Quantitative model on MPF Assets allocation

Analyst: Ko Wai Mei

Are you confident in your MPF asset allocation?

What if a good asset allocation can save your MPF account from loss or it even gains more than HSI?

1. Backtesting Information

- *Background information of investor*
- *Choices of funds*
- *Preview of the backtesting result*

2. System explanation

- *Workflow of the system*

3. Model exploration

- *Introduction of the LightGBM model*
- *Model Performance and factor independence*

4. Portfolio Performance

- *Portfolio Statistic*
- *Reason for portfolio*
- *Crisis management*

Background Information of backtesting

Profile of investor

1. Will contribute fixed amount per month to his/her MPF account
2. In the backtesting example, assuming HKD2000/month
3. Willing to rebalance his/her portfolio each month
4. Aggressively get capital growth with a relatively safe asset allocation

Choices of funds (Using AIA MPF funds as sample)

- Total 24 funds

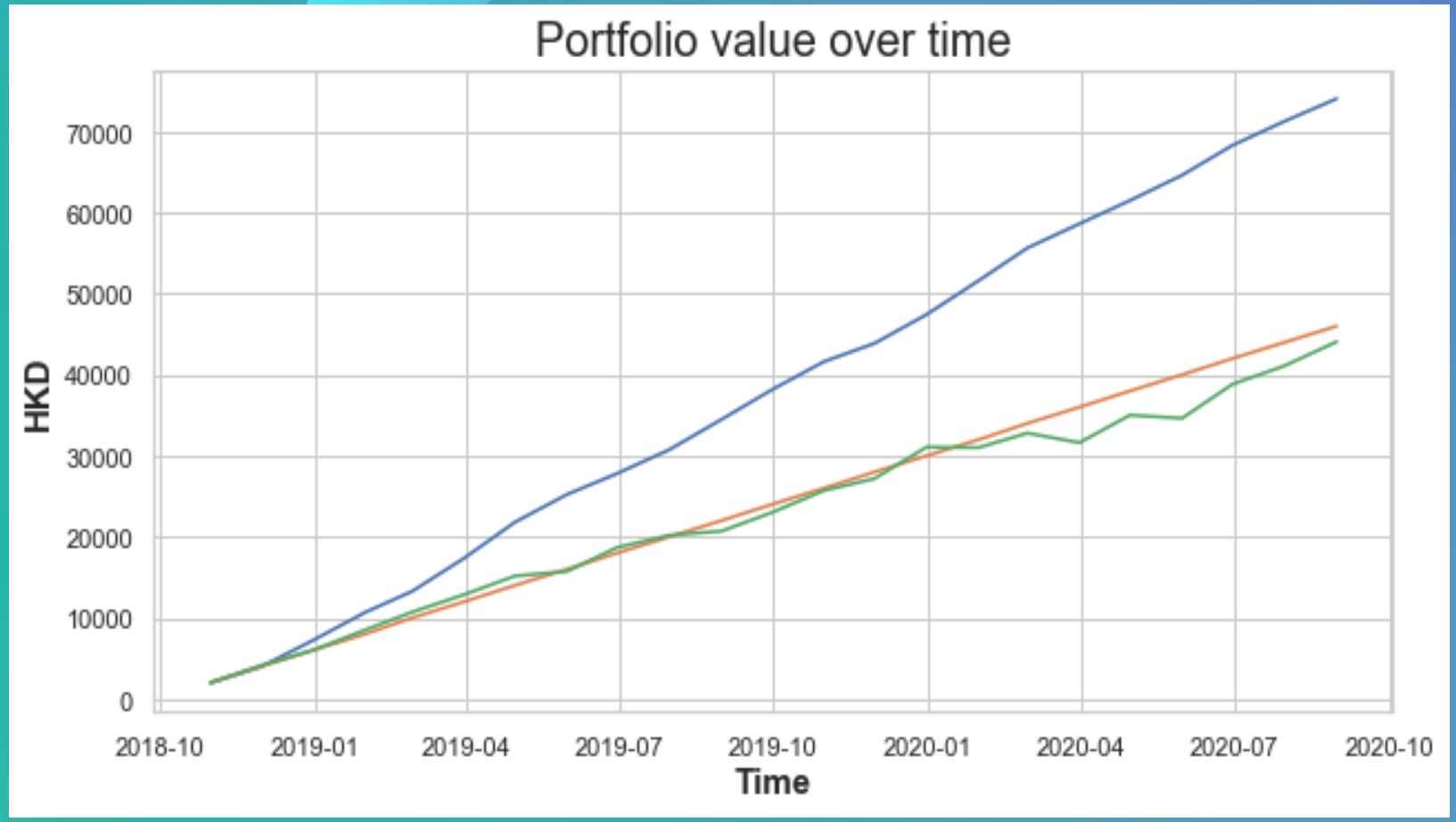
65歲後基金
大中華股票基金
中港動態資產配置基金
中港基金
日本股票基金
北美股票基金
全球基金
均衡組合
亞洲股票基金
亞洲債券基金
亞歐基金
美洲基金
香港股票基金
核心累積基金
基金經理精選退休基金
強積金保守基金
富達增長基金
富達穩定資本基金
富達穩定增長基金
綠色退休基金
增長組合
歐洲股票基金
環球債券基金
穩定資本組合

