Bloomberg Trading Project

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April 30,2019

Abstract

In this project, one short maturity and one long maturity trading portfolios are constructed in Bloomberg, each with two swaptions. Each swaption is hedged by two swaps according to the corresponding key rate risk. Then, we analyze the short maturity hedging portfolios with 6 scenarios (+1bp Small Parallel Up, -1bp Small Parallel Down, PC2 -3σ Shock, PC2 +3σ Shock, Lehman Default 2008, PC1 +1 σ Shock). Finally, we analyze the long maturity hedging portfolios with 2 scenarios (long-end flattener, long-end steepener).

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2.1.1. PC1-hedged Portfolios Construction

We have two short maturity swaptions, and separately construct PC1-hedged portfolios. In the following, we take long-payer swaption as an example.

First, we open a position on a 100MM 1Y*5Y long payer swaption.

Figure1 short maturity long payer swaption

To make a hedge the PC1 risk, we calculate the risk of this swaption in Bloomberg and get the following result. The key rate risk come from 12-month swap rate and 6-year swap rate.

Figure2 short maturity long payer swaption key rate risk

The DV01 of 12-month swap rate is 4898.89, so we add a new 12-month pay swap with DV01 of -4898.89 to our portfolio. The DV01 of 6-year swap rate is -27743.94, so we add a new 6-year receive swap with DV01 of -27743.94 to our portfolio.

Figure3 1 year swap to hedge short maturity long payer swaption

Figure4 6-year swap to hedge short maturity long payer swaption

Similarly, we construct another PC1-hedged portfolio, using a 100MM 1Y*5Y short payer swaption, and two swaps as shown below.

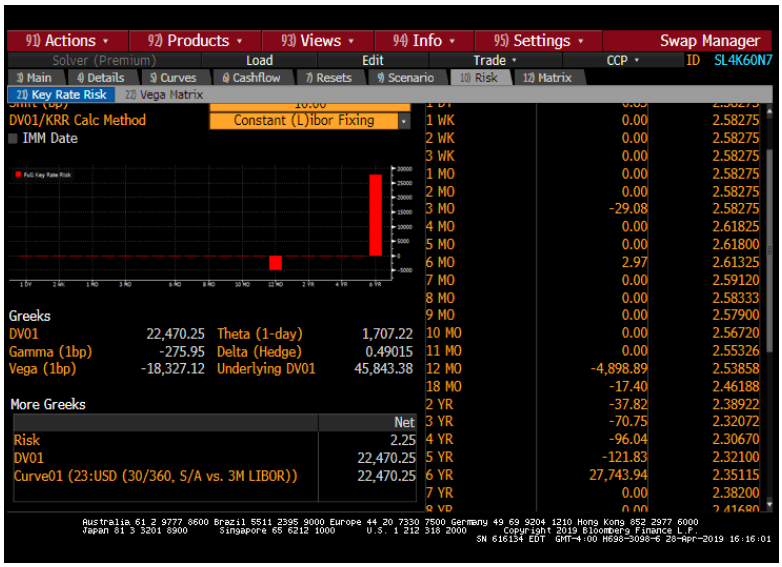

Figure5 short maturity short payer swaption key rate risk

Figure6 6-year swap to hedge short maturity short payer swaption

Figure7 1-year swap to hedge short maturity short payer swaption

2.1.2. Global Portfolio Construction

We combine the previous two portfolios together to construct the Global Portfolio.

