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Incorporating a Geopolitical Risk Index in momentum investment strategies

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Motivation and objectives

Motivation:

- Robust investment strategies have gained attention due to negative geopolitical events

- Geopolitical risk can be a key determinant of investment decisions as geopolitical events and uncertainties can impact financial markets

Objectives:

- Investigate the relationship between equity index returns and geopolitical risk

- Construct momentum investment strategies, that make investment decisions on equity indices based on past changes in geopolitical risk

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Geopolitical Risk Index (GPR index)
Theoretical background

- Constructed by Caldara and Iacoviello [1] to characterize real-time geopolitical tensions covered by the press through an automated text-search methodology

  - Value is calculated by the share of articles related to negative geopolitical events from all articles published in 10 major newspapers from the US, the UK, and Canada

- Geopolitical risk is defined as a threat, realization, and escalation of negative geopolitical events related to wars, terrorism, and any tension among states and political actors that can affect the peaceful course of international relations

- The monthly country-specific index measures the exposure of specific countries to global risks and reflects geopolitical events that are relevant for individual countries or regions

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Momentum investing
Theoretical background

- In momentum investing well-performing assets (winners) are bought and poor-performing assets (losers) are sold

  - Assets with strong historical performance are likely to continue their momentum and assets with poor performance will continue to decline

    - Performance is typically based on historical returns, the idea of the thesis is to use the GPR index instead

  - Parameters:

    - **Ranking period:** stocks are ranked by their returns during this period to determine the winners and losers, in this thesis change in the GPR index during this period is calculated which determines the investment decision

    - **Holding period:** the amount of time that the position is held

    - **Rebalancing frequency:** how often the ranking is done to construct new winners and losers

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The Sharpe ratio
Theoretical background

- The performance of the investment strategy is evaluated based on the Sharpe ratio

$$\text{Sharpe ratio} = \frac{R_p - Rf}{\sigma_p}$$

- R_p = return of the portfolio

- R_f = risk-free rate

- σ_p = standard deviation of the portfolio's excess return, volatility

- When comparing the results annualized Sharpe ratio calculated from the whole sample is used

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Main findings from the literature review

- **Increasing geopolitical risk leads to lower investment returns [1], [2], [3]**

  - Increases in the GPR index result in decreases in stock prices, decreasing GPR threat increases investment returns, higher values of the GPR index are associated with a higher probability of economic disasters

- **GPR impacts investor sentiment negatively [4], [5]**

  - Uncertainty aversion, lower expectations about the future, response to GPR is more sensitive to domestic geopolitical events

