

In []:

```
# Sources
# https://matheusfacure.github.io/python-causality-handbook/15-Synthetic-Control.html
# https://nbviewer.jupyter.org/github/OscarEngelbrektsen/SyntheticControlMethods/blob/master/examples/user\_guide.ipynb
# https://github.com/Jaykim1234/Python/blob/main/UvA%20projects/Thesis/Codes/Impact%20of%20Brexit%20thesis%20on%20the%20economy.ipynb
```

In []:

```
import warnings
import imp
import ascm # get module reference for reload
import copy
import numpy as np
import os
import pandas as pd
import seaborn as sns
import statsmodels.formula.api as smf
from ascm.graph import graph_original
from ascm.graph import ascm_dataframe
from ascm.graph import ascm_visualize
from ascm.graph import rmspe_table
from ascm.graph import p_value
from ascm.graph import placebo
from ascm.graph import ascm_limit_donor_pool
from matplotlib import style
from matplotlib import pyplot as plt
from matplotlib.colors import LogNorm
from operator import add
from scipy import stats
from scipy.optimize import fmin_slsqp
from scipy.stats import ttest_ind
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LinearRegression,Ridge
from toolz import reduce, partial
from typing import List

imp.reload(ascm.graph)
warnings.filterwarnings('ignore')
%matplotlib inline
pd.set_option("display.max_columns", 6)
style.use("fivethirtyeight")

# read data file
# pandas read_csv
dirs = os.getcwd()
files = os.listdir(dirs)

data = pd.read_excel(r'/Users/jinhyun/Documents/GitHub/Python/UvA projects/Thesis/MSc/data/processed raw data_2.xlsx')
data = data.loc[ (data.year < 2021) & (data.year >= 1965)]
raw_data = copy.deepcopy(data)# Copy dataframe
```

1. Data processing

In []:

```
data_gdp = data[
['year', 'country', 'GDP (current US$)',  

 'Foreign direct investment, net inflows (BoP, current US$)', 'GDP growth (annual %)', 'Life expectancy at birth,  

 , 'Agriculture, forestry, and fishing, value added (% of GDP)'  

 , 'Adolescent fertility rate (births per 1,000 women ages 15-19)'  

 , 'Inflation, GDP deflator (annual %)'  

 , 'School enrollment, primary (% gross)'  

 , 'Fertility rate, total (births per woman)'  

 , 'Surface area (sq. km)'  

 , 'Mortality rate, under-5 (per 1,000 live births)']]  
  
data_gdp_growth = data[  

 ['year', 'country', 'GDP growth (annual %)', 'Industry (including construction), value added (% of GDP)',  

 'Life expectancy at birth, total (years)', 'Inflation, GDP deflator (annual %)']]  
  
data_inv = data[  

 ['year', 'country', 'Gross capital formation (% of GDP)',  

 'Industry (including construction), value added (% of GDP)',  

 'Adolescent fertility rate (births per 1,000 women ages 15-19)',  

 'Inflation, GDP deflator (annual %)',  

 'Merchandise trade (% of GDP)',  

 'Agriculture, forestry, and fishing, value added (% of GDP)',  

 'School enrollment, primary (% gross)']]  
  
data_export = data[  

 ['year', 'country', 'Exports of goods and services (% of GDP)',  

 'Industry (including construction), value added (% of GDP)',  

 'Adolescent fertility rate (births per 1,000 women ages 15-19)',  

 'Inflation, GDP deflator (annual %)',  

 'Surface area (sq. km)']]
```

```
'Merchandise trade (% of GDP)',  
'Life expectancy at birth, total (years)',  
'School enrollment, primary (% gross)']]
```

```
data_import = data[  
    ['year', 'country', 'Imports of goods and services (% of GDP)',  
     'Industry (including construction), value added (% of GDP)',  
     'Adolescent fertility rate (births per 1,000 women ages 15-19)',  
     'Inflation, GDP deflator (annual %)',  
     'Surface area (sq. km)',  
     'Merchandise trade (% of GDP)',  
     'Life expectancy at birth, total (years)',  
     'School enrollment, primary (% gross)']]  
  
data_fdi = data[  
    ['year', 'country', 'Foreign direct investment, net inflows (BoP, current US$)',  
     'Adolescent fertility rate (births per 1,000 women ages 15-19)',  
     'Agriculture, forestry, and fishing, value added (% of GDP)',  
     'Exports of goods and services (% of GDP)',  
     'Fertility rate, total (births per woman)',  
     'GDP (current US$)', 'GDP growth (annual %)',  
     'Imports of goods and services (% of GDP)',  
     'Industry (including construction), value added (% of GDP)',  
     'Inflation, GDP deflator (annual %)',  
     'Life expectancy at birth, total (years)',  
     'Merchandise trade (% of GDP)',  
     'Mortality rate, under-5 (per 1,000 live births)',  
     'Population density (people per sq. km of land area)',  
     'Population, total',  
     'School enrollment, primary (% gross)', 'Surface area (sq. km)',  
     'Urban population growth (annual %)']]
```

In []:

```
display(data_gdp)
```

year	country	GDP (current US\$)	...	Fertility rate, total (births per woman)	Surface area (sq. km)	Mortality rate, under-5 (per 1,000 live births)
5 1965	Algeria	3.136259e+09	...	7.675000	2381740.000	244.500000
6 1966	Algeria	3.039835e+09	...	7.676000	2381740.000	245.200000
7 1967	Algeria	3.370843e+09	...	7.672000	2381740.000	245.200000
8 1968	Algeria	3.852116e+09	...	7.666000	2381740.000	244.200000
9 1969	Algeria	4.257219e+09	...	7.656000	2381740.000	242.000000
...
4570 2016	European Union	1.389326e+13	...	1.566241	4172271.600	4.165583
4571 2017	European Union	1.476599e+13	...	1.556049	4172076.830	4.110764
4572 2018	European Union	1.597821e+13	...	1.542059	4172838.889	4.031467
4573 2019	European Union	1.568936e+13	...	1.525078	18270.000	3.943376
4574 2020	European Union	1.529193e+13	...	1.495717	18270.000	3.909295

4200 rows × 13 columns

In []:

```
display(data_gdp_growth)
```

year	country	GDP growth (annual %)	Industry (including construction), value added (% of GDP)	Life expectancy at birth, total (years)	Inflation, GDP deflator (annual %)
5 1965	Algeria	6.206898	35.860933	48.394000	1.501331
6 1966	Algeria	-4.804971	35.860933	48.811000	1.817815
7 1967	Algeria	9.452963	35.860933	49.210000	1.312041
8 1968	Algeria	10.796239	35.860933	49.597000	3.142056
9 1969	Algeria	8.433280	35.860933	49.982000	1.921085
...
4570 2016	European Union	2.008266	22.793653	80.949865	0.874115
4571 2017	European Union	2.813595	22.723281	80.930839	1.464064

European

4572	2018	Union	2.065499	22.704654	81.027024	2.002209
4573	2019	European Union	1.816850	22.646120	81.313270	2.199604
4574	2020	European Union	-5.955778	22.513421	80.463702	1.596823

4200 rows × 6 columns

In []:

```
display(data_inv)
```

	year	country	Gross capital formation (% of GDP)	...	Merchandise trade (% of GDP)	Agriculture, forestry, and fishing, value added (% of GDP)	School enrollment, primary (% gross)
5	1965	Algeria	22.603944	...	41.705741	11.106980	74.465683
6	1966	Algeria	17.324132	...	41.581210	11.106980	74.465683
7	1967	Algeria	23.434417	...	40.405322	11.106980	74.465683
8	1968	Algeria	27.867922	...	42.703804	11.106980	74.465683
9	1969	Algeria	32.352736	...	45.640126	11.106980	74.465683
...
4570	2016	European Union	20.947080	...	69.037866	1.587936	101.602577
4571	2017	European Union	21.569979	...	71.975157	1.693777	101.832970
4572	2018	European Union	22.146677	...	73.506501	1.609880	101.509720
4573	2019	European Union	22.934326	...	72.454613	1.591050	101.294121
4574	2020	European Union	22.069685	...	69.324204	1.651606	106.739441

4200 rows × 9 columns

In []:

```
display(data_export)
```

	year	country	Exports of goods and services (% of GDP)	...	Merchandise trade (% of GDP)	Life expectancy at birth, total (years)	School enrollment, primary (% gross)
5	1965	Algeria	22.603944	...	41.705741	48.394000	74.465683
6	1966	Algeria	25.986198	...	41.581210	48.811000	74.465683
7	1967	Algeria	23.434417	...	40.405322	49.210000	74.465683
8	1968	Algeria	23.135635	...	42.703804	49.597000	74.465683
9	1969	Algeria	23.788777	...	45.640126	49.982000	74.465683
...
4570	2016	European Union	46.684512	...	69.037866	80.949865	101.602577
4571	2017	European Union	48.354594	...	71.975157	80.930839	101.832970
4572	2018	European Union	49.198138	...	73.506501	81.027024	101.509720
4573	2019	European Union	49.344668	...	72.454613	81.313270	101.294121
4574	2020	European Union	46.648574	...	69.324204	80.463702	106.739441

4200 rows × 10 columns

In []:

```
display(data_import)
```

	year	country	Imports of goods and services (% of GDP)	...	Merchandise trade (% of GDP)	Life expectancy at birth, total (years)	School enrollment, primary (% gross)
5	1965	Algeria	25.833078	...	41.705741	48.394000	74.465683
6	1966	Algeria	24.653572	...	41.581210	48.811000	74.465683
7	1967	Algeria	21.631769	...	40.405322	49.210000	74.465683

8	1968	Algeria	24.187254	...	42.703804	49.597000	74.465683
9	1969	Algeria	28.070758	...	45.640126	49.982000	74.465683
...
4570	2016	European Union	42.306978	...	69.037866	80.949865	101.602577
4571	2017	European Union	44.077874	...	71.975157	80.930839	101.832970
4572	2018	European Union	45.325864	...	73.506501	81.027024	101.509720
4573	2019	European Union	45.897118	...	72.454613	81.313270	101.294121
4574	2020	European Union	42.871214	...	69.324204	80.463702	106.739441

4200 rows × 10 columns

In []: `display(data_fdi)`

year	country	Foreign direct investment, net inflows (BoP, current US\$)	...	School enrollment, primary (% gross)	Surface area (sq. km)	Urban population growth (annual %)	
5	1965	Algeria	8.012000e+07	...	74.465683	2381740.000	6.729878
6	1966	Algeria	8.012000e+07	...	74.465683	2381740.000	5.894366
7	1967	Algeria	8.012000e+07	...	74.465683	2381740.000	3.266680
8	1968	Algeria	8.012000e+07	...	74.465683	2381740.000	3.307126
9	1969	Algeria	8.012000e+07	...	74.465683	2381740.000	3.292629
...	
4570	2016	European Union	7.297543e+11	...	101.602577	4172271.600	0.479309
4571	2017	European Union	5.400017e+11	...	101.832970	4172076.830	0.430422
4572	2018	European Union	-3.415352e+10	...	101.509720	4172838.889	0.445310
4573	2019	European Union	1.783994e+11	...	101.294121	18270.000	0.359546
4574	2020	European Union	2.960592e+11	...	106.739441	18270.000	0.359835

4200 rows × 20 columns

Result

1. Raw data

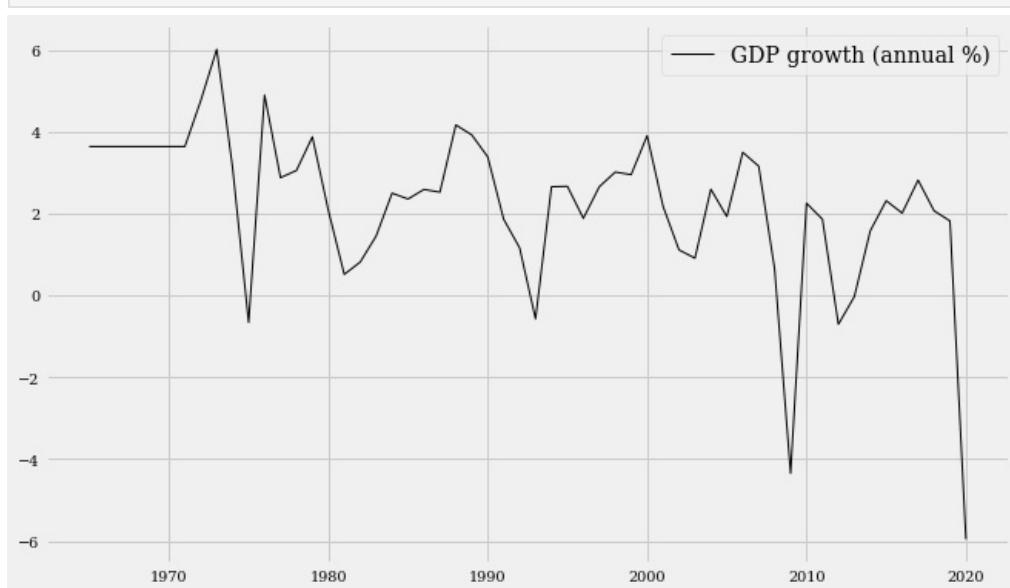
In []: `graph_original('European Union', 'GDP (current US$)', data_gdp)`





```
In [ ]: ascm_visualize('European Union','Foreign direct investment, net inflows (BoP, current US$)', data_fdi, incident=
```

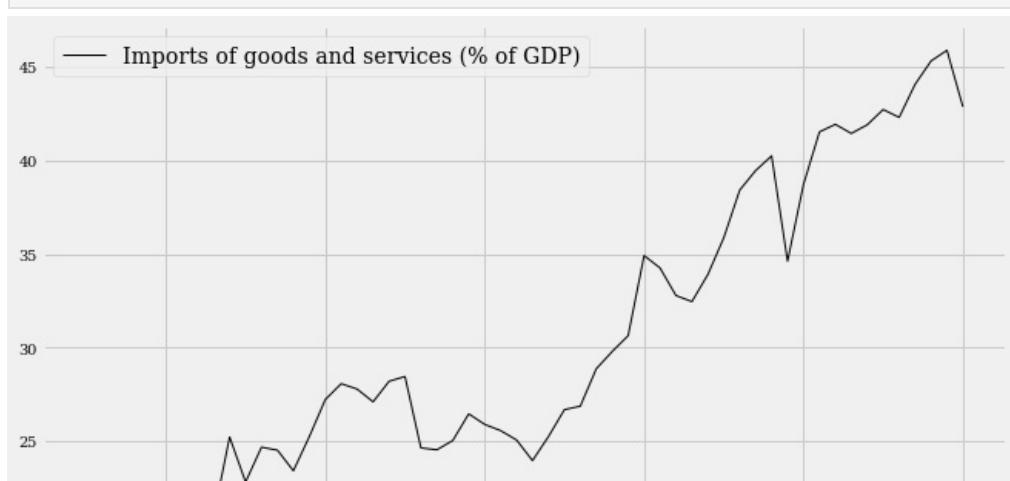
```
In [ ]: graph_original('European Union','GDP growth (annual %)',data_gdp_growth)
```



```
In [ ]: graph_original('European Union','Exports of goods and services (% of GDP)', data_export)
```

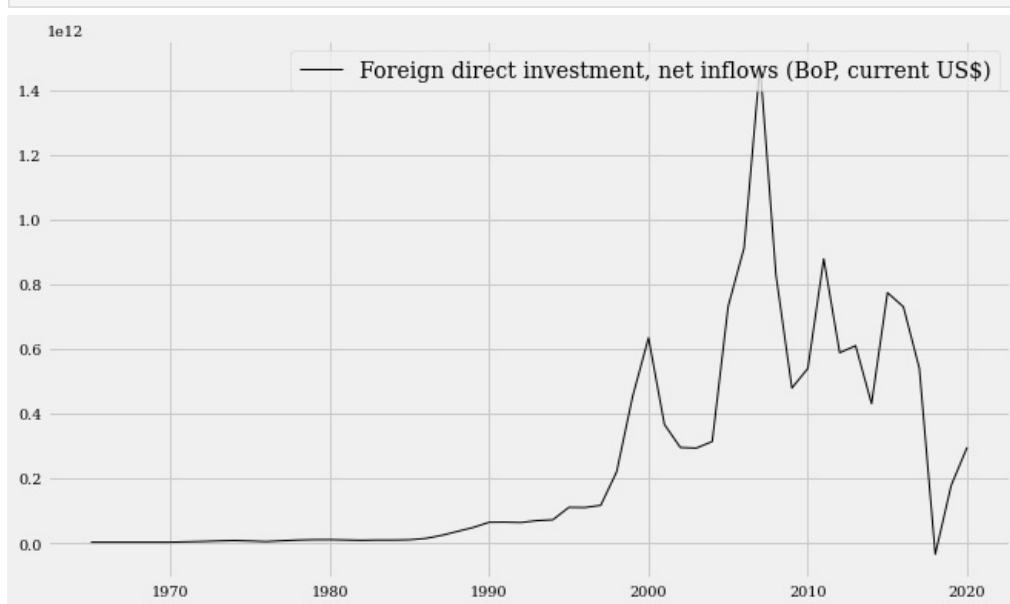


```
In [ ]: graph_original('European Union','Imports of goods and services (% of GDP)', data_import)
```





In []: `graph_original('European Union', 'Foreign direct investment, net inflows (BoP, current US$)', data_fdi)`



In []: `graph_original('European Union', 'Gross capital formation (% of GDP)', data_inv)`



1.2 Dataframe of Difference

In []: `ascm_dataframe('European Union', 'GDP (current US$)', data_gdp, incident='QE', incident_year=2009)`

Pre- RMSPE : 0.672182387459166
Post- RMSPE : 1.7296717596378866

Out[]: `country year GDP (current US$) ASCM Difference`

4519	European Union	1965	7.259311e+11	1.976478e+11	5.282834e+11
4520	European Union	1966	7.259311e+11	2.304571e+11	4.954740e+11
4521	European Union	1967	7.259311e+11	2.078856e+11	5.180455e+11
4522	European Union	1968	7.259311e+11	1.954812e+11	5.304499e+11
4523	European Union	1969	7.259311e+11	2.175651e+11	5.083660e+11
4524	European Union	1970	7.259311e+11	2.537035e+11	4.722276e+11
4525	European Union	1971	8.208130e+11	2.772500e+11	5.435630e+11

4526	European Union	1972	9.904287e+11	3.311914e+11	6.592373e+11
4527	European Union	1973	1.282021e+12	4.246519e+11	8.573687e+11
4528	European Union	1974	1.451750e+12	3.850346e+11	1.066715e+12
4529	European Union	1975	1.690875e+12	5.041165e+11	1.186759e+12
4530	European Union	1976	1.770054e+12	4.283603e+11	1.341694e+12
4531	European Union	1977	2.004900e+12	4.640460e+11	1.540855e+12
4532	European Union	1978	2.442696e+12	3.751789e+11	2.067518e+12
4533	European Union	1979	2.952838e+12	5.026880e+11	2.450150e+12
4534	European Union	1980	3.303182e+12	6.766747e+11	2.626507e+12
4535	European Union	1981	2.879984e+12	7.009525e+11	2.179032e+12
4536	European Union	1982	2.777377e+12	4.355578e+11	2.341819e+12
4537	European Union	1983	2.702070e+12	5.258286e+11	2.176241e+12
4538	European Union	1984	2.603395e+12	6.434572e+11	1.959938e+12
4539	European Union	1985	2.677661e+12	9.403014e+11	1.737360e+12
4540	European Union	1986	3.744042e+12	7.622508e+11	2.981791e+12
4541	European Union	1987	4.631251e+12	6.459640e+11	3.985287e+12
4542	European Union	1988	5.084288e+12	6.505909e+11	4.433697e+12
4543	European Union	1989	5.193669e+12	6.168973e+11	4.576772e+12
4544	European Union	1990	6.498472e+12	7.218652e+11	5.776607e+12
4545	European Union	1991	6.736016e+12	8.829104e+11	5.853106e+12
4546	European Union	1992	7.406290e+12	1.170741e+12	6.235549e+12
4547	European Union	1993	6.761115e+12	1.616510e+12	5.144605e+12
4548	European Union	1994	7.161872e+12	2.055437e+12	5.106435e+12
4549	European Union	1995	8.296026e+12	2.042153e+12	6.253873e+12
4550	European Union	1996	8.431518e+12	2.560011e+12	5.871507e+12
4551	European Union	1997	7.733761e+12	3.094841e+12	4.638921e+12
4552	European Union	1998	7.969786e+12	3.776813e+12	4.192973e+12
4553	European Union	1999	7.925751e+12	4.168291e+12	3.757460e+12
4554	European Union	2000	7.276100e+12	4.714951e+12	2.561149e+12
4555	European Union	2001	7.393823e+12	5.518455e+12	1.875368e+12
4556	European Union	2002	8.083838e+12	6.085657e+12	1.998181e+12
4557	European Union	2003	9.931880e+12	6.407244e+12	3.524636e+12
4558	European Union	2004	1.141903e+13	7.101929e+12	4.317098e+12
4559	European Union	2005	1.191085e+13	8.300035e+12	3.610811e+12
4560	European Union	2006	1.271392e+13	1.010002e+13	2.613904e+12
4561	European Union	2007	1.472876e+13	1.303778e+13	1.690981e+12
4562	European Union	2008	1.629763e+13	1.676312e+13	-4.654938e+11
4563	European Union	2009	1.476378e+13	1.845278e+13	-3.688997e+12
4564	European Union	2010	1.455764e+13	2.166847e+13	-7.110831e+12
4565	European Union	2011	1.575949e+13	2.662600e+13	-1.086650e+13
4566	European Union	2012	1.463620e+13	2.989827e+13	-1.526207e+13
4567	European Union	2013	1.529973e+13	3.398700e+13	-1.868727e+13
4568	European Union	2014	1.565210e+13	3.777348e+13	-2.212139e+13
4569	European Union	2015	1.355193e+13	3.964489e+13	-2.609297e+13
4570	European Union	2016	1.389326e+13	4.052396e+13	-2.663070e+13
4571	European Union	2017	1.476599e+13	4.431011e+13	-2.954412e+13
4572	European Union	2018	1.597821e+13	5.029363e+13	-3.431542e+13
4573	European Union	2019	1.568936e+13	5.205010e+13	-3.636074e+13
4574	European Union	2020	1.529193e+13	5.352401e+13	-3.823208e+13

In []:

ascm_dataframe('European Union','GDP growth (annual %)', data_gdp_growth, incident='QE', incident_year=2009)

Pre- RMSPE : 1.9642319552773726
Post- RMSPE : 23.30646654554046

Out[]:

	country	year	GDP growth (annual %)	ASCM	Difference
4519	European Union	1965	3.634559	3.439565	0.194994
4520	European Union	1966	3.634559	4.178231	-0.543672
4521	European Union	1967	3.634559	6.184115	-2.549556
4522	European Union	1968	3.634559	5.644118	-2.009559
4523	European Union	1969	3.634559	5.619359	-1.984800
4524	European Union	1970	3.634559	5.160246	-1.525687
4525	European Union	1971	3.634559	4.949930	-1.315371
4526	European Union	1972	4.759649	8.125599	-3.365950
4527	European Union	1973	6.009138	4.642669	1.366469
4528	European Union	1974	3.095644	2.780397	0.315247
4529	European Union	1975	-0.662398	1.600681	-2.263079
4530	European Union	1976	4.892440	2.128359	2.764081
4531	European Union	1977	2.874141	3.959511	-1.085369
4532	European Union	1978	3.049864	5.600964	-2.551100
4533	European Union	1979	3.872202	5.343137	-1.470935
4534	European Union	1980	2.075142	4.258790	-2.183648
4535	European Union	1981	0.511768	3.262400	-2.750632
4536	European Union	1982	0.812387	0.171121	0.641266
4537	European Union	1983	1.448999	-0.049457	1.498455
4538	European Union	1984	2.496149	3.694523	-1.198375
4539	European Union	1985	2.352823	0.532643	1.820179
4540	European Union	1986	2.586134	3.538130	-0.951996
4541	European Union	1987	2.520144	4.388482	-1.868338
4542	European Union	1988	4.162331	2.497478	1.664853
4543	European Union	1989	3.917985	3.527175	0.390810
4544	European Union	1990	3.382122	4.933169	-1.551047
4545	European Union	1991	1.859380	1.828605	0.030775
4546	European Union	1992	1.160409	4.484291	-3.323881
4547	European Union	1993	-0.573951	5.306373	-5.880324
4548	European Union	1994	2.652073	4.323351	-1.671278
4549	European Union	1995	2.662323	3.600438	-0.938115
4550	European Union	1996	1.880633	3.633056	-1.752423
4551	European Union	1997	2.652813	3.131167	-0.478354
4552	European Union	1998	3.010355	0.830870	2.179485
4553	European Union	1999	2.948183	3.853576	-0.905393
4554	European Union	2000	3.899841	3.565640	0.334201
4555	European Union	2001	2.175088	0.333083	1.842004
4556	European Union	2002	1.109577	2.491956	-1.382379
4557	European Union	2003	0.907652	2.101990	-1.194338
4558	European Union	2004	2.591565	4.728632	-2.137068
4559	European Union	2005	1.924095	2.619255	-0.695160
4560	European Union	2006	3.493434	3.885630	-0.392197
4561	European Union	2007	3.154771	3.738439	-0.583668
4562	European Union	2008	0.641010	1.977386	-1.336377
4563	European Union	2009	-4.348065	-0.859390	-3.488675
4564	European Union	2010	2.249315	3.725215	-1.475899
4565	European Union	2011	1.857767	4.104334	-2.246567
4566	European Union	2012	-0.706732	2.881751	-3.588483
4567	European Union	2013	-0.031993	2.435184	-2.467177
4568	European Union	2014	1.575669	2.318313	-0.742644
4569	European Union	2015	2.310708	2.144831	0.165876
4570	European Union	2016	2.008266	2.292924	-0.284657

4571	European Union	2017	2.813595	3.356289	-0.542694
4572	European Union	2018	2.065499	2.818476	-0.752977
4573	European Union	2019	1.816850	0.963374	0.853476
4574	European Union	2020	-5.955778	-6.679379	0.723600

```
In [ ]: ascn_dataframe('European Union','Exports of goods and services (% of GDP)', data_export, incident= 'QE', incident= 'QE')

Pre- RMSPE : 0.1418782476654889
Post- RMSPE : 0.21279190540557036
```

	country	year	Exports of goods and services (% of GDP)		ASCM	Difference
4519	European Union	1965	19.364094	16.948190	2.415903	
4520	European Union	1966	19.364094	17.454319	1.909775	
4521	European Union	1967	19.364094	16.333475	3.030618	
4522	European Union	1968	19.364094	16.975612	2.388481	
4523	European Union	1969	19.364094	16.426232	2.937862	
4524	European Union	1970	19.364094	17.237396	2.126697	
4525	European Union	1971	19.370930	15.306019	4.064911	
4526	European Union	1972	19.635161	16.086094	3.549067	
4527	European Union	1973	20.591952	18.127542	2.464410	
4528	European Union	1974	23.685329	16.964089	6.721240	
4529	European Union	1975	22.069584	17.330226	4.739358	
4530	European Union	1976	22.970526	18.774165	4.196362	
4531	European Union	1977	23.273726	17.556629	5.717097	
4532	European Union	1978	23.082467	18.143332	4.939135	
4533	European Union	1979	23.903104	18.936461	4.966642	
4534	European Union	1980	24.254874	18.076110	6.178765	
4535	European Union	1981	25.840240	19.505714	6.334527	
4536	European Union	1982	25.847606	20.245702	5.601904	
4537	European Union	1983	26.102573	21.473154	4.629419	
4538	European Union	1984	27.709373	24.120461	3.588912	
4539	European Union	1985	27.942254	22.921038	5.021215	
4540	European Union	1986	25.058035	25.366337	-0.308302	
4541	European Union	1987	24.395741	23.228544	1.167197	
4542	European Union	1988	24.805027	25.322495	-0.517468	
4543	European Union	1989	25.861708	22.925472	2.936237	
4544	European Union	1990	25.457830	23.255824	2.202006	
4545	European Union	1991	25.257004	21.800250	3.456754	
4546	European Union	1992	24.962593	22.233003	2.729590	
4547	European Union	1993	25.158326	23.176324	1.982002	
4548	European Union	1994	26.590439	24.269464	2.320975	
4549	European Union	1995	28.284042	25.839365	2.444677	
4550	European Union	1996	28.627611	27.399924	1.227687	
4551	European Union	1997	30.923806	28.382120	2.541685	
4552	European Union	1998	31.542094	30.984109	0.557985	
4553	European Union	1999	31.917286	29.492379	2.424908	
4554	European Union	2000	35.690537	31.714000	3.976537	
4555	European Union	2001	35.699648	33.420919	2.278730	
4556	European Union	2002	35.100714	31.877861	3.222853	
4557	European Union	2003	34.346139	31.795544	2.550596	
4558	European Union	2004	35.987162	32.738722	3.248440	
4559	European Union	2005	37.444530	33.116179	4.328352	
4560	European Union	2006	39.629381	37.779200	1.850180	
4561	European Union	2007	40.718783	37.834416	2.884368	
4562	European Union	2008	41.101448	38.645214	2.456235	

4563	European Union	2009	36.275067	36.893633	-0.618566
4564	European Union	2010	40.322782	36.327729	3.995054
4565	European Union	2011	43.214743	38.254938	4.959805
4566	European Union	2012	44.803858	38.339177	6.464682
4567	European Union	2013	44.964306	36.708540	8.255766
4568	European Union	2014	45.690230	37.888631	7.801600
4569	European Union	2015	47.109744	35.776938	11.332806
4570	European Union	2016	46.684512	34.202935	12.481577
4571	European Union	2017	48.354594	35.498917	12.855677
4572	European Union	2018	49.198138	35.557432	13.640706
4573	European Union	2019	49.344668	37.926492	11.418175
4574	European Union	2020	46.648574	35.131249	11.517325

In []:

```
ascm_dataframe('European Union','Imports of goods and services (% of GDP)', data_import, incident= 'QE', incident
```

Pre- RMSPE : 0.09023993688066338

Post- RMSPE : 0.13278616557844877

Out[]:

	country	year	Imports of goods and services (% of GDP)	ASCM	Difference
4519	European Union	1965	20.039114	21.017813	-0.978698
4520	European Union	1966	20.039114	19.823885	0.215229
4521	European Union	1967	20.039114	19.141817	0.897297
4522	European Union	1968	20.039114	19.402812	0.636303
4523	European Union	1969	20.039114	18.673138	1.365976
4524	European Union	1970	20.039114	20.081758	-0.042644
4525	European Union	1971	19.709263	18.997910	0.711352
4526	European Union	1972	19.687489	17.355766	2.331723
4527	European Union	1973	20.986673	17.923323	3.063350
4528	European Union	1974	25.208597	23.533594	1.675003
4529	European Union	1975	22.796644	23.202581	-0.405937
4530	European Union	1976	24.663365	22.541100	2.122265
4531	European Union	1977	24.501317	22.313860	2.187457
4532	European Union	1978	23.399347	21.363277	2.036069
4533	European Union	1979	25.228771	24.207704	1.021067
4534	European Union	1980	27.208442	22.705979	4.502462
4535	European Union	1981	28.060497	23.853322	4.207175
4536	European Union	1982	27.770764	23.488292	4.282472
4537	European Union	1983	27.087821	22.778501	4.309320
4538	European Union	1984	28.186726	25.124458	3.062269
4539	European Union	1985	28.443245	23.919917	4.523328
4540	European Union	1986	24.623586	24.480295	0.143290
4541	European Union	1987	24.522521	22.804180	1.718342
4542	European Union	1988	25.020035	24.224064	0.795971
4543	European Union	1989	26.444708	25.647102	0.797605
4544	European Union	1990	25.882299	26.393835	-0.511536
4545	European Union	1991	25.549442	18.933730	6.615712
4546	European Union	1992	25.047363	22.592163	2.455200
4547	European Union	1993	23.943423	24.084235	-0.140811
4548	European Union	1994	25.229102	26.495458	-1.266356
4549	European Union	1995	26.669936	27.836499	-1.166563
4550	European Union	1996	26.858338	29.637203	-2.778865
4551	European Union	1997	28.856918	31.749355	-2.892438
4552	European Union	1998	29.782432	29.627644	0.154788
4553	European Union	1999	30.627813	32.189781	-1.561968
4554	European Union	2000	34.913638	36.427116	-1.513478

4555	European Union	2001	34.252356	36.075909	-1.823553
4556	European Union	2002	32.775894	35.588066	-2.812172
4557	European Union	2003	32.451372	35.216322	-2.764950
4558	European Union	2004	33.897041	37.050355	-3.153314
4559	European Union	2005	35.871965	37.123741	-1.251776
4560	European Union	2006	38.418644	40.476572	-2.057928
4561	European Union	2007	39.464692	39.727641	-0.262949
4562	European Union	2008	40.248658	43.287599	-3.038941
4563	European Union	2009	34.615295	36.988738	-2.373443
4564	European Union	2010	38.724018	38.443215	0.280804
4565	European Union	2011	41.531607	41.091480	0.440127
4566	European Union	2012	41.935169	41.125897	0.809272
4567	European Union	2013	41.449658	38.395617	3.054041
4568	European Union	2014	41.911613	37.573177	4.338436
4569	European Union	2015	42.729792	35.860942	6.868851
4570	European Union	2016	42.306978	34.176459	8.130519
4571	European Union	2017	44.077874	35.553133	8.524742
4572	European Union	2018	45.325864	36.829757	8.496107
4573	European Union	2019	45.897118	39.209255	6.687862
4574	European Union	2020	42.871214	36.699199	6.172015

In []:

```
ascm_dataframe('European Union','Gross capital formation (% of GDP)', data_inv, incident= 'QE', incident_year=2008)
```

Pre- RMSPE : 0.10039886536924084

Post- RMSPE : 0.10750962227906978

Out[]:

	country	year	Gross capital formation (% of GDP)	ASCM	Difference
4519	European Union	1965	30.016778	24.164495	5.852283
4520	European Union	1966	30.016778	24.679121	5.337657
4521	European Union	1967	30.016778	25.912190	4.104588
4522	European Union	1968	30.016778	25.036915	4.979863
4523	European Union	1969	30.016778	26.203840	3.812938
4524	European Union	1970	30.016778	25.231608	4.785170
4525	European Union	1971	28.812516	26.624576	2.187940
4526	European Union	1972	28.234240	24.573879	3.660361
4527	European Union	1973	28.790352	26.515435	2.274917
4528	European Union	1974	28.848407	28.401136	0.447271
4529	European Union	1975	25.687307	24.787313	0.899994
4530	European Union	1976	26.719477	24.799165	1.920312
4531	European Union	1977	25.795400	24.470862	1.324538
4532	European Union	1978	25.030293	23.938736	1.091556
4533	European Union	1979	25.946631	24.856150	1.090481
4534	European Union	1980	26.571832	23.964693	2.607139
4535	European Union	1981	24.166421	24.767412	-0.600991
4536	European Union	1982	23.595495	25.009832	-1.414336
4537	European Union	1983	22.827601	23.017714	-0.190113
4538	European Union	1984	22.883117	22.277431	0.605686
4539	European Union	1985	22.793550	20.066754	2.726796
4540	European Union	1986	22.691101	18.591759	4.099342
4541	European Union	1987	22.773053	19.650900	3.122153
4542	European Union	1988	23.838765	19.978788	3.859977
4543	European Union	1989	24.698552	21.563862	3.134689
4544	European Union	1990	24.906968	23.339666	1.567302

4545	European Union	1991	24.312559	20.229115	4.083444
4546	European Union	1992	23.321159	18.933411	4.387749
4547	European Union	1993	21.439828	21.004546	0.435282
4548	European Union	1994	21.844436	23.503778	-1.659342
4549	European Union	1995	22.288772	22.916249	-0.627477
4550	European Union	1996	21.731648	23.310098	-1.578451
4551	European Union	1997	21.960926	22.678942	-0.718016
4552	European Union	1998	22.712536	21.710308	1.002228
4553	European Union	1999	22.989767	23.198403	-0.208636
4554	European Union	2000	23.650538	23.141381	0.509156
4555	European Union	2001	23.014342	21.188202	1.826140
4556	European Union	2002	22.074910	21.333679	0.741231
4557	European Union	2003	22.043892	21.702819	0.341073
4558	European Union	2004	22.291448	22.668126	-0.376677
4559	European Union	2005	22.523369	22.557014	-0.033645
4560	European Union	2006	23.556302	21.006515	2.549787
4561	European Union	2007	24.441943	22.041296	2.400647
4562	European Union	2008	24.016839	24.004748	0.012091
4563	European Union	2009	20.628513	17.780325	2.848187
4564	European Union	2010	21.188788	19.631272	1.557516
4565	European Union	2011	21.737717	21.613107	0.124610
4566	European Union	2012	20.306324	22.523592	-2.217268
4567	European Union	2013	19.887914	22.464457	-2.576543
4568	European Union	2014	20.294543	20.382952	-0.088409
4569	European Union	2015	20.744377	19.202468	1.541908
4570	European Union	2016	20.947080	18.173271	2.773808
4571	European Union	2017	21.569979	20.627629	0.942350
4572	European Union	2018	22.146677	22.658263	-0.511586
4573	European Union	2019	22.934326	19.699749	3.234577
4574	European Union	2020	22.069685	17.255336	4.814348

```
In [ ]: ascm_dataframe('European Union', 'Foreign direct investment, net inflows (BoP, current US$)', data_fdi, incident=
```

Pre- RMSPE : 0.7663515731978118
Post- RMSPE : 2.385431102871565

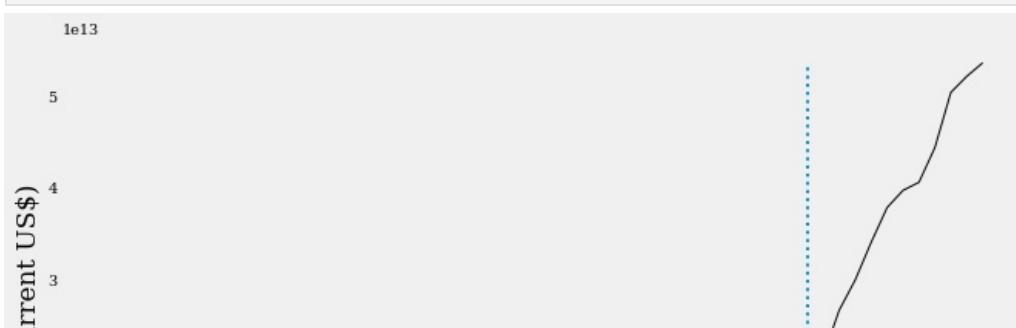
	country	year	Foreign direct investment, net inflows (BoP, current US\$)	ASCM	Difference
4519	European Union	1965	2.899569e+09	1.684756e+08	2.731094e+09
4520	European Union	1966	2.899569e+09	1.684756e+08	2.731094e+09
4521	European Union	1967	2.899569e+09	1.684756e+08	2.731094e+09
4522	European Union	1968	2.899569e+09	1.684756e+08	2.731094e+09
4523	European Union	1969	2.899569e+09	1.684756e+08	2.731094e+09
4524	European Union	1970	2.899569e+09	1.684756e+08	2.731094e+09
4525	European Union	1971	4.101957e+09	-1.040175e+08	4.205975e+09
4526	European Union	1972	5.247234e+09	5.565637e+08	4.690670e+09
4527	European Union	1973	6.849956e+09	1.045566e+09	5.804390e+09
4528	European Union	1974	8.012974e+09	6.313010e+08	7.381673e+09
4529	European Union	1975	6.594487e+09	7.179732e+08	5.876513e+09
4530	European Union	1976	4.895514e+09	1.418509e+09	3.477005e+09
4531	European Union	1977	7.411237e+09	9.868824e+08	6.424355e+09
4532	European Union	1978	9.556880e+09	1.001479e+09	8.555401e+09
4533	European Union	1979	1.067430e+10	3.345042e+09	7.329256e+09
4534	European Union	1980	1.084950e+10	3.455527e+09	7.393973e+09
4535	European Union	1981	9.811505e+09	6.453296e+09	3.358209e+09

