3º Workshop Duxus de Risco

Uma questão de controle.

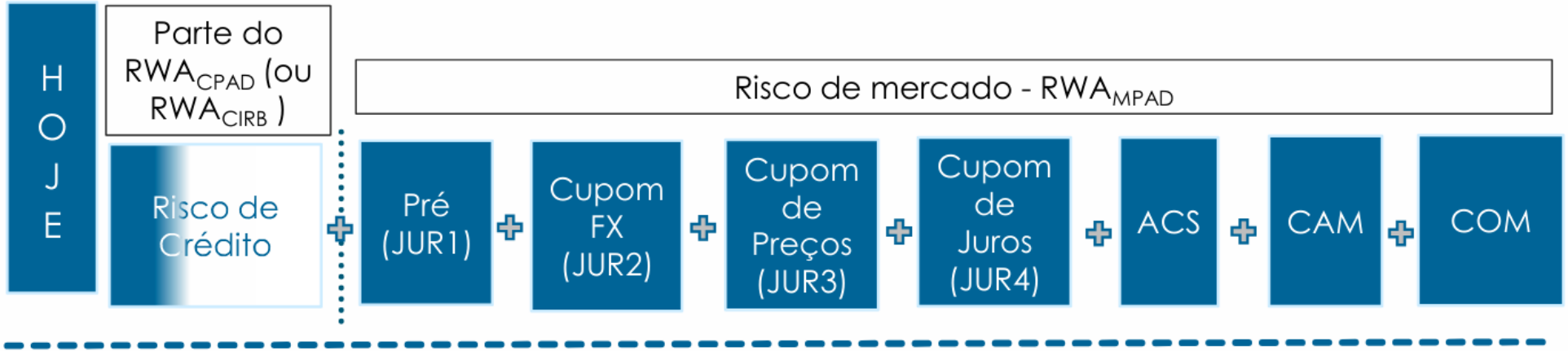
Élin Duxus

FRTB – SBM

Fábio Henrique Costa Corrêa
Rodrigo Leme De Oliveira

Q&A

FRTB – Relembrando



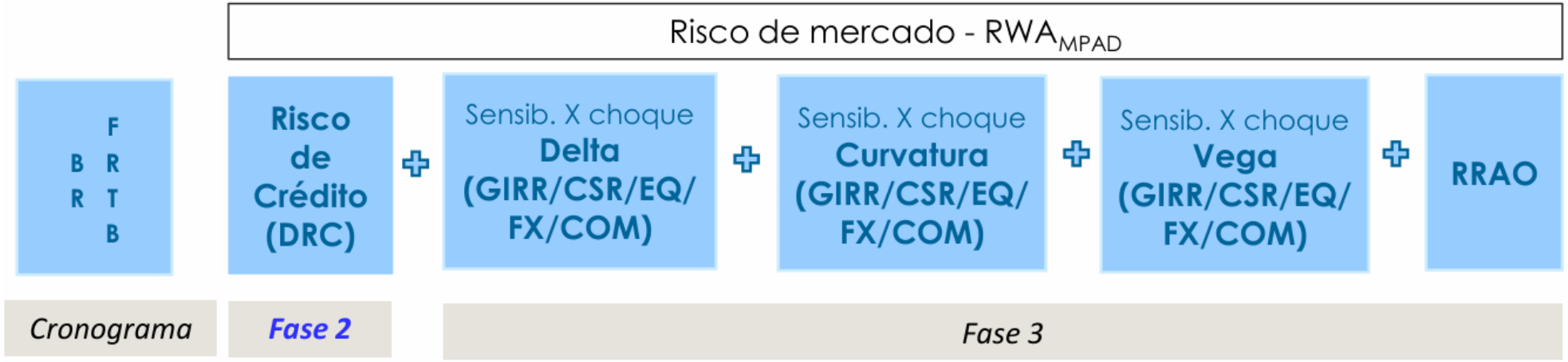
FRTB – Fragilidades

VaR com fraquezas

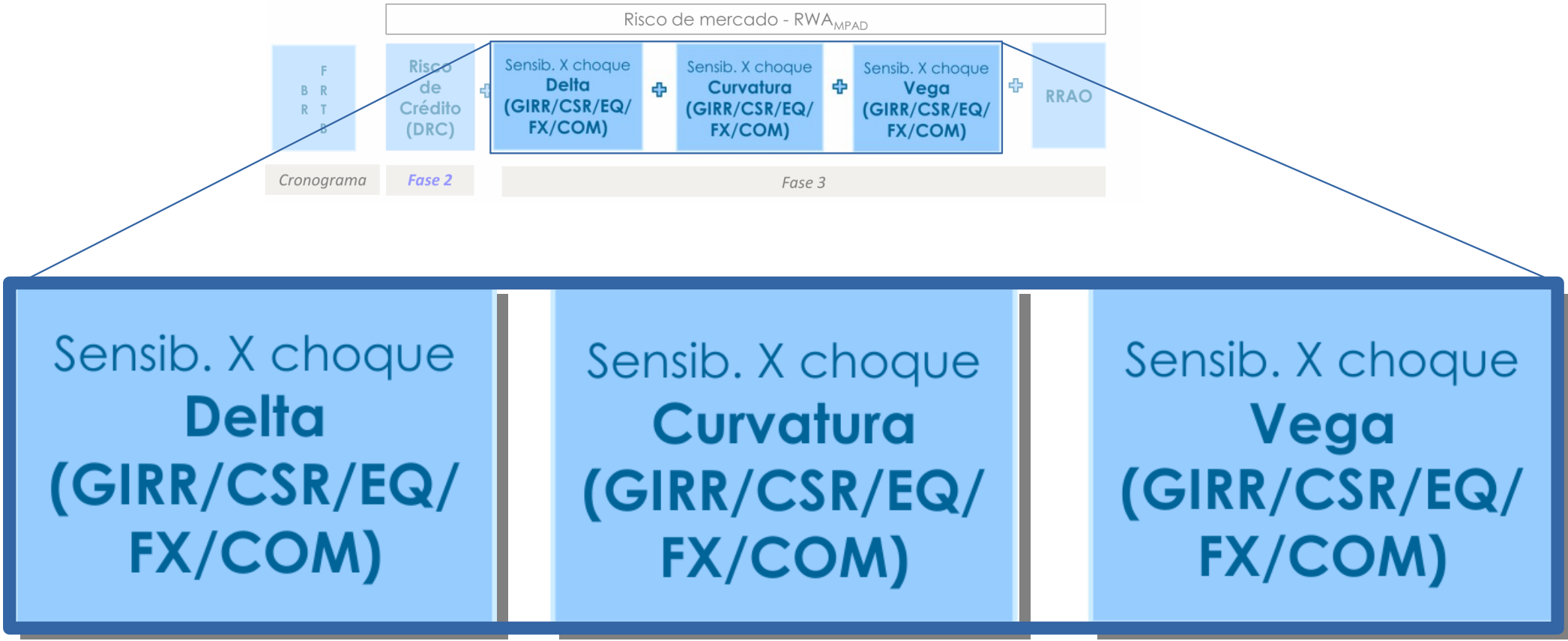
Separação clara entre trading e banking

Modelo mais robusto

FRTB — Fundamental Review of Trading Book



FRTB — Fundamental Review of Trading Book



O Futuro

$$k_b = \sqrt{max(0, \sum_k WS_k^2 + \sum_k \sum_{k \neq l} \rho_{kl} WS_k WS_l}$$

$$WS_k = RW_k s_k \; Delta(respectivevega) = \sqrt{\sum_b K_b^2 + \sum_b \sum_{c \neq_b} \gamma_{bc} s_b s_b}$$

$$K_b = max(K_b^+, K_b^-) \; V_i\left(X_k^{(RW^{(curvature)}+)}\right) \; and \; V_i\left(X_k^{(RW^{(curvature)}-)}\right)$$

$$K_b^+ = \sqrt{max(0, \sum_k max(CVR_k^+, 0)^2 + \sum_{l \neq k} \sum_k \rho_{kl} CVR_k^+ CVR_l^+ \psi(CVR_k^+, CVR_l^+))}$$

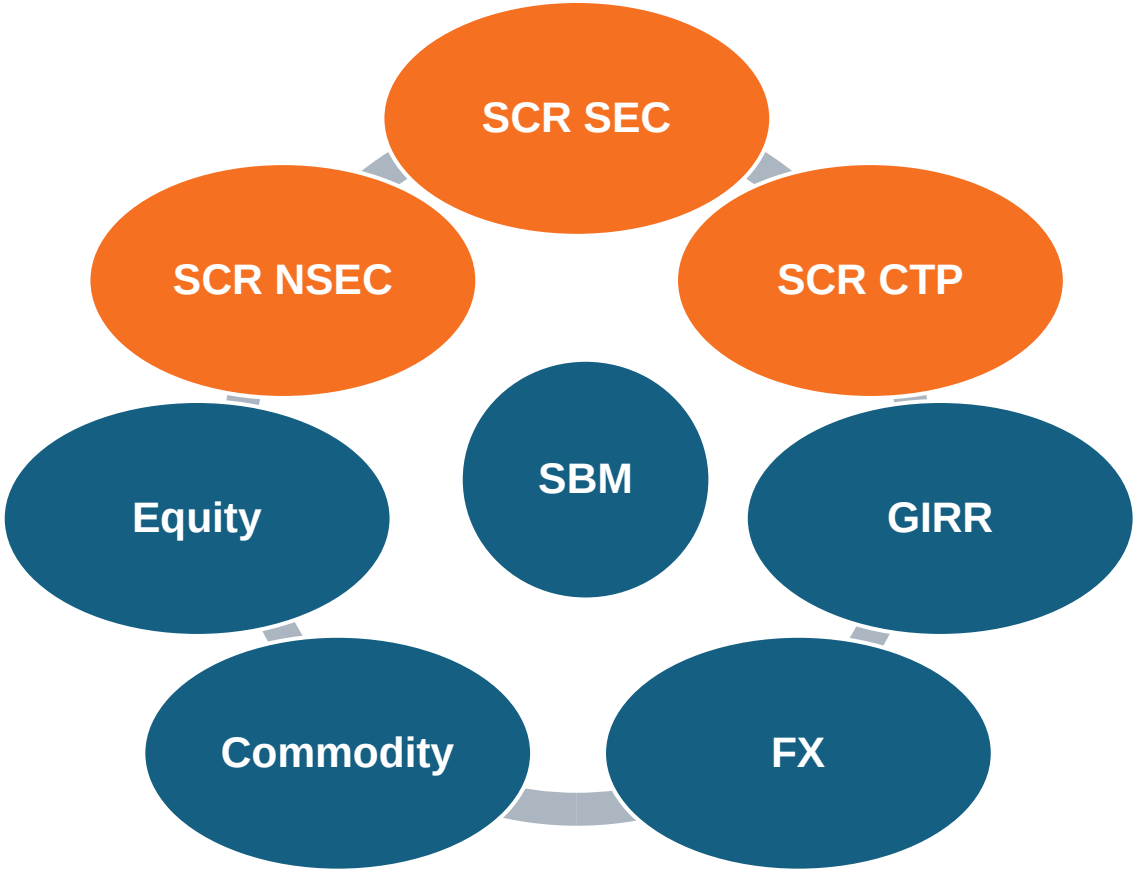
$$K_b^- = \sqrt{max(0, \sum_k max(CVR_k^-, 0)^2 + \sum_{l \neq k} \sum_k \rho_{kl} CVR_k^- CVR_l^- \psi(CVR_k^-, CVR_l^-))}$$

$$CVR_k^- = -\sum_i \{V_i(x_k^{RW(curvature)^-}) - V_i(x_k) - RW_k^{Curvature} \times s_{ik}\}$$

$$CVR_k^+ = -\sum_i \{V_i(x_k^{RW(curvature)^+}) - V_i(x_k) - RW_k^{Curvature} \times s_{ik}\}$$

$$Curvature\ risk = \sqrt{max(0, \sum_b k_b^2 + \sum_{c \neq b} \sum_b \gamma_{bc} s_b s_c \psi(s_b, s_c)}$$

