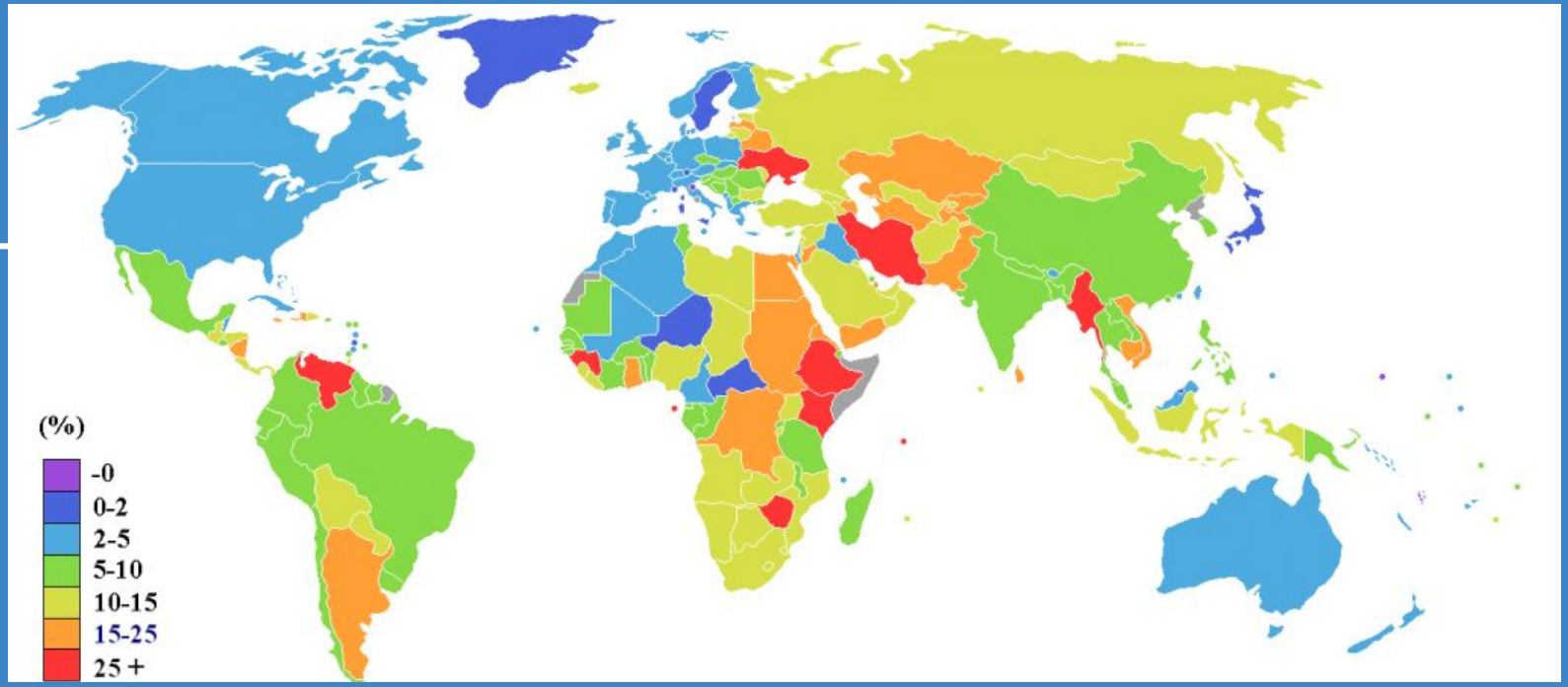
Monthly Global CPI Price



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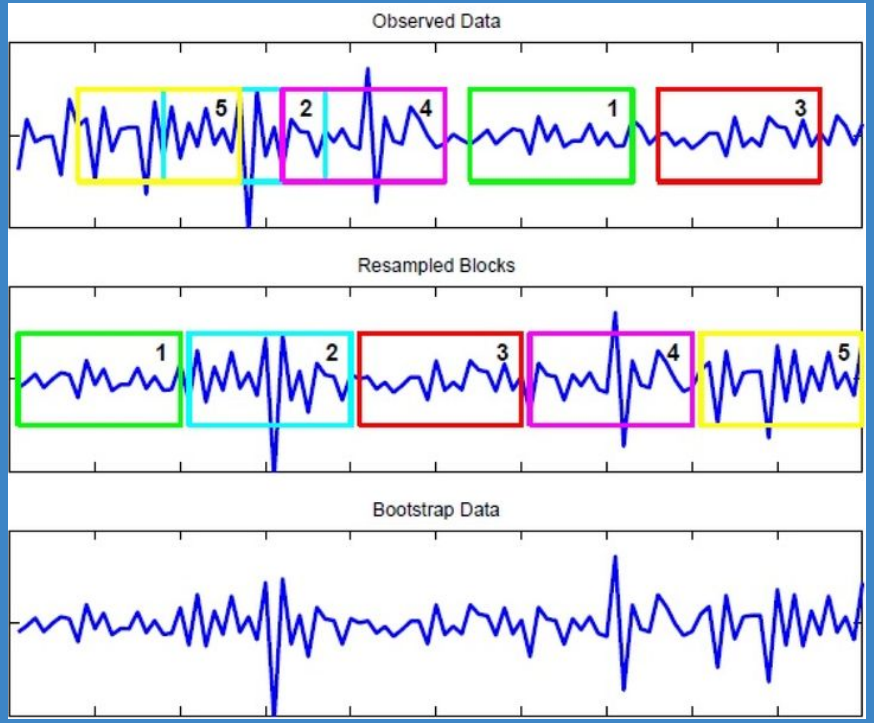
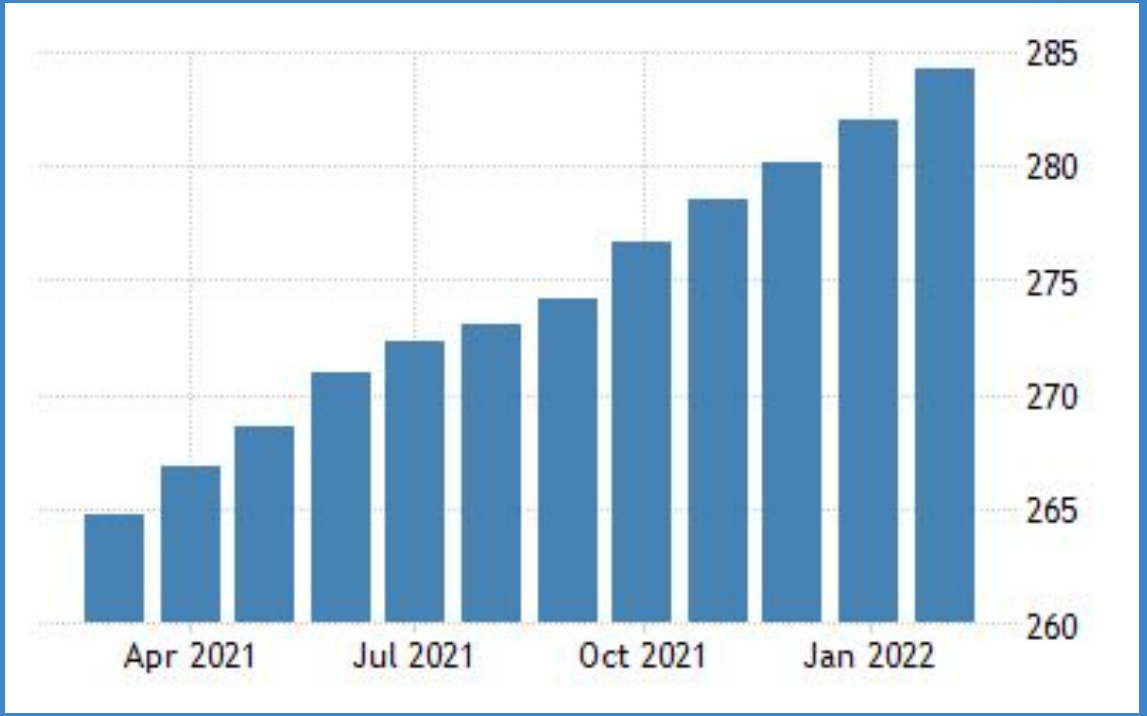
Introduction



The purpose of this project is to apply a moving block bootstrap to monthly Consumer Price Index prices of different countries grouped by development, region, and income.

Hypothesis

If we forecast CPI from 1989 to 2019, then we will see an increase in the average change in prices in high, middle, and developing countries.



What is CPI? How is it measured?