- **Safe-haven assets can lose their safe-haven status [6], [7]**

  - Many studies have evaluated the performance of safe-haven assets in protecting investments against geopolitical risks. Their efficiency and adequacy have been criticized.
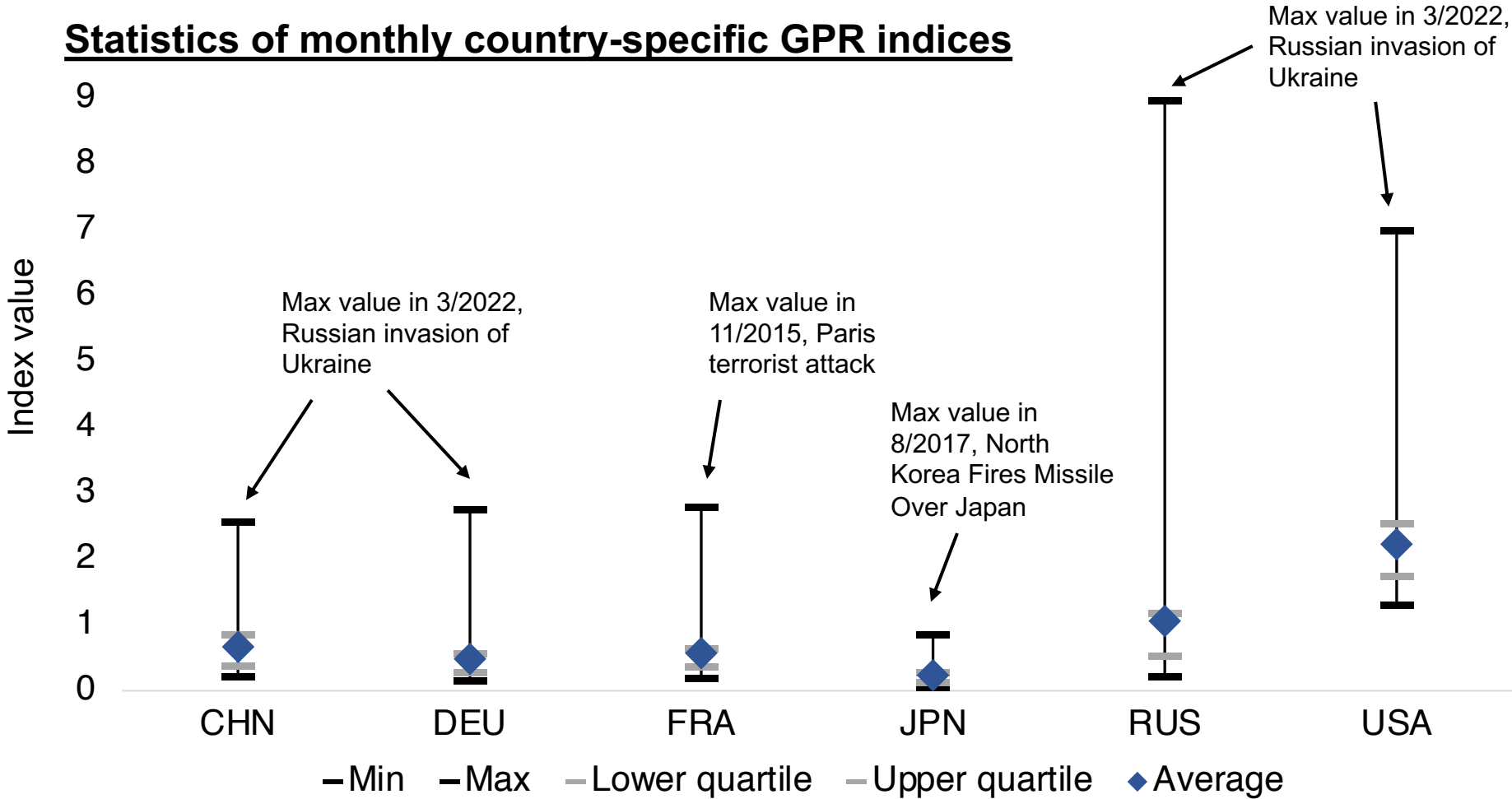
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Data – Country-specific equity indices

- Investment strategies are constructed for the main equity indices of six countries: China, Germany, France, Japan, Russia, and the United States

- Daily returns from January 2010 to the end of October 2023

  - Corresponding compounded monthly returns are used in the strategy

Country	Equity index
China	SSE
Germany	DAX
France	CAC40
Japan	Nikkei225
Russia	MOEX
The United States	S&P 500

Data – GPR index

- Country-specific GPR index for China, Germany, France, Japan, Russia, and the United States

Statistics of monthly country-specific GPR indices

Max value in 3/2022, Russian invasion of Ukraine

Max value in 3/2022, Russian invasion of Ukraine

Max value in 11/2015, Paris terrorist attack

Max value in 8/2017, North Korea Fires Missile Over Japan

Index value

CHN   DEU   FRA   JPN   RUS   USA

— Min — Max — Lower quartile — Upper quartile ◆ Average

Constructing the investment strategy – Overview

- **Objective**: construct an investment strategy for each main equity index that utilizes changes in geopolitical risk

- **Assumption**: increasing country-specific GPR index in the past is followed by decreasing equity index

