The Glory of ROIC

A secret to gain 12% annualized Alpha*

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*Thanks for Shi et al. (2020) provide us the factor models' data of Chinese stock market.

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摘要

We construct a roughly sector-neutral long-only portfolio based on ROIC(TTM), and the backtest shows our strategy beats the market continues in the long run. The annualized Alpha of our backtest is 0.12, and the Sharpe ratio is 0.73. The Alpha is generally statistically significant in several standard factor models as well. Considering the actual trading cost and slippage, the downside risk is never no more than the market. We think the Alpha we found may be from the monopolists' hidden market power.

According to the Salop circle model(Salop, 1979), each company may occupy a niche market and preserve their business. Thus, the company' s profitability is much independent and stable, and we believe that the company with high-profit ability will have better stock performance in the long run. It occurs to us constructing a long-only portfolio based on the profitability of companies and the most common corresponding financial ratios are ROA and ROE. However, because asset structures vary among industries, our portfolio may deviate from sector-neutral. We only focus on the nature of business, whereas ROE includes the effect of leverage. Surprisingly, if we combine ROA and ROE, we find ROIC satisfies our requirement, which characterizes the long-term return accurately for the invested capital. (see formula 1[1].

$$\text{ROIC(TTM)} = \frac{\sum_{t=0}^{-3} \text{operating income}_t \times (1 - \text{tax rate})}{\text{Book Value of Invested Capital}_{t-1}} \tag{1}$$

<Table 1 Here >

<Figure 1 Here>

Once we select the factor, we choose data of two years, 2017 and 2018, to test factor predictability (see Table 1[2]). Because hedges fund suffered considerable losses in 2017[3] but beat the market drastically in 2018[4], these two years are kindly representative. As shown in figure 1, stocks with high ROIC significantly outperform those with lower ROIC, which indicates the effectiveness of our indicator. Then, we run a complete backtest according to our strategy. Due to limited computation power, we merely select the stock from CSI 800 Index (中证 800), which contains the most representative securities with excellent liquidity and ranging from medium

[1] "t=0" represents the present quarter.

[2] To accelerate the computation, we have standardized the data.

[3] 2017 年被量化投资“虐”哭的你，今年还会继续投它吗?：每经网

[4] 2018 年私募基金行业年报：（四）专题分析：兴业证券

to large market cap. We adjust our portfolio according to the latest ROIC(TTM) ranking. We will buy the top 20 stocks with the highest ROIC(TTM). It is costly to involve more securities because our initial capital is only 1 million yuan. Expressly, we set trade time at 2:40 pm for it is less likely for stock to crash or shoot up at this time and set rebalancing frequency at one month. We will try to invest as fully as possible, and the commission fee is usual (see Appendix C).

<Figure 2 Here>

<Table 2 Here >

<Figure 3 Here>

<Figure 4 Here>

Figure 2 and Table 2 show the performance of the strategy. Annualized return of our portfolio during the backtest period is 22%. Its annualized Alpha is 12%, and the Sharpe ratio is 0.73. Overall, we beat the market in the long run[5]. Figure 3 and 4 record the monthly return of our backtest, which is of Leptokurtic distribution.

<Figure 5 Here>

<Figure 6 Here>

<Figure 7 Here>

<Figure 8 Here>

<Table 3 Here >

<Figure 9 Here>

As sketched by figure 5 and figure 6, our portfolio all have positive returns, except for the bear market year, and the Alpha is non-negative. We find the volatility of our portfolio is generally a little bit higher than and highly consistent with the market's (see figure 7). However, we only include 20 stocks in our portfolio, and the position level is always on the verge of 100%[6] (see figure 8). The downside risk of our portfolio is lower than the market, and its recovery rate is much high. For example, the maximum drawdown of our portfolio is 37.56%, and it recovers in 495 days. In contrast, the most significant drawdown of the market is 47.57%, whose recovery time is 2037 days (see Table 3 and figure 9).