$$CPI_t = \frac{C_t}{C_0} * 100$$

The Consumer Price Index (CPI) is a measure that examines the weighted average of prices of a basket of consumer goods and services, such as transportation, food, and medical care.

It is calculated by taking price changes for each item in the predetermined basket of goods and averaging them.

The Dataset

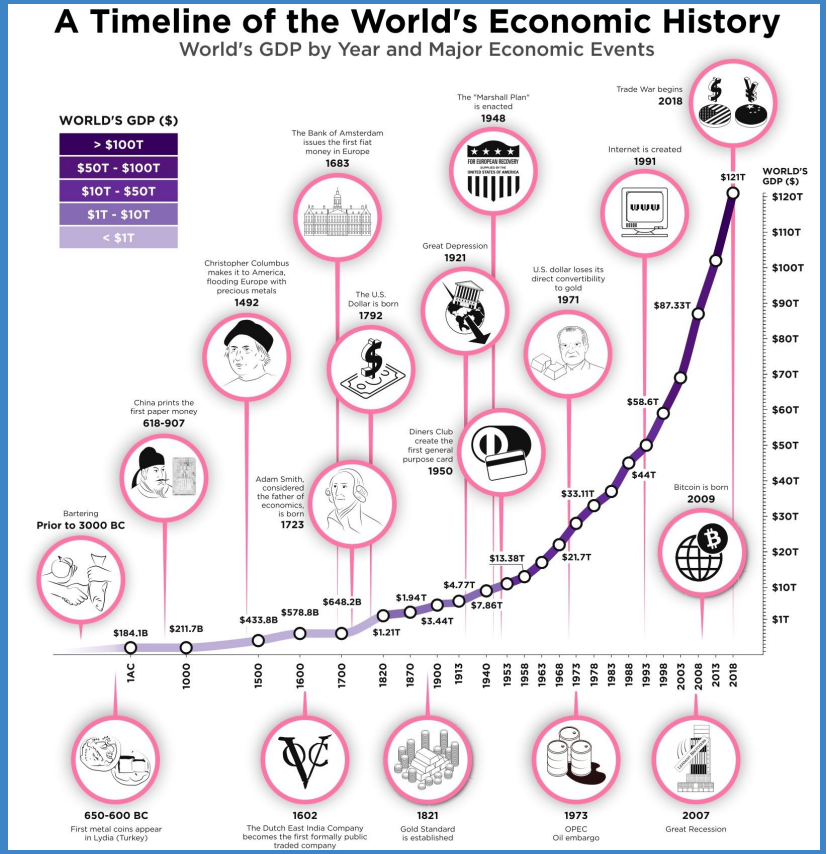
We got our dataset from: https://www.kaggle.com/datasets/theworldbank/global-economic-monitor (monthly)

Providing daily updates of global economic developments, with coverage of high income as well as developing countries.