Backtesting result during 31/10/2018 - 30/9/2020

Our portfolio

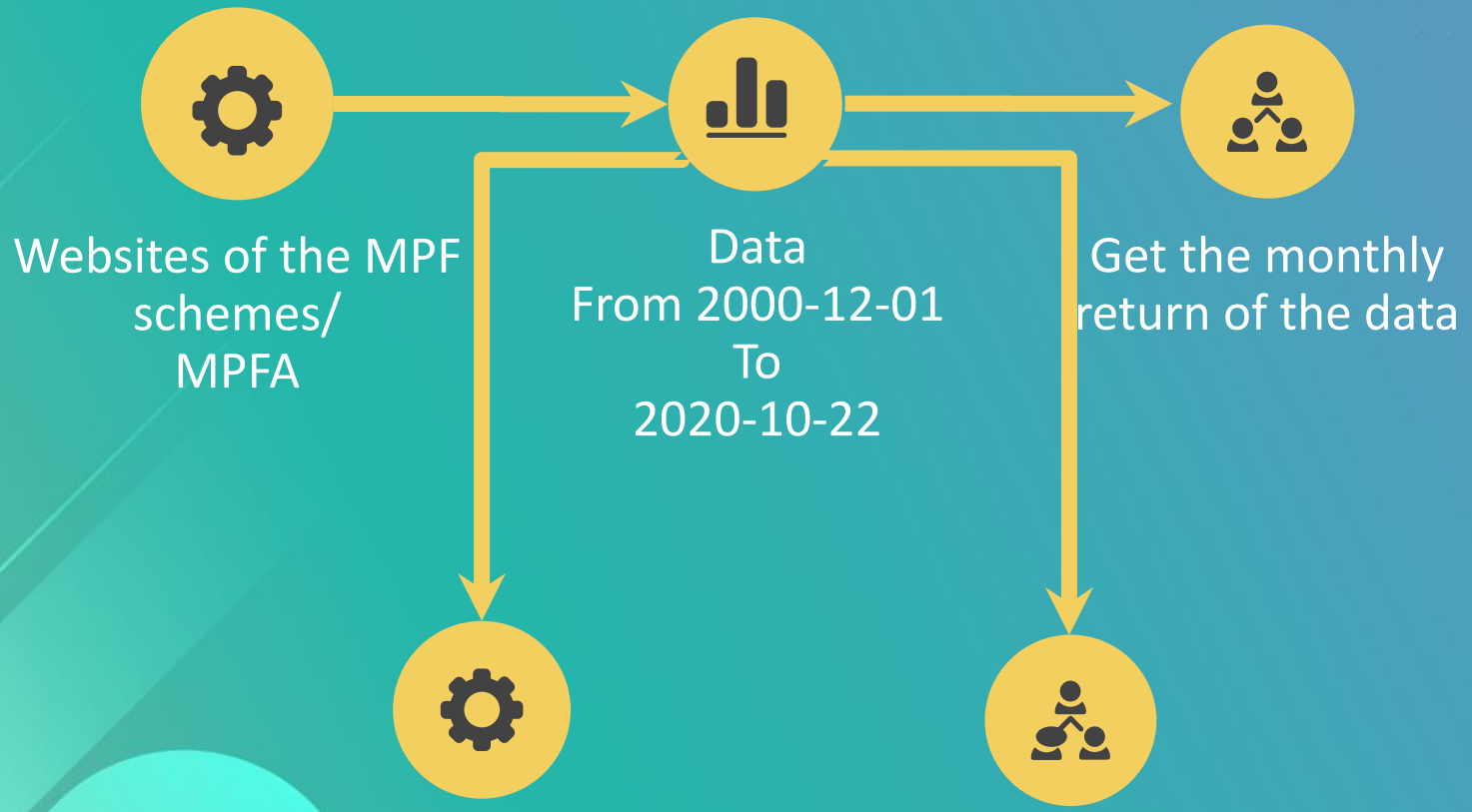
VS

Other assets allocation



System Explanation

Funds allocation System



Funds allocation System

Modeling data
From 2000-12-01
to
2018-09-30

1. Use slicing window and generate weight for each fund in each period
2. Each weighting cannot be smaller than 2%

Analyse the monthly return
by applying the weightings for a month

Label the data:

With 1:
1. Portfolio monthly return >= HIS monthly return+3%
2. Portfolio monthly standard derivation < HIS monthly standard derivation

With 0:
1. Portfolio monthly return < HIS monthly return+3%
2. Portfolio monthly standard derivation > HIS monthly standard derivation

Labelling Illustration

Portfolio 1

Date	Fund 1		Fund 24	Portfolio Value	Portfolio Return	Portfolio Volatility
2001-01-31	1.1403	.....	103.3820	208.2536		
2001-02-28	1.1605	.....	105.3451	219.3535	5.33%	4.57%

Weighting 1 . . . Weighting 24

Weightings are randomized for simulating different market portfolios

Calculated by:
2001-01-31 weighting
x
2001-02-28 Assets prices

Labelling Illustration

Portfolio 1

Date	Fund 1		Fund 24	Portfolio Value	Portfolio Return	Portfolio Volatility
2001-01-31	1.1403	……	103.3820	208.2536		
2001-02-28	1.1605	……	105.3451	219.3535	5.33%	4.57%

Weighting 1 • • • Weighting 24

More than 3%

Only these two conditions are met

⇒ **Label the weightings for 2001-01-31 with 1**

⇒ **Otherwise, label with 0**

1%

HSI Return for Feb

6%

HSI Volatility for Feb

Funds allocation System

Inputs:

1. Weightings for each fund
2. Label associated with weightings (Target Variable)

LightGBM Model

- Learn what factors make the weightings being good

-> those labelled with 1

Output:
Trained Model

Funds allocation System

Inputs:
1. Weightings for each fund for each month

Trained Model

Outputs:
Good weightings

Selected a best weighting for that period depending on your choice
- Highest return
- Minimum volatility
- - Highest Sharpe ratio

