SUMMARY OF THE EXAMPLE RUN

The purpose of this script is to show what the example run does. This script has 2 main sections:

- What inputs are used
- What the run shows

In [30]:
```
import pandas as pd
from ImportData import import_SWEiopa
import matplotlib.pyplot as plt
import matplotlib.ticker as mtick
```

What inputs are used

The OSEM model uses two portfolios. The first one with a small portfolio of equities and the second one with a small portfolio of corporate bonds.

In [31]:
```
path_param = "Input\\parameters.csv"

param = pd.read_csv(path_param,index_col=0)
```

In [32]:
```
display(param)
```

	Value
Parameter	
EIOPA_param_file	Input/Param_no_VA.csv
EIOPA_curves_file	Input/Curves_no_VA.csv
country	Slovenia
run_type	Risk Neutral
n_proj_years	50
Precision	1E-10
Tau	0.0001
compounding	-1
Modelling_Date	29/04/2023

Initial liquidity

In [33]:
```
path_cash = "Input\\Cash_Portfolio_test.csv"
cash = pd.read_csv(path_cash,index_col=0)
```

In [34]:
```
display(cash)
```

	Bank_Account
Asset_ID	
1	10000

Portfolio of equity shares

In [35]:
```
path_equity = "Input\\Equity_Portfolio_test.csv"
equity = pd.read_csv(path_equity,index_col=0)
```

In [36]:
```
display(equity)
```

	Asset_Type	NACE	Issue_Date	Dividend_Yield	Frequency	Units	Market_Price	Terminal
Asset_ID								
1125	Equity_Share	A1.4.5	3/12/2021	0.03	1	1	94	1
2123	Equity_Share	B5.2.0	3/12/2021	0.05	1	1	92	1
3232	Equity_Share	B8.9.3	3/12/2019	0.04	1	1	96	1
3237	Equity_Share	B8.9.3	3/12/2019	0.04	1	1	96	1

Portfolio of corporate bonds

In [37]:
```
path_bonds = "Input\\Bond_Portfolio_test.csv"
bonds = pd.read_csv(path_bonds,index_col=0)
```

In [38]:
```
display(bonds)
```

	Asset_Type	NACE	Issue_Date	Maturity_Date	Notional_Amount	Coupon_Rate	Z_Sprea
Asset_ID							
1234	Corporate_Bond	A1.4.5	3/12/2021	12/12/2026	100	0.03	0.0
2889	Corporate_Bond	B5.2.0	3/12/2021	12/12/2028	100	0.05	0.0
31	Corporate_Bond	B8.9.3	3/12/2019	3/12/2025	100	0.04	0.0

Commitments (Outflows)

In [39]:
```
path_liability = "Input\\Liability_Cashflow.csv"
liability = pd.read_csv(path_liability, index_col=0)
```

In [40]:

```
display(liability)
```

	Liability_Size
Liability_Date	
1/9/2023	6
2/10/2023	92
2/11/2023	93
3/12/2023	2
3/1/2024	7
...	...
19/3/2049	14
19/4/2049	28
20/5/2049	53
20/6/2049	92
21/7/2049	41

306 rows × 1 columns

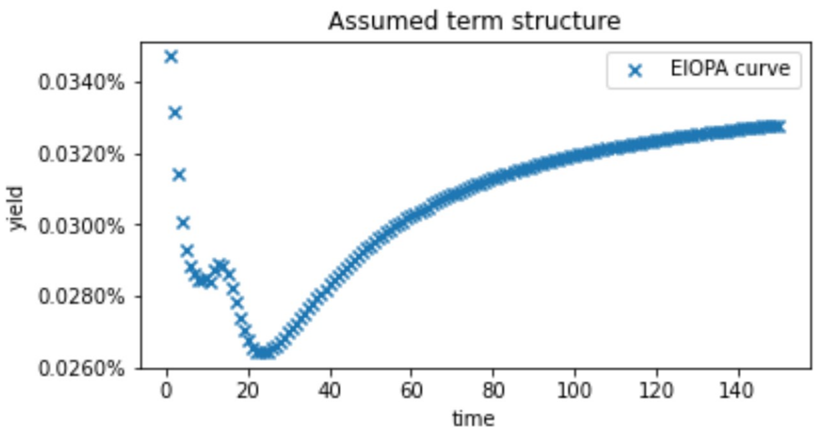
Economic environment

In [41]:

```
[maturities_country, curve_country, extra_param, Qb] =  import_SWEiopa(param.loc["EI(
                    param.loc["EIOPA_curves_file"][0], param.loc["country"][0])
```