<Figure 10 Here>

<Table 4 Here>

<Figure 11 Here>

[5]We select CSI 300 Index as the market benchmark (the same below)

[6]We may keep a tiny bit of money in our hands for some reason, such as we have no more money to buy even one lot of stock.

The previous backtest consider the trading cost but ignores the slippage effect. If we concern about the shock of our orders on the market, the result is robust (see figure 10) because our turnover rate is much lower (see Table 4). The max monthly turnover rate is below 50%, and nearly one-half of the monthly turnover rates are around zero (see figure 11).

<Figure 12 Here>

<Table 5 Here>

<Figure 13 Here>

As we stated at the head of this paper, we believe the companies with high ROIC will have better stock performance in the future. We have tested ROIC on several standard factor models, except the q-factor model[7]; all Alphas are statically significant (see Table 5). Meanwhile, Large numbers of research have proved the existence of ROIC's Alpha (Brown & Rowe, 2007; Kanuri & McLeod, 2016; Zaremba & Czapkiewicz, 2017). Liu (2016) also shows the ROIC also applies to China stock market and can generate an annualized Alpha as high as 13.2%.

However, all these researches attribute the Alpha to the productivity premium while we think a more apt description of the Alpha's source is the monopolist's hidden market power. The productivity of companies is relatively independent of the macro-policy, especially for compulsory and optional consumption sectors whose beta is usually low and precisely the most considerable two parts of our portfolio (see figure 12). Still, the Alpha transiently disappears in 2014Q4[8] and 2019H1[9] (see figure 6). During these two time periods, the Chinese central government concentrated on the anti-corruption and de-leverage separately, which both hinder the leading enterprises' market power because these companies usually have vague relationships with governments and large state-owned enterprises (SOE). Some SOEs even play a role as shadow banks for private companies (Li, 2014), contributing to their hidden market power. Thus, if the market power is not disturbed by antitrust, de-leveraging, or other policies that may affect the leading companies' market power, we believe ROIC will continue its glory in 2021 (see figure 13[10]).

[7] Hou et al. (2015) exclude the finance sector when construct their factor model whereas we also allocate part of capital on finance companies' stocks (see figure 12).

[8] 中纪委亮出去年成绩单“打虎”数量创近 30 年纪录：新华网

[9] 中国的“去杠杆”已经结束：华尔街日报

[10] We have deployed an mock trading program on joinquant.com (password: **xp75gy**), you can follow us if you are interested in the following story of ROIC

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A Table

No	min	max	mean	std	count	count %
1	-0.547	0.030	-0.003	0.065	12792	20.06
2	0.020	0.057	0.038	0.008	12721	19.95
3	0.042	0.091	0.068	0.011	12748	19.99
4	0.078	0.142	0.108	0.014	12721	19.95
5	0.126	1.152	0.212	0.089	12788	20.05

表 1: The quantile distribution of ROIC factor (2013Q1 - 2020Q4)

Annualized return	0.22
Sharpe ratio	0.73
Cumulative return	3.7
R-square of reg ln(Cumulative return) on time	0.87
Annualized fluctuations	0.25
Maximum drawdown (daily)	0.38
Alpha	0.12
Skewness	-0.52
Beta	0.9
Kurtosis	3.25

表 2: Backtest Result(2013/01/01 – 2020/12/31)

No	drawdown	start_date	end_date	recovery date	length_of_time
1	37.56%	2015/6/12	2016/1/28	2017/6/23	495
2	35.30%	2017/11/13	2019/1/3	2020/1/7	526
3	17.79%	2013/10/21	2014/5/19	2014/10/8	237
4	13.49%	2013/5/28	2013/7/31	2013/10/14	90
5	11.37%	2020/3/5	2020/3/23	2020/4/20	32

表 3: The largest 5 drawdown

Holding Days	
average holding days	341.86
median holding days	183
max holding days	2923
min holding days	28
Trading	
# trading	175
% trading with profit	63.4%