Daily data updates are provided for exchange rates, equity markets, and emerging market bond indices.

Monthly data coverage (updated daily and populated upon availability) is provided for consumer prices, high-tech market indicators, industrial production and merchandise trade.

Cleaning the Dataset

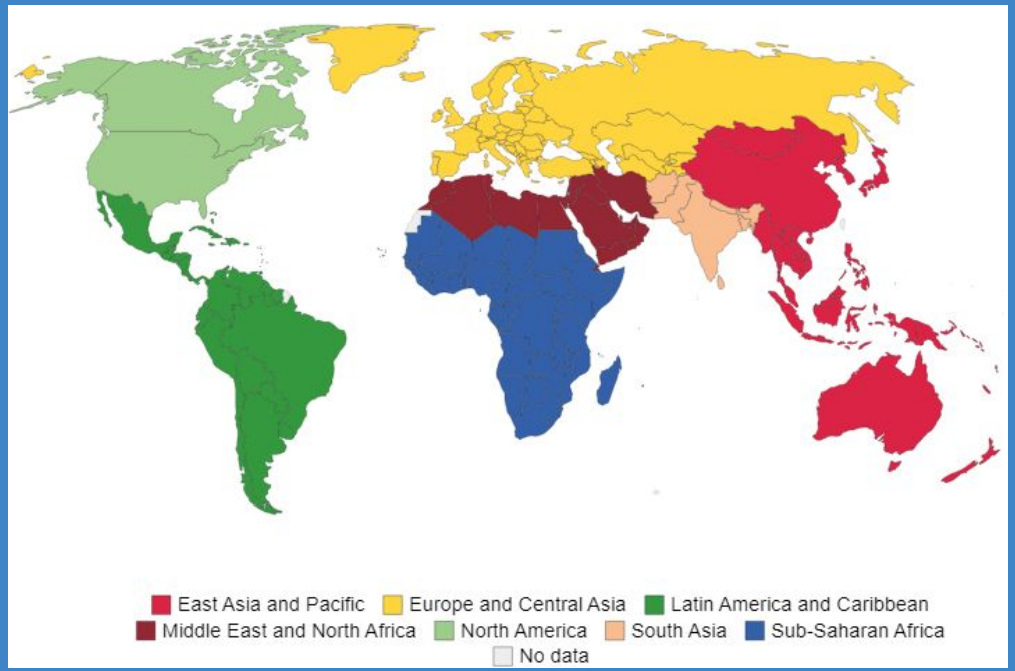


Removed the low income country column because a lot of the data was missing and there were a lot of negative values

Removed the last month because there were missing values

Created three subsets for several time periods(1989-2019, 2012-2019, 2017-2019)

Regions in the Dataset



Developing Countries

- Developing Asia
- East Asia/Pacific Developing
- Europe/Central Asia Developing
- Latin America/Caribbean Developing
- South Asia Developing
- Sub-Saharan Africa Developing
- Middle East/North Africa Developing

High Income Countries

- High Income OECD Countries
- High Income Non-OECD Countries

Middle Income Countries

Low Income Countries

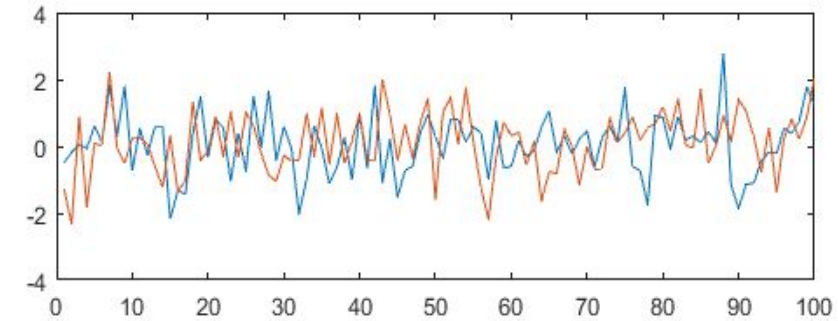
R Code

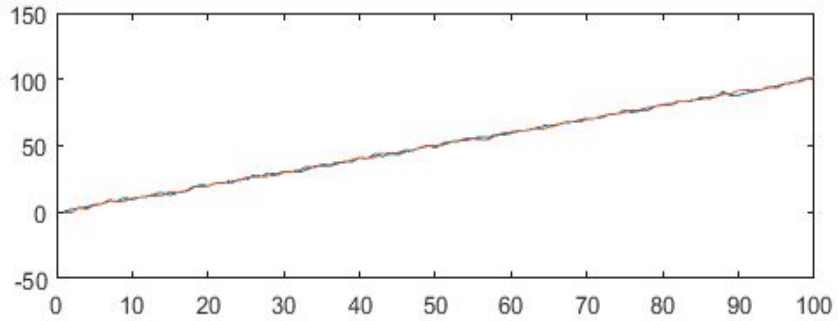
```
for(w in 2:15) {
 start <- tsp(ts(my_data[[w]],frequency = 12))[2]-1
 #Skip because not enough data
 if(w==9) {
  next
 }
 sim <- bld.mbb.bootstrap(ts(my_data[[w]],frequency = 12), 10) %>%
  as.data.frame() %>%
  ts(frequency=12, start=1989.5)
 fc <- purrr::map(as.list(sim),
            function(x){forecast(ets(x))[["mean"]]}) %>%
  as.data.frame() %>%
  ts(frequency=12, start=start+1989.5)

 print(autoplot(ts(my_data[[w]],frequency = 12,start=1989.5)) +
  autolayer(sim, colour=TRUE) +
  autolayer(fc, colour=TRUE) +
  autolayer(ts(my_data[[w]],frequency = 12,start=1989.5), colour=FALSE) +
  ylab("Consumer Price Index") +
  guides(colour="none") + ggtitle(names(my_data[w])) )

 cat("The average predicted value for", names(my_data3[w]), "is:", mean(fc), "\n"  )
 cat("The standard deviation of the predicted value for", names(my_data3[w]), "is:", sd(fc) )
}
```

