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Franco Fiordelisi, Carlo Palego, Annalisa Richetto, Giulia Scardozzi

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Franco Fiordelisi (University of Essex, UK and University of Rome III, Italy), Carlo Palego (Banca di Asti, Italy), Annalisa Richetto (Intesa SanPaolo, Italy), Giulia Scardozzi (Università degli Studi Internazionali di Roma, Italy)

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Abstract

We analyze what are the main pricing components for performing loans. By exploiting a survey conducted by the authors in AIFIRM (2021), we provide empirical evidence about whether and to what extent various pricing criteria are related to interest income within the internal model framework. Our main findings are that banks' interest income is positively related to the adoption of advanced internal risk-based models, the calculation of the break-even rate, and the implementation of the risk-adjusted profitability measures in the pricing, while it is negatively linked to higher market competition, a decentralized pricing function (allowing more customer-oriented loans prices). The results make urgent to monitor and develop improve current risk models to support both central offices and the sales network in the process of formulating loan prices and monitoring the value consequently created.

Keywords: Pricing, Interest income

Acknowledgment: We would like to thank AIFIMR, and especially Corrado Meglio and Maurizio Vallino for kindly inviting us to develop this paper and allowing us to report the results of the survey carried out in the *AIFIRM's Position Paper on* "Pricing and risk-adjusted return measures". A special thanks to Andrea Favretti (Prometeia) for his outstanding support and active role in the AIFIRM (2021).

1. Introduction

The accurate pricing of lending activities has become crucial for banks over the last decades given the unprecedented low levels of market interest rates in the Eurozone. The European Authorities have been inviting banks to adopt a risk-adjusted pricing framework adequately integrated with banks' business model, risk profile, and overall risk governance. The methodological and organizational process of determining risk-adjusted pricing is made even more complex by the ongoing Covid19 pandemic. Through the highly asymmetrical impacts on customer segments and industrial sectors, loan pricing assesses the risk component of the sectors themselves even more relevant from a prospective and macroeconomic perspective (such as Covid19 pandemic).

How do banks price their loans? We address this question in the first part of the paper by identifying the main pricing components adopted by the banks that joined the survey. Loan pricing is the sum of three components: the "break-even rate" (or "hurdle rate"), the "market", and the "client" components. The "break-even rate" or "hurdle rate" component is the rate that generates interest flows to cover operating costs, expected losses, and the remuneration of production factors (in particular, capital and liquidity) employed (also called price to value). This rate is considered a threshold or minimum rate. The "market" component is interpreted as the spread (usually a mark-up) on the hurdle rate aimed at achieving expected revenues on the loans granted taking care of the market considerations.

This component may therefore be determined according to the market segment to which the borrower belongs, the size, and the technical form of the loan. The sum of these two components (hurdle rate and "market") represents the "internal benchmark rate" of a credit transaction (so-called price-to-market). The "client" component is interpreted as the spread (either markup or markdown) on the "reference rate" of the loan transaction. This component is determined based on the "specific" or "idiosyncratic" characteristics of the borrower and cannot be determined a priori: it is based on the specific relationship with the borrower, the possibility of cross-selling and similar considerations. The sum of these three components provides the "actual rate" charged to the borrower on the loan transaction.

What is the relationship between pricing components and banks' profits? We address this question in the second part of the paper. To this aim, we run an empirical exercise where variables capturing pricing components are obtained by transforming answers obtained in the survey in the AIFIRM (2021) into a dummy or categorical variable. Bank profits are measured by a few variables by the ratio of interest income on total loans. To this aim, we developed a standard panel data regression model and collect a sample of Italian banks between 2017 and 2020.

The remainder of the paper is structured as follows: first, we summarize past scientific papers dealing with loan pricing (section 2), then we describe what are the three main pricing components and their organizational issues (section 3). The discussion of these three pricing components relies on AIFIRM (2021), which is a working paper realized by the authors in collaboration with the Italian Association of Financial Risk Management Industry summarizing the main pricing methodological and organizational issues and running a survey conducted among Italian banks. In section 4, we report the main results of the survey carried out by the authors in AIFIRM (2021)[1].

[1] We would like to thank AIFIRM, and especially Corrado Meglio for the great support provided us during the survey. We also would like to thank all participants of the AIFIRM (2021) working group, and banks participating in the survey. A special thanks to Andrea Favretti (Prometeia) for his

2. Literature review

Loan pricing is widely discussed in the literature. Specifically, risk-adjusted pricing was first discussed in the 1990s and subsequently implemented by banks (Greenspan, 1995) when the benefits were highlighted in the literature. Risk-adjusted pricing is a suitable practice to improve the performance of banks, which experience an increase in profits because of adopting these practices (Jung and Strohhecker, 2009). Competition in the banking market has led to lower interest rates in the past, which has eroded banks' operating profits (Motley, 2006) thus necessitating risk-adjusted pricing policies by banks. The literature has grown considerably in the aftermath of the introduction of the new regulatory frameworks by the Basel Committee. Hasan and Zazzara (2006) derived mathematical formulas to allow bankers to calculate credit risk reserves regarding Basel II regulations; specifically, the authors proposed a methodology to estimate risk-adjusted interest rates for bank loans in the corporate sector according to Basel II capital requirements. Similarly, Curcio and Gianfrancesco (2009) derived a similar formula using as input data the factors to be used for the application of internal models to estimate credit risk. Ruthenberg and Landskroner (2008) also conducted the same study using data from Israelian banks, showing that larger banks can attract the best borrowers because they can apply internal models through which risk-adjusted pricing results in lower interest rates.

This paper aims at formalizing how risk-adjusted pricing formulas can be amended under IFRS9. The main change introduced by IFRS9 compared to IAS39 is the calculation of reserves from a forward-looking perspective: the interaction of IFRS9 with the Basel regulations is thus able to promote financial stability (Novotny-Farkas, 2016) through a more correct measurement of credit risk from a lifetime rather than an annual perspective. The IFRS9 regulations provide little detail regarding the possibilities of measuring lifetime expected loss. Chawla et al. (2016a), Skoglund (2017), Xu (2016), and Bellini (2019) provide some suggestions for calculating credit risk under the IFRS9 framework. Engelmann (2021) derives in more detail some formulas for calculating lifetime expected credit loss according to IFRS9, both for fixed and floating rates, concluding that the most adopted formulas are inconsistent with measurements based on discounted cash flow methods, the latter being more onerous for banks.

The new method of calculating reserves to cover credit risk, therefore, has an impact on banks' regulatory capital: Kruger et al. (2018), and Seitz et al. (2018) showed that reserves are calculated according to IFRS9 would allow banks to be promptly recapitalized in economically adverse times. However, the impact is not homogeneous across countries: Loew et al. (2019) analyzed European countries and found that financially distressed countries, such as Greece and Italy, experience a greater impact of the new IFRS9-compliant reserve calculation methods than financially stronger countries.

3. Pricing components

Loan pricing is defined as the determination of the lending rate on bank loans charged by the bank to ordinary customers. This is the sum of three components: the "break-even rate" component (section 3.1), the market component (section 3.2), and the "client" component (section 3.3).

3.1 Price to value

The "price to value" or "hurdle rate" is designed to cover the underlying costs of the transaction. It is therefore a break-even price that can vary significantly depending on the cost components considered (cost of interest rate risk, funding, capital, credit risk costs, direct and indirect transaction costs) and how they are calculated. In the main practice adopted by the industry, the hurdle rate represents the minimum remuneration level (break-even) of the credit transaction.