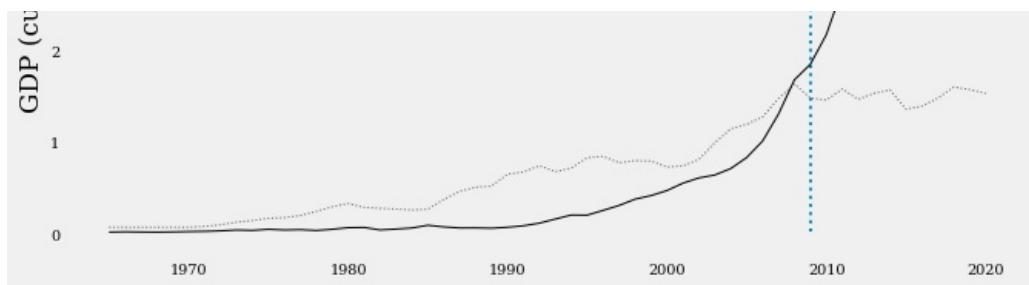
4536	European Union	1982	8.777234e+09	3.871658e+09	4.905576e+09
4537	European Union	1983	9.639296e+09	3.851160e+09	5.788136e+09
4538	European Union	1984	9.617571e+09	4.484672e+09	5.132899e+09
4539	European Union	1985	1.047970e+10	4.570674e+09	5.909023e+09
4540	European Union	1986	1.448270e+10	4.973135e+09	9.509561e+09
4541	European Union	1987	2.385013e+10	5.350972e+09	1.849915e+10
4542	European Union	1988	3.614308e+10	5.234207e+09	3.090887e+10
4543	European Union	1989	4.846455e+10	7.154011e+09	4.131054e+10
4544	European Union	1990	6.450684e+10	4.451863e+09	6.005498e+10
4545	European Union	1991	6.477330e+10	1.488474e+10	4.988856e+10
4546	European Union	1992	6.365260e+10	1.699788e+10	4.665472e+10
4547	European Union	1993	6.960930e+10	3.127967e+10	3.832963e+10
4548	European Union	1994	7.227635e+10	5.297166e+10	1.930469e+10
4549	European Union	1995	1.105267e+11	4.490567e+10	6.562102e+10
4550	European Union	1996	1.099802e+11	5.513176e+10	5.484847e+10
4551	European Union	1997	1.167305e+11	6.523571e+10	5.149483e+10
4552	European Union	1998	2.201441e+11	7.425254e+10	1.458915e+11
4553	European Union	1999	4.525799e+11	8.618347e+10	3.663965e+11
4554	European Union	2000	6.339867e+11	9.385916e+10	5.401276e+11
4555	European Union	2001	3.662528e+11	1.094194e+11	2.568334e+11
4556	European Union	2002	2.953436e+11	9.477556e+10	2.005680e+11
4557	European Union	2003	2.935076e+11	9.044325e+10	2.030644e+11
4558	European Union	2004	3.138361e+11	1.031303e+11	2.107057e+11
4559	European Union	2005	7.312790e+11	1.867643e+11	5.445147e+11
4560	European Union	2006	9.118601e+11	1.472885e+11	7.645716e+11
4561	European Union	2007	1.477512e+12	1.936283e+11	1.283884e+12
4562	European Union	2008	8.284609e+11	1.876545e+11	6.408064e+11
4563	European Union	2009	4.789910e+11	1.282452e+11	3.507458e+11
4564	European Union	2010	5.394358e+11	2.661752e+11	2.732605e+11
4565	European Union	2011	8.779705e+11	2.587413e+11	6.192292e+11
4566	European Union	2012	5.880297e+11	2.190557e+11	3.689740e+11
4567	European Union	2013	6.095910e+11	3.189103e+11	2.906806e+11
4568	European Union	2014	4.307128e+11	2.448406e+11	1.858722e+11
4569	European Union	2015	7.734355e+11	2.369516e+11	5.364838e+11
4570	European Union	2016	7.297543e+11	1.947620e+11	5.349923e+11
4571	European Union	2017	5.400017e+11	1.845480e+11	3.554537e+11
4572	European Union	2018	-3.415352e+10	2.292836e+11	-2.634371e+11
4573	European Union	2019	1.783994e+11	1.860027e+11	-7.603308e+09
4574	European Union	2020	2.960592e+11	2.109397e+11	8.511952e+10

1.3 Augmented Synthetic Control Method

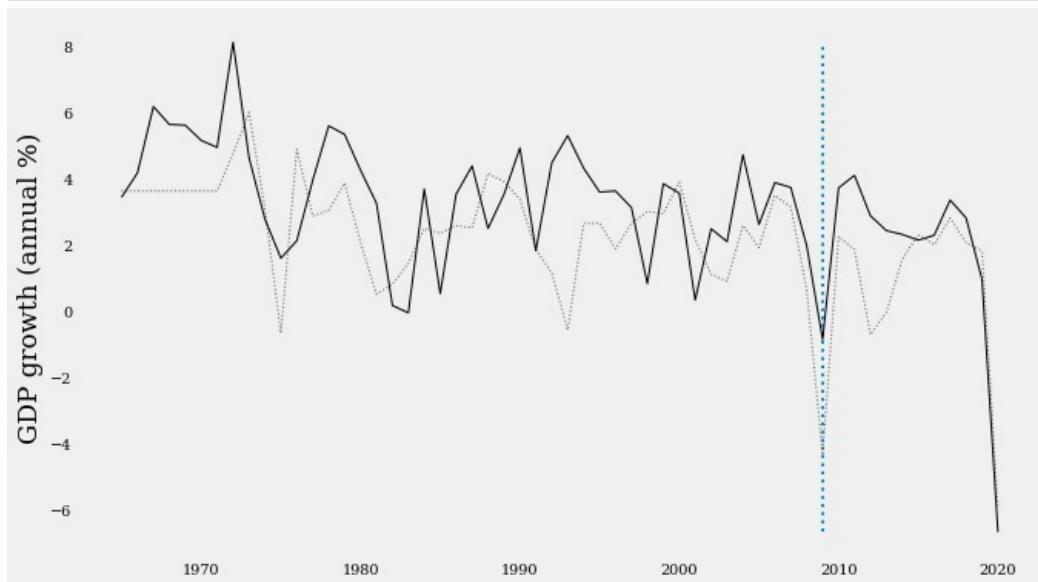
In []:

```
ascm_visualize('European Union','GDP (current US$)', data_gdp, incident= 'QE', incident_year=2009, std_scaling=True)
```

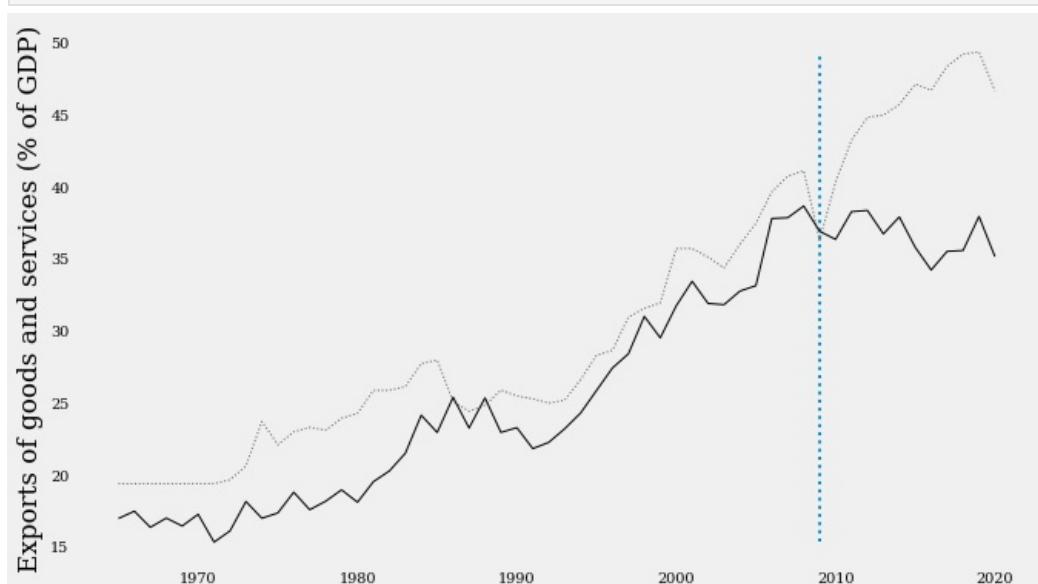




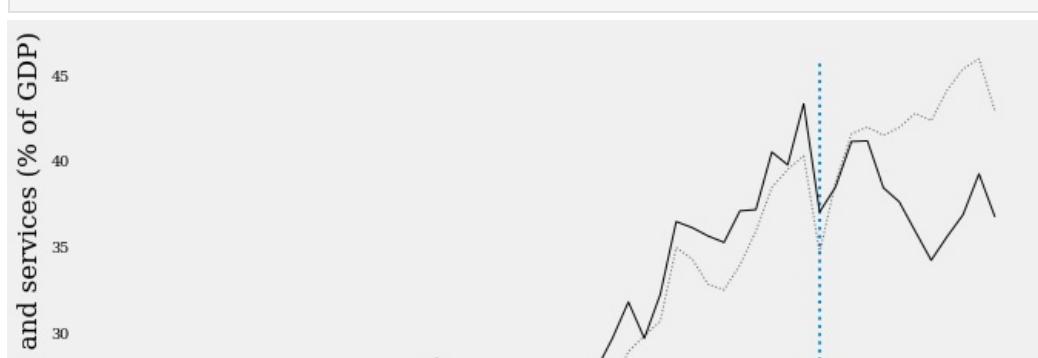
```
In [ ]: ascm_visualize('European Union','GDP growth (annual %)', data_gdp_growth, incident= 'QE', incident_year=2009, stc
```



```
In [ ]: ascm_visualize('European Union','Exports of goods and services (% of GDP)', data_export, incident= 'QE', incident
```

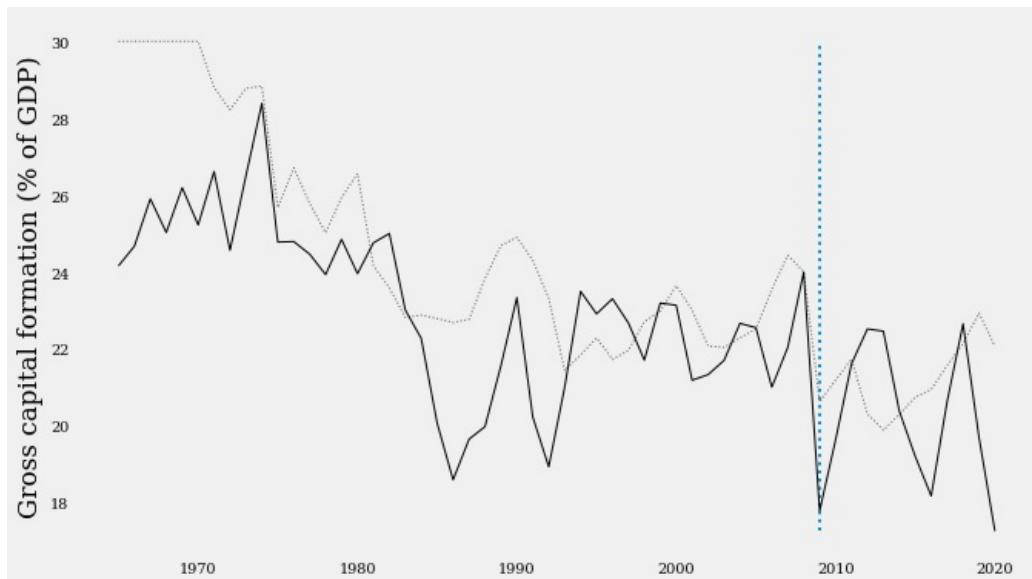


```
In [ ]: ascm_visualize('European Union','Imports of goods and services (% of GDP)', data_import, incident= 'QE', incident
```

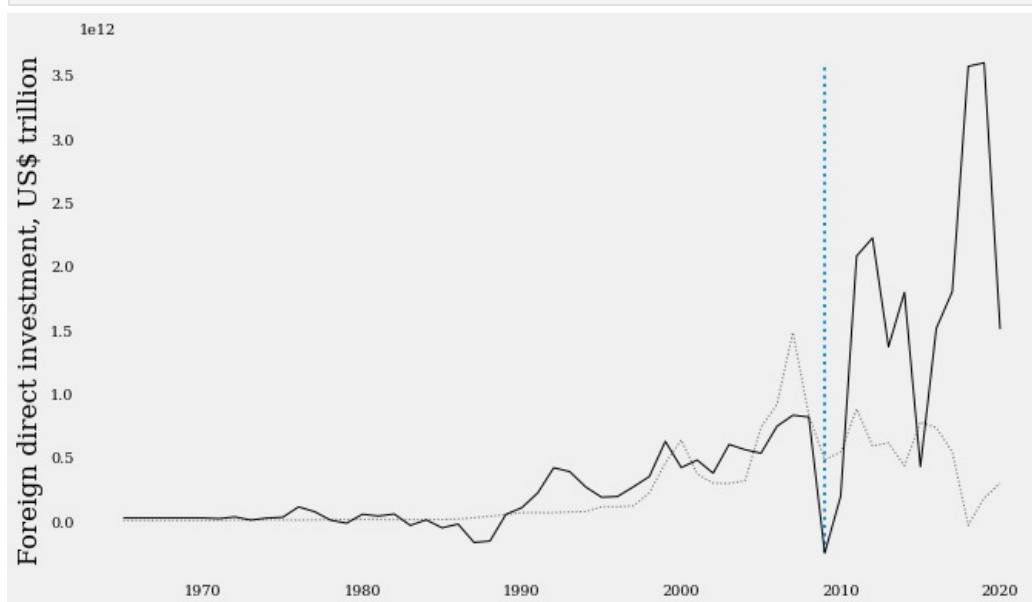




```
In [ ]: ascm_visualize('European Union','Gross capital formation (% of GDP)', data_inv, incident= 'QE', incident_year=2009)
```

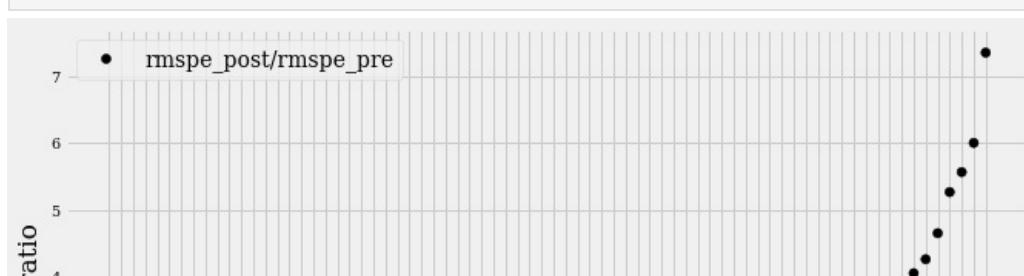


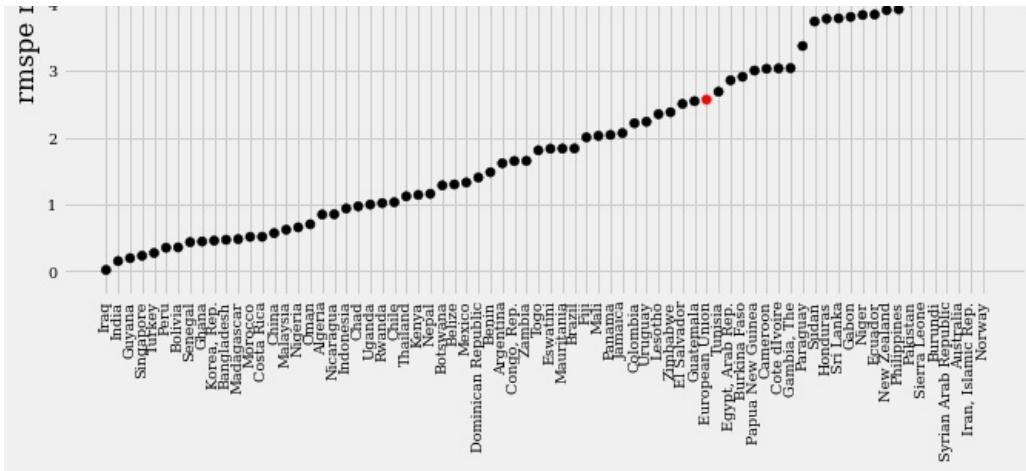
```
In [ ]: ascm_visualize('European Union','Foreign direct investment, net inflows (BoP, current US$)', data_fdi, incident= 'QE', incident_year=2009)
```



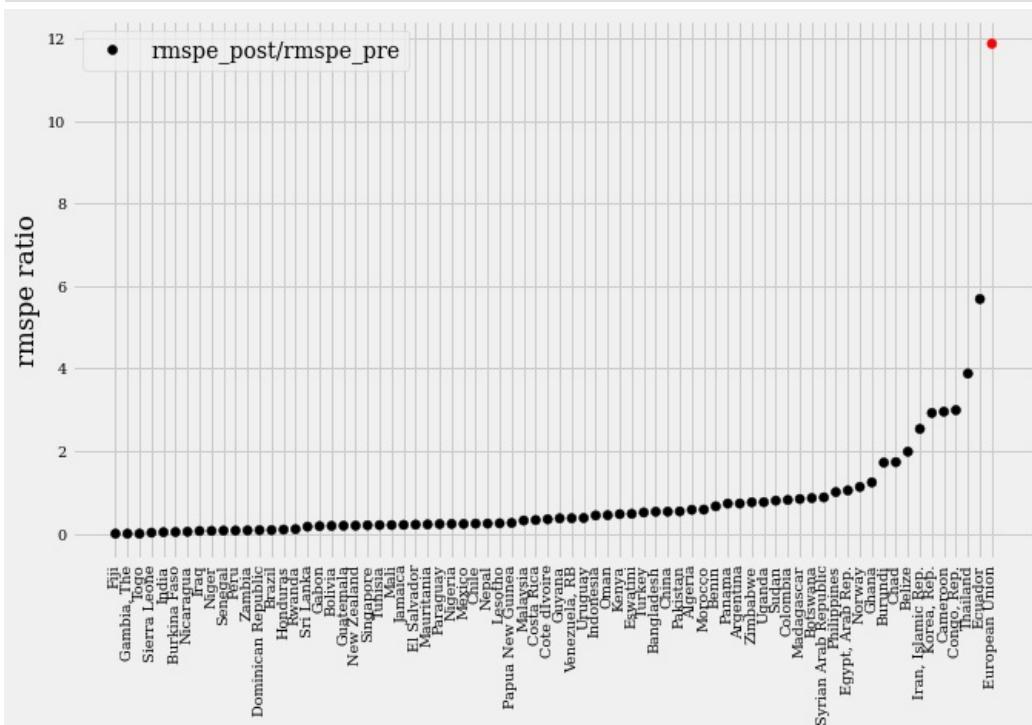
1.4 RMSPE ratio

```
In [ ]: rmspe_table('European Union', 'GDP (current US$)', data_gdp, incident= 'QE', incident_year=2009, outlier = 1)
```

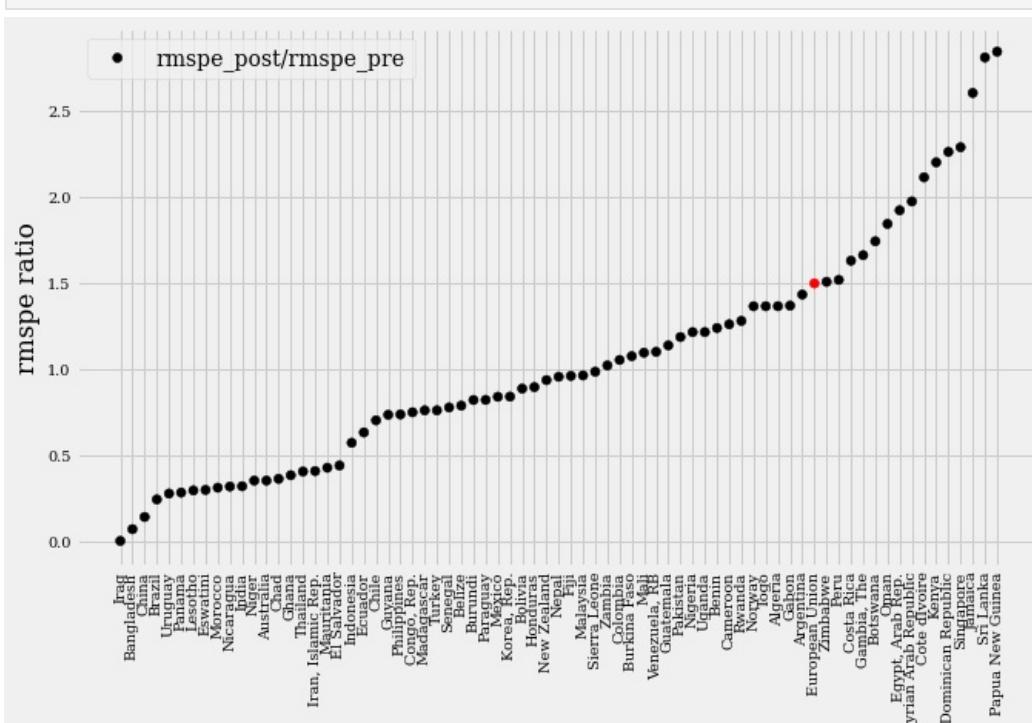




```
In [ ]: rmspe_table('European Union', 'GDP growth (annual %)', data_gdp_growth, incident='QE', incident_year=2009, outl
```

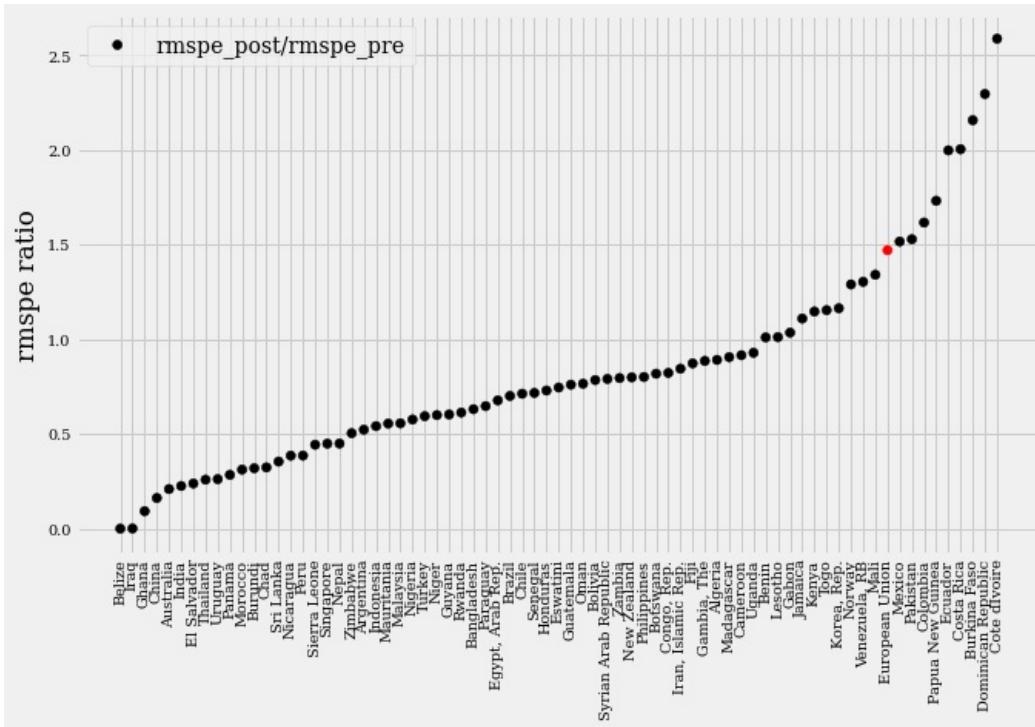


```
In [ ]: rmspe_table('European Union', 'Exports of goods and services (% of GDP)', data_export, incident='QE', incident_
```



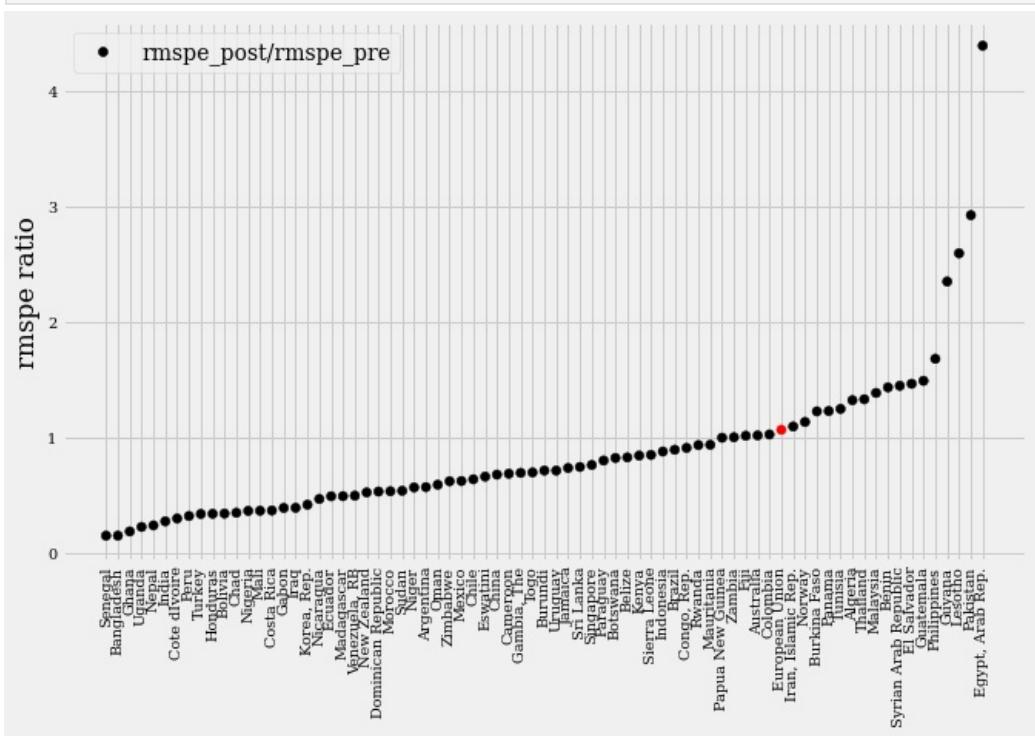
In []:

```
rmspe_table('European Union', 'Imports of goods and services (% of GDP)', data_import, incident= 'QE' ,incident_
```



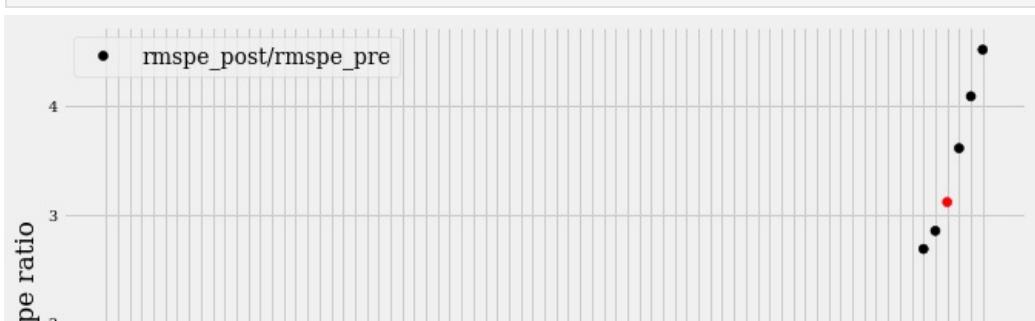
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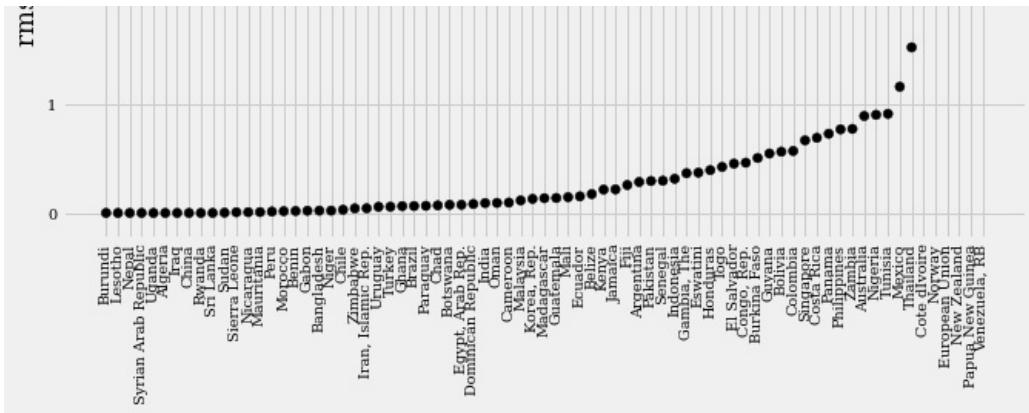
```
rmspe_table('European Union', 'Gross capital formation (% of GDP)', data_inv, incident= 'QE' ,incident_year=2009)
```



In []:

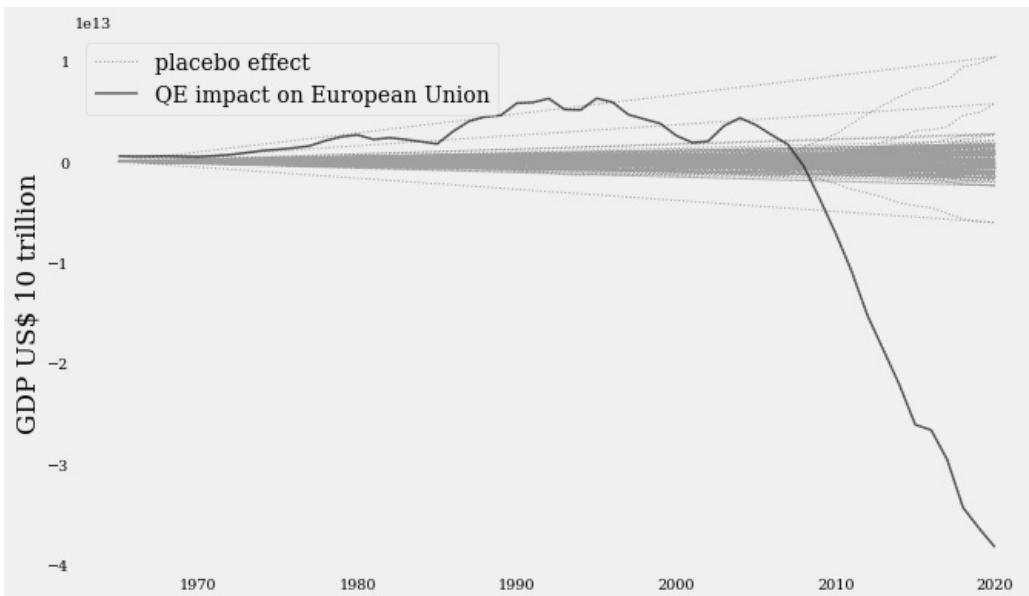
```
rmspe_table('European Union', 'Foreign direct investment, net inflows (BoP, current US$)', data_fdi, incident= 'C'
```



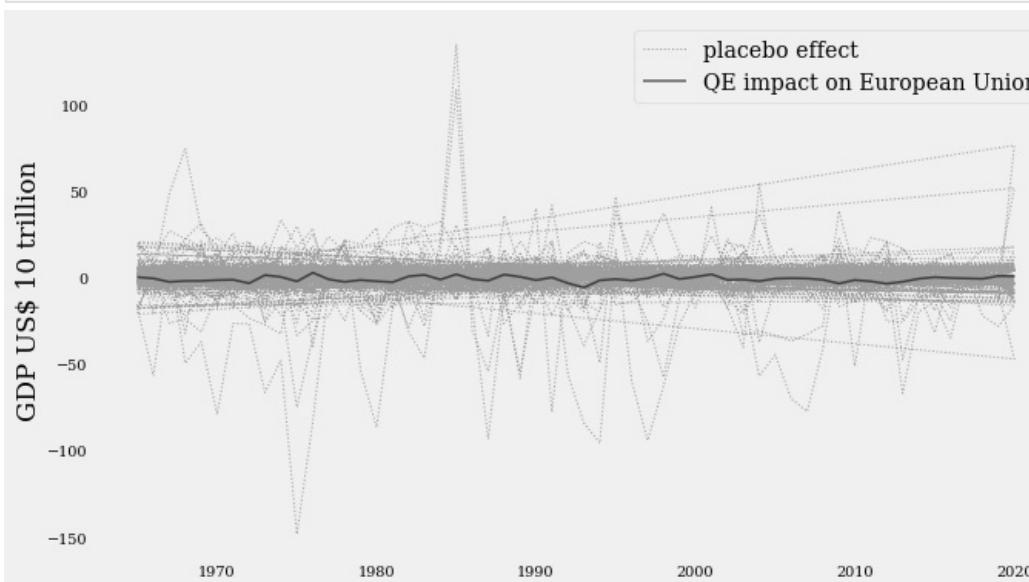


1.5 placebo effect analysis

```
In [ ]: placebo('European Union', 'GDP (current US$)', data_gdp, incident_year = 2009, ylabel="GDP US$ 10 trillion" )
```

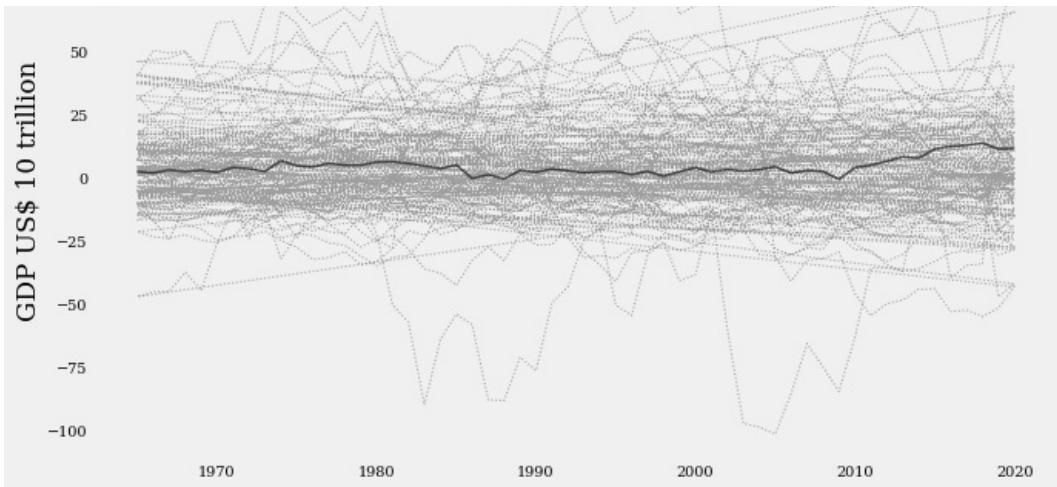


```
In [ ]: placebo('European Union', 'GDP growth (annual %)', data_gdp_growth, incident_year = 2009, ylabel="GDP US$ 10 trillion" )
```

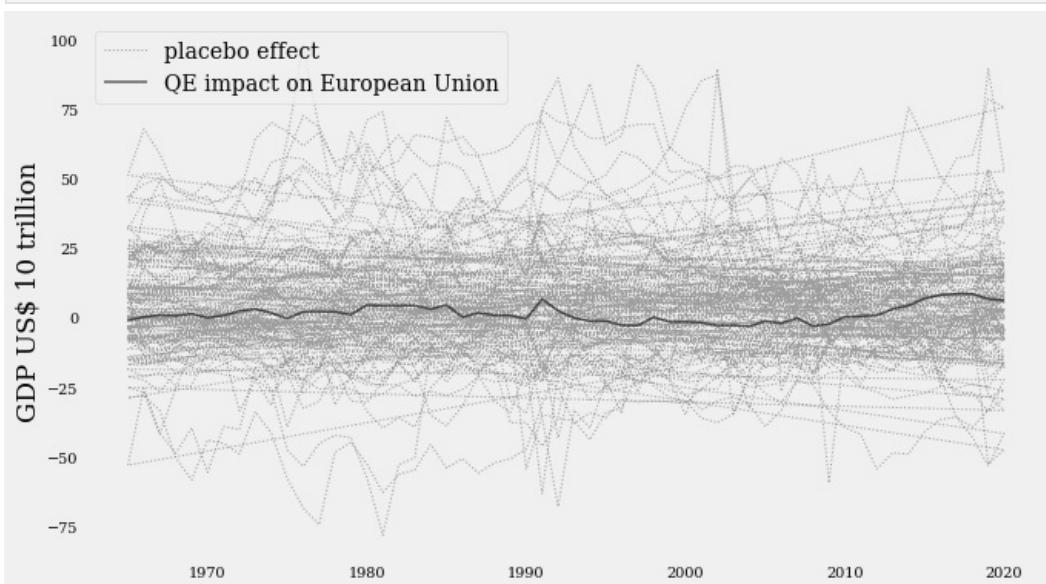


```
In [ ]: placebo('European Union', 'Exports of goods and services (% of GDP)', data_export, incident_year = 2009, ylabel="Exports of goods and services (% of GDP)" )
```

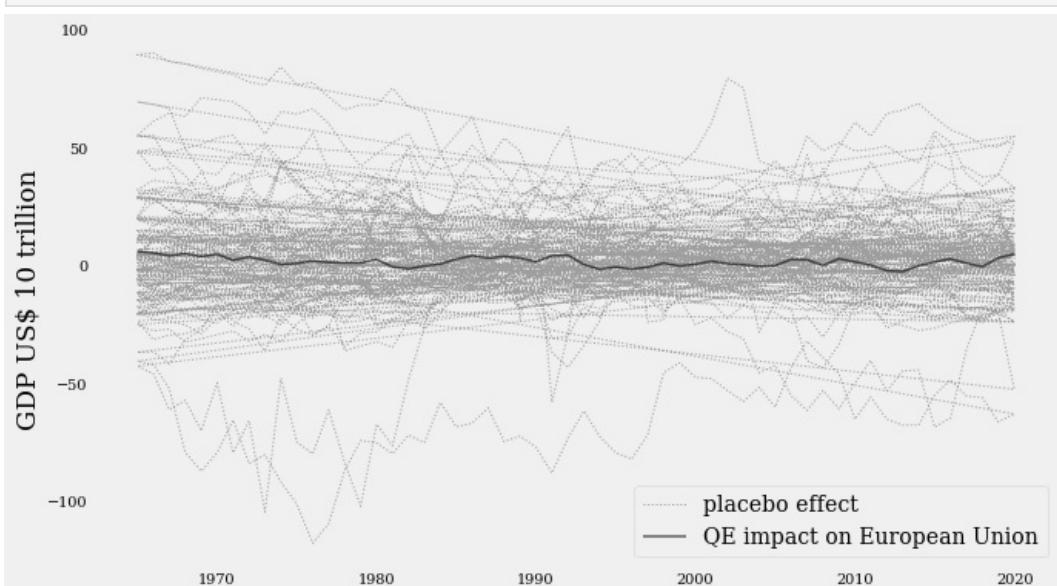




```
In [ ]: placebo('European Union', 'Imports of goods and services (% of GDP)', data_import, incident_year = 2009, ylabel='GDP US$ 10 trillion')
```

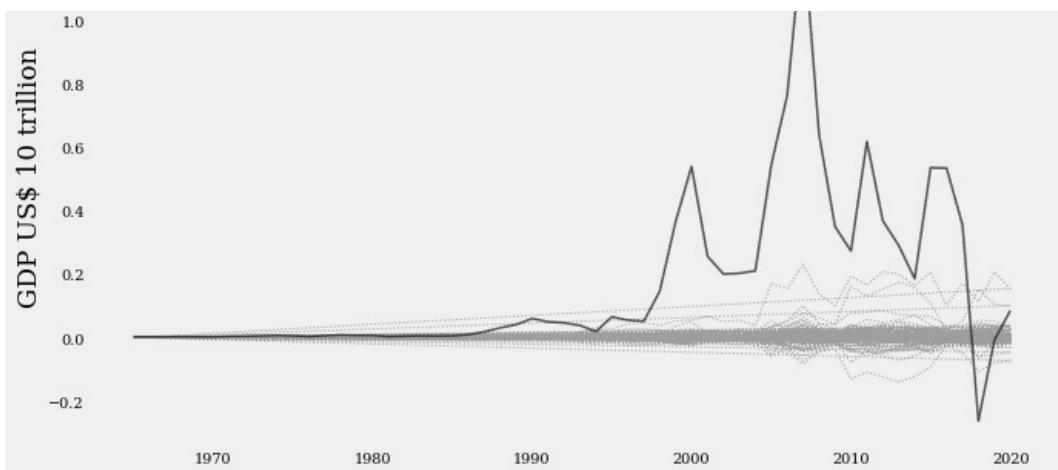


```
In [ ]: placebo('European Union', 'Gross capital formation (% of GDP)', data_inv, incident_year = 2009, ylabel="GDP US$ 10 trillion")
```