The Box-Cox and Loess Moving Block Bootstrap

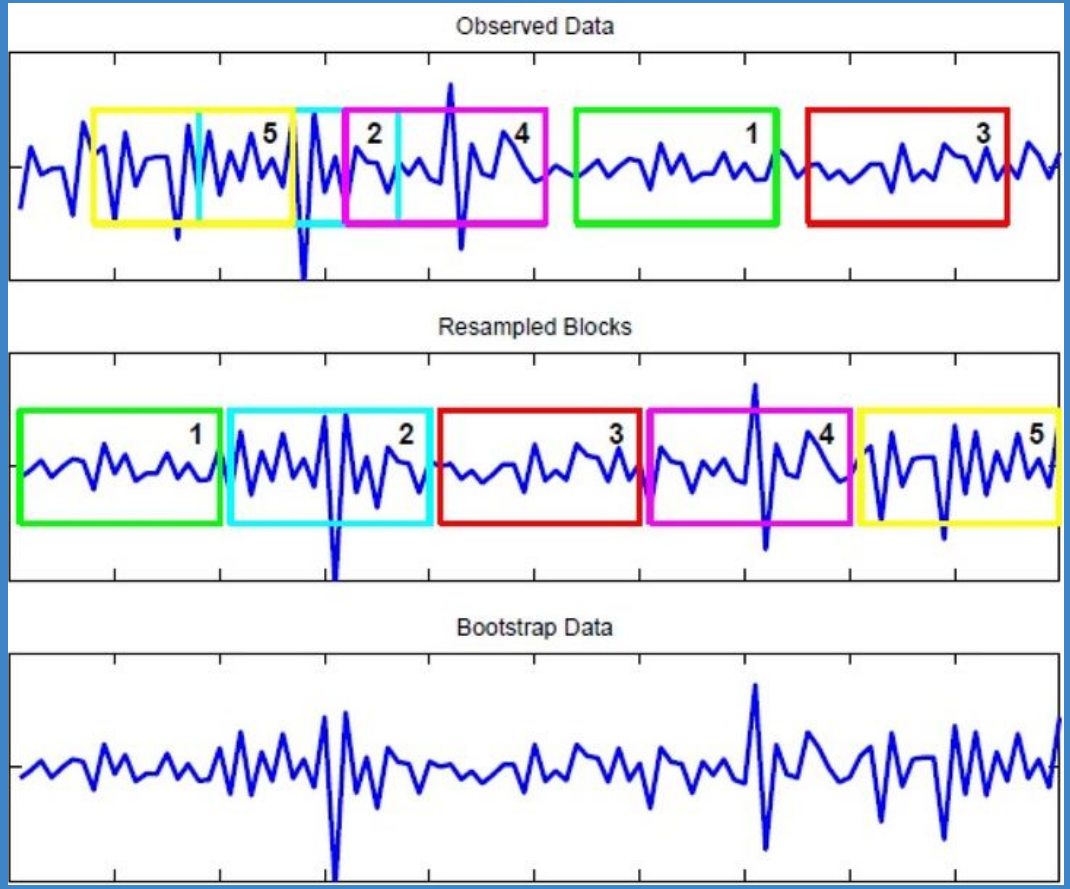




The time series is Box-Cox transformed then decomposed into trend, seasonal, and random variation components

Random variation components are bootstrapped from contiguous sections of the time series and joined together

Trend and seasonal components are combined with bootstrap variation components, Box-Cox transform inverted