The total components are shown following:

Figure8 List of the instruments in the short maturity portfolio

2.2. Portfolios Performance analysis

2.2.1. Overall Performance

The six scenarios for the three portfolios are following:

Long payer portfolio:

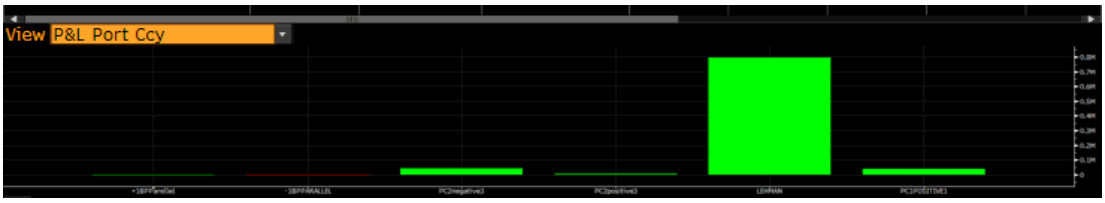

Figure9 the result of stress tests with long payer portfolio for short maturity

Short payer portfolio:

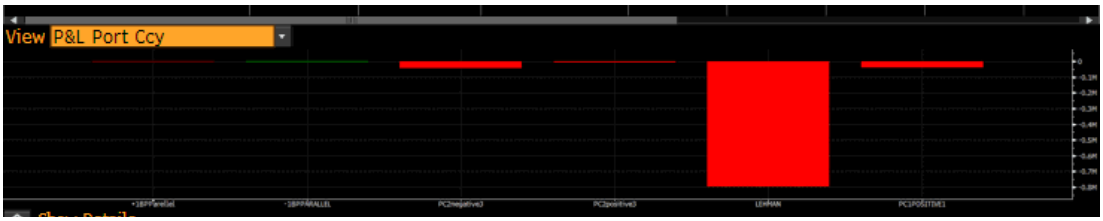

Figure10 the result of stress tests with short payer portfolio for short maturity

Global Portfolio:

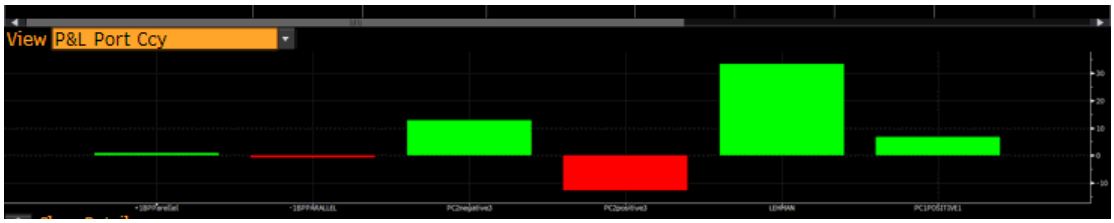

Figure11 the result of stress tests with global portfolio for short maturity

2.2.2. Detailed PC1-hedged Portfolios Performance Analysis

Since Short payer swaption portfolio's performance is exactly opposite to that of Long payer one, we decide to take the analysis on the Long payer one as an example.

Scenario 1 +1bp Small Parallel Up

Table1 Scenario1 result for short maturity long payer portfolio

Scenario	Date	P&L Portfolio Currency
+1BPParellel	28-Apr-19	949.707097
/IRS 2.31 04/30/25	28-Apr-19	23781.54519
/SWAP 2.32 04/30/20	28-Apr-19	4898.508589
/SWAP 2.32 04/30/25	28-Apr-19	-27730.34669

In this scenario, USD swap curve has been parallelly shift upward by 1 basis point. The swaption gains $23781.55, but the hedging receiver swap loses $27730.35, and the payer swap gains $4898.51. In total, the portfolio gains $949.71. The hedging effect is quite good in terms of 100MM notional.

Scenario 2 -1bp Small Parallel Down

Table2 Scenario2 result for short maturity long payer portfolio

Scenario	Date	P&L Portfolio Currency
-1BPPARALLEL	28-Apr-19	-625.0914014
/IRS 2.31 04/30/25	28-Apr-19	-23474.80257
/SWAP 2.32 04/30/20	28-Apr-19	-4899.244961
/SWAP 2.32 04/30/25	28-Apr-19	27748.95613

In this scenario, USD swap curve has been parallelly shift downward by 1 basis point. The swaption loses $23474.80, but the hedging receiver swap gains $27748.96, and

the payer swap loses $4899.24. In total, the portfolio loses $625.09. The hedging effect is reasonably good in terms of 100MM notional.