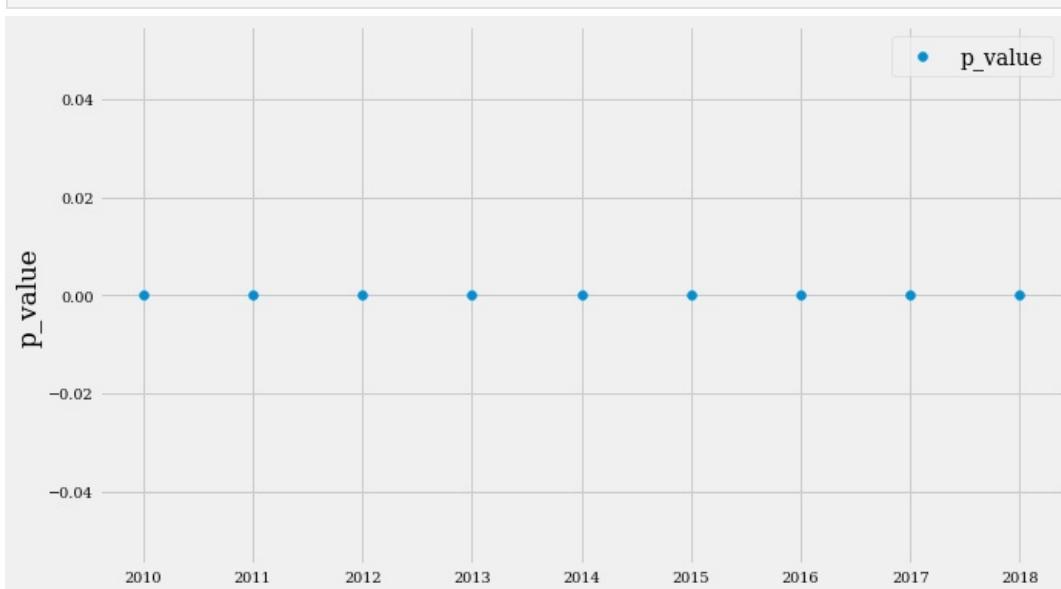
```
In [ ]: placebo('European Union', 'Foreign direct investment, net inflows (BoP, current US$', data_fdi, incident_year = 2009, ylabel="GDP US$ 10 trillion")
```



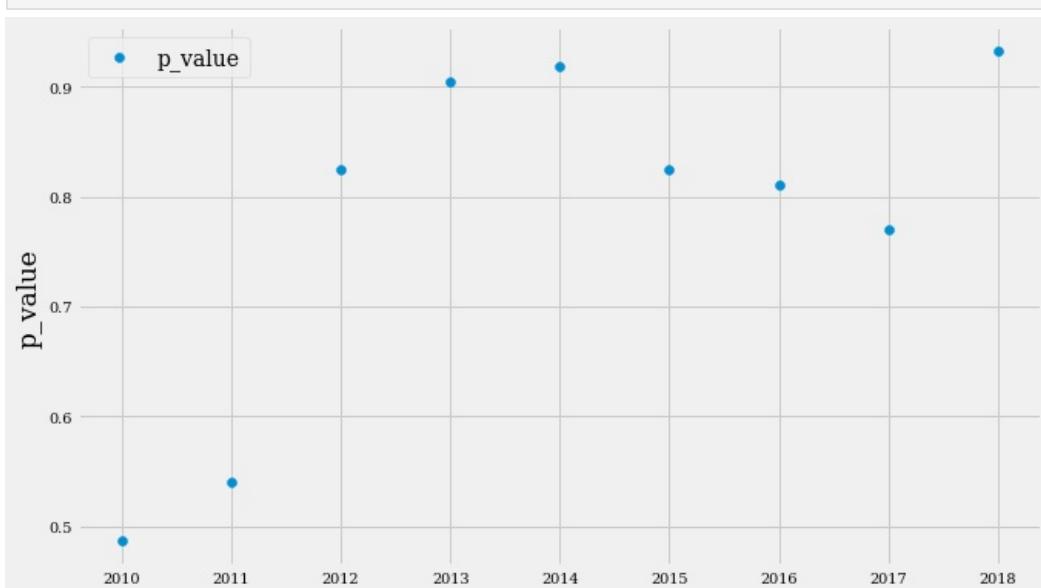


1.6 p-value analysis

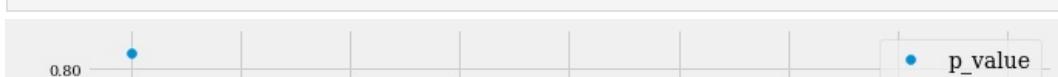
```
In [ ]: p_value('European Union', 'GDP (current US$)', data_gdp, incident_year = 2009, detail= False)
```

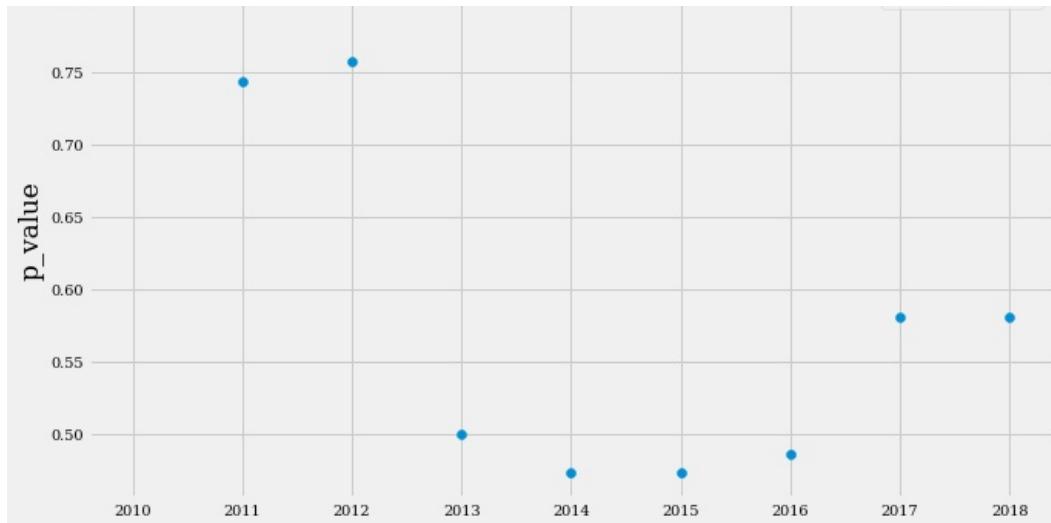


```
In [ ]: p_value('European Union', 'GDP growth (annual %)', data_gdp_growth, incident_year = 2009, detail= False)
```

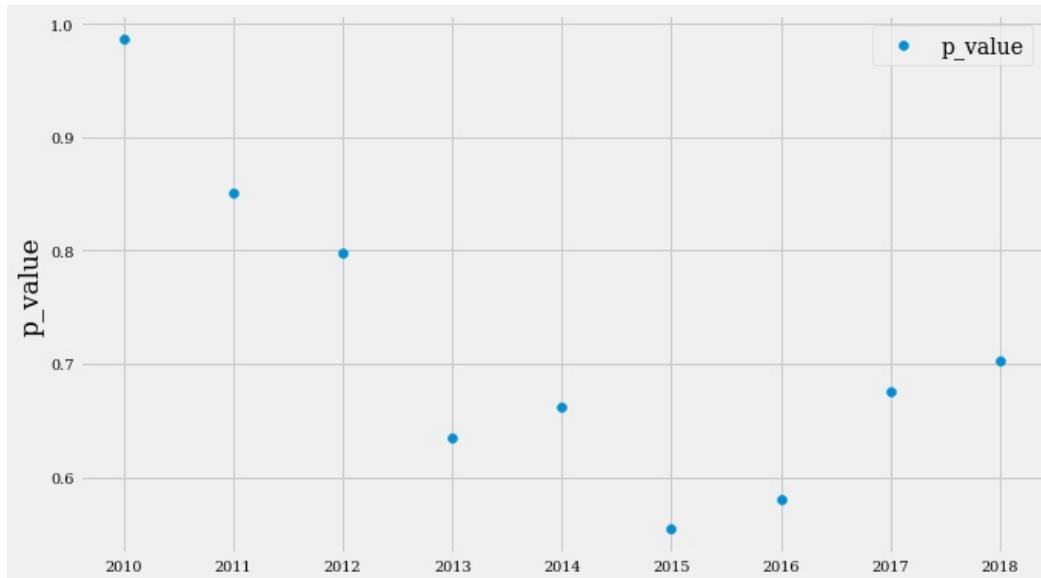


```
In [ ]: p_value('European Union', 'Exports of goods and services (% of GDP)', data_export, incident_year = 2009, detail= False)
```

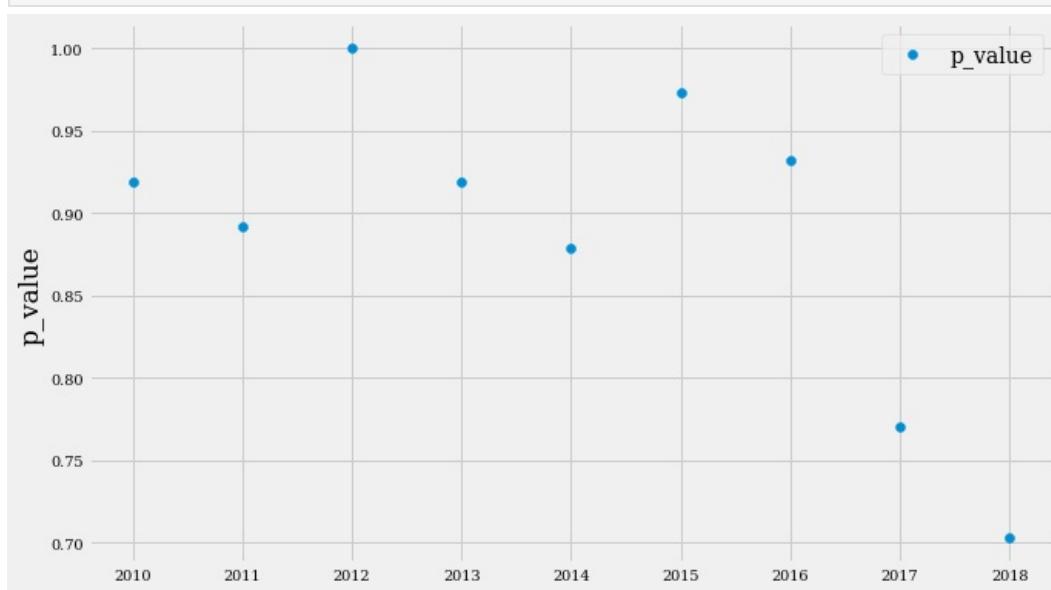




```
In [ ]: p_value('European Union', 'Imports of goods and services (% of GDP)', data_import, incident_year = 2009, detail=False)
```

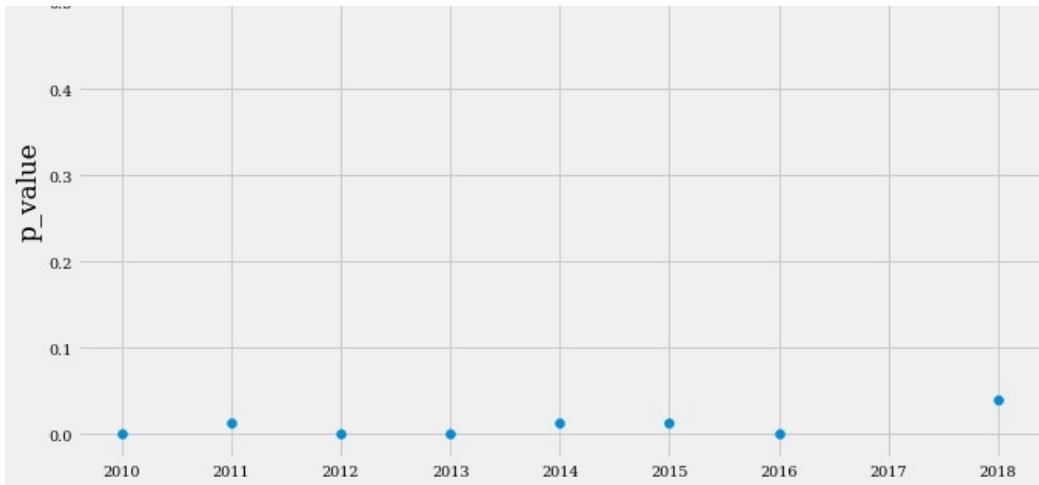


```
In [ ]: p_value('European Union', 'Gross capital formation (% of GDP)', data_inv, incident_year = 2009, detail=False)
```



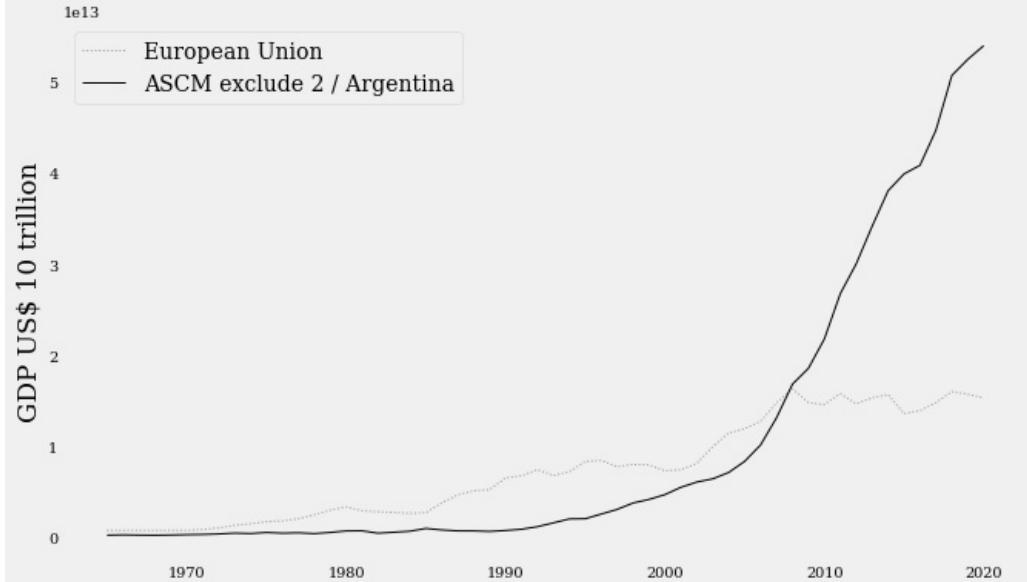
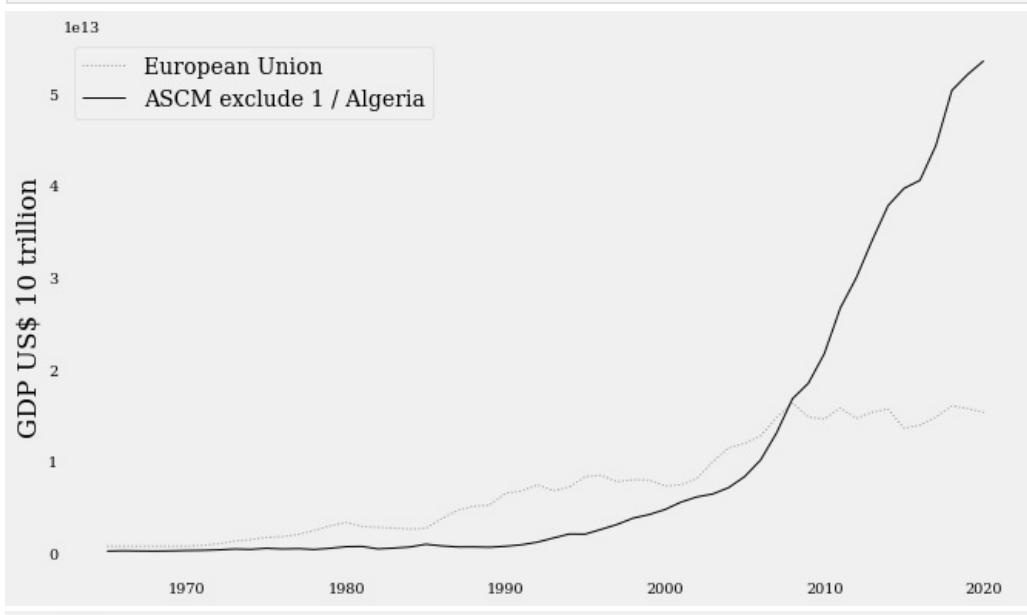
```
In [ ]: p_value('European Union', 'Foreign direct investment, net inflows (BoP, current US$)', data_fdi, incident_year = 2009, detail=False)
```

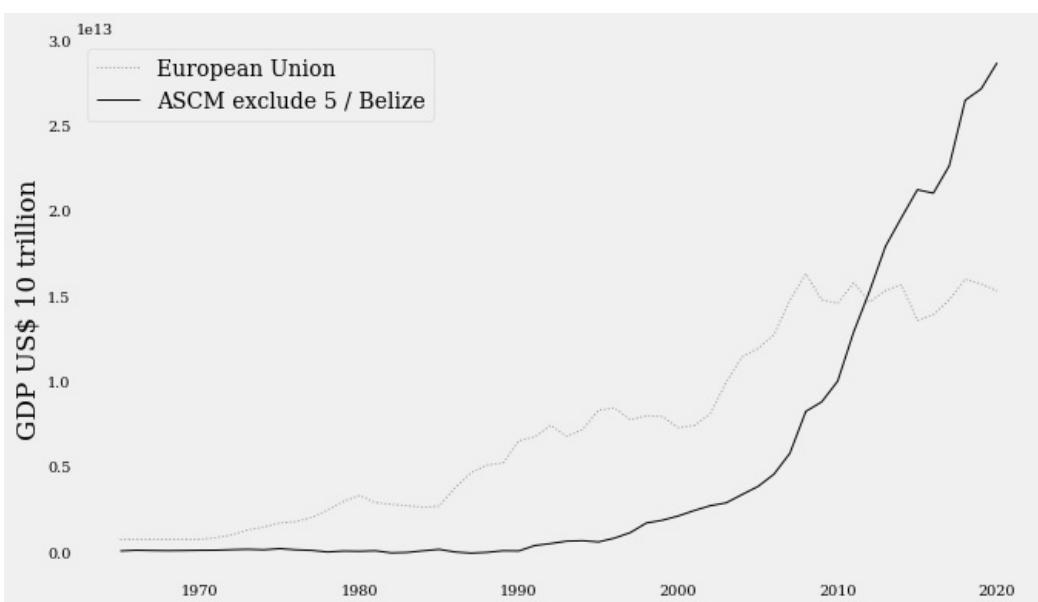
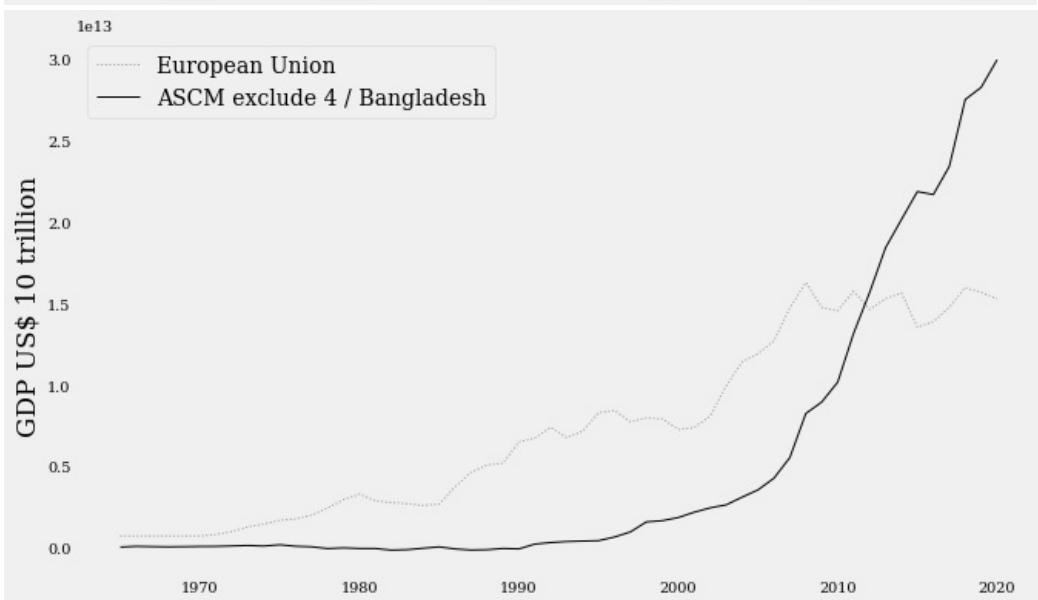
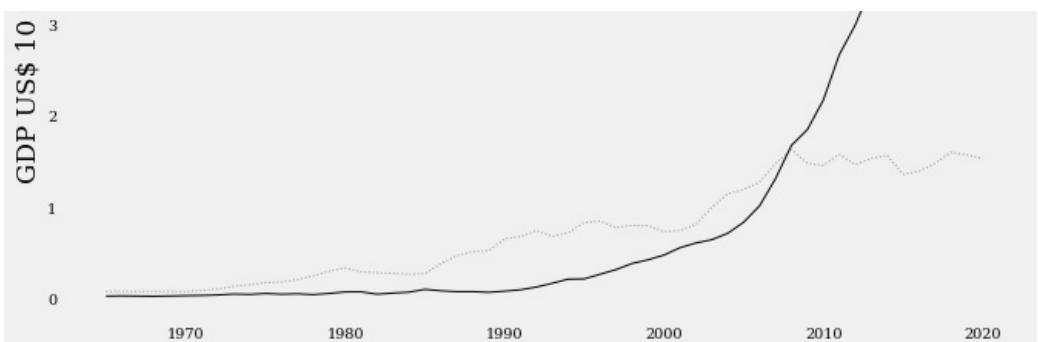


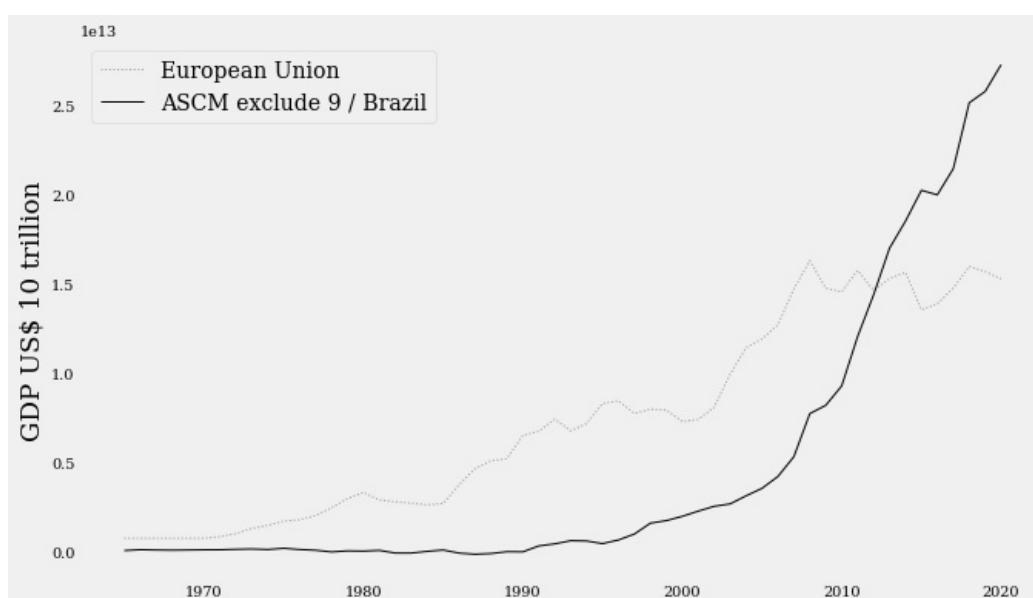
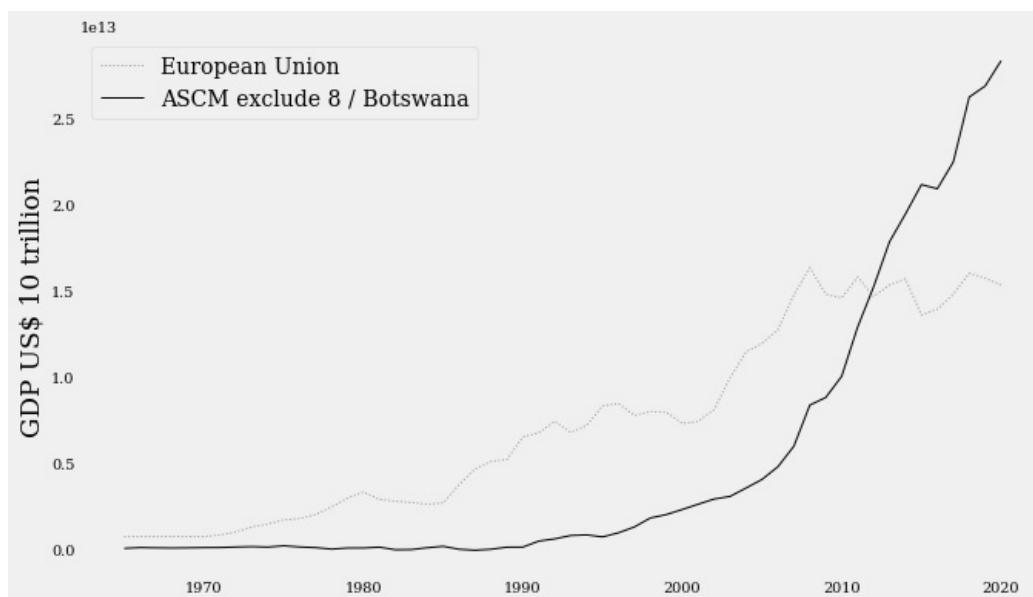
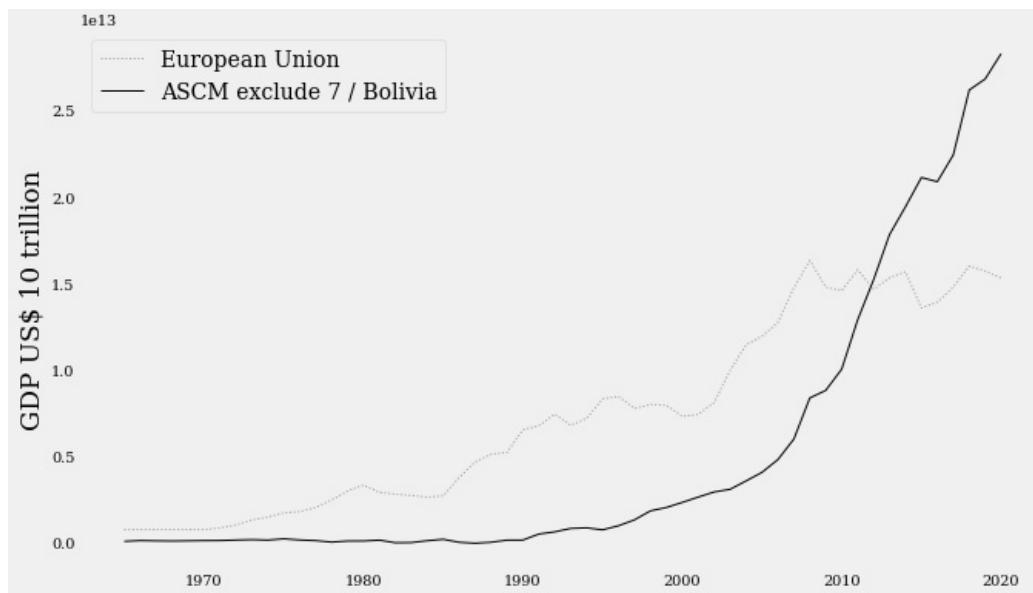


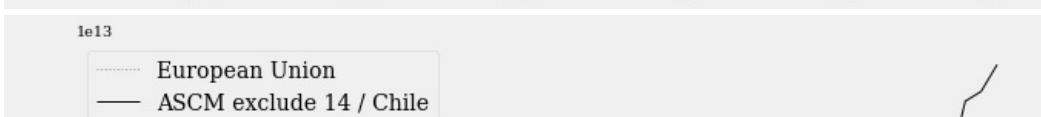
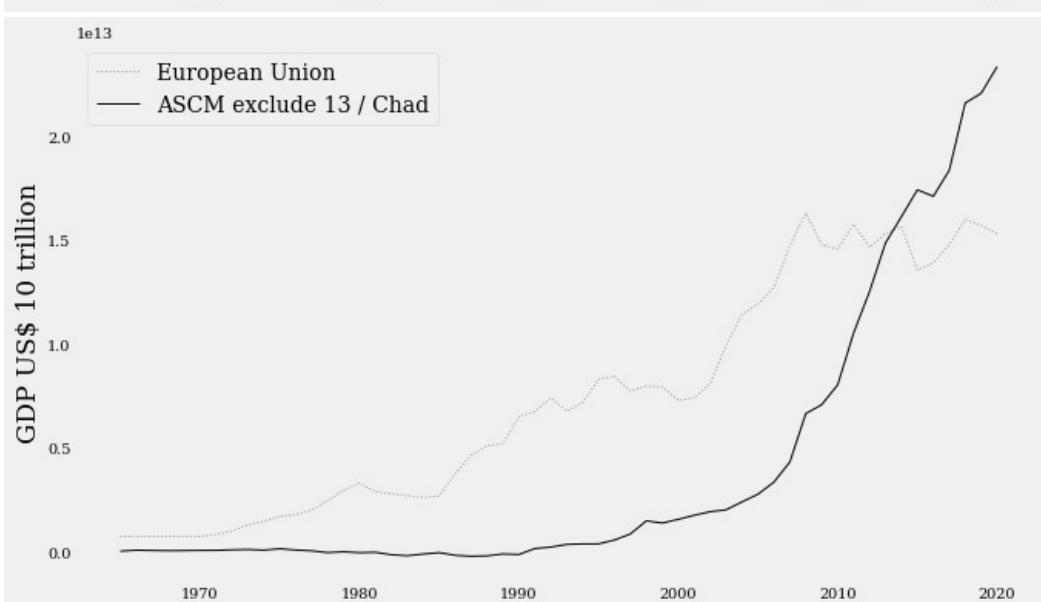
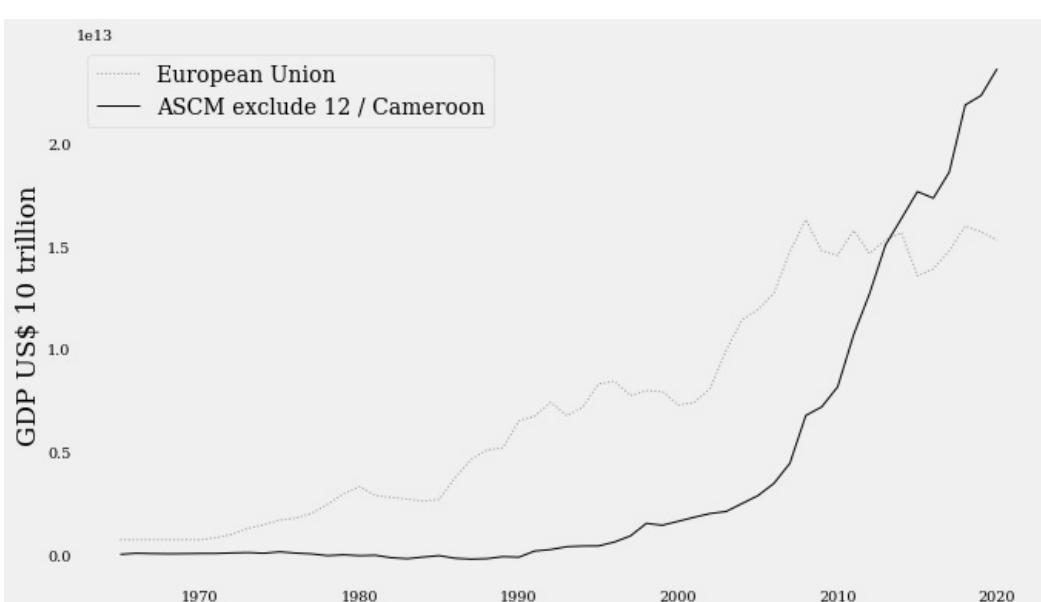
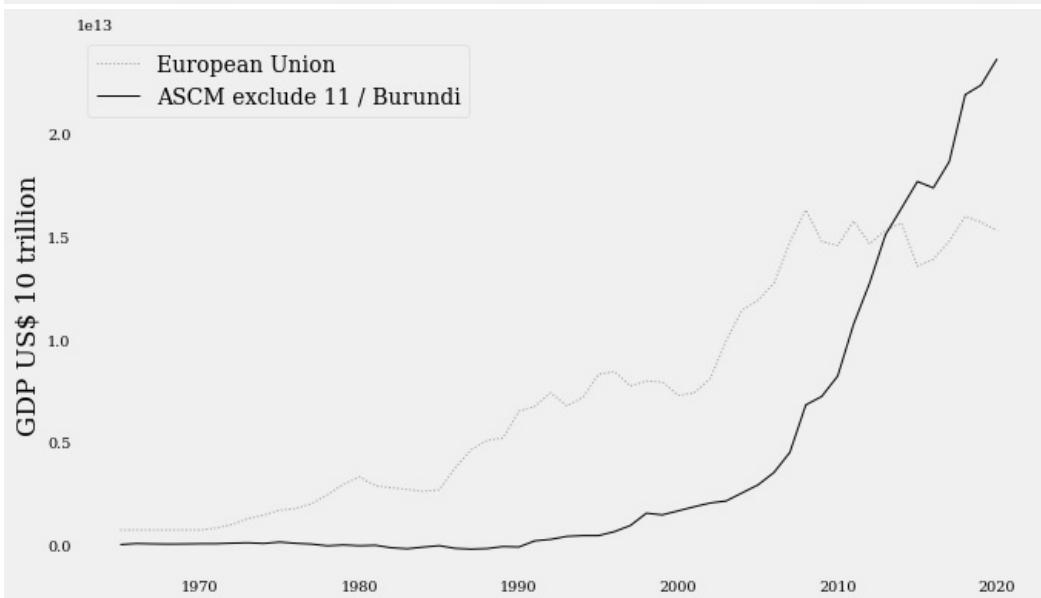
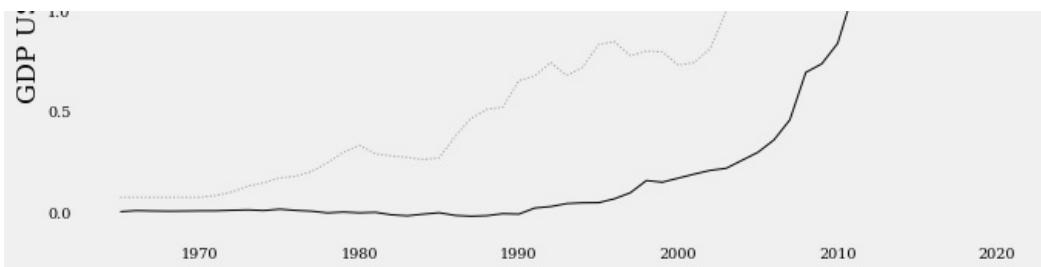
1.7 Limitation of donor pool test

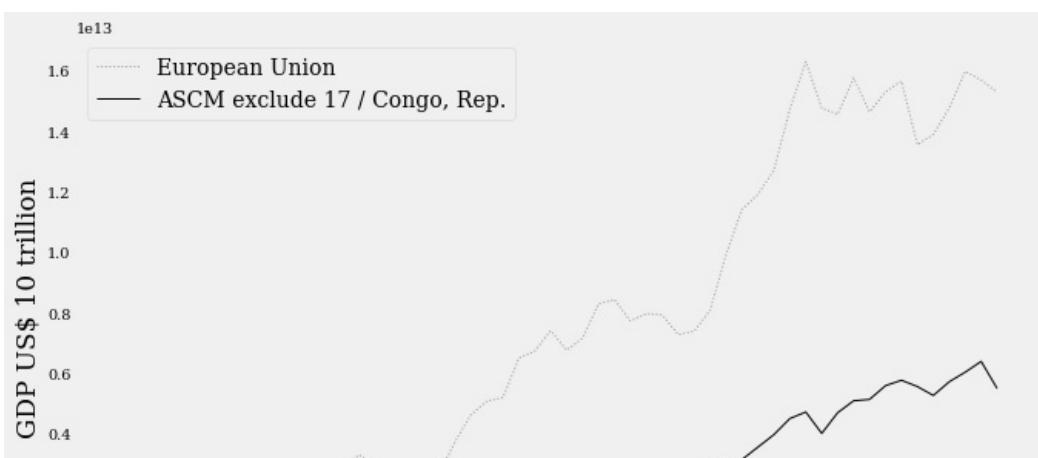
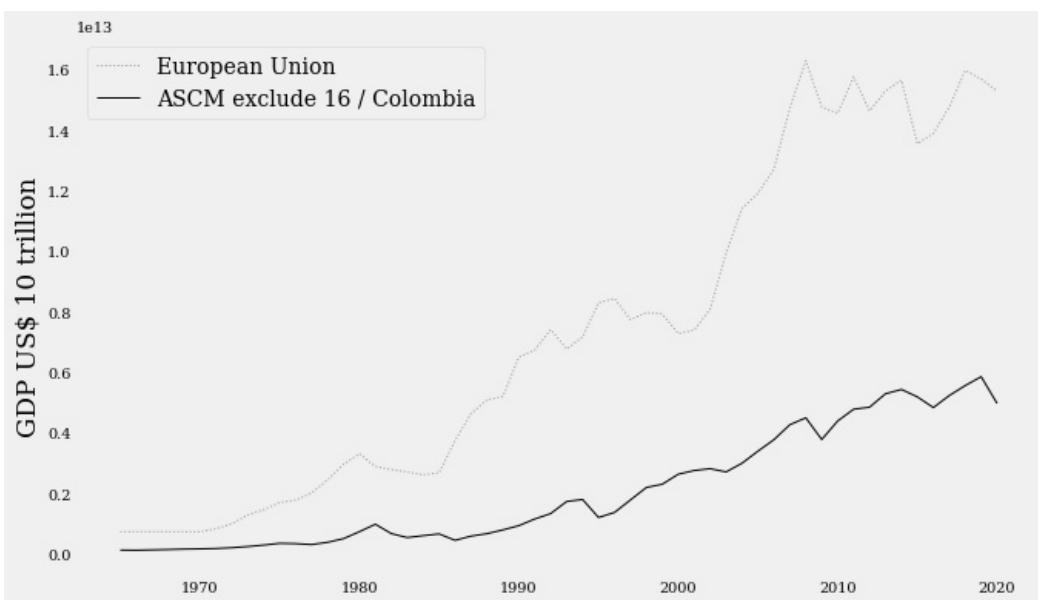
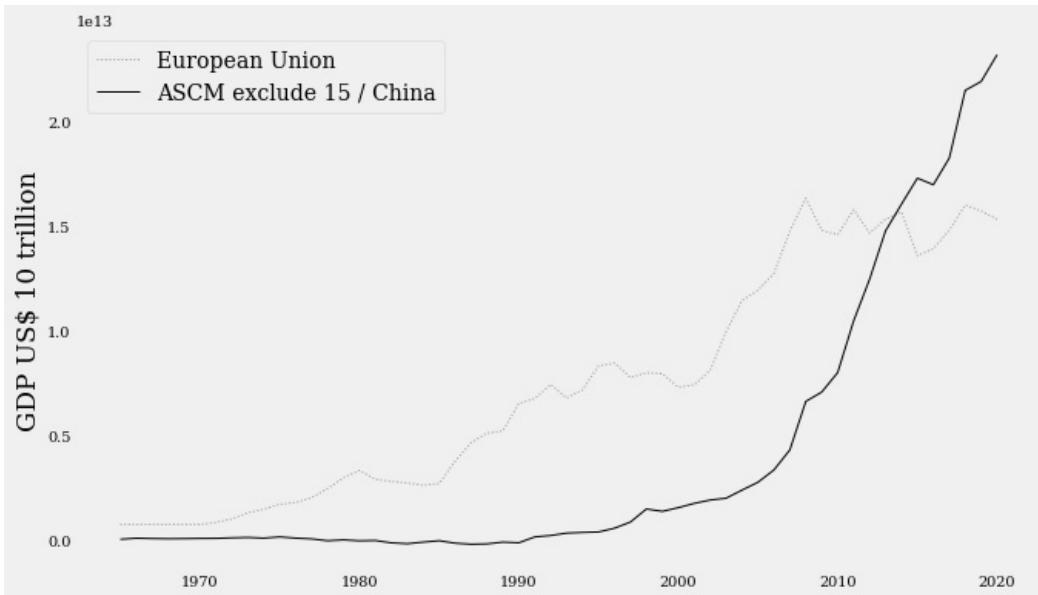
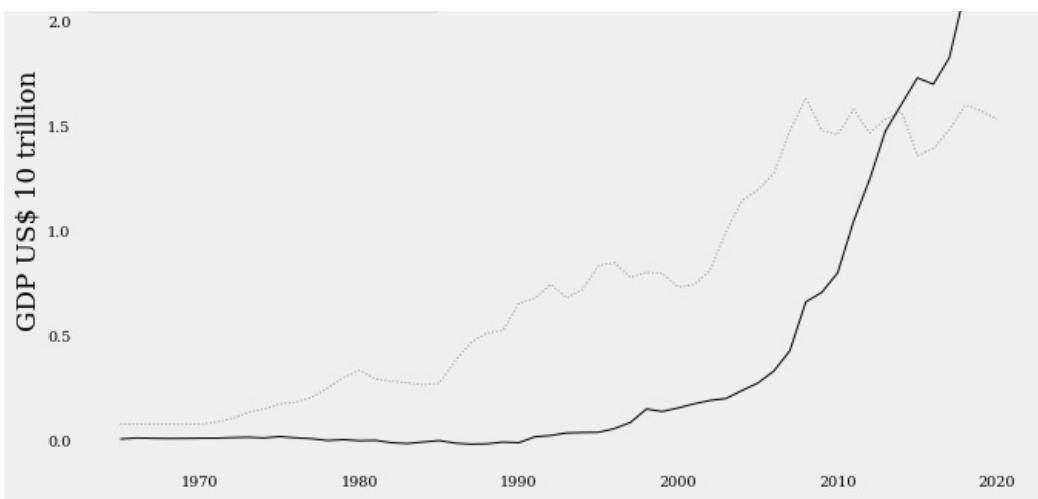
```
In [ ]: ascm_limit_donor_pool('European Union','GDP (current US$)', data_gdp, incident_year = 2009, std_scaling=True, de
```

