation of the trading portfolio.

This requirement is generally met by most of the banks, with the exception of those who do not calculate VaR. However, two of them mentioned that their mark to market frequency is on a monthly basis, and three others defined their risk frequency as monthly. We assigned a 50% compliance to the monthly mark to market system, and the same 50% compliance to the monthly VaR calculation.

Table 4. Compliance with Risk Management Principle 4:
Daily mark to market and risk measures

Number of Banks and compliance score					Total
0%	25%	50%	75%	100%	76,5%
0	2	5	0	10	17

Source: Elaborated upon survey

Current banking software vendors in Chile provide the ability to perform a daily mark to market of the trading portfolio. In that sense, banks that are not able to perform this operation are showing a technological gap in their infrastructure.

In terms of daily risk measurements, the answer seems similar, hence the compliance to this best practice is very high.

Principle 5: *Risk measurement model should be used to define limits, and allocate capital, and measure performance: risks and returns should be informed together.*

The recommendation underlying this best practice policy is that the most important uses of VaR and other risk management results is to define trading limits. This is the first and probably most important role for VaR: limiting the size of bets in the trading floor.

It also says that risk and returns should be informed together and used to allocate capital by promoting risk adjusted return performance measurements. This last objective is actually a step forward for risk management systems to transform the risk measurement unit into a risk management one.

Capital allocation according to expected return and risk, market risk in this case, is a longer term goal that usually requires a larger degree of maturity in the banks. The risk model needs to be accepted and known by all relevant units in the bank, and performance measures need to be adjusted by the risk figures. This means for example that end of year bonuses might be calculated accounting for the risk taking in the financial activities.
Most of the banks that uses VaR to measure portfolio risks, are also calculating VaR limits (or will do it shortly). However, it is less common to see VaR used in the calculation of performance measurements. This requires a more integrated approach to risk management, and therefore seems further up in the learning curve.

We had two banks answering that have or will implement shortly, risk adjusted return measurements. These are banks that have a long history of VaR calculation, and furthermore have a very strong risk management organization.

Table 5. Compliance with Risk Management Principle 5:
VaR Limits and Risk Adjusted Return Measurements

Number of Banks and compliance score					Total
0%	25%	50%	75%	100%	52,9%
0	7	3	5	2	17

Source: Elaborated upon survey

Seven banks had a trading limit established with a system different from VaR, or are in the process to develop it. Trading limit was based more on stop losses, and sensitivities to particular scenarios (typically term structure perturbations). The other ten banks showed VaR limits but three of them and had no particular plan on performance measurements

while five banks mentioned that they will include risk adjusted profitability parameters in their reporting in the future.

In general, we see that on a global basis half of this recommendation is applied: VaR limits exist or will be implemented soon. However, the majority of the banks still do not use the risk figures for capital allocation purposes.

Principle 6: *Strong risk management group, regularly updated in their knowledge basis*

This principle focuses on the technical capability of the risk management team, and their ability to communicate and promote the risk culture throughout the bank. It also asks for the permanent technical update or initial training the team members require to have.

To capture this recommendation, we asked risk managers at banks for their professional background and training courses taken by the team. We also asked for specialized magazines or web page subscriptions. The global discussion on technical issues allowed us to obtain a qualitative level of understanding of their technical ability, and sort banks in relative terms.

For example we established that there are five banks where we could discuss issues such as potential improvements to the actual parametric model to capture all the subtleties of the Chilean yield curves, or how to incorporate inflation risk in an explicit manner. These 5 banks are the same where we saw a strong top management commitment.

On the other side we saw 7 banks where the level of understanding of the technical team is still insufficient. These persons are just being trained in Value at Risk methods, or are considering it in the near future.

The rest of the banks have a fair understanding of the technical issues around the VaR calculations but are not investing in expanding their knowledge base. Actually, of the 17 banks interviewed only 4 are subscribed to a technical publication on the subject.
Table 6 summarizes the score given to the different banks.