In [42]:

```
fig, ax1 = plt.subplots(1, 1)
ax1.scatter(curve_country.index, curve_country.values, label="EIOPA curve", marker=">
ax1.set_ylabel("yield")
ax1.set_title('Assumed term structure')
ax1.set_xlabel("time")
ax1.legend()
ax1.yaxis.set_major_formatter(mtick.PercentFormatter())
fig.set_figwidth(6)
fig.set_figheight(3)
plt.show()
```



What the run shows

In [43]:
```
path_summary = "Output\\Results.csv"
summary = pd.read_csv(path_summary,index_col=0)
```

In [44]:
```
display(summary)
```

	Start cash	End cash	Start market value	After growth market value	End market value	Portfolio return	Div cash
2023-04-29	NaN	1.000000e+04	NaN	NaN	944.000000	NaN	
2024-04-28	1.000000e+04	0.000000e+00	944.000000	1131.647758	11094.910085	0.198779	15.2
2025-04-28	0.000000e+00	-6.821210e-13	11094.910085	11257.140153	12979.814124	0.014622	152.3
2026-04-28	-6.821210e-13	0.000000e+00	12979.814124	13090.969540	17276.502093	0.008564	178.9
2027-04-28	0.000000e+00	-5.911716e-12	17276.502093	17395.189415	18978.761104	0.006870	240.5
2028-04-27	-5.911716e-12	-1.136868e-12	18978.761104	19090.621750	18958.562891	0.005894	267.4
2029-04-27	-1.136868e-12	-9.094947e-13	18958.562891	19072.185893	22132.001591	0.005993	270.6
2030-04-27	-9.094947e-13	-1.136868e-13	22132.001591	22263.127554	21957.250051	0.005925	320.1
2031-04-27	-1.136868e-13	-1.023182e-12	21957.250051	22088.246116	21861.138535	0.005966	321.8
2032-04-26	-1.023182e-12	-6.821210e-13	21861.138535	22003.641584	21805.518160	0.006519	324.8
2033-04-26	-6.821210e-13	1.932676e-12	21805.518160	21953.298651	21560.698954	0.006777	328.4
2034-04-26	1.932676e-12	6.821210e-13	21560.698954	21718.528748	21529.569890	0.007320	329.0
2035-04-26	6.821210e-13	-1.364242e-12	21529.569890	21678.832059	21381.669841	0.006933	332.8
2036-04-25	-1.364242e-12	-5.684342e-14	21381.669841	21610.041897	21524.092039	0.010681	335.0
2037-04-25	-5.684342e-14	-8.526513e-13	21524.092039	21768.263786	21574.961530	0.011344	340.6
2038-04-25	-8.526513e-13	6.252776e-13	21574.961530	21809.998612	21753.789221	0.010894	344.7
2039-04-25	6.252776e-13	3.922196e-12	21753.789221	21973.050479	21686.278232	0.010079	351.2