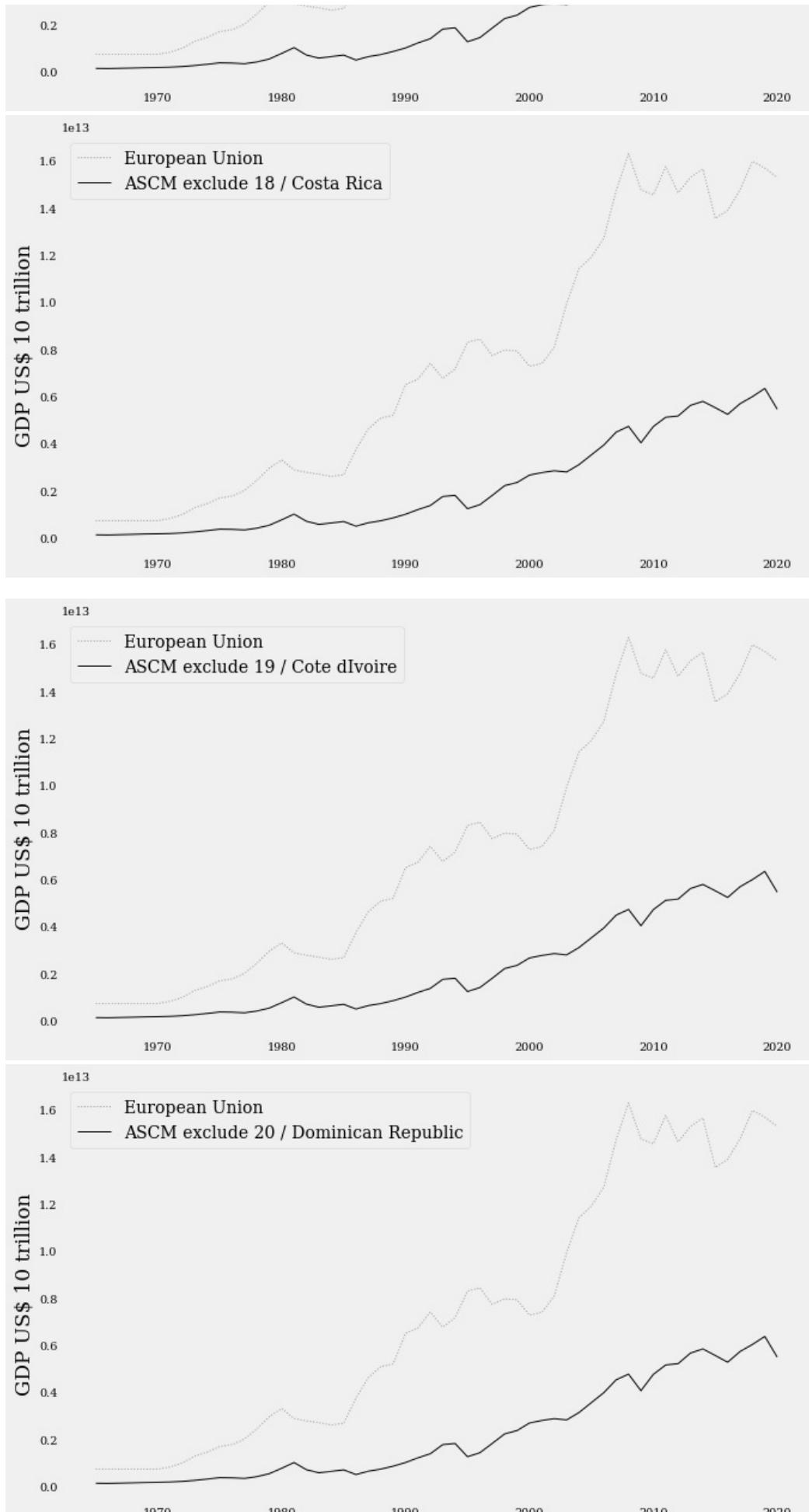


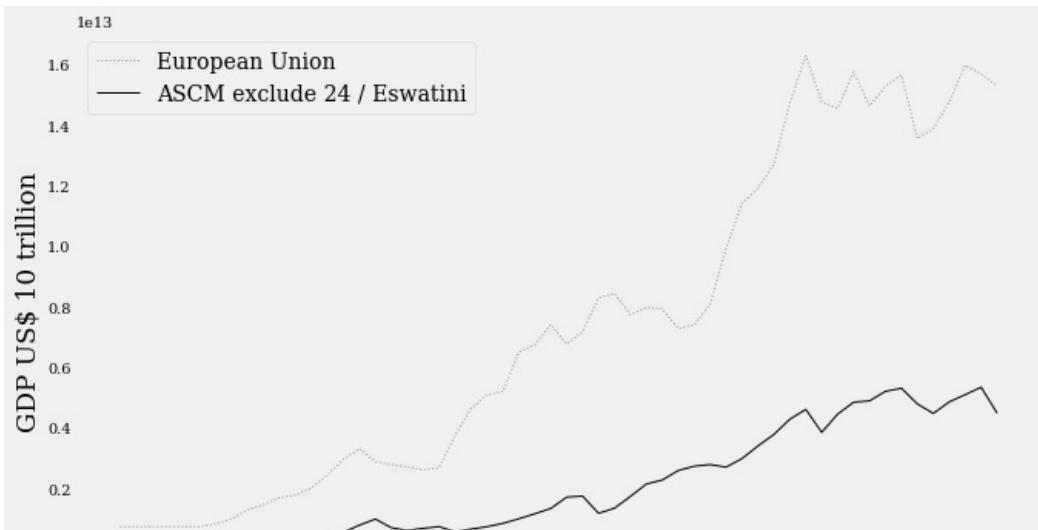
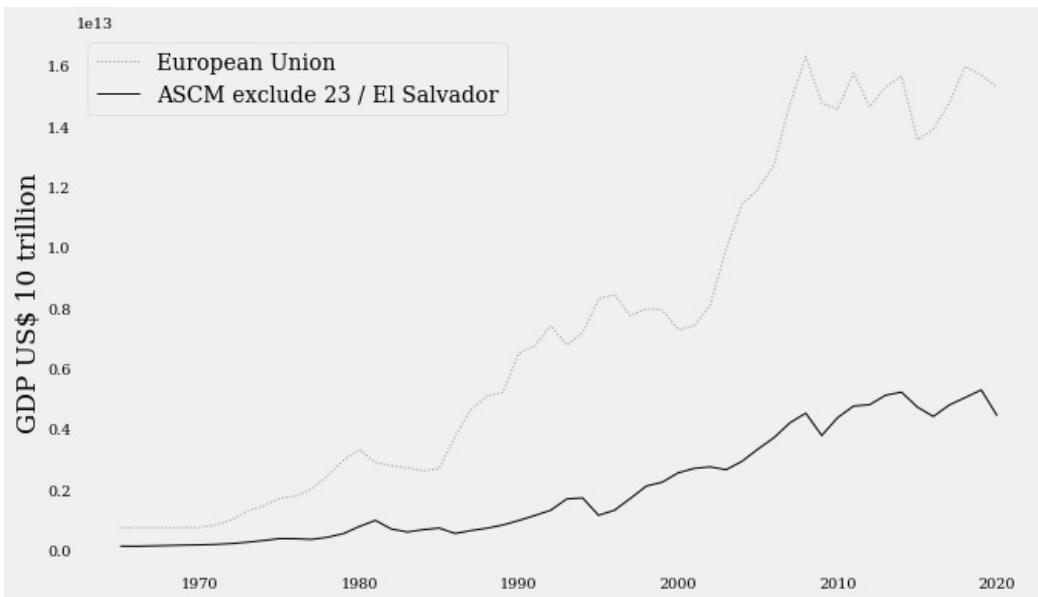
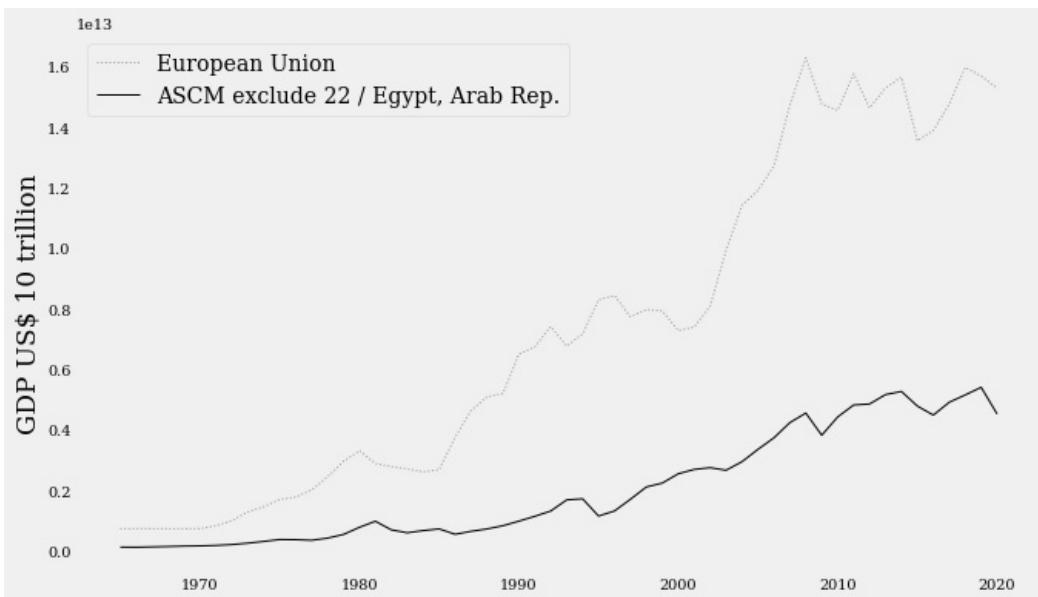
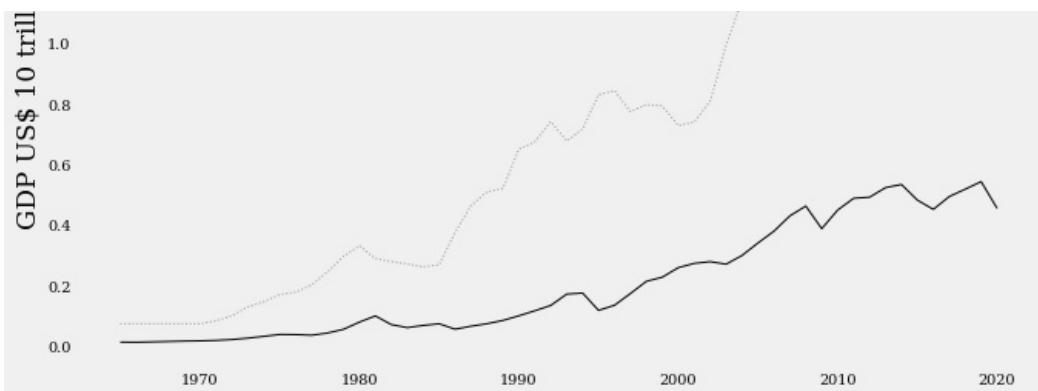


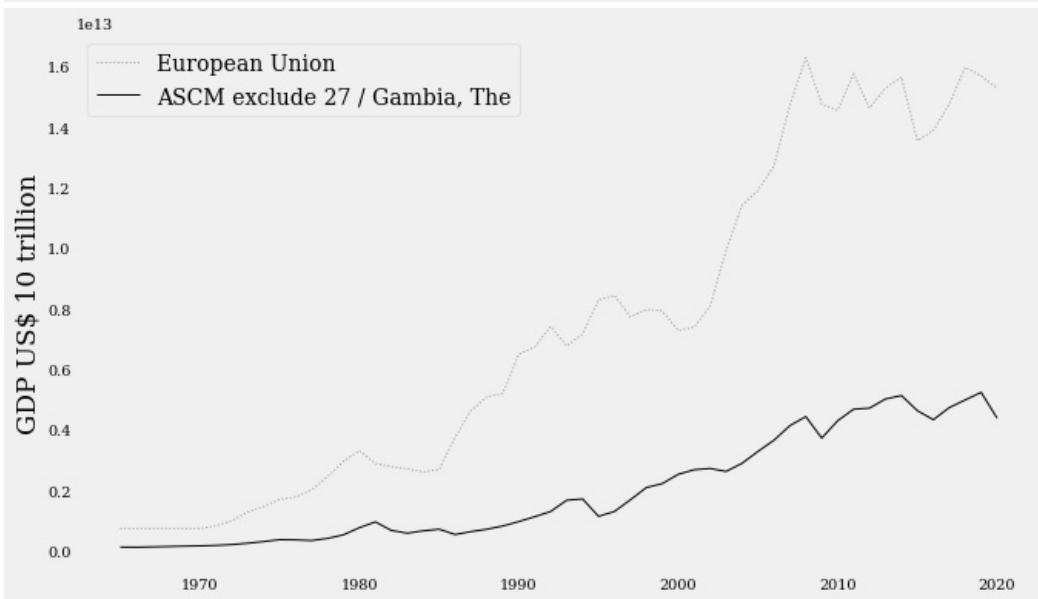
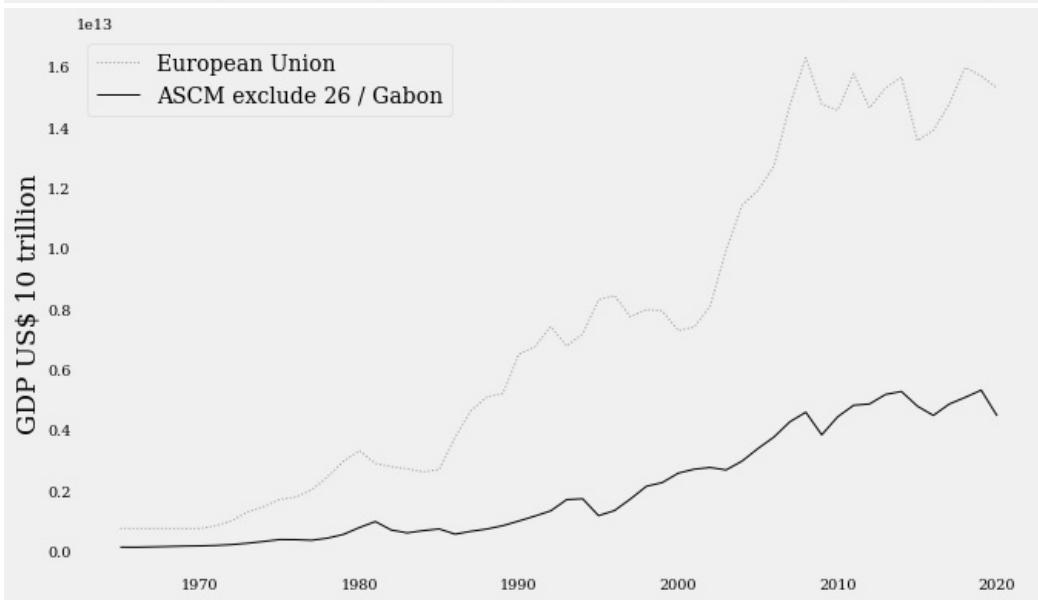
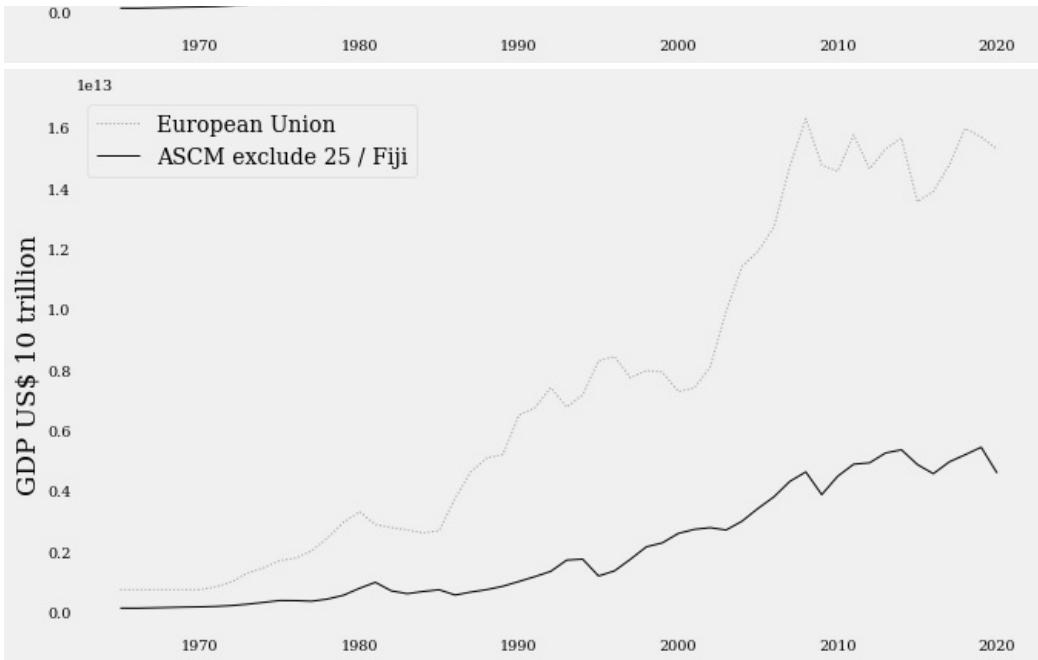


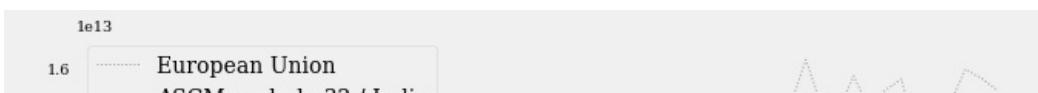
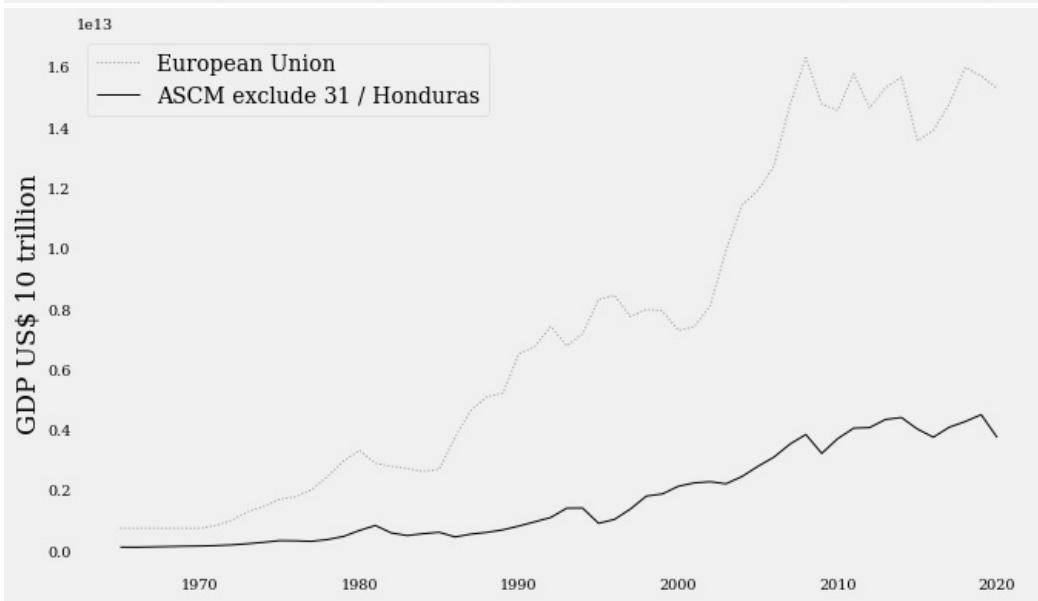
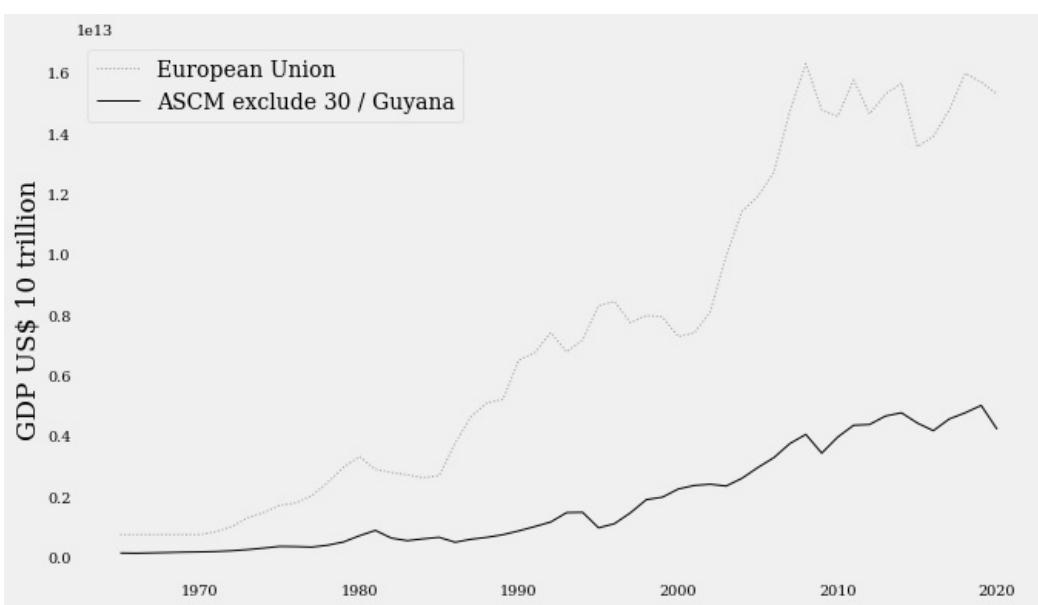
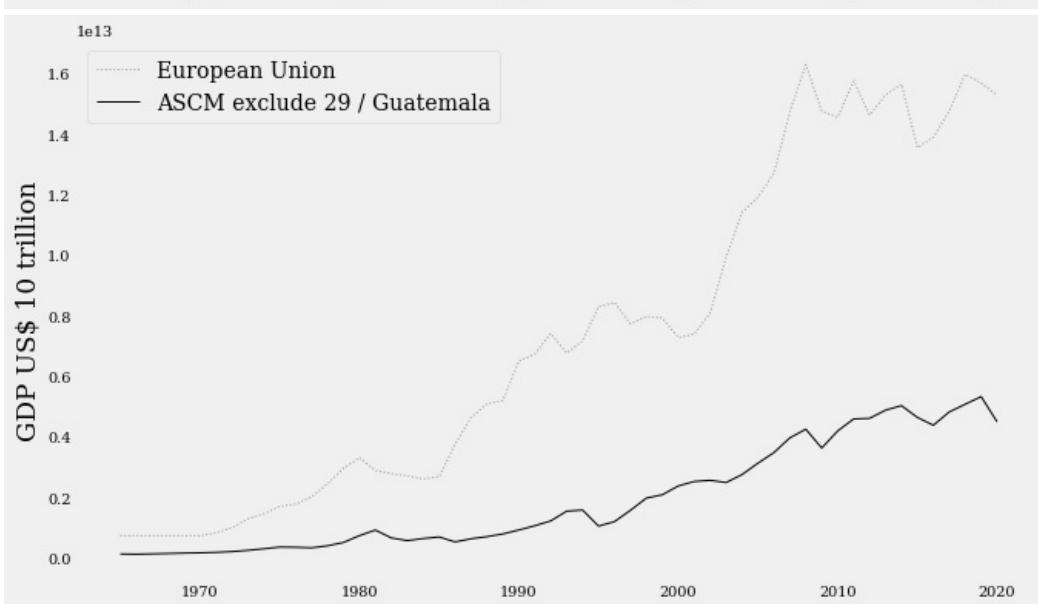
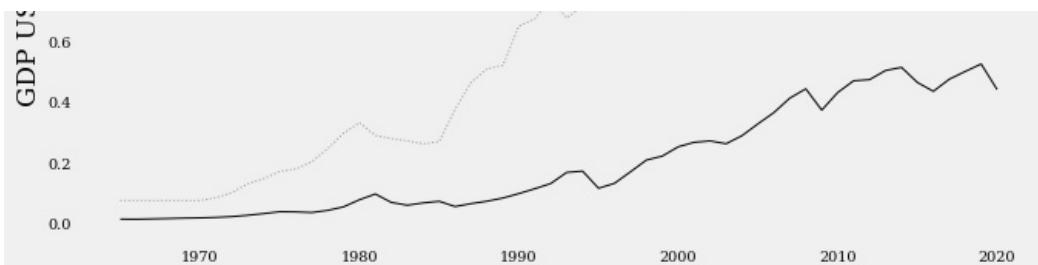


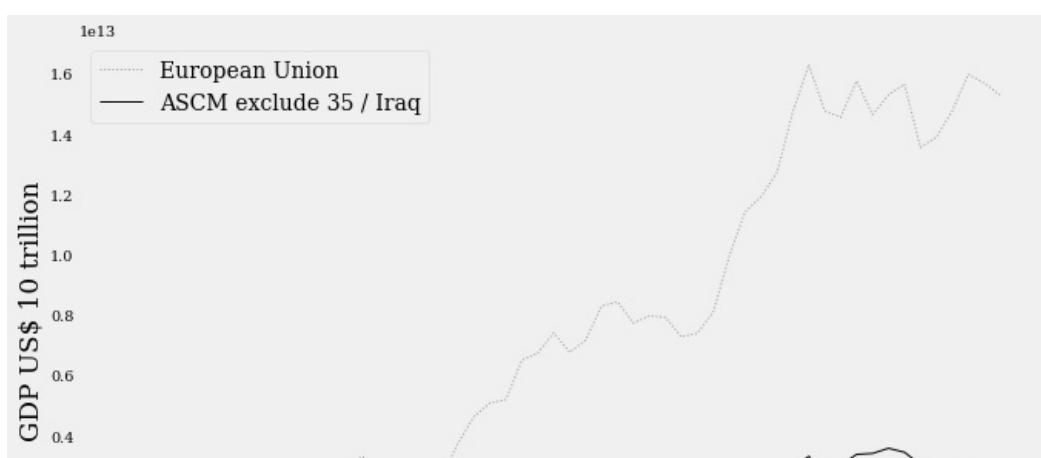
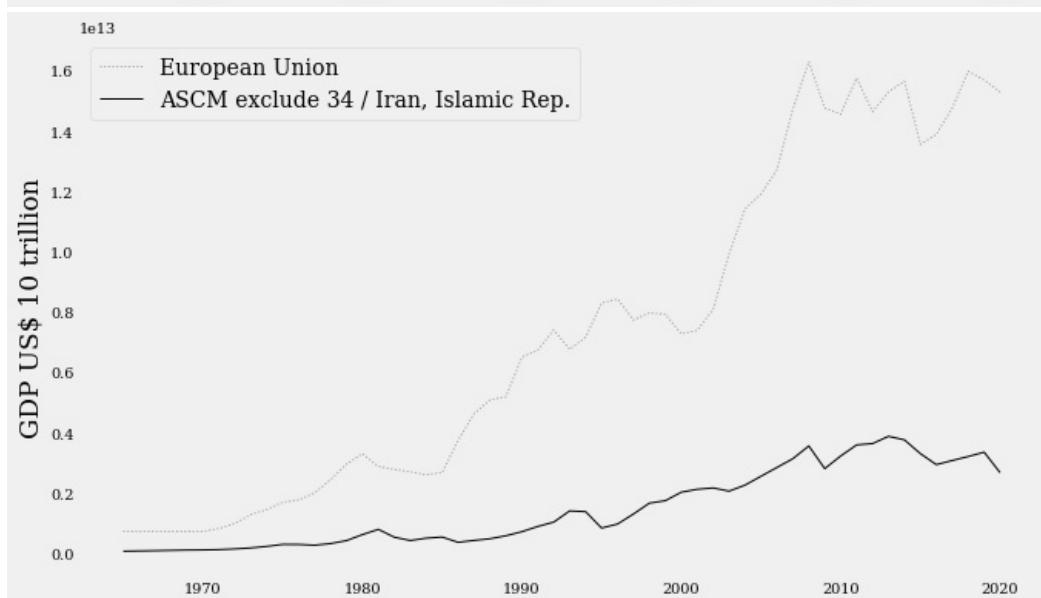
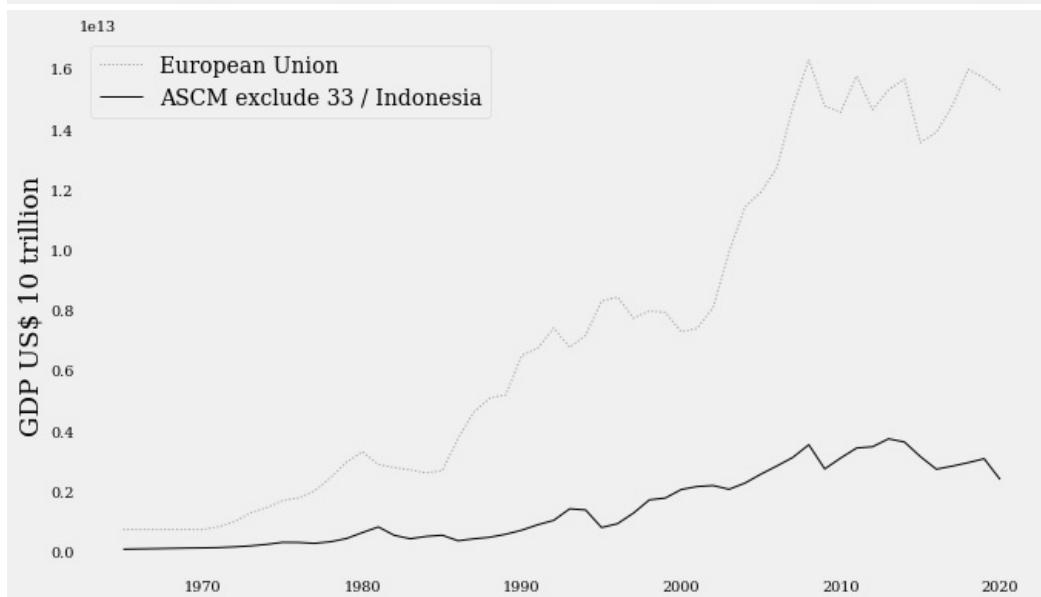
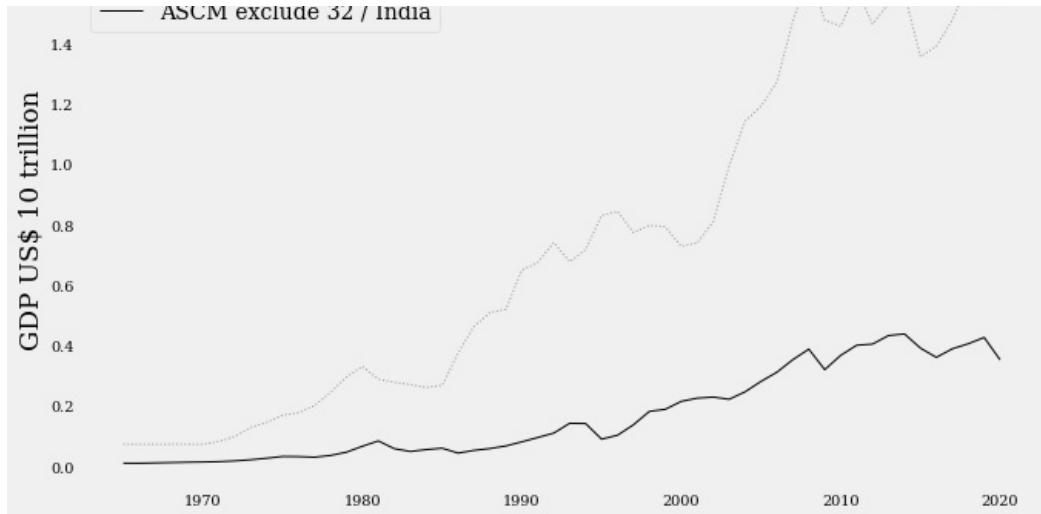


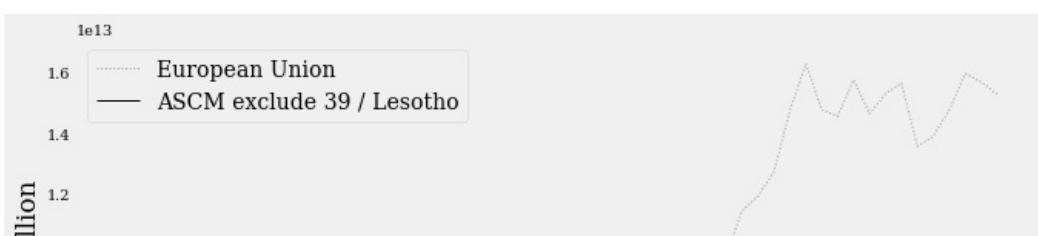
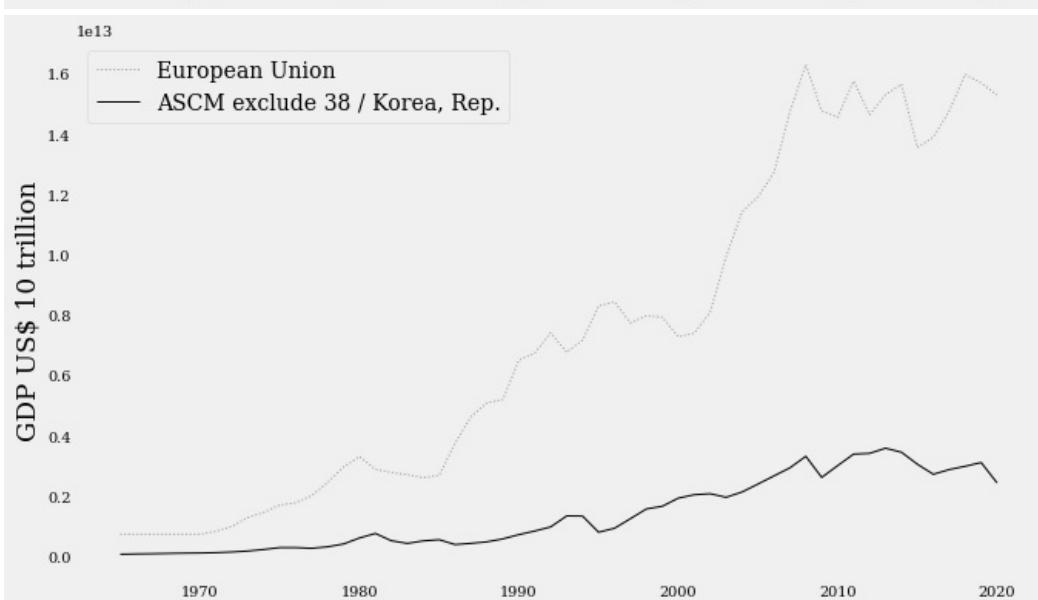
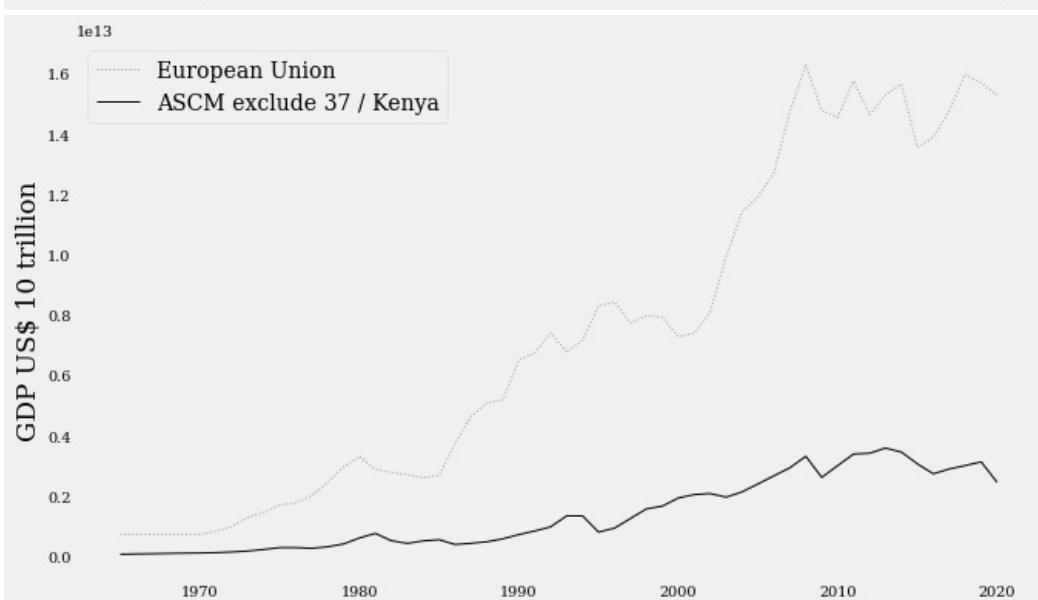
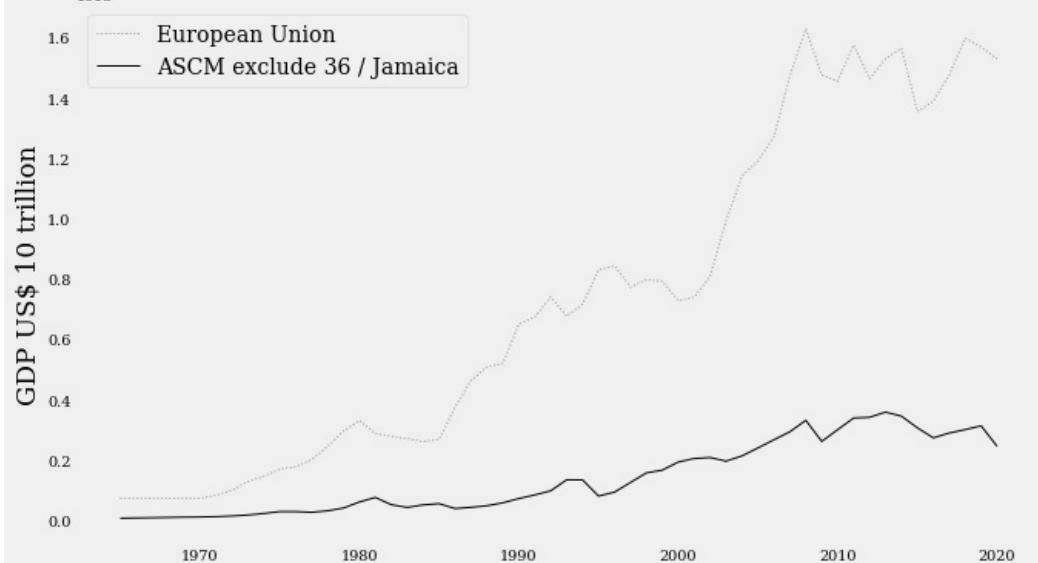
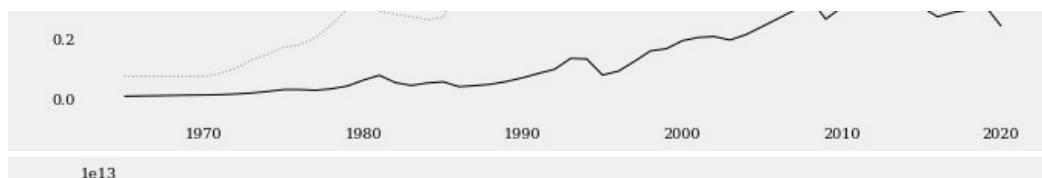