表 4: Holding days and tradings

Factor Model	Annualized Alpha
CAPM	0.12**
	(2.12)
Carhart (Carhart, 1997)	0.11**
	(2.37)
Daniel-Hirshleifer-Sun (Daniel et al., 2020)	0.18***
	(3.00)
Fama-French-3(Fama & French, 1993)	0.12**
	(2.45)
Fama-French-5 (Fama & French, 2006, 2015)	0.10**
	(2.03)
Hou-Xue-Zhang (Hou et al., 2015)	0.04
(q-factor)	(0.85)
Novy-Marx (Novy-Marx, 2013)	0.15***
	(2.89)
Stambaugh-Yuan (Stambaugh & Yuan, 2017)	0.09*
	(1.95)

表 5: Annualized Alpha based on common factor models

B Figure

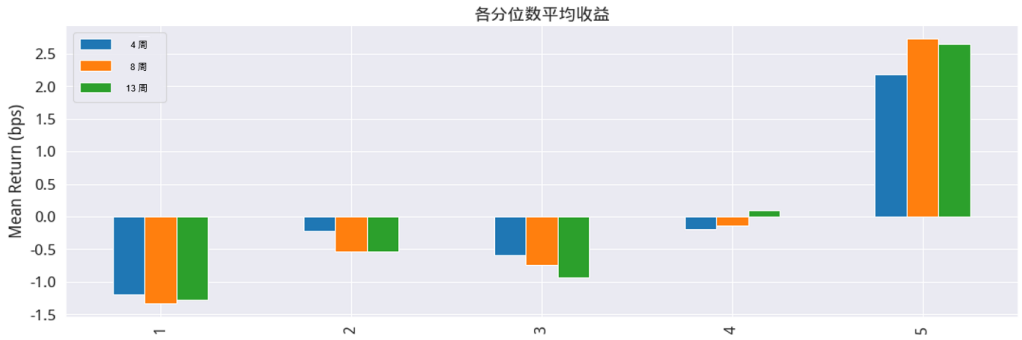

图 1: Average Cumulative Return by Quantile: ROIC(TTM)

图 2: Accumulated Return (logarithmic axis)

	1	2	3	4	5	6	7	8	9	10	11	12
2013	3.52%	3.90%	1.29%	0.77%	7.04%	-11.14%	-0.32%	7.93%	-0.28%	-3.81%	3.11%	0.27%
2014	0.73%	-0.66%	-4.28%	0.79%	0.10%	2.23%	6.02%	2.86%	4.69%	0.79%	0.72%	1.28%
2015	7.87%	3.31%	11.27%	15.48%	15.63%	-5.75%	-9.95%	-14.23%	-0.58%	19.82%	2.06%	4.86%
2016	-22.05%	-0.48%	16.23%	-1.84%	-0.07%	5.06%	1.95%	-1.24%	1.18%	1.21%	-0.54%	-4.00%
2017	1.58%	3.45%	9.33%	1.60%	-1.82%	9.34%	5.02%	0.69%	4.45%	7.01%	-4.28%	2.57%
2018	0.92%	2.63%	-2.55%	-5.32%	7.70%	-4.34%	0.74%	-12.08%	-0.23%	-17.78%	-2.27%	-5.75%
2019	5.51%	18.63%	9.28%	-0.85%	-6.98%	9.74%	-0.79%	4.73%	-0.49%	1.71%	-0.34%	6.44%
2020	1.96%	1.73%	-1.80%	7.06%	7.96%	11.58%	22.94%	5.62%	-6.86%	-0.40%	-2.19%	14.35%

图 3: Monthly Return (2013.01 – 2020.12)