- **Structure**: constructed for the six equity indices individually

  - Monthly investment decisions based on past changes in the country-specific GPR index

- **Momentum**: the change in the GPR index determines whether the investor should buy the equity index or sell it short

  - Ranking period, holding period, rebalancing frequency = one month

  - If the change in the GPR index is large enough (above the cutoff value), the strategy shorts the equity index and if the change is not significant the strategy buys the equity index

  - The portfolio is either short or long all the time (in each strategy the portfolio consists of the main equity index)

Constructing the investment strategy – Tuning the parameters

- **Skipping period**: the monthly investment decision is implemented with a lag (skipping period) depending on the correlation between the change in country-specific GPR index and the equity index returns

    - The delay in reacting to geopolitical tension may differ

    - At least one month must be used

- **Cutoff value**: value of the change in the GPR index that is seen as large enough to affect the returns of the equity index negatively

    - Chosen so that the annualized Sharpe ratio is maximized

Statistics of monthly changes in country-specific GPR indices
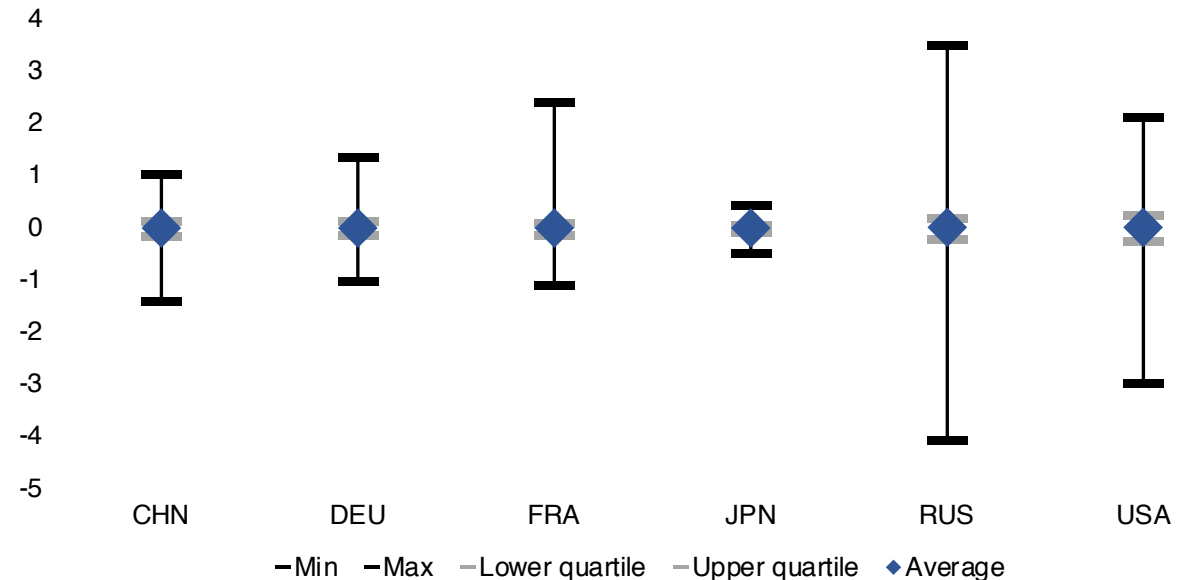
Country	Equity index	Skipping period	Cutoff value
China	SSE	1	0.16
Germany	DAX	2	0.23
France	CAC40	2	0.16
Japan	Nikkei225	1	0.01
Russia	MOEX	1	0.25
The United States	S&P 500	2	1.25

Strategy algorithm

Algorithm 1 Monthly return for the strategy

1: **initalise.** skipping period t_s, cutoff value c, month t:
2: **if** $\Delta GPR_{t,t-1} > c$ **then**
3:     $R_{p,t+t_s} = -R_{e,t+t_s}$
4: **else**
5:     $R_{p,t+t_s} = R_{e,t+t_s}$
6: **end if**
7: **end**

- $R_{p,t}$ = monthly return of the strategy during month t

- $R_{e,t}$ = monthly return of the equity index during month t

- $\Delta GPR_{t,t-1}$ = change in the country-specific GPR index between the month t and the month t-1

- Algorithm is repeated each month by changing the value t

- Position is held for a month, after which a new position is chosen based on the change in the GPR index, no overlapping positions

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Country-specific strategy results

- Performance is evaluated using the annualized Sharpe ratio and compared to the performance of the equity index in each country.

