Basel II Operational Risks: Study Applied for Financial State of Rio Grande do Sul, Brazil

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A R T I C L E   I N F O

A B S T R A C T

This Over time, financial activities became complex and risks originate associated with this scenario, among which, the operational risk. Operational risk, by definition, results from loss in internal organizational processes, people failures, inadequate systems or of fraud. So, to regulate the risk environment and maintain the financial health of financial institutions, the Basel II Accord, edited in 2004, brought parameters defining assumptions and models for the management of risks and, in particular, the operational risk. The Brazil, in turn, joined the Basel II and established the first half of 2013 to capital requirements, to cover operational risks, to take effect. In this line, this study presents an exploratory research, applied in financial Rio Grande do Sul, with the use of statistical techniques (descriptive, time series and probability calculations), combined with the model equations of Basel, where they identify the operational risk management structures, the loss of an operational nature and the models of Basel used by RS's financial; as well, the results of the combination of operational losses with the allocated volumes of capital. Finally, it is concluded that the Models used by Financial Basel surveyed, are at odds with the realities of operational losses experienced therefore suggesting recommendations and improvements in future works.

INTRODUCTION

The concept of risk is linked to the expectation and the result produced by a particular upcoming event. Thus, risk is exposure to a loss or damage situation of insecurity, so the possibility of certain financial loss is the reproduction of the idea of probability and uncertainty associated with the risk (SECURATO, 1996; GITMAN, 2001; JORION, 2003).

In this context, the risks can reach the business environment and, in particular, financial institutions where elements linked to the market, credit, liquidity and operational inefficiencies produce financial losses and affect results. Thus, after numerous global crises and the evolution of complexity of financial affairs in 1988 was signed the first regulatory framework of commercial banks, which became known as Basel I, since it was signed in Basel, Switzerland, which sought to strengthen the soundness and stability of the global banking system, the creation of common minimum standards to all financial institutions (GRANDSON and RIBEIRO, 2006).

Later, in 2004, in the face of the Asian crisis, the Basel Committee signed a new version of the agreement, called Basel II, where the great innovation was the improvement of modeling for credit risk, market risk and the introduction of capital requirement for operational risk (SANTIN, 2010; BCBS, 2004).

Brazil, in turn, adopted Basel II through the Communiqué of the Central Bank of Brazil from 12,746 in December 2004, which established the schedule for implementing the control of operational risk for the first half of 2013 (Notice BACEN 19,028 / 09), which determines that financial institutions adopt mechanisms for detection, measurement and creates demand for equity, to face the events of operational risk losses.

Among the options of modeling operational risk, which are being adopted by financial institutions, are the models suggested in Basel II: basic approach, standardized approach and advanced approach. Consequently, whatever the model chosen, impact, more or less, on the Required Referential Equity (PRE), which weighs the risk assets of a financial organization and sets the standard of the Basel ratio that has therefore, among others, need to reserve holdings of the institution to face operational risks and establishes limitations on leverage, with direct impacts on results.

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Being the Basel Index one of the limiters volumes of operations of a financial institution and being banks, generally speaking, financial middlemen, according to Carvalho (2000, p. 212), "enable separation between who has the command over the personal income and who will use it effectively"; then, "the credit enables people, albeit with modest resources, to buy houses, cars and consumer goods, and this, in turn, creates jobs and increases the volume of economic opportunities," which comes to reflect on growth and economic development of a country (CAOUETTE *et al*. 2009, p. 19).

In this scenario, this research aimed to identify what are the approaches of Basel or Basel, the Financial Models of Rio Grande do Sul used for compliance with the regulation and what are the risk management assumptions that led to the choice of models elected.

To this end, the research was exploratory and descriptive in nature, in order to obtain new insights of the operational risk, in its variants of operating losses; as well as, associations between variables were identified in the research. Associated with this, the survey was conducted by means of a multiple case study, which provided the detail knowledge about the events collected in the financial statements and semi-structured questionnaire submitted to descriptive statistical techniques, time series study, normal distribution, probability and confrontation with the equations of the models of Basel (GIL, 2002; YIN, 2001; DEER and BERVIAN, 2002).

Theoretical Framework:

Being risk a risk of loss, although in theory the risk finance is, according to Jorion (2003, p. 71), the "dispersion of unexpected results, due to fluctuations in financial variables" or risk is the combination of danger with opportunity (DAMODARAN, 2005), so he might be associated, in generic sense, systemic events (conjuncture), following the example of macroeconomic variables, or to a specific business, which can be an enterprise.

Of the same form, at the level of companies, the risk may be linked to a business (business risk) or financial (monetary variables bound). In this, the risk may be logged in the market variables (rates, currencies, prices of goods, etc.), to credit, for example, when associated with bad liquidity when cash and operational imbalances, which stems from loss on internal processes, people, systems, inadequate and frauds (JORION, 2003; RESTI and SIRONI, 2010; CROUHY, GALAI and MARK, 2004; DAMODARAN, 2005 and ASSAF NETO, 2008).

Context of Risk Adjustment:

Historical precedent as the crash of 1929 the New York Stock Exchange that exposed systemic risk, control over the exchange rates from the creation of the International Monetary Fund (1944) and the increasing complexity of financial transactions associated with the global economic crisis have established the conditions for the first regulatory framework of commercial banks, signed in Basel, in 1988, which became known as Basel I (International Convergence of Capital Measurement and Capital Standards).

Basel I sought to strengthen the soundness and stability of the global banking system, by creating common to all financial institutions minimum standards such as the consideration of credit risks facing the minimum requirements of 8 equity capital. Brazil adopted Basel I in 1994, through the Central Bank Resolution No. 2,099. (CARVALHO, 2000; CORAZZA, 2005; Crouhy, Galai and Mark, 2004; NETO and Ribeiro, 2006; BCBS, 1988).