Apply the optimal weightings to construct your portfolio

Model Exploration

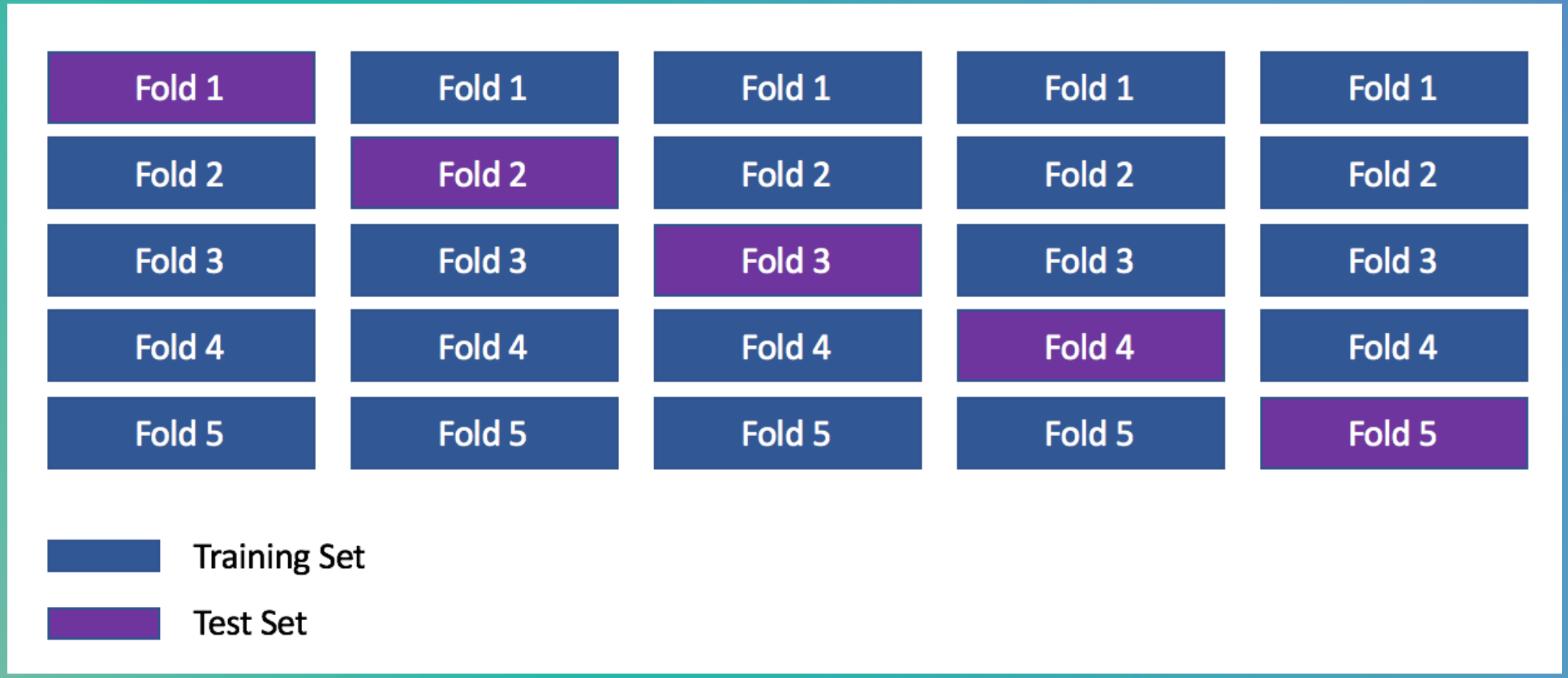
Introduction of the LightGBM model

- The most common model used by the Kaggle champions
- Fast training speed and low memory usage
- High-performance gradient boosting framework – for financial data

```
gkf = KFold(n_splits=5, shuffle=True, random_state=42).split(x_train, y_train)

param_grid = {
#     'learning_rate' : [round(x,2) for x in np.random.uniform(0, 1, 10)],
    'learning_rate' : [0.01,0.05,0.1,0.3,0.6],
    'max_depth' : np.random.randint(5, 20,5),
    'feature_fraction' : [0.5,0.7,0.8,0.9],
#     'cat_smooth' : [1,10,15],
    'num_leaves': np.random.randint(10, 50,5),
#     'min_data_in_leaf': np.random.randint(5, 20,5),
#     'lambda_l1': [round(x,2) for x in np.random.uniform(0, 1, 3)],
#     'lambda_l2': np.random.randint(0, 50 ,3),
    'boosting_type' : ['gbdt','rf','dart']
    }

lgb_estimator = lgb.LGBMClassifier(objective='binary', num_boost_round=100, metric='binary_logloss',num_class=2)
gsearch = GridSearchCV(estimator=lgb_estimator, param_grid=param_grid, cv=gkf)
lgb_model = gsearch.fit(x_train, y_train)

# Best Score
print("Best score: %0.3f" % lgb_model.best_score_)
print("Best parameters set:")

# Best params
best_parameters = lgb_model.best_estimator_.get_params()
for param_name in sorted(best_parameters.keys()):
    print("\t%s: %r" % (param_name, best_parameters[param_name]))
```

Techniques for optimising the model

- Cross validation



Techniques for optimising the model

- Grid Search
- Tuning the hyper parameters of the model for better prediction

- Sample of parameters adopted by the model

```
param_grid = {
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    'learning_rate' : [0.01,0.05,0.1,0.3,0.6],
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    'num_leaves': np.random.randint(10, 50,5),
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#     'lambda_l2': np.random.randint(0, 50 ,3),
    'boosting_type' : ['gbdt','rf','dart']
    }

lgb_estimator = lgb.LGBMClassifier(objective='binary', num_boost_round=100, metric='binary_logloss',num_class=2)
```

Performance of the model

Reference: Dummy Model

```
from sklearn.dummy import DummyClassifier
from sklearn.model_selection import KFold
from sklearn.model_selection import cross_val_score
strategy = ['uniform','stratified']
for str_item in strategy:
    # define the reference model
    model = DummyClassifier(strategy=str_item)
    # evaluate the model
    gkf = KFold(n_splits=5, shuffle=True, random_state=0).split(x_train, y_train)
    scores = cross_val_score(model, x_train, y_train, scoring='accuracy', cv=gkf, n_jobs=-1)
    # summarize performance
    print('Mean Accuracy: %.3f (%.3f)' % (scores.mean(), scores.std()))
```

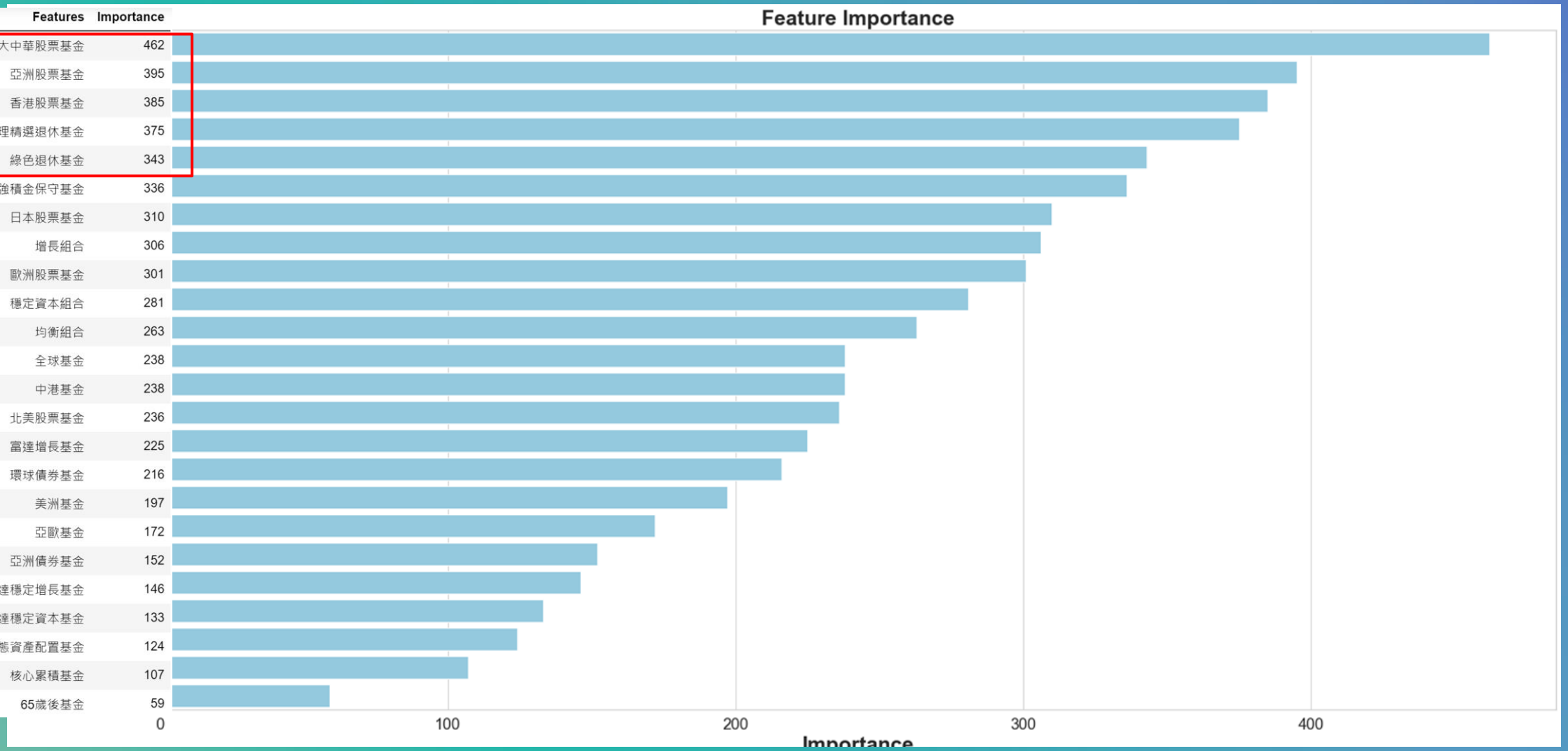
```
Mean Accuracy: 0.508 (0.014)
Mean Accuracy: 0.671 (0.010)
```

Result of LightGBM model

```
Best score: 0.788
Best parameters set:
        boosting_type: 'gbdt'
        class_weight: None
        colsample_bytree: 1.0
        feature_fraction: 0.5
        importance_type: 'split'
        is_unbalance: True
        learning_rate: 0.01
```