Observed Data
5
2
4
1
3
Resampled Blocks
1
2
3
4
5
Bootstrap Data

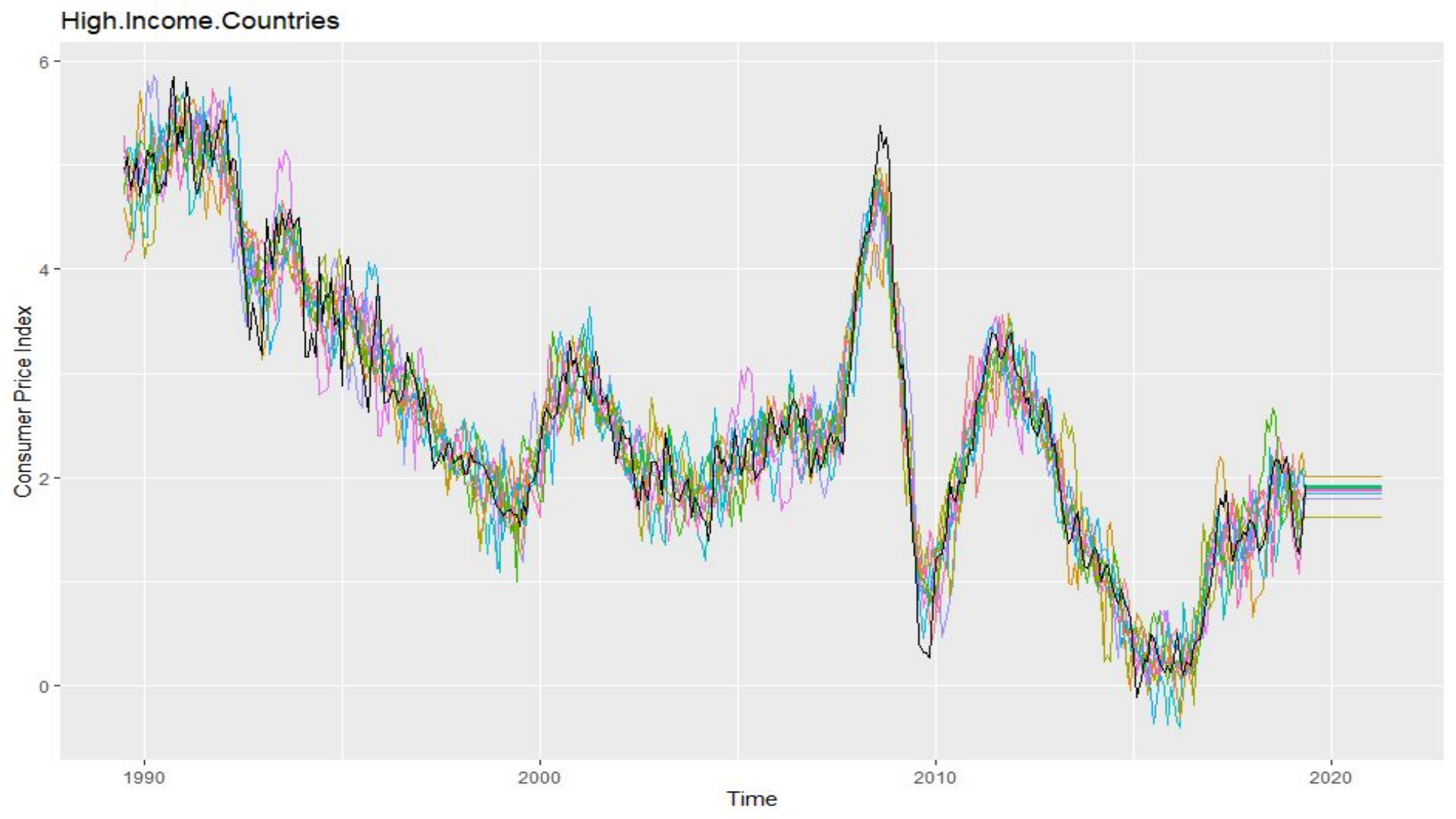
Purpose of Moving Block Bootstrap

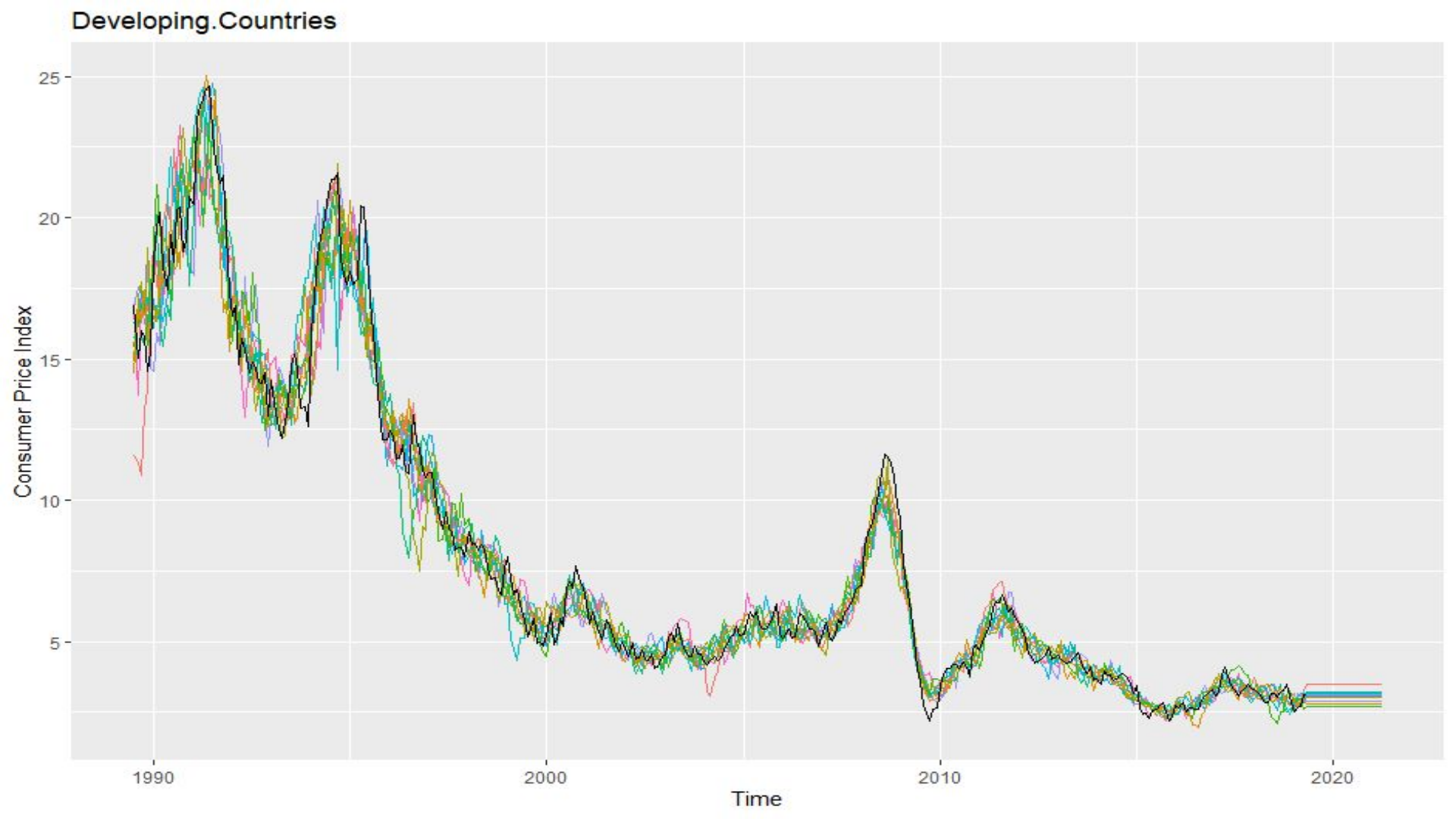
- Time series models have at least four sources of uncertainty:
  a. Random error
  b. Parameter estimate error
  c. Model choice
  d. Assumption of correlation between historical and future data