The crises in Asia (1997) and Russia (1998) unleashed a new version of the Basel Accord, signed in 2004, and which became known as Basel II (International Convergence of Capital Measurement and Capital Standard: A Revised Framework). In Basel II the major innovation was improved modeling for credit risk and market and the introduction of capital requirements for operational risk, hitherto outside the universe control risk management (SANTIN, 2010; BCBS, 2004).

The Brazil adopts Basel II in the same year of its creation and establishes the year of 2013 for the implementation of the requirements for operational risk (ANNOUNCEMENTS the Central Bank 12.746/04 and 19.028/09).

Operational Risk:

In this scenario, with major investments in information technology, began to occur risk of computerised systems failures, human errors of programming and experimentation of new technologies associated with the processing of its activities, which produce losses in scales and multiple values of individual human errors, in addition to exposure to fraud and security systems (MARTELANC, PASIN and CHANDEL, 2005; COSTA, COSTA and ALVIM, 2011).

Associated with this, the evolution of complexity of financial transactions, with new creations, products and or services through true engineering, too, are elements that, if on the other hand bring opportunities for results; on the other hand, present a risk of an operational nature, such as faults and mistakes, of course, the bulge in his which presupposes the need for control (CROUHY, GALAI and MARK, 2004; JORION, 2003; RESTI and SIRONI, 2010).

The concern to identify and calculate the operational risk is due to financial losses arising in large losses of failures, derangements or fraud (internal or external). The literature of financial disasters linked to operational risk, the exponent breaking the Bank Barings PLC in 1995, English institution with 233 years, who suffered losses in derivatives, of U$ 1.3 billion by uncontrolled activity a single operator: Nicholas Leeson. (JORION, 2003).

Resti and Sironi (2010, p. 617) present some of the definitions, by then in use by international banks, according to its financial statements. Among them are: "the potential of any activity to harm the Organization, including physical, financial and legal risks, ...", or "the risk of deficiency in information systems or internal controls will result in financial loss, ..., or an adverse impact on the reputation of the Bank", or also "all risks except banking". In fact, what is being used by the financial industry as operational risk is the concept introduced in Basel II, which is "the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events" (Sound Practices for the Management and Supervision of Operational Risk, BIS, 2003).

The definition, therefore, brings a new component: external events, namely, hand to recognise the external fraud, failure of suppliers, or in outsourced operations, criminal events like theft, vandalism as well as natural events such as fires, earthquakes, among others, that impact the operational business. This definition explicitly includes the operational risk and legal risk, deliberately excludes strategic and reputational risks of operational sphere, since the operational risk is not assumed voluntarily, because it originates from errors or flaws, which makes it different from other types of risks, which are assumed.

Brazilian regulations, in turn, incorporated these principles with the issue of Resolution 3.38006, issued by the Central Bank of Brazil, who in his second article defines operational risk as being:

The possibility of occurrence of losses resulting from failure, deficiency or inadequacy of internal processes, people and systems, or from external events, including the legal risk associated with the inadequacy or deficiency in contracts signed by the institution, as well as the sanctions on grounds of violation of legal provisions and claims for damages to third parties arising from the activities undertaken by the institution.

Models of Basel:

The Basel I accord, published in 1988, as Assaf Neto (2008, p. 123), "had as its basic goal the internationalization of banking activity"; already, the 2004 accord, or Basel II, which was introduced in Brazil by BACEN of Releases Nos. 12.74604, 16.13707 and 19.02809, as Resti and Sironi (2010) and Crouhy, Galai and Mark (2004) aimed to ensure the financial health of the global banking system (solvency), promote the balance of competition between banks in different countries and broaden the risk approach, such as the inclusion of operational risk between the events of risks to be controlled by the global banking system.

The new approach of Basel, as BCBS (2004), designed under three structural pillars: minimum capital requirement, or sizing of capital (pillar I), banking supervisors (Pillar II) and requirement of market discipline, or transparency of information (Pillar III). In addition, altered the weighting of risk in four categories with different weights, namely: 20, 50, 100 and 150, depending on the exposure of risk (loans), which was a big improvement compared to Basel I, who just came from exposure to 100 for all levels of risks (ASSAF NETO, 2008, p. 122).

In this line, Basel II introduced three regulatory approaches, for "capital allocation", following levels of complexity and precision: Basic (Basic Indicator Approach-BIA), Standardized (Standardized Approach-STA) and advanced (Advanced Measurement Approachs-AMA) (BCBS, 2004).

The basic indicator approach, which is the simplest among the alternatives, has as reference the gross operating profit (Gross Operating Income-GOI) of the institution. In this method, from the average of the gross, (IE: operational risk Exposure indicator is equal to financial intermediation Revenue (+) recipe Providing services (-) financial intermediation Expenses), for the last three years (or 36 months) of financial institution applies the factor of 15 and obtained the capital allocation for operational risk. In case of negative values (operating loss), should be excluded from the calculation of the average, for the purpose of calculating the capital requirement. The equation of the Basic Indicator, for "Z=1", according to BACEN Circular n°. 3.38308, is:

$$Popr = Z \cdot \frac{\sum_{t=1}^{3} max[0,15 \cdot IEt;0]}{m} \tag{1}$$

Already, the standardized approach presents developments in relation to the previous one, since it establishes new requirement: separation of the gross balance of the financial institution for eight business lines, as the performance of the institution, applied on the average for the preceding three years (or 36 months) the result of each row that is called β. This approach already adjusts for capturein a way, the specific risks of the various fronts of a financial organization and, in turn, requires capital in proportion to these risks incurred. The lines of action are: (i) corporate finance, which allocates 18%; (ii) retail banks, 12%; (iii) commercial banks,

15%; (iv) negotiations and sales, 18%; (v) payments and liquidations, 18%; (vi) services of financial agents, 15%; (vii) asset administration, 12%; and (viii) retail brokers, 12%.