Features Importance

Features	Importance
大中華股票基金	462
亞洲股票基金	395
香港股票基金	385
基金經理精選退休基金	375
綠色退休基金	343
強積金保守基金	336
日本股票基金	310
增長組合	306
歐洲股票基金	301
穩定資本組合	281
均衡組合	263
全球基金	238
中港基金	238
北美股票基金	236
富達增長基金	225
環球債券基金	216
美洲基金	197
亞歐基金	172
亞洲債券基金	152
富達穩定增長基金	146
富達穩定資本基金	133
中港動態資產配置基金	124
核心累積基金	107
65歲後基金	59



Portfolio Performance

Portfolio Statistics

Backtesting result during 31/10/2018 - 30/9/2020

	System Selected Portfolio	HSI	Difference
Total period retuen (%)	9.69	-15.58	25.27
Total period standard deviation (%)	4.44	0.06	4.38
Annulised return (%)	4.74	-8.12	12.86
Annulised standard deviation (%)	1.13	0.79	0.34

Why do we need a portfolio?

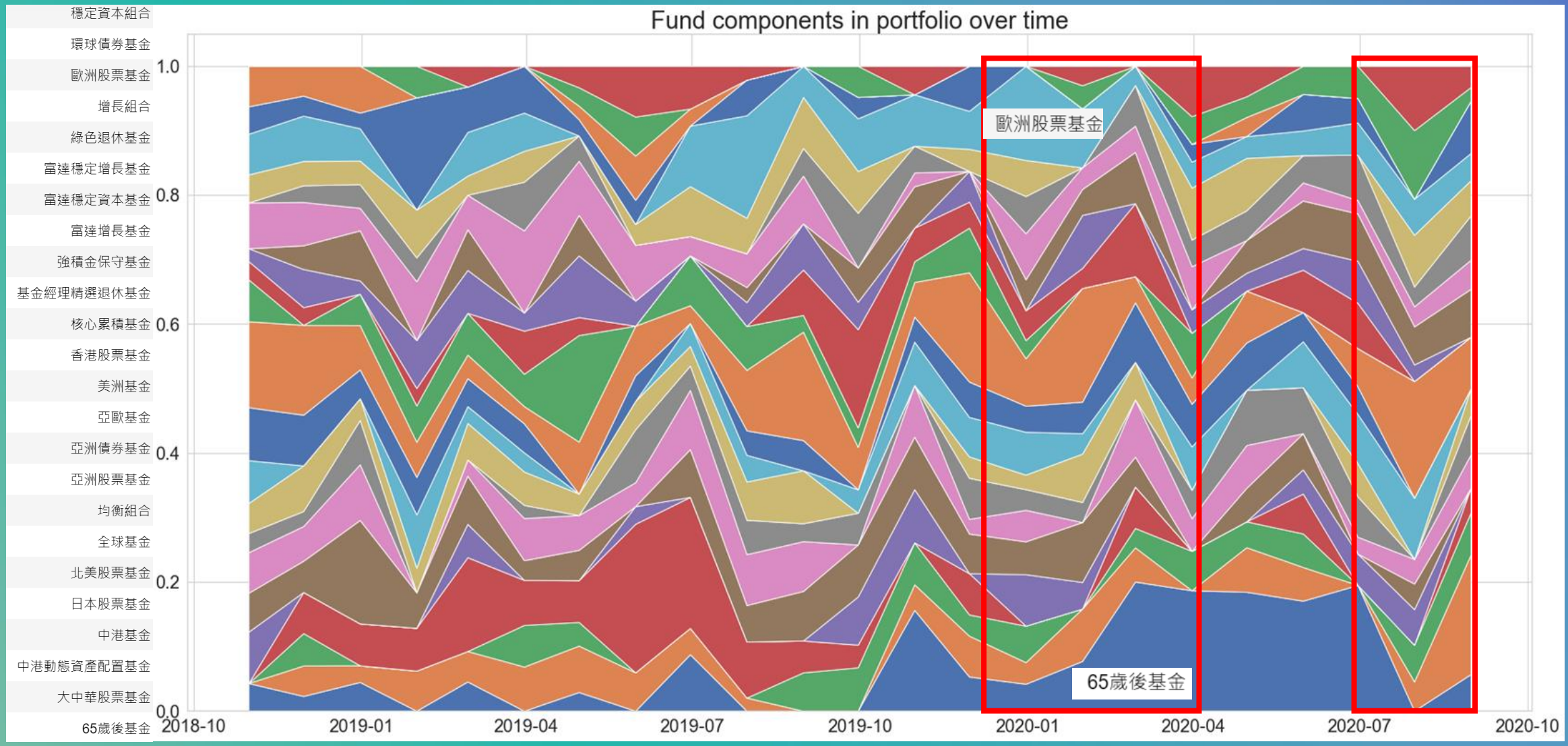
Reasons for constructing a portfolio

Risk Diversification and Reduction

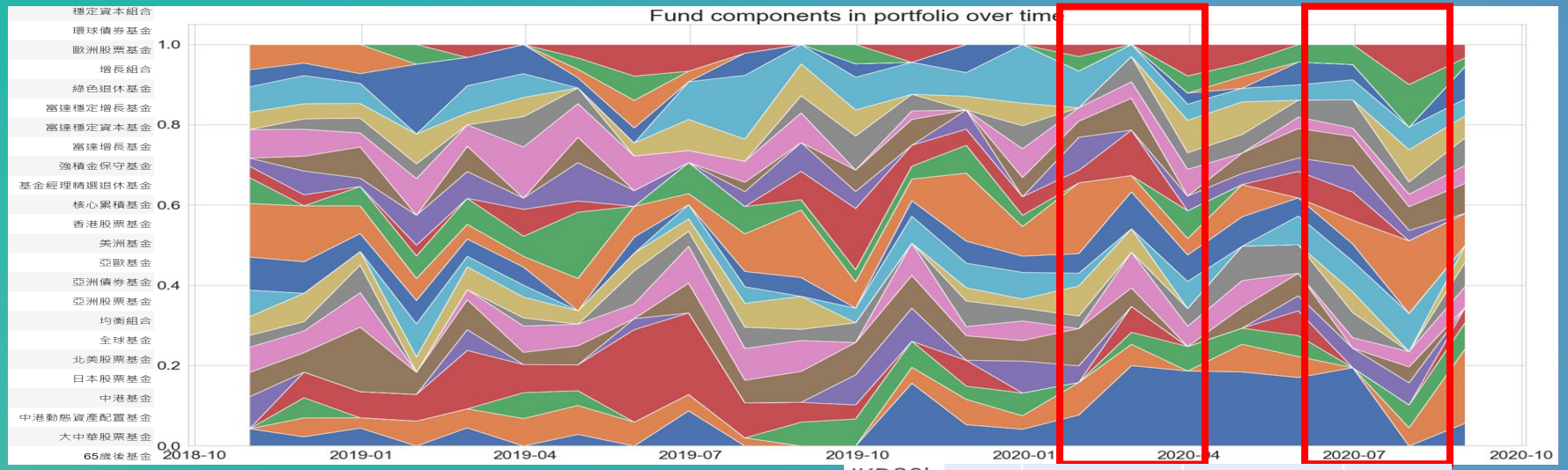
Seek advantage of different investment instruments