The basic costs, i.e., those typically included by the banking industry in the algorithm for calculating the hurdle rate, are[2]: Cost of interest rate risk, funding cost, cost of credit risk, cost of the remuneration of employed capital expected by shareholders, and operating costs.

The cost of interest rate risk (base rate) is the cost of hedging the interest rate risk generated by the lending operation. It is calculated based on the market risk-free curve possible movements or volatility and according to the financial characteristics of the operation, such as duration, amortization, and type of rate, as well as to the banking book asset and liability durations. The funding cost is the cost of using the liquidity provided by the bank for its lending operation by paying an additional spread over the market risk-free rate. This cost is a function of the duration of the loan and the corresponding funding source and of the other specific liquidity characteristics of the source itself. The cost of funding thus represents the remuneration of the liquidity factor used for granting the loan and it is defined considering the characteristics of the bank's funding sources and the liquidity conditions of the interbank market. Credit risk cost covers the expected loss generated by the credit transaction. The bank calculates an expected credit loss and an unexpected credit loss on each credit exposure. The former represents the cost a bank can expect on average from the possible default of the financed counterpart, in respect to which the bank must, in each year in which that exposure remains in its assets, set aside a corresponding amount (provision), in line with the accounting principles and in compliance with the indications of the Supervision Authority too. The cost of the remuneration of employed capital expected by shareholders is related to minimum capital requirements

outstanding support and active role in the AIFIRM (2021). Last but not least, we would like to thank Maurizio Vallino, and Corrado Meglio for their kind inviting us to develop this paper and allowing us to report the results of the survey carried out in AIFIRM (2021).

[2] The cost components described are not exhaustive of all possible cost components that may come into play in any loan transaction. The exact identification/listing (and subsequent quantification) of cost components is the responsibility of the individual lending bank.

to cover the unexpected credit loss over the remaining life of the exposure. The capital must be remunerated at market prices or, in the absence of reliable market references, based on alternative criteria for adequate shareholder remuneration. The cost of equity, the function of the unexpected credit loss (UCL), is thus the remuneration of the "capital" input (or production factor) absorbed by the credit transaction. In final, operating costs are those directly attributable to the operation (direct costs) and the costs indirectly attributable as a share of overall costs ("management costs" or "industrial product costs").

The sum of the individual cost components, determined using specific calculation models, is used to determine the hurdle rate (*hr*), as shown in model (1).

$$hr = r + \frac{S_{fund} + S_{ECL} + S_{UCL} + S_{man}}{n} \quad (1)$$

where *r* is the base rate calculated based on the risk-free market curve for the date of the loan; S_{fund} is the spread over the base rate against the cost of funding calculated at the date of the loan; S_{ECL} is the spread (in percentage) for the cost of credit risk; S_{UCL} is the spread (in percentage) for the cost of unexpected loss (or absorbed capital factor); S_{man} is the spread (in percentage) for operating costs, and *n* represents the contractual term of the loan (expressed in year and fraction of year).

3.2 Credit risk cost Lifetime compliant

The spread covering the cost of credit risk represents the component covering the credit loss that the bank is expected to incur during the residual life of the granted loan (LifeTime Expected Credit Loss - LTECL). LTECL differs from the expected credit loss (ECL), which is calculated by the bank's internal credit loss measurement systems and typically has a time horizon of one year[3]. The lifetime expected loss is estimated as follows:

$$LTECL = \sum_{i=1}^{n} PD_{f,i} * LGD_{f,i} \quad (2)$$

where $PD_{f,i}$ and $LGD_{f,i}$ are the Probability of Default (PD) and Loss Given Default (LGD) *forward* parameters respectively estimated concerning each time bucket *i* (*i=1*, … , *n*) into which the remaining lifetime of the loan for which the lender's rate is being determined is conventionally divided.

They are generally obtained from transition matrices calculated based on AIRB ratings, possibly adjusted, under a management perspective, to neutralize the strictly prudential and regulatory components)[4]; and n is the last bucket into which the residual lifetime of the loan for which the rate is being determined is conventionally divided.

Compared to the annual ECL, the Life-Time Expected Credit Loss, therefore, introduces the components of the forward credit loss, i.e., expected from the financed counterpart's default event at the various future points in time into which the remaining life of the loan is divided:

$$\boldsymbol{S_{ECL} = \sum_{i=1}^{n} \frac{PD_{forward,i} * LGD_{forward,i}}{(1 - PD_{forward,i} * LGD_{forward,i})} * \frac{1}{(1+r_i)^i}} \quad (3)$$

where S_{ECL} is the previously mentioned spread, r_i is the risk-free curve rate for maturity *i*. Several elements can be deduced from formula (3).

First, *ECL* is calculated from the credit risk parameters (usually produced by the AIRB system in its management application - AIRBGest[5]), as PD and LGD. The adoption of these parameters implies that the credit risk costs to be covered by the lending rate are represented by the unrecoverable costs and foregone recoveries at the closure of a currently performing loan position, conditional on the event of default of the latter before the final maturity of the exposure. The credit risk parameters of PD and LGD, applied to the estimated future exposure at the time of default (EAD), replace the size of the accounting provisions in the calculation of the "cost of credit risk" spread.

Second, the expected credit loss (in the hurdle rate framework) is calculated in lifetime logic based on forwarding or multi-period PDs. In principle, forward values should also be used for the LGD parameter in the lifetime formulation of the ECL. The adoption of lifetime logic, i.e., about the entire residual life of the transaction, is also very important in determining the cost of credit risk because it adjusts the risk with the duration and therefore the greater uncertainty of the transaction.

[3]Assuming for simplicity of representation the exposure (EAD) to be constant and unitary the ECL is given by the product between the Probability of Default (PD) and the Loss Given Default (LGD).

[4]Forward parameters are estimated to represent the measured risk (probability of default, loss at default) over a longer time horizon than the typical AIRB models time horizon (1-year) and therefore can be extended to the entire residual life of the position. So the application of such parameters is necessary in calculation processes that must determine metrics with reference to the entire life of an exposure, such as credit pricing. Finally, AIRB models are typically used as the basis for estimating forward parameters from a management perspective, i.e. they are stripped of the strictly prudential components required to calculate RWA for regulatory purposes, such as LGD adjustments for downturns, MoC and others.

[5]With regard to credit risk, supervisory regulations provide for two methods of calculating capital requirements: the Standardized Approach and the Internal Rating Based (IRB) method, in which risk weights are a function of banks' internal assessments of debtors. The internal ratings-based approach is divided into a Foundation Internal Rating Based (FIRB) and an Advanced Internal Rating Based (AIRB) IRB, which are differentiated by the risk parameters that banks must estimate; in the foundation approach, banks use their own estimates of PDs and regulatory values for other risk parameters, while in the advanced approach all the relevant risk parameters are internally estimated.

The lifetime logic adopted by the banking sector for the calculation of the ECL in the calculation of the hurdle rate for Stage 1 positions is like that adopted under IFRS9 and related supervisory rules, to calculate the cost of credit in the balance sheet for performing positions classified as Stage 2. In addition to being consistent with the recurring nature of the costs that the annual lending rate is required to cover, this approach allows for a better estimate of risk from a Lifetime perspective and greater consistency with the accounting evidence.

