

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 $+3\sigma$ Shock, Lehman Default 2008, PC1 $+1\sigma$ Shock). Finally, we analyze the long maturity hedging portfolios with 2 scenarios (long-end flattener, long-end steepener).

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2. Short-to-medium Maturity

2.1. Portfolios Construction

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.

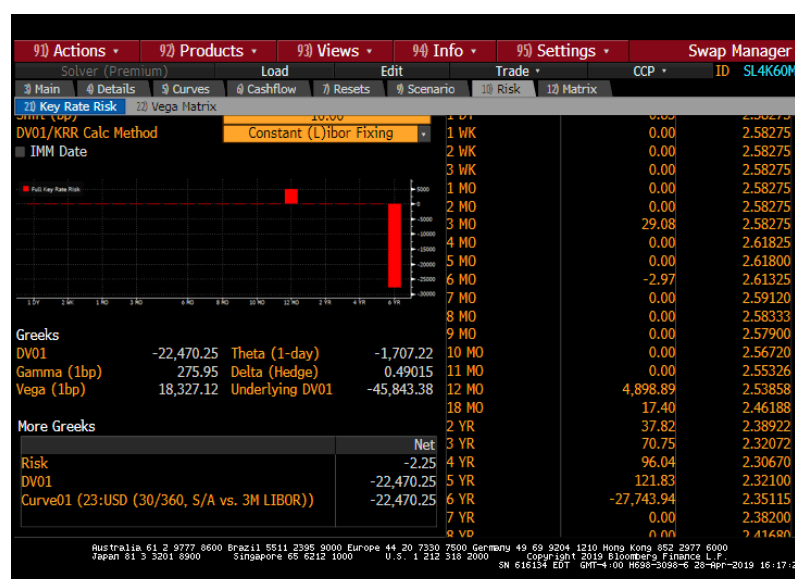


Figure2 short maturity long payer swaption key rate risk

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.

Field	Value	Field	Value
Deal	SL4K60N1	Counterparty	SL4K60N2
Leg 1: Fixed	Pay	Leg 2: Float	Receive
Notional	65,422,600	Notional	65,422,600
Currency	USD	Currency	USD
Effective	04/30/2019	Effective	04/30/2019
Maturity	04/30/2020	Maturity	04/30/2020
Coupon	2.322599 %	Index	3M US0003M
Pay Freq	SemiAnnual	Spread	0.000 bp
Day Count	30I/360	Leverage	1.00000
Calc Basis	Money Mkt	Latest Index	2.58275
Reset Freq		Quarterly	
Pay Freq		Quarterly	
Day Count		ACT/360	
Leg 1: NPV	138,607.20	Leg 2: NPV	0.02
Accrued	0.00	Accrued	0.00
Premium	0.21	Premium	0.00
DV01	-6,559.59	DV01	1,660.71
Par Cpn	2.538577	Premium	0.21186
Principal	138,607.21	BP Value	21.18644
Accrued	0.00	PV01	-6,417.68
NPV	138,607.21	DV01	-4,898.88
		Gamma (1bp)	-0.74

Figure3 1 year swap to hedge short maturity long payer swaption

Field	Value	Field	Value
Deal	SL4K60N4	Counterparty	SL4K60N5
Leg 1: Fixed	Receive	Leg 2: Float	Pay
Notional	49,843,989	Notional	49,843,989
Currency	USD	Currency	USD
Effective	04/30/2019	Effective	04/30/2019
Maturity	04/30/2025	Maturity	04/30/2025
Coupon	2.322599 %	Index	3M US0003M
Pay Freq	SemiAnnual	Spread	0.000 bp
Day Count	30I/360	Leverage	1.00000
Calc Basis	Money Mkt	Latest Index	2.58275
Reset Freq		Quarterly	
Pay Freq		Quarterly	
Day Count		ACT/360	
Leg 1: NPV	-79,272.99	Leg 2: NPV	-0.01
Accrued	0.00	Accrued	0.00
Premium	-0.16	Premium	0.00
DV01	29,005.12	DV01	-1,265.26
Par Cpn	2.351150	Premium	-0.15904
Principal	-79,273.00	BP Value	-15.90422
Accrued	0.00	PV01	27,766.23
NPV	-79,273.00	DV01	27,739.86
		Gamma (1bp)	18.61