Set your mind more peaceful

Components of fund over time



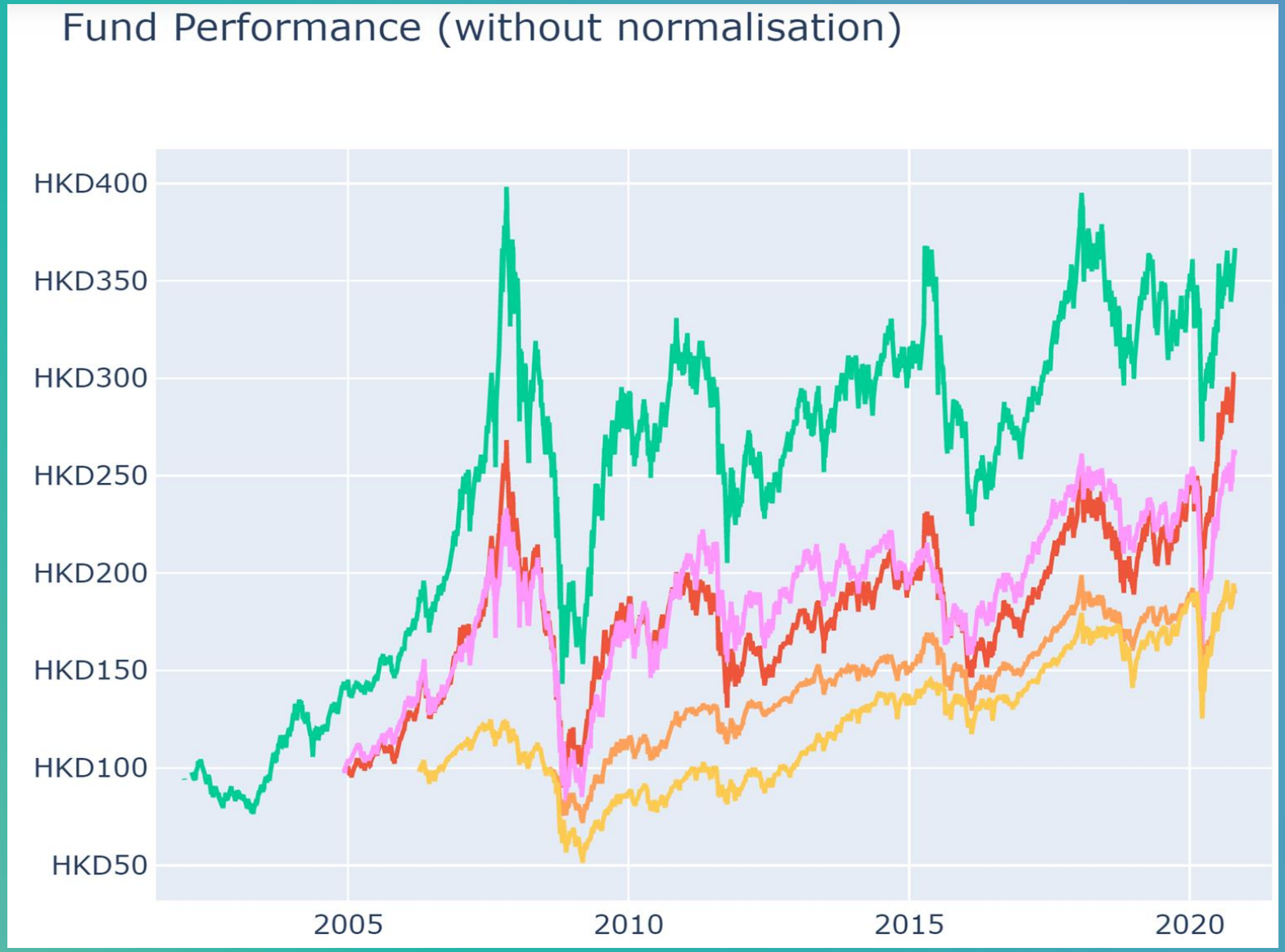
HSI in the same period



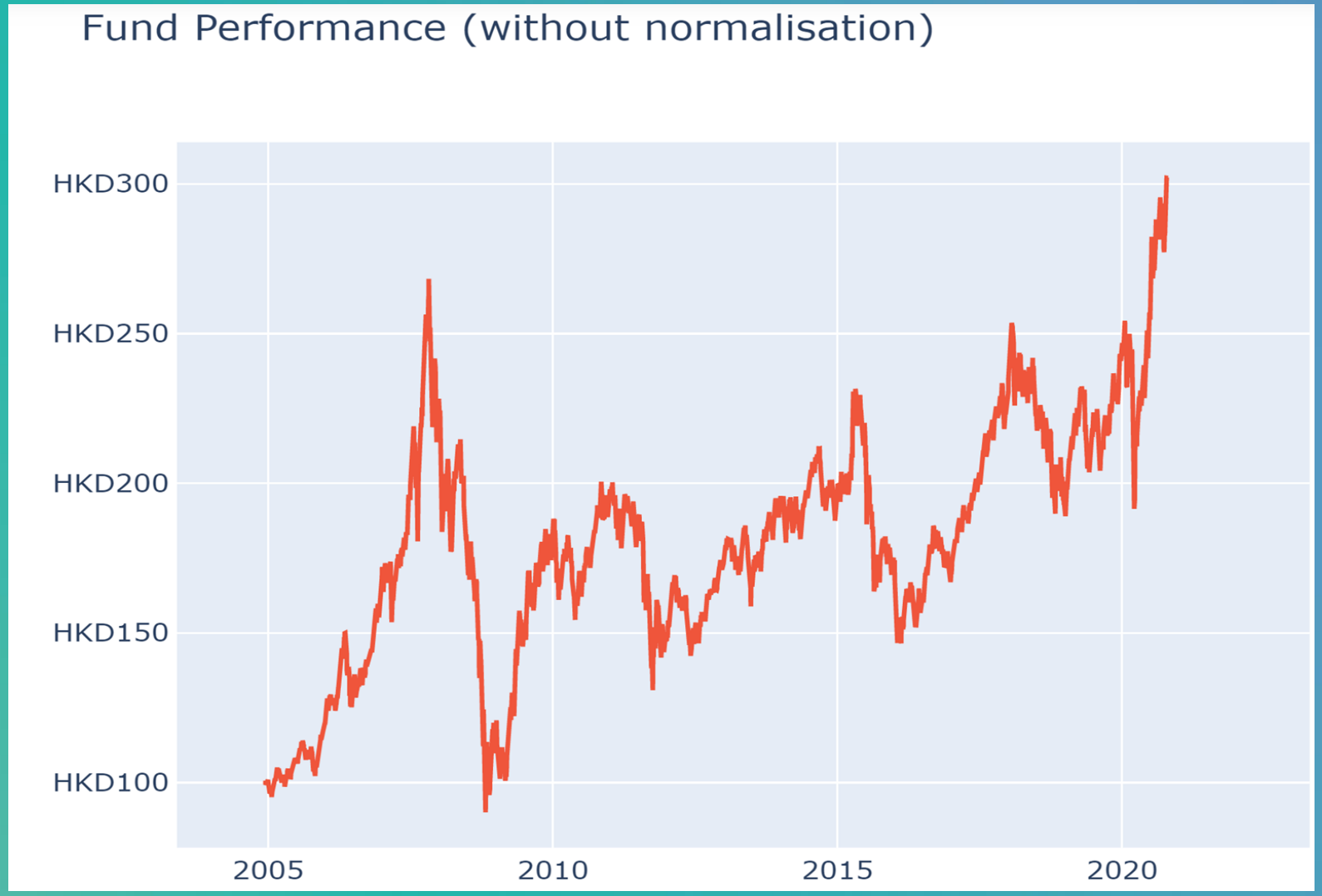

What can be next?
BUSINESS
Economy of the European Union
25 great jobs for people who love to travel
CASHBOOK