With the identification of the line of action, the need for capital will take place using the equation of Standardized Indicator, according to BACEN Circular 3.38308:

$$\text{Popr} = Z \cdot \frac{\sum_{t=1}^{3} max\left[\left(\sum_{t=1}^{2} IAE \cdot \beta\right) + \left(\sum_{t=3}^{3} IE \cdot \beta\right); 0\right]}{3} \tag{2}$$

Finally, the advanced approach, that this is the most complex approach, because it comprises the adoption of measurement methods, including quantitative and qualitative criteria, the financial institution itself and its mitigation. In other terms, is the construction of a proper and exclusive modeling of financial institution, therefore consists of a series of possible methodologies and models that fit the specific reality of that organization.

Methodology:
Characterization of the Research:
Exploratory research sought to identify which Basel financial model of Rio Grande do Sul have adopted on the occasion of the acts established by the Central Bank of Brazil, and why the choices of Basel models used. Thus, the bibliographic survey sought the conceptual understanding of the subject, object of the survey, and the survey of financial statements and questionnaire presented the real context of administrative acts and facts, so the combination of these elements gave the real dimension of operational risks in the institutions surveyed and allowed the understanding of its reflections on the Basel model chosen by the institutions. Also, the survey took the descriptive character by associating variables combined data collection of operational loss events, in their frequency and magnitude components, combined with the parameters of the published financial statements and the results of the questionnaires applied (GIL, 2002; DEER and BERVIAN, 2002; ROESCH, 2009).

Finally, by combining the objectives of understanding the problem, events associate for decision making and identify the causes or explanations so that certain events occurred and how it influenced the decision-making of the administrators, the choices of models of Basel, the search is over, too, assuming the explanatory character. As Gil (2002, p. 42), is the "research that further deepens the knowledge of reality, because it explains the reason why of things."

Finally, the research method used was that of quantitative research, because it involved data collection, following the example of the financial statements, the array of risk events, which demonstrates the losses with operational risk events, their frequencies and amounts involved; as well as, determined and quantified the probability of these events recur.

Selection of Case Study:
Yin (2001) stresses that the case study can gather descriptive or exploratory phenomena depending on the purpose and the subject of research, in addition to the focus on time (can be current or historical cases). To Creswell (2010, p. 38) "case studies are a research strategy in which the researcher explores deeply a program, an event, an activity, a process, or one or more individuals." Still, for Yin (2001, p. 19), "the case study is one of the ways of doing research, and experiments, surveys, historical research and analysis of information in files ... and is intended to answer questions such as" how" and "why ", as well as concentrate on contemporary events" contributing "in a manner unparalleled understanding of individual, organizational, social phenomena and politicians."

Thus, the research was applied to a multiple case study, where the analysis of the various elements gave body to the extent of understanding and conclusions extrapolated, and explore phenomena from various angles, within the chosen context. Therefore, in view of the objectives of the research, the selection fell on credit, financing companies and investments (or, commonly called, financial) of the State of Rio Grande do Sul. Such a choice was based on two factors: the Rio Grande do Sul, Brazil holds the second largest concentration of Brazil's financial, according to the Division of Cadastral Systems-DISIC, Department Financial System monitoring-DESIG, organs of the Central Bank of Brazil. There are 58 in operation in the country (Financial Data-base: setembro2013. Available at: http: www.bcb.gov.br?RELINST), and of this total, 27 institutions act in São Paulo; 13, in Rio Grande do Sul; 6, in Paraná; 4, Santa Catarina; 3, in Espírito Santo; 2, in Rio de Janeiro and 1, respectively, in the States of CE, DF and MG; Second, the geographical advantage, for the execution of the search, as the researcher is a native of Rio Grande do Sul.

Characterization of the object of study:
To be invited to participate, eleven of the thirteen financial institutions adhered to research and integrate the study: Financial Agiplan S/A - CFI, Financial Boncred S/A - CFI, Crediare S/A - CFI, Credit S/A-CFI,

Finansinos S/A - CFI, Grazziotin Financier S/A - CFI, CFI Financial S/A - HS, Portocred SA - CFI, CFI Financial S/A - Stara, Todescredi S/A - CFI and Via Certain Financier S/A - CFI.

In the face of strategic issues, individuals to each participant of the research, and the duty of bank secrecy, the elements of the sample will not be individualized, so will be processed in the data set. In this sense, the present Financial distributed as follows in relation to time of Foundation, practice and dimension line of business: three institutions have less than five years of Foundation; two, feature more than fifteen years of activities and the rest are between five and fifteen years. Now, as to the operation, five working in the retail line, five on commercial airline and operates in both segments. As for the size of the business, the Table 1 presents the values recorded in the main accounting groups.

Table 1: Main ledger accounts

Accounting accounts (R$ mil)	Years		
	dez/2010	dez/2011	dez/2012
Income from financial intermediation	324.142	384.563	522.270
Net profit	113.807	186.049	276.245
Credit operations	697.144	1.005.611	1.002.162
Liquid assets	235.599	264.153	319.567

Data Collection:

For the application of the questionnaires, in face of the complexity of the theme, preliminary visits were used to clarify the objectives of the research, the methodology used and the concepts contained in the instrument of the questionnaire; and, explain the need to supplement the information contained in the questions, with published data in the financial statements and in the provision of operational risk events array of organizations.

Treatment of the Data:

The treatment of the data followed the techniques applicable to quantitative analysis, as described below:

Characterization of Financial:

Operational risk is one of the components that directly influence equity requirement of financial institutions, to deal with its operations, which, in turn, has the required reference equity (PRE) compound that adds credit risk, market risk and operational risk, respectively, according to the following expression: PRE=PEPR+(PCAM+PJUR+ PCOM+PACS) + POPR (Res. BACEN n°s 3.44407, 3.49007 and 4.19313).