The logic applied for pricing purposes, however, has some peculiarities within the IFRS9 framework. The lifetime ECL IFRS 9-compliant approach requires the use of macroeconomic scenarios expected over a given time horizon, usually three years, for the valuation of Stage 2 positions (the predominant approach used in the industry is the so-called "multi-scenario"); by contrast, for pricing purposes, the industry's practices in adopting macro scenarios vary, with no scenarios applied for lifetime expected credit loss computation purposes (that is the most widespread banking practice), with some banks excluding Stage 1 positions from some scenarios, others weighting the scenarios differently and others (very few) adopting the IFRS9 multi-scenario in full. The IFRS9-compliant frameworks adopted by the banks provide for the use of forwarding LGD curves to measure the expected loss on Stage 2 positions: that is true, particularly for larger banks; however, as noted above, algorithms for calculating the credit cost component of the hurdle rate typically consider the AIRB LGD parameter to be constant over time and equal to the parameter produced for the managerial one year expected credit loss computation purposes.

3.3 Price To Market

Price to market refers to the strategic direction and the expected risk-adjusted profitability of the credit institution. Specifically, the price is calibrated considering the range and type of products and services offered to customers, the target market, and therefore the type of business model specific to each financial institution. A fundamental regulatory element, which can influence an institution's risk policies, concerns the regulation of usury, which, especially in conditions of high risk-return, is an essential constraint on pricing policies and which, in certain contexts, could influence lending policies, with direct consequences for the local and national economy and the related social implications.

Monitoring and reporting activities are worth mentioning. To guarantee an adequate market placement and sustainable profitability over time, it is necessary to carefully monitor the discipline of the prices applied and the market shares by segment and product, and also to activate the necessary corrective actions to the pricing strategies by the strategic supervisory bodies.

Two types of pricing can be envisaged in the pricing-to-market: "public prices", which are communicated to customers in prospectuses for all product types, and “benchmark prices”, which are defined for specific product types and considered the specific risk level of both the product and customer group.

The formulation of "Public prices" takes place considering also external factors (e.g., reference regulations), specifically for all types of products, and in respect of the defined target market, considering and considering the strategic and business initiatives promoted by the institution; in this context, prices are defined in line with the reference regulations which act as the maximum standard value applied to customers. Public prices are therefore the prices communicated in the information provided to customers (transparency).

In summary, price-to-market is aimed at identifying and structuring possible mark-ups for price-to-value (hurdle rate), through "external" benchmarks (assessment of market prices on clusters of comparable customers, products, areas, etc.) or "internal" benchmarks (assessment of prices applied on the bank's customer portfolio, also in this case employing an expert or statistical clustering analysis). It should be noted that the basic logic underlying the formulation of the price-to-market must also consider the competition of the market, which does not always allow for the setting of mark-ups on hurdle rates fully consistent with the desired profitability or risk/return objectives. In addition, analytical calculation models for the determination of the price-to-market component are not yet widespread in the Italian banking industry at least, showing a significant difference from the quantitative-analytical approach that has long been used by Italian banks to determine the price-to-value component of the final interest rate applied to customers (borrowers).

3.4 Price To Client

The price-to-client leads to the final price applied to the customer for the given credit transaction, possibly even in derogation of the list price foreseen for that transaction. While the Price to Value and the Price to Market components are two structured processes, this component introduces subjectivity in the pricing process since the final rate may be subject to further evaluation at the overall level of the customer or of a specific loan portfolio.

Pricing actions can therefore be defined with a structural logic or dedicated to individual positions with the counterparty's membership of specific clusters, consistency with strategic/commercial objectives, the counterparty's overall profitability characteristics, and the overall assessment of the relationship with the counterparty. The final price, therefore, reflects market logic that leads the price-to-client to a value that may differ from the list price due to discounts, agreements, competitive pressures, incentive systems, and so on. In the case of the Price to Client, therefore, the adjustment is linked both to methodological aspects (e.g., definition of metrics for measuring the risk-adjusted profitability of the transaction and the client as a whole, analysis, and assessments relating to the performance of the relationship with the counterparty, etc.), and to process aspects (e.g., influence on the price by portfolio policies, commercial campaigns, cross-selling, etc.).

4 The Survey

To support the analysis of the pricing process, we discuss some of the results from the AIFIRM (2021) survey[6], which involved 20 Italian banks (eight "Significant" and twelve "Less Significant" banks).

First, we focus on the model used by banks to measure credit risk. As shown in Table 1, the standard approach is the most widely adopted (65%). The internal model (specifically AIRB) is adopted by the remaining 35% of respondent banks for, at least, a part of their loan portfolio. Not surprisingly, Less Significant banks mostly use a standard approach to calculate Risk-Weighted Assets (RWA) for credit risk measurement.

Table 1 Survey respondents' composition

The table shows the number of banks using standard or internal models (e.g., AIRB) for Risk-Weighted Assets computation. Source: Authors' own production using data of AIFIRM (2021).

Model	Less Significant banks	Significant banks	Total
Standard	10	3	13
AIRB	2	5	7
Total	12	8	20

Surprisingly, not all Significant banks adopted an internal model. In general, banks using internal models mostly do so for corporate banks (see Figure 1).

Figure 1 Segments for which the Price to Value has been applied

The figure reports the answers to the question: "To which macro-segments the Price To Value has been applied?" Source: Authors' own production using data of AIFIRM (2021).

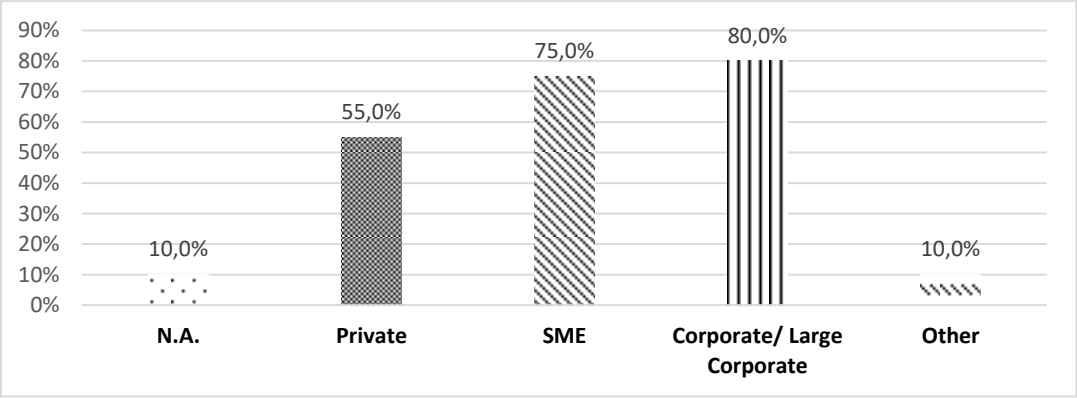
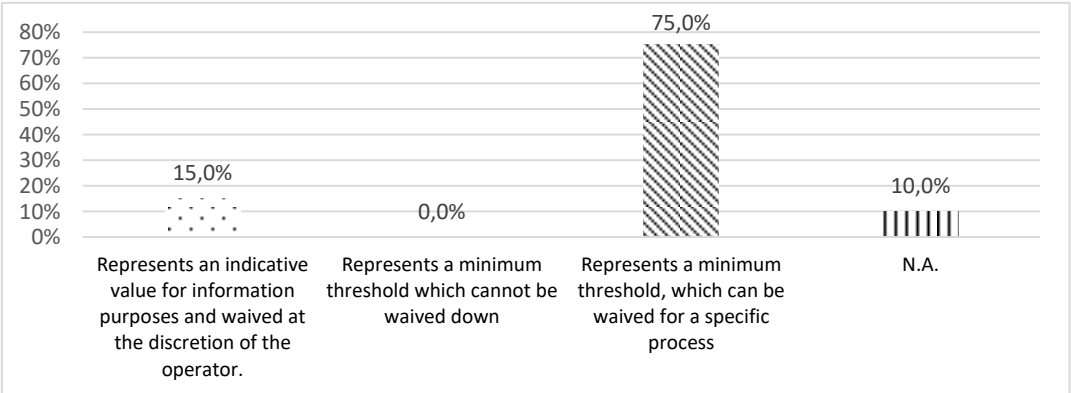


Figure 2 Weight of the Price to Value in the formulation of the final price to the customer

The figure reports the answers to the question: "What weight does the Price to Value take in the formulation of the final price to the customer?" Source: Authors' own production using data of AIFIRM (2021).