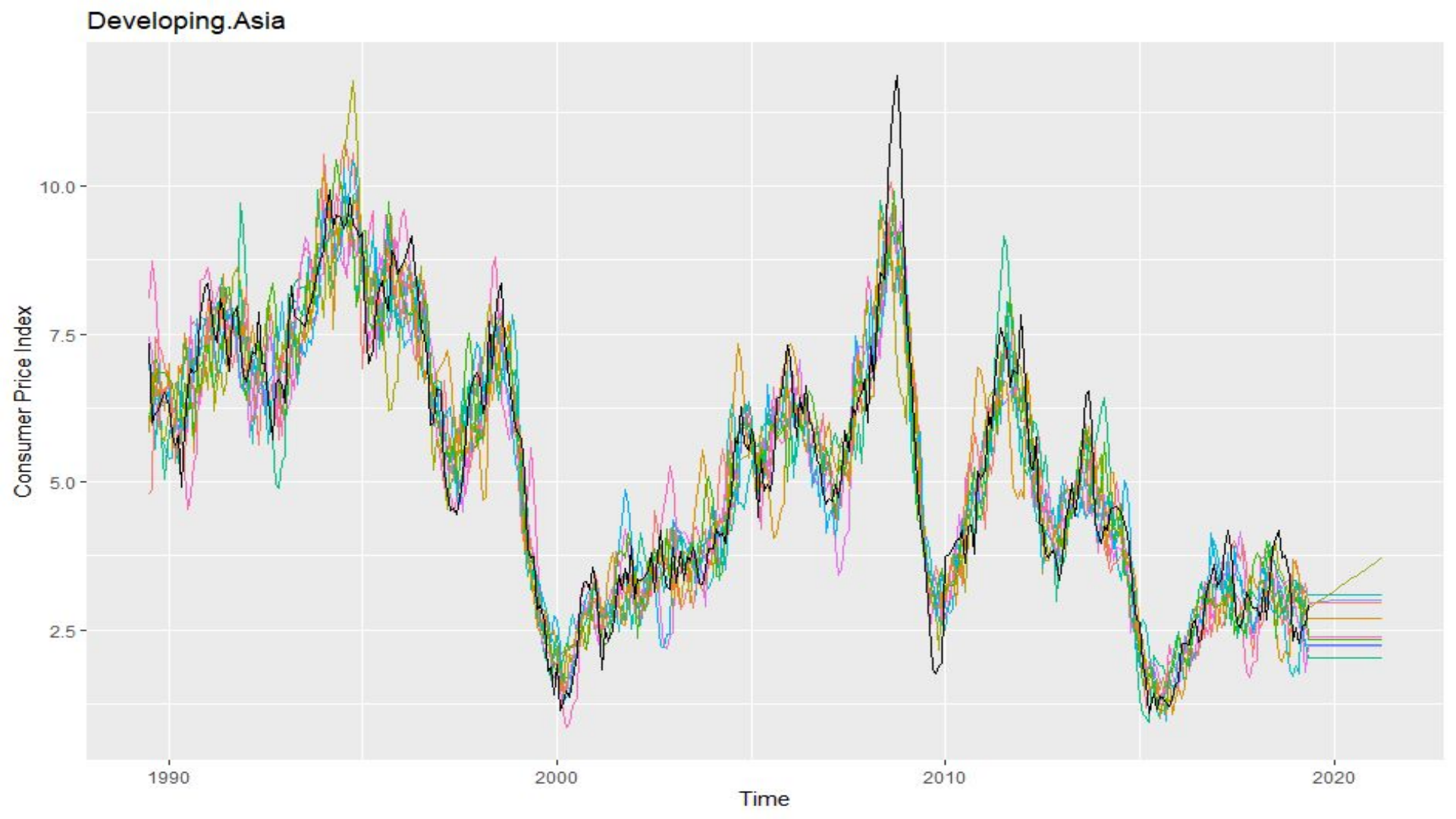
- Moving bootstraps use “bagging” (bootstrap aggregating) and take into account (a) and (b) whereas traditional models only incorporate (a)