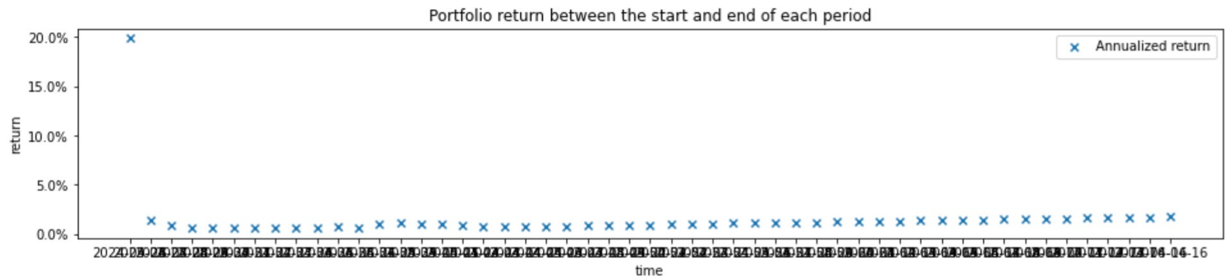
	Start cash	End cash	Start market value	After growth market value	End market value	Portfolio return	Div cash
2040-04-24	3.922196e-12	-2.842171e-12	21686.278232	21886.408829	21517.513631	0.009228	354.1
2041-04-24	-2.842171e-12	-2.330580e-12	21517.513631	21696.149770	21625.877419	0.008302	355.7
2042-04-24	-2.330580e-12	-1.193712e-12	21625.877419	21795.727934	21537.092387	0.007854	362.3
2043-04-24	-1.193712e-12	-1.023182e-12	21537.092387	21698.555578	21541.564985	0.007497	366.0
2044-04-23	-1.023182e-12	1.250555e-12	21541.564985	21704.092608	21298.596704	0.007545	371.5
2045-04-23	1.250555e-12	-1.762146e-12	21298.596704	21468.625817	21297.462374	0.007983	372.8
2046-04-23	-1.762146e-12	2.501110e-12	21297.462374	21476.426369	21231.742458	0.008403	378.3
2047-04-23	2.501110e-12	-1.136868e-12	21231.742458	21420.567785	21218.202737	0.008894	382.6
2048-04-22	-1.136868e-12	-2.444267e-12	21218.202737	21413.183152	21027.031321	0.009189	387.8
2049-04-22	-2.444267e-12	-5.684342e-14	21027.031321	21228.644711	21141.477881	0.009588	389.8
2050-04-22	-5.684342e-14	1.705303e-13	21141.477881	21351.811038	21563.256400	0.009949	397.4
2051-04-22	1.705303e-13	-3.694822e-12	21563.256400	21785.098782	22196.092436	0.010288	410.9
2052-04-21	-3.694822e-12	-1.705303e-12	22196.092436	22433.072412	22861.939110	0.010677	428.8
2053-04-21	-1.705303e-12	9.094947e-13	22861.939110	23112.844745	23560.596662	0.010975	447.7
2054-04-21	9.094947e-13	8.526513e-13	23560.596662	23827.850311	24295.503678	0.011343	467.6
2055-04-21	8.526513e-13	2.842171e-13	24295.503678	24576.565910	25065.229392	0.011568	488.6
2056-04-20	2.842171e-13	3.808509e-12	25065.229392	25365.211948	25876.064736	0.011968	510.8
2057-04-20	3.808509e-12	3.865352e-12	25876.064736	26189.085366	26723.416963	0.012097	534.3
2058-04-20	3.865352e-12	7.958079e-13	26723.416963	27057.686072	27616.797070	0.012508	559.1
2059-04-20	7.958079e-13	-5.229595e-12	27616.797070	27970.986407	28556.295698	0.012825	585.3
2060-04-19	-5.229595e-12	4.547474e-13	28556.295698	28932.223612	29545.241182	0.013164	613.0
2061-04-19	4.547474e-13	-4.661160e-12	29545.241182	29943.749542	30586.127999	0.013488	642.3
2062-04-19	-4.661160e-12	3.979039e-12	30586.127999	31004.476520	31677.885148	0.013678	673.4
2063-04-19	3.979039e-12	9.094947e-13	31677.885148	32121.457807	32827.721434	0.014003	706.2
2064-04-18	9.094947e-13	5.798029e-12	32827.721434	33298.828117	34039.891093	0.014351	741.0
2065-04-18	5.798029e-12	4.206413e-12	34039.891093	34541.801654	35319.792675	0.014745	777.9
2066-04-18	4.206413e-12	7.958079e-13	35319.792675	35846.828724	36663.903227	0.014922	817.0
2067-04-18	7.958079e-13	2.273737e-13	36663.903227	37223.937641	38082.452851	0.015275	858.5
2068-04-17	2.273737e-13	1.250555e-12	38082.452851	38672.158044	39574.628009	0.015485	902.4
2069-04-17	1.250555e-12	-4.661160e-12	39574.628009	40208.927710	41158.108763	0.016028	949.1
2070-04-17	-4.661160e-12	-1.477929e-12	41158.108763	41826.354722	42825.042713	0.016236	998.6
2071-04-17	-1.477929e-12	8.185452e-12	42825.042713	43527.953243	44579.205900	0.016414	1051.2