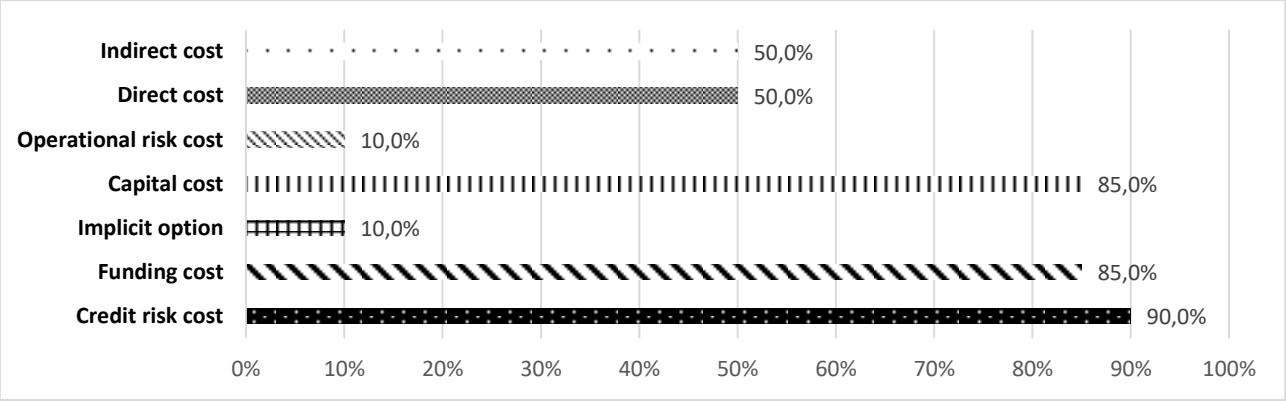


[6] The questions asked in the survey are listed in the Appendix (Table A5).

The survey also shows that the cost of credit risk is the main component in the determination of the hurdle rate (Figure 3).

Figure 3 Cost components in Price to Value determination

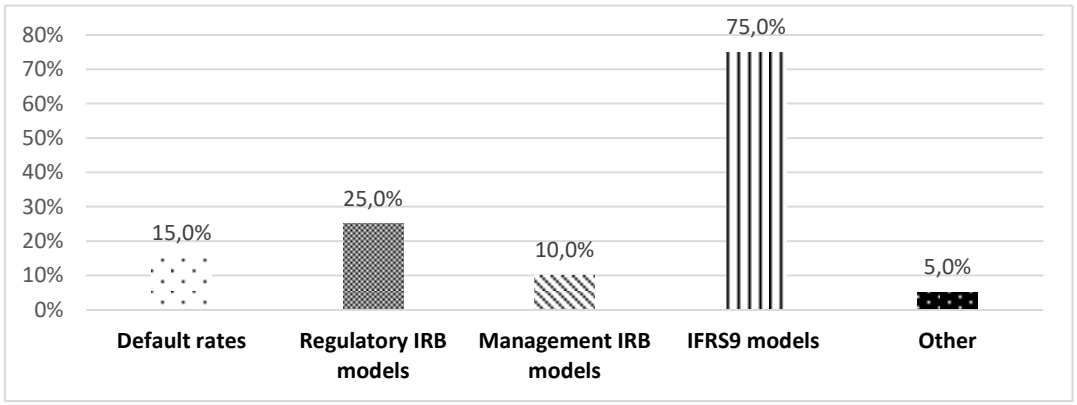
The figure reports the answers to the question: "Indicate the presence of the following components in the calculation of the Price to Value" Source: Authors' own production using data of AIFIRM (2021).



Regarding the IFRS9 logic, we observe a progressive adoption of such metrics, although not yet complete (e.g.: not widespread adoption of macro-scenarios). From an economic perspective, some elements of this framework may penalize pricing concerning the higher cost of expected risk. From a risk management perspective, they offer the possibility of more accurate measurements, more informed pricing decisions, and greater adherence to supervisory guidelines. Figure 4 shows that banks primarily (66.7%) calculate credit risk using IFRS9 logic.

Figure 4 Credit risk calculation

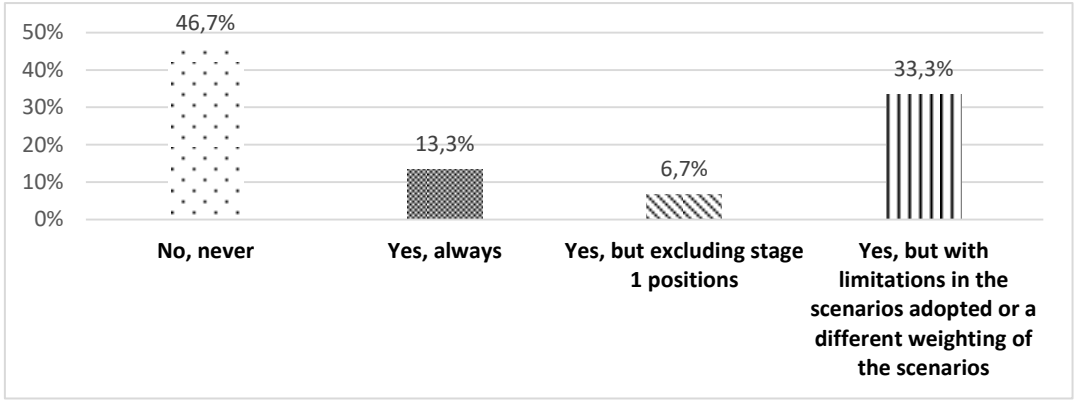
The figure reports the answers to the question: "How is the cost of credit risk calculated?". Source: Authors' own production using data of AIFIRM (2021).



However, our survey shows a substantial lack of adoption of alternative macro-scenarios when adopting IFRS9 models (Figure 5).