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:

Position	Notional	DV01	MktVal	Port Ccy	MktVal	MktPx	P&L	Port Ccy	P&L CostPx
Portfolio Totals		0	0		0		0		
USD		0	0		0		0		
/SWAP 2.32 04/3	49,979,679.70	23,473	3,755		3,755	.01	3,755		.00
Receive Fixed	49,979,679.70	24,742	3,755		3,755	.01			
Pay Float	49,979,679.70	-1,269	0		0	.00			
/SWAP 2.32 04/3	49,979,786.10	-23,473	-3,755		-3,755	-.01	-3,755		.00
Pay Fixed	49,979,786.10	-24,742	-3,755		-3,755	-.01			
Receive Float	49,979,786.10	1,269	0		0	.00			
/SWAP 2.32 04/3	50,318,444.00	-75,820	2,678,997		2,678,997	-5.32	-375		-5.32
Pay Fixed	50,318,444.00	-77,098	2,678,997		2,678,997	-5.32			
Receive Float	50,318,444.00	1,277	0		0	.00			
/SWAP 2.32 04/3	50,318,444.00	75,820	-2,678,997		-2,678,997	-5.32	375		-5.32
Pay Fixed	50,318,444.00	77,098	-2,678,997		-2,678,997	-5.32			
Receive Float	50,318,444.00	-1,277	0		0	.00			
/IRS 2.81 05/01	100,000,000.00	47,864	-5,886,937		-5,886,937	-5.89	-3,787		-5.88
Pay Float	100,000,000.00	-47,864	5,886,937		5,886,937	5.89	3,787		5.88

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:



Figure 11 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

Table 1 Scenario 1 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

Table 2 Scenario 2 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 3σ 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 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 $+3\sigma$ Shock: “Downward Flattenner”

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 3σ 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-

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

Deal Added To Portfolio																	
93 Actions		92 Products		93 Views		94 Info		95 Settings		Swap Manager							
Solver (Premium)		Load		Edit		Trade		CCP		ID SL484PC							
3 Main	4 Details	5 Curves	6 Cashflow	7 Resets	8 Scenario	10 Risk	12 Matrix										
Path Prog		Shift at Hzn Date		Fwd Evolution		No		Reinvestment Rate		Flat Rate		APR		0.05 %		Save Settings	
Scenario 1				Scenario 2				Scenario 3				Scenario 4					
Market Shifts (SHOC)		Customized		Customized		No Change		Positive Change									
Time Shift		Today		05/01/2019		Today		05/01/2019		Today		05/01/2019		6 Mo		11/01/2019	
Interest Rate Vol																	
4 YR		0		2.34		4 YR		0		2.34		4 YR		0		2.34	
5 YR		0		2.3525		5 YR		0		2.3525		5 YR		0		2.3525	
6 YR		0		2.376		6 YR		13.65		2.5125		6 YR		0		2.376	
7 YR		0		2.401		7 YR		0		2.401		7 YR		0		2.401	
8 YR		0		2.434		8 YR		0		2.434		8 YR		0		2.434	
9 YR		0		2.4663		9 YR		0		2.4663		9 YR		0		2.4663	
i) Calculate		Basic Results															
Basic Results																	
DV01		-21,103.53				-26,302.09				-21,187.02				-40,761.01			
Gamma (1bp)		316.42				312.22				316.61				242.17			
Vega		18,116.04				18,066.11				18,127.06				6,890.60			
Theta (1-day)		-1,574.80				-1,542.64				-1,575.41				-1,195.83			
Accrued		0.00				0.00				0.00				0.00			
Principal		918,710.67				1,304,850.78				924,138.48				2,172,050.72			
Leg 1 PV		-370,654.51				400,824.38				-358,570.18				2,049,684.78			
Leg 2 PV		0.00				0.00				0.00				0.00			
Net PV		918,710.67				1,304,850.78				924,138.48				2,172,050.72			
View Cashflow				View Cashflow				View Cashflow				View Cashflow					
* The future tickers at horizon dates are for display purpose only.																	
Australia 61 2 9777 8600 Brazil 5511 2595 9000 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000																	
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2019 Bloomberg Finance L.P.																	
SN 223775 Ref: GHT-4-00 BLM27-2701-2 01-Feb-2019 21:35:12																	