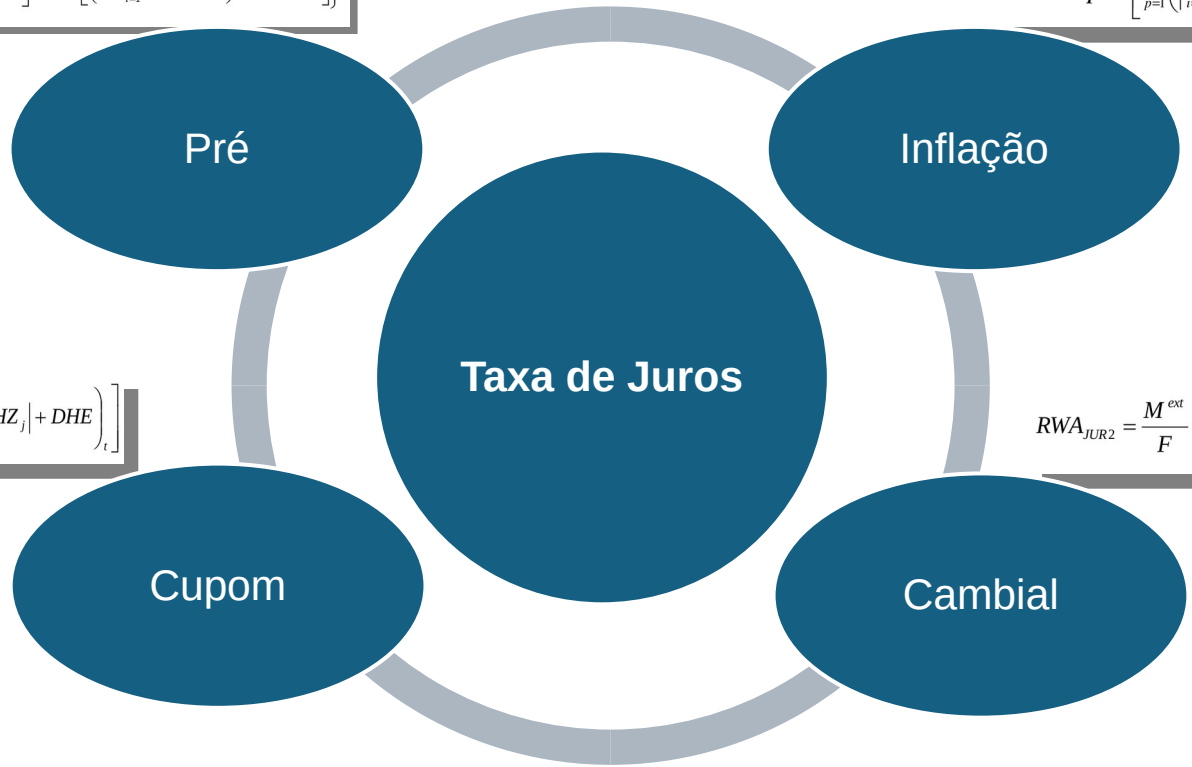
SBM



SBM – GIRR

$$RWA_{JUR1} = \frac{1}{F} \cdot \left\{ \max\left[\left(\frac{M^{pre}_{t-1}}{60} \sum_{i=1}^{60} VaR^{Padrão}_{t-i} \right), VaR^{Padrão}_{t-1} \right] + \max\left[\left(\frac{1}{60} \sum_{i=1}^{60} sVaR^{Padrão}_{t-i} \right), sVaR^{Padrão}_{t-1} \right] \right\},$$

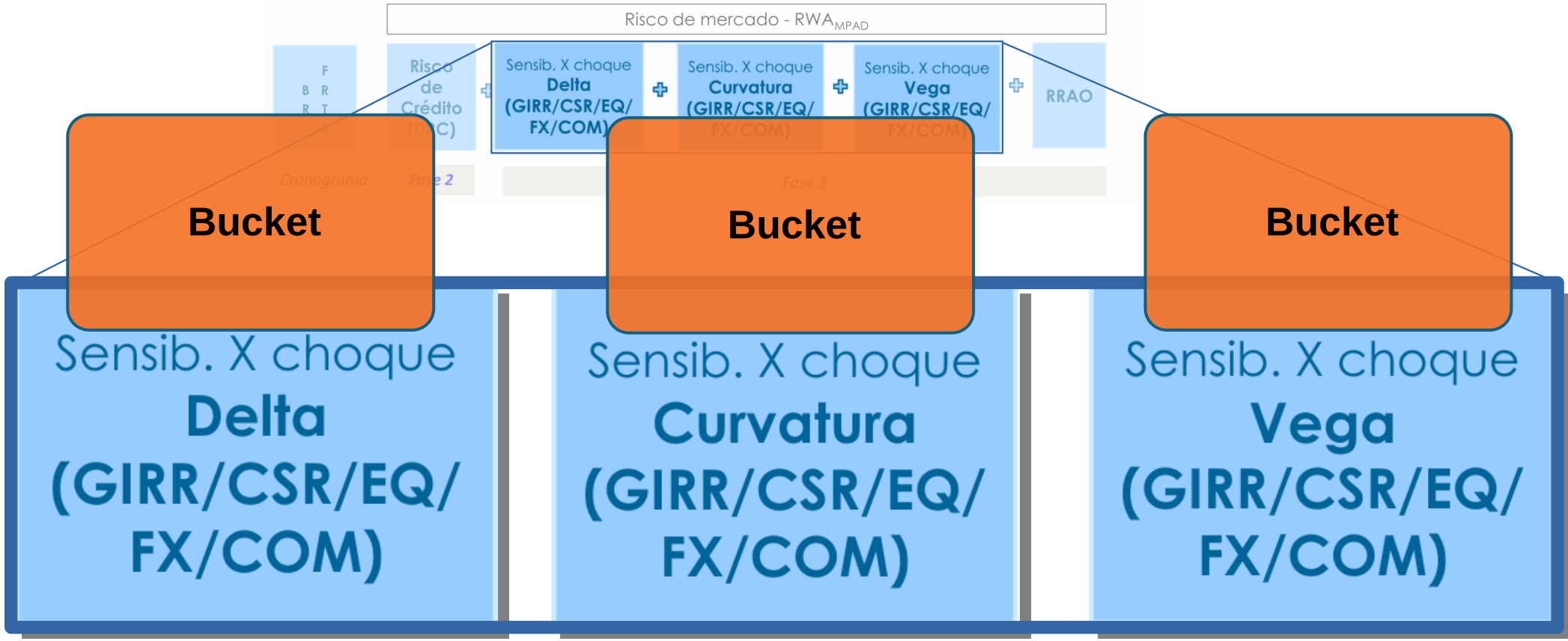
$$RWA_{JUR3} = \frac{M^{pco}}{F} \cdot \left[\sum_{p=1}^{p1} \left(\left| \sum_{i=1}^{11} EL_i \right| + \sum_{i=1}^{11} |DV_i| + \sum_{j=1}^{3} |DHZ_j| + DHE \right)_p \right]$$



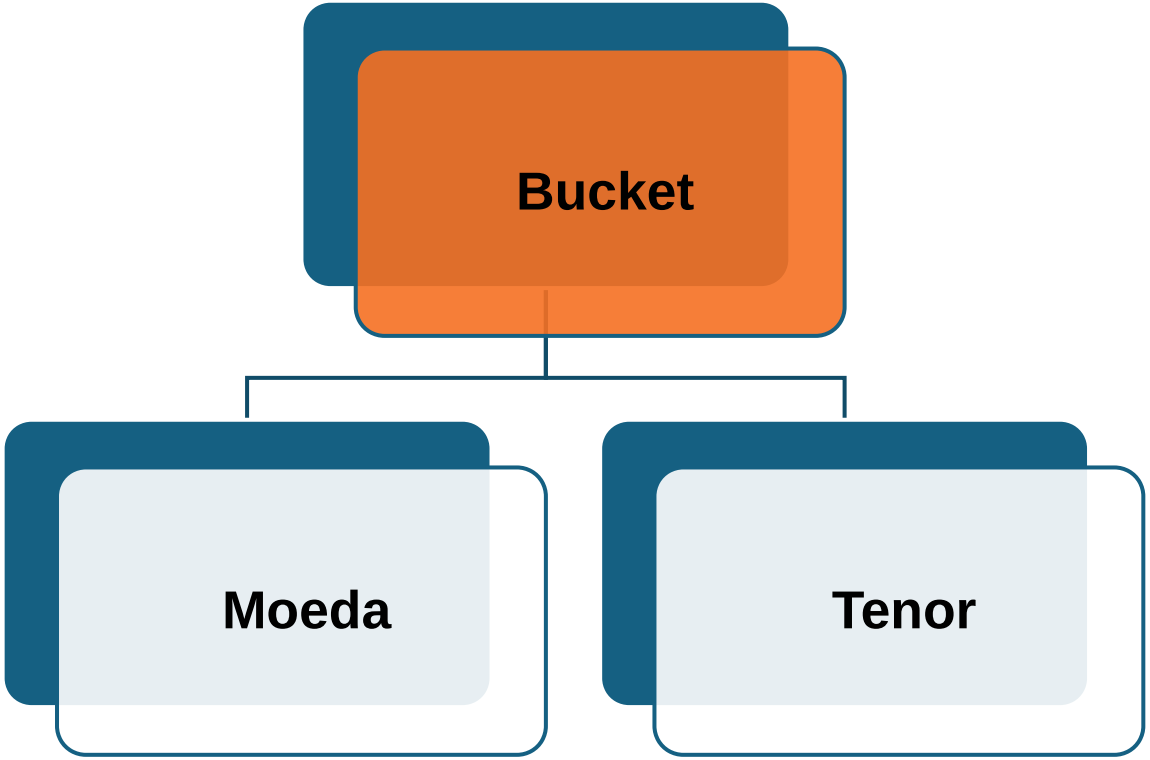
$$RWA_{JUR4} = \frac{M^{jur}}{F} \cdot \left[\sum_{t=1}^{t1} \left(\left| \sum_{i=1}^{11} EL_i \right| + \sum_{i=1}^{11} |DV_i| + \sum_{j=1}^{3} |DHZ_j| + DHE \right)_t \right]$$

$$RWA_{JUR2} = \frac{M^{ext}}{F} \cdot \left[\sum_{k=1}^{m1} \left(\left| \sum_{i=1}^{11} EL_i \right| + \sum_{i=1}^{11} |DV_i| + \sum_{j=1}^{3} |DHZ_j| + DHE \right)_k \right]$$

FRTB — Fundamental Review of Trading Book

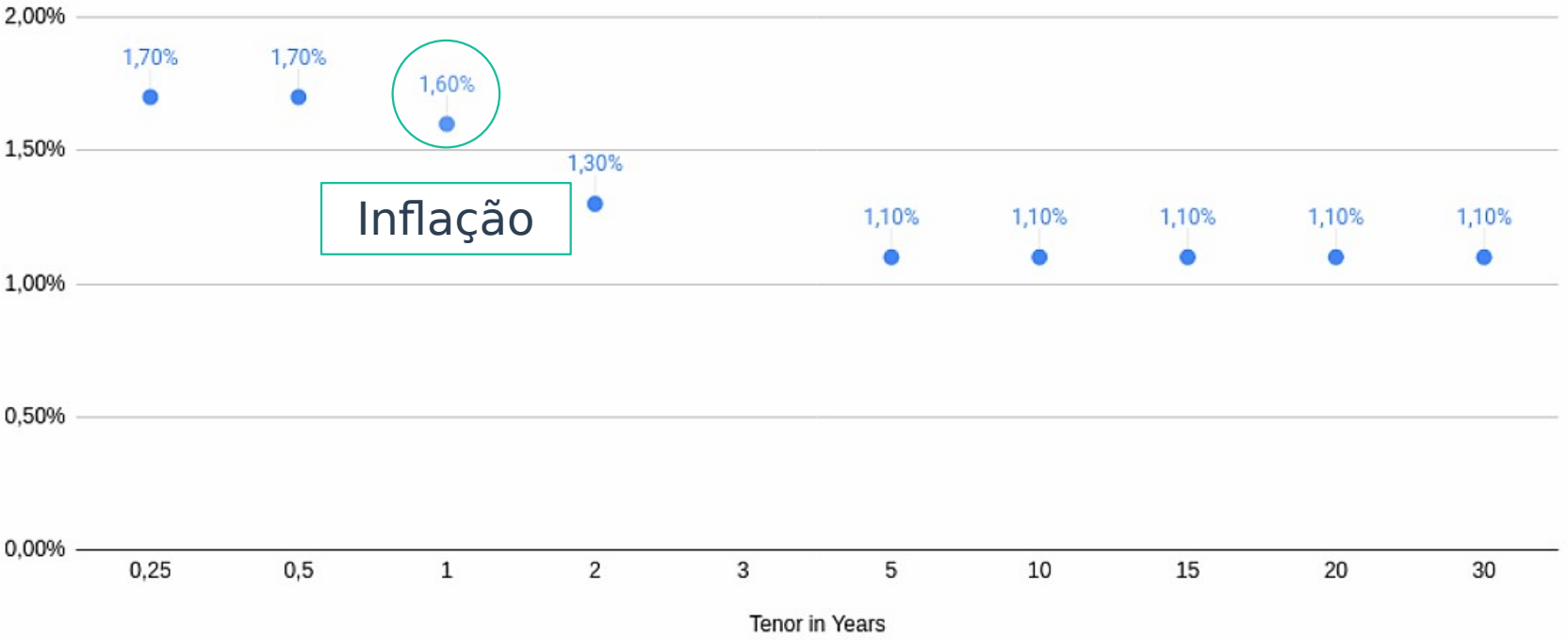


SBM – Buckets GIRR



SBM – GIRR – Buckets

Tenor	0,25 year	0,5 year	1 year	2 year	3 year	5 year	10 year	15 year	20 year	30 year
Risk weight	1,70%	1,70%	1,60%	1,30%	1,20%	1,10%	1,10%	1,10%	1,10%	1,10%