Scenario 3 PC2 -3σ Shock: "Upward Steepener"

Table3 Scenario3 result for short maturity long payer portfolio

Scenario	Date	P&L Portfolio Currency
PC2negative3	28-Apr-19	44202.25811
/IRS 2.31 04/30/25	28-Apr-19	-274237.4476
/SWAP 2.32 04/30/20	28-Apr-19	79951.36473
/SWAP 2.32 04/30/25	28-Apr-19	238488.341

In this scenario, USD swap curve has been shifted by a negative 3 σshock corresponding to the standard deviation of the 2nd PCA risk factor. To be more specific, we modify the 3-month, 6-month, 1-year, 2-year, 3-year, 5-year, 7-year, 10-year, 30-year swap rate respectively by 26.75, 19.24, 13.84, 3.19, -1.04, -6.54, -10.63, -12.27,

-11.26 basis points. According to the table above, it is obvious that the 1Y payer swap increases in value due to the increase in 1Y rate while the 6Y receiver swap also rises in value due to the fall in 6Y rate. The swaption loses $274237.45, but the hedging receiver and payer swaps totally gain $512725.79. In total, the portfolio gains $44202.26. The hedging strategy's performance is not relatively good in terms of 100MM notional.

Scenario 4 PC2 +3σ Shock: "Downward Flattener"

Table4 Scenario4 result for short maturity long payer portfolio

Scenario	Date	P&L Portfolio Currency
PC2positive3	28-Apr-19	6073.340721
/IRS 2.31 04/30/25	28-Apr-19	324511.9176
/SWAP 2.32 04/30/20	28-Apr-19	-80192.4399
/SWAP 2.32 04/30/25	28-Apr-19	-238246.137

In this scenario, USD swap curve has been shifted by a positive 3 σ shock corresponding to the standard deviation of the 2nd PCA risk factor. To be more specific, we modify the 3-month, 6-month, 1-year, 2-year, 3-year, 5-year, 7-year, 10-

year, 30-year swap rate respectively by -26.75, -19.24, -13.84, -3.19, 1.04, 6.54, 10.63, 12.27,
11.26 basis points. According to the table above, it is obvious that the 1Y payer swap decreases in value due to the fall in 1Y rate while the 6Y receiver swap also decreases in value due to the increase in 6Y rate. The swaption gains $324511.92, but the hedging receiver and payer swaps totally loses $318438.58. In total, the portfolio gains $6073.34. The hedging effect is not bad in terms of 100MM notional.

Scenario 5 My Lehman Default 2008

Table5 Scenario5 result for short maturity long payer portfolio

Scenario	Date	P&L Portfolio Currency
LEHMAN	28-Apr-19	796650.602
/IRS 2.31 04/30/25	28-Apr-19	2477443.674
/SWAP 2.32 04/30/20	28-Apr-19	212394.9389
/SWAP 2.32 04/30/25	28-Apr-19	-1893188.011

In this scenario, we modify 1-year and 6-year swap rate respectively by 43 and 69 basis points under Flat Extrapolation approach. The swaption gains $2477443.67, but the hedging receiver swap loses $1893188.01, and the payer swap gains $212394.94. In total, the portfolio gains $796650.60. The hedging strategy is obviously not effective under this situation. This is because the DV01 at the new swap curve is very different from the original swap curve.