Figure12 new short maturity long payer swaption

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

91) Actions	92) Products	93) Views	94) Info	95) Settings	Swap Manager
Solver (Premium)	Load	Edit	Trade	CCP	ID SL484PR1
3 Main	4 Details	5 Curves	6 Cashflow	7 Resets	8 Scenario
9 Risk	10 CVA	11 Matrix			
Deal	Fixed Float Swap	Counterparty	SWAP CNTRPARTY	Ticker / SWAP	20 Properties
Swap	SL484PR2	SL484PR3		Valuation Settings	
Leg 1:Fixed	Pay	Leg 2:Float	Receive	Curve Date	05/01/2019
Notional	45,880,000	Notional	45,880,000	Valuation	05/01/2019
Currency	USD	Currency	USD	CSA Coll Ccy	N/A
Effective	05/03/2019	Effective	05/03/2019	OIS DC Stripping	
Maturity	05/03/2020	Maturity	05/03/2020		
Coupon	2.560569 %	Index	3M US0003M		
Pay Freq	SemiAnnual	Spread	0.000 bp		
Day Count	301/360	Leverage	1.00000		
Calc Basis	Money Mkt	Latest Index	2.57563		
		Reset Freq	Quarterly		
		Pay Freq	Quarterly		
		Day Count	ACT/360		
Market					
Leg 1: NPV	1,427.68	Leg 2: NPV	0.00		
Accrued	0.00	Accrued	0.00		
Premium	0.00	Premium	0.00		
DV01	-4,631.93	DV01	1,189.80		
Valuation Results				20 Calculators	
Par Cpn	2.563725	Premium	0.00311	PV01	-4,524.55
Principal	1,427.68	BP Value	0.31118	DV01	-3,442.12
Accrued	0.00			Gamma (1bp)	-0.52
NPV	1,427.68				

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

91) Actions	92) Products	93) Views	94) Info	95) Settings	Swap Manager
Solver (Premium)	Load	Edit	Trade	CCP	ID SL484PR4
3 Main	4 Details	5 Curves	6 Cashflow	7 Resets	8 Scenario
9 Risk	10 CVA	11 Matrix			
Deal	Fixed Float Swap	Counterparty	SWAP CNTRPARTY	Ticker / SWAP	20 Properties
Swap	SL484PR5	SL484PR6		Valuation Settings	
Leg 1:Fixed	Receive	Leg 2:Float	Pay	Curve Date	05/01/2019
Notional	50MM	Notional	50MM	Valuation	05/01/2019
Currency	USD	Currency	USD	CSA Coll Ccy	N/A
Effective	05/03/2019	Effective	05/03/2019	OIS DC Stripping	
Maturity	05/03/2025	Maturity	05/03/2025		
Coupon	2.376000 %	Index	3M US0003M		
Pay Freq	SemiAnnual	Spread	0.000 bp		
Day Count	301/360	Leverage	1.00000		
Calc Basis	Money Mkt	Latest Index	2.57563		
		Reset Freq	Quarterly		
		Pay Freq	Quarterly		
		Day Count	ACT/360		
Market					
Leg 1: NPV	0.00	Leg 2: NPV	0.00		
Accrued	0.00	Accrued	0.00		
Premium	0.00	Premium	0.00		
DV01	29,133.29	DV01	-1,296.65		
Valuation Results				20 Calculators	
Par Cpn	2.376000	Premium	0.00000	PV01	27,836.43
Principal	0.00	BP Value	0.00000	DV01	27,836.65
Accrued	0.00			Gamma (1bp)	18.70
NPV	0.00				

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 -3 σ Shock: “Upwards Flatteners”

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 +3 σ Shock: “Downward Flatteners”

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 +1 σ 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.