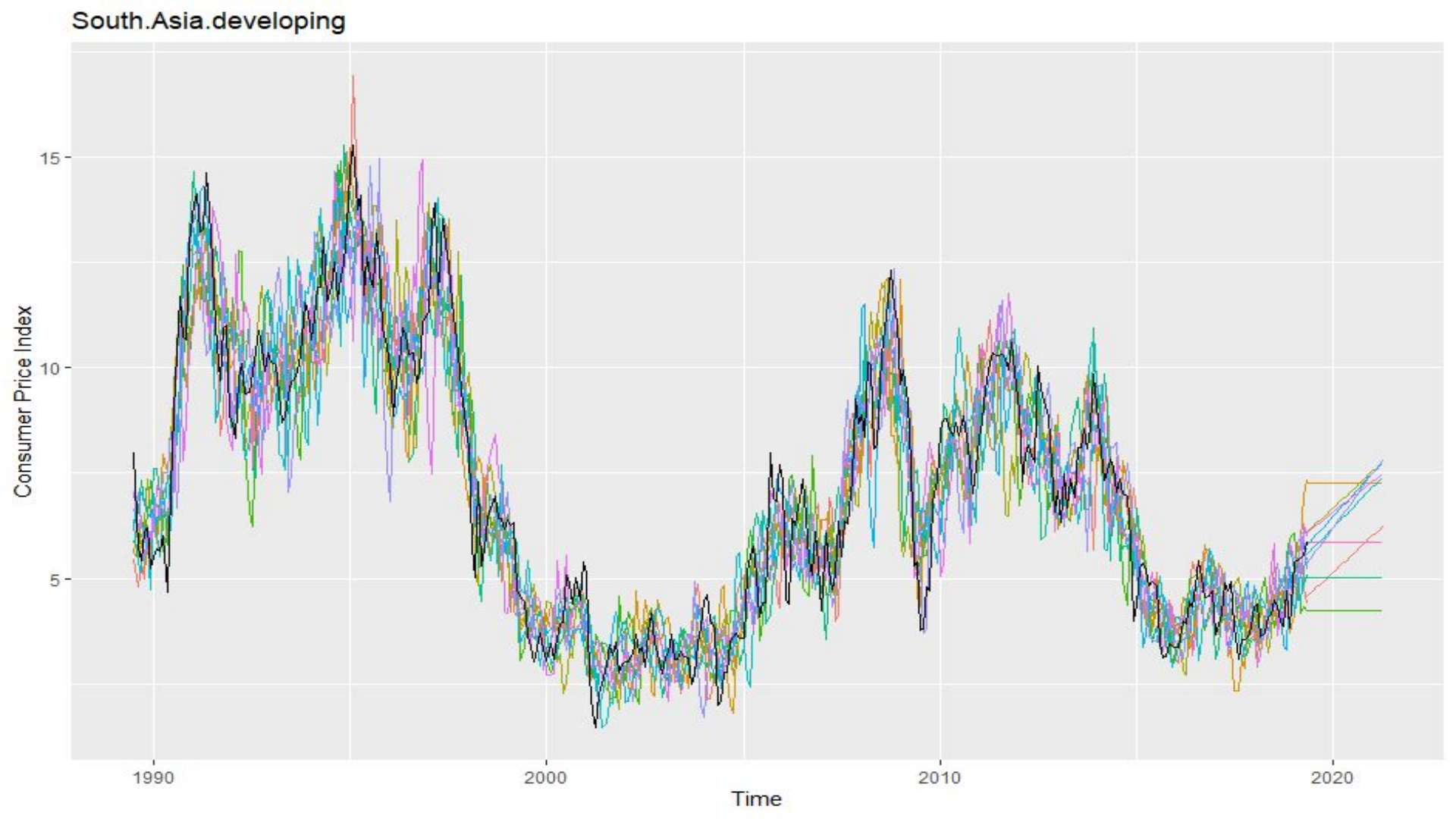
- This project used 10 simulations each with different parameter estimates

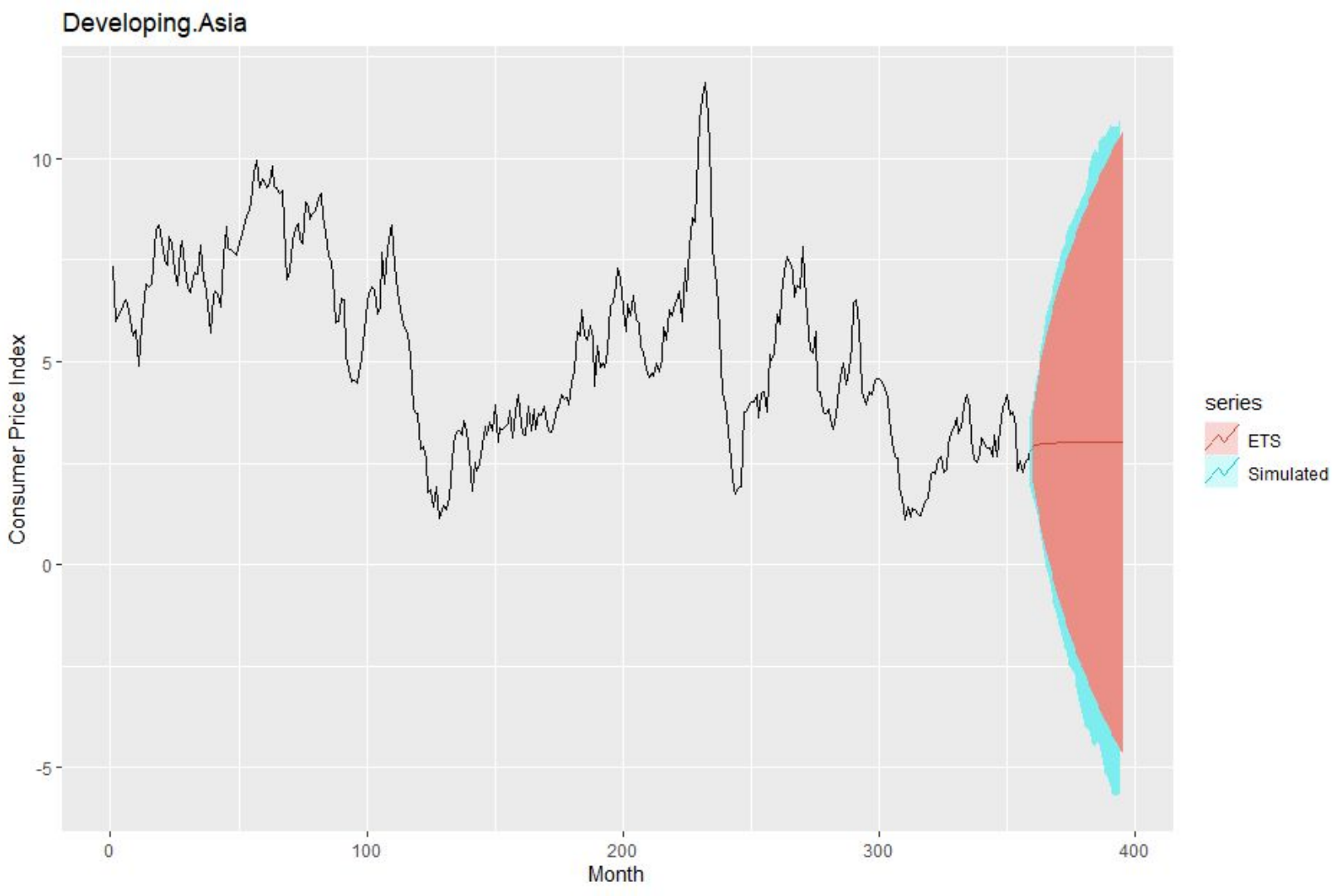
	1989-2019		2012-2019		2017-2019	
Region	Mean	SD	Mean	SD	Mean	SD
Developing Asia	2.622865	0.4238488	2.664424	0.2242972	2.904942	0.1968006
Developing Countries	3.031491	0.228516	2.956536	0.2557012	2.986759	0.1745987
East Asia & Pacific Developing	2.008672	0.7626217	2.153814	0.3893575	2.665854	0.2200477
Europe & Central Asia Developing	4.517229	2.33392	2.859172	0.4202721	2.96644	0.2694802
High Income Countries	1.862138	0.09621868	1.703219	0.2691937	1.887336	0.1776456
High Income: OECD	1.822395	0.2109424	1.807372	0.180072	2.07341	0.1624291
Latin America & Caribbean Developing	2.907194	0.5468851	2.711332	0.1542485	2.877627	0.01174036
Middle Income Countries (MIC)	2.901799	0.2477294	3.063643	0.2310371	3.048797	0.03380985
Middle East and North Africa Developing	3.995953	1.007695	3.672488	0.5255686	3.900084	0.3054027
High Income: Non-OECD	1.261122	0.2821389	1.088916	0.1690771	1.280971	0.2129597
South Asia Developing	6.133724	1.017179	6.157171	0.6973637	5.667757	0.2166167
Sub Saharan Africa Developing	3.773362	0.3844401	3.503667	0.260516	3.473896	0.1186552
World (WBG members)	2.154067	0.1958899	2.107762	0.2420809	2.262963	0.08984811