Thus, the Basel index (IB), which translates as an institution is leveraged in relation to its reference heritage, is demonstrated through the following formulation: IB (PR x 11) PRE, where PR translates the reference institution and heritage 11 is the index set and accepted in Brazil (BACEN Res. n°s 4.19213 and 4.19313).

In response to the questionnaires, aligned to the previous exhibition, the Basle index in December 2012, of the institutions surveyed is, respectively: 11.58%, 13.06%, 17.52%, 22.00%, 25.40%, 29.21%, 36.10%, 41.66%, 56.00%, 66.87% and 110.00%. These indices show that the Financial State of Rio Grande do Sul are, without exception, subject to the minimum requirements defined by the national rules.

The 11 surveyed Financial feature 26 employees dedicated to risk management, which have varied training profiles: 36.4% of higher education require for Financial risk management; 54.5% require practical knowledge of the subject and 9.1% require combination of academic training with practical knowledge of the theme "managing risks". Thereby, in continuation of the replies to the questionnaire, the agenda established himself on the sequencing of issues aiming to identify the effective management and control of operational risks, namely:

a) if the processes are (or were) mapped to identify their weak points;
b) if operating loss events were recorded and accounted for in the last 36 months;
c) if there is a risk matrix, which consolidate frequencies and volumes of operational loss events;
d) whether there is any technique being used able to predict the likelihood of recurrence of events;
e) lastly, what the Basel model was used in financial and if he is suited to the reality of the Organization's records.

So, in answer to the questions above, the research presented the following reality, in terms of processes mapped: 72.73% (eight) have their Financial processes mapped and 27.27%, or three, still do not have mappings. The mapping of the processes is the initial step of a procedure aimed at the management of risk events. On the other hand, only 27.27%, i.e. Financial losses are three with operational risk events mapped and

catalogued. The other, 72.73% lack this control. Of the three, which have documented losses, only one presents structured into groups by cataloging similarities, which enables the use of data for projections; the other, or in structuring, or not present events to document losses.

In complementarity, to process cross-mapped and recorded losses is evidenced that only three feature Financial these two combined variables (Table 2)

Table 2: Processes mapped versus a loss recorded

		Recorded losses		
		Yes	No	Total
Processes mapped	Yes	3	5	8
	No	0	3	3
Total		3	8	11

In terms of financial volumes involved (R$), one of the non-existence of Financial events, does not present data from volumes recorded. In contrast, the other institutions do not have documented information, able to direct them to operational risk decisions, namely, 72.73%.

Thus, when asked about the existence of a "General" risk matrix, four respond "Yes", i.e., they mention the existence of 36.36% an array, although one is under construction and not yet documented data. Therefore, when responding to question "what methodology, or procedure, they use to calculate the probability of each event is repeated and, to repeat, what the value involved (expected loss probability of loss versus event given the event)", only two mention that Financial estimate the "expected loss" and use for this purpose, "tests of evidence" and "impact versus probability".

These two: a Financial, presents occurrences "nil", that is, there is no documented operational loss events and the other, is structuring the data set to submit to projections of incidences. In short, only a proper structuring features Financial to compare events of operational losses in their volume and frequency variables (severities), in addition to structuring in its variants of fraud losses (internal and external), involving processes, people, etc., since it presents the last documented data 48 months, although, does not have a consolidated methodology for predictions of future events (Table 3).

Table 3: Severity Matrix versus probability Calculation

		Calculation of probability		
		Yes	No	Total
Risk matrix-Severity	Yes	1	1	2
	No	1	8	9
Total		2	9	11

Even though, the surveyed Financial, a uniformity of practice in relation to the administration of the operational risk, your choices fell predominantly about the basic approach of Basel, i.e. the Financial 81.82% adopted the "basic model", which is equivalent to nine in 11 institutions surveyed. Of the remaining, one chose the "Standardized Template" and another is undefined in your choice.

Simultaneously, the information of the model chosen, the Basel were questioned Financial if the choice of the model was "adjusted" to the realities with operating losses, or if the choice went on criteria of opportunity and convenience. Understanding, therefore, the surveyed Financial establishes a dichotomy, where five of them understand that the chosen model is adjusted to your reality of operational losses and other five, understand that the choice doesn't fit, but they did it for some convenience criterion. There are of note, finally, that an institution has not yet made his choice of model to be applied.

Treatment of losses variables:
Quantitative data relating to published financial statements, of the events resulting from the application of questionnaires and the treatment of operational risk events arrays, respectively of each institution searched, were analyzed in accordance with the following procedures:
3.4.2.1 For models of Basel
For the calculations of the models of Basel, belongs to two models used by the surveyed Financial (basic and Standardized), the base used were the financial statements published, relating to financial years 2010, 2011 and 2012, where the exposure indicator (IE) took into account the resultant of additions and subtractions of the following accounting headings: financial intermediation income (-) financial intermediation expenses (+) service revenues (+/-) gains/losses on securities/derivatives not negotiable (+) provisions expenses (-) reversal of provisions. This result have been applied the equations "1" and "2", already referenced in item 2.3.
3.4.2.2 For the array of operational risk events
For the treatment of the events listed in the array of risks resulting from events cataloging of losses of an

operational nature of each of the surveyed Financial, in its variants of: (i) internal fraud; (ii) external fraud; (iii) claims for practices of recruitment, selection and job security; (iv) losses arising out of practices geared toward customers, products and services; (v) damage to physical assets; (vi) losses arising from errors or failures of processes; and, (vii) loss arising from failures of information technology systems, were used in the following applications: in a first moment, with the goal of understanding the behavior of the set of events over time and to seek, in its comments of frequencies, making predictions has been used the Box-Jenkins methodology (1976). Box-Jenkins, according to Souza and Camargo (2004), intended to capture the autocorrelation of the behavior between the values of a time series with views to establishing forecasts and identify the behavior of variables sequentially in time. After the data were submitted to calculations of probabilities and quantified its likely re-offenders.