Figure 5 Alternative scenario implementation

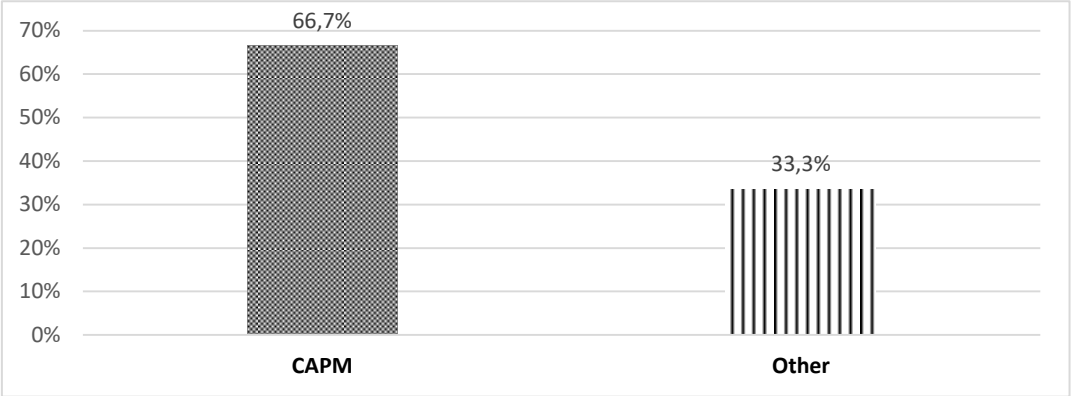
The figure reports the answers to the question: "If IFRS9 models are adopted, are alternative scenario analyses applied?" Source: Authors' own production using data of AIFIRM (2021).



Concerning the setting of the rate of return on absorbed capital (k_e), i.e., the percentage remuneration ideally expected by the bank shareholder, the survey shows that most of the banks involved (about 66.7% of the sample) use the CAPM approach, also for reasons of procedural and managerial simplification.

Figure 6 Methodologies applied to determine the rate of return on capital

The figure reports the answers to the question: "What methodologies are applied to determine the rate of return on capital?" Source: Authors' own production using data of AIFIRM (2021).

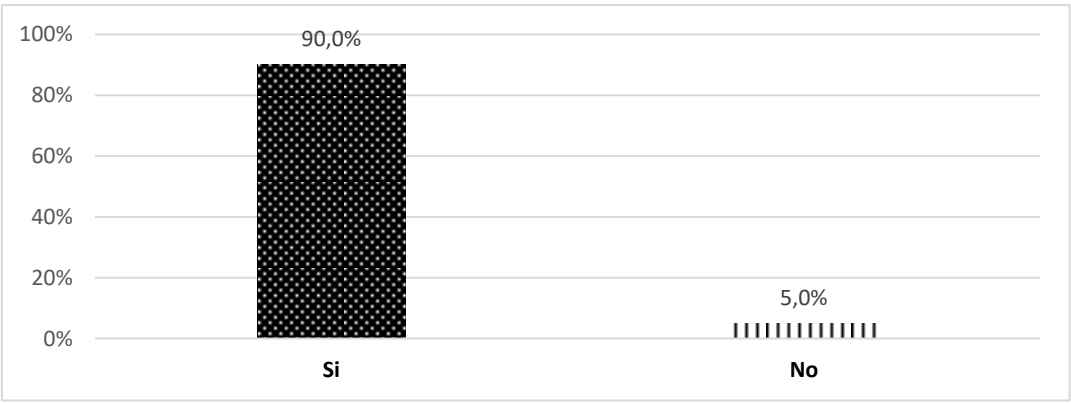


Banks' ability to modulate their k_e, according to the absorption of the capital factor, is still limited on average. However, it should be remembered that the latter is dependent, with the same notional exposure and technical form of credit, on the regulator's SREP Decision on each company and on the credit risk measurement methodology adopted by the company itself.

Concerning the Price to Market implementation, the survey highlights that most of the respondent banks define the Price to Market in their pricing process.

Figure 7: Price to Market calculation

The figure reports the answers to the question: "In the broader process of pricing, are there price-to-market logics?" Source: Authors' own production using data of AIFIRM (2021).



5 Empirical Analysis

What is the relationship between pricing components and banks' profits? To address this question, we run an empirical exercise where variables capturing pricing components are obtained by transforming answers obtained in the survey in the AIFIRM (2021) into a dummy or categorical variables. Variables related to banks' balance sheets are *Orbis Bankfocus*.

To this aim, we developed a standard panel data regression model and collect a sample of Italian banks between 2017 and 2020. Table 2 reports the descriptive statistics about the sample: not surprisingly, banks are heterogeneous in terms of size, amount of loans granted, credit quality, capitalization, and profitability (Table 2)[7].

Table 2 Summary statistics.

The table shows the summary statistics of the independent variables of the sample. The data have been collected for the period 2017-2020 from Orbis BankFocus and the survey AIFIRM (2021). The number of observations is given by the product between the number

[7] The description of the variables is reported in the Appendix (Table A1).

of banks (20) by the years collected (4) minus 2 because one bank does not have financial data for 2017 and 2018. Source: Authors' own production using data of AIFIRM (2021).

	N	Mean	Std. Dev	Min	Median	Max
Total Assets (billions of €)	78	110.602	202.923	0.885	24.462	1002.614
Loans	78	66.037	108.811	0.584	15.718	489.272
Performing Loans (billions of €)	78	61.000	102.976	0.450	12.254	468.29
Cost of funding	78	0.005	0.003	0.000	0.004	0.012
NPL ratio	78	0.093	0.081	0.001	0.079	0.525
Equity/Total Assets	78	0.072	0.019	0.038	0.069	0.135
Loans/Total Assets	78	0.665	0.143	0.216	0.688	0.914
Interest income on Total Loans	78	0.004	0.018	-0.069	0.004	0.070
Interest income on Performing Loans	78	0.004	0.021	-0.090	0.004	0.072
AIRB	78	0.359	0.483	0.000	0.000	1.000
Price to Value	78	0.359	0.483	0.000	0.000	1.000
Price to Market	78	0.769	0.424	0.000	0.000	1.000
Multi-scenario	78	0.359	0.483	0.000	0.000	1.000
Other Capital Remuneration	78	0.308	0.465	0.000	0.000	1.000
Indirect cost	78	0.513	0.503	0.000	0.000	1.000
Monitoring	78	0.744	0.439	0.000	0.000	1.000
Risk Adjusted Profitability	78	0.769	0.424	0.000	0.000	1.000
Simulations	78	0.641	0.483	0.000	0.000	1.000

Our empirical analysis aims to show the correlation between bank interest income and pricing components. To this aim, we analyze the relationship between each pricing component (using the answers obtained in the survey) and bank interest income ratio, after controlling for various factors (such as funding cost, credit quality, capitalization, and bank size). Accurate pricing is expected to allow banks to increase their interest income ratio, obtained as the ratio between the interest income over the volume of the loans granted by the bank. A greater and positive ratio is expected when the pricing is implemented by the bank via a more accurate estimate of risk, especially when the valuation is developed from a lifetime perspective.

