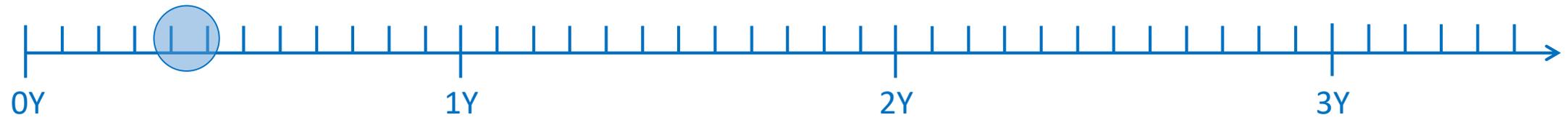


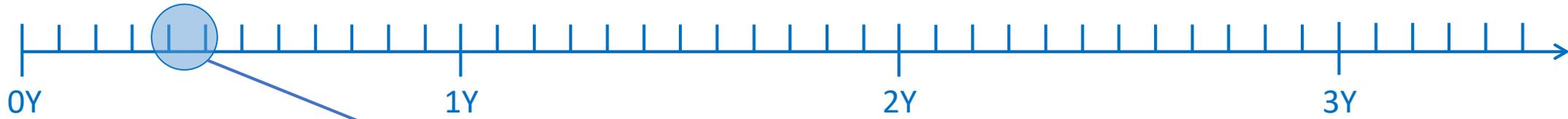
Getting to know each other by... sharing code

Francesco Garue
SimCorp Italiana

Asset and Liability Management



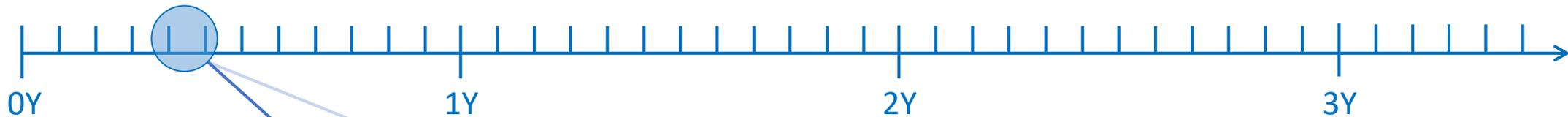
Asset and Liability Management



- Transactions

	Certified rate	Holdings detail	Cash flows	Graphs									
	Per.	Date	Sec. Int. Code	tr tp	Security name	ISIN code	Sofia Asset Kind	Currency	Amount (LC)	Transaction value (clean) (LC)	Transaction par value	P/L realized (LC)	Transaction price
1	JN'19	03/06/2019	128173	CP	PHILIP MORRIS IN 3,125 06/03/33	XS0940697187	Coupon Bond	EURO	124.924	124.924	4.000.000	0	3,12309
2	JN'19	03/06/2019	135112	SC	GENERALI MONEY MKT-A EUR AC...	LU1079698293	Unit Fund Money...	EURO	656.285	656.285	6.598	-191	99,47300
3	JN'19	04/06/2019	135112	AC	GENERALI MONEY MKT-A EUR AC...	LU1079698293	Unit Fund Money...	EURO	-8.750.000	8.750.000	87.963	0	99,47400
4	JN'19	05/06/2019	141431	CP	CEZ AS 3 06/05/28	XS0940293763	Coupon Bond	EURO	38.556	38.556	1.286.000	0	2,99817
5	JN'19	05/06/2019	182878	CP	TENNET HLD BV 2 06/05/34	XS1828037827	Coupon Bond	EURO	99.939	99.939	5.000.000	0	1,99878
6	JN'19	08/06/2019	168442	CP	ESB FINANCE DAC 2,125 06/08/27	XS1239586594	Coupon Bond	EURO	106.185	106.185	5.000.000	0	2,12370
7	JN'19	11/06/2019	133476	CP	ASFINAG 2,75 06/11/32	XS0790003023	Coupon Bond	EURO	268.125	268.125	9.750.000	0	2,75000
8	JN'19	12/06/2019	183331	CP	JPMORGAN CHASE 1.812 06/12/29	XS1835955474	Coupon Bond	EURO	90.545	90.545	5.000.000	0	1,81089
9	JN'19	13/06/2019	164810	CP	TENNET HLD BV 1,875 06/13/36	XS1432384409	Coupon Bond	EURO	18.739	18.739	1.000.000	0	1,87386
10	JN'19	14/06/2019	164817	CP	INDONESIA (REP) 3,75 06/14/28	XS1432493440	Coupon Bond	EURO	187.500	187.500	5.000.000	0	3,75000
11	JN'19	14/06/2019	168441	CP	ESB FINANCE DAC 1,875 06/14/31	XS1428782160	Coupon Bond	EURO	74.954	74.954	4.000.000	0	1,87386
12	JN'19	15/06/2019	181417	CP	FAURECIA 2,625 06/15/25	XS1785467751	Coupon Bond	EURO	51.992	51.992	4.000.000	0	1,29980
13	JN'19	17/06/2019	135112	AC	GENERALI MONEY MKT-A EUR AC...	LU1079698293	Unit Fund Money...	EURO	-3.500.000	3.500.000	35.186	0	99,47100
14	JN'19	18/06/2019	135112	SC	GENERALI MONEY MKT-A EUR AC...	LU1079698293	Unit Fund Money...	EURO	1.323.179	1.323.179	13.302	-330	99,47100
15	JN'19	20/06/2019	135112	SC	GENERALI MONEY MKT-A EUR AC...	LU1079698293	Unit Fund Money...	EURO	1.285.048	1.285.048	12.919	-320	99,47100
16	JN'19	21/06/2019	179337	CP	AMER INTL GROUP 1,875 06/21/27	XS1627602201	Coupon Bond	EURO	56.136	56.136	3.000.000	0	1,87121
17	JN'19	22/06/2019	173527	CP	BELGIAN 0338 1.6 06/22/47	BE0000338476	Coupon Bond	EURO	160.000	160.000	10.000.000	0	1,60000
18	JN'19	22/06/2019	188462	CP	BELGIAN 0348 1.7 06/22/50	BE0000348574	Coupon Bond	EURO	172.282	172.282	27.000.000	0	0,63808
19	JN'19	23/06/2019	147228	CP	2,215% Dt. Pfandbriefbank HYPN...	13100086	Coupon Bond	EURO	221.500	221.500	10.000.000	0	2,21500
20	JN'19	27/06/2019	164917	CP	DZ BANK AG 1.55 06/27/41	XS1438039452	Coupon Bond	EURO	77.481	77.481	5.000.000	0	1,54963
21	JL'19	01/07/2019	178405	RE	NORDEA KREDIT 2 10/01/50	DK0002038744	Coupon Bond	DKK	31.585	31.585	235.872	408	100,00000
22	JL'19	01/07/2019	178405	RE	NORDEA KREDIT 2 10/01/50	DK0002038744	Coupon Bond	DKK	-152	-152	-1.135	-2	100,00000
23	JL'19	01/07/2019	178405	CP	NORDEA KREDIT 2 10/01/50	DK0002038744	Coupon Bond	DKK	27.496	27.496	41.067.964	0	0,50000

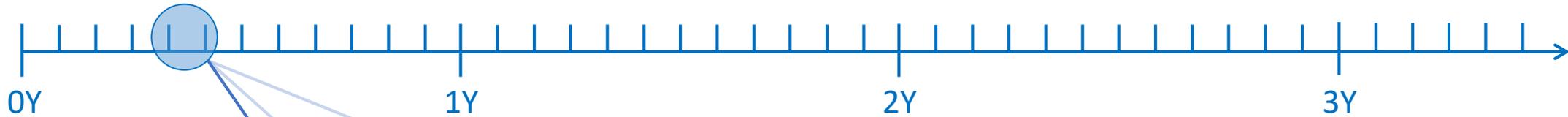
Asset and Liability Management



		Certified rate	Holdings detail	Cash flows	Graphs									
		Per.	Date	Sec. Int. Code	tr tp	Security name	ISIN code	Sofia Asset Kind	Currency	Amount (LC)	Transaction value (clean) (LC)	Transaction par value	P/L realized (LC)	Transaction price
		Certified rate	Holdings detail	Cash flows	Graphs									
	Per.	End Date	Security Internal Code	Asset description	Sofia Asset Kind	Par value End	Book value (LC) End	Historical value (LC) End	Theor/Mkt value (LC) End	P/L total (LC)	Average capital (LC)	Yield in period		
1	JN'19	30/06/2019	128173	PHILIP MORRIS IN 3,125 06/03/33	Coupon Bond	4.000.000,00	4.557.435,53	4.557.435,53	4.740.276,97	9.677,86	4.569.465,61	2,57683		
2	JN'19	30/06/2019	133476	ASFINAG 2,75 06/11/32	Coupon Bond	9.750.000,00	12.182.596,18	12.182.596,18	12.305.531,84	21.345,72	12.273.482,02	2,11599		
3	JN'19	30/06/2019	135112	GENERALI MONEY MKT-A EUR A...	Unit Fund Money...	551.461,44	54.868.099,43	54.868.099,43	54.856.075,58	-841,34	53.435.175,26	-0,01916		
4	JN'19	30/06/2019	141431	CEZ AS 3 06/05/28	Coupon Bond	1.286.000,00	1.472.223,87	1.472.223,87	1.438.957,29	2.915,62	1.478.367,91	2,39950		
5	JN'19	30/06/2019	147228	2,215% Dt. Pfandbriefbank HYP...	Coupon Bond	10.000.000,00	10.000.000,00	10.000.000,00	10.979.690,99	18.193,87	10.155.859,14	2,17962		
6	JN'19	30/06/2019	164810	TENNET HLD BV 1,875 06/13/36	Coupon Bond	1.000.000,00	1.039.073,96	1.039.073,96	1.086.185,17	1.421,69	1.046.642,64	1,65264		
7	JN'19	30/06/2019	164817	INDONESIA (REP) 3,75 06/14/28	Coupon Bond	5.000.000,00	5.724.201,85	5.724.201,85	5.766.207,14	14.590,35	5.805.308,22	3,05782		
8	JN'19	30/06/2019	164917	DZ BANK AG 1.55 06/27/41	Coupon Bond	5.000.000,00	4.999.859,54	4.999.859,54	5.169.155,40	6.316,31	5.063.922,15	1,51757		
9	JN'19	30/06/2019	168441	ESB FINANCE DAC 1,875 06/14/31	Coupon Bond	4.000.000,00	3.940.443,10	3.940.443,10	4.253.909,56	5.494,58	3.973.203,69	1,68254		
10	JN'19	30/06/2019	168442	ESB FINANCE DAC 2,125 06/08/27	Coupon Bond	5.000.000,00	5.406.738,32	5.406.738,32	5.630.537,31	7.798,19	5.433.638,70	1,74612		
11	JN'19	30/06/2019	173527	BELGIAN 0338 1.6 06/22/47	Coupon Bond	10.000.000,00	9.907.988,55	9.907.988,55	10.824.954,93	12.829,66	10.015.989,49	1,55845		
12	JN'19	30/06/2019	179337	AMER INTL GROUP 1,875 06/21/...	Coupon Bond	3.000.000,00	3.022.793,84	3.022.793,84	3.092.193,07	3.703,75	3.059.765,70	1,47274		
13	JN'19	30/06/2019	181417	FAURECIA 2,625 06/15/25	Coupon Bond	4.000.000,00	4.079.707,91	4.079.707,91	4.021.406,07	2.838,76	4.107.197,70	0,84092		
14	JN'19	30/06/2019	182878	TENNET HLD BV 2 06/05/34	Coupon Bond	5.000.000,00	5.216.841,63	5.216.841,63	5.543.269,26	7.536,95	5.232.787,47	1,75240		
15	JN'19	30/06/2019	183331	JPMORGAN CHASE 1.812 06/12/...	Coupon Bond	5.000.000,00	5.045.764,87	5.045.764,87	5.277.393,56	6.444,50	5.079.991,08	1,54347		
16	JN'19	30/06/2019	188462	BELGIAN 0348 1.7 06/22/50	Coupon Bond	27.000.000,00	27.850.970,33	27.850.970,33	29.433.383,83	36.938,87	27.950.404,52	1,60793		
17	JL'19	31/07/2019	128173	PHILIP MORRIS IN 3,125 06/03/33	Coupon Bond	4.000.000,00	4.556.852,24	4.556.852,24	4.732.580,12	9.997,54	4.566.651,09	2,57767		
18	JL'19	31/07/2019	133476	ASFINAG 2,75 06/11/32	Coupon Bond	9.750.000,00	12.181.920,56	12.181.920,56	12.281.274,87	22.034,42	12.196.515,24	2,12714		
19	JL'19	31/07/2019	135112	GENERALI MONEY MKT-A EUR A...	Unit Fund Money...	551.461,44	54.868.099,43	54.868.099,43	54.856.075,58	0,00	54.868.099,43			