91 Actions

92 Products

93 Views

94 Info

95 Settings

Swap Manager

Solver (Premium)

Load

Edit

Trade

CCP

ID SL4K60NF

3 Main

4 Details

5 Curves

6 Cashflow

7 Resets

8 Scenario

9 Risk

10 Matrix

Deal

Option

Style

Position

Type

Expiration

Swap Start

Swap End

Notification Days

Underlying

Market

Swaption

Counterparty

European

Long Payer

5Y X 15Y

04/29/2024

05/01/2024

05/01/2039

2

BD

IRS

CNTRPARTY

Notional

Currency

Strike

Delivery

Fee(Pay)

Fee Date

Premium Paid At Expiry

100MM

USD

2.813567 %

Price (Cash)

0.00

04/29/2024

Ticker /

IRS

Valuation Settings

Curve Date

Valuation

Model

Volatility Type

CSA Coll Ccy

OIS DC Stripping

04/28/2019

04/28/2019

Normal

Normal

N/A

Valuation Results

Calculators

ATM Strike

2.814258

Implied Vol (bp)

60.60

DV01

-47,863.59

Yield Value (bp)

54.117

Underlying Prem

0.00751

Gamma (1bp)

202.96

NPV Without Fee

5,886,936.98

Forward Prem

6.60863

Vega (1bp)

97,084.73

NPV

5,886,936.98

Premium

5.88694

Theta (1-day)

-1,188.34

Australia 61 2 9777 8600

Brazil 55 11 2395 9000

Europe 44 20 7330 7500

Germany 49 69 9204 1210

Hong Kong 852 2977 6000

Japan 81 3 3201 8900

Singapore 65 6212 1000

U.S. 1 212 510 2000

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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.

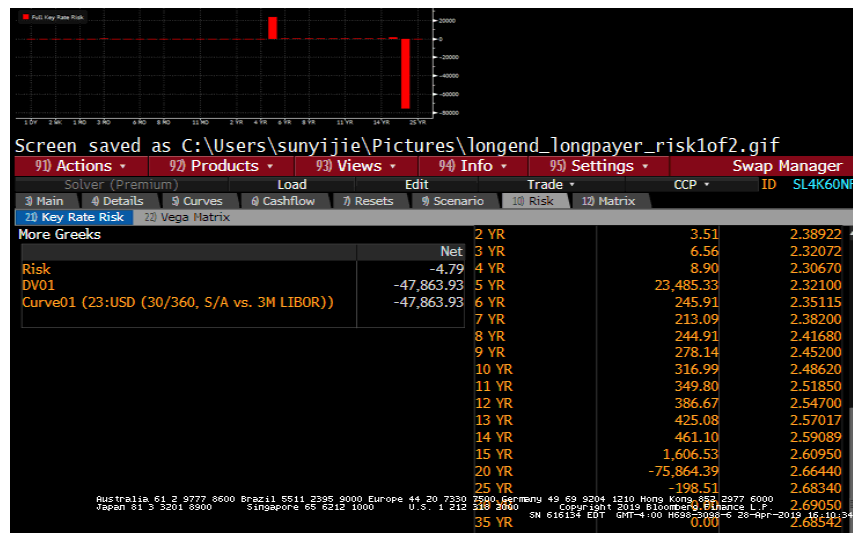


Figure16 Long maturity long payer swaption key rate risk

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.