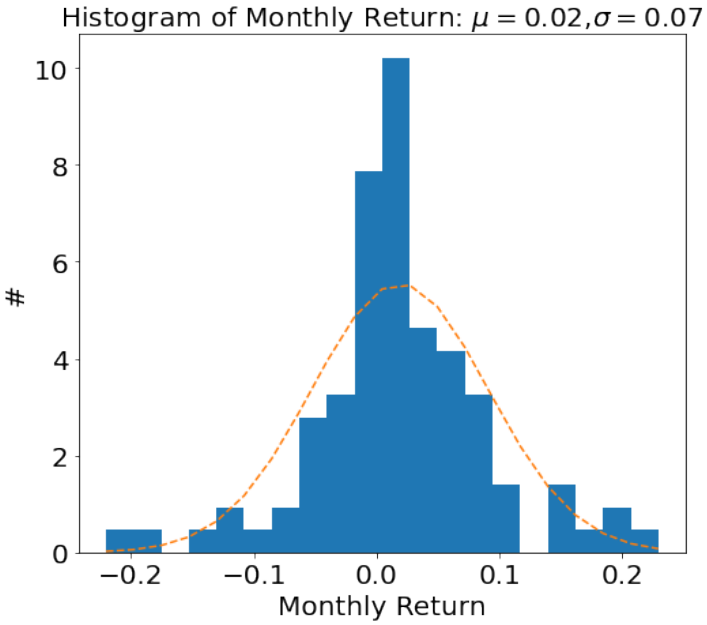

图 4: Histogram of Monthly Return (2013.01 – 2020.12)

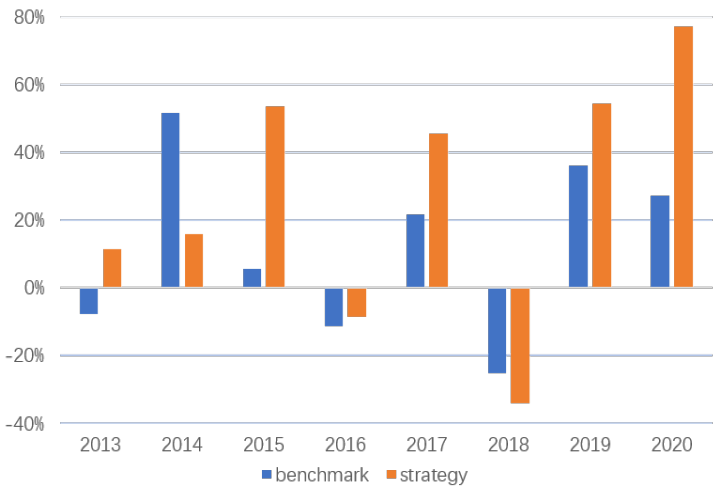

图 5: Yearly Return Comparison

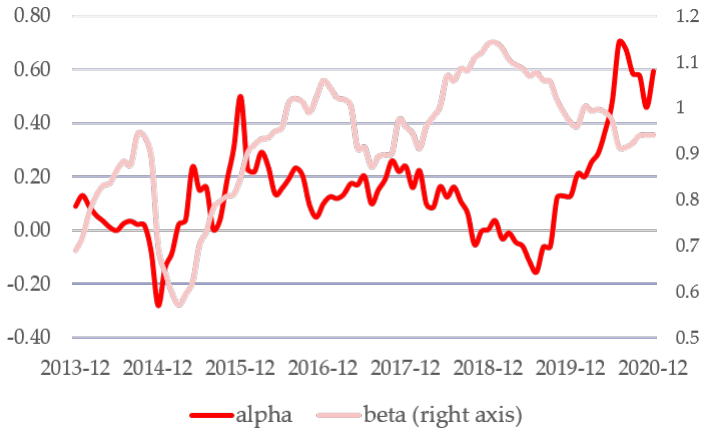

图 6: Alpha and Beta (TTM)