- Transactions
- Holdings situation

Asset and Liability Management

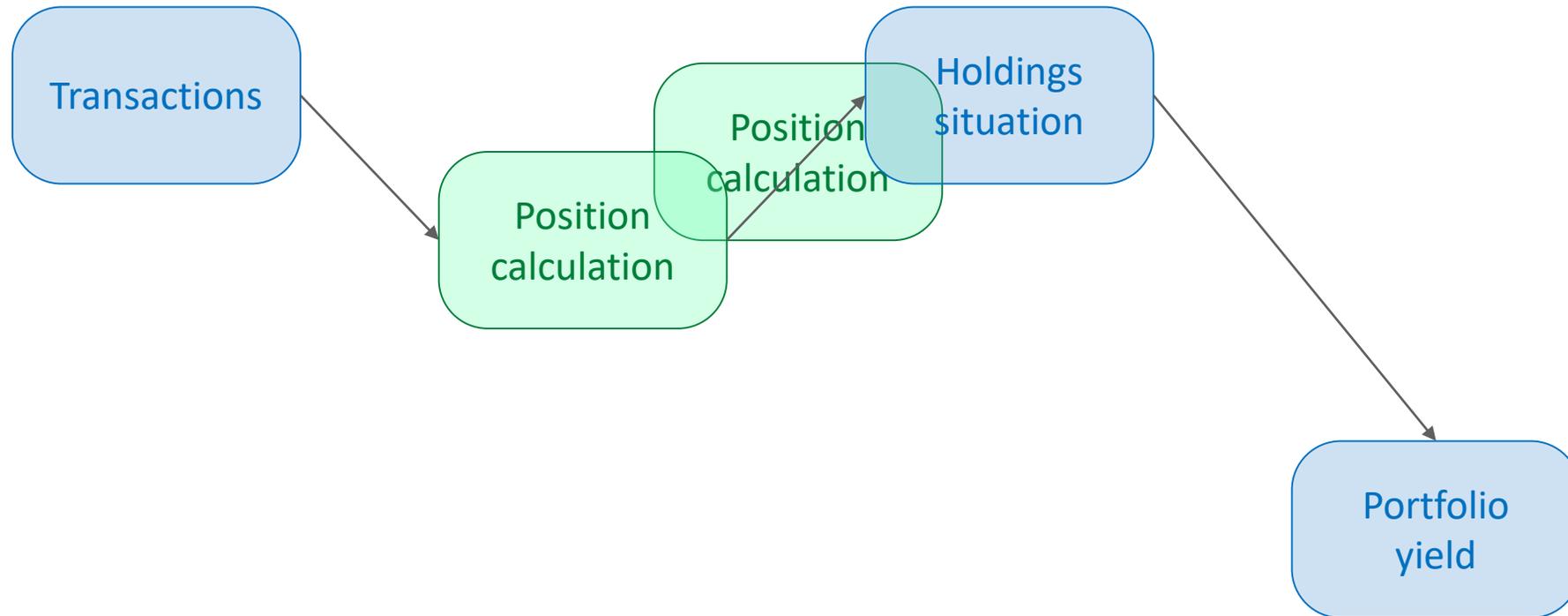


- Transactions
- Holdings situation
- Portfolio yield

Certified rate		Holdings detail		Cash flows		Graphs									
Per.	Date	Sec. Int. Code	tr tp	Security name	ISIN code	Sofia Asset Kind	Currency	Amount (LC)	Transaction value (clean) (LC)	Transaction par value	P/L realized (LC)	Transaction price			
JN'19	03/06/2019	128173	CP	PHILIP MORRIS IN 3,125 06/03/33	XS0940697187	Coupon Bond	EURO	124.924	124.924	4.000.000	0	3,12309			
JN'19	03/06/2019	133112	SC	GENERAL MONEY MKT-A EUR AC...	LU1079698293	Unit Fund Money...	EURO	656.285	656.285	6.598	-191	99,47300			
JN'19	04/06/2019	133112	AC	GENERAL MONEY MKT-A EUR AC...	LU1079698293	Par Value	EURO	1.000.000	1.000.000	87.963	0	99,47400			
Per/JN'19	03/06/2019	133112	CP	CEZ description	LU40293763	Coupon Bond	EURO	556.556	556.556	1.000.000	0	Average capital	Yield	in period	
JN'19	19/03/2019	128173	CP	PHILIP MORRIS IN 3,125 06/03/33	XS0940697187	Coupon Bond	EURO	4.557.435,53	4.740.276,97	9.677,860	4.569.465,61	2,57968			
JN'19	19/03/2019	133476	CP	ASFINAG 6,750 06/03/33	XS0940697187	Coupon Bond	EURO	9.750.000,00	12.182.596,18	29.345,720	12.273.482,02	2,11599			
JN'19	19/03/2019	135112	SC	GENERAL MONEY MKT-A EUR A...	LU1079698293	Unit Fund Money...	EURO	54.868.099,49	54.856.075,58	9.750,000	53.435.175,26	-0,91916			
JN'19	19/03/2019	141431	CP	CEZ AS 8,06 05/08 CHASE 1,812 06/03/33	XS0940697187	Coupon Bond	EURO	1.472.823,87	1.438.057,29	8.815,620	1.478.367,91	2,39959			
												5,859,14	2,17962		
Certified rate		Holdings detail		Cash flows		Graphs									
Per.	Total income	Average capital total assets	Monthly certified rate	Total income (annual)	Average capital total assets (annual)	Annual certified rate	Coupon (incl. simulated assets)	Estimated dividends	Redemptions	Purchases	Sales (incl. simul. assets)				
JN'19	3.228.601	2.484.739.324	1,58090	122.925.429	2.328.457.224	5,27927	1.748.859	0	0	-12.250.000	3.264.512	3,922,15	1,51757		
JL'19	3.337.517	2.480.773.619	1,58405	118.695.960	2.344.673.346	5,06237	3.925.999	0	139.384	0	-242.068	3,203,69	99,48254		
AU'19	3.326.048	2.484.047.337	1,57652	118.093.094	2.354.008.010	5,01668	1.312.766	0	0	0	-169.779.584	3,638,70	99,74612		
SE'19	3.225.270	2.487.379.981	1,57760	116.009.521	2.369.146.150	4,89668	1.912.825	0	0	0	0	5,989,49	99,45845		
OC'19	3.333.614	2.490.476.883	1,57603	115.328.373	2.372.728.662	4,86058	2.081.002	0	139.885	0	0	9,768,70	1,47274		
NO'19	3.211.967	2.493.261.105	1,56738	114.726.592	2.380.417.875	4,81960	2.772.325	0	0	0	0	7,197,70	0,84092		
DE'19	3.333.694	2.496.289.238	1,57240	61.944.844	1.606.213.199	3,85658	2.944.692	0	0	0	0	2,787,47	0,75240		
JA'20	3.335.619	2.499.089.288	1,57154	58.229.298	2.468.319.252	2,35907	5.410.832	0	140.584	-12.800.513	-72.163.315	9,991,08	1,54947		
FE'20	3.113.160	2.502.696.894	1,56563	59.307.093	2.463.662.167	2,40727	4.264.163	0	0	0	0	0,404,52	1,60793		
MR'20	10.046.787	2.504.837.397	4,72257	46.452.288	2.517.072.153	1,84549	6.618.821	6.713.223	0	-17.450.251	-9.412.203	6,653,09	102,57767		
AP'20	3.137.286	2.514.975.125	1,51772	46.210.118	2.509.877.621	1,84113	2.509.737	0	3.141.287	0	0	6,515,24	102,02704		
MA'20	3.305.176	2.518.598.489	1,54514	45.934.740	2.472.687.220	1,85769	6.218.049	0	0	-11.847.789	0	8,090,43	0,50000		