	Start cash	End cash	Start market value	After growth market value	End market value	Portfolio return	Div cash
2072-04-16	8.185452e-12	-6.821210e-13	44579.205900	45326.709083	46433.795641	0.016768	1107.0
2073-04-16	-6.821210e-13	3.637979e-12	46433.795641	47229.842884	48396.345222	0.017144	1166.5
2074-04-16	3.637979e-12	1.091394e-11	48396.345222	49243.241880	78883.551001	0.017499	0.0

Return of the entire portfolio

In [45]:

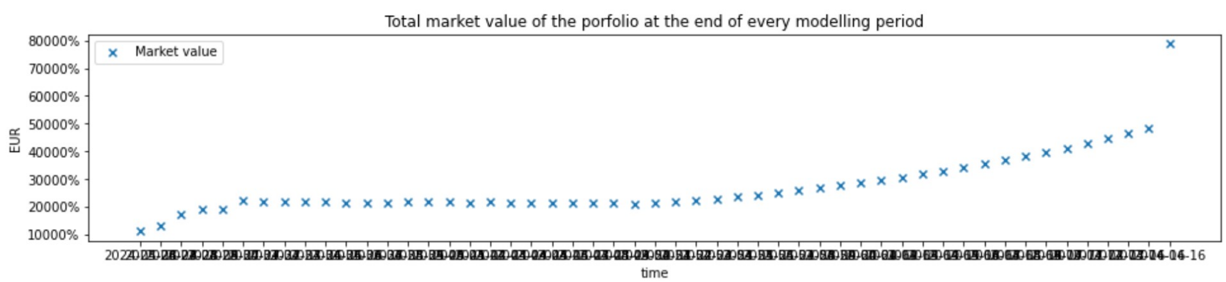
```
fig, ax1 = plt.subplots(1, 1)
ax1.scatter(summary["Portfolio return"].index[1:], summary["Portfolio return"].values
ax1.set_ylabel("return")
ax1.set_title('Portfolio return between the start and end of each period')
ax1.set_xlabel("time")
ax1.legend()
ax1.yaxis.set_major_formatter(mtick.PercentFormatter())
fig.set_figwidth(16)
fig.set_figheight(3)
plt.show()
```



Total market value of the portfolio

In [46]:

```
fig, ax1 = plt.subplots(1, 1)
ax1.scatter(summary["End market value"].index[1:], summary["End market value"].values
ax1.set_ylabel("EUR")
ax1.set_title('Total market value of the porfolio at the end of every modelling peric
ax1.set_xlabel("time")
ax1.legend()
ax1.yaxis.set_major_formatter(mtick.PercentFormatter())
fig.set_figwidth(16)
fig.set_figheight(3)
plt.show()
```

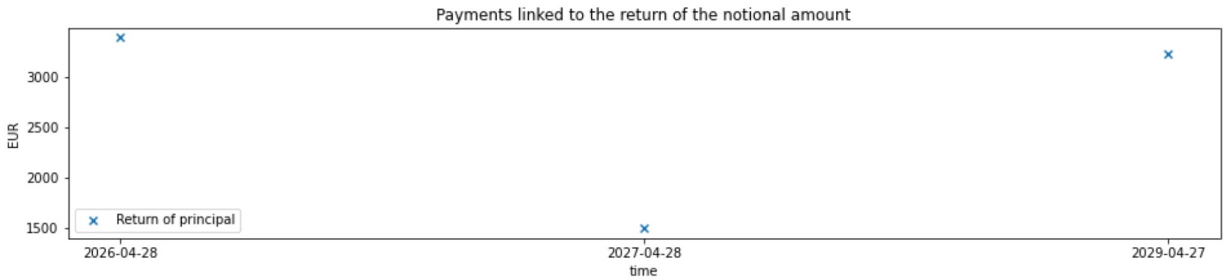


Corporate bond flows

When bond expire they return their notional amount:

In [47]:
```
notionals = summary["Notional cash flow"][1:]
notionals = notionals[notionals>0]
```

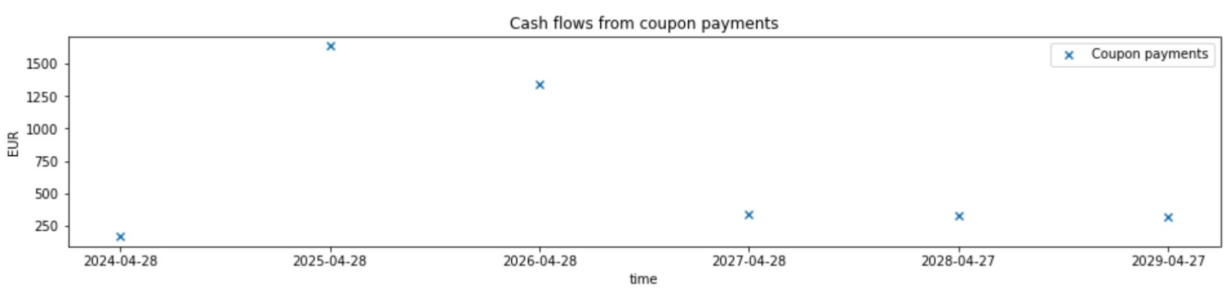
In [48]:
```
fig, ax1 = plt.subplots(1, 1)
ax1.scatter(notionals.index, notionals.values, label="Return of principal", marker="x
ax1.set_ylabel("EUR")
ax1.set_title('Payments linked to the return of the notional amount')
ax1.set_xlabel("time")
ax1.legend()
fig.set_figwidth(16)
fig.set_figheight(3)
plt.show()
```



Before expiration, they pay out regular coupon payments:

In [49]:
```
coupons = summary["Coupon cash flow"][1:]
coupons = coupons[coupons>0]
```

In [50]:
```
fig, ax1 = plt.subplots(1, 1)
ax1.scatter(coupons.index, coupons.values, label="Coupon payments", marker="x")
ax1.set_ylabel("EUR")
ax1.set_title('Cash flows from coupon payments')
ax1.set_xlabel("time")
ax1.legend()
fig.set_figwidth(16)
fig.set_figheight(3)
plt.show()
```



Equity flows

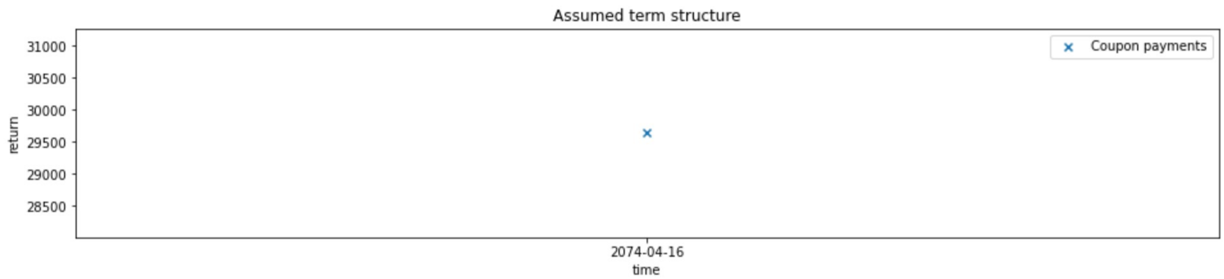
Entire equity portfolio is sold at the end of the period in OSEM:

In [51]:

```
terminal = summary["Terminal cash flow"][1:]
terminal = terminal[terminal>0]
```

In [52]:

```
fig, ax1 = plt.subplots(1, 1)
ax1.scatter(terminal.index, terminal.values, label="Coupon payments", marker="x")
ax1.set_ylabel("return")
ax1.set_title('Assumed term structure')
ax1.set_xlabel("time")
ax1.legend()
fig.set_figwidth(16)
fig.set_figheight(3)
plt.show()
```