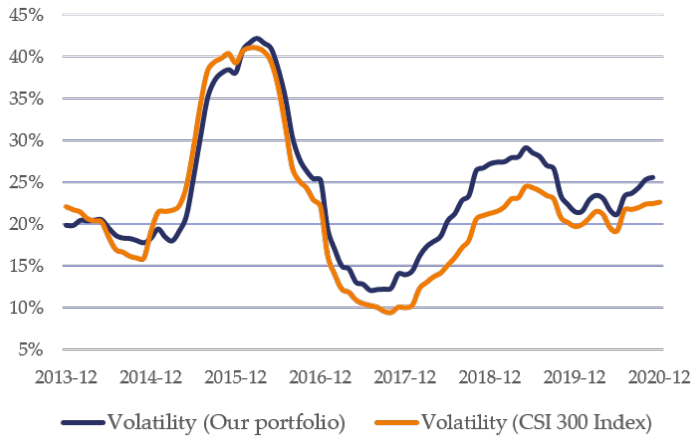

图 7: Volatility(TTM) Comparison

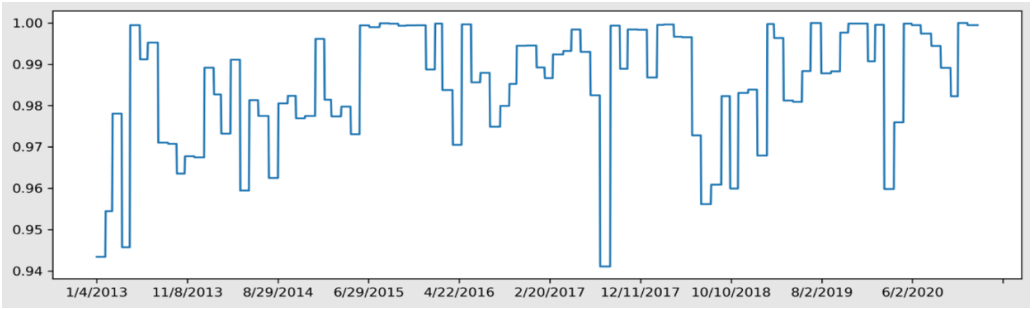

图 8: Historical Position Level

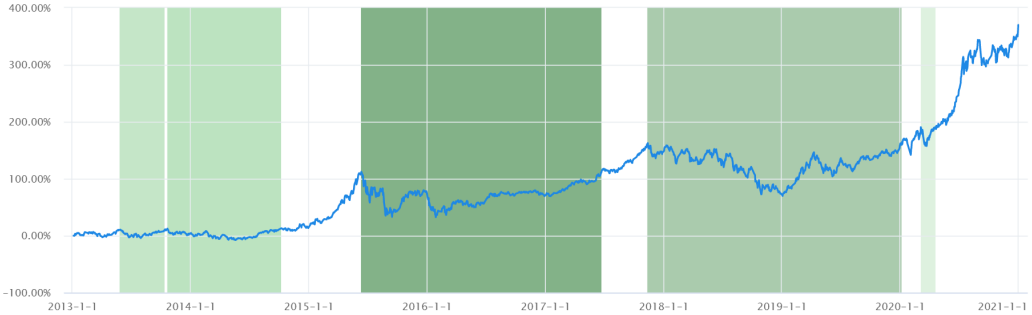

图 9: The Largest 5 Drawdown

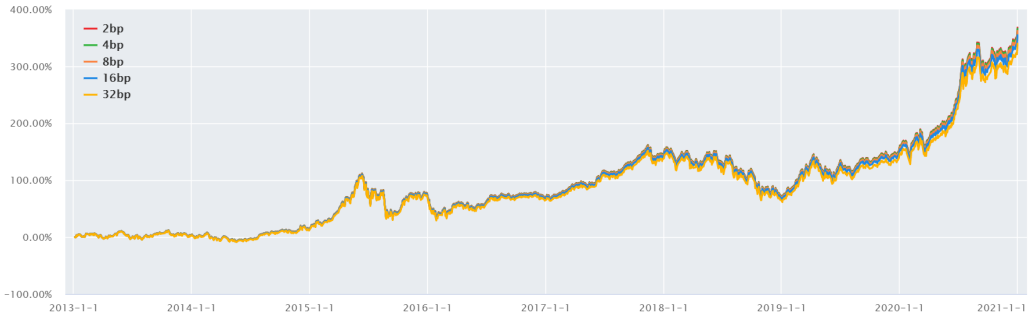

图 10: Slippage Effect

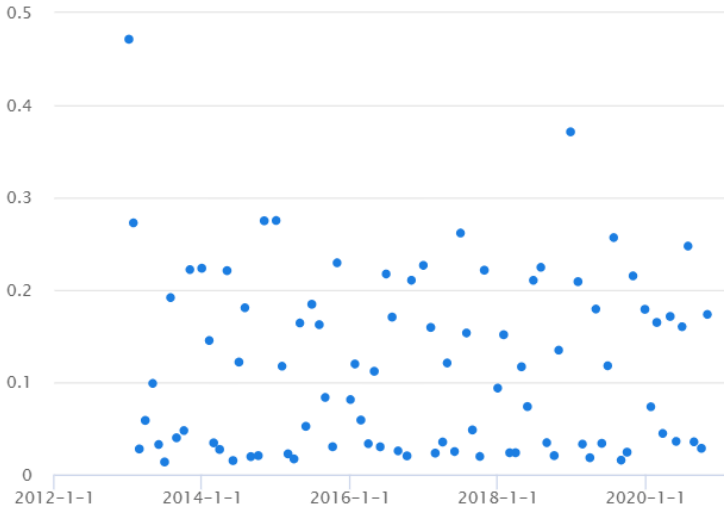

图 11: Turnover Rate (2013.01 – 2020.12)