SBM – GIRR – Correlation

Delta GIRR correlations (ρ_{kl}) within the same bucket, with different tenor and same curve — Table 2

	0.25 year	0.5 year	1 year	2 year	3 year	5 year	10 year	15 year	20 year	30 year
0.25 year	100.0%	97.0%	91.4%	81.1%	71.9%	56.6%	40.0%	40.0%	40.0%	40.0%
0.5 year	97.0%	100.0%	97.0%	91.4%	86.1%	76.3%	56.6%	41.9%	40.0%	40.0%
1 year	91.4%	97.0%	100.0%	97.0%	94.2%	88.7%	76.3%	65.7%	56.6%	41.9%
2 year	81.1%	91.4%	97.0%	100.0%	98.5%	95.6%	88.7%	82.3%	76.3%	65.7%
3 year	71.9%	86.1%	94.2%	98.5%	100.0%	98.0%	93.2%	88.7%	84.4%	76.3%
5 year	56.6%	76.3%	88.7%	95.6%	98.0%	100.0%	97.0%	94.2%	91.4%	86.1%
10 year	40.0%	56.6%	76.3%	88.7%	93.2%	97.0%	100.0%	98.5%	97.0%	94.2%
15 year	40.0%	41.9%	65.7%	82.3%	88.7%	94.2%	98.5%	100.0%	99.0%	97.0%
20 year	40.0%	40.0%	56.6%	76.3%	84.4%	91.4%	97.0%	99.0%	100.0%	98.5%
30 year	40.0%	40.0%	41.9%	65.7%	76.3%	86.1%	94.2%	97.0%	98.5%	100.0%

SBM – GIRR – Correlation

$\rho_{kl} \times .$

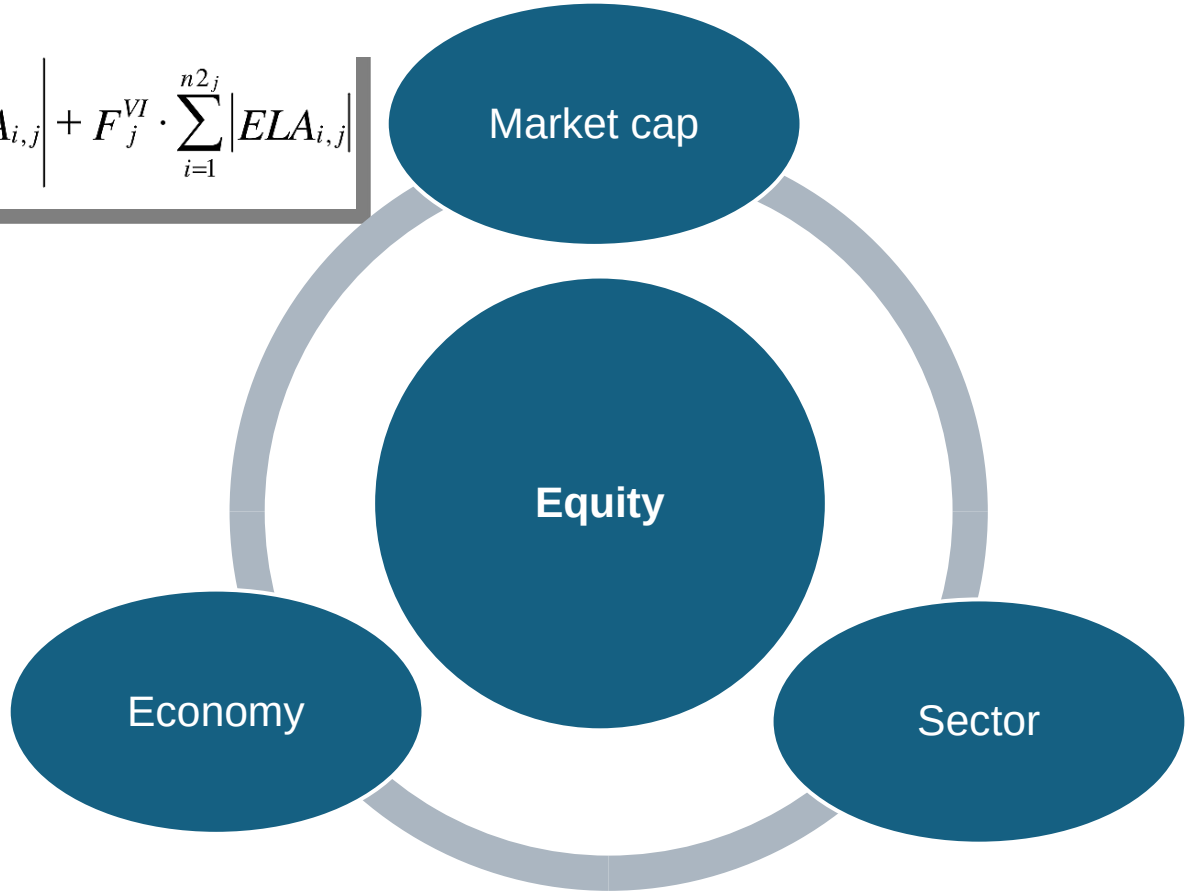
99,90%

γ_{bc}

50%

SBM – Equity

$$RWA_{ACS_{[j]}} = F^{V} \cdot \left| \sum_{i=1}^{n2_j} ELA_{i,j} \right| + F_j^{VI} \cdot \sum_{i=1}^{n2_j} \left| ELA_{i,j} \right|$$



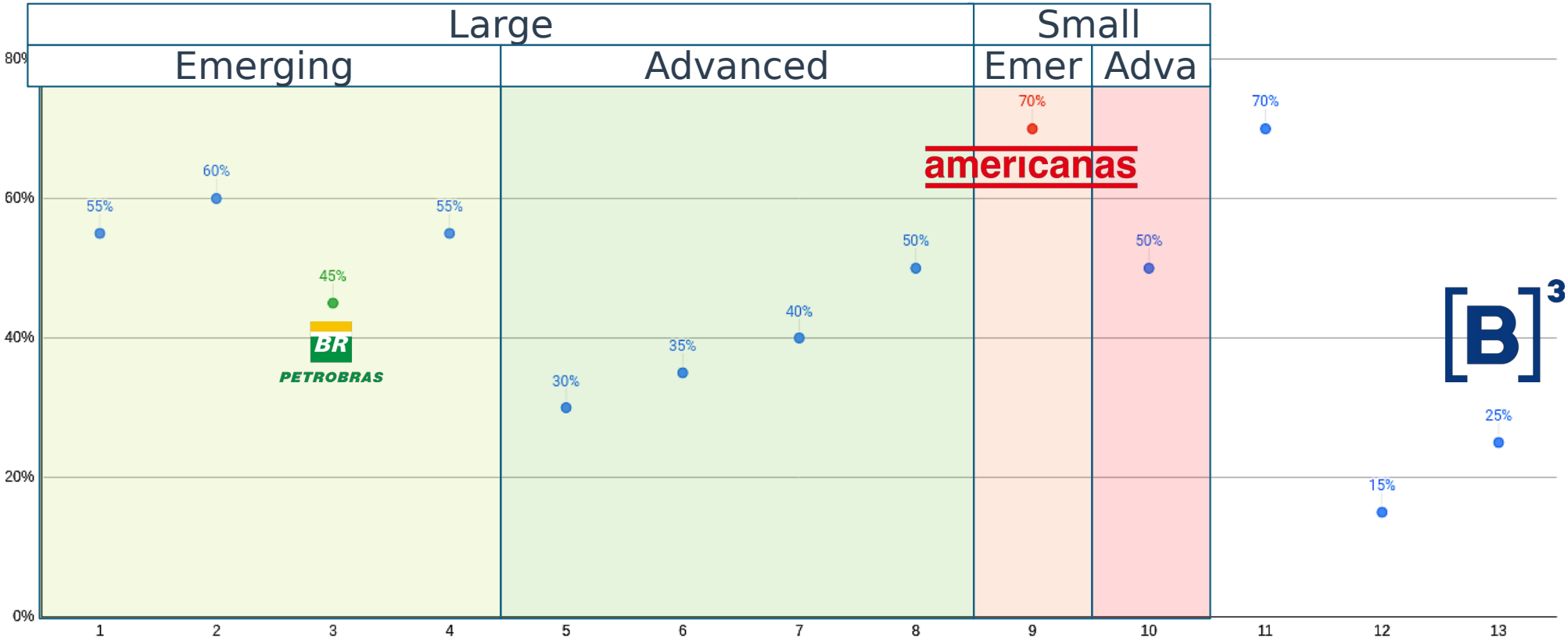
SBM – Equity – Buckets

Market cap	Economy	Bucket number	Sector	Risk weight for equity spot price	Risk weight for equity repo rate
Large	Emerging market economy	1	Consumer goods and services, transportation and storage, administrative and support service activities, healthcare, utilities	55%	0.55%
		2	Telecommunications, industrials	60%	0.60%
		3	Basic materials, energy, agriculture, manufacturing, mining and quarrying	45%	0.45%
		4	Financials including government-backed financials, real estate activities, technology	55%	0.55%
	Advanced economy	5	Consumer goods and services, transportation and storage, administrative and support service activities, healthcare, utilities	30%	0.30%
		6	Telecommunications, industrials	35%	0.35%
		7	Basic materials, energy, agriculture, manufacturing, mining and quarrying	40%	0.40%
		8	Financials including government-backed financials, real estate activities, technology	50%	0.50%