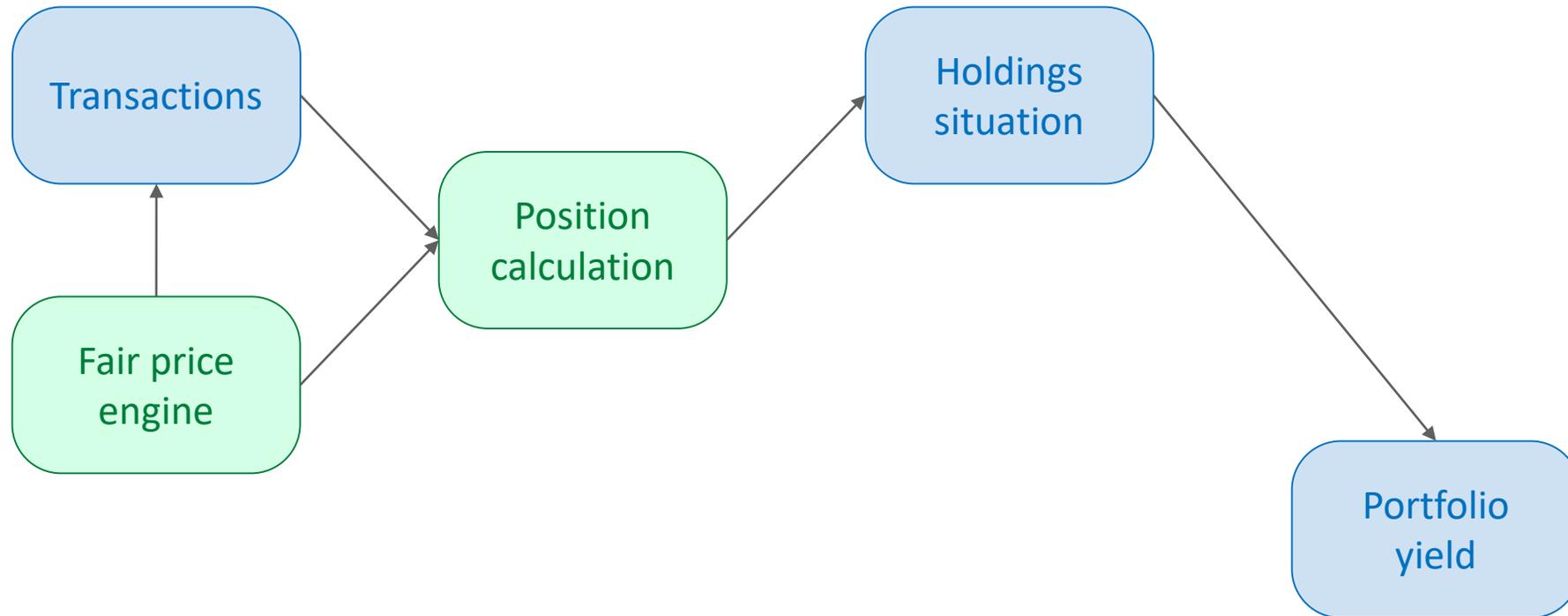
Asset and Liability Management

A **quite** simple scheme



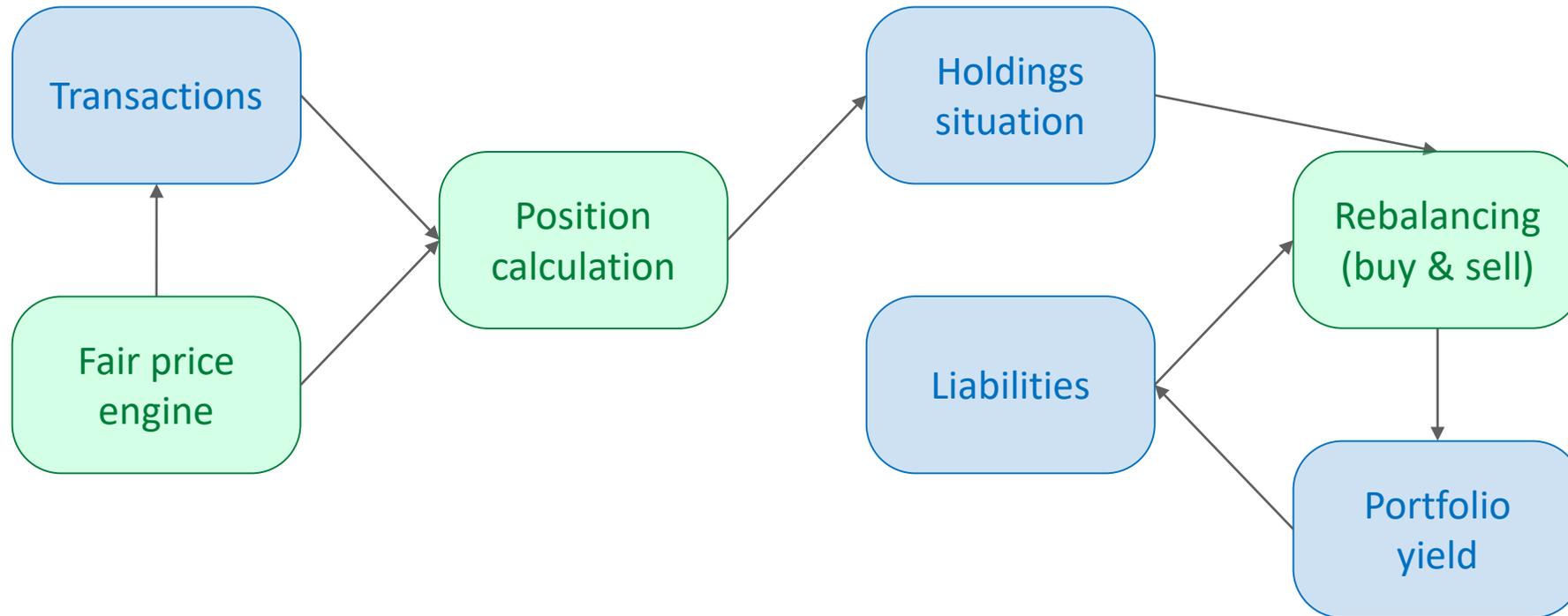
Asset and Liability Management

A **quite** simple scheme



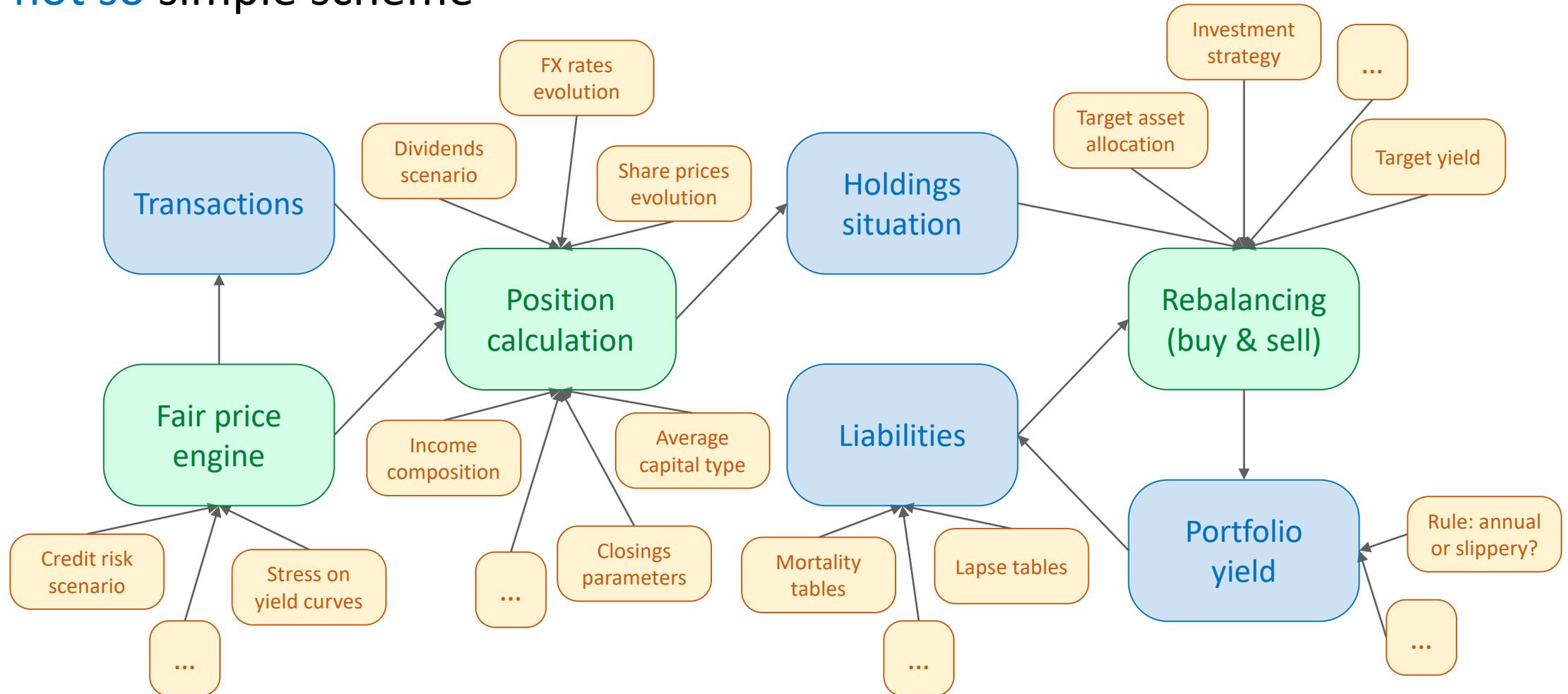
Asset and Liability Management

A **quite** simple scheme



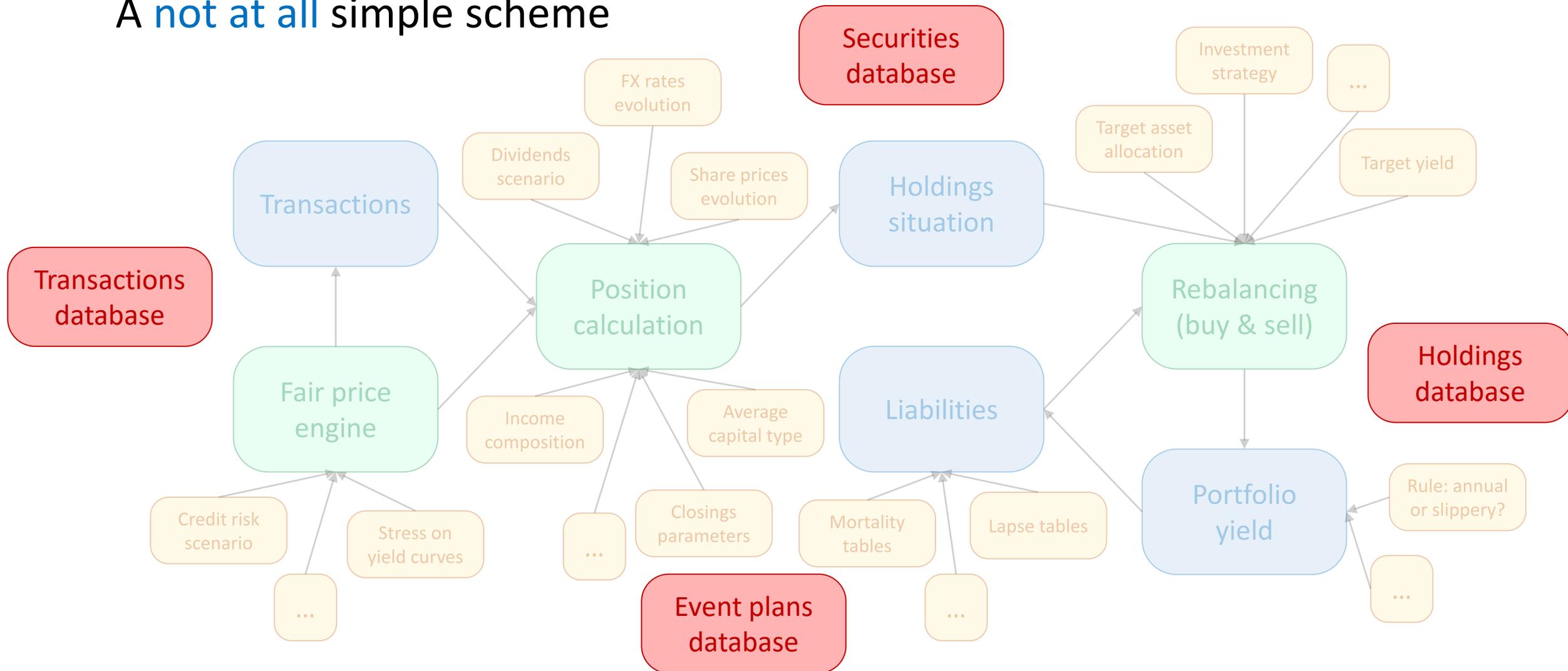
Asset and Liability Management

A **not so** simple scheme



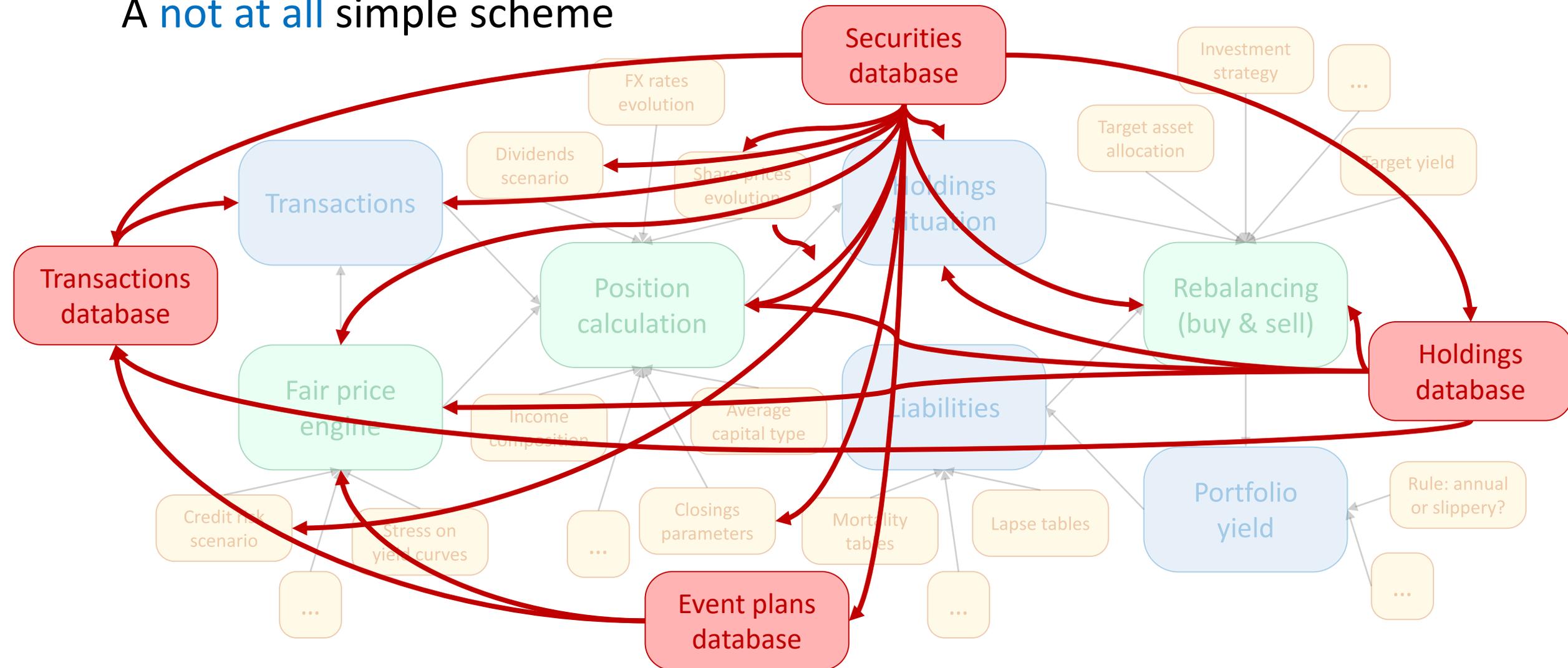
Asset and Liability Management

A **not at all** simple scheme



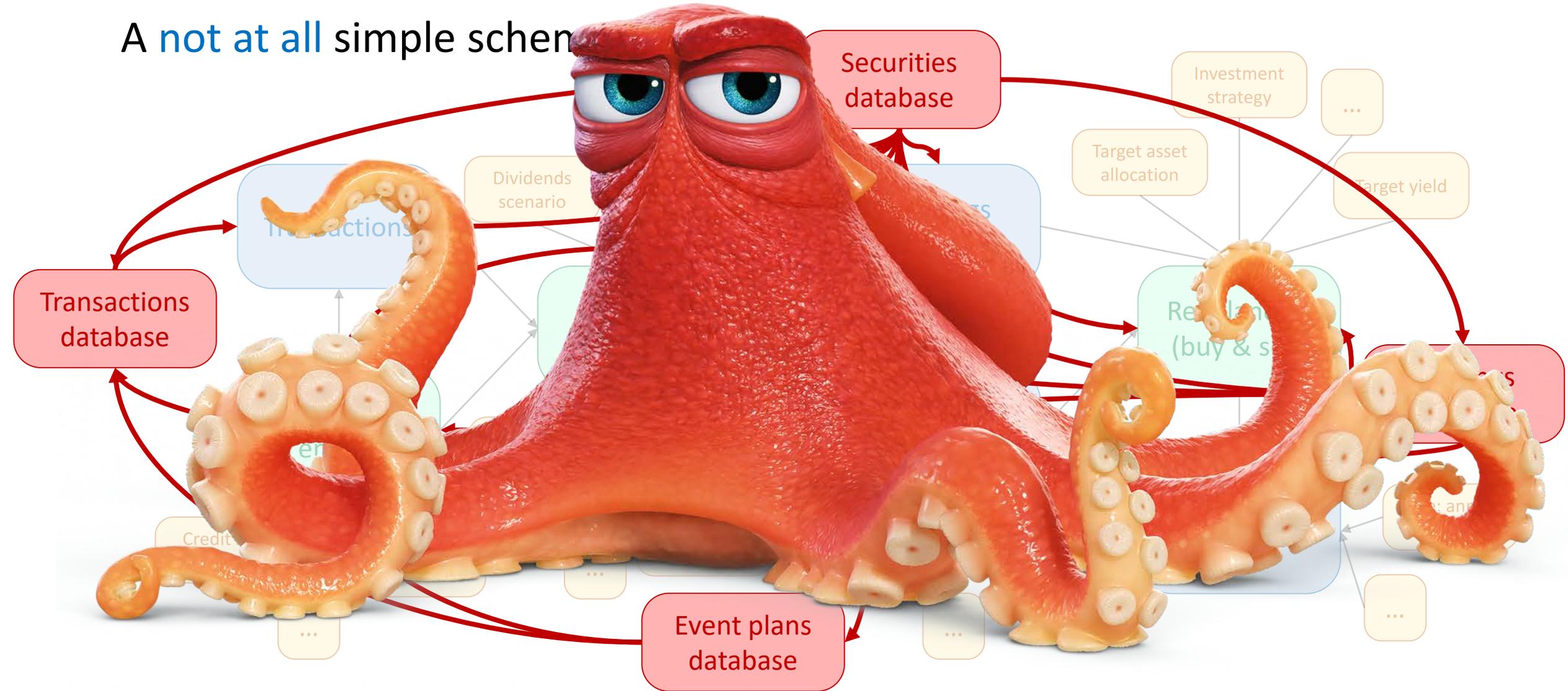
Asset and Liability Management

A **not at all** simple scheme



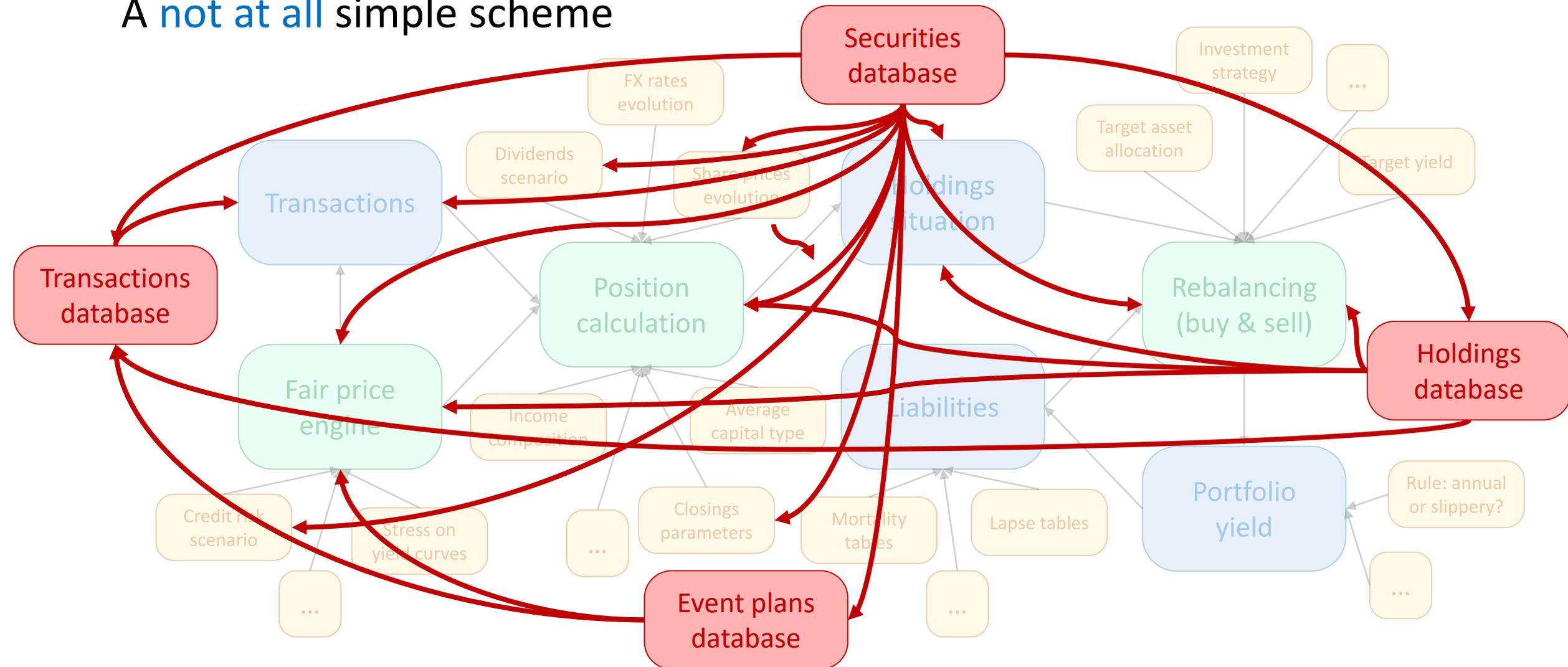
Asset and Liability Management

A **not at all** simple scheme



Asset and Liability Management

A **not at all** simple scheme



The new adventure

The game

- SimCorp was aiming to build Dimension's own ALM module
- Sofia had already learnt the ropes of ALM over the years