Specifically, we use the following regression model in which the pricing components are included among our independent variables:

$$Y_{i,t} = X_{i,t} + Z_{i,t} + \varepsilon_{i,t} \quad (4)$$

where the dependent variable $Y_{i,t}$ is the ratio of interest income on total loans granted (as a robustness test, we also use the ratio of interest income on the fraction of performing loans) for the *i-th* bank at the time *t*. $X_{i,t}$ is a vector of variables capturing the pricing components, as: 1) the adoption of an AIRB model using a dummy equals to 1 if the bank applies at least for one fraction of the portfolio the internal model for credit risk computation[8], and zero otherwise; 2) the two main pricing components (i.e., *Price to Value, and Price to Market*)[9]; 3) the application of alternative scenarios (*Multi-scenario*) using a dummy equal to 1 for the banks that compute the pricing using multi scenario approach[10], and zero otherwise; 4) the capital remuneration factor (*Other Capital Remuneration*) using a dummy equals to 1 for the banks that use a different measure of capital remuneration rather than CAPM[11], and zero otherwise; 5) the taking into account of the indirect cost (*Indirect cost*) using a dummy equal to 1 for the banks that include the indirect costs for the Price To Value determination[12], and zero otherwise; 6) the monitoring process application (*Monitoring*) using a dummy equals to 1 if there is a structured monitoring and reporting system on the waivers made on Price To Market[13], and zero otherwise; 7) the application of risk-adjusted techniques for profitability (*Risk Adjusted Profitability*) using a dummy equal to 1 if in formulating the final price assessments related to risk-adjusted profitability are made[14], and zero otherwise; and 8) the application simulations (*Simulations*) using a dummy equal to 1 if simulations are performed in the price formulation with respect to target values of these metrics[15], and zero otherwise. Moreover, $Z_{i,t}$ is a vector of control variables that may influence the link between interest income and pricing determinants, such as the cost of funding (calculated as the ratio between interest expenses and total liabilities),

[8] question 1.2.1 of the survey
[9] question 1.2.4 of the survey
[10] question 2.2.8 of the survey
[11] question 2.3.4 of the survey
[12] question 2.4.1 of the survey
[13] question 3.2.2 of the survey
[14] question 4.1.1 of the survey
[15] question 4.1.3 of the survey

the capitalization (calculated as the ratio between the equity and the total assets - Equity/TA), and the bank risk represented by the NPL ratio (given by the ratio between impaired loans and total loans). In final, we estimate the model (4) by saturating the model with Time fixed-effects years to control for time-variant unobservable factors and using robust standard error to control for heteroscedasticity problem.

5.1 Results

The results of model 1 are reported in table 3, where the dependent variable is the interest income ratio on total loans (column 1) and the interest income ratio on performing loans (column 2).

Table 3 Regression analysis.

*The table shows the results of model (1). The dependent variables are the ratio between the interest income and total loans granted (column 1), and the ratio between the interest income and performing loans (column 2). The sample period is 2017- 2020. The model includes year fixed effects. Standard errors in parentheses. ***, **, * means that p<0.01, p<0.05, and p<0.1, respectively. Source of data: Orbis BankFocus and Aifirm (2021).*

	(1)	(2)
	Interest Income on Total Loans	*Interest Income on Performing Loans*
Cost of funding	0.618	0.569
	(0.397)	(0.468)
Equity/TA	0.062	0.050
	(0.051)	(0.056)
Log of Total Assets	-0.001**	-0.001
	(0.001)	(0.001)
NPL ratio	0.014	0.078***
	(0.012)	(0.010)
AIRB	0.009***	0.010***
	(0.002)	(0.003)
Price to Value	0.004**	0.004**
	(0.002)	(0.002)
Price to Market	-0.007***	-0.008***
	(0.002)	(0.003)
Multi-scenario	0.003	0.004
	(0.002)	(0.003)
Other Capital Remuneration	-0.005*	-0.007**
	(0.002)	(0.003)
Indirect cost	0.001	0.001
	(0.001)	(0.001)
Monitoring	-0.012***	-0.015***
	(0.002)	(0.003)
Risk Adjusted Profitability	0.003*	0.005***
	(0.002)	(0.002)
Simulations	0.002	0.003**
	(0.002)	(0.002)
Significant	0.000	-0.003*
	(0.002)	(0.002)
Constant	0.043***	0.035***
	(0.010)	(0.011)
Observations	78	78
R-squared	0.681	0.812
R-squared adjusted	0.743	0.760

Our results suggest various considerations. The AIRB dummy variable is positive and statistically significant at the 1% confidence level: this suggests that banks using advanced internal models show a higher interest income ratio. As the probability of default distribution is exponential, that implies that implementing an advanced internal model allows pricing better (and higher) for the riskier customers: the availability of an advanced rating based internal model whose performance, in terms of discriminating capacity, is sufficiently high, constitutes a decisive factor for a bank's capacity of optimizing the risk/return ratio of its loans. As a matter of fact, a typical commercial bank usually pursues the maximum profitability of its lending activity, by means of opportunely managing the natural trade-off relationship existing between the riskiness of a loan and the return of the latter. It's therefore clear that being able to exactly measure the expected loss and the risk (unexpected loss) associated with any loan facility (a capacity in principle assured by

the availability of a proper A-IRB model), enables a bank to exploit the loan crucial risk/return trade-off till the very limit which allows reaching the goal of its earning maximization with sustainable levels of credit risk.

Looking at pricing components, coefficient estimates for the price-to-value are positive and significant at a 10% confidence level: the price-to-value concerns a scientific valuation of the costs of the loan for the bank, hence the banks that implement the calculation of the Price-To-Value component fully cover all the relevant costs of the loan transaction, this enhances greater interest income. Conversely, Price-to-Market coefficient estimates have the opposite sign (negative) and are statistically significant at the 1% confidence level. This is not surprising since the survey has been conducted in a low-interest rate and quite competitive market. Hence, we argue that more competitive banks must somehow implicitly consider caps on their loan prices: high competition erodes interest revenues, and this impacts more on banks intensively adopting the Price-to-Market approach. Furthermore, the adoption of a model different than CAPM to measure shareholders' expectation return shows a negative link with the interest income ratio: thus, the CAPM adoption seems to overestimate expected returns.

Coefficient estimates for Monitoring are statistically significant at the 1% confidence level and negative. Although this might be somewhat surprising, could be interpreted as a signal of a decentralized pricing function: the negative sign of the association monitoring practices decreasing loan prices captures the observed-in-the-industry-practice that banks characterized by more decentralized loan pricing powers are usually more inclined to match the customers' requests for lower loan interest rates than the banks with more centralized pricing decisions or pricing processes (physiologically less sensitive to the ordinary customers' instances). Even if the result of the coefficient Monitoring is significant, this has not a direct effect on the earnings of the commercial lending activity, but an indirect one on loan prices. As concerns the coefficient of the Risk-adjusted profitability variable, we note a positive sign that is statistically significant at a 10% confidence level or less. The coefficient sign is as expected: this variable concerns a better calibration of the trade-off risk-return, the correlation with the risk is higher, hence the loan prices tend to be more favourable for banks that more intensively adopt risk-adjusted profitability indicators.

The other independent variables included in the model are not statistically significant at the 10% level or less: hence, the adoption of alternative scenarios (*Multi-scenario*), the consideration of the indirect costs in the Price To Value determination, and, the implementation of the simulations concerning the target values (Simulation variable) does not show a statistically significant link with banks' interest income ratio.

6. Conclusion

Our paper analyses the main loan pricing components in the Italian banking system, and empirically addresses their link with the bank's economic performance[16]. By using data collected in the survey conducted by the authors in AIFIRM (2021), we provide readers with new insights into the link between pricing components and bank interest income ratio. We implement an empirical model[17] showing that the application of advanced internal risk-based models, the calculation of the break-even rate, and the implementation of the risk-adjusted profitability measures in the pricing improve banks' performance. Conversely, market competition, a decentralized pricing function allowing more customer-oriented loans prices, and the use of non-CAPM models to estimate shareholders' expected capital remuneration erode the interest income ratio.