Scenario 6 PC1 +1 σ Shock

Table6 Scenario6 result for short maturity long payer portfolio

Scenario	Date	P&L Portfolio Currency
PC1POSITIVE1	28-Apr-19	-38765.66765
/SWAP 2.32 04/30/25	28-Apr-19	376938.9032
/IRS 2.31 04/30/25	28-Apr-19	-372401.9235
/SWAP 2.32 04/30/20	28-Apr-19	-43302.64736

In this scenario, USD swap curve has been shifted by a positive 1 σ shock corresponding to the standard deviation of the 1st PCA risk factor. To be more specific, we modify the 3-month, 6-month, 1-year, 2-year, 3-year, 5-year, 7-year, 10-

year, 30-year swap rate respectively by 6.07, 7.52, 10.07, 13.06, 13.77, 13.93, 13.36, 12.28, 8.01 basis points. The long payer swaption gain $372401.92, the hedging payer swap gain $43309.53, the hedging receiver swap loses $376938.97. The portfolio gains $38772.38 in total. The hedging effect is quite well. Increasing PC1 factor by one sigma means the level of the swap rate would be raised, which leads to the gain of payer swaption and payer swap, and the loss of the receiver swap.

A New Risk-adjusted Portfolio for the Scenario 6 PC1 +1 σ Shock

To achieve a better hedging effect, we calculate the Net Value changes by adding 10.06 basis points in 1 year and 13.65 basis points in 6 year, using the scenario tab in SWPM. The net value of the swaption would increase 5427.81 and decrease 380712.3 respectively.

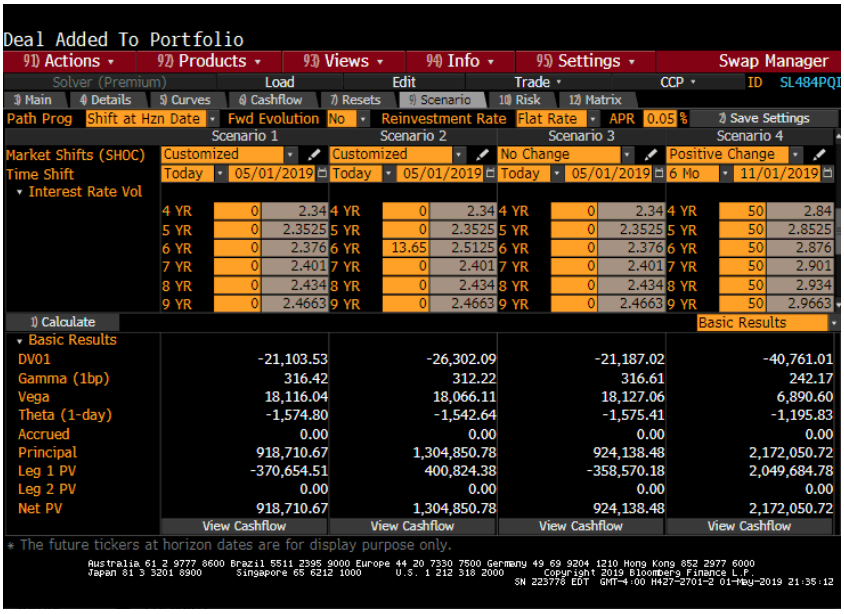

Figure12 new short maturity long payer swaption

Therefore, we add a 1-year swap and a 6-year swap to hedge the risk.