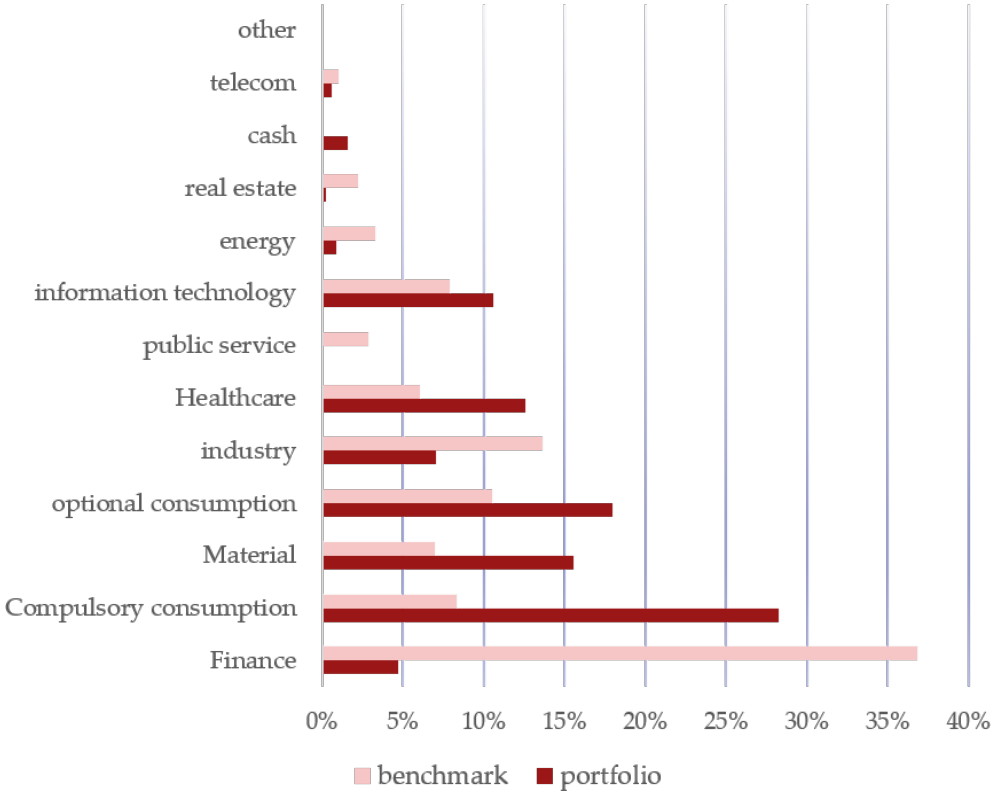

图 12: Industry Weights Comparison

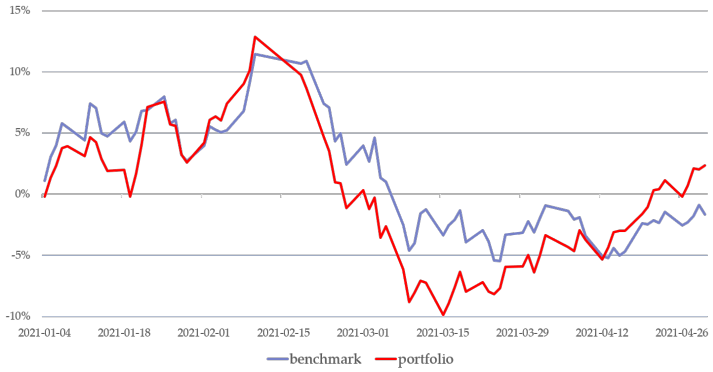

图 13: The Performance of Strategy in 2021 (by the end of 2020.04)