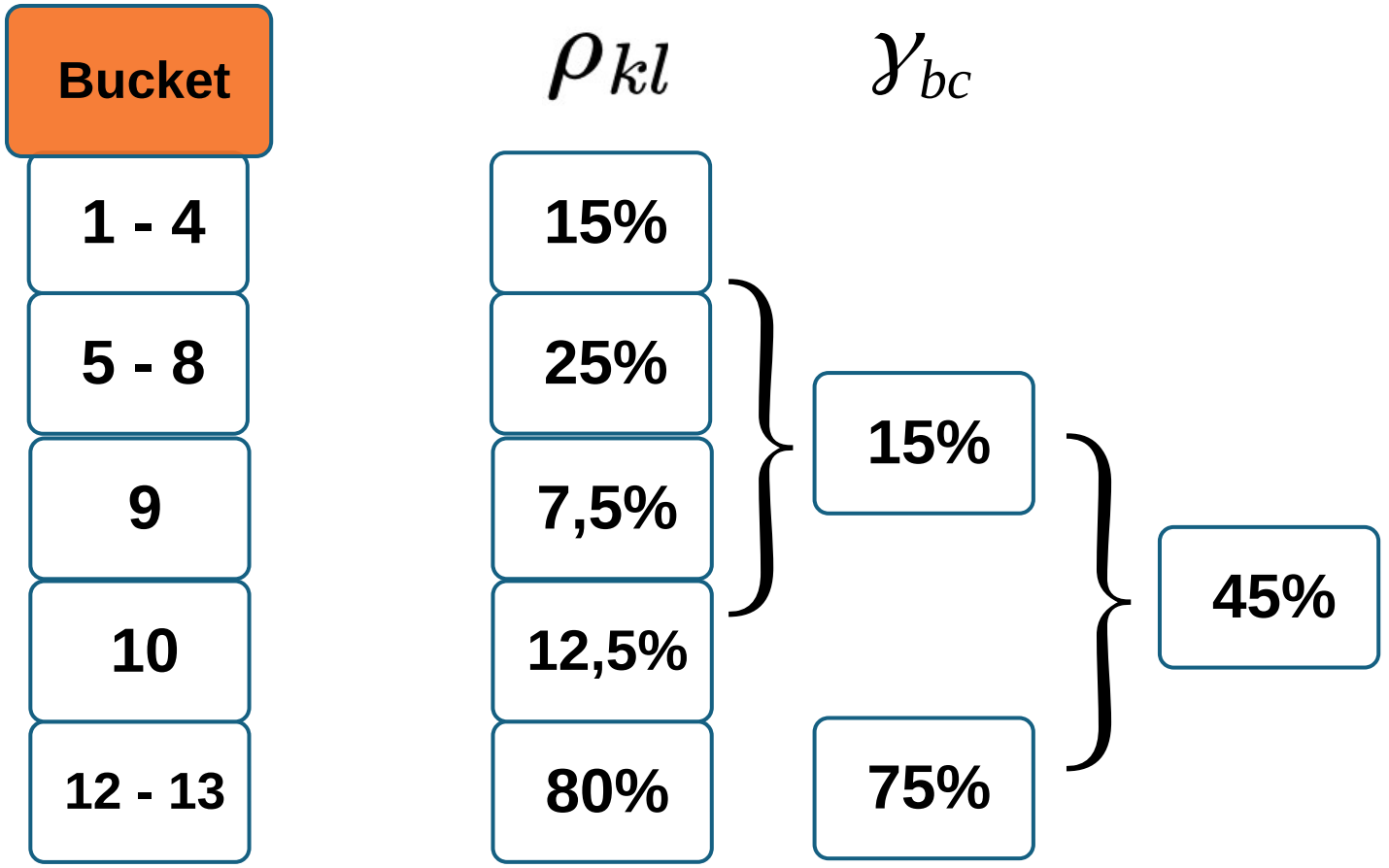
SBM – Equity – Buckets

Bucket number	Market cap	Economy	Sector	Risk weight for equity spot price	Risk weight for equity repo rate
9	Small	Emerging market economy	All sectors described under bucket numbers 1, 2, 3 and 4	70%	0.70%
10		Advanced economy	All sectors described under bucket numbers 5, 6, 7 and 8	50%	0.50%
11	Other sector20			70%	0.70%
12	Large market cap, advanced economy equity indices (non-sector specific)			15%	0.15%
13	Other equity indices (non-sector specific)			25%	0.25%

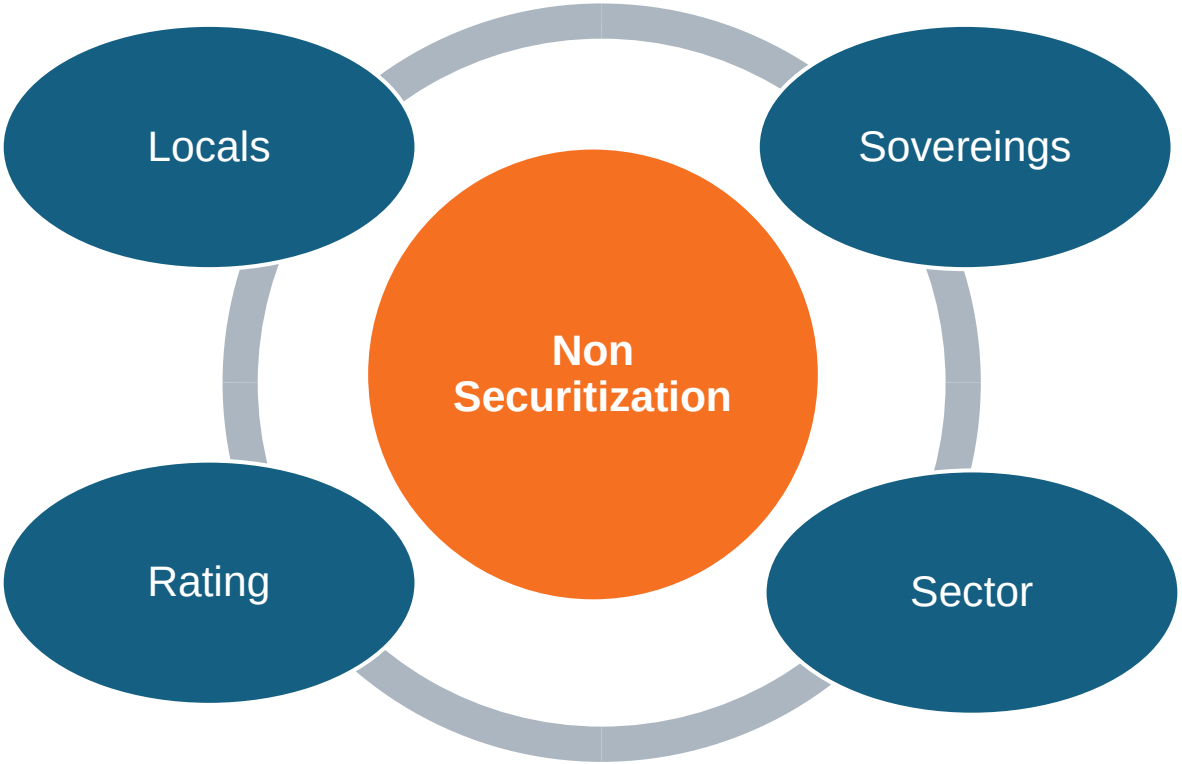
SBM – Equity – Buckets



SBM – Equity – Correlation



SBM – Non Securitization



SBM – Non Securitization – Buckets

Credit quality	Bucket number	Sector	Risk weight
Investment grade (IG)	1	Sovereigns including central banks, multilateral development banks	0.5%
	2	Local government, government-backed non-financials, education, public administration	1.0%
	3	Financials including government-backed financials	5.0%
	4	Basic materials, energy, industrials, agriculture, manufacturing, mining and quarrying	3.0%
	5	Consumer goods and services, transportation and storage, administrative and support service activities	3.0%
	6	Technology, telecommunications	2.0%
	7	Health care, utilities, professional and technical activities	1.5%
	8	Covered bond	2.5

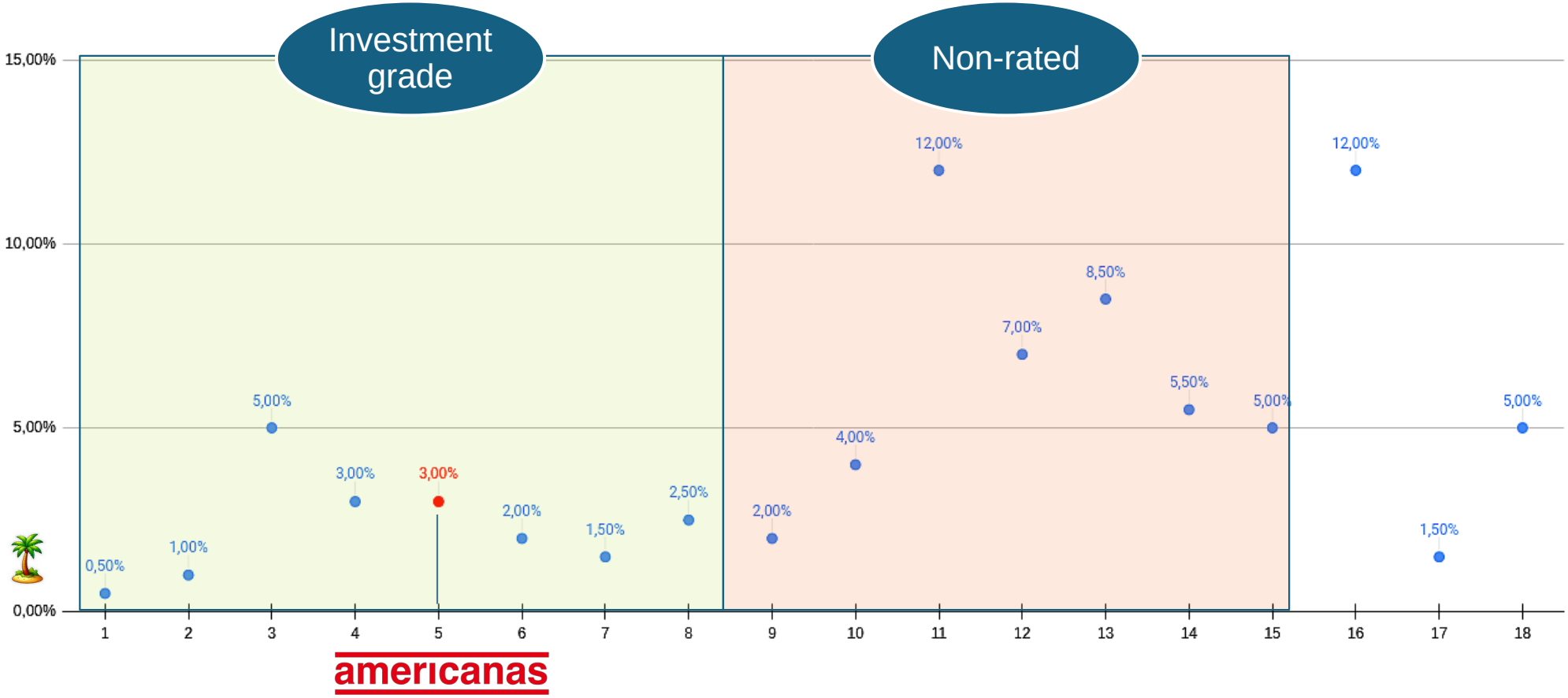
SBM – Non Securitization – Buckets

Credit quality	Bucket number	Sector	Risk weight
High yield (HY) & non-rated (NR)	9	Sovereigns including central banks, multilateral development banks	2.0%
	10	Local government, government-backed non-financials, education, public administration	4.0%
	11	Financials including government-backed financials	12.0%
	12	Basic materials, energy, industrials, agriculture, manufacturing, mining and quarrying	7.0%
	13	Consumer goods and services, transportation and storage, administrative and support service activities	8.5%
	14	Technology, telecommunications	5.5%
	15	Health care, utilities, professional and technical activities	5.0%

SBM – Non Securitization – Buckets

Bucket number	Credit quality	Risk weight
16	Other sector	12.0%
17	IG indices	1.5%
18	HY indices	5.0%

SBM – Non Securitization – Buckets



SBM – Non Securitisation – Correlations

Name	**1**	**35%**
Tenor	**1**	**65%**
Basis	**1**	**99,90%**

$$\rho_{kl} = \rho_{kl}^{(name)} \times \rho_{kl}^{(Tenor)} \times \rho_{kl}^{(Basis)}$$