Time Series Models With Action:

  A time series is a set of remarks prepared for sequential mode in time and among the parametric models, most commonly used for these analyses are the regression models. Among them, second Box and Jenkins (1976), the autoregressive model of moving averages (autoregressive-moving average model -ARMA).

  The model ARMA (p,q) with interventions can be represented by equation 3 (BOX; TIAO, 1975).

$$\hat{X}_t = \sum_{j=1}^{k} \frac{\varpi_j(B)B^b}{\delta_j(B)} I_{i,t} + \frac{\theta(B)}{\phi(B)} a_t \tag{3}$$

onde:

$X_{t\,=}$ variable under study;

$\hat{X}_{t\,=}$ estimated by the model for the variable X_t;

$\phi(B) = (1 - \phi_1 B - ... - \phi_p B^p)$ = autorregressive polynomial of order p;

$\theta(B) = (1 - \theta_1 B - ... - \theta_q B^q)$ = moving averages polynomial of order q;

a_t = is a sequence of white noise that follows an $N(0, \sigma_a^2)$;

$I_{j,t\,=}$ represents the intervention variables for j=1, ..., k; for the observation (t) where the intervention occurred.

$$\varpi_j(B) = (\varpi_0 - \varpi_1 B - ... - \varpi_s B^s);$$
$$\delta_j(B) = (\delta_0 - \delta_1 B - ... - \delta_r B^r).$$

  The $\varpi_i's$ represent the initial effects of the intervention and $\delta_i's$ represent the permanent effects of the intervention. In this study, consider the following types of intervention, based on Box and Tiao (1975):

  i. Function *step*

$$S_t^T = \begin{cases} 0, t < T \\ 1, t \geq T \end{cases} \tag{4}$$

  ii. Impulse function

$$P_t^T = \begin{cases} 0, t \neq T \\ 1, t = T \end{cases} \tag{5}$$

  iii) Seasonal impulse function

$$P_t^s = \begin{cases} 0, t \neq s \\ 1, t = s \end{cases} \tag{6}$$

Discussion And Analysis Of Results:

  From the methodology set out in the previous section and with the Financial data supplied by the (financial statements, questionnaires and matrices of operational risk events), the sum of capital allocated to cover events with aggregate operating losses, Financial was R$ 60.3 million (Table 4).

**Table 4:** Allocation in proportion to operational risk (POPR)

Year	Financial	Display indicator (RS mil)	Factor	Capital allocation (R$ mil)
2010	Total Financial Institutions	311.485	*	46.723
2011	Total Financial Institutions	371.877	*	49.168
2012	Total Financial Institutions	502.896	*	63.485
Number of years with exposure Indicator (IE) positive				**
Total allocation of capital				60.324

* Calculated according to Basel model chosen in each of the Financial
**Calculated according to the reality of each Financial

The values, quantified in Table 4, could not be confronted with the operating loss events occurring in each of the surveyed Financial, the lack of information available, except for one of the participants, called Sigma, for the purpose of preserving the identity and the bank secrecy of the organization. For this, the values recorded in operating losses in each of the categories related to the theme, will be demonstrated in the following sequence: (i) reality of losses recorded by categories; (ii) projections of probability of recurrences versus value given to the expected loss; (iii) calculation of capital allocation for operational risk coverage, the basic approach of Basel indicator, which is the default used by Sigma Financial; (iv) a comparison of the results of the calculations set out in items "ii" and "iii" to identify whether the Basel approach used by Sigma Financial is adjusted to your reality with documented operating losses.

In this way, the first step was the identification and description of the event number of operational losses, in the sum of their categories of external fraud losses with mistakes of people or processes, losses on customers, products and services, judicial losses by human resources practices and work safety, internal fraud, losses due to failures of information technology systems and damage to fixed assets. These events were separated by the equivalent of years of records, i.e. every period of 12 months, without compliance with the calendar year, i.e. the first year, starts in Sep/09 until Aug/10; the second year, Sep/10 to Aug/11; the third year, Sep/11 to Aug/12; and, finally, the fourth year of set/12 to Aug/13. Figure 1 demonstrate the behavior of the "losses".
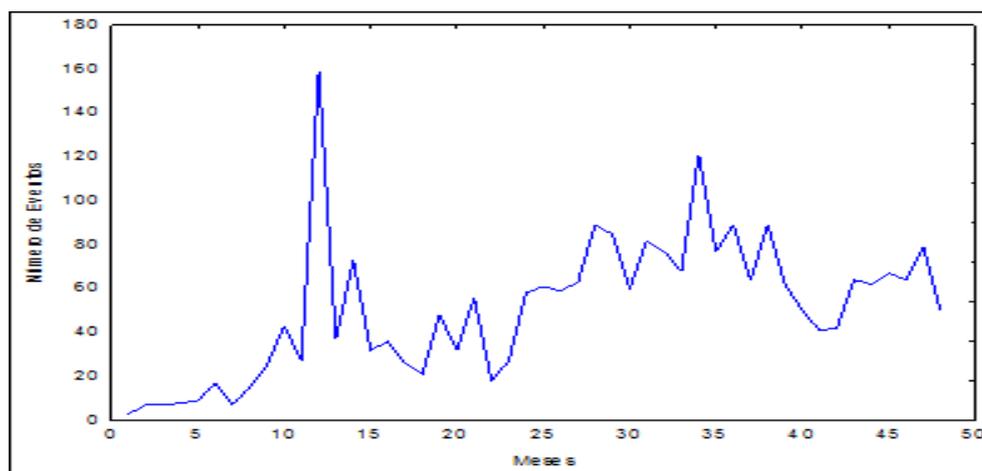
Fig. 1: Behavior of variable operational losses