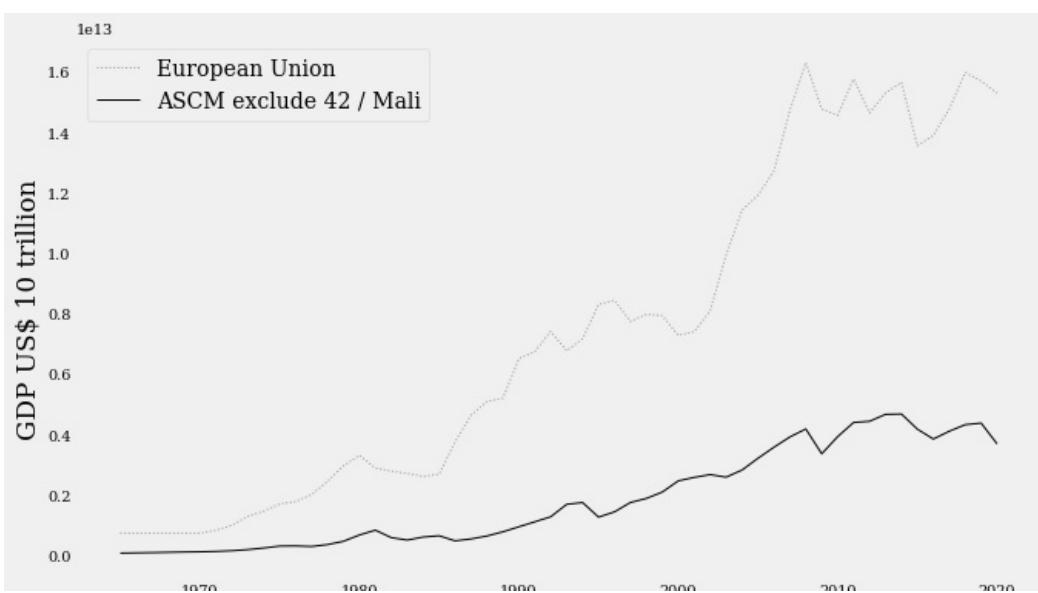
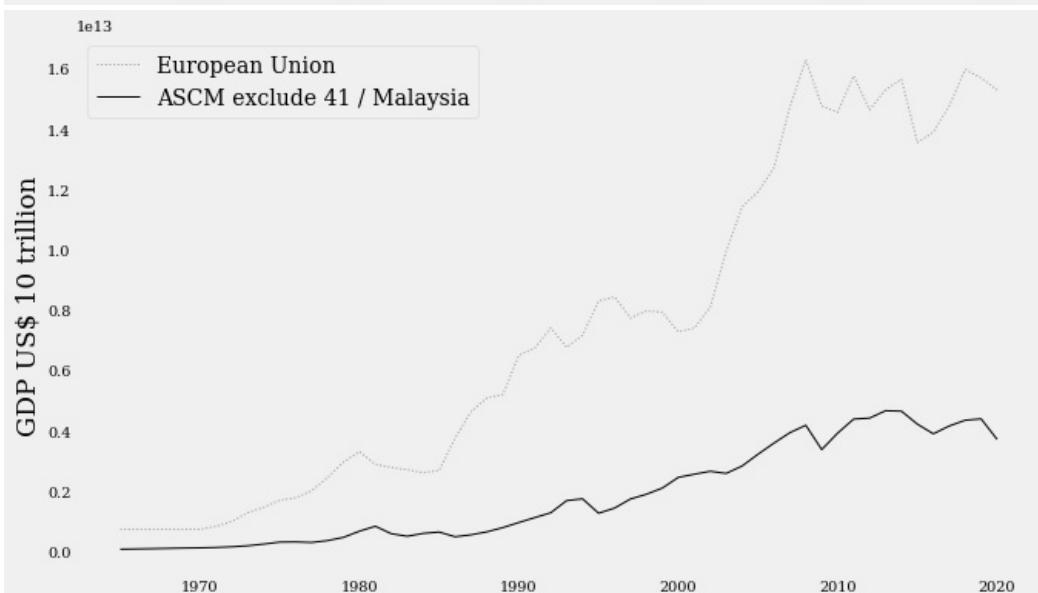
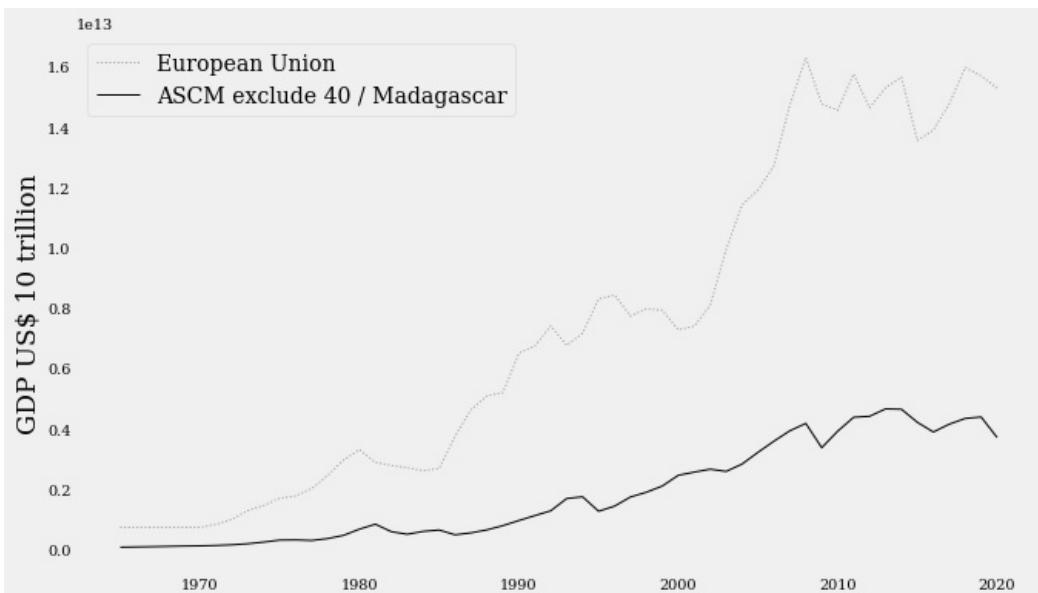
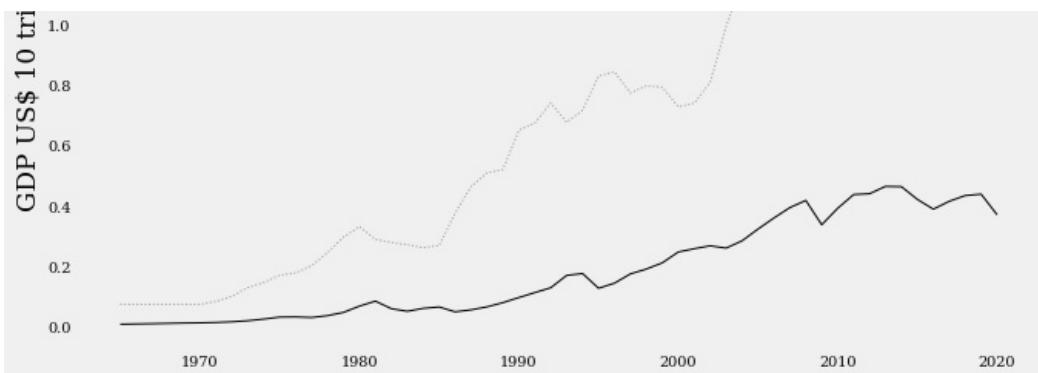


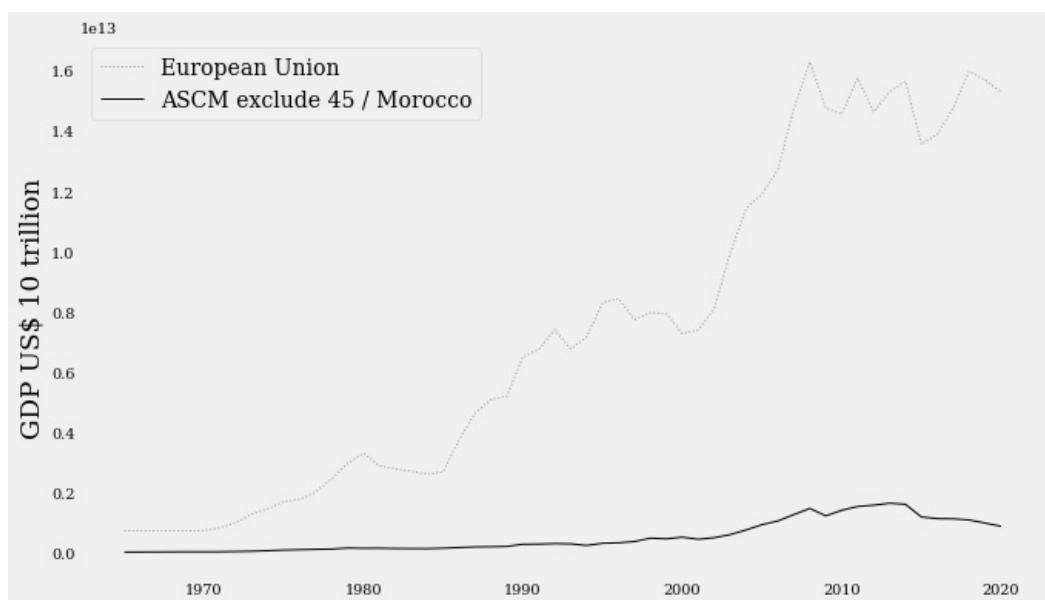
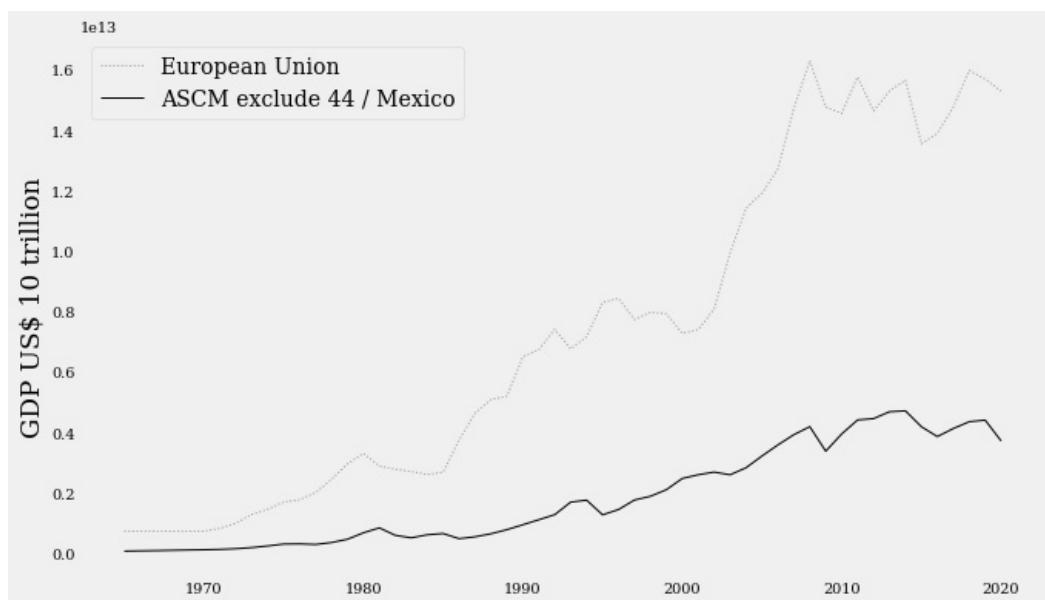
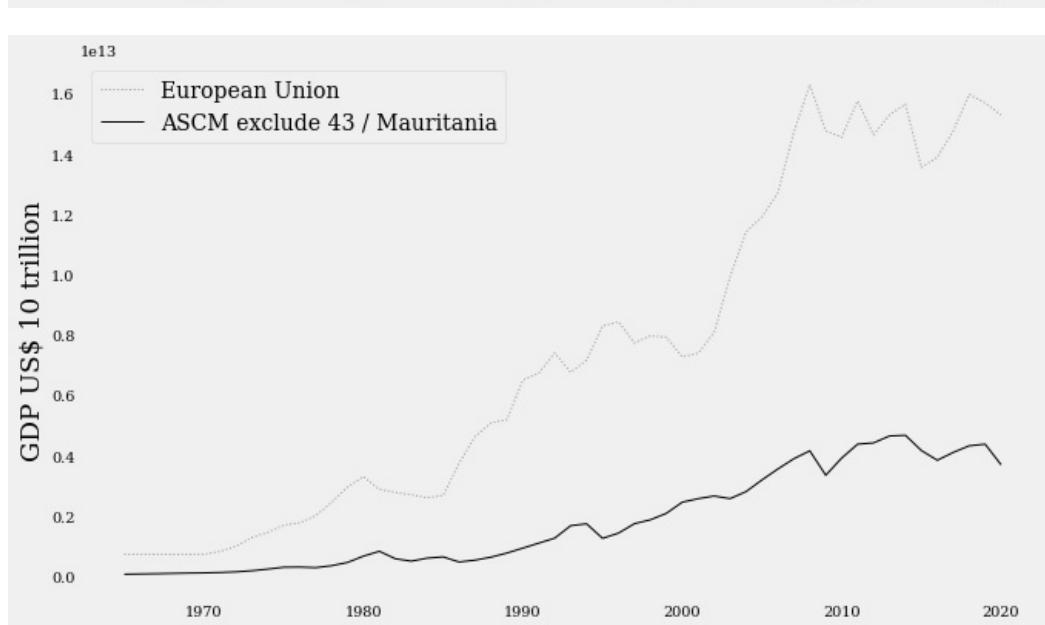


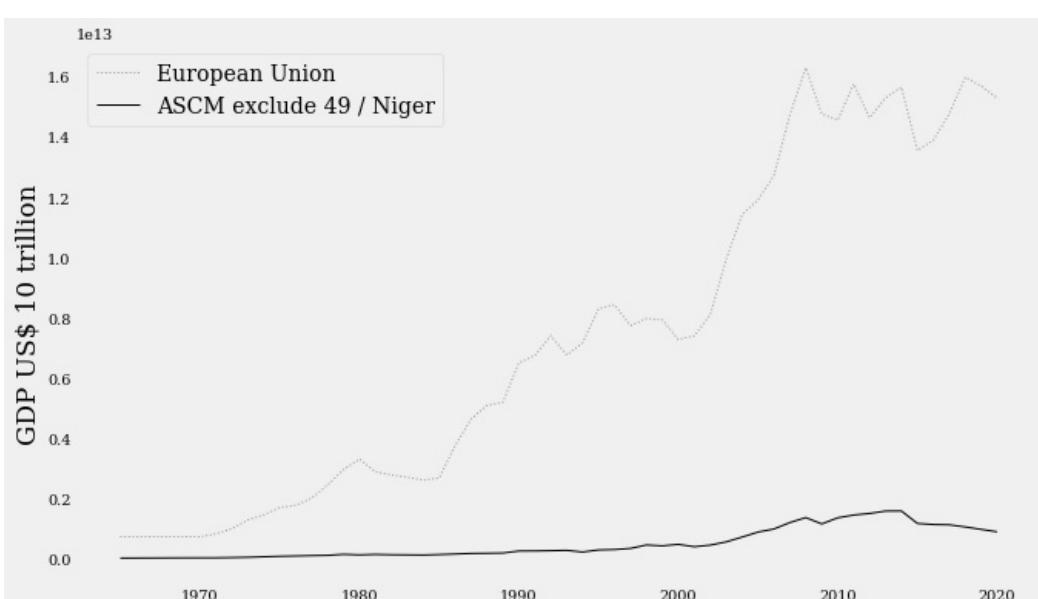
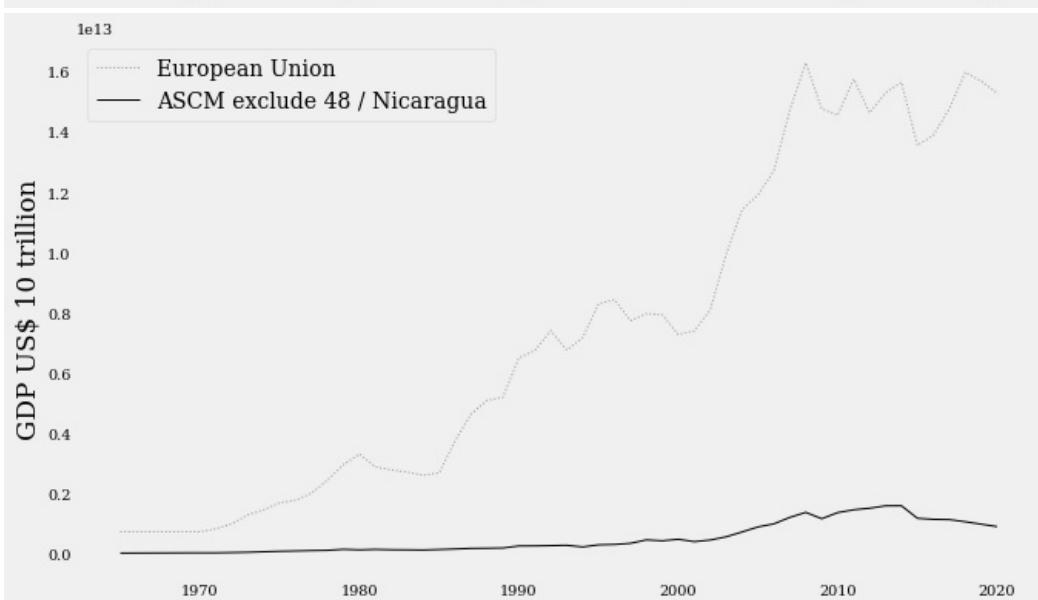
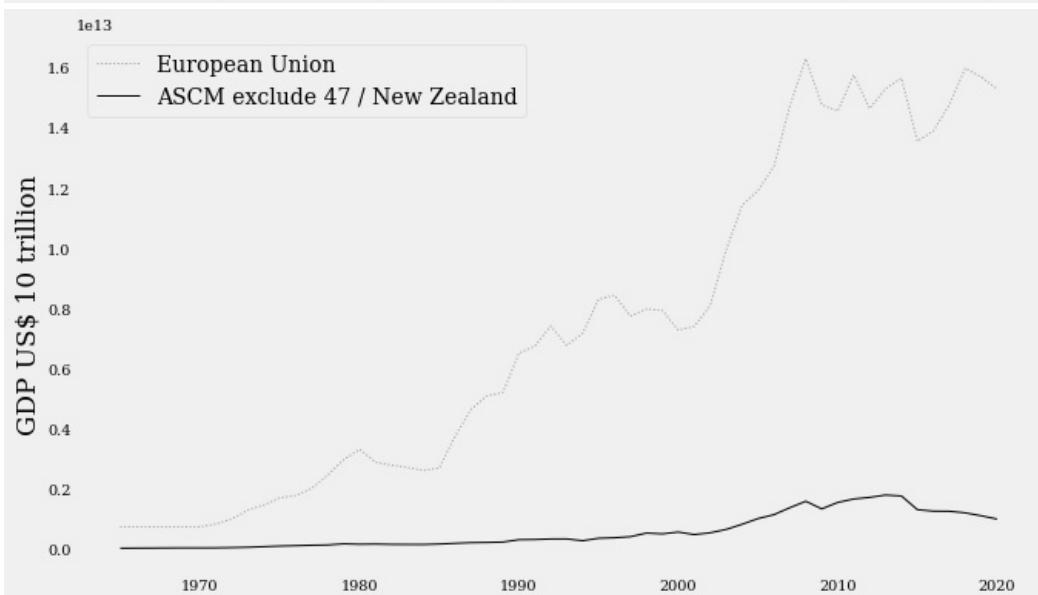
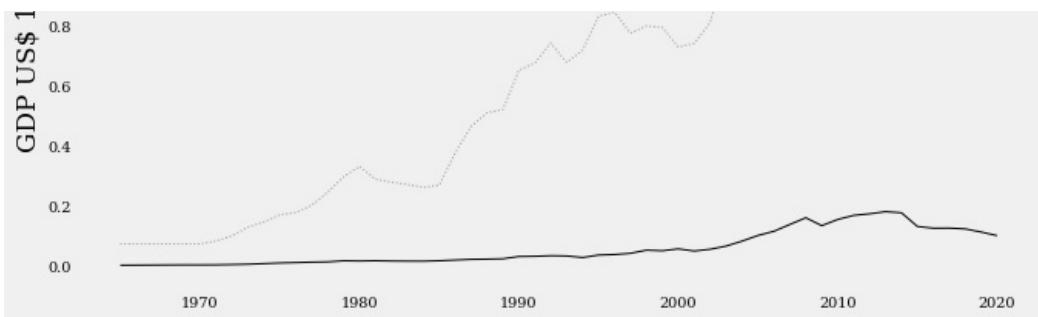




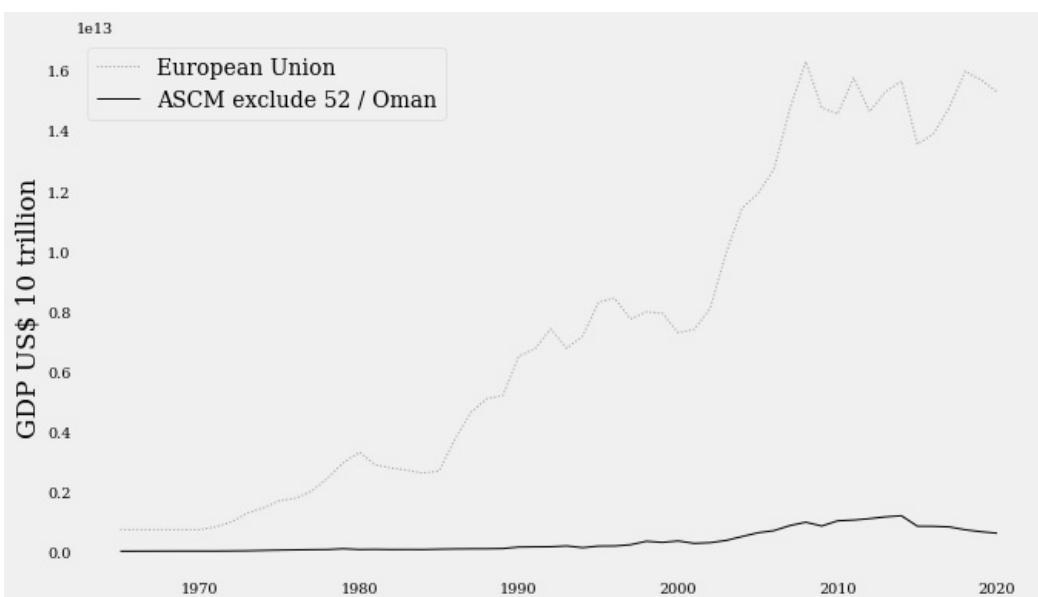
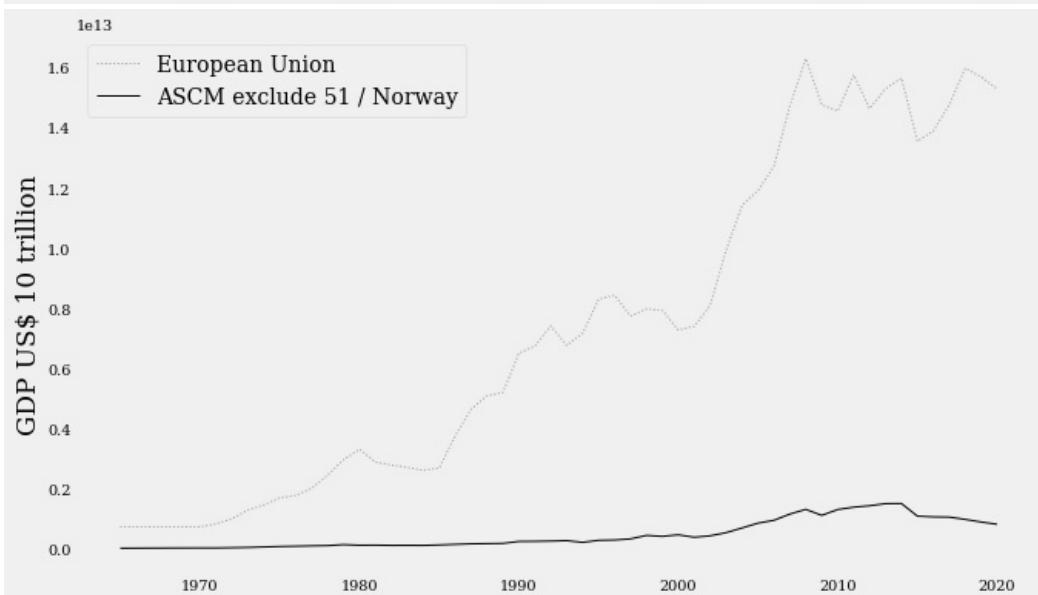
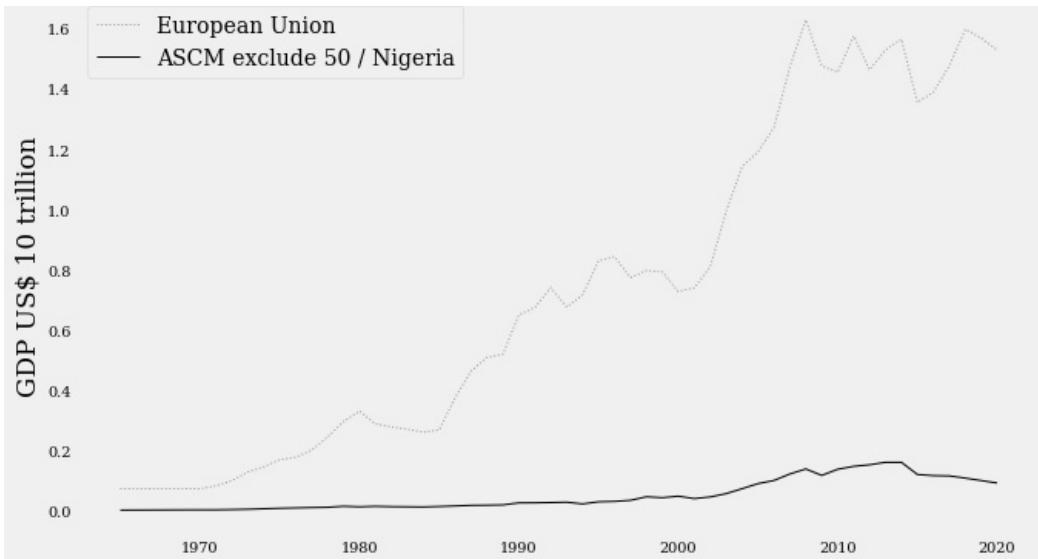


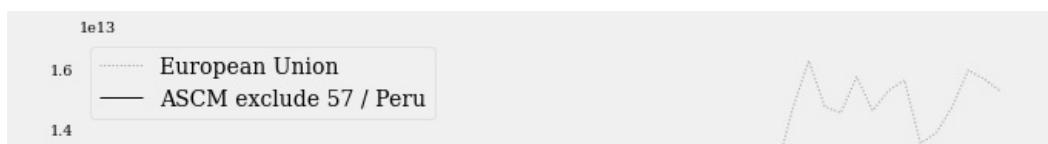
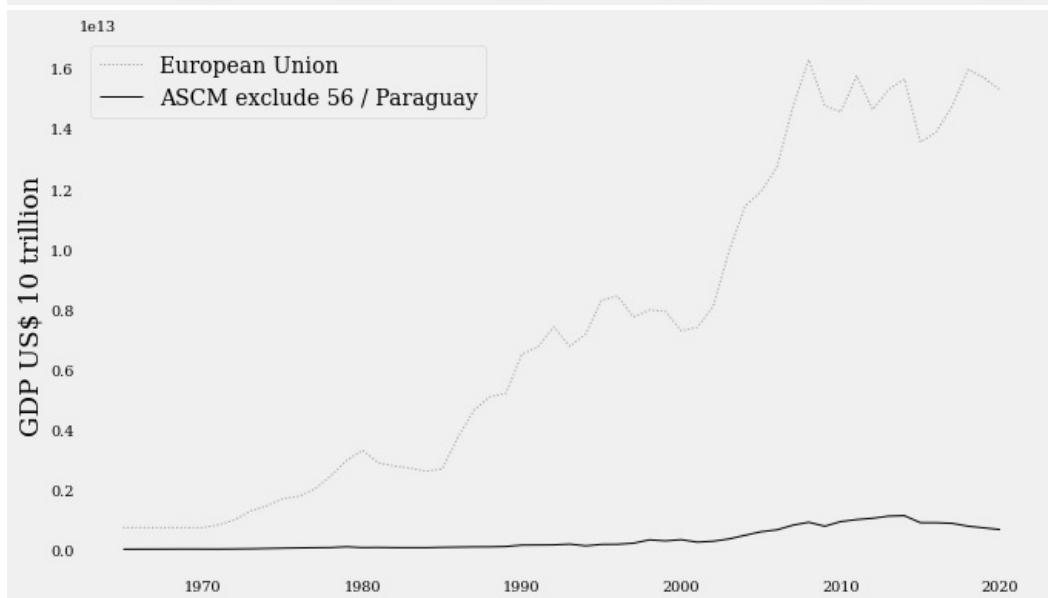
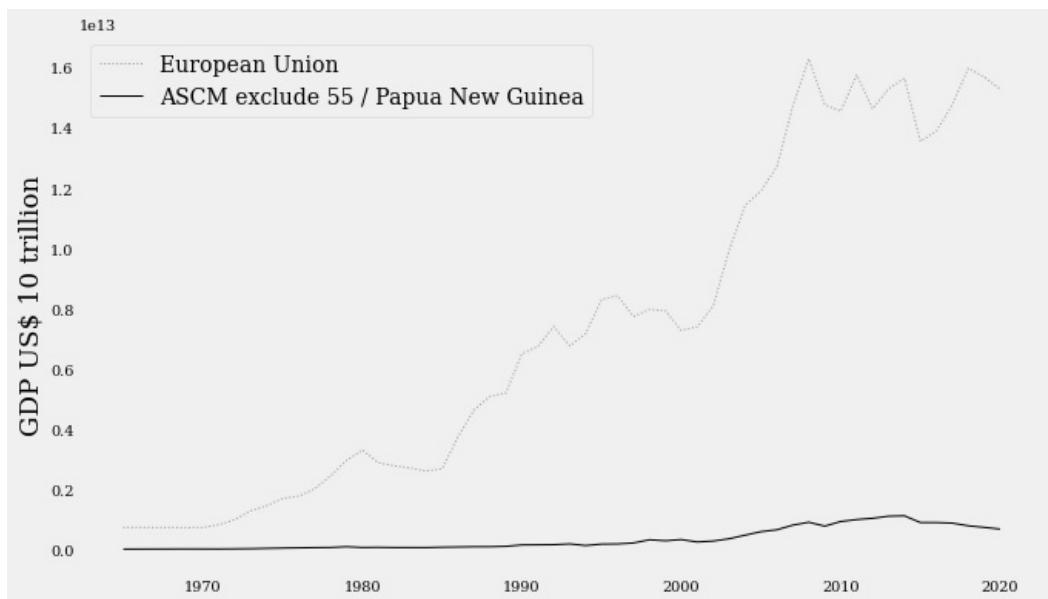
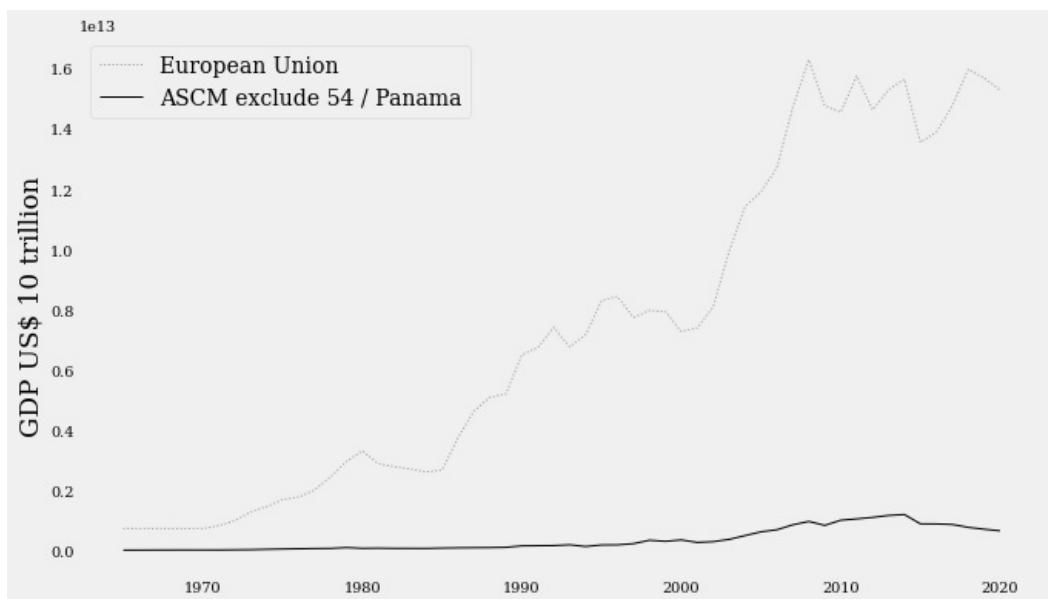
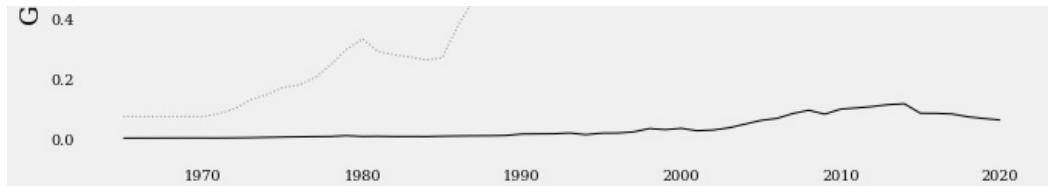


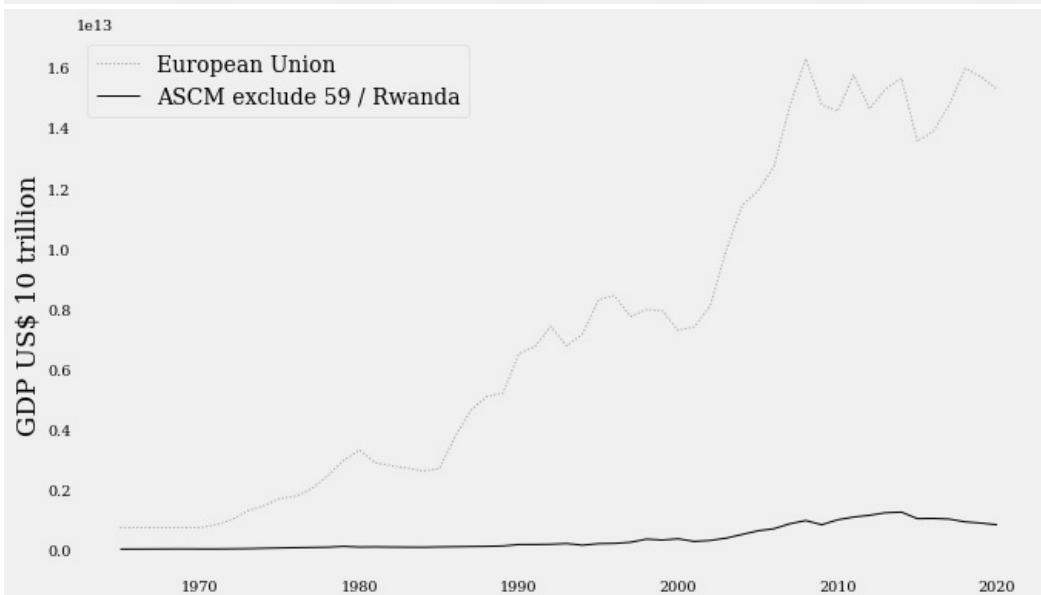
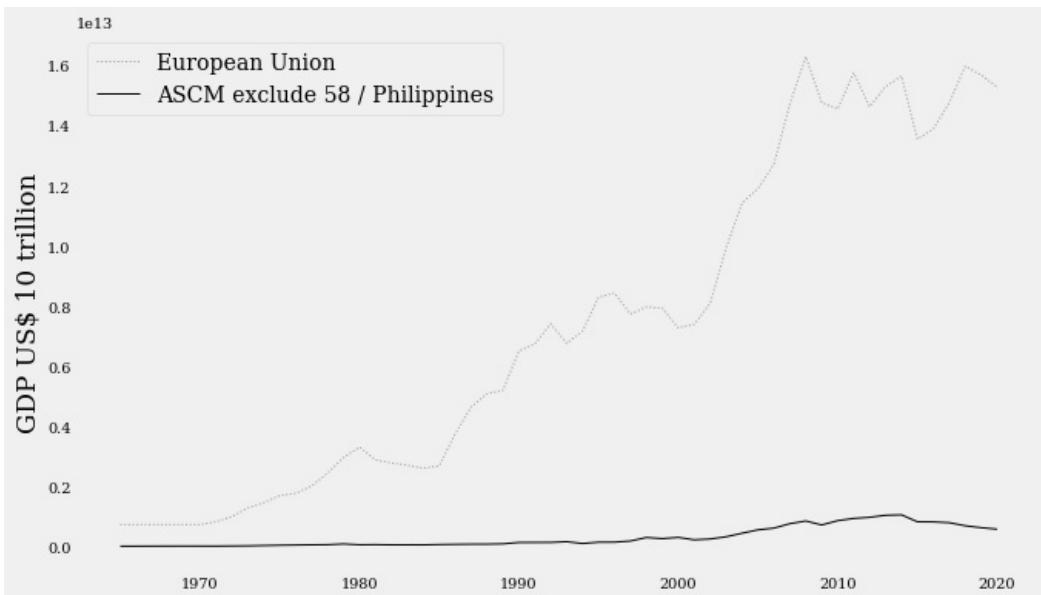
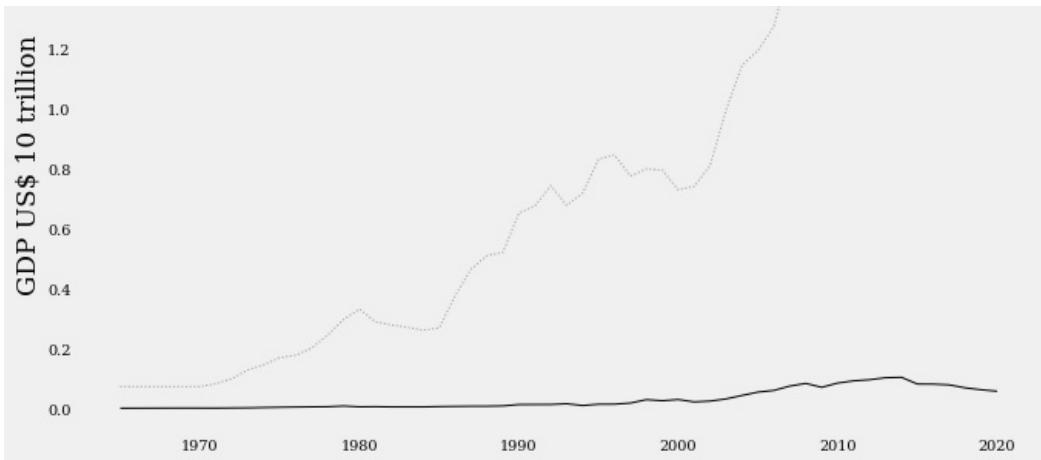