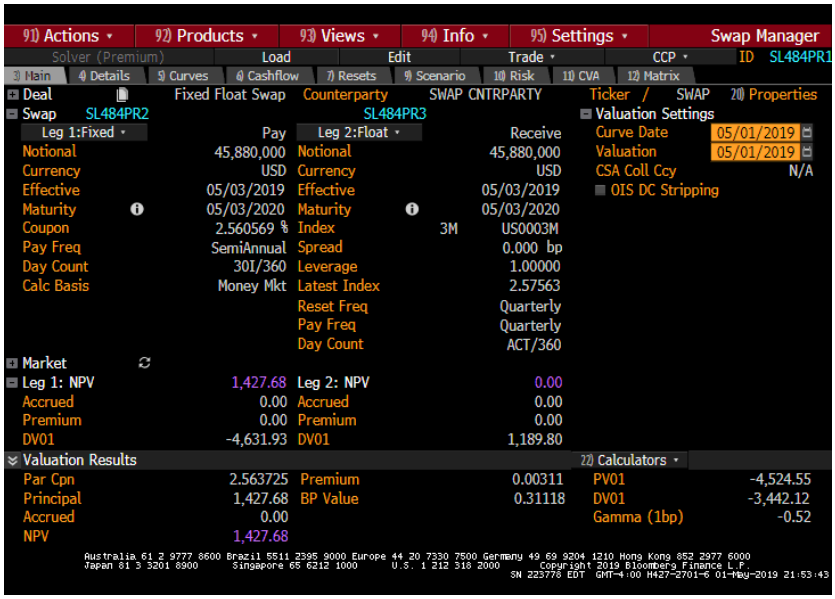

Figure13 1 year swap to hedge the new short maturity long payer swaption

Figure14 6 year swap to hedge the new short maturity long payer swaption

The same scenario for this new portfolio performs as following:

Table7 Scenario6 result for risk-adjusted short maturity long payer portfolio

Scenario	Date	P&L Portfolio Currency
PC1POSITIVE1	01-May-19	-9711.370321
/SWAP 2.56 05/03/20	01-May-19	30532.83803
/SWAP 2.38 05/03/25	01-May-19	-378233.7591
/IRS 2.41 05/06/25	01-May-19	337989.5507

The P&L is -9711.37, which is much smaller than -38765.66. We can see from the table that the hedging performance is much better than previous. This results from the exact calculation to hedge the shock.

2.2.3. Detailed Global Portfolios Performance Analysis

Scenario 1 +1bp Small Parallel Up

In this scenario, USD swap curve has been parallel shift upward 1 basis point, the swaptions gain total of $0, the hedging payer swaps gain $4898.51 and $27730.34; and the hedging receiver swaps loss $4897.72 and $27730.35. In total, the portfolio gains $0.77. The hedging effect is quite good in terms of 100MM notional.

Scenario 2 -1bp Small Parallel Down

In this scenario, USD swap curve has been parallel shift downwards 1 basis point, the swaptions gain total of $0, the hedging payer swap loss $4898.51 and $27730.34; and the hedging receiver swaps gain $4897.72 and $27730.35. In total, the portfolio loss $0.77. The hedging effect is quite good in terms of 100MM notional.

Scenario 3 PC2 -3σ Shock: “Upwards Flattener”

In this scenario, the swap rates shift relevant-maturity swap rates by negative sigma shock, the swaptions gain total of $0, the hedging payer swaps gain $238488.34 and $79951.37; and the hedging receiver swaps loss $238488.30 and $79938.65. In total, the portfolio gains $12.75. The hedging effect is quite good in terms of 100MM notional.

Scenario 4 PC2 +3σ Shock: “Downward Flattener”

In this scenario, the swap rates shift relevant-maturity swap rates by positive sigma shock, the swaptions gain total of $0, the hedging payer swaps loss $238246.13 and $80192.44; and the hedging receiver swaps gain $238246.09 and $80179.69. In total, the portfolio loss $12.75. The hedging effect is quite good in terms of 100MM notional.

Scenario 5 My Lehman Default 2008

In this scenario, the swap rates shift 43.4bp up in 1 year and 69.6bp up in 6 years with flat exploration. The swaptions gain total of $0, the hedging payer swaps gain $ 212394.94 and $ 1893187.67; and the hedging receiver swaps loss $212361.17 and $1893188.01. In total, the portfolio gains $33.42. The hedging effect is quite good in terms of 100MM notional.

Scenario 6 PC1 +1σ Shock2

In this scenario, the swaptions gain total of $0, the hedging receiver swaps loses $ 376938.97 and $ 43302.65; and the hedging payer swaps gain $ 376938.90 and $ 43309.53. In total, the portfolio gains $6.82. The hedging effect is quite good in terms of 100MM notional.