So, as the data are time series, it is necessary, first, to examine the stationarity of data, in order to avoid problems in the estimation of the parameters. A time series is stationary if the mean and the variance does not change systematically over time and the value of the autocovariance, between two periods of time any, depends only and only the number of intervals in the time and not the delayed period of effective time at which the autocovariance is calculated (BOX; JENKINS, 1976). According to Bueno (2008, p. 15), it is essential to the realization of stationarity, as it allows making inferences based on a stochastic process, i.e., "the concept of stationary is the main idea that one should be to estimate a temporal series." To this end, autocorrelation coefficients were calculated. Analyzing the autocorrelation function, we can affirm, with a significance level of 5%, that the series of monthly operating losses is stationary, because it presents a fast decay to zero from the lag k=4 (Figure 2).
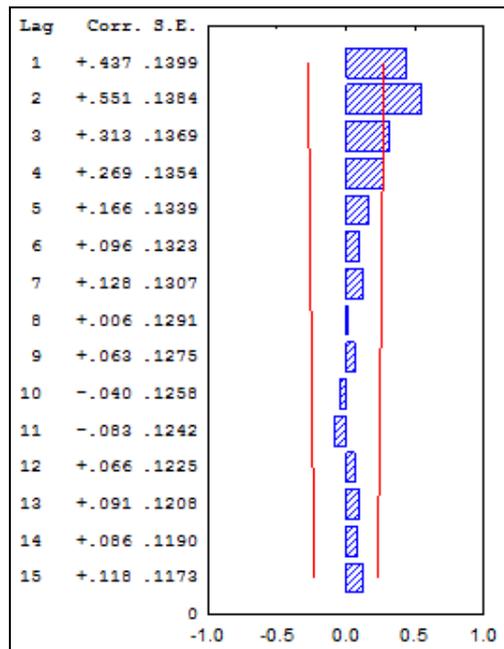
Fig. 2: Autocorrelation coefficients

Figure 3 presents the partial autocorrelation coefficients, whose purpose is to verify the behavior of the autoregressive components of the model.
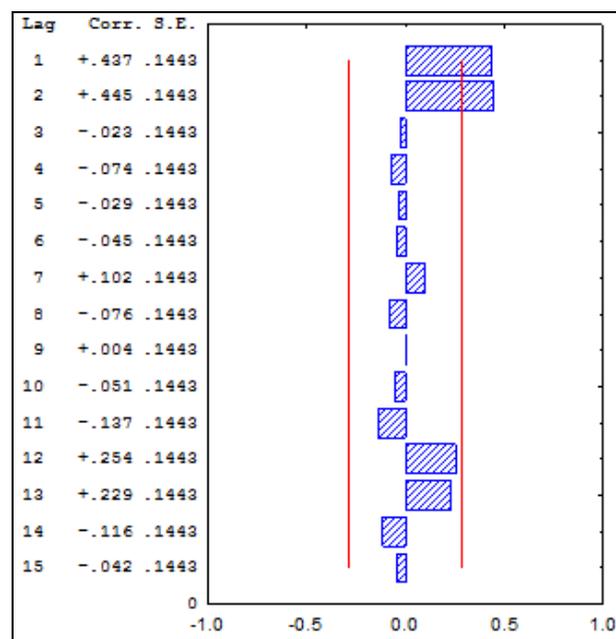

Fig. 3: Partial autocorrelation coeficients

Analyzing the behavior of the autocorrelation and partial autocorrelation functions there is an initial indication of the true model contains components of moving averages and, it is observed that the lags 1 and 2 feature meaningful value for $p < 0.05$, indicating that the series of monthly operating losses may possess autoregressive component of order 2.

Thus, analyzing the behavior of the autocorrelation functions set, which measures the dependence between terms, and partial autocorrelation, which measures the intensity between the observations of the series, were adjusted several attempts, with the models best model found was a seasonal model autoregressive of moving

averages with intervention (seasonal autoregressive moving average), i.e. SARMA $(1, 0, 1)$ x $(0, 0, 1)_6$, for series of operating losses. This model featured a coefficient of explanation (R^2) of 90.92%.

In this way, gives the robustness of Box-Jenkins model with five interventions. So we can say that, on average, about 91% of the total variation of the operating losses of current events is explained by variations in own lagged variable in time and by the interventions occurred in the analysis period (Table 5).

Table 5: Model parameters SARMA $(1, 0, 1)$ x $(0, 0, 1)_6$ with intervention

Parameters	Values	t_{teste}
Constant	0,3033	9,96
ϕ_1	0,51882	4,13
θ_{12}	0,54071	2,78
Θ_1	0,4441	2,41
ξ_1	1,1961	14,86
ξ_2	0,40244	8,68
ξ_3	0,42479	5,13
ξ_4	0,28905	3,68
ξ_5	-0,16528	-4,73

The intervention types detected automatically by the Box-Jenkins methodology: type 1 (impulse) intervention, intervention type 2 (step) and intervention type 3 (seasonal impulse); as well as the specification of the moment and the period that corresponds to each intervention, are represented in Table 6.