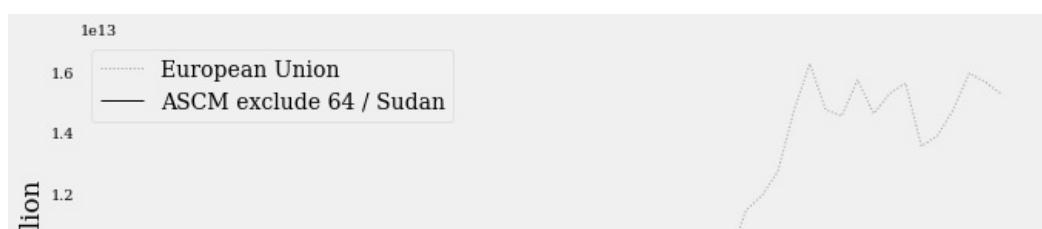
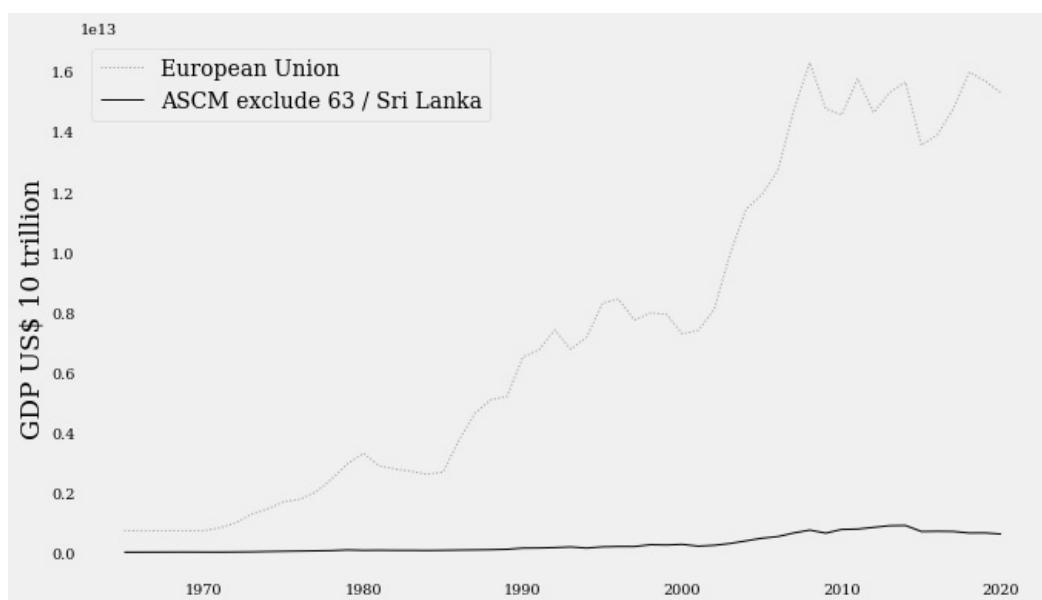
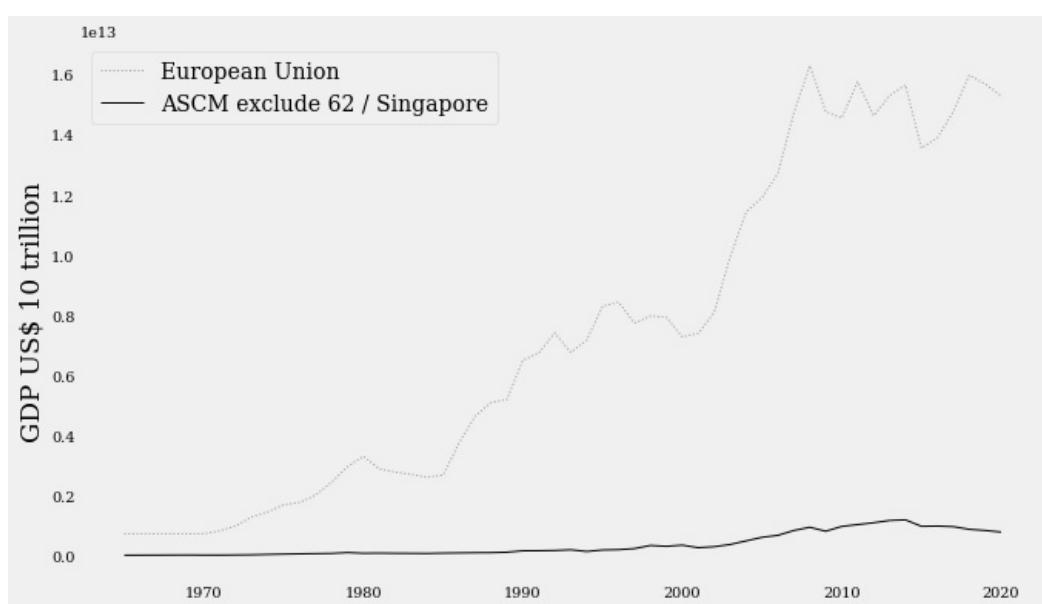
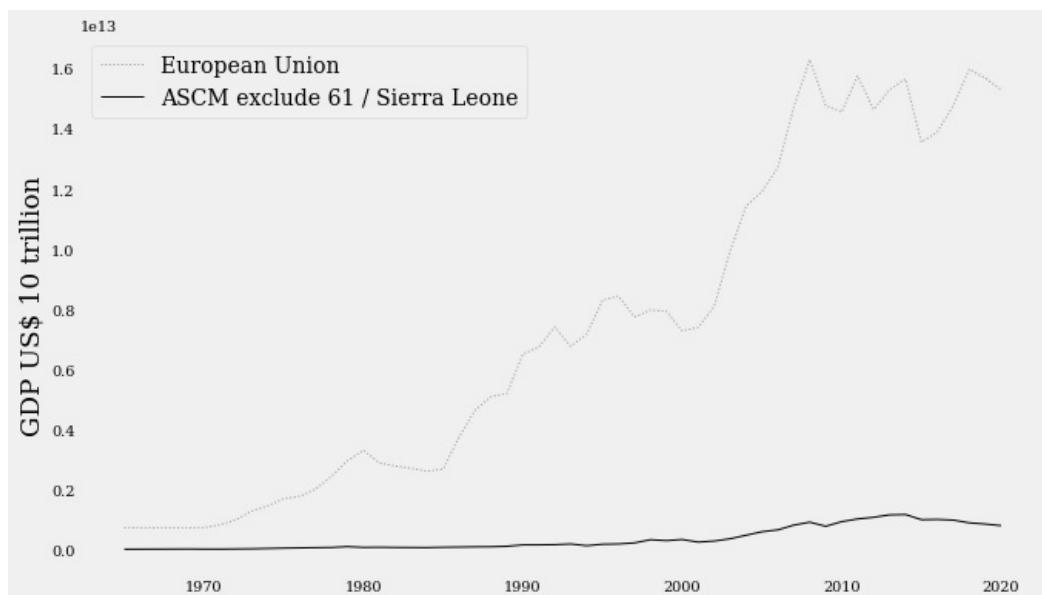
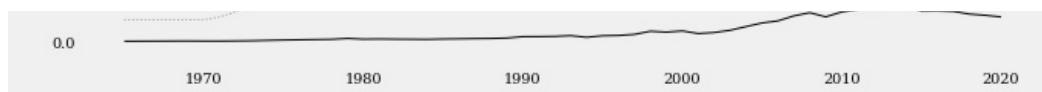


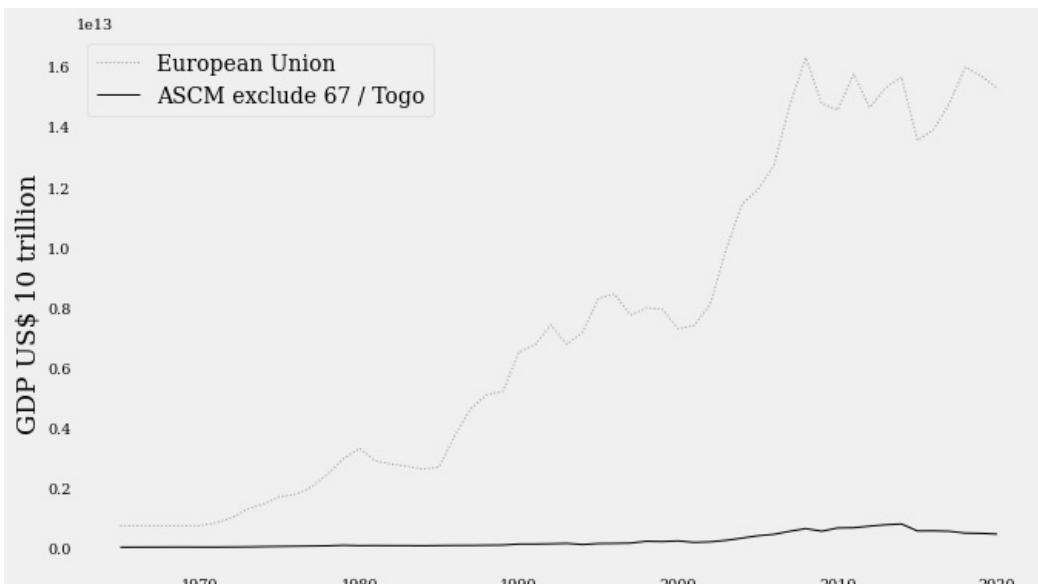
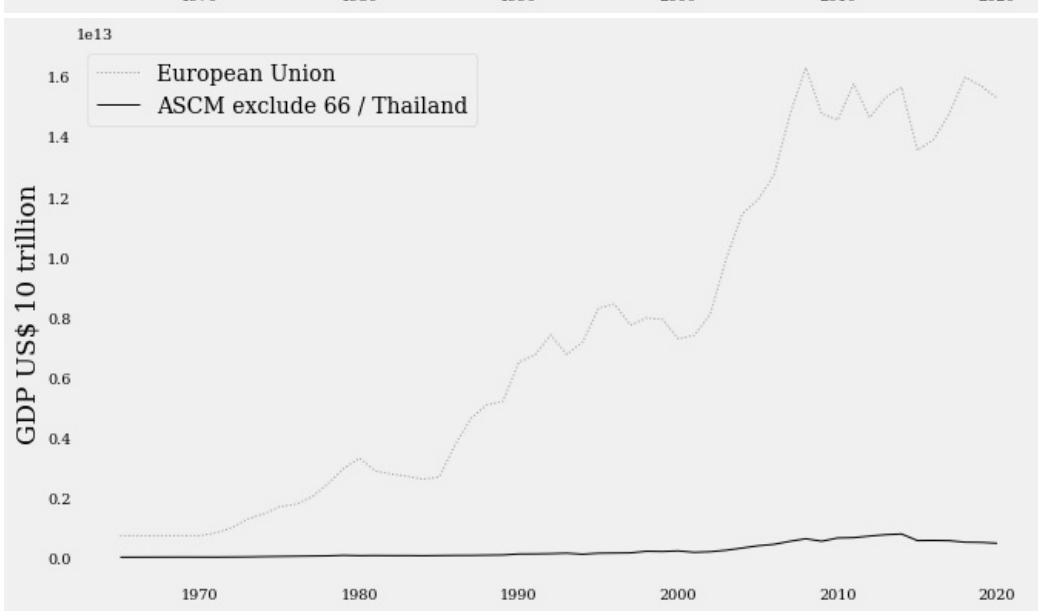
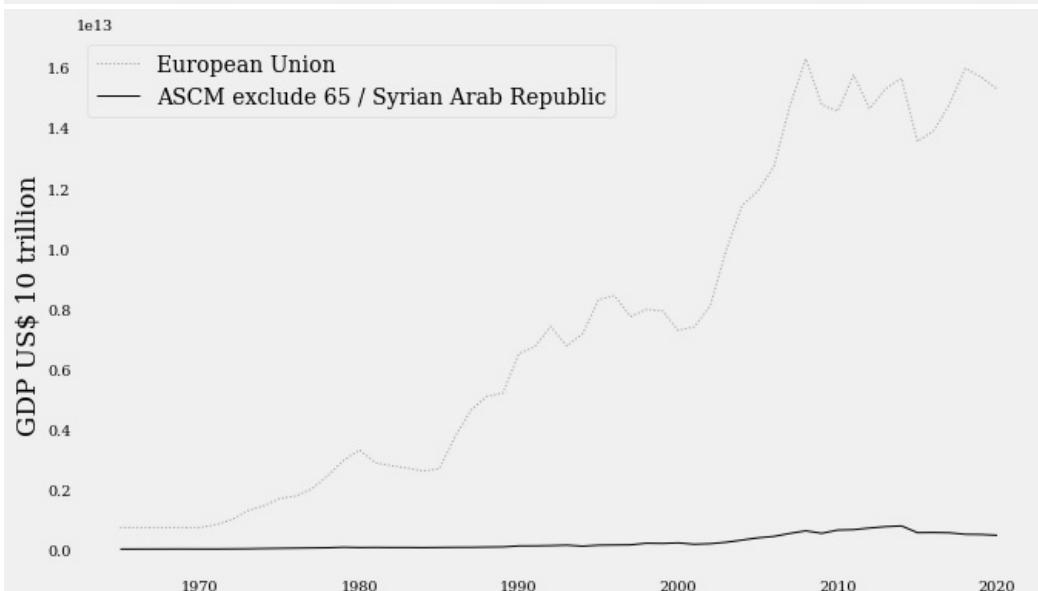
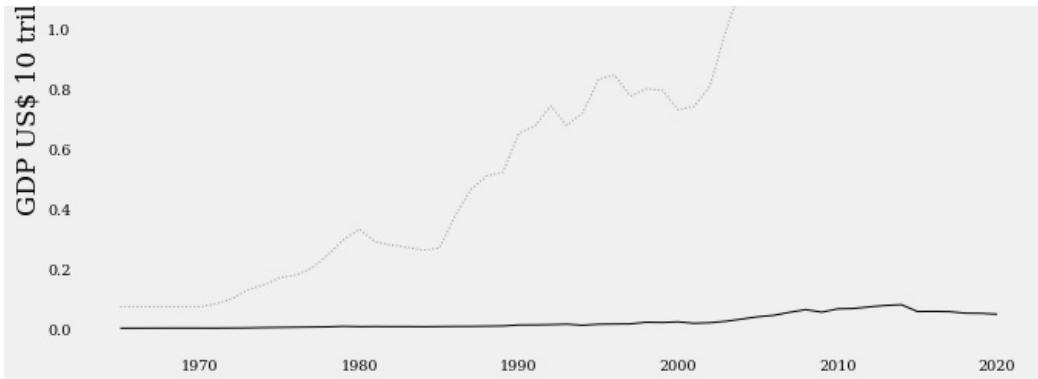
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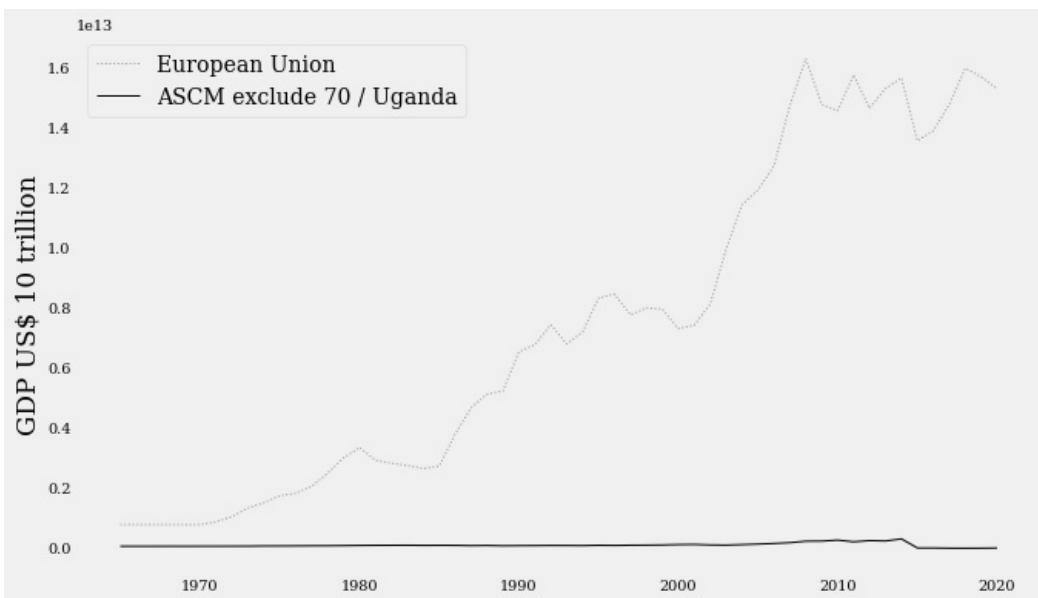
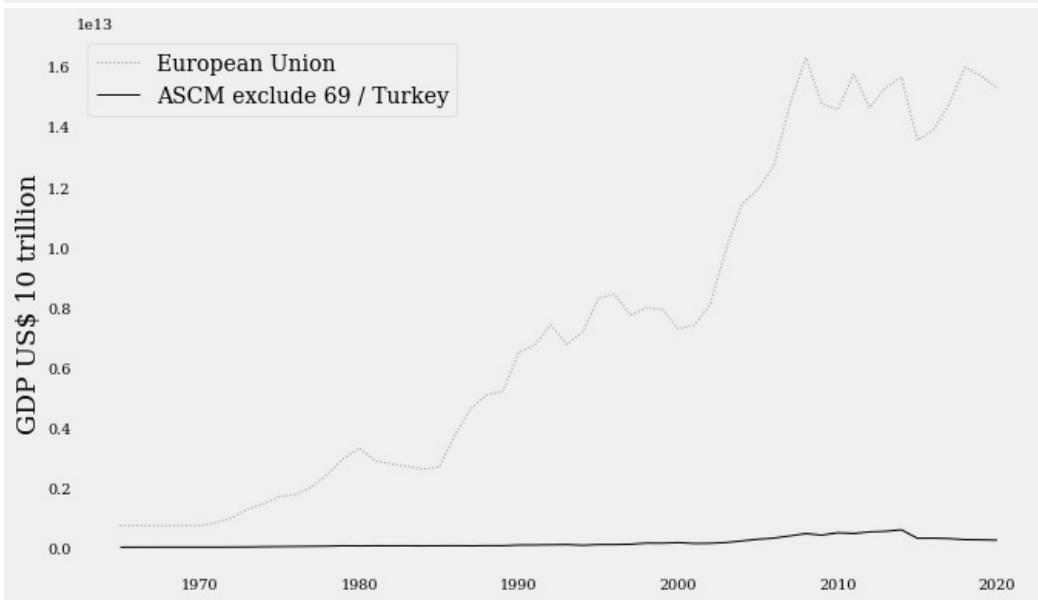
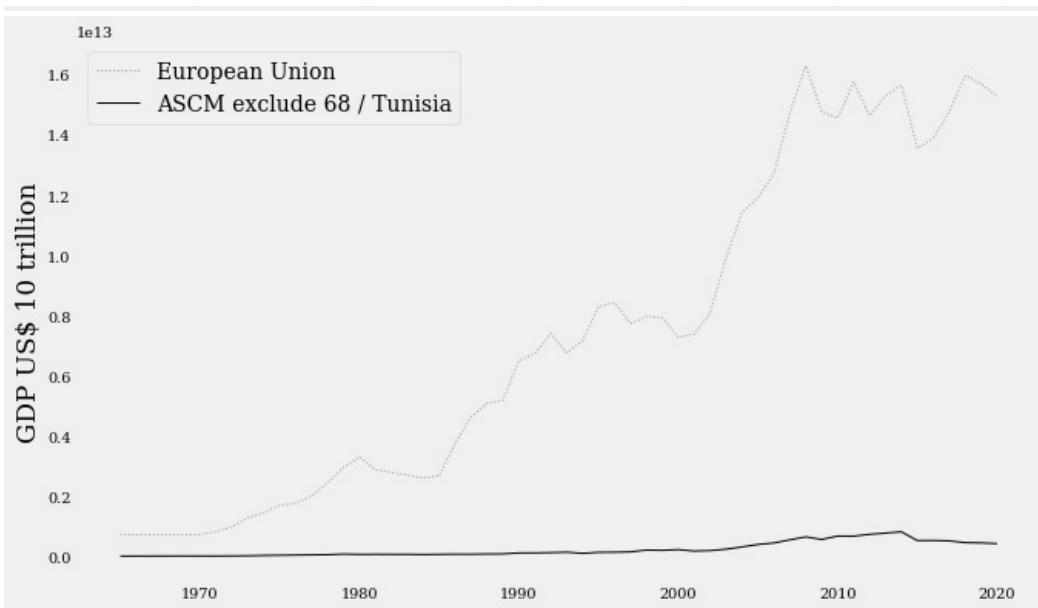


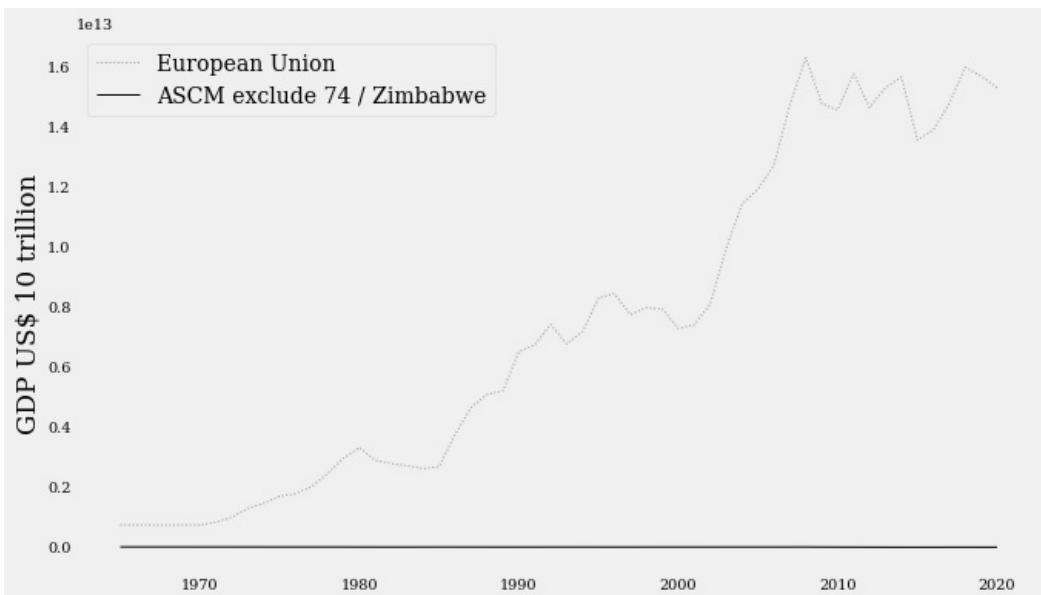
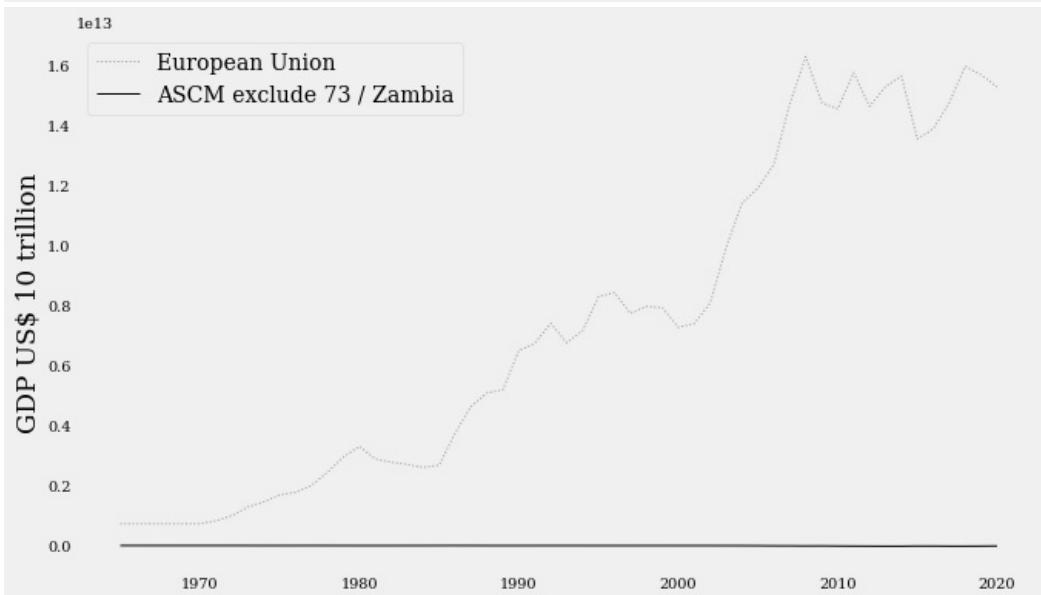
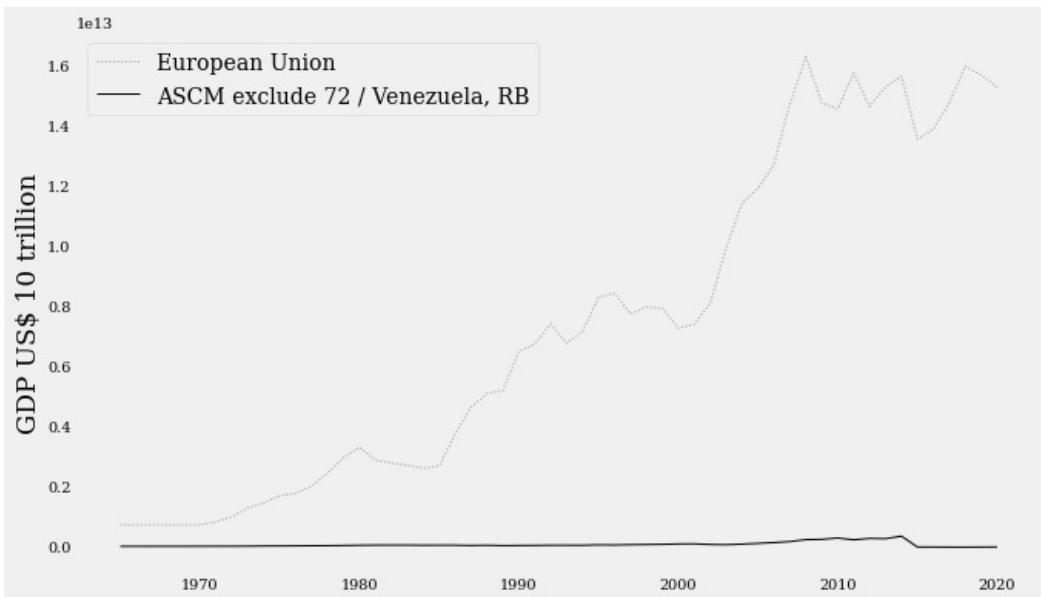
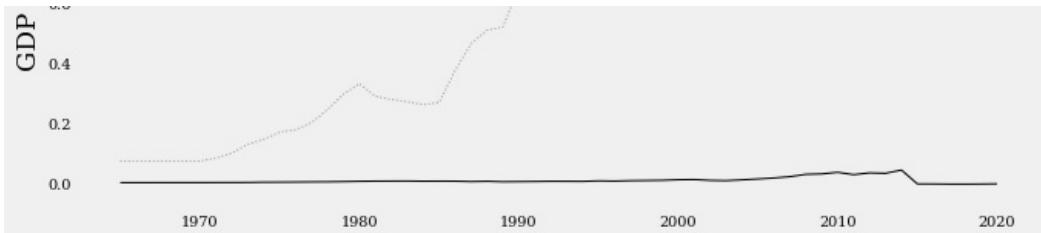






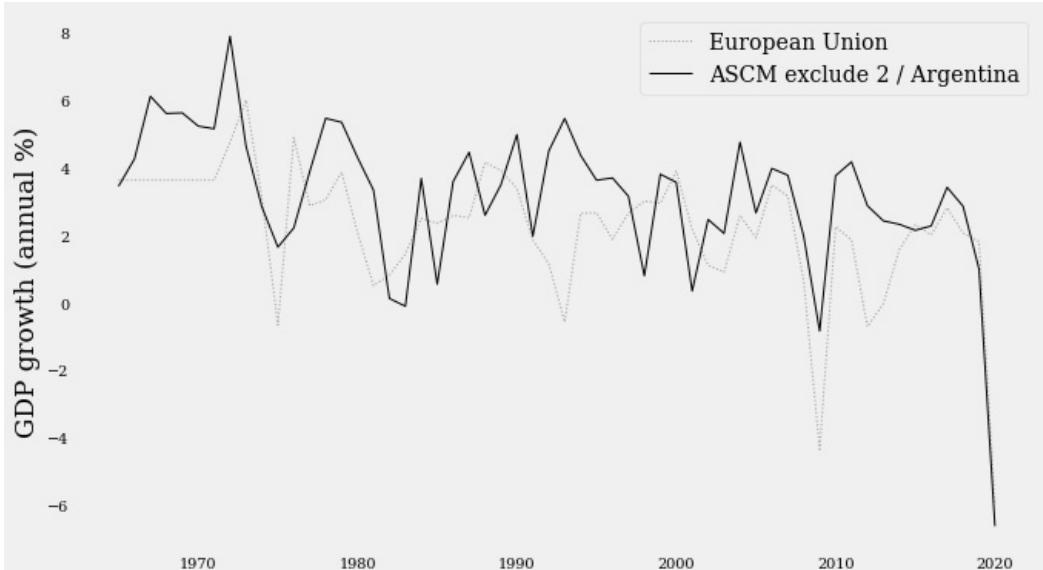
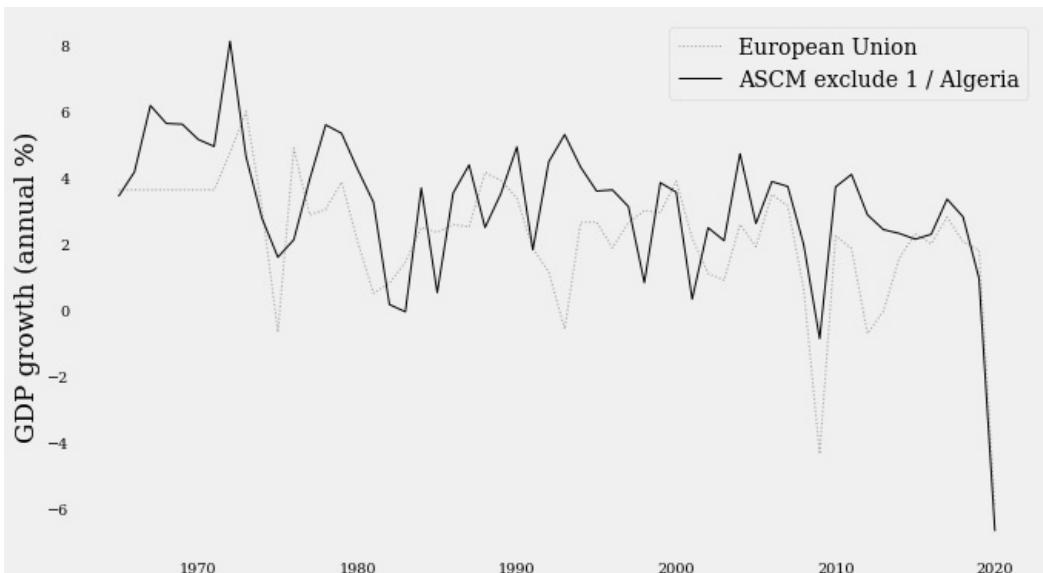


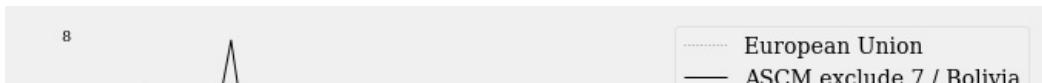
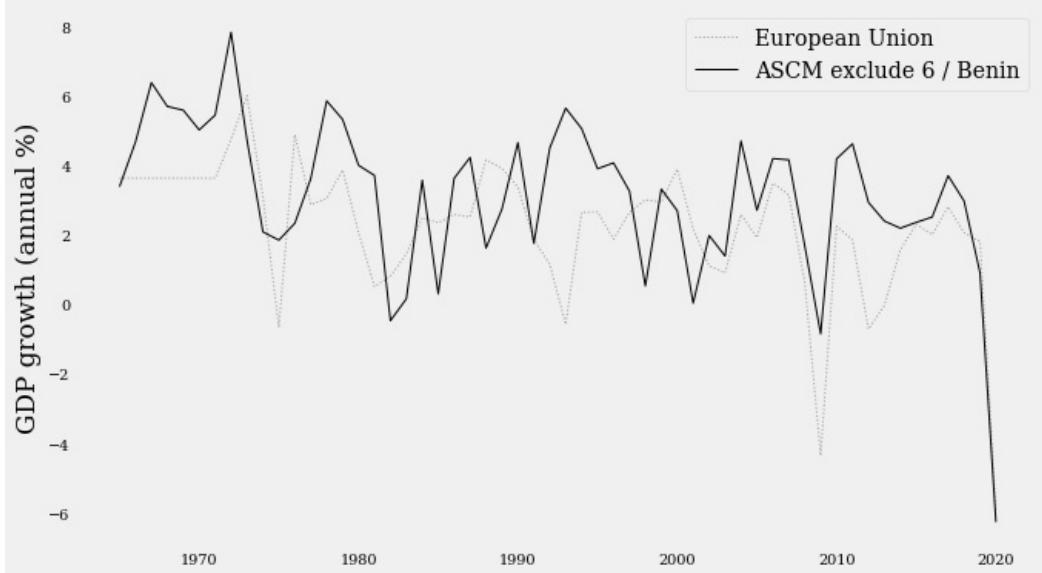
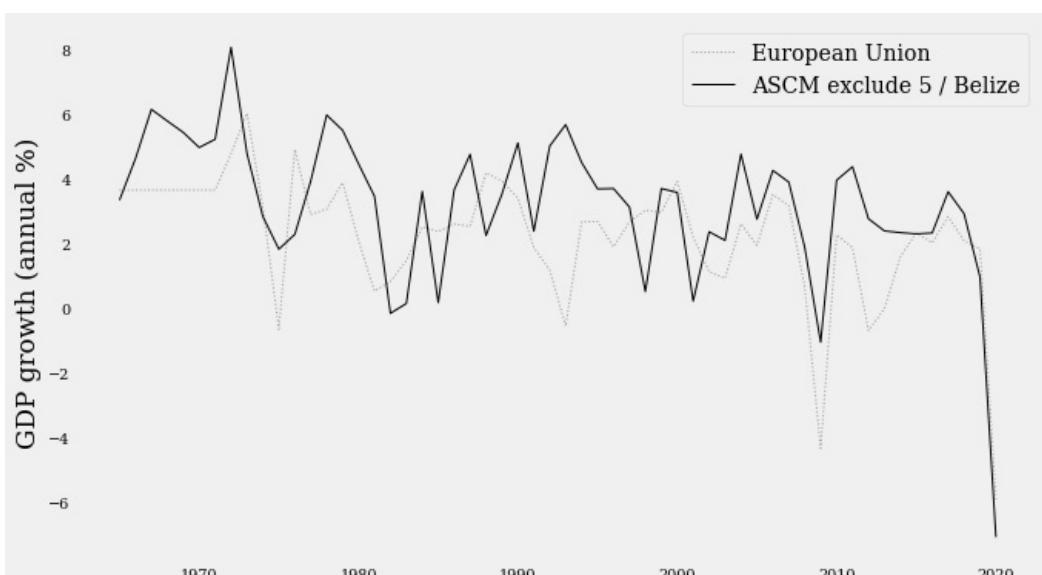
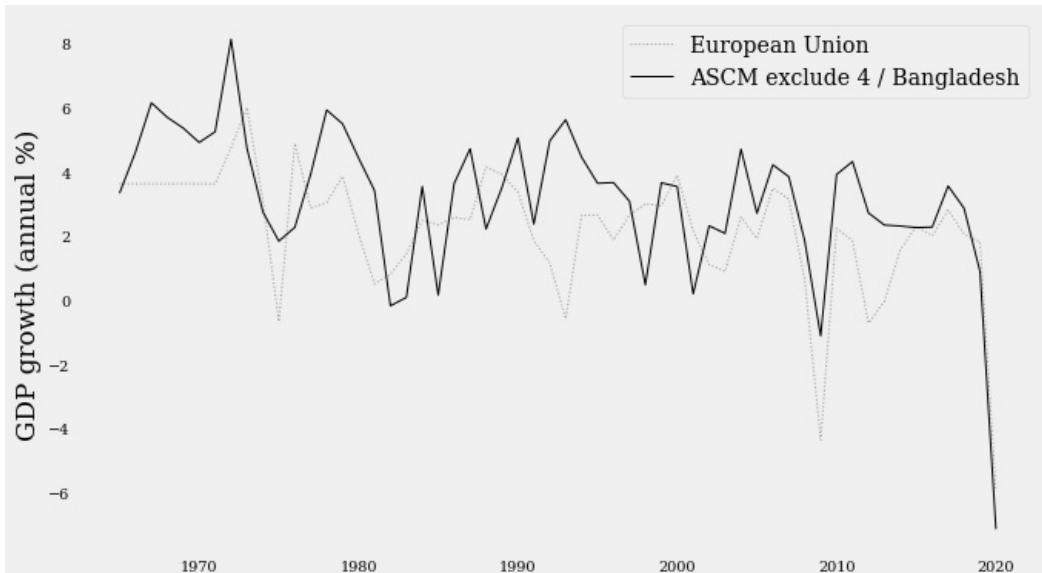
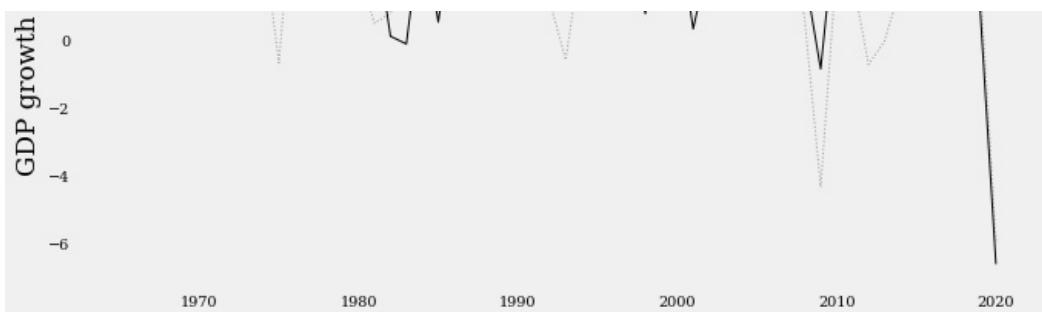