Appendix: Details of funds with high importance in model

Combined funds graph

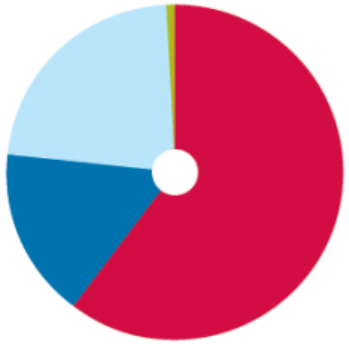


大中華股票基金


Fund Performance (without normalisation)
HKD300
HKD250
HKD200
HKD150
HKD100
2005
2010
2015
2020

大中華股票基金

資產分布 | ASSET ALLOCATION



- 60.37% 中國 China
- 16.31% 香港 Hong Kong
- 22.66% 台灣 Taiwan
- 0.66% 現金及其他 Cash and Others

十大投資項目# | TOP TEN HOLDINGS#

截至2020年7月31日 As at 31 July 2020

	佔資產淨值百分比 % of NAV
台灣積體電路製造股份有限公司 TAIWAN SEMICONDUCTOR MANUFACTURING CO LTD	9.60%
騰訊控股 TENCENT HOLDINGS LTD	9.53%
阿里巴巴集團 ALIBABA GROUP HOLDING LTD	4.87%
美團點評 MEITUAN DIANPING	3.94%
中國平安 PING AN INSURANCE (GROUP) CO OF CHINA LTD H	3.61%
友邦保險 AIA GROUP LTD	3.37%
香港交易所 HONG KONG EXCHANGES & CLEARING LTD	3.15%
金蝶國際軟件集團有限公司 KINGDEE INTERNATIONAL SOFTWARE GROUP LIMITED	2.07%
招商銀行 CHINA MERCHANTS BANK	1.98%
藥明生物 WUXI BIOLOGICS	1.89%

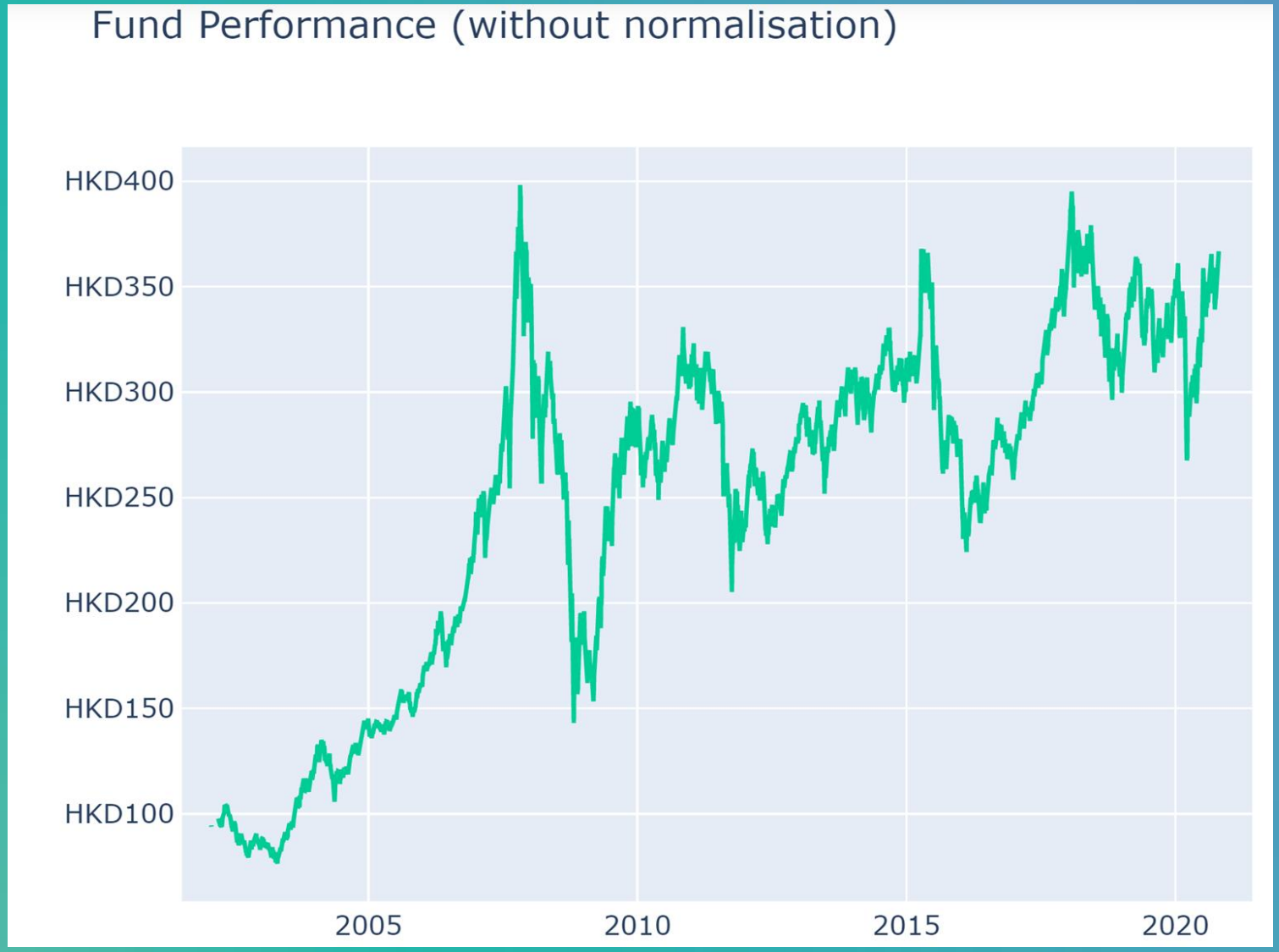
基金表現 | FUND PERFORMANCE

（資產淨值對資產淨值，以港元計算□ NAV to NAV, in HK Dollars□）

	一年 1 Year	三年 3 Years	五年 5 Years	十年 10 Years	成立至今 Since Launch	年初至今 YTD
累積回報 Cumulative Return (%)						
基金 Fund	36.64	33.61	67.77	69.01	190.39	19.20
平均成本法回報▲ Dollar Cost Averaging Return (%)▲	21.79	28.65	42.84	52.03	69.74	19.25
年度化回報 Annualized Return (%)						
基金 Fund	36.64	10.14	10.90	5.39	7.00	-
平均成本法回報▲ Dollar Cost Averaging Return (%)▲	21.79	8.76	7.39	4.28	3.42	-
曆年回報 Calendar Year Return(%)	**2019**	**2018**	**2017**	**2016**	**2015**	**-**
基金 Fund	24.57	-15.08	35.23	-2.32	-11.33	-
平均成本法回報▲ Dollar Cost Averaging Return (%)▲	10.32	-11.35	12.53	2.04	-9.41	-

source:
aia mpf prime value choice fund performance review-aug-2020

香港股票基金


Fund Performance (without normalisation)
HKD400
HKD350
HKD300
HKD250
HKD200
HKD150
HKD100
2005
2010
2015
2020