C Code

```
enable_profile()

# 导入函数库
import time
import datetime
import pandas as pd

from jqdata import *
from jqdata import finance
from jqfactor import get_factor_values


# 显示所有列
pd.set_option('display.max_columns', None)

# 初始化函数，设定基准等等
def initialize(context):
    # 设定沪深300作为基准
    set_benchmark('000300.XSHG')
    # 开启动态复权模式(真实价格)
    set_option('use_real_price', True)
    # 输出内容到日志 log.info()
    log.info('初始函数开始运行且全局只运行一次')
    # 过滤掉order系列API产生的比error级别低的log
    # log.set_level('order', 'error')
    ### 股票相关设定 ###
    # 股票类每笔交易时的手续费是：买入时佣金万分之三，卖出时佣金万分之三加千分之一印
     花税，每笔交易佣金最低扣5块钱
    set_order_cost(OrderCost(close_tax=0.001, open_commission=0.0003,
     close_commission=0.0003, min_commission=5), type='stock')
    # 开盘前运行
    run_monthly(before_market_open, monthday=1, time='before_open',
     reference_security='000300.XSHG')
    # 盘中运行
    run_monthly(market_open, monthday=1,time='14:40', reference_security='000300.XSHG
     ')
    # 收盘后运行
    run_monthly(after_market_close, monthday=1, time='after_close',
     reference_security='000300.XSHG')
    # 定义交易月份
    g.Transfer_date=list(range(1,12,1))


# 定义获取ROIC的函数
def get_ROIC(security,watchday):
    # 获取观测日所处季度
```

```
def get_curr_quarter(watchday):
    str_date = str(watchday)
    quarter = str_date[:4]+'q' + str((int(str_date[5:7])-1)//3+1)
    return quarter

# 获取观测日所处季度的前一个季度
def get_pre_quarter(quarter):
    if quarter[-1] == '1':
        res = str(int(quarter[:4])-1) + 'q4'
    else:
        res = quarter[:-1] + str(int(quarter[-1])-1)
    return res

# 获取四个季度的EBIT（TTM）数据
def get_4quarter_ebit_data(security,watchday):
    q = query(income.code,income.financial_expense,indicator.adjusted_profit,
income.income_tax_expense).filter(income.code.in_(security))
    curr_q = get_curr_quarter(watchday)
    quarter = curr_q
    EBIT_data = pd.DataFrame()
    for i in range(4):
        q_data = get_fundamentals(q, statDate=quarter)
        q_data.fillna(0,inplace=True)
        quarter = get_pre_quarter(quarter)
        if EBIT_data.empty:
            EBIT_data = q_data
        else:
            EBIT_data = EBIT_data.append(q_data)
    return EBIT_data

# 对过去4个季度EBIT求和
def calc_ebit(ebit_data):
    EBIT_data1 = ebit_data.groupby('code').sum()
    EBIT_data1['EBIT'] = EBIT_data1['financial_expense'] + EBIT_data1['
adjusted_profit'] + EBIT_data1['income_tax_expense']
    return EBIT_data1

# 获取四个季度的投入资本（TTM）
def get_4quarter_roic_cap(security,watchday):
    q = query(balance.code,balance.total_owner_equities,balance.
non_current_liability_in_one_year,balance.longterm_loan,balance.bonds_payable,
balance.longterm_account_payable).filter(balance.code.in_(security))
    curr_q = get_curr_quarter(watchday)
    quarter = curr_q
    Cap_data = pd.DataFrame()
    for i in range(4):
        q_data = get_fundamentals(q, statDate=quarter)
        q_data.fillna(0,inplace=True)
```

```
            quarter = get_pre_quarter(quarter)
            if Cap_data.empty:
                Cap_data = q_data