SBM – Non Securitisation – Correlations

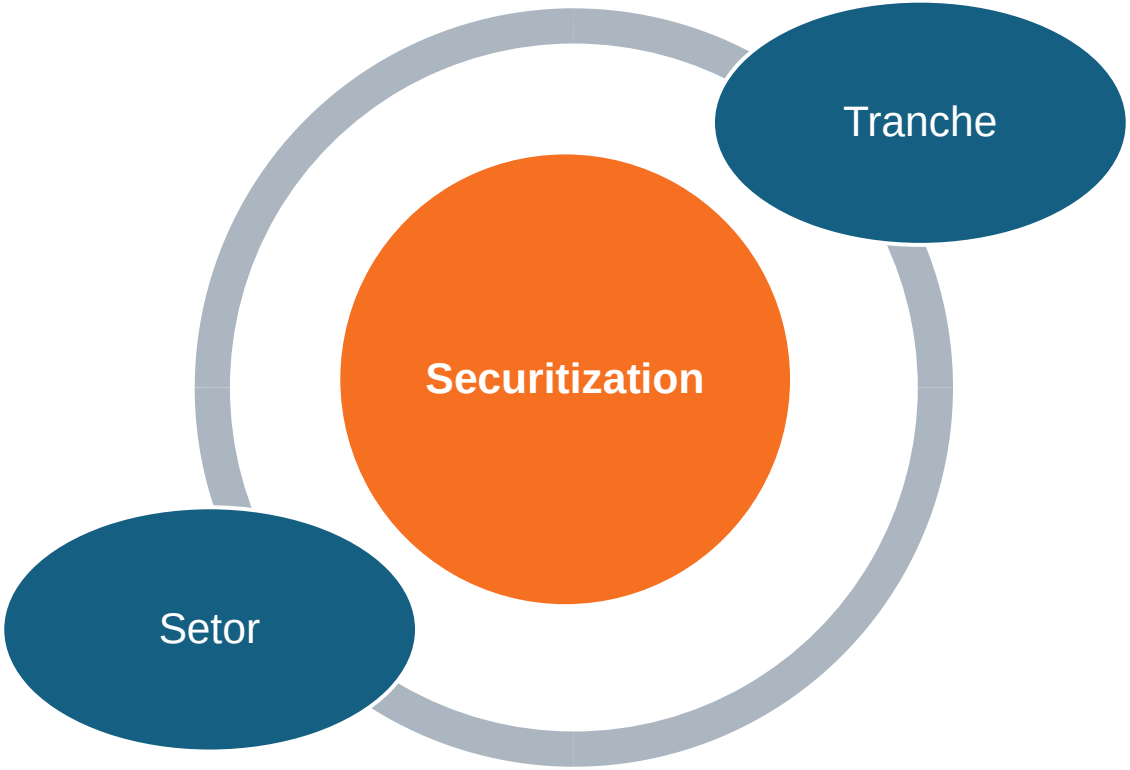
$$\gamma_{bc} = \gamma_{bc}^{(rating)} \cdot \gamma_{bc}^{(sector)}$$

Table 5

Values of $\gamma_{bc}^{(sector)}$ where the buckets do not belong to the same sector

Bucket	1 / 9	2 / 10	3 / 11	4 / 12	5 / 13	6 / 14	7 / 15	8	16	17	18
1 / 9		75%	10%	20%	25%	20%	15%	10%	0%	45%	45%
2 / 10			5%	15%	20%	15%	10%	10%	0%	45%	45%
3 / 11				5%	15%	20%	5%	20%	0%	45%	45%
4 / 12					20%	25%	5%	5%	0%	45%	45%
5 / 13						25%	5%	15%	0%	45%	45%
6 / 14							5%	20%	0%	45%	45%
7 / 15								5%	0%	45%	45%
8									0%	45%	45%
16										0%	0%
17											75%
18											

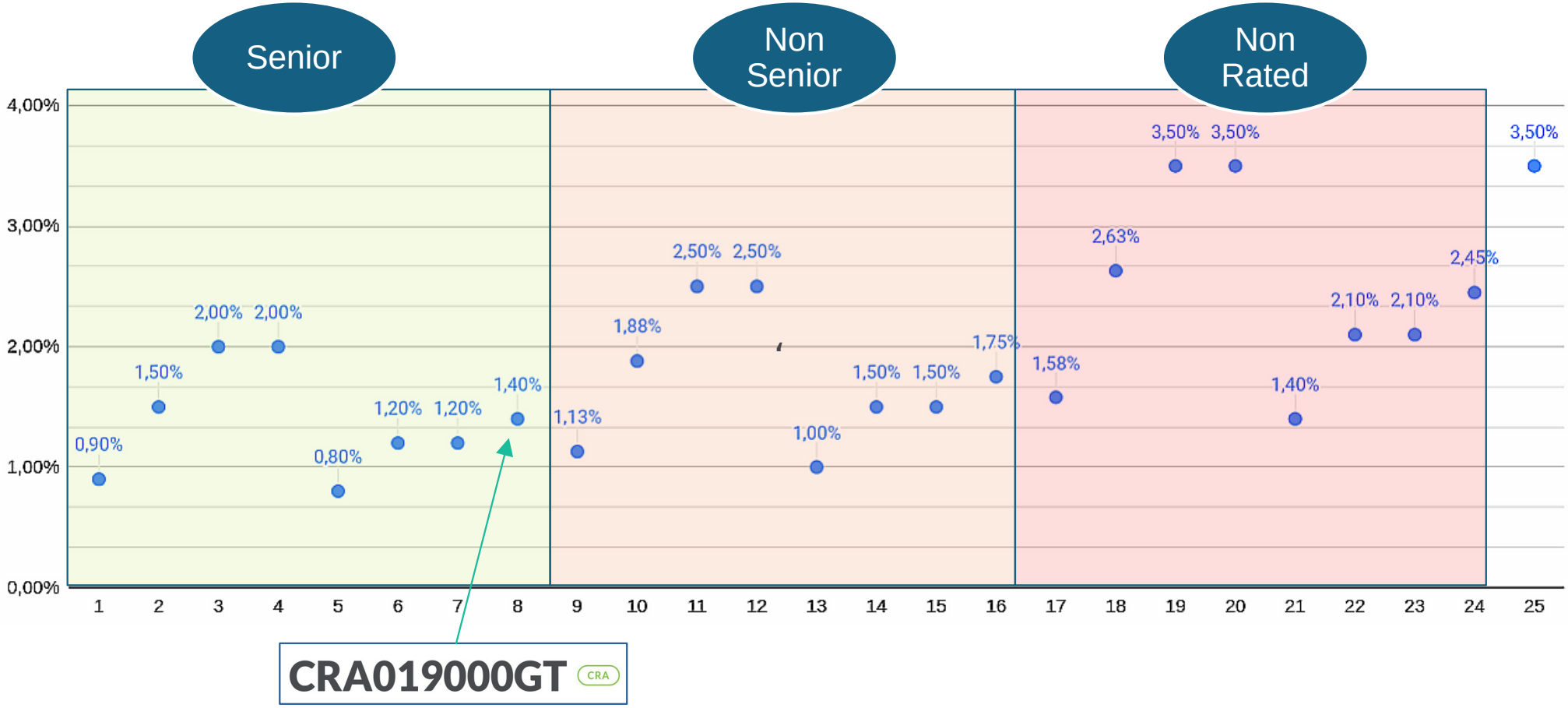
SBM – Securitisation



SBM – SEC – Buckets

Credit quality	Bucket number	Sector	Risk weight (in percentage points)
Senior investment grade (IG)	1	RMBS – Prime	0.9%
	2	RMBS – Mid-prime	1.5%
	3	RMBS – Sub-prime	2.0%
	4	CMBS	2.0%
	5	Asset-backed securities (ABS) – Student loans	0.8%
	6	ABS – Credit cards	1.2%
	7	ABS – Auto	1.2%
	8	Collateralised loan obligation (CLO) non-CTP	1.4%

SBM – SEC – Buckets

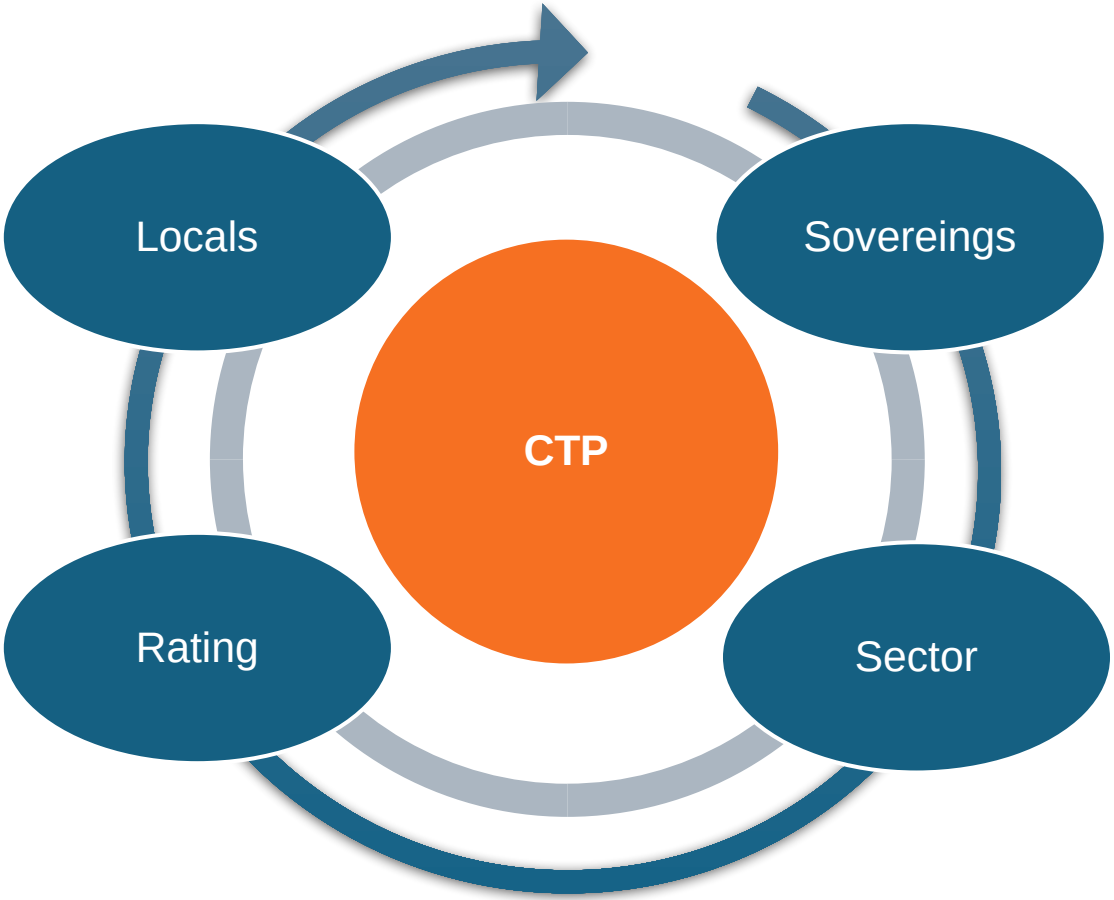


SBM – Securitisation – Correlations

Tranche	1	40%
Tenor	1	80%
Basis	1	99,90%

$$\rho_{kl} = \rho_{kl}^{(Tranche)} \times \rho_{kl}^{(Tenor)} \times \rho_{kl}^{(Basis)}$$