  - Returns are indexed at 1 on 2/2010 for skipping period of 1 and on 3/2010 for skipping periods of 2

  - Final index value is on 10/2023

- % of correct predictions: how often the strategy predicts the movements of the equity index correctly based on the past monthly change in the GPR index

  - Prediction is correct if the change in the GPR index is larger than the cutoff value and this is followed by a negative monthly return in the main equity index after a specified skipping period (and vice versa)

	Final index value	Sharpe ratio	% of correct predictions
Strategy CHN	3.17	0.53	56.10 %
SSE	0.99	0.10	
Strategy DEU	3.80	0.66	60.12 %
DAX	2.41	0.50	
Strategy FRA	4.15	0.72	57.67 %
CAC40	1.73	0.36	
Strategy JPN	3.98	0.77	57.93 %
Nikkei225	2.30	0.49	
Strategy RUS	3.40	0.47	53.05 %
MOEX	0.99	0.14	
Strategy USA	6.65	1.12	65.03 %
S&P 500	4.58	0.93	

Example from FRA:
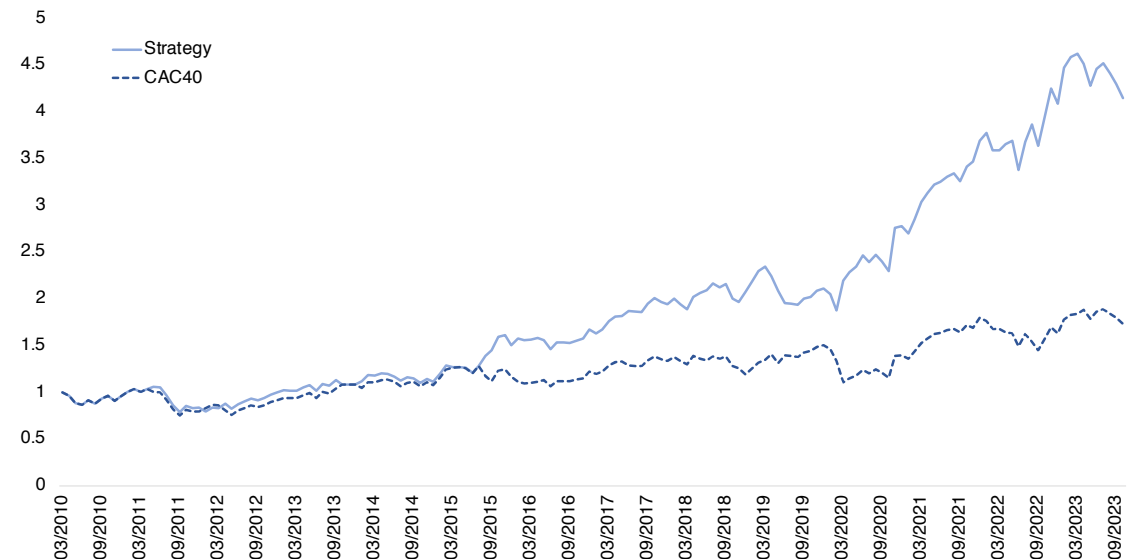
Sensitivity analysis

- Data is divided into training data and testing data
    - Training data from January 2010 to December 2019
    - Test data from January 2020 to October 2023
- The training data is used to construct the skipping periods and cutoff values, and the test data will be used to test the performance of the strategy
- Sharpe ratios are lower for each strategy, except for France, compared to the Sharpe ratios calculated for the original strategies
    - For the countries with a larger skipping period, the final index value and Shape ratio are worse compared to the values from the equity index
- Parameter values need to be updated constantly as new data becomes available