- So... We decided to go **green** and **reuse** some Sofia code!



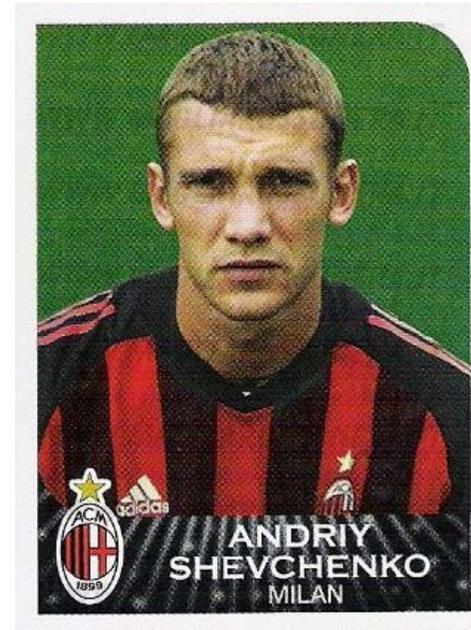
The new adventure

The players

- 2 scrums in Copenhagen
- 2 scrums in Kiev
- 3 programmers in Milan



Denmark



Ukraine



Italy

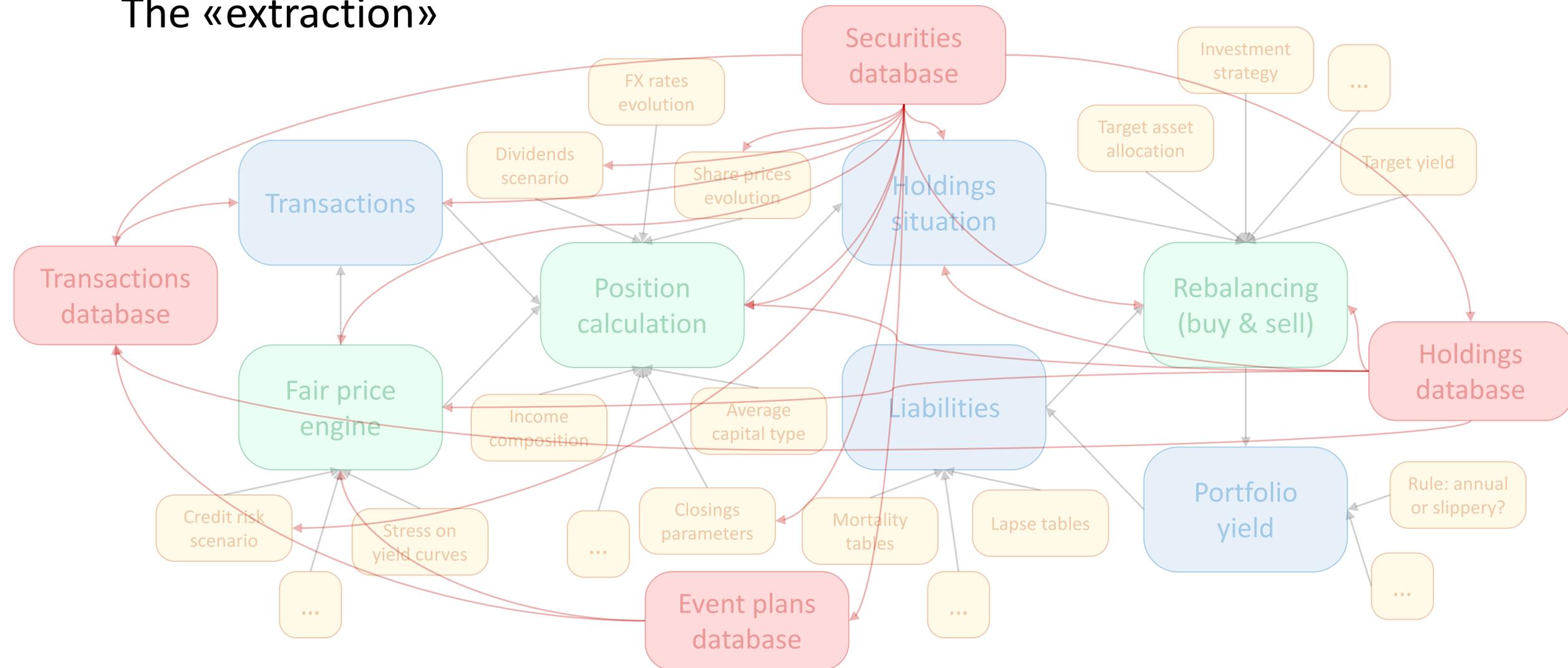
The new adventure

The players



The Rebalancing Component

The «extraction»



The Rebalancing Component

The «extraction»

**Rebalancing
(buy & sell)**

The Rebalancing Component

What it does

- Reads transactions and holdings situation
- Sums all cash flows to get the total liquidity
- Buys and sells to achieve the target asset allocation
- Computes fair prices and cash flows of all new assets bought
- Iterates for each period

Rebalancing
(buy & sell)

The Rebalancing Component

What it does, **what it needs to do it**

Rebalancing
(buy & sell)

- Reads transactions and holdings situation
 - Sums all cash flows to get the total liquidity
 - Buys and sells to achieve the target asset allocation
 - Computes fair prices and cash flows of all new assets bought
 - Iterates for each period
- Transactions and holdings situation stored in a «comfortable» data structure
 - Asset allocation classes
 - Asset allocation target weights
 - Fictitious assets information
 - Yield curves

The Rebalancing Component

The «extraction»: a few bumps along the way

Rebalancing
(buy & sell)

- Remove dependency on system-specific databases or tables
- Avoid reading and writing files for intermediate results
- Translate, map, adapt

The Rebalancing Component

Rebalancing
(buy & sell)

The «extraction»: a few bumps along the way

- Remove dependency on system-specific databases or tables
- Avoid reading and writing files for intermediate results
- Translate, map, adapt
- Refactor, refactor, refactor

«No guts, no glory...»