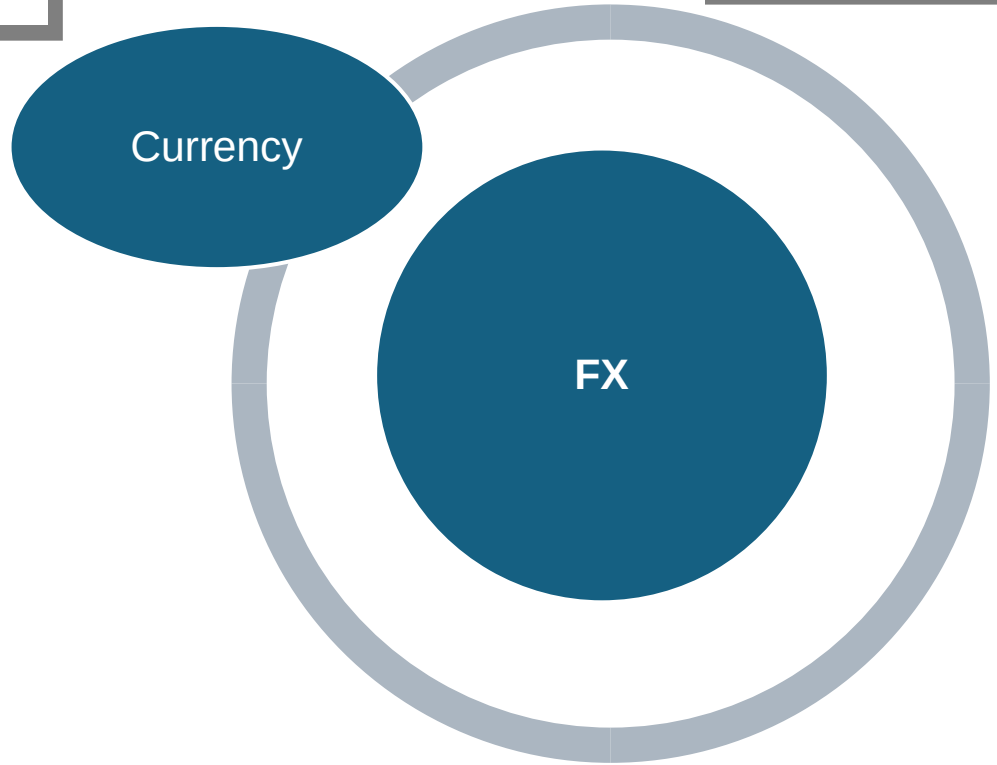
SBM – CTP – Buckets



MAR 21 – FX Buckets

$$RWA_{CAM} = \frac{F'' \cdot EXP}{F}$$

$$EXP = Exp_1 + H \cdot Exp_2 + G \cdot Exp_3$$



SBM – FX — Bucket and correlation

Bucket

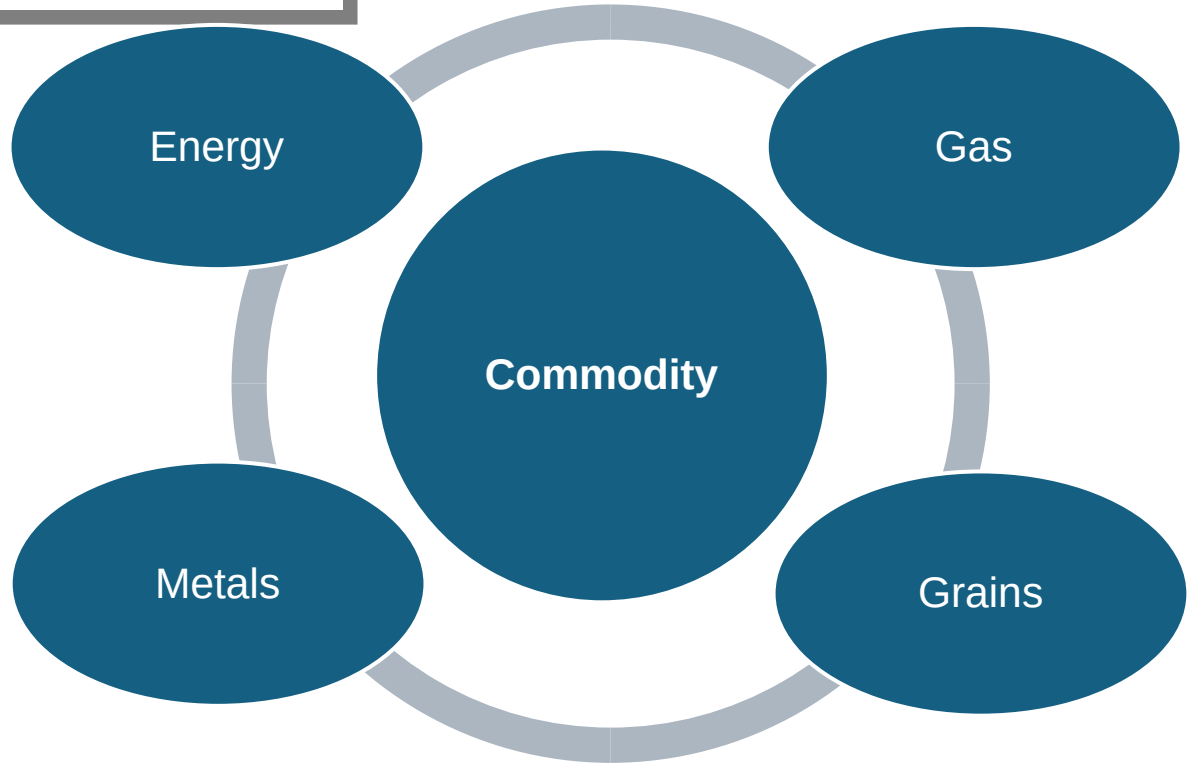
15%

Correlation

60%

SBM – Commodity

$$RWA_{COM} = \frac{1}{F} \cdot \left[\left(F''' \cdot \sum_{i=1}^{n} |EL_i| \right) + \left(F^{IV} \cdot EB \right) \right]$$



SBM – Commodity – Buckets

Delta commodity buckets and risk weights			
Bucket number	Commodity bucket	Examples of commodities allocated to each commodity bucket (non-exhaustive)	Risk weight
1	Energy - solid combustibles	Coal, charcoal, wood ium	30%
2	Energy - liquid combustibles	Light-sweet crude oil; heavy crude oil; West Texas Intermediate (WTI) crude; Brent crude; etc (ie various types of crude oil) Bioethanol; biodiesel ; etc (ie various biofuels) Propane; ethane; gasoline; methanol; butane; etc (ie various petrochemicals) Jet fuel; kerosene; gasoil; fuel oil; naphtha; heating oil; diesel etc (ie various refined fuels)	35%

SBM – Commodity – Buckets

Delta commodity buckets and risk weights			
Bucket number	Commodity bucket	Examples of commodities allocated to each commodity bucket (non-exhaustive)	Risk weight
3	Energy - electricity and carbon trading	Spot electricity; day-ahead electricity; peak electricity; off-peak electricity (ie various electricity types) Certified emissions reductions; in-delivery month EU allowance; Regional Greenhouse Gas Initiative CO2 allowance; renewable energy certificates; etc (ie various carbon trading emissions)	60%
4	Freight	Capesize; Panamax; Handysize; Supramax (ie various types of dry-bulk route) Suezmax; Aframax; very large crude carriers (ie various liquid-bulk/gas shipping route)	80%

SBM – Commodity – Buckets

Delta commodity buckets and risk weights			
Bucket number	Commodity bucket	Examples of commodities allocated to each commodity bucket (non-exhaustive)	Risk weight
5	Metals – non-precious	Aluminium; copper; lead; nickel; tin; zinc (ie various base metals) Steel billet ; steel wire; steel coil ; steel scrap; steel rebar; iron ore; tungsten; vanadium; titanium; tantalum (ie steel raw materials) Cobalt; manganese; molybdenum (ie various minor metals)	40%
6	Gaseous combustibles	Natural gas; liquefied natural gas	45%

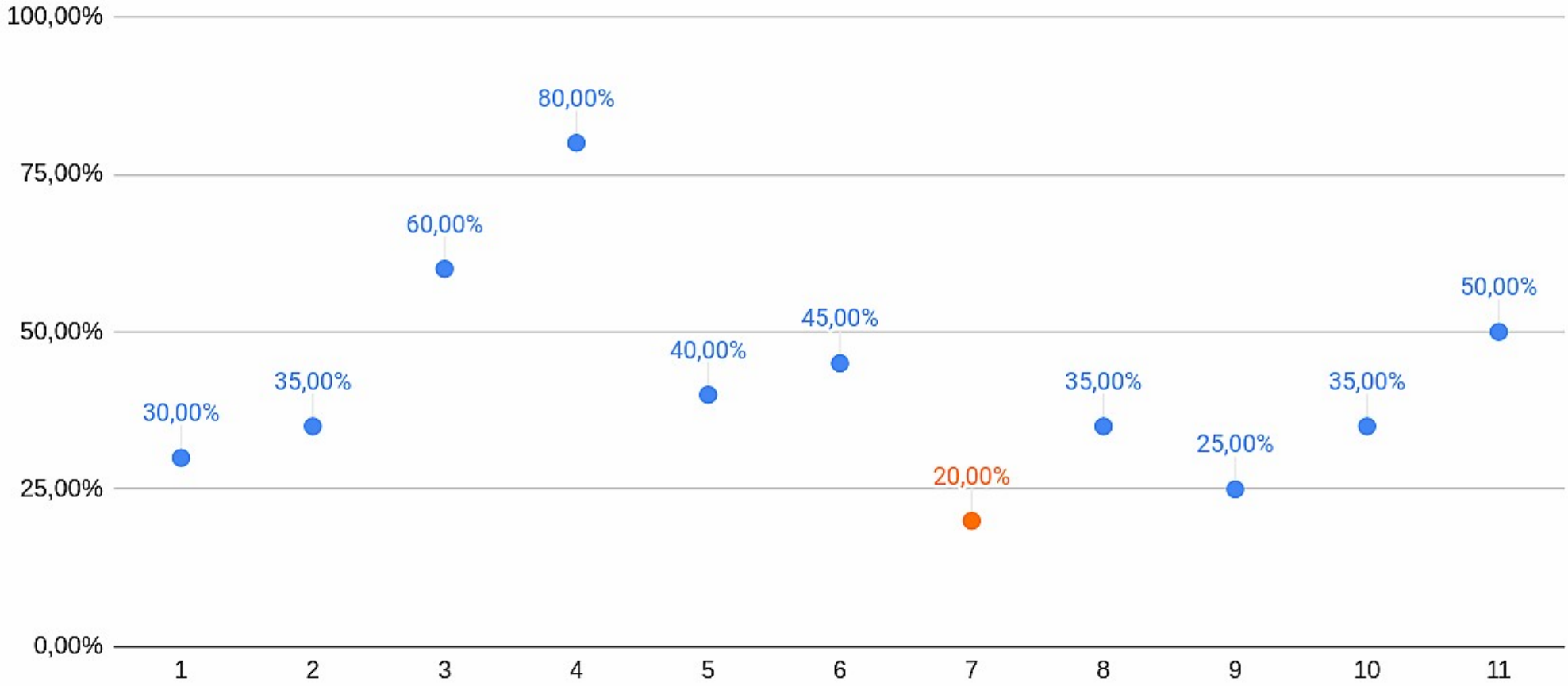
SBM – Commodity – Buckets

Delta commodity buckets and risk weights			
Bucket number	Commodity bucket	Examples of commodities allocated to each commodity bucket (non-exhaustive)	Risk weight
7	Precious metals (including gold)	Gold; silver; platinum; palladium	20%
8	Grains and oilseed	Corn; wheat; soybean seed; soybean oil; soybean meal; oats; palm oil; canola; barley; rapeseed seed; rapeseed oil; rapeseed meal; red bean; sorghum; coconut oil; olive oil; peanut oil; sunflower oil; rice	35%

SBM – Commodity – Buckets

Delta commodity buckets and risk weights			
Bucket number	Commodity bucket	Examples of commodities allocated to each commodity bucket (non-exhaustive)	Risk weight
9	Livestock and dairy	Live cattle; feeder cattle; hog; poultry; lamb; fish; shrimp; milk; whey; eggs; butter; cheese	25%
10	Softs and other agriculturals	Cocoa; arabica coffee; robusta coffee; tea; citrus juice; orange juice; potatoes; sugar; cotton; wool; lumber; pulp; rubber	35%
11	Other commodity	Potash; fertilizer; phosphate rocks (ie various industrial materials) Rare earths; terephthalic acid; flat glass	50%