Parameter values from training data

Country	Equity index	Skipping period	Cutoff value
China	SSE	3 ▲	0.09 ▼
Germany	DAX	2	0.15 ▼
France	CAC40	2	0.16
Japan	Nikkei225	1	0.18 ▲
Russia	MOEX	4 ▲	0.68 ▲
The United States	S&P 500	4 ▲	1.25

Results from test data

	Final index value	Sharpe ratio	% of correct predictions
Strategy CHN	0.59	-0.92	49.38 %
SSE	0.99	0.05	
Strategy DEU	1.49	0.61	63.04 %
DAX	1.12	0.24	
Strategy FRA	1.97	0.98	63.04 %
CAC40	1.15	0.28	
Strategy JPN	1.44	0.66	56.52 %
Nikkei225	0.99	0.07	
Strategy RUS	0.59	-0.19	52.17 %
MOEX	0.74	-0.03	
Strategy USA	1.15	0.29	56.52 %
S&P 500	1.38	0.56	

Explorative analysis – Industry analysis

- Investigate the exposure of different industries to the change in the GPR index

- The exposure is calculated by regressing daily portfolio returns in the 49 industry groups to changes in the daily GPR index

$$R_{k,t} = \alpha_k + \beta_k \Delta GPR_t + \epsilon_{k,t},$$

  - $R_{k,t}$ is the annualized daily excess return in industry k over the one-month Treasury bill rate and ΔGPR_t is the change in the daily GPR index
    - β_k coefficients are estimated and demeaned and the signs are changed so that **positive values indicate high exposure**

  - Higher values indicate a larger decline in industry daily stock returns after an increase in the daily GPR index, and vice versa

- Investigate sector allocations in the six main equity indices

  - For all indices (except MOEX), most industries have a positive exposure

  - For all indices, some sectors are negatively exposed → false predictions

  - Largest sectors in MOEX are negatively exposed, but strategy performs better than the index