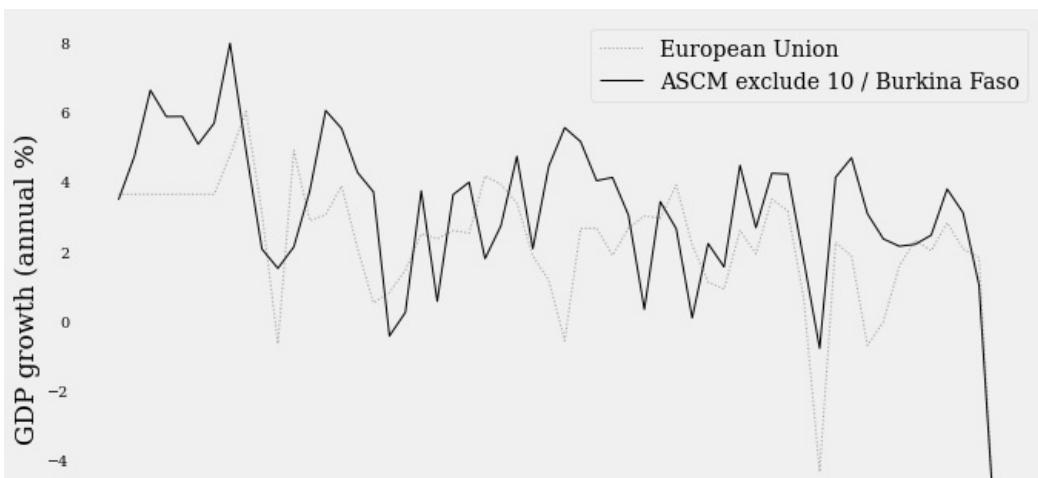
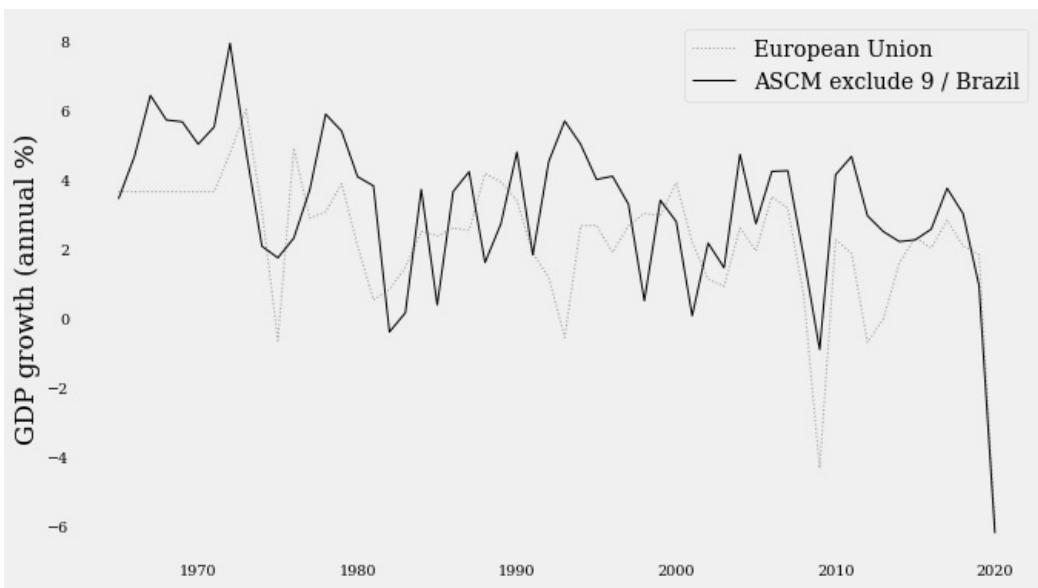
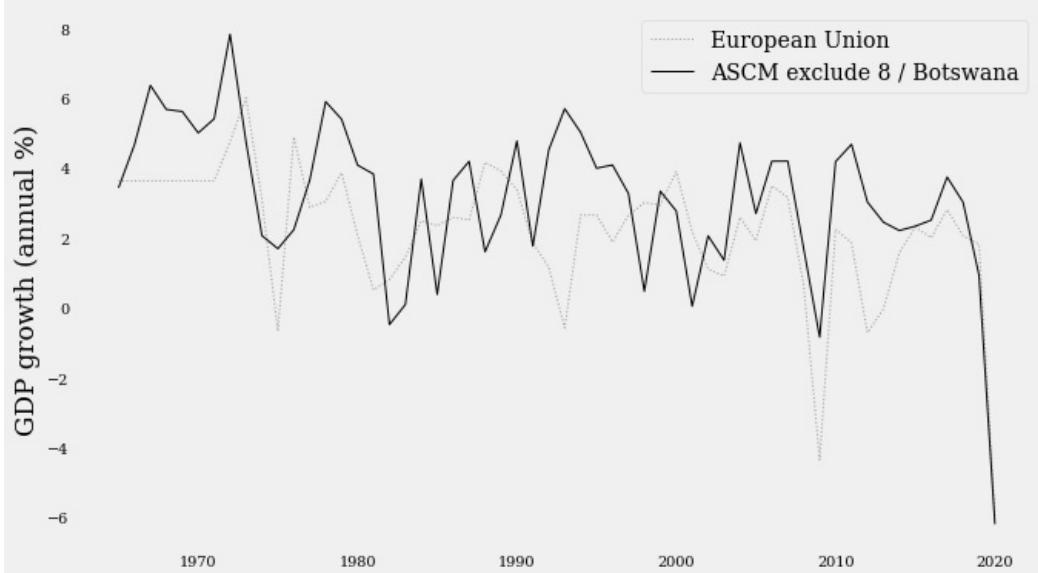
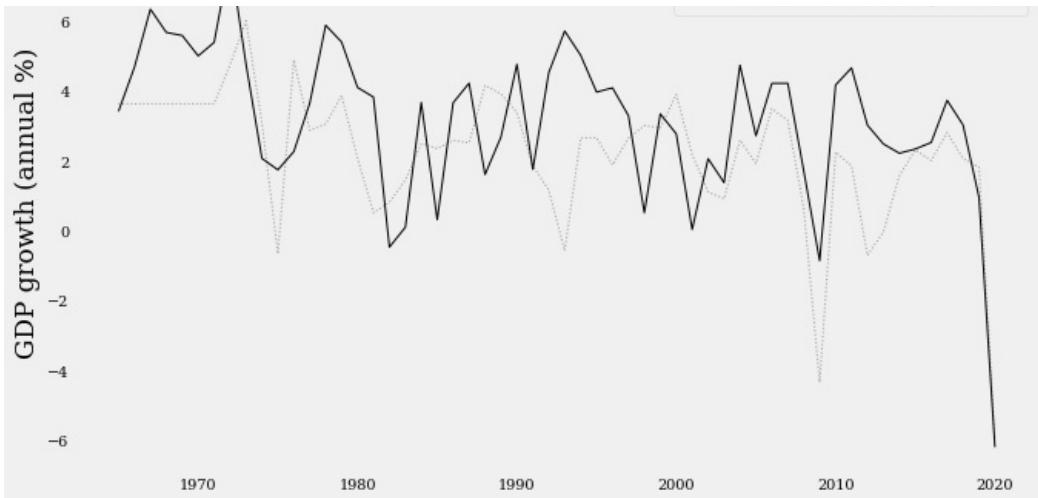


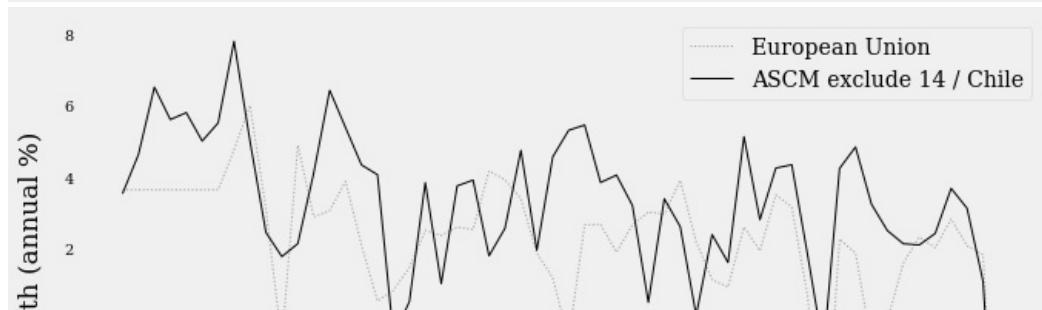
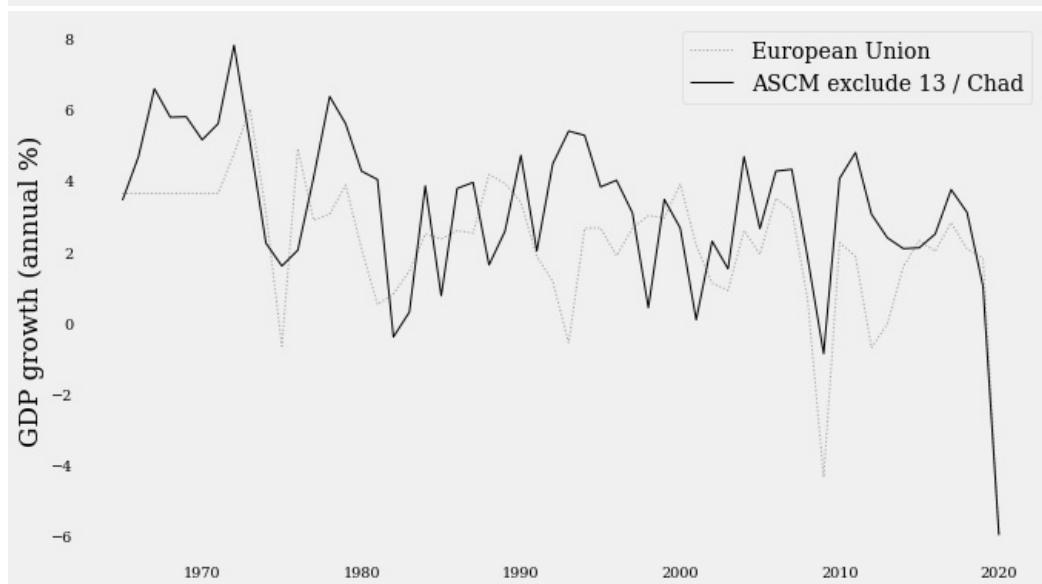
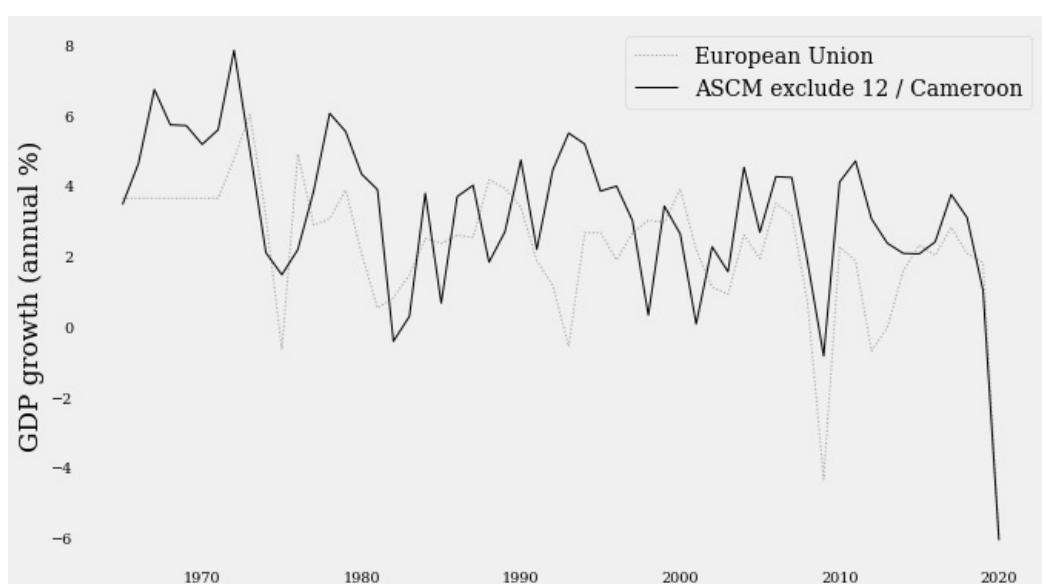
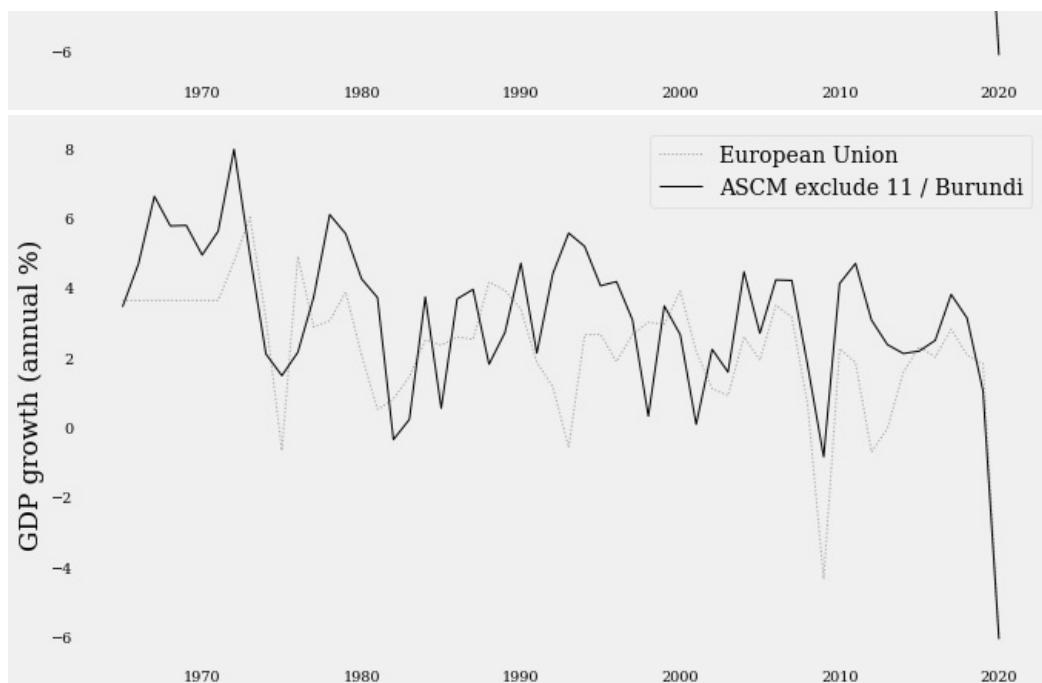
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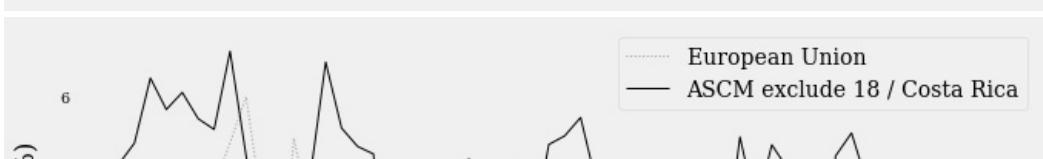
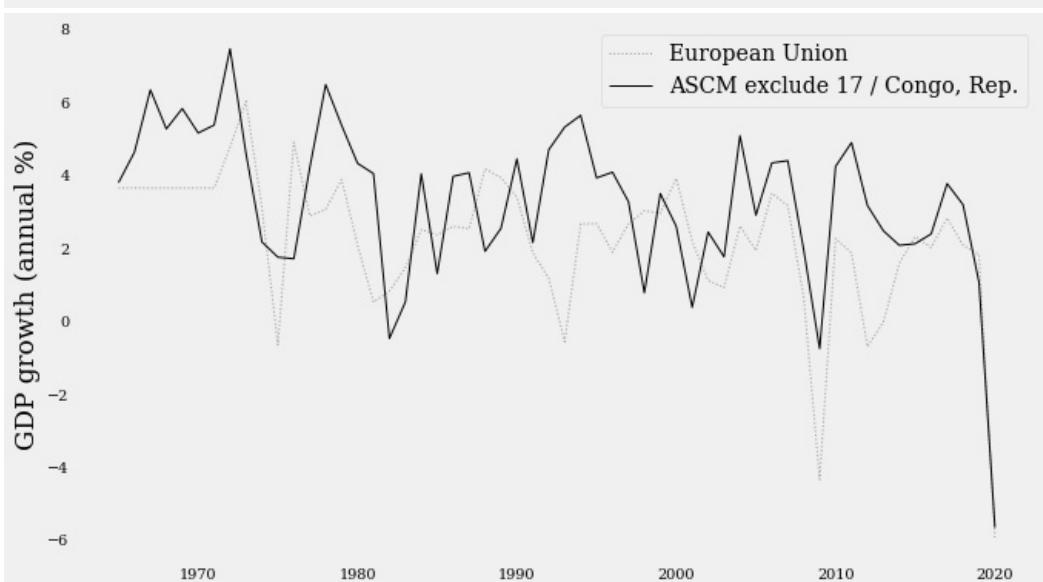
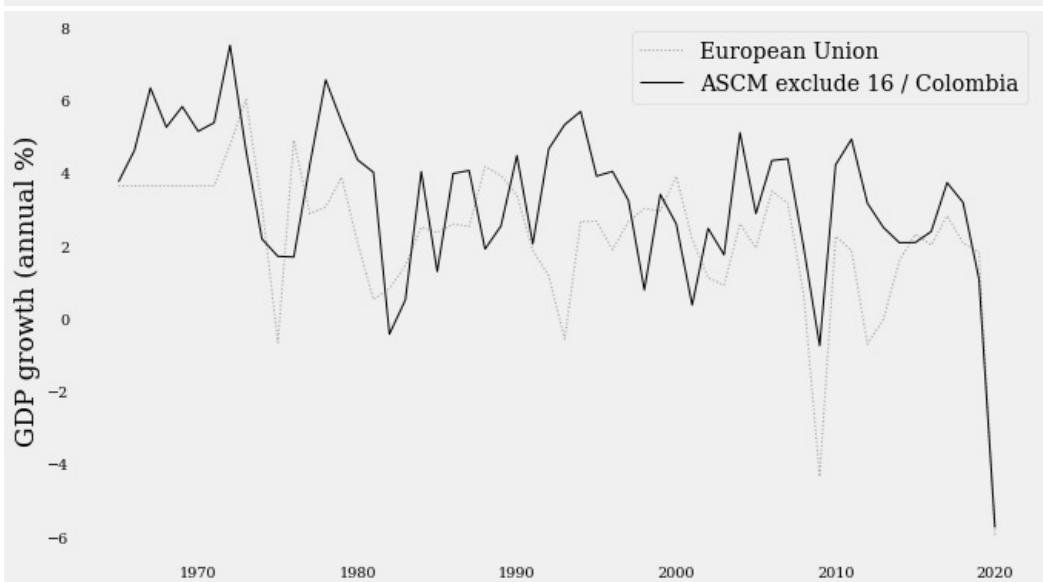
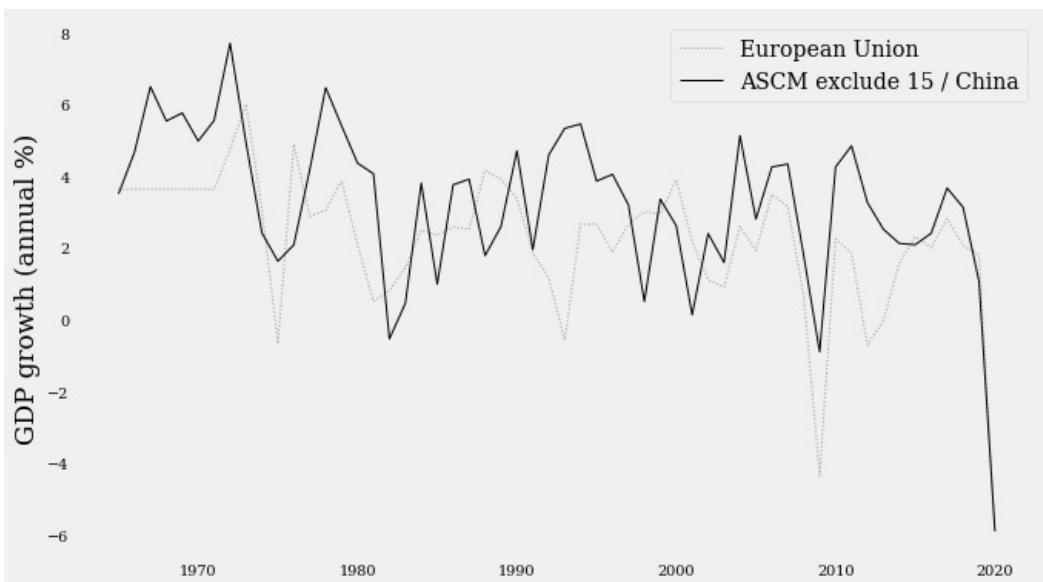
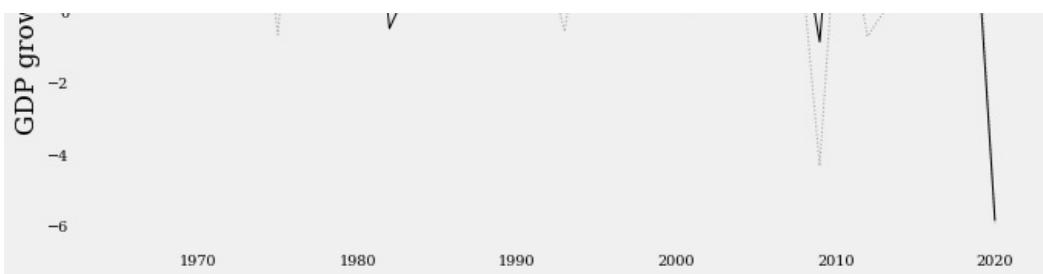
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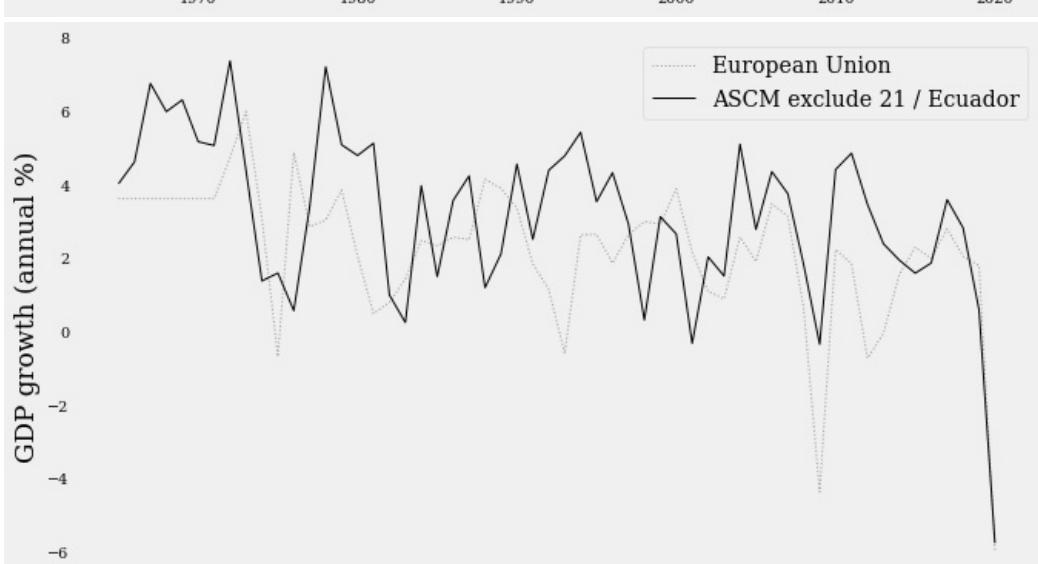
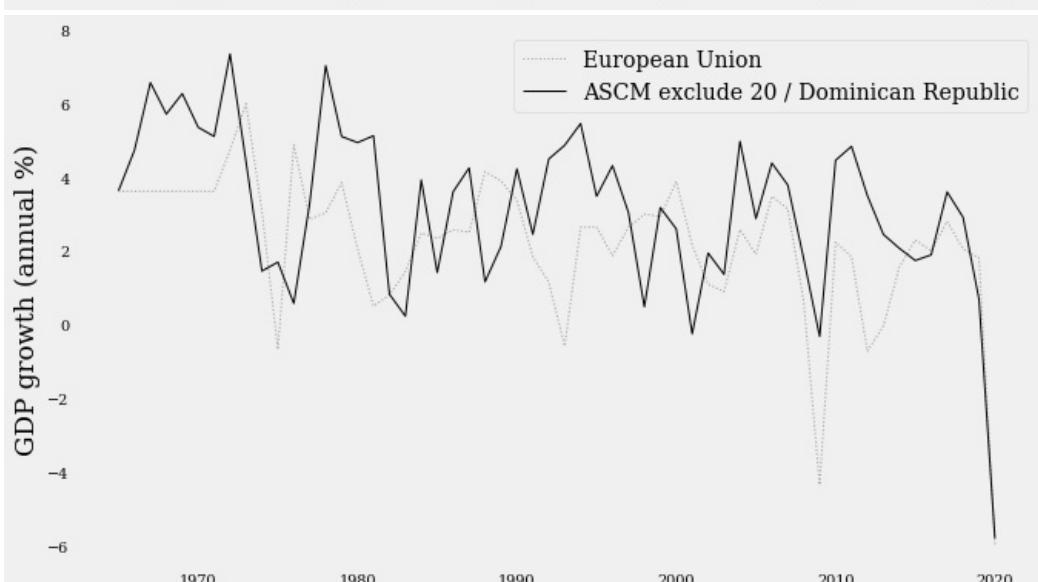
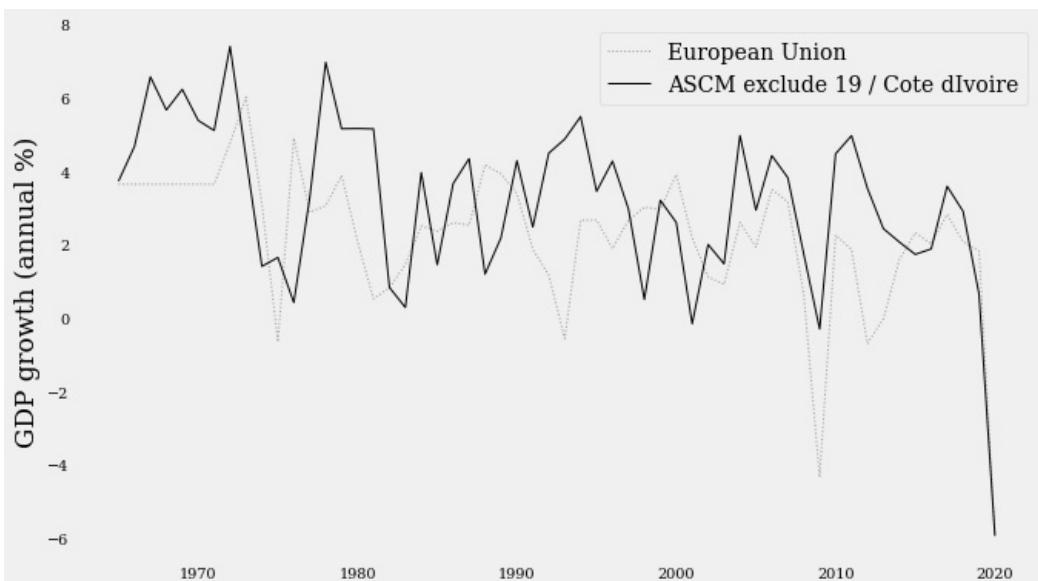
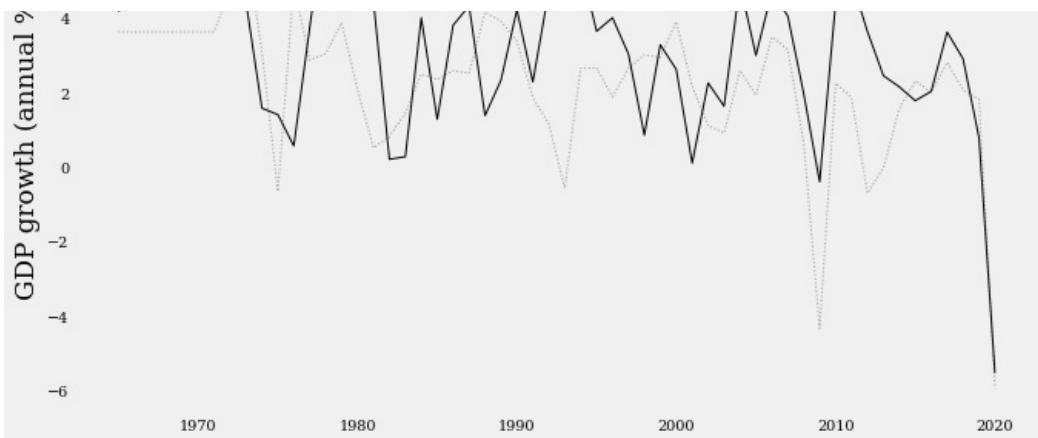




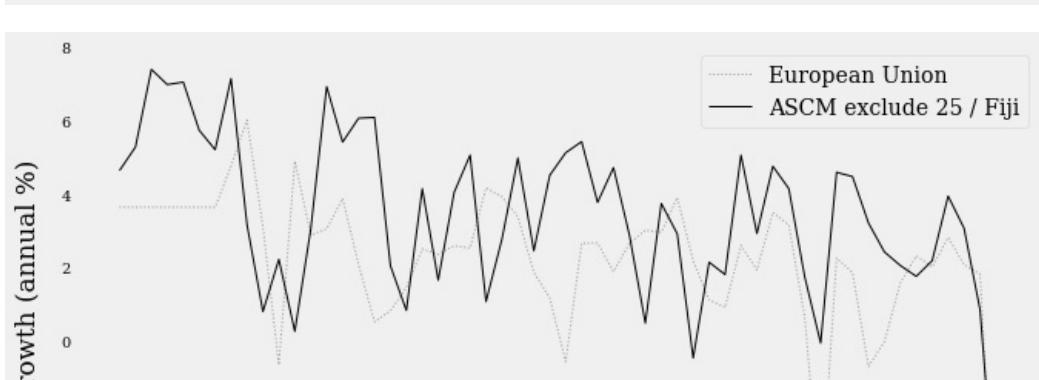
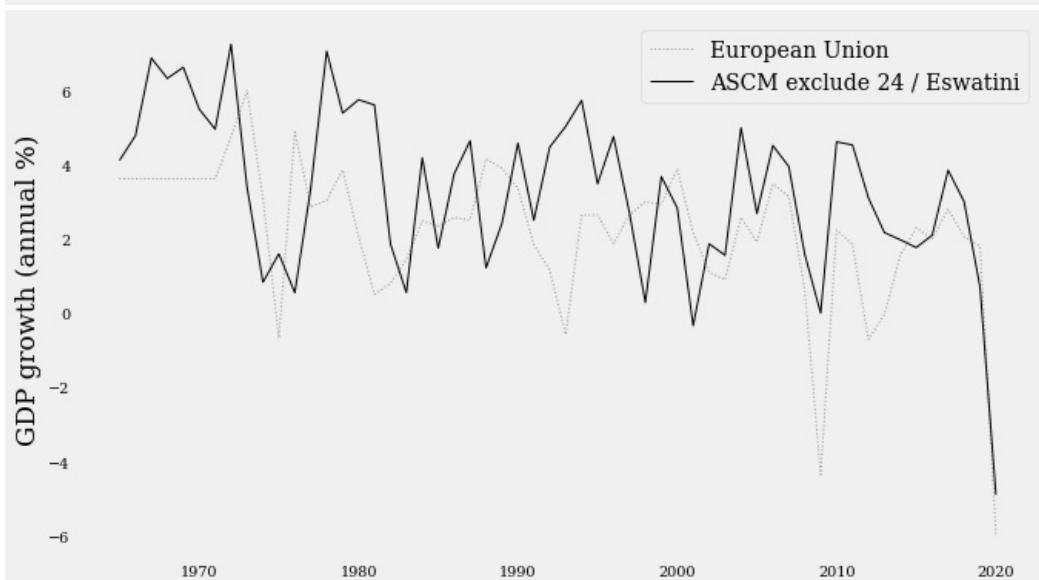
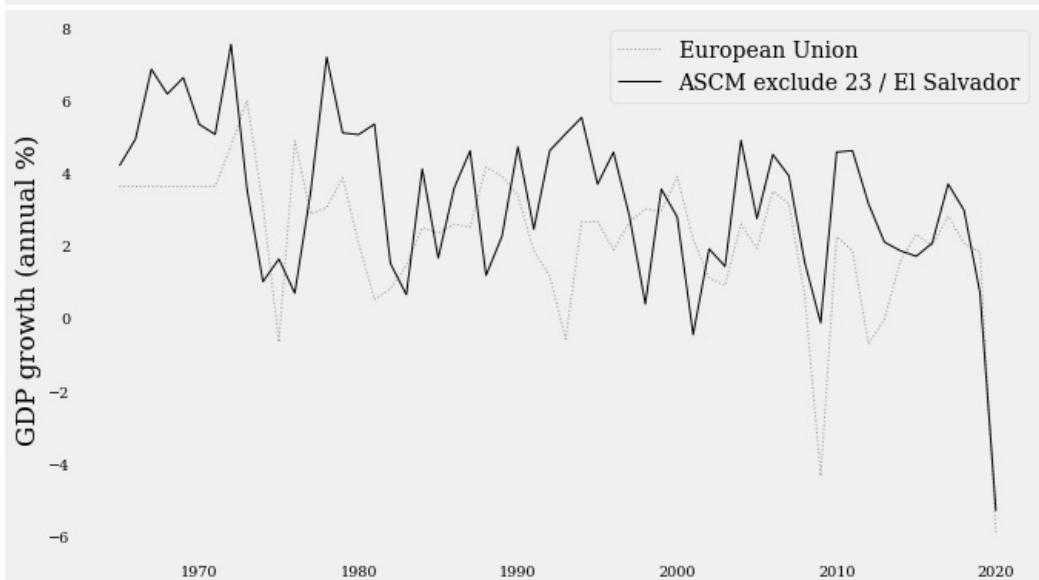
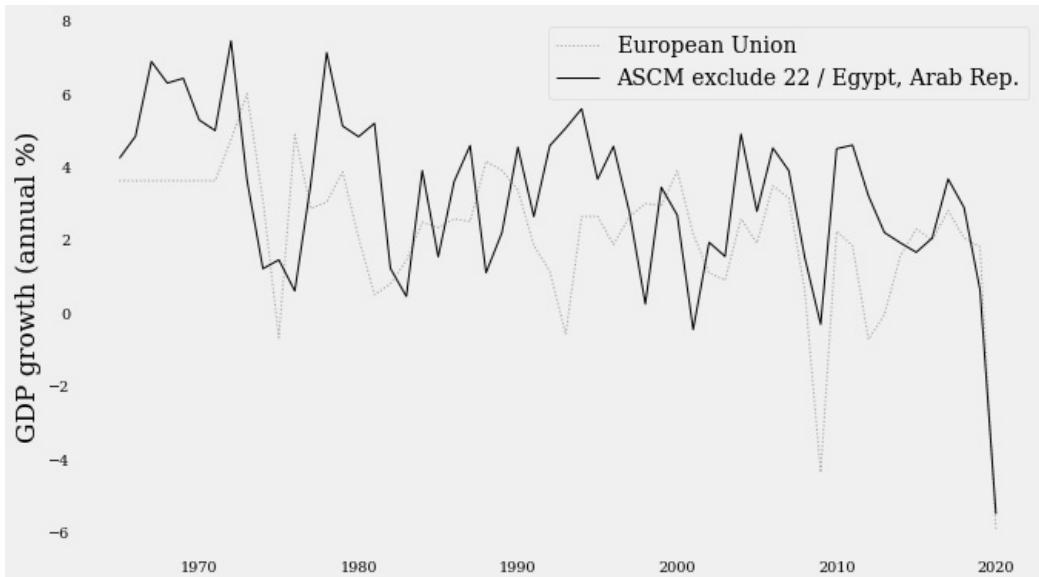


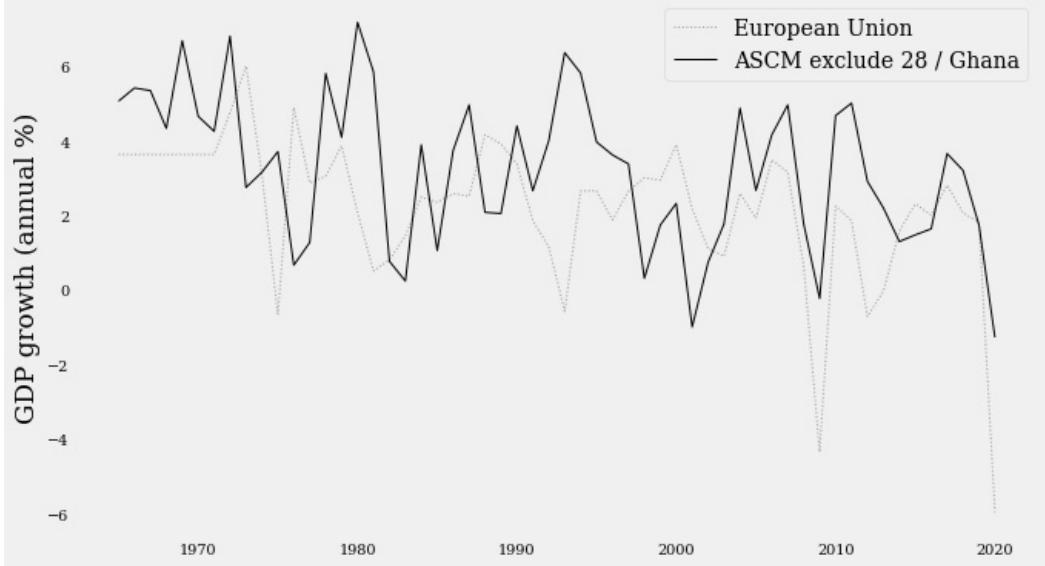
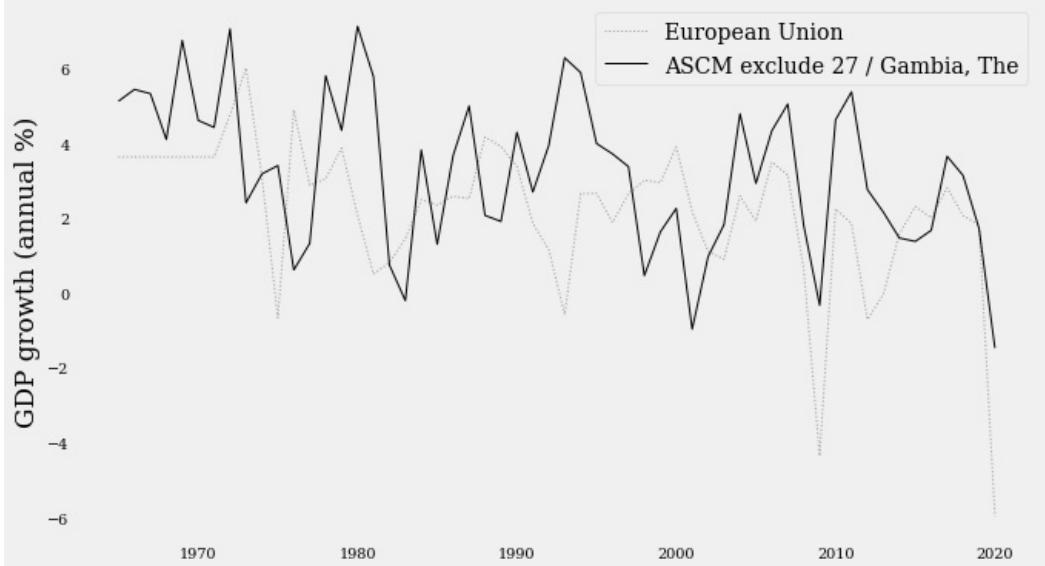
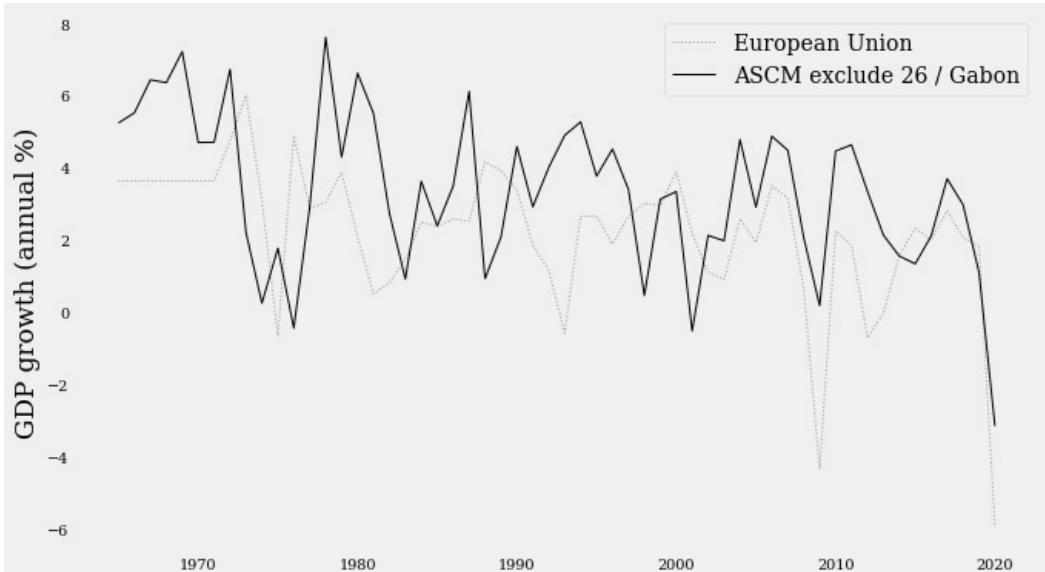
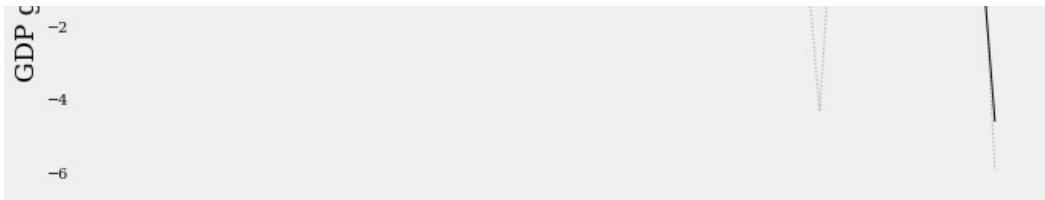