Table 6: Intervention types detected for the variable operational losses

Intervention variables	Type of intervention	Instant
X_{1t}	Impulse	August - 2010
X_{2t}	Step	August - 2011
X_{3t}	Impulse	June - 2012
X_{4t}	Impulse	October - 2010
X_{5t}	Seasonal Impulse	February -2011

There is, therefore, a predominance of intervention of type 1 (impulse), followed by the type 2 (step) and type 3 (seasonal impulse). As regards interventions detected, they had expected, as well as signals, refer to events that had a major influence on the behaviour of the variable "operational losses". Consequently, imposed the model adequacy testing, what was accomplished through the tests of normality and independence for the series. To check the normality of the residuals, as Conover (1971), was applied the Kolmogorov-Smirnov test, which showed a value p-value $= 0.46 > 0.05$, and thus ensure that the data fit a normal distribution, the significance level of 5%. To test independence autocorrelation coefficients were calculated and it is confirmed that the data are independent, since all the coefficients of autocorrelation function are within the control limits, i.e. ± 2 errors (Figure 4).

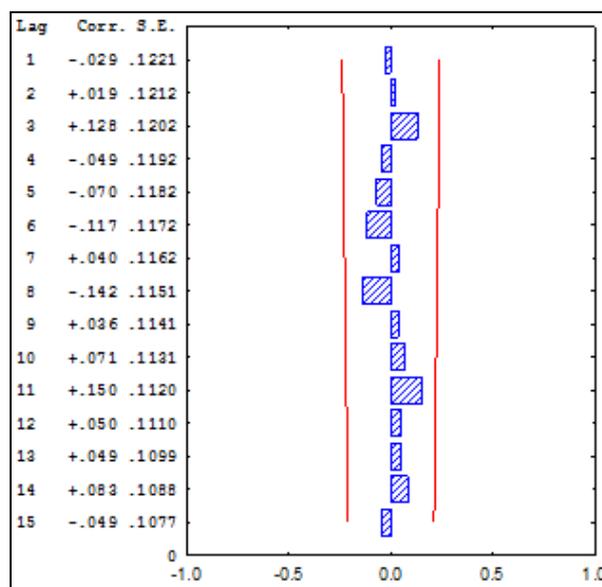| Lag	Corr.	S.E.
1	-.029	.1221
2	+.019	.1212
3	+.128	.1202
4	-.049	.1192
5	-.070	.1182
6	-.117	.1172
7	+.040	.1162
8	-.142	.1151
9	+.036	.1141
10	+.071	.1131
11	+.150	.1120
12	+.050	.1110
13	+.049	.1099
14	+.083	.1088
15	-.049	.1077

Fig. 4: Coefficients of autocorrelation function of residue

As well as necessary assumptions of normality and independence of the measures are guaranteed, the model can be used to analyze the behavior of operational losses. Thus, it was noticed that the behavior of the "impulses", originated during the periods of August/2010, October/2010 and June/ 2012 have been identified and associated with the three concentrations, unusual, events related to fraud, so described: in August/2010, was a characteristic event of internal fraud linked to consumer direct credit operations and October/2010 and June/2012, two other events. This time external fraud, associated with two episodes involving the goods consignment INSS and cloning of credit cards. Aside from that, August/2011 had a change in the number of events logged, which featured a step, and, in contrast, February/2011 demonstrated a sharp reduction, characteristic of a seasonal impulse

The data, excluding differences (outliers) and loss categories without representative of observations minimum example of: (i) damage to fixed assets; (ii) judicial losses by practices of recruitment, selection and job security; (iii) internal fraud; and, (iv) loss arising from information technology systems, the other categories represented by: (i) external fraud; (ii) losses arising out of practices geared toward customers, products and services; and, (iii) losses arising from errors of people and process failures, totaling 91.68% of all logged events, behave within the normal range for the test application attested pattern of adjustment of normality, represented by the chi-squared distribution (χ^2), significance levels of 5%, as Table 7.

Table 7: Chi-square test of categories of operational losses to normal distribution

Events	X^2_{teste}	P(value)
External Fraud	0,4447	0,9309
Losses on customers, products and services	4,6168	0,0994
Losses with people or processes	1,6789	0,4320

Thus, with the exception of data for 12 months, the new descriptive statistics, by category of operating loss (events) in 36 months of observations is presented in Table 8.

Table 8: Descriptive statistics for operational loss events

Events	Nº Events	Minimum	Mean**	Maximun	Median	Standard Desviation**	Variation Coefficient
External Fraud	1455	9	41	96	39	19	46%
Losses on customers, products and services	196	0	6	21	5	4	67%
Losses with people or processes	301	2	9	15	8	4	44%

** Rounding for more

Thus, the events of losses are associated with monetary values (R$). The monetary values (R$) representing the loss, recorded in the same period of observation from Table 8, are represented in Table 9, which consolidates and presents the main variants of the dataset, for losses on R$.

Table 9: Descriptive statistics of the values involved in operational losses (R$ mil)

Events	Nº Events	Minimum	Mean**	Maximum	Median	Standard Desviation**	Variation Coeficient
External Fraud	3.481	7	97	220	91	54	56%
Losses on customers, products and services	428	0	12	35	10	9	74%
Losses with people or processes	1.081	4	30	62	30	16	55%

On the basis of the data presented in tables 5 and 6, it was calculated the probability (p) of recurrence (X), with the use of the software BioEstat 5.3, for less than the minimum values (X<mín.), in excess of the maximum values (X>máx.) and between the minimum and maximum values (min. <X <max), by means of the Z test. The Z_{test} was used for each of the events categorized into operating losses, as Table 10.

Tabela 10: Likelihood of recurrence of the events of operational losses

Events	Probability of recurrence					
	In quantities			In values R$		
	X<mín	X>máx	mín<X<max	X<mín.	X<max	mín<X<máx
External Fraud	4,68%	0,15%	95,17%	5,03%	1,19%	93,78%
Losses with people or processes	8,75	0,01%	91,24%	8,73%	0,04%	90,84%
Losses on customers, products and services	3,42%	2,85%	93,73%	5,70%	2,51%	91,79%

Thus, the probability of recurrences combined between quantities and values (Table 10) were used to calculate the probable future loss for "p>0.05", i.e. the expected loss given the likelihood of re-offending. Thus, the estimated losses, for the expected recurrences above 5% combining frequencies with magnitude, are R$ 3.8 million, as Table 11.