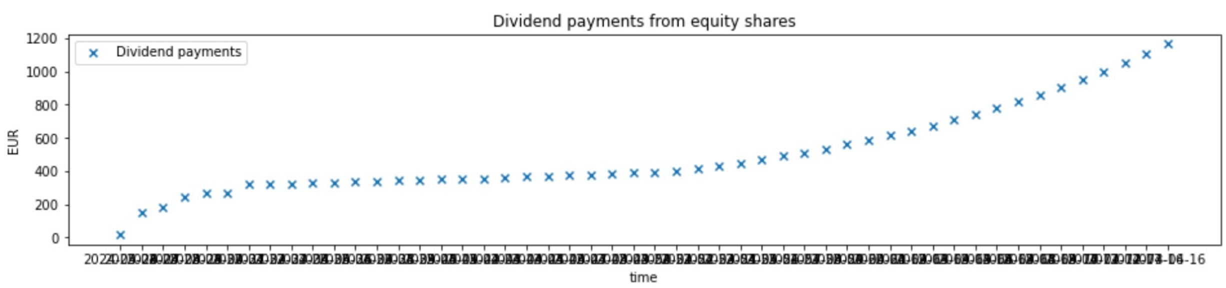
Each equity can pay regular dividends as % of their market value:

In [53]:

```
dividends = summary["Dividend cash flow"][1:]
dividends = dividends[dividends>0]
```

In [54]:

```
fig, ax1 = plt.subplots(1, 1)
ax1.scatter(dividends.index, dividends.values, label="Dividend payments", marker="x")
ax1.set_ylabel("EUR")
ax1.set_title('Dividend payments from equity shares')
ax1.set_xlabel("time")
ax1.legend()
fig.set_figwidth(16)
fig.set_figheight(3)
plt.show()
```



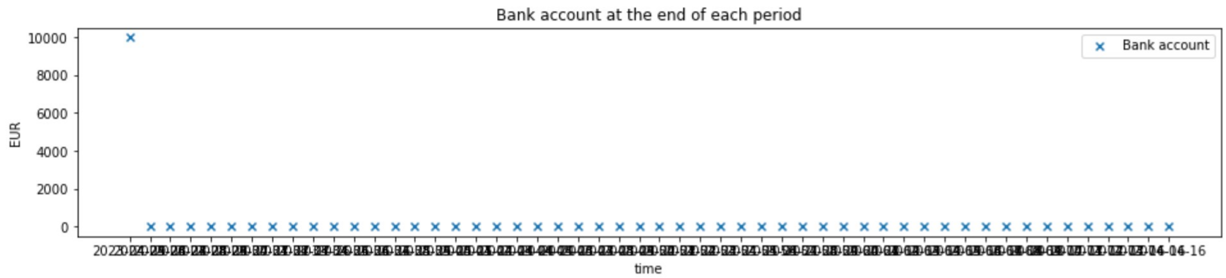
Cash account

In [55]:

```
cash = summary["End cash"]
```

In [56]:

```
fig, ax1 = plt.subplots(1, 1)
ax1.scatter(cash.index, cash.values, label="Bank account", marker="x")
ax1.set_ylabel("EUR")
ax1.set_title('Bank account at the end of each period')
ax1.set_xlabel("time")
ax1.legend()
fig.set_figwidth(16)
fig.set_figheight(3)
plt.show()
```



Liability cash flows

The company has future commitments (liabilities) that needs to honor:

In [57]:

```
liability_cf = summary["Liability cash flow"][1:]
liability_cf = liability_cf[liability_cf<0]
```

In [58]:

```
fig, ax1 = plt.subplots(1, 1)
ax1.scatter(liability_cf.index, liability_cf.values, label="Outflows", marker="x")
ax1.set_ylabel("EUR")
ax1.set_title('Outflows from the company in each modelling period ')
ax1.set_xlabel("time")
ax1.legend()
fig.set_figwidth(16)
fig.set_figheight(3)
plt.show()
```