SBM – Commodity – Buckets



SBM – Commodity – Correlations

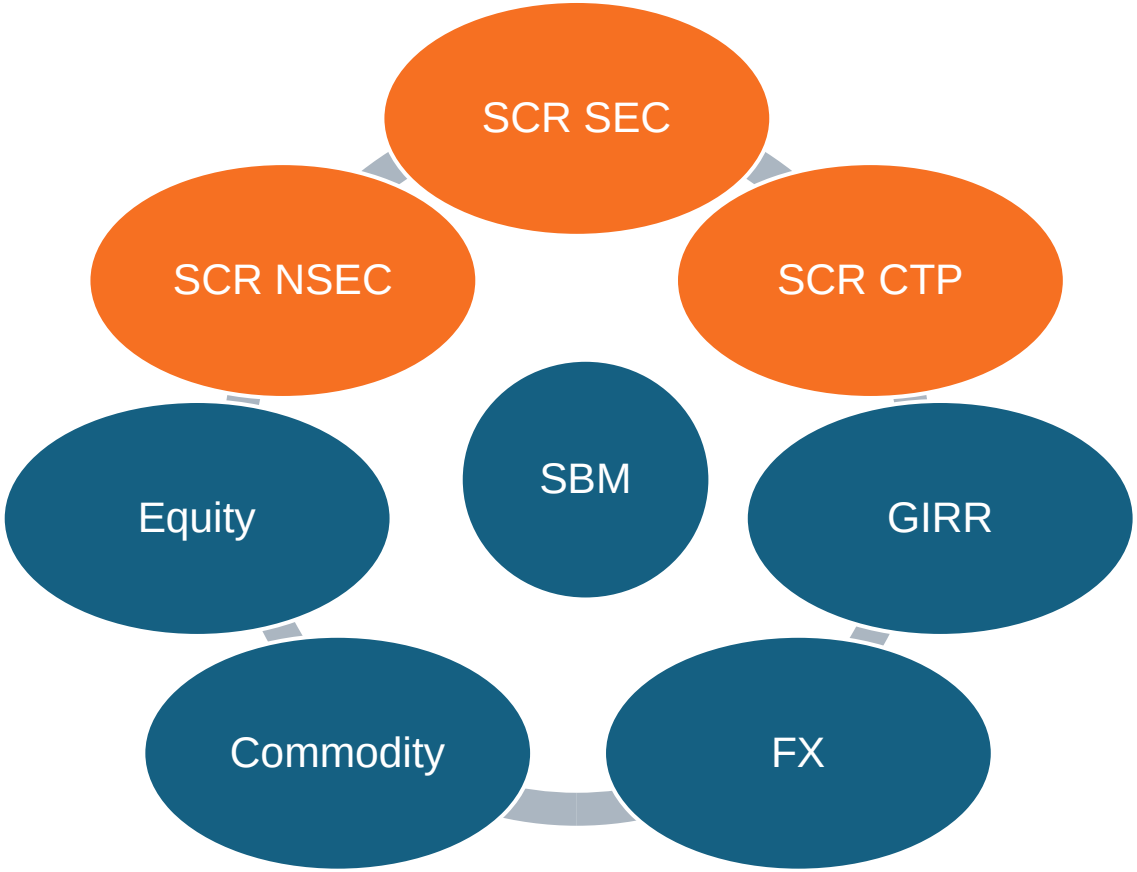
cty	1	cty_i
Tenor	1	99,90%
Basis	1	99,90%

$$\rho_{kl} = \rho_{kl}^{(cty)} \times \rho_{kl}^{(Tenor)} \times \rho_{kl}^{(Basis)}$$

SBM – Commodity – correlation

Bucket number	Commodity bucket	Correlation ($\rho_{kl}^{(cty)}$)
1	Energy - Solid combustibles	55%
2	Energy - Liquid combustibles	95%
3	Energy - Electricity and carbon trading	40%
4	Freight	80%
5	Metals - non-precious	60%
6	Gaseous combustibles	65%
7	Precious metals (including gold)	55%
8	Grains and oilseed	45%
9	Livestock and dairy	15%
10	Softs and other agriculturals	40%
11	Other commodity	15%

SBM



MAR 21 - Delta

$$\Delta GIRR = s_{k,r_t} = \frac{V_i(r_t+0{,}0001, cs_t) - V_i(r_t, cs_t)}{0{,}0001}$$

$$s_{k,cs_t} = \frac{V_i(r_t, cs_t+0{,}0001) - V_i(r_t, cs_t)}{0{,}0001}$$

$$s_k = \frac{V_i(RTS_k+0{,}0001) - V_i(RTS_k)}{0{,}0001}$$

$$s_k = \frac{V_i(1{,}01FX_k) - V_i(FX_k)}{0{,}01}$$

$$s_k = \frac{V_i(1{,}01EQ_k) - V_i(EK_k)}{0{,}01}$$

$$s_k = \frac{V_i(1{,}01CTY_k) - V_i(CTY_k)}{0{,}01}$$

Cupom de dólar

DU	249
VF	R$1.000,00

Delta – GIRR

252

126

R$ 22,30

R$ 914,45

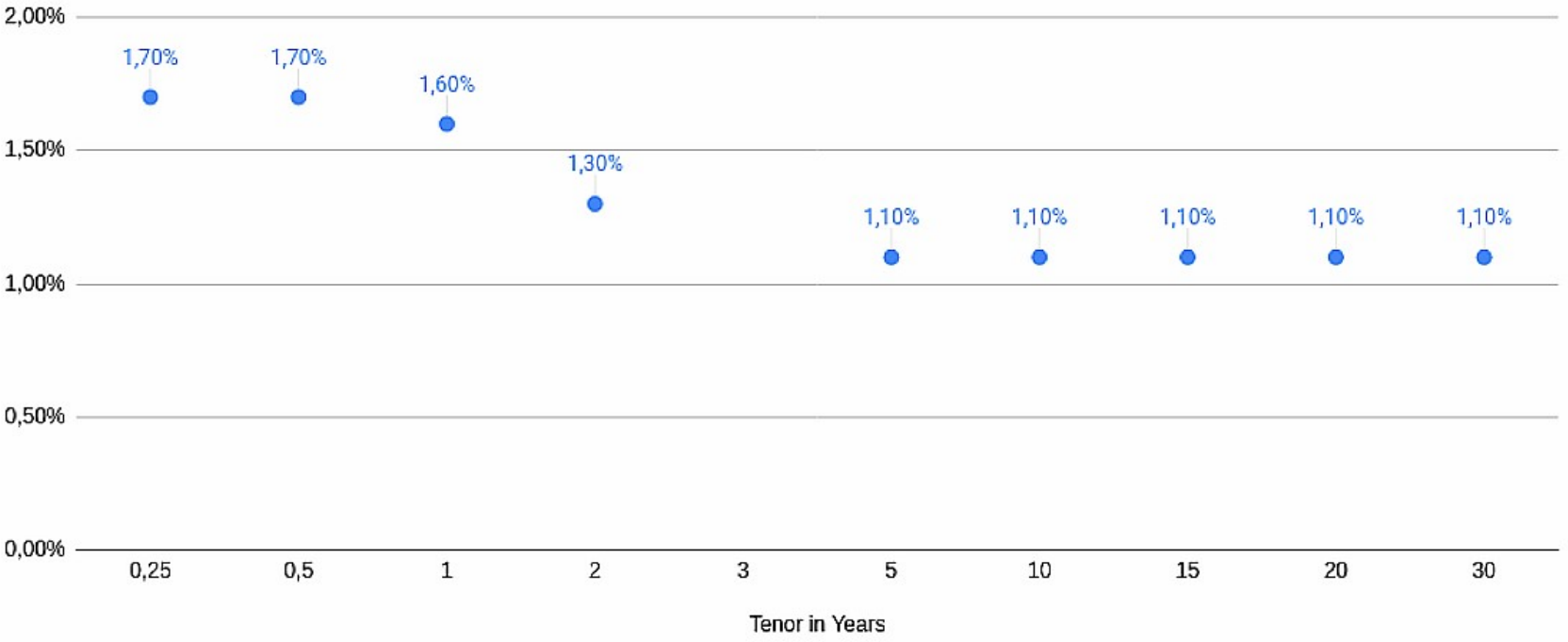
6,84%
a.a

Delta – GIRR

252	R$ -20,63
126	R$ -845,67

GIRR – Buckets

Tenor	0,25 year	0,5 year	1 year	2 year	3 year	5 year	10 year	15 year	20 year	30 year
Risk weight	1,70%	1,70%	1,60%	1,30%	1,20%	1,10%	1,10%	1,10%	1,10%	1,10%



GIRR – Buckets

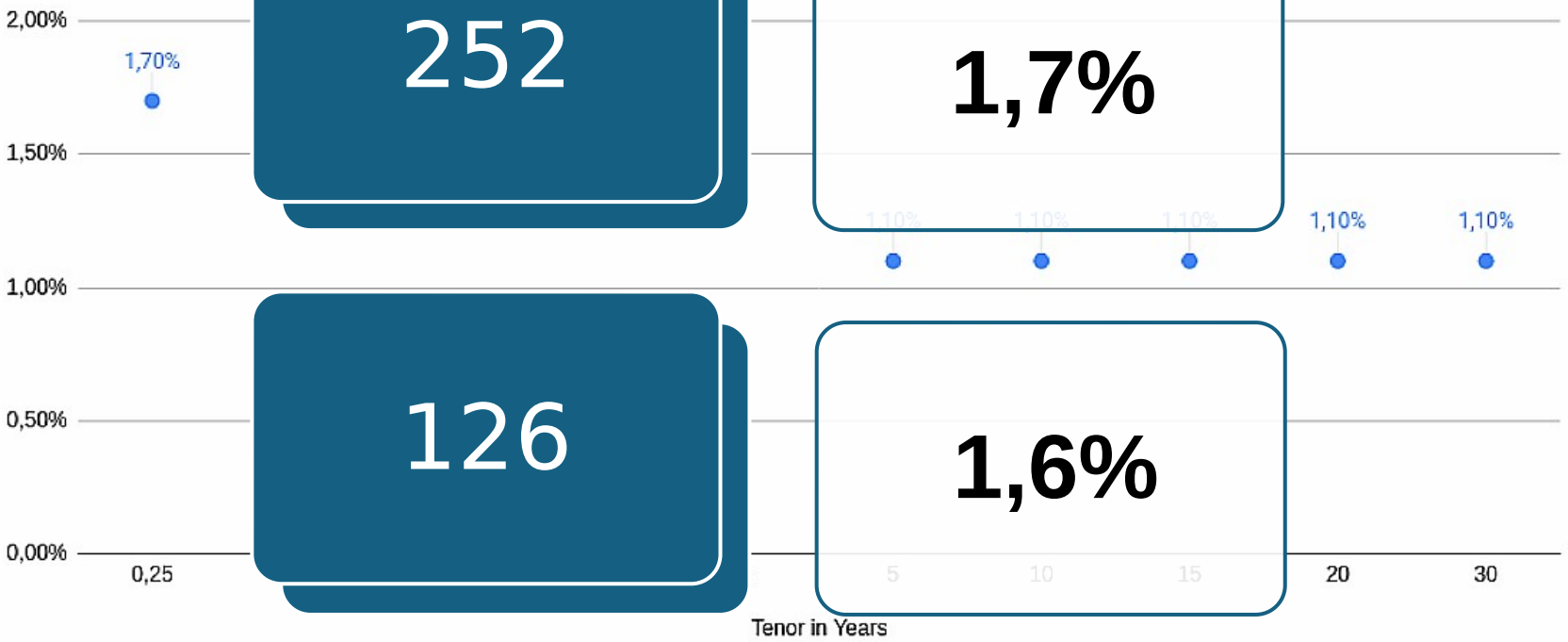
Tenor	0,25 year	0,5 year	1 year	2 year	3 year	5 year	10 year	15 year	20 year	30 year
Risk weight	1,7				1,20%	1,10%	1,10%	1,10%	1,10%	1,10%

252

1,7%

126

1,6%



Delta – GIRR

252	R$ -0,25
126	R$ -9,57

Delta Correlation – GIRR

$$k_b = \sqrt{max(0, \sum_k WS_k^2 + \sum_k \sum_{k \neq l} \rho_{kl} WS_k WS_l}$$

$$k_b = \sqrt{max(0, \sum_k WS_k^2 + \sum_k \sum_{k \neq l} \rho_{kl} WS_k WS_l}$$

Delta GIRR correlations (ρ_{kl}) within the same bucket, with different tenor and same curve — Table 2

	0.25 year	0.5 year	1 year	2 year	3 year	5 year	10 year	15 year	20 year	30 year
0.25 year	100.0%	97.0%	91.4%	81.1%	71.9%	56.6%	40.0%	40.0%	40.0%	40.0%
0.5 year	97.0%	100.0%	97.0%	91.4%	86.1%	76.3%	56.6%	41.9%	40.0%	40.0%
1 year	91.4%	97.0%	100.0%	97.0%	94.2%	88.7%	76.3%	65.7%	56.6%	41.9%
2 year	81.1%	91.4%	97.0%	100.0%	98.5%	95.6%	88.7%	82.3%	76.3%	65.7%
3 year	71.9%	86			100.0%	98.0%	93.2%	88.7%	84.4%	76.3%
5 year	56.6%	76			98.0%	100.0%	97.0%	94.2%	91.4%	86.1%
10 year	40.0%	56			93.2%	97.0%	100.0%	98.5%	97.0%	94.2%
15 year	40.0%	41.9%	65.7%	82.3%	88.7%	94.2%	98.5%	100.0%	99.0%	97.0%
20 year	40.0%	40.0%	56.6%	76.3%	84.4%	91.4%	97.0%	99.0%	100.0%	98.5%
30 year	40.0%	40.0%	41.9%	65.7%	76.3%	86.1%	94.2%	97.0%	98.5%	100.0%