香港股票基金

資產分布 | ASSET ALLOCATION

- 11.38% 消費品 Consumer Goods
- 14.60% 消費服務 Consumer Services
- 40.80% 金融 Financials
- 6.20% 健康護理 Health Care
- 3.78% 工業 Industrials
- 15.34% 科技 Technology
- 5.93% 其他行業 Other Sectors
- 1.97% 現金及其他 Cash and Others

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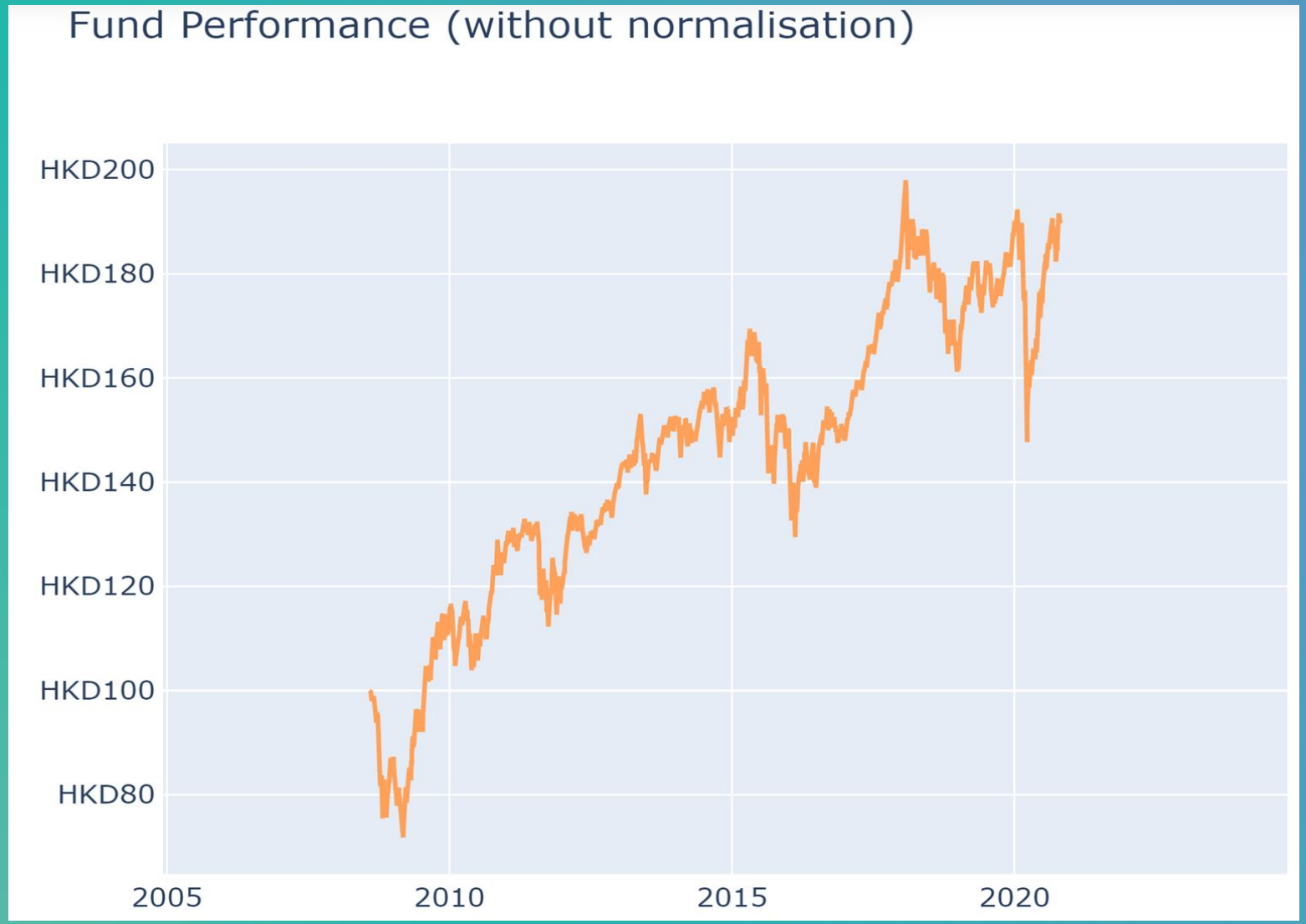
	一年 1 Year	三年 3 Years	五年 5 Years	十年 10 Years	成立至今 Since Launch	年初至今 YTD
累積回報 Cumulative Return (%)						
基金 Fund	14.04	8.55	32.20	31.11	260.67	3.49
平均成本法回報▲ Dollar Cost Averaging Return (%)▲	11.26	7.45	17.08	21.53	73.10	12.44
年度化回報 Annualized Return (%)						
基金 Fund	14.04	2.77	5.74	2.75	7.11	-
平均成本法回報▲ Dollar Cost Averaging Return (%)▲	11.26	2.42	3.20	1.97	2.98	-
曆年回報 Calendar Year Return(%)	**2019**	**2018**	**2017**	**2016**	**2015**	**-**
基金 Fund	12.89	-13.48	35.44	-4.76	-10.75	-
平均成本法回報▲ Dollar Cost Averaging Return (%)▲	3.77	-10.11	13.66	1.95	-9.13	-

source:
aia mpf prime value choice fund performance review-aug-2020

基金經理精選退休基金


Fund Performance (without normalisation)
HKD200
HKD180
HKD160
HKD140
HKD120
HKD100
HKD80
2005
2010
2015
2020

基金經理精選退休基金

資產分布 | ASSET ALLOCATION

- 14.31% 歐洲股票 Europe Equities
- 22.25% 香港股票 Hong Kong Equities
- 9.20% 日本股票 Japan Equities
- 14.52% 美國股票 United States Equities
- 9.37% 其他股票 Other Equities
- 28.83% 其他債券 Other Bonds
- 1.52% 現金及其他 Cash and Others