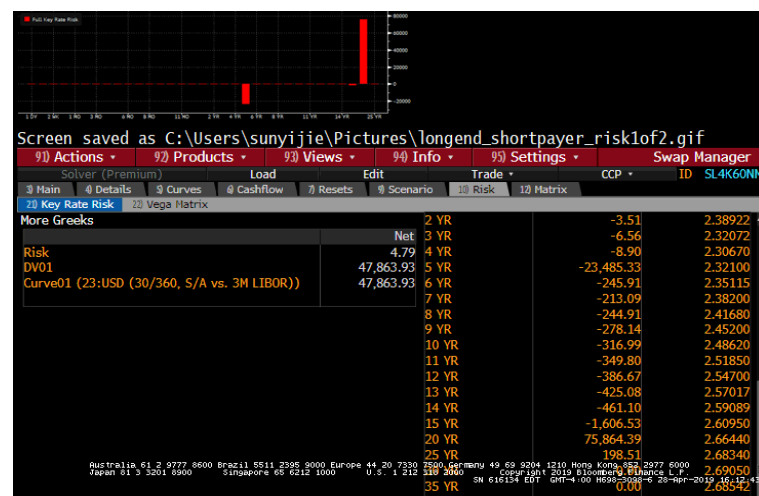


Figure19 Long maturity short payer swaption key rate risk

90 Actions	92 Products	93 Views	94 Info	95 Settings	Swap Manager
Solver (Premium)	Load	Edit	Trade	CCP	ID SL4K60NQ
Deal	Fixed Float Swap	Counterparty	SWAP CNTRPARTY	Ticker / SWAP	Properties
Swap SL4K60NR	Pay	Leg 2: Float	Receive	Valuation Settings	
Leg 1: Fixed	Pay	Leg 2: Float	Receive	Curve Date	04/28/2019
Notional	50,318,444	Notional	50,318,444	Valuation	04/28/2019
Currency	USD	Currency	USD	CSA Coll Ccy	N/A
Effective	04/30/2019	Effective	04/30/2019	OIS DC Stripping	
Maturity	04/30/2039	Maturity	04/30/2039		
Coupon	2.322599 %	Index	3M		
Pay Freq	SemiAnnual	Spread	0.000 bp		
Day Count	301/360	Leverage	1.00000		
Calc Basis	Money Mkt	Latest Index	2.58275		
		Reset Freq	Quarterly		
		Pay Freq	Quarterly		
		Day Count	ACT/360		
Market					
Leg 1: NPV	2,678,996.72	Leg 2: NPV	0.01		
Accrued	0.00	Accrued	0.00		
Premium	5.32	Premium	0.00		
DV01	-77,097.67	DV01	1,277.30		
Valuation Results				Calculators	
Par Cpn	2.664400	Premium	5.32409	PV01	-78,379.03
Principal	2,678,996.73	BP Value	532.40850	DV01	-75,820.37
Accrued	0.00			Gamma (1bp)	-146.58
NPV	2,678,996.73				

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

90 Actions	92 Products	93 Views	94 Info	95 Settings	Swap Manager
Solver (Premium)	Load	Edit	Trade	CCP	ID SL4K60NN
Deal	Fixed Float Swap	Counterparty	SWAP CNTRPARTY	Ticker / SWAP	Properties
Swap SL4K60NO	Receive	Leg 2: Float	Pay	Valuation Settings	
Leg 1: Fixed	Receive	Leg 2: Float	Pay	Curve Date	04/28/2019
Notional	49,979,679.7	Notional	49,979,679.7	Valuation	04/28/2019
Currency	USD	Currency	USD	CSA Coll Ccy	N/A
Effective	04/30/2019	Effective	04/30/2019	OIS DC Stripping	
Maturity	04/30/2024	Maturity	04/30/2024		
Coupon	2.322599 %	Index	3M		
Pay Freq	SemiAnnual	Spread	0.000 bp		
Day Count	301/360	Leverage	1.00000		
Calc Basis	Money Mkt	Latest Index	2.58275		
		Reset Freq	Quarterly		
		Pay Freq	Quarterly		
		Day Count	ACT/360		
Market					
Leg 1: NPV	3,755.03	Leg 2: NPV	-0.01		
Accrued	0.00	Accrued	0.00		
Premium	0.01	Premium	0.00		
DV01	24,741.88	DV01	-1,268.70		
Valuation Results				Calculators	
Par Cpn	2.321000	Premium	0.00751	PV01	23,471.97
Principal	3,755.02	BP Value	0.75131	DV01	23,473.18
Accrued	0.00			Gamma (1bp)	13.47
NPV	3,755.02				

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:

Screen saved as C:\Users\sunyjie\Pictures\shortbar.gif									
Multi Asset Risk System									
Views - Actions - Settings -									
728SHORT (Owned) USD 04/28/19 16:24									
Positions Scenario Chart Scenario Table Scenario Multi-asset Initial Margin									
Worksheet Standard Group by Currency Add Tickers Add Derivatives Add Strategy									
	Position	Notional	DV01	MktVal	Port Ccy	MktVal	MktPx	P&L	Port Ccy
Clear Filters									
[-] Portfolio Totals									
USD									
[-] /SWAP 2.32 04/30									
Pay Fixed									
Receive Float									
[-] /SWAP 2.32 04/30									
Receive Fixed									
Pay Float									
[-] /SWAP 2.32 04/30									
Pay Fixed									
Receive Float									
[-] /SWAP 2.32 04/30									
Pay Fixed									
Receive Float									
[-] /IRS 2.31 04/30									
Pay Float									
[-] /IRS 2.31 04/30									
Pay Float									

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.