Interest rate risk measurement for banking institutions
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Измерение процентного риска в банковских институтах
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Abstract: *the article analyses the main ways of interest rate calculation and evaluation for banking institutions. There is a methodology, a calculation example and advantages discussed for every model.*
Аннотация: *в статье рассматриваются основные способы расчёта и оценки процентного риска банковских институтов. Для каждого способа представлена методология, рассматривается калькуляционный пример, а также представлены преимущества модели.*

Keywords: *interest rate risk, bank, maturity gap, funding gap.*
Ключевые слова: *процентный риск, банк, разрыв в сроках погашения, дефицит финансирования, процентная ставка.*

Usually, banks use a wide range of measurements for different aspects of interest rate risk. Nevertheless, there are three major ways to measure risk exposure arising from mismatched maturities between assets and liabilities.

Re-pricing model (funding gap model)

Analyses the difference between interests earned by assets and paid by liabilities [1].

$$\Delta NII_i = (RSA_i\text{-}RSL_i)^*\Delta R_i,$$

where ΔNII_i – change in net interest income; ΔR_i – change in interest rate; RSA_i and RSL_i – risk-sensitive assets and liabilities.

The advantage of the model is that it has an information value and it is also very simple to point to a FI's net interest income exposure to changes of interest rates in different maturity buckets. The negative gap inside the model leads FI to the refinancing risk, while the positive one points on reinvestment risk that both were explained above [1].

Table 1. Repricing gap

(£m)	On demand	1 month	1-3 months	3-6 months	6-9 months	9 months to 1 year	1-2 years	2-5 years	Over 5 years	Total
Assets	23457	7215	5634	5269	4140	2996	10033	33686	231623	324053
Liabilities	135609	13081	9367	12203	8650	8474	19528	22282	51077	280271
GAP	-112152	-5866	-3733	-6934	-4510	-5478	-9495	11404	180546	43782
Cum. Gap		-5866	-9599	-16533	-21043	-26521	-36016	-24612	155939	
ΔNII	-1121.52	-58.66	-37.33	-69.34	-45.10	-54.78	-94.95	114.04	1805.46	437.82

It can be seen from the table, that a bank has negative gap for most of periods. Thus, if interest rates increase, the bank will face decrease of NII and vice versa. However, as long as total CGAP is positive, an increase of NII can be predicted, assuming increase of interest rate by 1 %:

$$\Delta NII_{Total} = GAP_{total}{}^*\Delta r_i = £43{,}782m * 1\% = £437.92\text{m}$$

Maturity model

Shows the difference between the average maturity of assets and liabilities with the following formula:

$$Maturity\ Gap = M_A\text{-}M_L,$$

where $M_{A(L)} = M_{i1}{*}W_{i1} + M_{in}{*}W_{in}$; M_A - maturity of assets, M_L - maturity of liabilities; W_{i1} - weight of M_{i1} maturity of one asset.

The maturity gap of the bank can be calculated as follows:

Table 2. Maturity Gap calculation

Maturity	0.1	0.4	0.6	0.9	1	2	3	5	10	Total
Assets, £m	7215	5634	5269	4140	2996	10033	23457	33686	231623	324053
Liabilities, £m	13081	9367	12203	8650	8474	19528	135609	22282	51077	280271
Assets Weight	0.0223	0.0174	0.0163	0.0128	0.0092	0.0310	0.0724	0.1040	0.7148	1
Liabilities Weight	0.0467	0.0334	0.0435	0.0309	0.0302	0.0697	0.4838	0.0795	0.1822	1
Weighted Assets	0.0022	0.0070	0.0098	0.0115	0.0092	0.0619	0.2172	0.5198	7.1477	7.9862
Weighted Liabilities	0.0047	0.0134	0.0261	0.0278	0.0302	0.1394	1.4515	0.3975	1.8224	3.9130

$$Maturity\ Gap = M_A\text{-}M_L = 7.9862 - 3.9130 = 4.0732 \text{ years}$$

The model advantage is that it better reflects the economic reality of the true value of assets and liabilities. The bigger maturity of the assets rather than liabilities show that the increase in interest rates leads to the falling of the value of assets more than the value of liabilities because assets mature later [2]. Thus, as the maturity gap of Santander is positive, the bank manager may want to shorten it.

Duration gap

Examines how interest rates change affects the economic value stockholders' equity change, comparing the duration of a bank's assets with the duration of the bank's liabilities. In general, duration is «the weighted average time to maturity on the loan using the relative present values of the cash flows as weights» [1, p. 228].

$$D = \frac{\sum_{t=1}^{N} CF_t{*}DF_t{*}t}{\sum_{t=1}^{N} CF_t{*}DF_t}$$

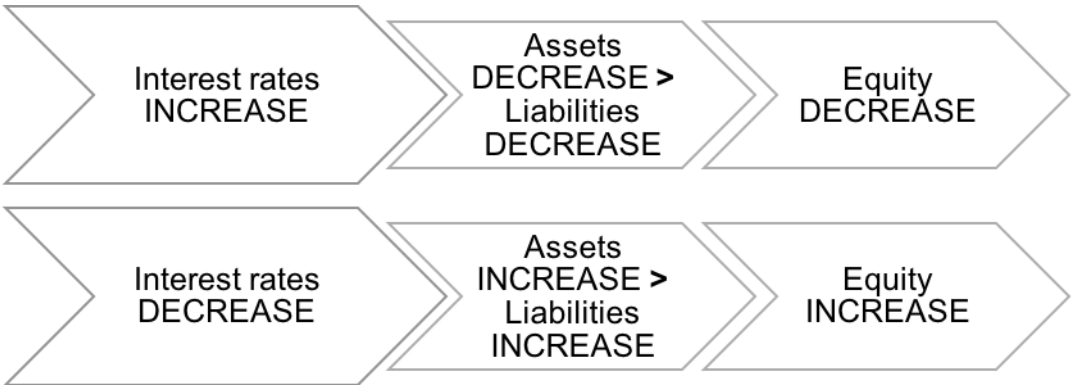
Where: D - duration in years; CF_t - cash flow received on the security at the end of period t; *N* - last period in which the cash flow is received; $DF_t = 1/(1-R)^t$ - discount factor, where R - interest rate.

As to Duration Gap, it is calculated as follows: $DGap = D_A\text{-}D_L$, where $D_A$and D_L are durations of assets and liabilities respectively. Due to the lack of accurate data, the durations were assumed for further calculation of duration gap [3].

Table 4. Duration Gap calculation

	£m	Assumed Duration	Size X duration
Asset side			
Treasury	79761	10	797610
Loan	201645	5	1008225
Total	281406	15	1805835
Total asset duration =1805835/281406 = **6.4172 years**			
Liability side			
Cap note	93395	2	186790
CD	172352	2	344704
Equity	15659		
Total liabilities + equities	281406		531494
Total liabilities	265747		
Total liabilities duration = 531494/265747 = **2 years**			
K = liabilities/assets = **0.94435**			
Duration Gap = 6.4172 – (2*0.94435) = **4.5285 years**			

Positive DGap of the bank indicates that on average assets are more sensitive to a price than liabilities. So, the reaction on interest rate change of a FI with positive duration gap can be summarized as follows:



This model is very convenient to use to immunize both particular liability and the whole FI balance sheet. Moreover, it is important when measuring duration gap on balance sheet and assessing the interest rate sensitivity of entity [1].

References

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