3. Long-end Maturity

3.1. Portfolios Construction

3.1.1. PC1-hedged Portfolios Construction

We have two long maturity swaptions, and separately construct PC1-hedged portfolios. In the following, we take long-payer swaption as an example.

First, we open a position on a 100MM 5Y*15Y long payer swaption.

Figure15 Long maturity long payer swaption

To make a hedge on the PC1 risk, we calculate the risk of this swaption in Bloomberg and get the following result. The key rate risk comes from 5-year swap rate and 20-year swap rate.

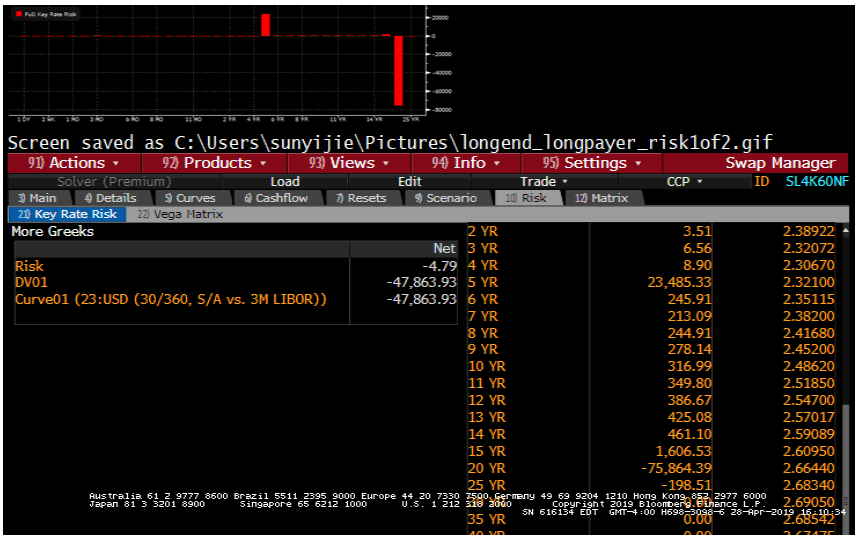

Figure16 Long maturity long payer swaption key rate risk

The DV01 of 5-year swap rate is 23485.33, so we add a new 5-year payer swap with DV01 of -23485.33 to our portfolio. The DV01 of 20-year swap rate is -75864.39, so we add a new 20-year receiver swap with DV01 of 75864.39 to our portfolio.

Figure17 20-year swap to hedge long maturity long payer swaption

Figure18 5-year swap to hedge long maturity long payer swaption

Similarly, we construct another PC1-hedged portfolio, using a 100MM 5Y*15Y short payer swaption, and two swaps as shown below.