We argue that the decision to apply the Lifetime Expected Loss criteria following IFRS 9 in calculating the hurdle rate for lending to Stage 1 positions should be left to the discretion of individual banks. The individual banks should make this choice autonomously in terms of opportunities, methods, and the general incorporation of multi-scenario and sector analysis tools into their business processes, based on the degree of refinement of the IFRS 9 framework and considering new regulations in existence or soon to be applied, which will then obviously be subject to market and competitive scrutiny.

In final, the monitoring of the macroeconomic context (induced by the Covid-19 pandemic outbreak) deserves specific attention. The impacts on pricing and methodologies are difficult to interpret, at least for the following reasons: 1) the presence of government interventions that introduce "distorting" factors to the normal process/methodological framework for assessing, granting, and pricing credit on the one hand and for limiting the risk taken on the other (due to the combined effect of high average PDs and low LGDs for guarantee schemes), but with a possible acceleration of credit quality deterioration in 2021; 2) the still uncertain course of the pandemic; and c) the highly asymmetrical impact on industrial sectors. Thus, it is urgent to monitor and develop improve current risk models, incorporate multi-scenario prospective evaluations at the sector level, enhance organizational processes for waivers and frameworks for monitoring the impact of waivers on value creation, and in final develop adequate tools, as the IT tools, to support both central offices and the sales network in the process of formulating loan prices and monitoring the value consequently created.

Our paper provides readers with a first step in showing what are the main pricing components for performing loans and their effect on banks' interest income. This topic deserves future research by focusing on each of the pricing components. The lack of publicly available data is a major issue to run further research on this area and we are grateful to AIFIRM to let us use data on the 2021 survey to run this paper.

[16] The analysis conducted deserves future researches in different papers studying the pricing components effects on other items of the banking business.

[17] We are aware about the limit of our sample of 20 banks. We deserve future research in case a new survey will be conducted with many banks.

Appendix

Table A1 Variables description

The table reports the description and the acronymous of the variables used in the analysis. Source: Authors' own production.

Variable	Acronymous	Description
AIRB	*AIRB*	A dummy variable taking the value of 1 for banks that apply (at least for a fraction of the loan portfolio) internal risk-based models, and zero otherwise
Capitalisation	*Equity/TA*	The ratio of the bank's equity and total assets
Cost of funding	*Cost of funding*	The ratio between interest expenses and total liabilities
Indirect cost	*Indirect cost*	A dummy variable taking the value of 1 for banks that include the indirect costs for the Price to Value determination
Interest income ratio	*Interest Income Ratio 1*	It is a ratio among the interest income and the total volume of loans
Interest Income ratio performing	*Interest Income Ratio 2*	It is a ratio among the interest income and the fraction of performing loans
Loans	*Loans*	Total loans (assets) of the bank in billions of euros
Monitoring	*Monitoring*	A dummy variable taking the value of 1 for banks that apply monitoring processes when waivers are made related to Price to Market computation, and zero otherwise
Multi-scenario	*Multi-scenario*	A dummy variable taking the value of 1 for the banks that compute the pricing using a multi-scenario approach
Non-Performing Loans ratio	*NPL ratio*	The ratio of impaired loans over total loans
Other Capital Remuneration	*Other Capital Remuneration*	A dummy variable taking the value of 1 for the banks that use a different measure of capital remuneration rather than CAPM, and zero otherwise
Price To Market	*Price to Market*	A dummy variable taking the value of 1 if the bank calculated Price to Market, and zero otherwise
Price To Value	*Price to Value*	A dummy variable taking the value of 1 if the bank calculated Price to Value, and zero otherwise
Risk-adjusted profitability	*Risk Adjusted Profitability*	A dummy variable taking the value of 1 if the bank in formulating the final price implements risk-adjusted profitability assessments, and zero otherwise
Simulations	*Simulations*	A dummy variable taking the value of 1 if simulations are performed in the price formulation with respect to target values of these metrics, and zero otherwise
Total Assets	*Total Assets*	Total assets of the bank in billions of euros

Table A2 The post estimation results

Panel 1: *The table reports the Variance Inflation Factor Indicator post estimated by model (1).*

VIF	1/VIF
4.610	0.217
4.580	0.218
4.090	0.245
4.020	0.249
3.870	0.258
3.700	0.270
3.100	0.323
2.550	0.392
2.200	0.455
2.170	0.460
1.990	0.502
1.900	0.527
1.860	0.538
1.750	0.572
1.710	0.586
2.940	

Panel 2*: *the table reports the p-value associated at the Breusch-Pagan test to check for heteroscedasticity.

Breusch-Pagan test for heteroskedasticity	
Assumption: Normal error terms	
Variable: Fitted values of Int_Inc_Loans	
H0: Constant variance	
chi2(1)	1.17
Prob > chi2	0.2788

Table A3 The matrix of correlation

The table reports the matrix of correlation of the variables included in model (1).

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Interest Income on Total Loans	1.000										
(2) AIRB	0.241	1.000									
(3) Price To Value	0.008	-0.098	1.000								
(4) Price To Market	-0.269	-0.098	0.133	1.000							
(5) Multi-scenario	0.205	0.109	0.156	-0.098	1.000						
(6) Other Capital Remuneration	-0.042	-0.036	0.101	0.101	-0.499	1.000					
(7) Indirect cost	-0.220	-0.126	0.075	-0.169	-0.126	-0.017	1.000				
(8) Monitoring	-0.099	0.439	0.236	-0.322	0.439	-0.372	0.133	1.000			
(9) Risk adjusted Profitability	0.056	0.156	0.133	0.133	0.156	0.101	-0.169	0.236	1.000		
(10) Simulations	-0.059	-0.109	0.098	0.351	-0.109	0.036	-0.088	0.050	0.351	1.000	
(11) Significant	0.127	0.463	-0.038	0.209	0.245	-0.330	-0.021	0.251	0.209	0.407	1.000

Table A4 The Hausman (1978) specification test

The table reports the Hausman specification test for model (1). The p-value suggests that the preferred model is the one using fixed effects.

	Coef.
Chi-square test value	45.833
P-value	0.000

Table A5 The survey

The table reports the question and the set of possible answers submitted to the respondent banks. Source: AIFIRM(2021).

1.1.1	**Name of Respondent**
1.1.2	**Company/ Institute of Respondent**
1.1.3	**Organizational Unit of Respondent**
1.2.1	**Which is the authorized regulatory approach for calculating the Credit RWA?**
a	Standard
b	FIRB (at least for part of the portfolio)
c	AIRB (at least for part of the portfolio)
1.2.2	**If authorized to use the FIRB/ AIRB approach, (at least for part of the portfolio) indicate which models are used and for which segments**
a	PD Retail
b	CCF Retail
c	LGD Retail
d	PD SME Retail
e	CCF SME Retail
f	LGD SME Retail
g	PD Corporate
h	CCF Corporate
i	LGD Corporate
l	PD Banks
m	CCF Banks
n	LGD Banks
o	PD Public authority/ institution
p	CCF Public authority / institution
q	LGD Public authority / institution
1.2.3	**If NOT authorized to use FIRB/ AIRB approach, are there still credit risk internal models for management use? For which customer segments?**
a	None
b	PD Retail
c	CCF Retail
d	LGD Retail
e	PD SME Retail
f	CCF SME Retail
g	LGD SME Retail
h	PD Corporate
i	CCF Corporate
h	LGD Corporate
1.2.4	**Which components are included in the internal pricing process for performing credit operations? (Mark with x the included components)**
a	Price to value
b	Price to market
c	Price to client
1	Comments
2.1.1	**Does the bank consider the calculation of a "Price to value" or "hurdle rate" in the pricing determination process?**
a	Yes
b	No
2.1.2	**If it does, indicate for which macro segments**
a	N.A.
b	Household customers
c	SME
d	Corporate/ Large Corporate
e	Other
2.1.3	**Which is the weight of the Price to Value in formulating the final price to the customer?**
a	It is an approximate value provided to the manager for information, and which can be waived at the manager's discretion
b	It is a firm minimum threshold
c	It is a minimum threshold that can be waived through a specific process
d	N.A. (price to value not determined)
2.1.4	**Mark with x the presence of the following components in the calculation of the Price to Value**
a	N.A.