The Rebalancing Component

The architecture

Dimension

Position results 

Asset allocation
classes and weights,
investment strategy, 
yield curves

Rebalancing results 

Rebalancing

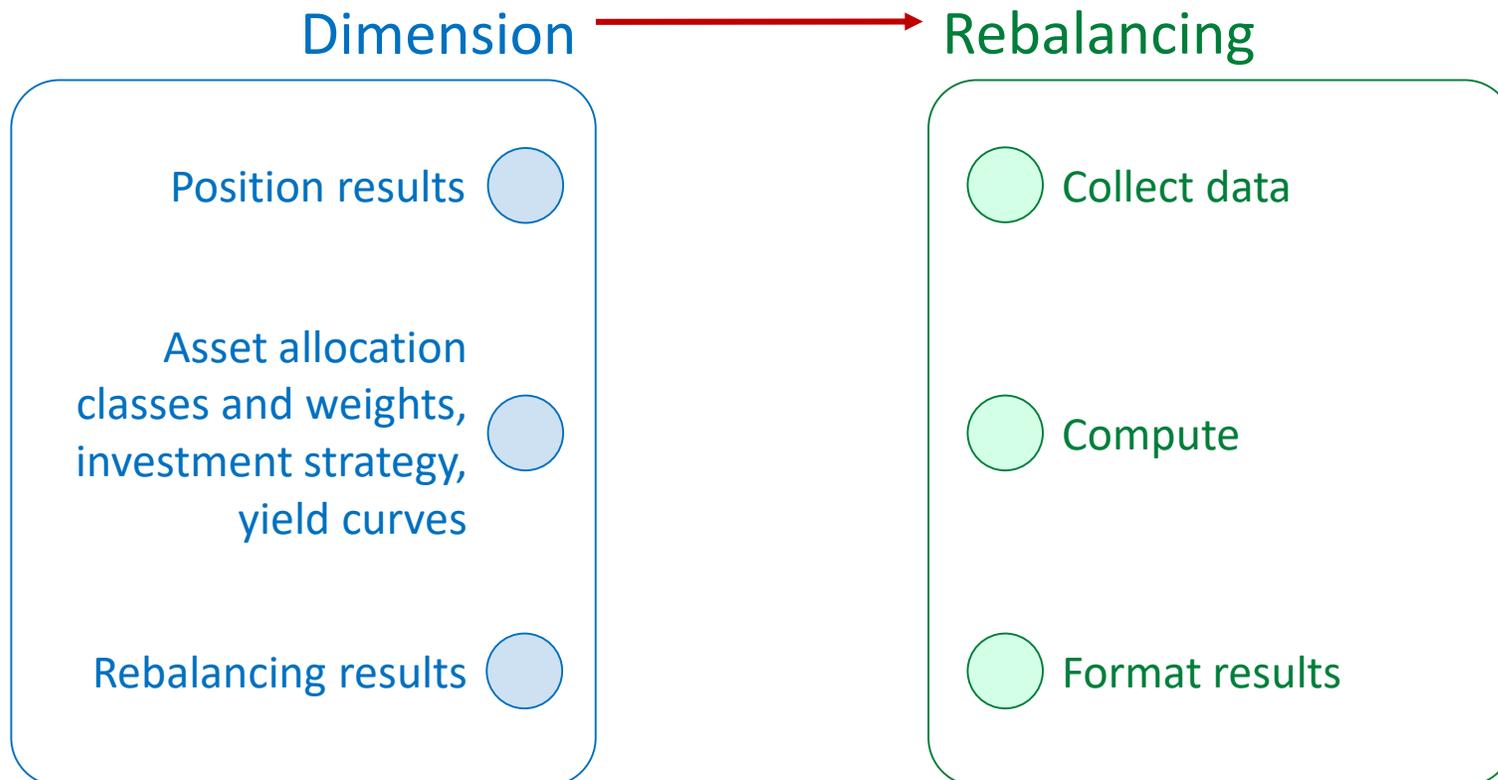
 Collect data

 Compute

 Format results

The Rebalancing Component

The architecture

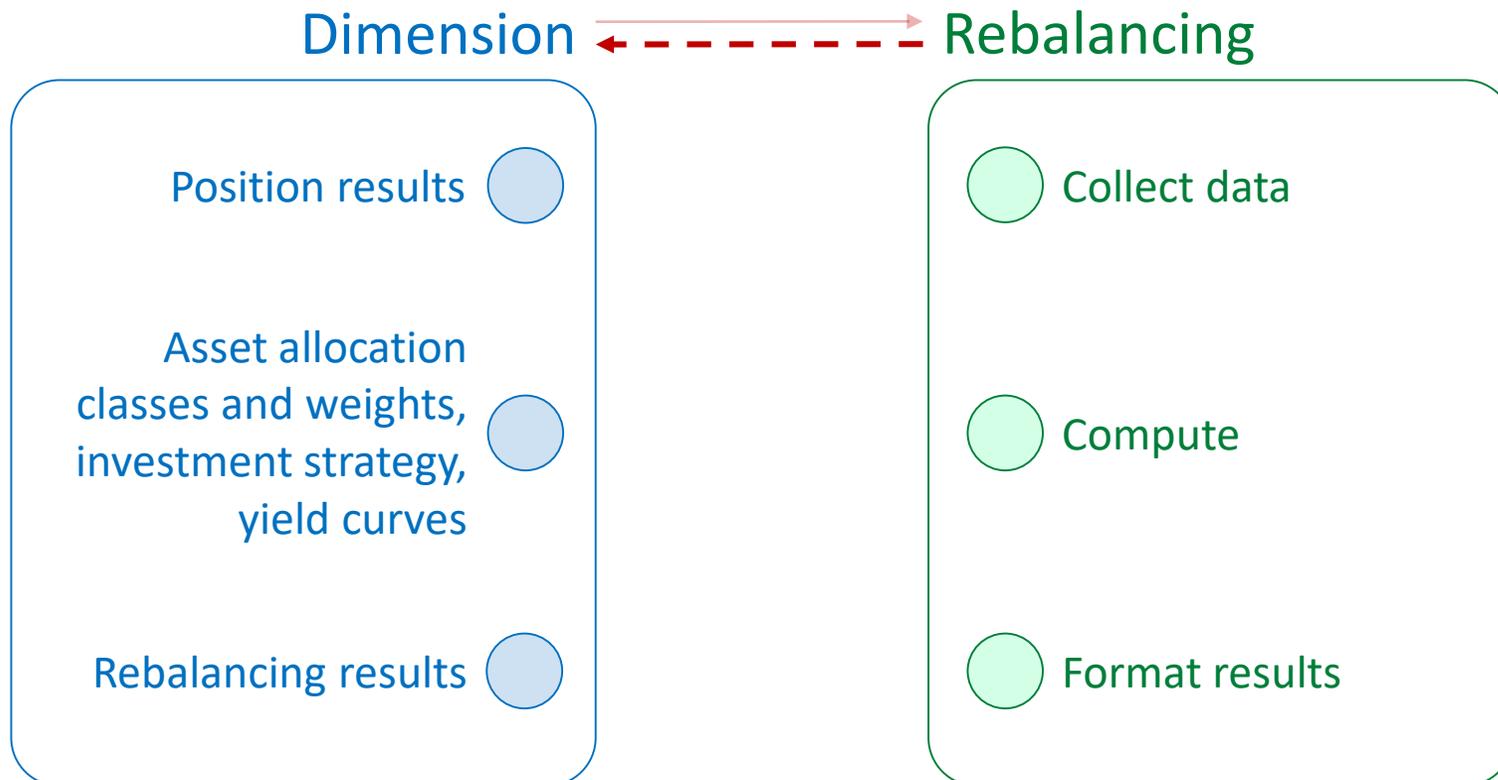


D: «Compute this!»

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The Rebalancing Component

The architecture

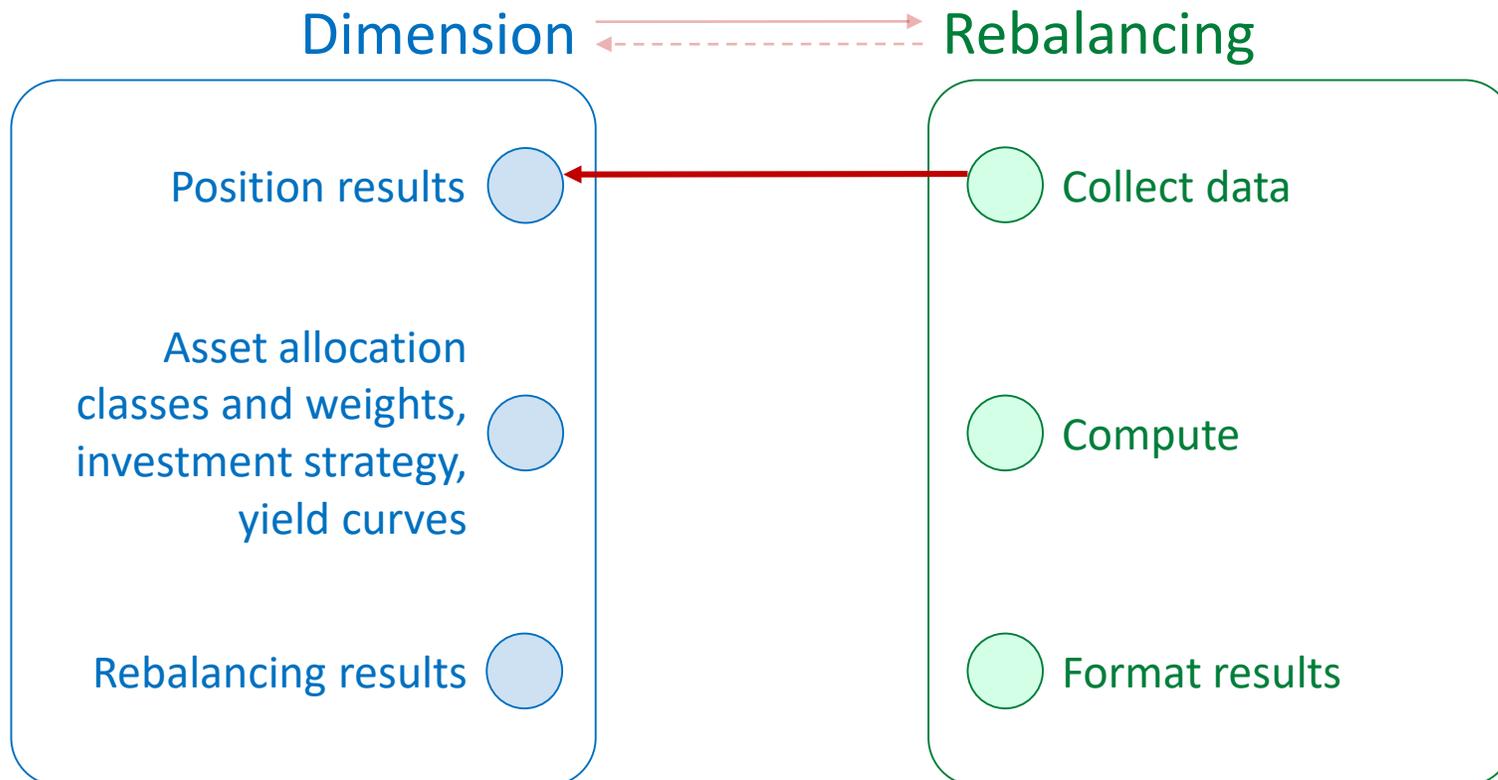


R: «Ok, work in progress»

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    "2019-08-23 10:01:28Z [2] Querying: Positi...",
    "2019-08-23 10:01:28Z [2] ... batch receiv...",
    "2019-08-23 10:01:28Z [2] ... done",
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  ]
}
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The Rebalancing Component