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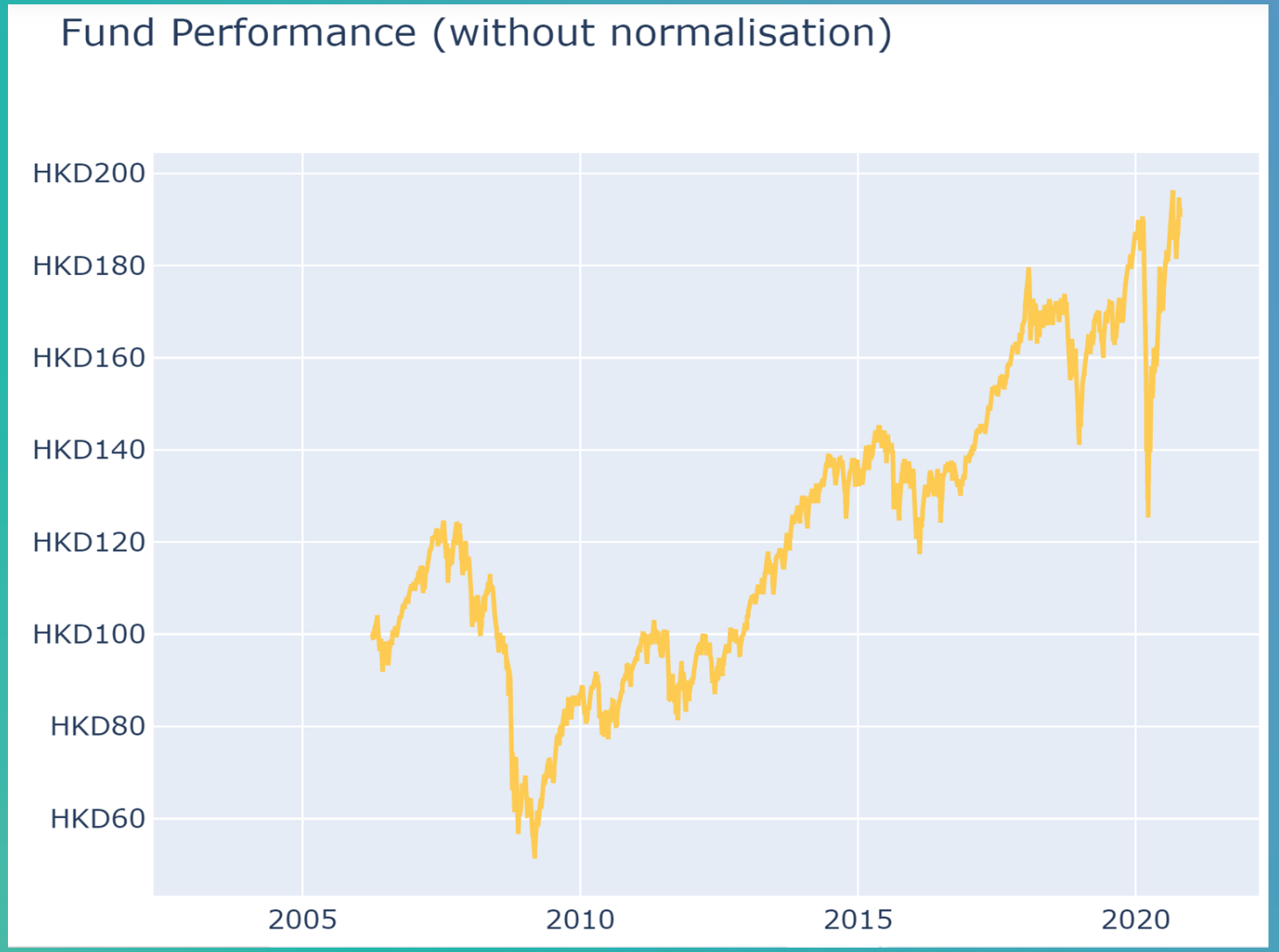
累積回報 Cumulative Return (%)						
基金 Fund	7.63	9.31	28.76	71.76	88.99	0.11
平均成本法回報▲ Dollar Cost Averaging Return (%)▲	6.93	6.17	13.58	24.37	36.41	8.58
年度化回報 Annualized Return (%)						
基金 Fund	7.63	3.01	5.19	5.56	5.41	-
平均成本法回報▲ Dollar Cost Averaging Return (%)▲	6.93	2.01	2.58	2.21	2.60	-
曆年回報 Calendar Year Return(%)	**2019**	**2018**	**2017**	**2016**	**2015**	**-**
基金 Fund	15.41	-11.49	24.47	-1.00	-1.27	-
平均成本法回報▲ Dollar Cost Averaging Return (%)▲	5.45	-8.71	9.97	1.83	-3.33	-

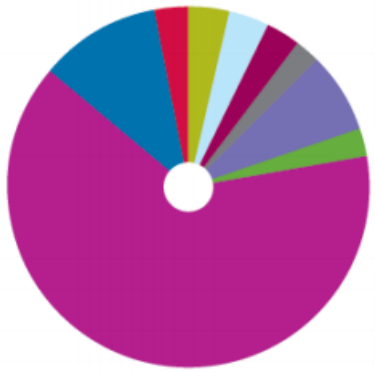
source:
aia mpf prime value choice fund performance review-aug-2020

綠色退休基金


Fund Performance (without normalisation)
HKD200
HKD180
HKD160
HKD140
HKD120
HKD100
HKD80
HKD60
2005
2010
2015
2020

綠色退休基金

資產分布 | ASSET ALLOCATION



- 3.82% 英國 Britain
- 3.62% 加拿大 Canada
- 3.09% 法國 France
- 2.08% 德國 Germany
- 7.26% 日本 Japan
- 2.57% 瑞士 Switzerland
- 63.85% 美國 United States
- 10.89% 其他國家 Other Countries
- 2.82% 現金及其他 Cash and Others

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阿里巴巴集團 ALIBABA GROUP HOLDING LTD	4.87%
美團點評 MEITUAN DIANPING	3.94%
中國平安 PING AN INSURANCE (GROUP) CO OF CHINA LTD H	3.61%
友邦保險 AIA GROUP LTD	3.37%
香港交易所 HONG KONG EXCHANGES & CLEARING LTD	3.15%
金蝶國際軟件集團有限公司 KINGDEE INTERNATIONAL SOFTWARE GROUP LIMITED	2.07%
招商銀行 CHINA MERCHANTS BANK	1.98%
藥明生物 WUXI BIOLOGICS	1.89%

基金表現 | FUND PERFORMANCE

（資產淨值對資產淨值，以港元計算□ NAV to NAV, in HK Dollars□）

	一年 1 Year	三年 3 Years	五年 5 Years	十年 10 Years	成立至今 Since Launch	年初至今 YTD
累積回報 Cumulative Return (%)						
基金 Fund	14.98	24.02	46.26	141.06	93.23	3.68
指標 Benchmark[4]	15.52	31.14	64.16	176.41	146.06	4.77
平均成本法回報▲ Dollar Cost Averaging Return (%)▲	11.42	14.95	25.09	50.46	70.06	13.17
年度化回報 Annualized Return (%)						
基金 Fund	14.98	7.44	7.90	9.20	4.67	-
指標 Benchmark[4]	15.52	9.45	10.41	10.69	6.44	-
平均成本法回報▲ Dollar Cost Averaging Return (%)▲	11.42	4.75	4.58	4.17	3.75	-
曆年回報 Calendar Year Return(%)	**2019**	**2018**	**2017**	**2016**	**2015**	**-**
基金 Fund	26.80	-12.49	22.38	2.08	-1.35	-
平均成本法回報▲ Dollar Cost Averaging Return (%)▲	9.70	-11.49	9.35	3.59	-1.71	-

source:
aia mpf prime value choice fund performance review-aug-2020