    - Geopolitical tensions may have affected other sectors more severely

    - Sanctions for Russia may have affected some industries differently than expected
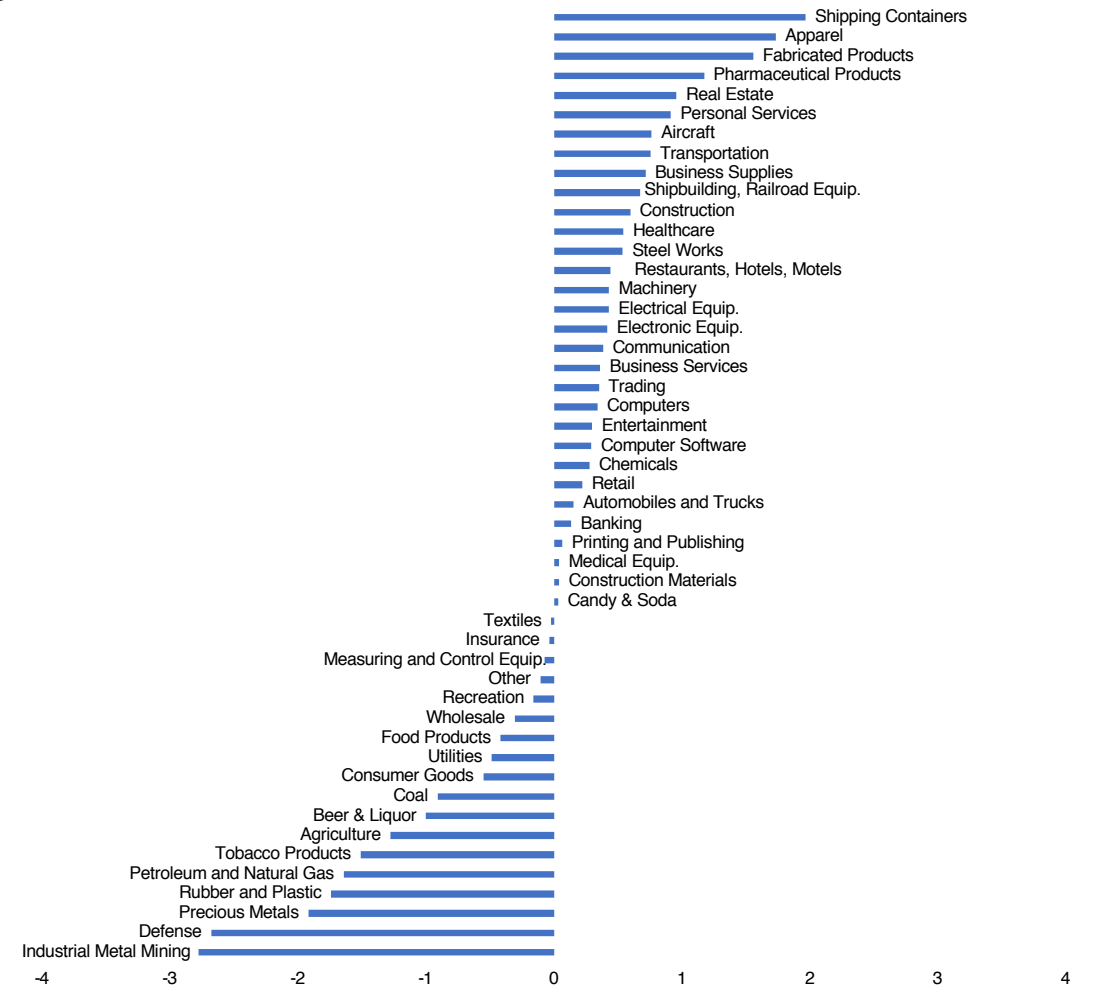
Average exposure to change in the GPR index for different industries [8]. Values are estimated on a sample from 1985 to 2019, which are standardized to have zero mean and unit standard deviation.

Explorative Analysis – Geopolitical events

- **Russia's invasion of Ukraine:** GPR index increased and equity indices experienced decreasing returns in all six countries
  - Many companies suspended or withdrew business from Russia, sanctions, investors' uncertainty
  - Fear of increasing energy prices: increasing geopolitical tension in a given country can also affect other countries, depending on its role in the global economy or a specific industry sector and the dependence of other countries on it
  - Secondary sanctions on China and the reassessment of the relationship in European countries most likely affected the equity indices of China, the US, Germany, and France
- **Covid-19 pandemic:** all equity indices were negatively affected, but the magnitude of this effect is dependent on the sector allocation of each equity index
  - The six equity indices include stocks from both industries performing well and from industries performing poorly during the pandemic
    - At a given equity index, well-performing industries were not enough to avoid the initial decrease in that index at the outburst of the pandemic, which was caused by the significant decrease in the poorly-performing industries in that index
  - Pandemic's effect on the equity index returns was not as significant in the SSE index
    - Effect is dependent on experience with similar situations and the actions made by the government

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Summary

- **Objective:** investigate the relationships between equity index returns and geopolitical risk and use it to construct investment strategies

- **Implementation**: negative correlation between GPR and the returns was used to construct investment strategies for six equity indices individually which used monthly changes in the GPR index to determine whether the investor should buy the equity index or short it each month and this position is then held for a month

- **Result**: the constructed strategies were successful in the sense that all of them outperformed the equity indices in the sample period

- **Future development:** further analysis revealed that the relationship between the GPR and equity index returns is more complex

  - Adding additional variables to the strategies that would together with the change in GPR determine the investment decision

  - Could be improved in the future if daily or weekly data for the country-specific GPR index becomes available

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Thank you!