97.0%

Delta Correlation – GIRR

ρ_{kl} 0,97

$$\rho_{kl}^{low} = max(2 \times \rho_{kl} - 100\%; 75\% \times \rho_{kl})$$

0,94

ρ_{kl}^{High} **Multiplied by** $1,25$**, with** ρ_{kl} **and** γ_{bc} **subject to a cap at** 100%**.**

1

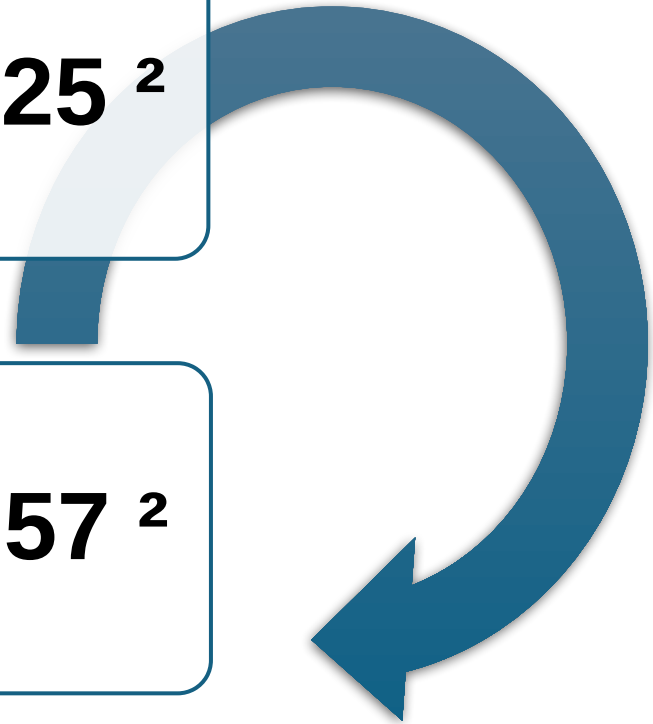
Delta Correlation – GIRR

252

R$ -0,25 ²

126

R$ -9,57 ²



Delta Correlation – GIRR

KB	**Raiz de R$ 91,54**
KB	**9,81**

Delta Correlation – GIRR

KB+	9,82
KB-	9,80

Delta Correlation – GIRR

$$k_b = \sqrt{max(0, \sum_k WS_k^2 + \sum_k \sum_{k \neq l} \rho_{kl} WS_k WS_l}$$

Pré	**99,90%**	Ipca

Delta Correlation Gama – GIRR

$$k_b = \sqrt{max(0, \sum_k WS_k^2 + \sum_k \sum_{k \neq l} \rho_{kl} WS_k WS_l}$$

γ_{bc}

Dólar	50%	Euro

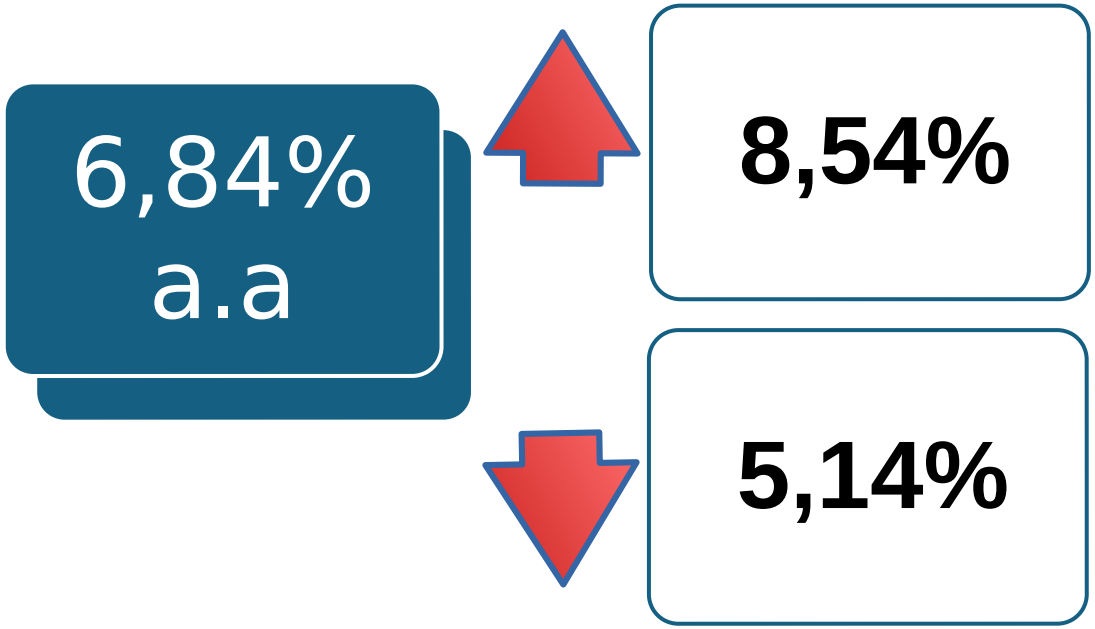
Delta Curvature – GIRR

$$CVR_k^- = -\sum_i \{V_i(x_k^{RW(curvature)^-}) - V_i(x_k) - RW_k^{Curvature} \times s_{ik}\}$$

$$CVR_k^+ = -\sum_i \{V_i(x_k^{RW(curvature)^+}) - V_i(x_k) - RW_k^{Curvature} \times s_{ik}\}$$

Delta Curvature – GIRR

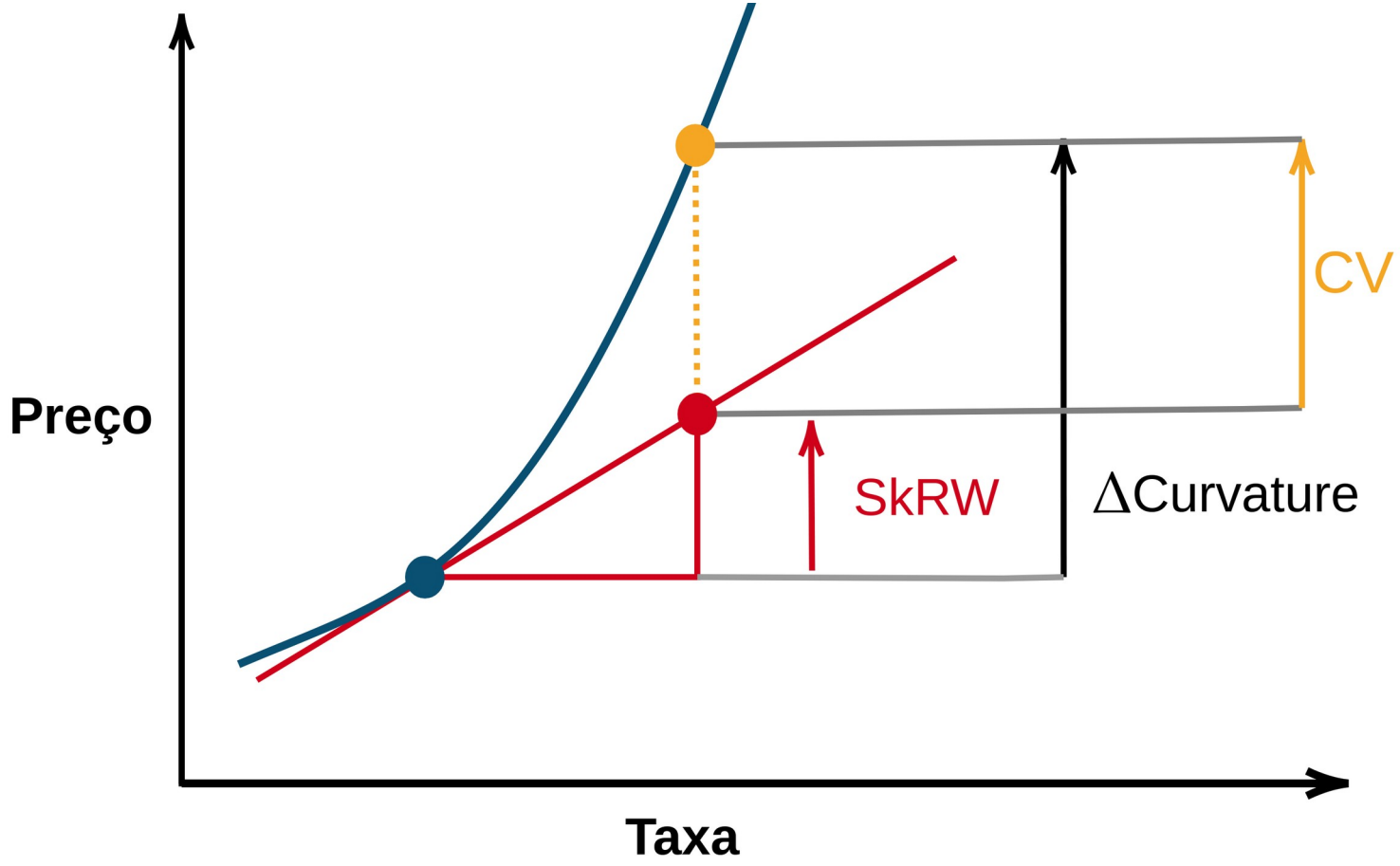
$$V_i\left(X_k^{(RW^{(curvature)}+)}\right) \; and \; V_i\left(X_k^{(RW^{(curvature)}-)}\right)$$



Delta Curvature – GIRR

		126	252
↑	8,54%	R$ 900,3	R$ 21,96
↓	5,14%	R$ 929,06	R$ 22,65

Delta Curvature – GIRR



Delta Curvature – GIRR

CVR UP	**R$ -0,23**
CVR DOWN	**R$ -0,24**

Delta Curvature Correlation – GIRR

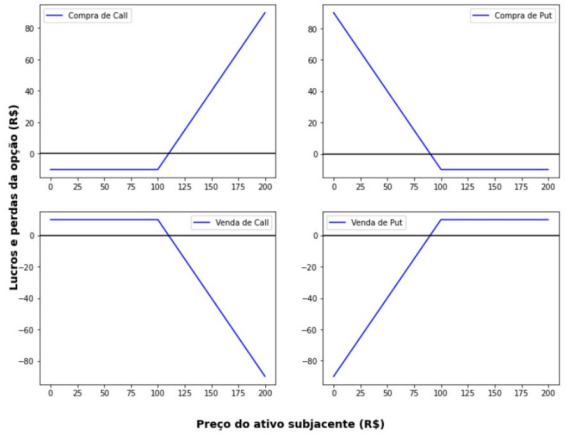
$$K_b^+ = \sqrt{max(0, \sum_k max(CVR_k^+, 0)^2 + \sum_{l \neq k} \sum_k \rho_{kl} CVR_k^+ CVR_l^+ \psi(CVR_k^+, CVR_l^+))}$$

$$K_b^- = \sqrt{max(0, \sum_k max(CVR_k^-, 0)^2 + \sum_{l \neq k} \sum_k \rho_{kl} CVR_k^- CVR_l^- \psi(CVR_k^-, CVR_l^-))}$$

Delta Vega

$$\frac{\partial V_i}{\partial \sigma_i}$$

$$s_k = vega \times implied\ volatility$$



Futuro em reais

DU	240
VF	R$100.000,00

Rwk Vega

126	R$387,87
252	R$8.660,37

Desdobramentos

Lamea 7

CRA

Futuro do futuro

SCO 60

1A

1B

2A

2B

Agradecimentos

Obrigado!

3º Workshop Duxus de Risco

Uma questão de controle.

Élin Duxus

Debate – FRTB – SBM

Fábio Henrique Costa Corrêa
Rodrigo Leme De Oliveira

Q&A