Table 11: Expected losses

Events	Amount of events (q)	Probability of recurrence		Values per event (R$ mil) (e)	Probability of recurrence		Expected loss (R$ mil)
	Mean	X<mín.	mín<q<máx	Mean	X<mín	mín<e>máx	Mean
External fraud	41		95,17%	96,7		93,78%	3.537,9
Losses with people or processes	9		93,73%	30,0		91,79%	232,4
Customer losses, prod. and Serv.	6		91,24%	11,9		90,84%	59,1
Customer losses, prod. and Serv.	3*	8,75%	91,24%	11,9	8,73%	90,84%	2,8
Total							3.829,4

* For (q < mín) => q = (q mín. + q mean)/2, i.e, (0 + 6)/2 = 3

Thus, in addition to the amount provided in table 8 Add more R$ 2.1 million, related to the total value of the categories not estimated, given the reduced number of observations: legal losses for human resources practices and job security, R$ 2.1 million; internal fraud, R$ 0.05 million; losses due to faults in it systems, R$ 0.001 million.

In short, following the same practices, Sigma Financial data suggest serves, having volumes in operating losses for the next period of 36 months, to the tune of R$ 6.0 million. In contrast, the approach of Basel in use is the basic model, which allocated in December 2012, capital for operational risk coverage in the amount of R 23.6 million.

The same way, if the Sigma Financial chose the Standardized Model, as an alternative to the basic model, yet would allocate capital in the order of R$ 18.8 million, or could use the variant of the Standardized Model, which is the Standardized alternative, where the capital reserve for the coverage of operational risks in R$ 20.5 million, therefore, all the approaches cited, excessive reserve capital allocation, before the risk scenario of Sigma Financial.

Conclusions:

The analysis, in general terms, the financial institutions of Rio Grande do Sul, Brazil, are young, in terms of functioning as 81.8% are in operations to less than 15 years. In addition, divided, virtually, in two lines of business: retail and commercial (90.9%). Even in that context, the volumes of assets (loans and financing), at the closing of the financial year 2012, outscored the R$ 1.0 billion which, in turn, generated revenue of intermediation (rents) of the order of R$ 0.52 billion, supported by a net worth of R$ 0.31 billion and net profit of R$ 0.27 billion, which demonstrates a substantial shareholding in the financial segment of the State.

The study, in turn, turned to the theme-specific understanding operational risk through their records of events of loss, and their unfoldings in the allocation of capital, through the approaches of Basel, in the RS. In responses, the risk management begins by identifying and mapping the organizational processes, to the point of recognizing what are your weaknesses able to generate losses (losses); as well as, if these losses are registered (documented) to serve as a basis for the decision-making process and in the combination of these two themes (map and register), only three of the eleven researched financial, presented the two combined variables, i.e. map and record all events with operating losses. Five other, map the processes, but does not record the events of loss. Furthermore, only one of the (Sigma) holds the full cataloging about to make studies of probabilities of re-offending.

The study devoted himself, then, to understand the "discomfort" in relation to the model chosen and, also, when he says he's adjusted to the reality of loss. To do so, were carried out the calculations of capital allocation, the methodology described in subsection 3.4.2 and all are allocating Financial, through the approaches chosen, i.e. Basel models in use, the value of R$ 60,3 million. However, the data available suggest that none of the models chosen are bonded to factual situation of financial reason only of the absence of operational loss events recorded at the height of the values allocated respectively.

It was studied the behavior of variable "operational losses" as losses set individually categorized (internal and external fraud, errors, etc.) of Sigma Financial, which presents data on conditions allowed, and how the data are time series, so we used the Box-Jenkins model, with five interventions, where, on average, about 91% of the total variation of the operating losses of current events is explained by variations in own lagged variable in time and interventions that occurred in the period under examination. This behavior was confirmed by analysis of autocorrelation and partial autocorrelation function, with a coefficient of explanation (R^2) of 90.92%, through the multiplicative seasonal ARIMA $(1,0,1) \times (0,0,1)_6$.

Once the explanation is in the variable "loss" model with deletions of the discrepant values (outliers) was adjusted and the series, this time with 36 months of observations (most recent events), presented a behavior within the characteristics of the standard normal distribution, which was confirmed by the Kolmogorov-Smirnov test and Chi-square. From then on, the chances of re-offending (both quantities and values involved) were calculated by Z_{test}.

The calculation of probability of recurrences used in the three categories of expected loss (those with standard normal behavior) was not submitted for losses plus pets, not to submit a minimum number of observations. Thus, the resulting value of this combination, for expected losses in the event of an operational nature, is R$6.0 million. On the other hand, allocation of capital, calculated from the basic model of Basel, used by Sigma Finance, amounted R$ 23.6 million.

The confrontation of the capital reserve, to cover events with operating losses, by Basel model chosen by Sigma Financial, compared with actual losses, demonstrates that there is an excess of capital allocation disproportionate to the reality of the facts recorded and on projections of losses.

This detachment from reality of losses with the allocation of Basel is not only preventing the growth of Sigma Financial, because, also, she's with leftover equity for leverage, i.e. with 25.40% Basel index. If all exceed the 11% is good, then it is worth mentioning that, as goes for the Sigma and the set of research, that there is little concern for the eventual collected indicative pressure Basel indices. Indeed we all are with enough reserves of Basel, the presses to improve operational risk management structure, as can be evidenced, in sequence, then: 11.58%, 13.06%, 17.52%, 22.00%, 25.40%, 29.21%, 36.10%, 41.66%, 56.00%, 66.87% and 110.00%.

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