The architecture



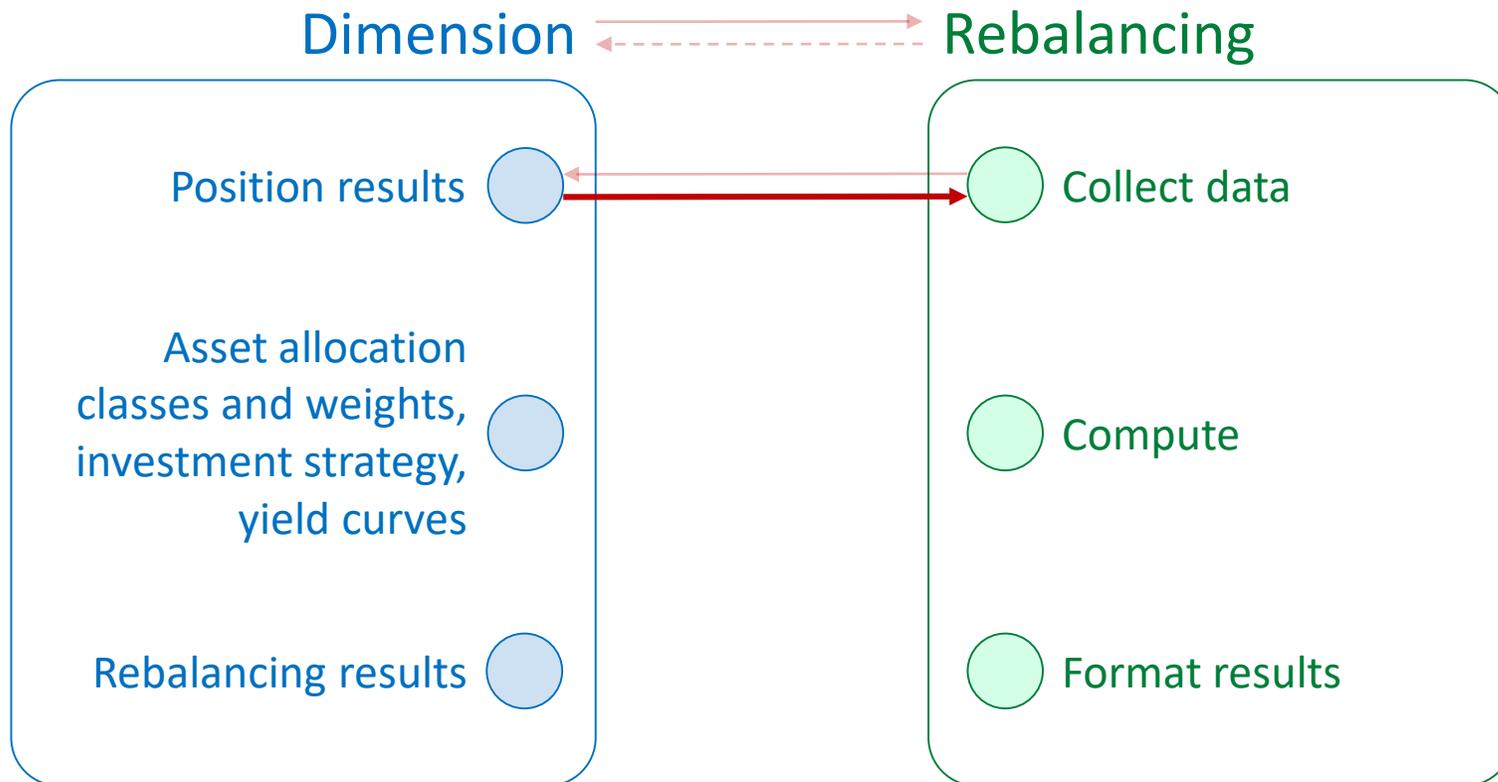
R: «Fetch me some data»

URL:

```
https://dk01sv8700.scdom.net:44300/odata/PositionResult?$filter=(PositionCalculationId eq 'NTTB D_FRST SMALL' and date(AnalysisDate) ge 2019-06-30 and date(AnalysisDate) le 2021-12-31 and AccountingFramework eq 'MAIN' and PricingProfile eq 'KYS PRICE' and PositionType eq 'Original')&$select=AnalysisDate,AccountingFramework,ExternalId,InstrumentType,Portfolio,SecurityId,Transactions,Nominal,AccruedInterestQC,AccruedInterestPC,AccountingAnalytics,CleanValueQC,CleanValuePC
```

The Rebalancing Component

The architecture



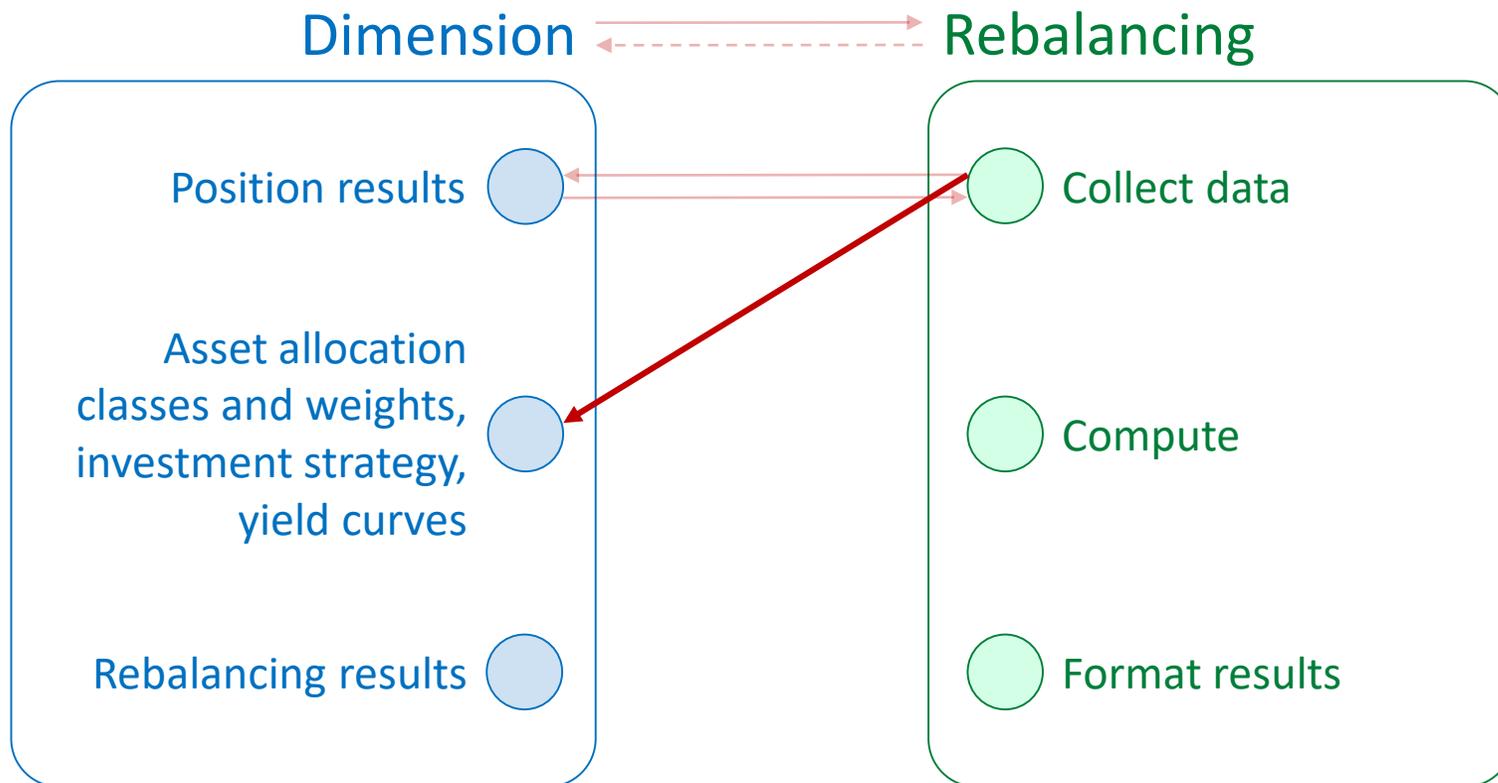
D: «Help yourself!»

JSON:

```
[
  {
    "AccruedInterestPC": 0,
    "AccruedInterestQC": 0,
    "AnalysisDate": "2020-08-31T02:00:00+02:00...",
    "CleanValuePC": 21000,
    "CleanValueQC": 21000,
    "ExternalId": "05f9a0a9-df36-47f4-afb7-94d...",
    "InstrumentType": "Equity",
    "Nominal": 1000,
    "Portfolio": "D_GI SMAL1",
    "SecurityId": "KYS EUR 01",
    "Transactions": [
      {
        "BankAccount": "D_GI BA1",
        "BusinessTransactionCode": "DividendPm...",
        "ElementaryTransactionCode": "Dividend...",
        "Nominal": 0,
        "NominalBasis": 1000,
        "PaymentAmountPC": 12000,
        "PaymentAmountQC": 12000,
        "PaymentDate": "2020-08-20T02:00:00+02...",
        "TradeDate": "2020-08-20T02:00:00+02:0..."
      }
    ]
  },
  "AccountingAnalytics": {
    ...
  }
]
```

The Rebalancing Component

The architecture



R: «Fetch me more data»

URL:

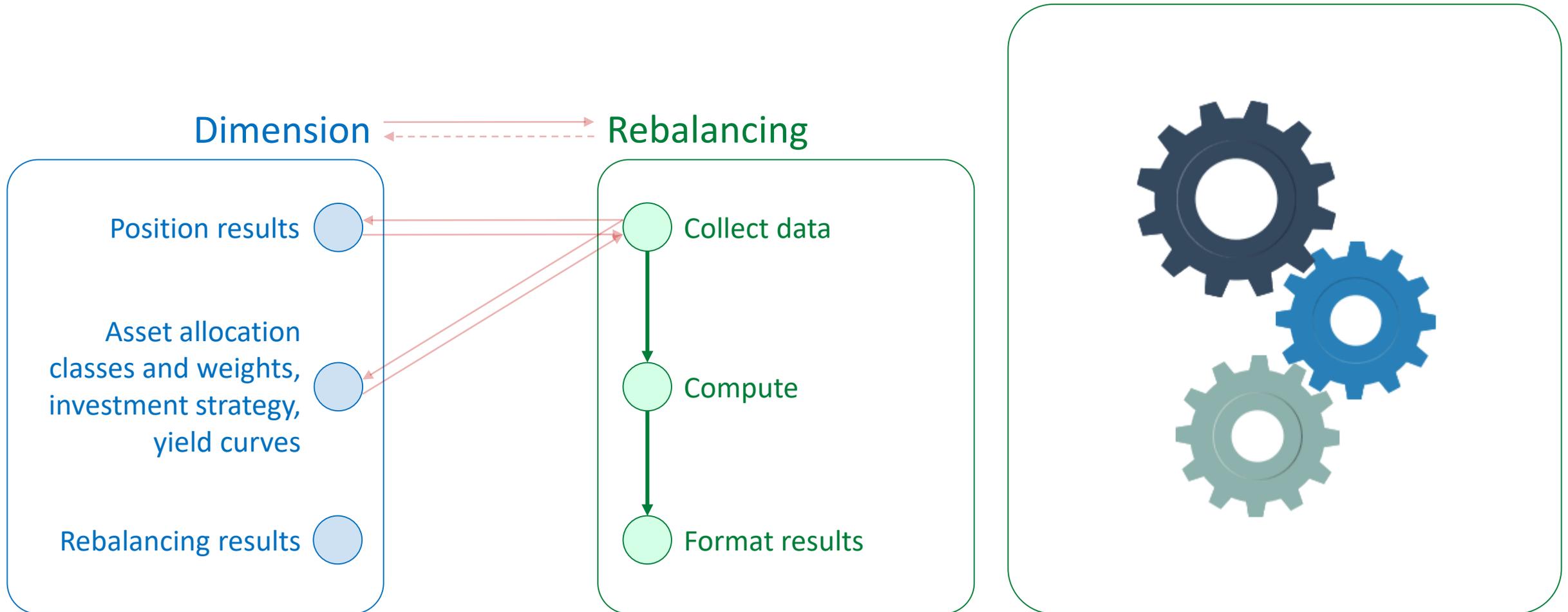
```
https://dk01sv8700.scdom.net:44300/odata/  
GetTargetAllocation
```