Table 6. Compliance with Risk Management Principle 6:
Strong Risk Management Group, Permanent Training

Number of Banks and compliance score					Total
0%	25%	50%	75%	100%	52,9%
1	6	5	0	5	17

Source: Elaborated upon survey

The explanation of this result seems to follow the same pattern shown before: for some banks, with a large size and an important level of business, it pays off to transform the risk management team into an investment that could even play an important role in quantitative analysis. In a sense some banks can afford to transform this “cost center” into a profit center.

Smaller or lagging institutions are not investing enough in a strong quantitative group, or are not training their personnel beyond the strictly necessary to comply with regulators.

Principle 7: *Bank must conduct periodic stress tests of their portfolios*

One of the important technical recommendations, is that VaR by itself is only measuring risk "as usual". VaR is not intended to analyze a scenario that might occur under a liquidity crisis, nor other critical events.

The difficulty here is to be able to generate relevant and plausible scenarios given the historical information available, and the market intelligence of the analysts. Of course that stress scenarios could be built through simple "what if" analysis of our market data. However, the challenge is to be able to produce sensible scenarios.

We asked for stress analysis, and how these were built. We found that almost everybody perform stress analysis although some of these scenarios in the case of foreign banks are sent as a head office requirement. In other words, the art of creating stress scenarios is somehow delegated to the international experts, however this is also an interaction that allows dialogue and discussion about the relevant scenarios to be considering for the local markets.

We were force to score the stress analysis through the simple impression we had on how sophisticated the procedure is. These scores are shown in Table 7.

Table 7. Compliance with Risk Management Principle 7:
Stress Testing

Number of Banks and compliance score					Total
0%	25%	50%	75%	100%	70,6%
2	0	6	0	9	17

Source: Elaborated upon survey

We found 6 banks that had a very simple stress test analysis, primarily based on repeating some historical or predefined scenario. The other 9 banks were more sophisticated spending more energy creating correlated scenarios for some variables fixed and other free to vary, or studying correlations and spreads and their impact on P&L.

In general terms, the level of sophistication of the stress analysis depends, as we could expect, on the complexity of the portfolio of the bank, and its size.
In general terms most of the banks that calculate VaR, use some level of stress testing, and the adequacy to this principle seems appropriate.

Principle 8: *Bank must conduct periodic backtesting procedures*

Backtesting is the procedure where the analysts can control the accuracy of the statistical estimate for VaR.

When we asked for backtesting procedures almost all of the banks that are calculating VaR answered they do this procedure or will implement it soon. Table 8 shows these results.

Table 8. Compliance with Risk Management Principle 8:
Backtesting

Number of Banks and compliance score					Total
0%	25%	50%	75%	100%	70,6%
2	4	0	0	11	17

Source: Elaborated upon survey

As in the stress test case, this requirement is met by most of the banks.

Principle 9: *Independent review of the risk management and measurement processes*

This best practice is focused on having independent third parties, internal or external to the bank, involved in the auditing of risk measurements and processes.

When asking for this audit reviews, most of the foreign banks had a strong control on the procedures and calculations performed for risk management purposes. However, local bank with the exception of two that had once a specific auditing process, do not face a formal review of the measurements, with the exception of the regulators. Usually local banks validate their methodology internally, without an independent opinion. Others find reassuring that calculations are provided and tested by third party software vendors.

Table 9. Compliance with Risk Management Principle 9:
Independent Auditing

Number of Banks and compliance score					Total
0%	25%	50%	75%	100%	54,4%
0	9	2	0	6	17

Source: Elaborated upon survey

Most of the banks are audited internally in their processes. However, it is difficult to find a more specific risk management functional auditing procedure.

The revision of risk measurements has been provided by software vendors and private consultants, but not in a systematic manner by external specialized risk auditing firms.

Principle 10: *Adequate risk management infrastructure of independent and accurate data, and integrated technology.*

How is the risk management infrastructure? How are the systems available?, How is the risk management technology used by banks?