            else:
                Cap_data = Cap_data.append(q_data)
        return Cap_data

    # 对过去四个季度投入资本求均值
    def calc_roic_cap(roic_cap):
        ROIC_data = roic_cap.groupby('code').mean()
        ROIC_data['投入资本'] = ROIC_data['total_owner_equities'] + ROIC_data['non_current_liability_in_one_year'] + ROIC_data['longterm_loan'] + ROIC_data['bonds_payable'] + ROIC_data['longterm_account_payable']
        return ROIC_data

    roic_cap = get_4quarter_roic_cap(security, watchday)
    cap = calc_roic_cap(roic_cap)
    ebit_data = get_4quarter_ebit_data(security, watchday)
    ebit = calc_ebit(ebit_data)
    # 合并‘投入资本’与EBIT数据
    ROIC_data2 = pd.concat([cap['投入资本'], ebit['EBIT']], axis=1)
    # 计算投入资本回报率
    ROIC_data2['ROIC_TTM'] = ROIC_data2['EBIT'] / ROIC_data2['投入资本']
    # 以投入资本回报率进行降序排列
    ROIC_data3 = ROIC_data2.sort_values(by='ROIC_TTM', ascending=False)
    return  ROIC_data3


## 开盘前运行函数
def before_market_open(context):
    # 输出运行时间
    log.info('函数运行时间(before_market_open)：' + str(context.current_dt.time()))
    # 获取前一个交易日的日期
    previous_day = context.previous_date
    # 获取要操作行业的股票代码列表
    g.security = get_index_stocks('000842.XSHG', date=context.previous_date)
    # 建立一个空字典，用来记录买入股票的开仓日期；
    g.entry_dates={code: None for code in g.security}
    # 获取ROIC的列表
    ROIC_list = get_ROIC(security=g.security, watchday=previous_day)
    g.buy_list = ROIC_list.iloc[0:80].index.tolist()


## 开盘时运行函数
def market_open(context):
    log.info('函数运行时间(market_open):' + str(context.current_dt.time()))
   # 获取当前交易日期的月份
    current_month = context.current_dt.month
```

```
    if current_month in g.Transfer_date:
        # 买入股票列表
        buy_list = g.buy_list
        # 简记当前组合
        p = context.portfolio
        # 获取当前时间数据
        cur_data = get_current_data()
        # 获取当前交易日期
        current_day = context.current_dt
        # 卖出股票
        for code in list(p.positions.keys()):
            if code not in buy_list:
                if cur_data[code].paused:
                    continue
                # 卖出股票
                order_target_value(code, 0)
            else:
                open_price = cur_data[code].day_open
                num_to_target = (p.total_value / len(buy_list)) / open_price // 100 *
 100
                order_target(code,num_to_target)
        # 买入股票
        for code in buy_list:
            if code not in p.positions:
                if cur_data[code].paused:
                    continue
                open_price = cur_data[code].day_open
                num_to_buy = (p.total_value / len(buy_list)) / open_price // 100 *
 100
                # 买入股票
                order_target(code, num_to_buy)
                #记录建仓日期
                g.entry_dates[code] = current_day


## 收盘后运行函数
def after_market_close(context):
    #获取当前交易的日期
    current_month = context.current_dt.month
    p = context.portfolio
    pos_level = p.positions_value / p.total_value
    record(pos_level = pos_level)
```

ROIC_800.py