JSON BODY:

```
{  
  "argument": {  
    "FromDate": "2019-07-31",  
    "TargetAllocationId": "NTTB D_GI SMALL2"  
  }  
}
```

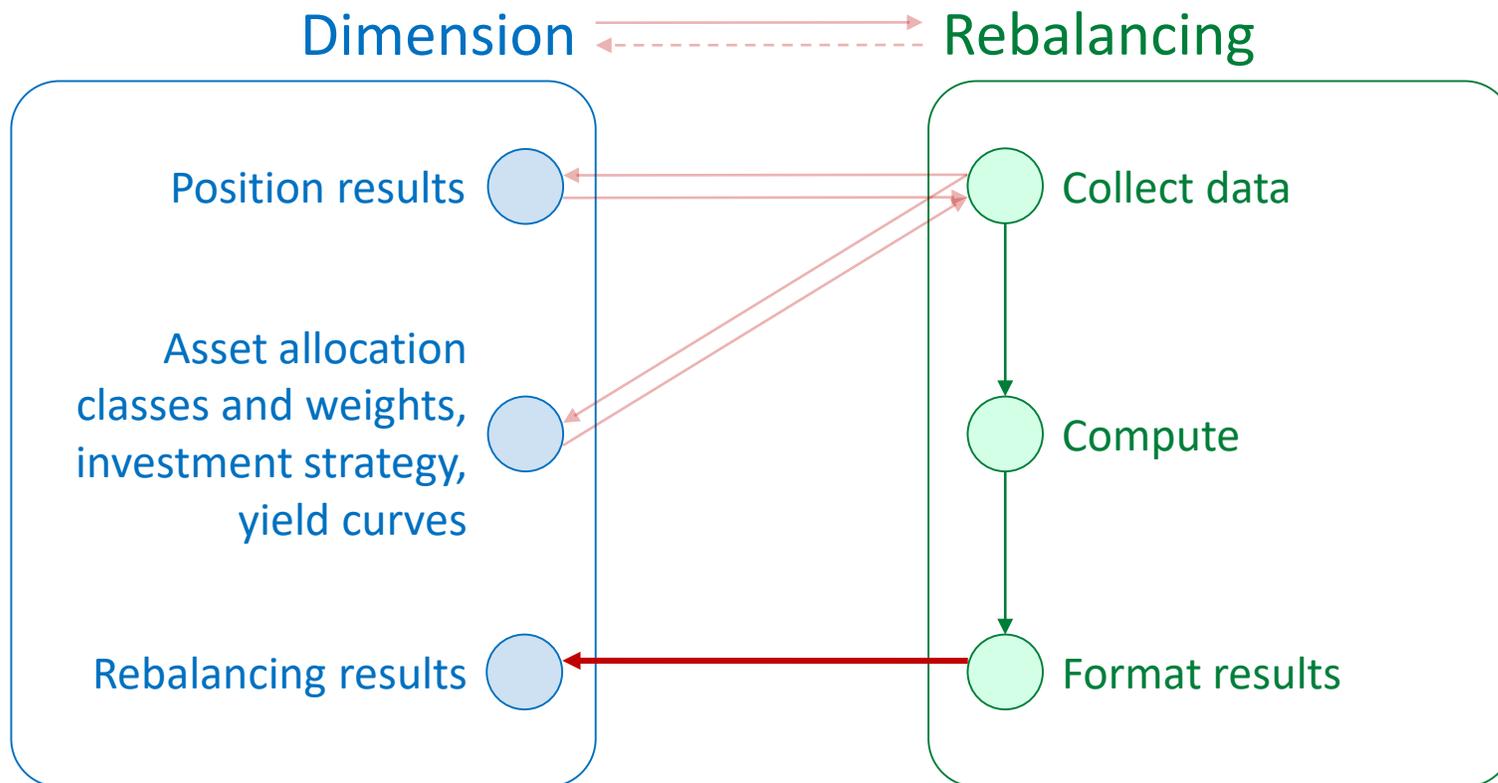

The Rebalancing Component

The architecture



The Rebalancing Component

The architecture



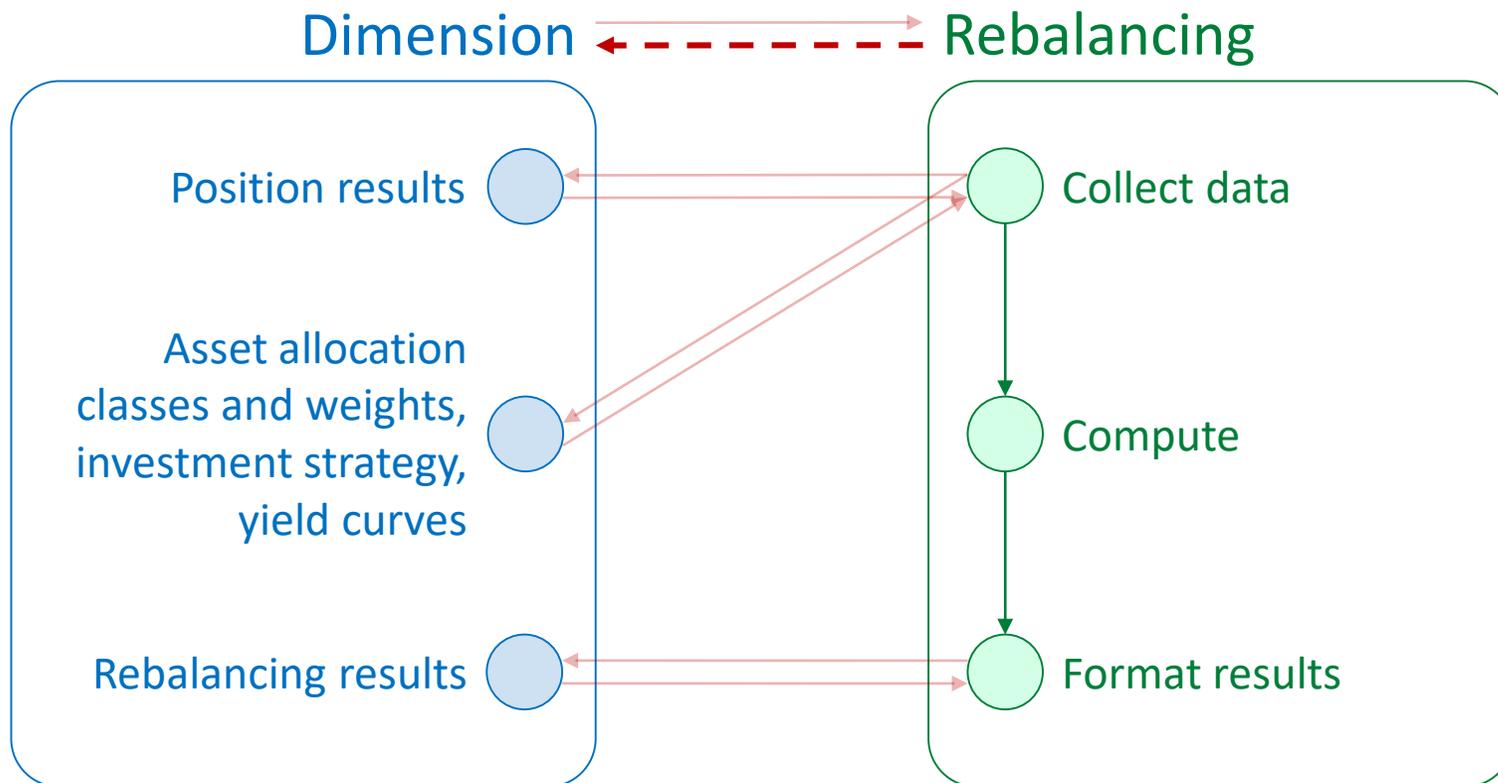
R: «Here's the result!»

JSON:

```
{
  "Portfolio": "",
  "PortfolioGroup": "",
  "PositionCalculationId": "NTTB D_FRST SMALL",
  "WhatIfLabel": "NTTB 20_8",
  "Simulations": [
    {
      "TradeDate": "2019-07-31",
      "Transactions": [
        {
          "BusinessTransactionCode": "Buy",
          "FictitiousSecurityCode": 1000001,
          "Nominal": 9142,
          "RepresentativeSecurityKey": 3968,
          "ExternalId": ""
        }
      ]
    },
    {
      "TradeDate": "2019-08-31",
      "Transactions": [
        {
          "BusinessTransactionCode": "Buy",
          "FictitiousSecurityCode": 1000002,
          "Nominal": 11000,
          "RepresentativeSecurityKey": 3968
        }
      ]
    }
  ]
}
```


The Rebalancing Component

The architecture



D: «I'm done!»

```
JSON:
{
  "done": true,
  "elapsed": 3719,
  "reqid": "3ZCKKYMYPYWEXEXQPG4+4LTMW2M",
  "status": "ok",
  "output": "https://dk01sv8700.scdom.net:4430...",
  "result": {
    "response": {
      "IsOk": true,
      "Message": null
    },
    "statusCode": "OK"
  },
  "log": [
    "2019-08-23 10:01:26Z [2] Checking argumen...",
    "2019-08-23 10:01:26Z [2] Starting",
    "2019-08-23 10:01:26Z [2] Defining paramet...",
    "2019-08-23 10:01:28Z [2] Querying: Positi...",
    "2019-08-23 10:01:28Z [2] ... batch receiv...",
    "2019-08-23 10:01:28Z [2] ... done",
    "2019-08-23 10:01:28Z [2] Converting the p...",
    "2019-08-23 10:01:28Z [2] Defining paramet...",
    "2019-08-23 10:01:28Z [2] Start the comput...",
    "2019-08-23 10:01:29Z [2] Formatting the r...",
    "2019-08-23 10:01:31Z [2] Result sent to: ..."
  ]
}
```

The Rebalancing Component

Demo time...