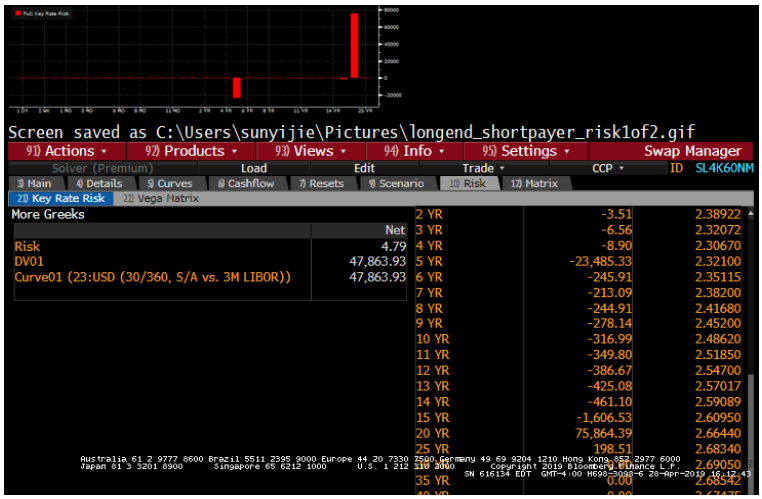

Figure19 Long maturity short payer swaption key rate risk

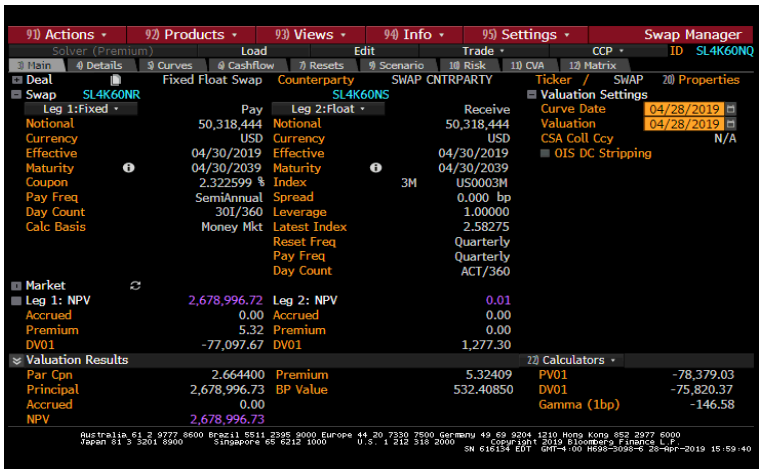

Figure20 20-year swap to hedge long maturity long payer swaption

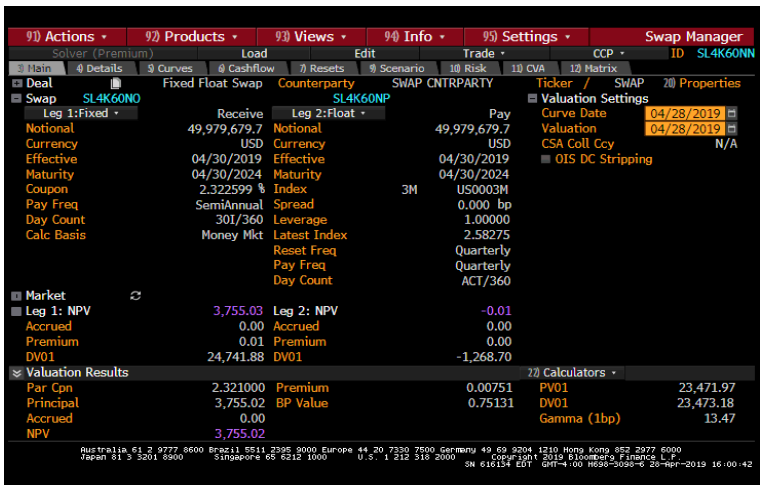

Figure21 5-year swap to hedge long maturity long payer swaption

3.1.2. Global Portfolio Construction

We combine the previous two portfolios together to construct the Global Portfolio.

The total components are shown following:

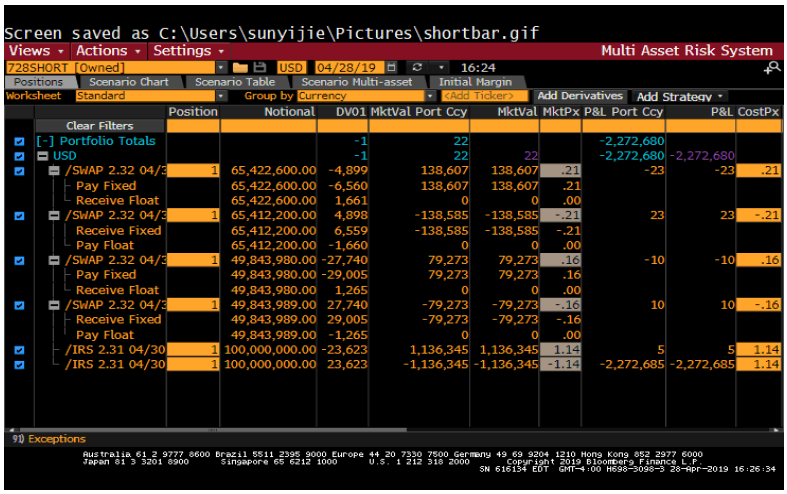

Figure22 List of the instruments in the long maturity portfolio

3.2. Portfolios Performance analysis

3.2.1. Overall Performance

The two scenarios of long-maturity steepener and long-maturity flattener is to plus 50bps for 20Y swap rate and minus 50bps for 20Y swap rate respectively. The two scenarios for the three portfolios are following:

Long payer portfolio:

Figure23 the result of stress tests with long maturity long payer portfolio

Short payer portfolio:

Figure24 the result of stress tests with long maturity short payer portfolio

Global Portfolio:

Figure25 the result of stress tests with long maturity global portfolio

3.2.2. Detailed PC1-hedged Portfolios Performance Analysis

Since Short payer swaption portfolio's performance is exactly opposite to that of Long payer one, we decide to take the analysis on the Long payer one as an example.

Scenario 1 long-maturity steepener

Table8 Scenario1 result for long maturity long payer portfolio

Scenario	Date	P&L Portfolio Currency
Steepener+50	28-Apr-19	520844.637
/IRS 2.81 05/01/39	28-Apr-19	3938847.095
/SWAP 2.32 04/30/24	28-Apr-19	291884.7242
/SWAP 2.32 04/30/39	28-Apr-19	-3709887.182

In this scenario, we added 50 basis point to the 20Y USD swap rate. If the yield curve steepens, the spread between long- and short-term interest rates increases. In other words, the yields on long-term bonds are rising faster than yields on short-term bonds, or short-term bond yields are falling as long-term bond yields are rising. The swaption gains $3938847.095, and the hedging payer swap gains $291884.7242. The receiver

swap losses $3709887.182. In total, the portfolio gains $520844.637. The hedging effect is quite good in terms of 100MM notional.

Scenario 2 long-maturity flattener

Table9 Scenario2 result for long maturity long payer portfolio

Scenario	Date	P&L Portfolio Currency
Flattener-50	28-Apr-19	890216.2813
/IRS 2.81 05/01/39	28-Apr-19	-2776312.716
/SWAP 2.32 04/30/24	28-Apr-19	-293245.6094
/SWAP 2.32 04/30/39	28-Apr-19	3959774.607

In this scenario, we minus 50 basis point to the 20Y USD swap rate. If the yield curve flattens, the spread between long- and short-term interest rates decreases. In other words, the yields on long-term bonds are decreasing faster than yields on short-term bonds, or short-term bond yields are rising as long-term bond yields are falling. The swaption losses $2776312.716, and the hedging payer swap losses $293245.6094. The receiver swap gains $3959774.607. In total, the portfolio gains $890216.2813. The hedging method is very effective in terms of 100MM notional.

3.2.3. Detailed Global Portfolios Performance Analysis

Scenario 1 long-maturity steepener

In this scenario with global portfolio, the swaption gains $0, and the hedging payer swaps gain $4001771.906. The receiver swaps lose $ 4001771.285. In total, the portfolio gains $ 0.62. The hedging effect is perfect in terms of 100MM notional.

Scenario 2. long-maturity flattener

In this scenario with global portfolio, the swaption losses $0, and the hedging payer swap losses $4253020.216. The receiver swap gains $ 4253019.592. In total, the portfolio gains $ 0.62. The hedging effect is perfect in terms of 100MM notional.

4. Conclusion

According to the scenarios above, we can conclude the short maturity PC1 hedged portfolios perform well in different kind of situation except the Lehman Default. To be more precise, the hedging performance of PC1 hedged portfolios is pretty well in

1bp Small Parallel Movement, acceptable in PC shocks, but perform poorly in Lehman Default. For the long maturity PC1 hedged portfolios, in both scenarios, the hedging effect is acceptable. For the global portfolios, the hedging effect is almost perfect.