In general terms we focused our attention on the procedure used to perform calculation: whether it is an internal or external software, or it is done in spreadsheets. Lack of good data is a problem for all the market participants, so we excluded from the scores.

Table 10. Compliance with Risk Management Principle 10: Infrastructure

Number of Banks and compliance score					Total
0%	25%	50%	75%	100%	60,3%
2	5	2	0	8	17

Source: Elaborated upon survey

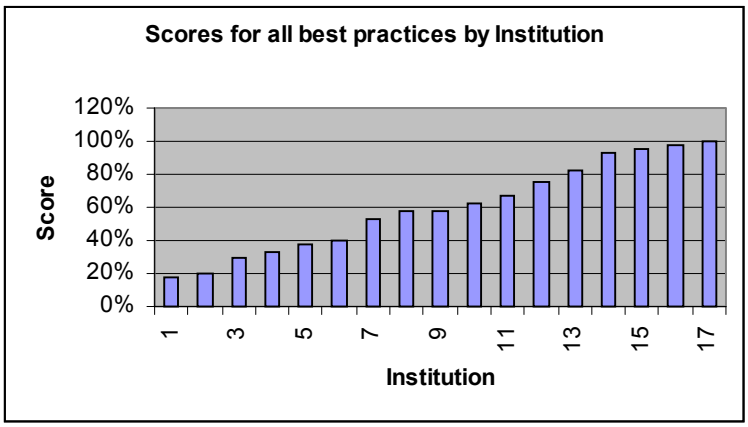
We found that there are 7 banks that do not have an adequate technology, although three of them are at this point switching from spreadsheets to an external system. Two other banks have internally developed systems that do not show the necessary flexibility or performance. The rest of the banks have internally developed systems or third party software that shows an adequate level of integration and consistency with the rest of the technological platform.

V) Conclusions

The survey conducted in mid 2003, reveals that after more than 7 years from the date of the Market Risk Amendment publication, the Chilean Banking industry is on average complying with 60% of the best practice recommendations.

The lowest compliance is found in Principles 2, Principle 3 and 5, with an average of 51% compliance score. This reveals that the major weakness is the lack of independence and a weak political market risk management organization. At the same time, although VaR is calculated in most of the banks, the technical teams are on average still lagging on the learning curve. Finally, risk management is not yet used in the capital allocation decisions.

Figure 1



These results are a confirmation of the recent adoption of the VaR techniques. Most of the banks declared that they had incorporated the VaR measurement three or less years ago.

On the other side, the areas that seem to be adequately covered are 4, 7 and 8. That is the technical basic aspect of the methodology are covered, in part due to the fact that the local banking superintendence has been very keen on requiring daily mark to market, backtesting and stress testing. Most of the banks that do not present a good score in these areas are in the process of implementing these type of solution.

Among the banks, the coverage seems fairly unequal: although the top five institutions have a degree of compliance of 94%, the five worst score 28%. The standard deviation of the scores is 27,5%, revealing an important room for improvement specially among the smaller local banks.

The major challenges in the Chilean financial market seem to be at the organization level, rather than at the technical level. We conclude that the specially for mid size and small local banks, risk management team require to be empowered to make important contributions at a strategic level.

On the other hand, some international banks, have a strong dependence on the international technical experts, and we are not always seeing the emergence of an equivalent local counterparty .

Finally more technical issues such as inflation risks, modeling of liquidity risks, creative generation of zero curves , treatment of mortgage bonds optionality, are being discussed by very few local experts. These issues are developed internally by these banks, or in conjunction with software vendors, but without a dialogue between practitioners. Although there is a risk management committee in the local banking association, the discussions has been more related to data availability. Lack of quality data, specially in the interest rate markets, has been an important challenge to build stronger expertise on risk analysis. At the same time we have the strong impression that a fruitful dialogue among practitioners could be an important step forward into the organizational and technical development of the risk management organizations.

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