b	Cost of credit risk
c	Cost of funding
e	Embedded options
f	Cost of Capital
g	Operating Risk cost
h	Costs directly connected to the operation
i	Indirect costs (for personnel, …)
j	Other (free text):
2.2.1	**Which is the logic behind the calculation of the credit risk cost of the operation?**
a	The logic of expected loss
b	The logic of accounting credit cost
2.2.2	**In which way is the operation credit risk cost calculated for the majority of segments that considers calculating the price to value?**
a	Observed default rates
b	Regulatory IRB models
c	Management IRB models
d	IFRS9 models
e	Other
2.2.3	**In case of use of "management" IRB models, which differences are envisaged compared to regulatory IRB models?**
a	Adjustment to short term default rates (Point in Time logic) for a greater correspondence to current risk levels
b	Adjustment to long term default rates ("long run average" logic) for higher stability of risk compared to the operation life cycle
c	Different adjustments based on the type of product / duration
d	Exclusion of certain prudential effects linked to the economic cycle trend
e	Introduction of specific remedies linked to the type of product / operation
f	Other (free text):
2.2.4	**Which is the main reason behind the use of IFRS9 models for calculating Price to Value – Credit Risk Spread?**
a	They are the only available internal models to estimate credit risk
b	They allow a better consistency with the accounting credit cost
c	They allow a better risk evaluation in a lifetime perspective
d	Other (free text):
2.2.5	**In case of use of IFRS9 models, are they implemented with any management change / remedy?**
a	**No**
b	**Yes**
2.2.6	**In case of use of IFRS9 models, how are the migrations between stages handled?**
a	Consistently with IFRS9, Stage 1 positions are associated with 1Y parameters and Stage 2 positions with Lifetime parameters
b	Differently from IFRS9, Lifetime parameters are associated to all positions, independent of their stage
c	Differently from IFRS9, 1Y parameters are associated to all positions, independent of their stage
d	Other
2.2.7	**In case of handling of stages consistent with the IFRS9 framework, are there any mechanisms to include in the pricing the migration risk from stage 1 to stage 2 or 3 and the resulting increase of risk (and of accounting cost)?**
a	No
b	Yes, through covenants which allow to change the spread according to the stage
c	Yes, through an estimate of the migration probability
d	Yes, other
2.2.8	**In case of use of IFRS9 models, are alternative scenario analyses implemented?**
a	No, never
b	Yes, always
c	Yes, but excluding positions in stage 1
d	Yes, but with limitations in the adopted scenarios or with a different weighting
2.3.1	**For defining the cost of capital which is the concept of capital used?**
a	Standard supervisory capital requirement
b	IRB supervisory capital requirement
c	Internal capital calculated as IRB minimum requirement with adjustments
d	Economic capital calculated through portfolio models
e	Other figures representing economic capital
2.3.2	**Are other metrics used to incorporate portfolio diversification effects (different from the portfolio models used to estimate ECAP)?**
a	No

b	Yes, management recommendations such as sector indications from Credit Strategies, …
c	Yes, quantitative indications of a different kind
2.3.3	**Which is the rationale behind the choice of the capital figure used?**
a	Regulatory supervisory cost of capital
b	"Management" regulatory approach, consistent with the risk capital and the competitive context
c	Internal metrics (e.g. ECAP) to optimise return compared to the actual allocation of capital
d	Other
2.3.4	**Which methods are implemented to determine the rate of return of capital?**
a	CAPM
b	Other (expected/ target ROE, ad hoc management assessments, …)
2.3.5	**Which are the advantages and weaknesses related to the used methods as of the previous question?**
a	Advantages (free text)
b	Weaknesses (free text)
2.4.1	**Are components of indirect cost considered in the formulation of the Price to Value?**
a	Yes (state which ones)
b	No
2.4.2	**Which are the main difficulties when estimating the indirect costs and which proxies are used? (explain in free text in box below)**
a	Free text
2.4.3	**Which methods are implemented to transfer the indirect costs on the price? (Explain in free text in box below)**
a	Free text
3.1.1	**Are there any "Price to market" logics in the broader pricing formulation process?**
a	Yes
b	No
3.1.2	**If present, in which way is the "Price to market" expressed?**
a	Minimum and maximum spreads applicable and not suspendable
b	Minimum and maximum spreads suspendable through a structured process
c	Minimum and maximum spreads with information value and suspendable at manager's discretion
d	Other (free text):
3.2.1	**In case of suspendable price to market, under which criteria can an exception be made/ requested?**
a	Objective criteria that do not need any authorisation
b	Objective criteria that need authorisation
c	Subjective criteria
d	Other (free text)
3.2.2	**Is there a structured system for monitoring and reporting the exceptions?**
a	No
b	Yes, only on the number of exceptions
c	Yes, on number and extent of exceptions
d	With differences according to the line of analysis (segments, products, …)
e	Yes, other ways
3.2.3	**Which drivers are used to differentiate the price to market? (mark with x the implemented drivers)**
a	Segment
b	Product
c	Rating class
d	Turnover class
e	Sector
f	Geographic area
g	Other
3.2.4	**How important are market prices in determining the price to market values?**
a	Not important
b	Half important
c	Very important
3.2.5	**Are internal benchmarks also used in determining the price to market values?**
a	No, only use of risk drivers or external benchmarks
b	Yes, through benchmarks on comparable divisions
c	Comments
4.1.1	**Are estimates linked to the risk adjusted return implemented in formulating the final price?**
a	Yes
b	No
4.1.2	**If they are, which metrics are used?**
a	Rorac

b	Raroc
c	Rarorac
d	EVA operation
e	EVA customer
f	Other
4.1.3	**Are estimates related to the target values of such metrics implemented in formulating the price? (Any further detail to the answer can be made in the Comments)**
a	Yes, vs target minimum values
b	Yes, vs portfolio targets
c	Yes, other
d	No
e	Comments
5.1.1	**Has the new current and prospect macroeconomic context caused by Covid-19 determined changes in the models or logic for pricing? (Further comments in relevant box)**
a	Yes, on the models implemented to measure the components of the credit risk cost
b	Yes, on the other cost components
c	Yes, on the ways to define the price to market
d	Yes, on the ways to define the price to client
e	Yes, other
f	No
5.1.2	**Are the measures introduced by the Government or the authorities impacting on prices for the customers in a positive way, a negative way or not at all? (Further comments in relevant box)**
a	The measures do not impact the prices or are compensated
b	The measures impact the prices for customers in a positive way, allowing for lower prices
c	The measures impact the prices for customers in a negative way, causing higher prices
5.1.3	**Are the measures introduced by the Government or the authorities impacting the bank's margins? (Further comments in relevant box)**
a	The measures do not impact the margins
b	The measures impact the margins positively
c	The measures impact the margins negatively
d	Comments

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