High.Income.Countries
6
4
2
0
Consumer Price Index
1990
2000
2010
2020
Time

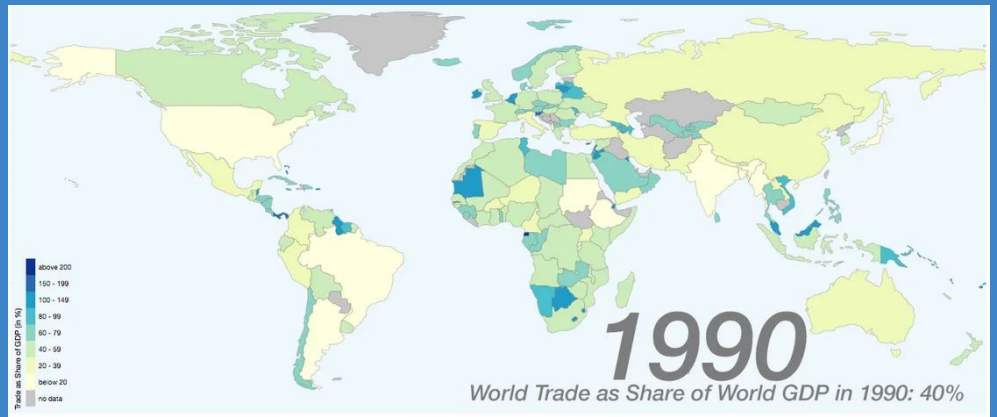

Developing.Countries
25
20
15
10
5
Consumer Price Index
1990
2000
2010
2020
Time


Developing.Asia
10.0
7.5
5.0
2.5
Consumer Price Index
1990
2000
2010
2020
Time


South.Asia.developing
Consumer Price Index
15
10
5
1990
2000
2010
2020
Time


Developing.Asia
Consumer Price Index
10
5
0
-5
0
100
200
300
400
Month
series
ETS
Simulated

Conclusion



The Average CPI for

- High Income Countries
  - did not match our hypothesis
  - decrease in the average change in prices
- Middle Income Countries
  - did match our hypothesis
  - increase in the average change in prices
- Developing Countries
  - did not match our hypothesis
  - decrease in the average change in prices

from the first subset of data (1989-2019) to the second subset (2012-2019).

Bibliography

- Analytics, Moody's. “Consumer Price Index (CPI) - Country / Jurisdiction List.” *Consumer Price Index (CPI) - Country List | Economic Indicators | Moody's Analytics*, https://www.economy.com/indicators/consumer-price-index-cpi.
- Bank, World. “Global Economic Monitor.” *Kaggle*, 16 May 2019, https://www.kaggle.com/datasets/theworldbank/global-economic-monitor.
- Fernando, Jason. “Consumer Price Index (CPI).” *Investopedia*, Investopedia, 7 Apr. 2022, https://www.investopedia.com/terms/c/consumerpriceindex.asp#:~:text=The%20Consumer%20Price%20Index%20(CPI)%20is%20a%20measure%20that%20examines,of%20goods%20and%20averaging%20them.