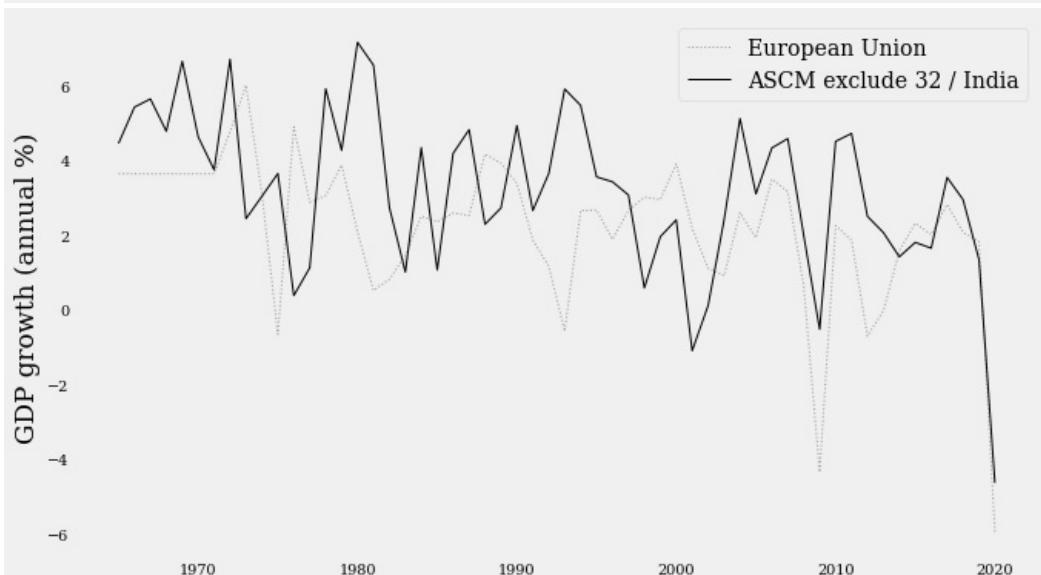
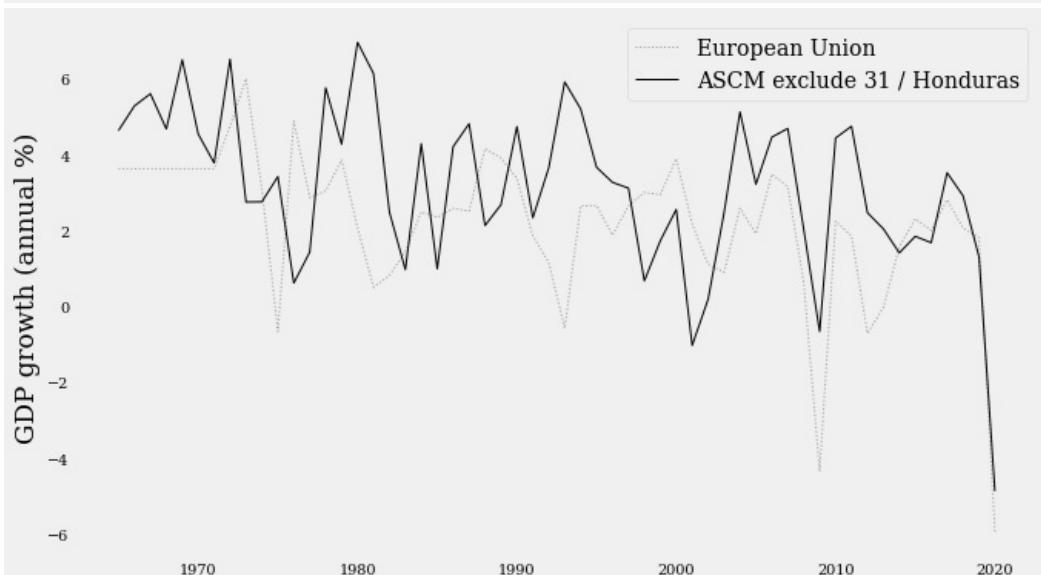
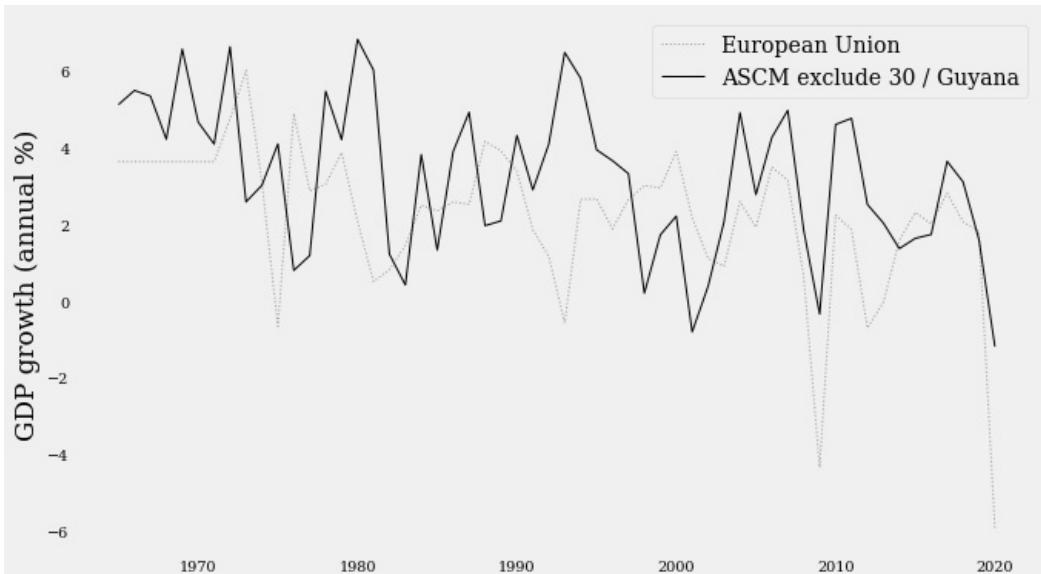
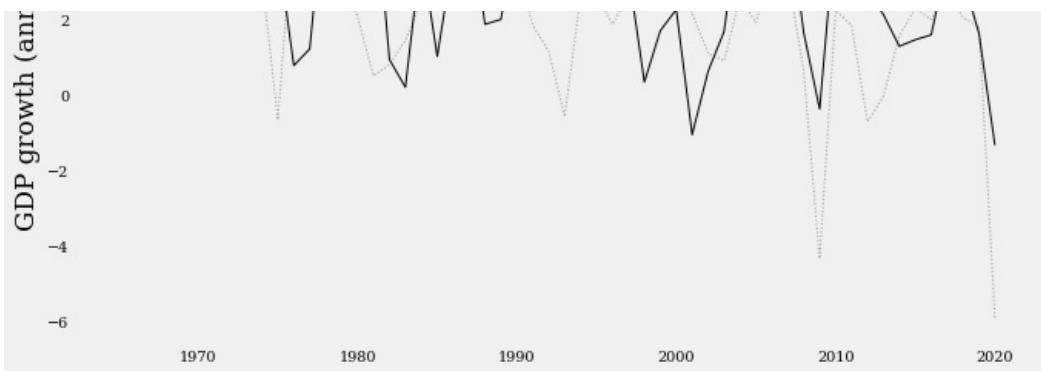


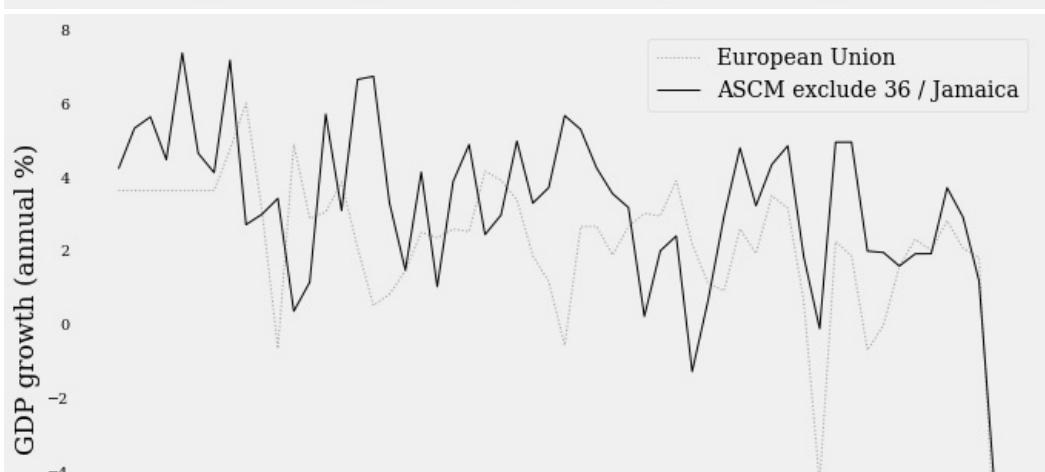
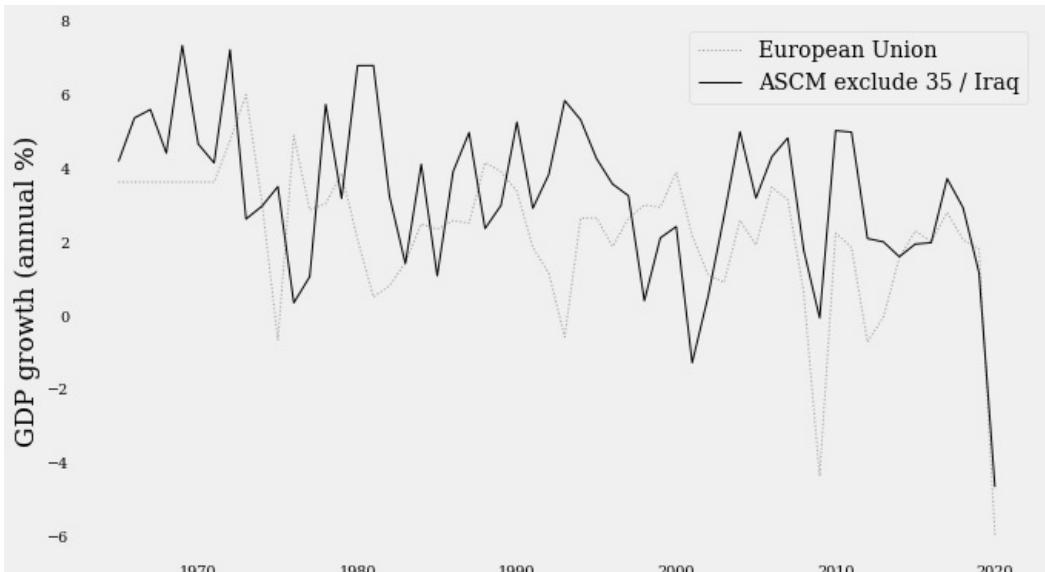
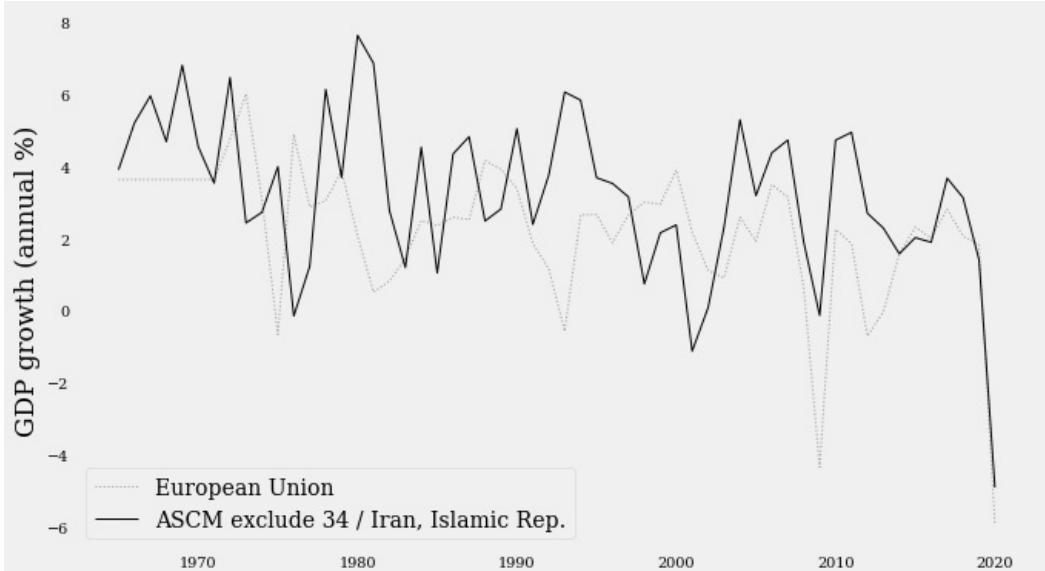
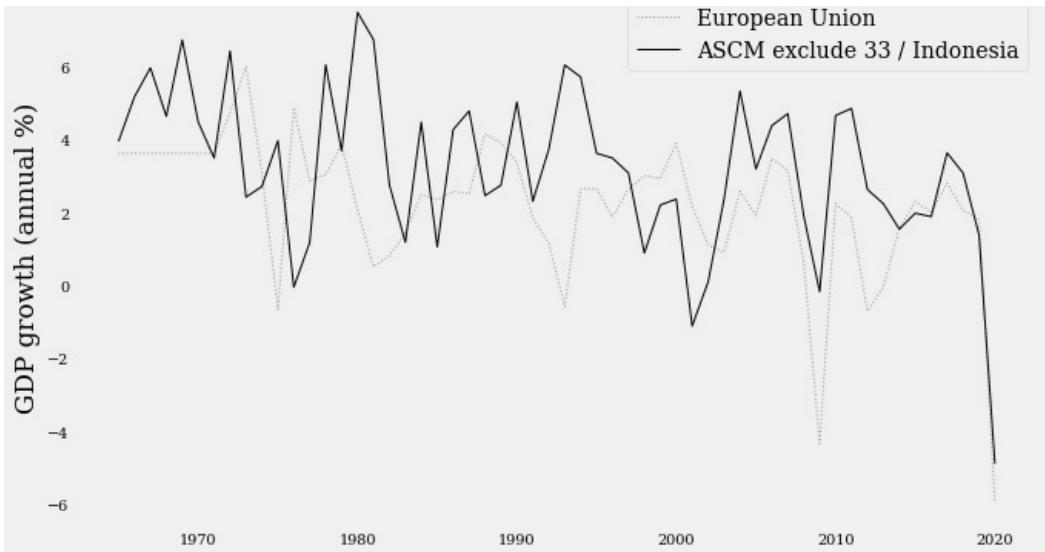


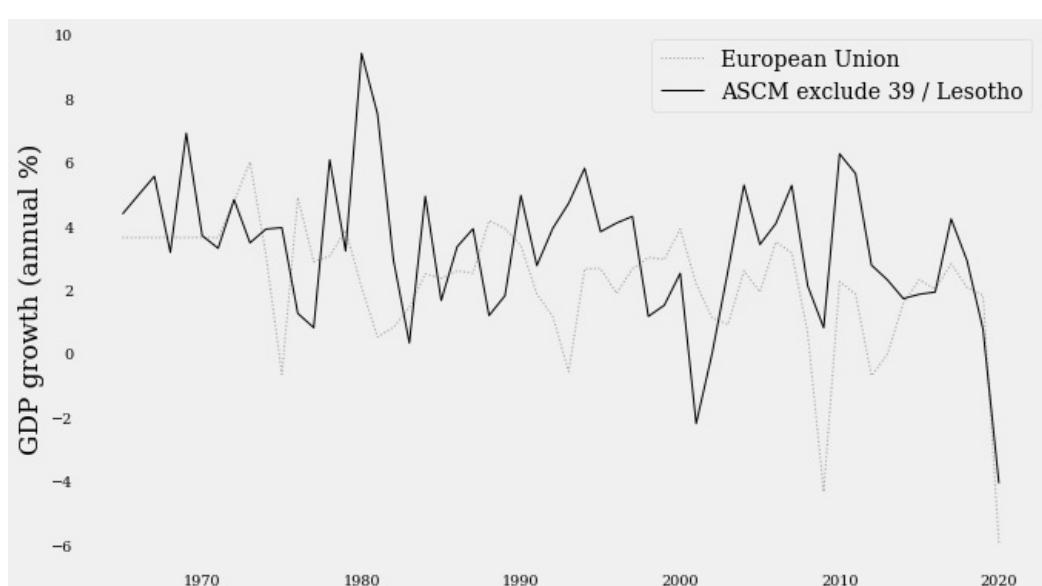
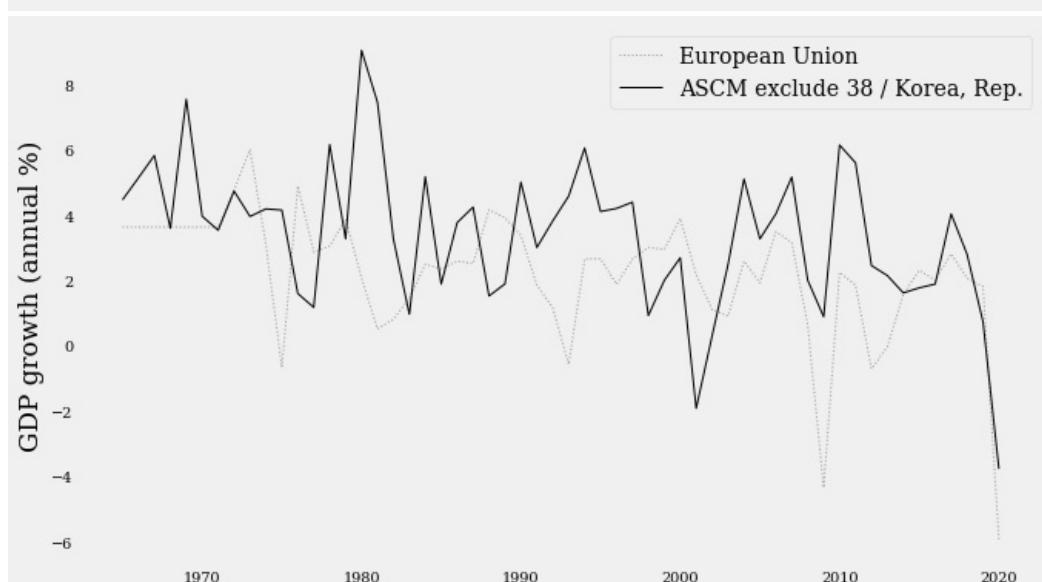
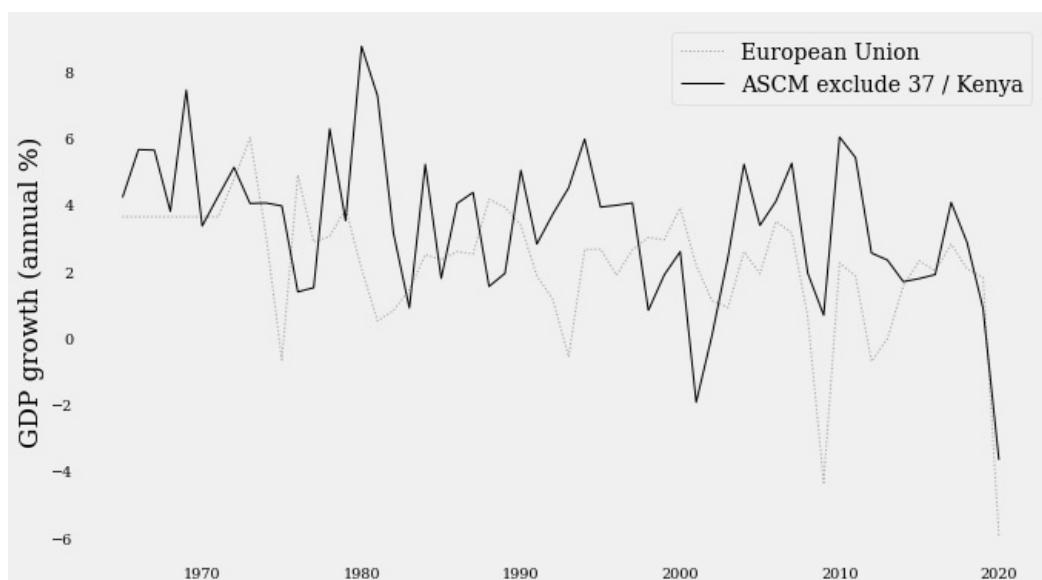
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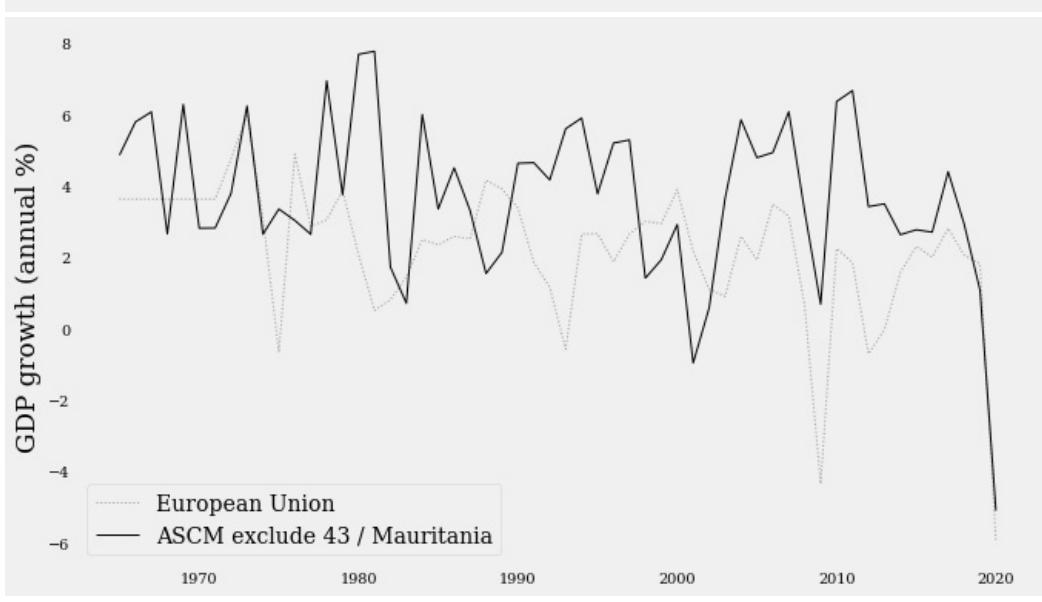
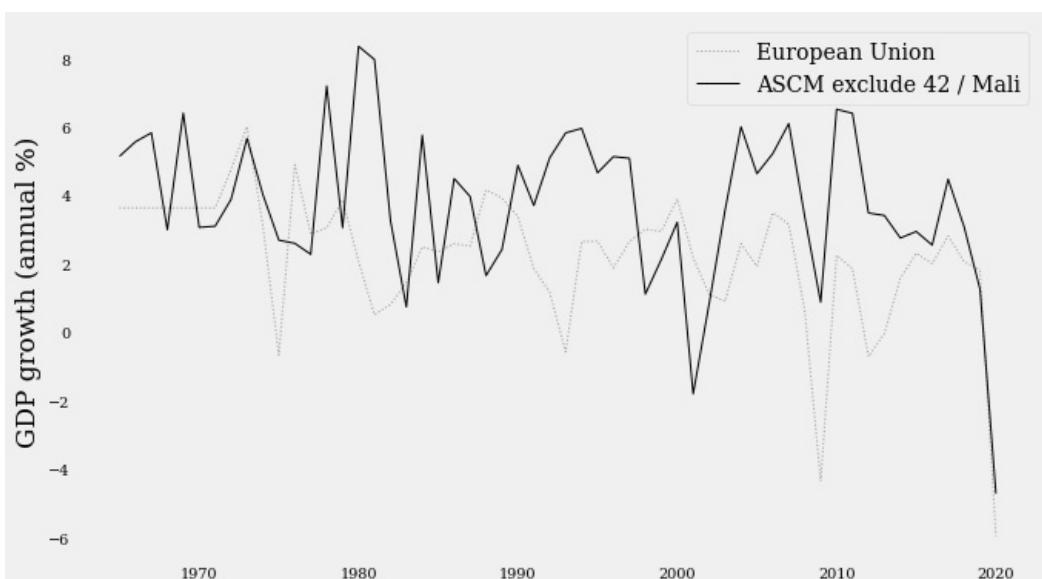
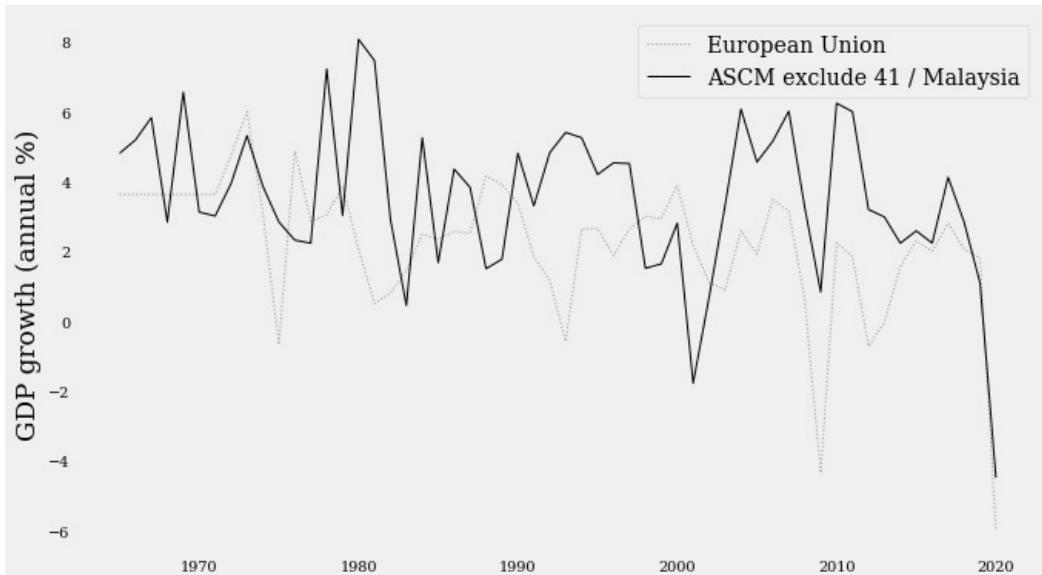
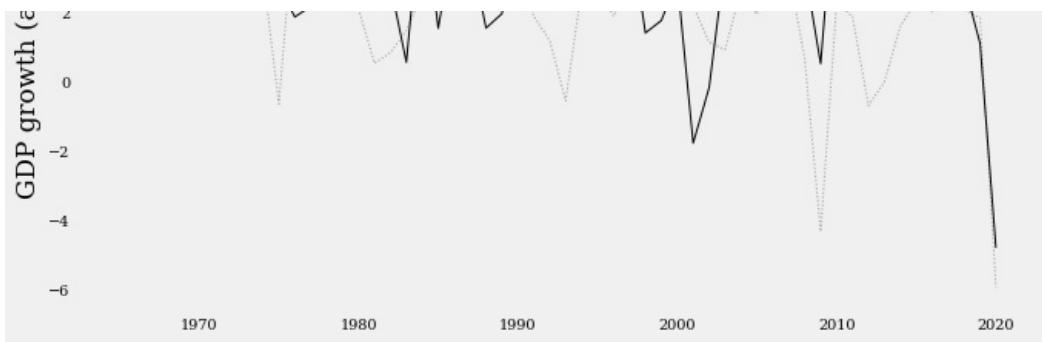


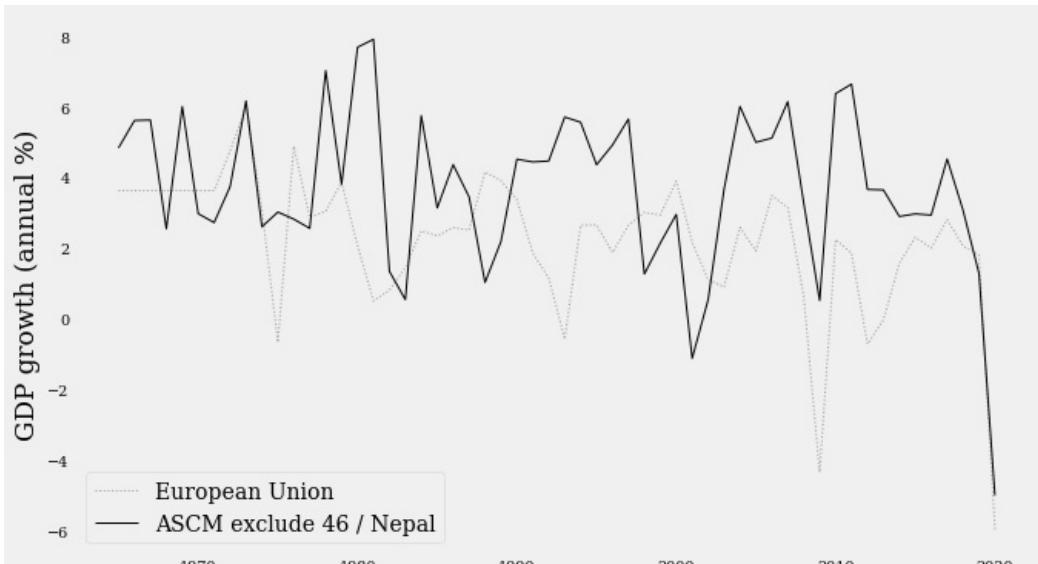
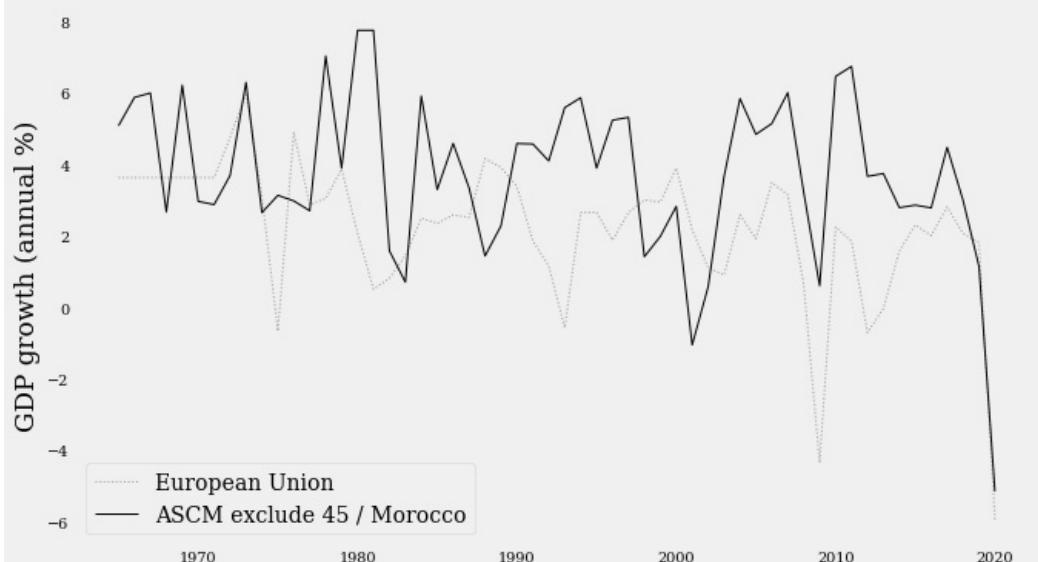
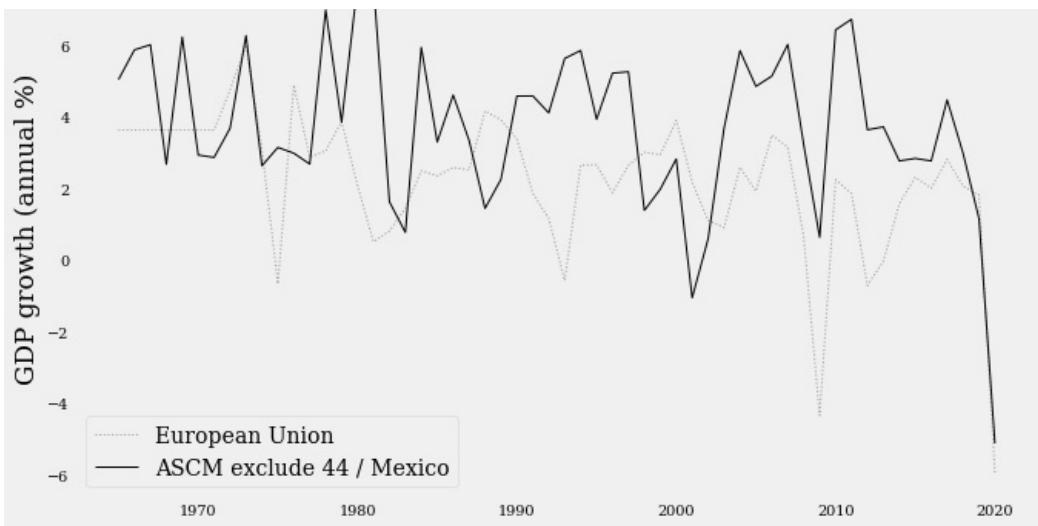


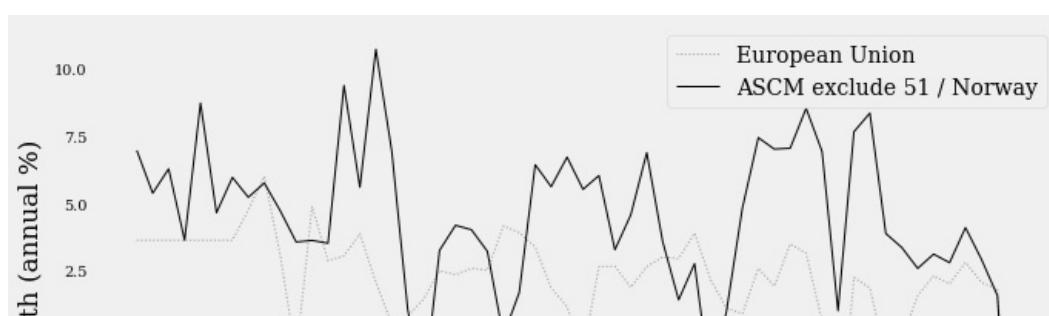
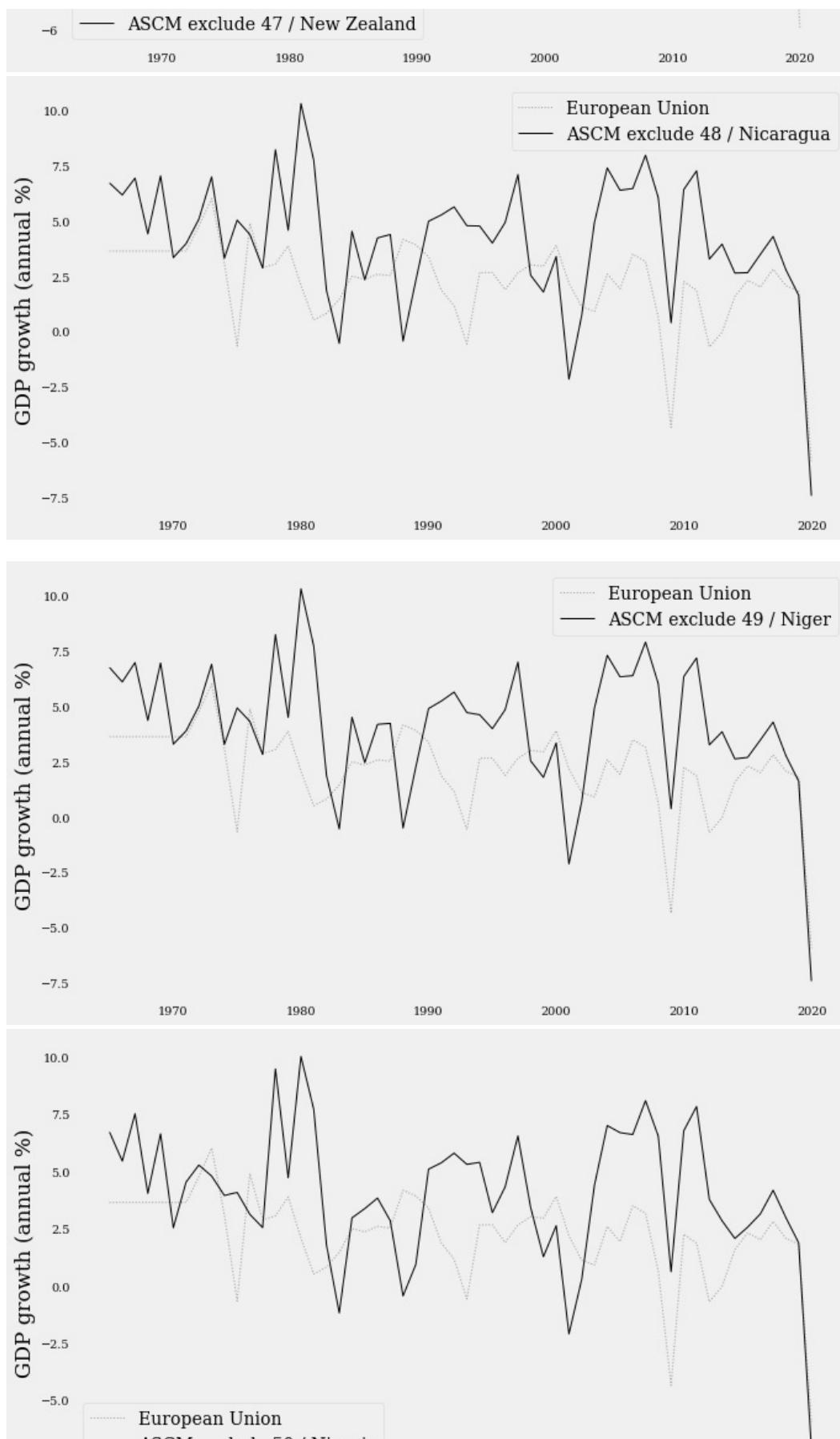


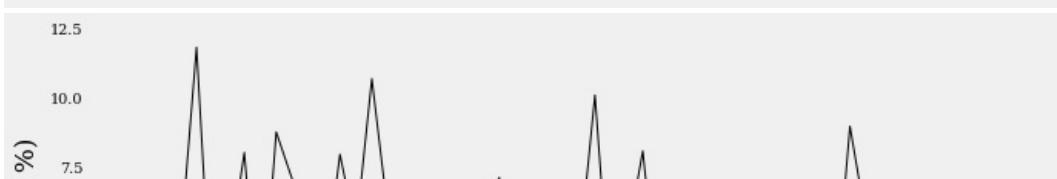
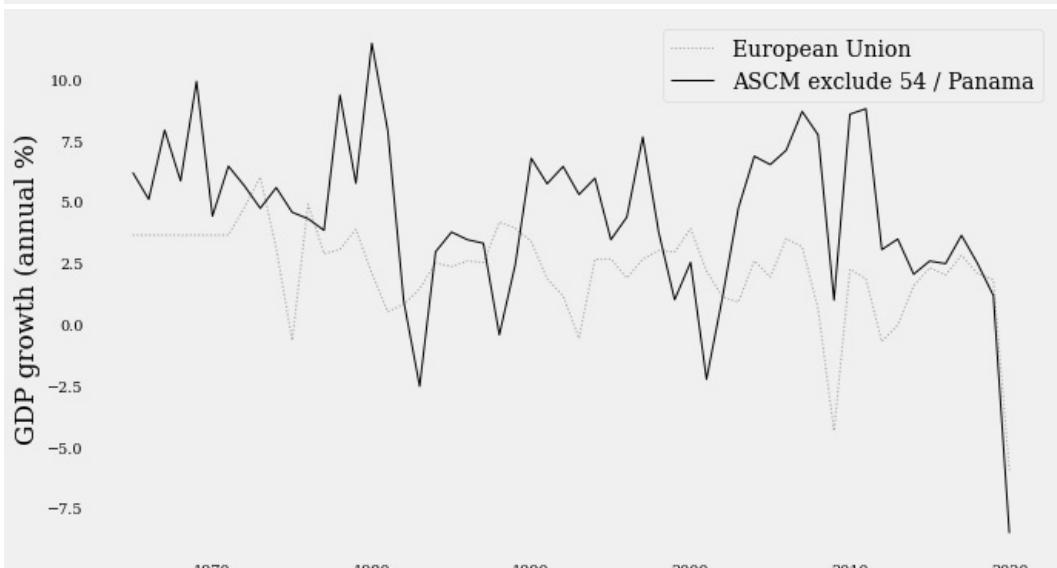
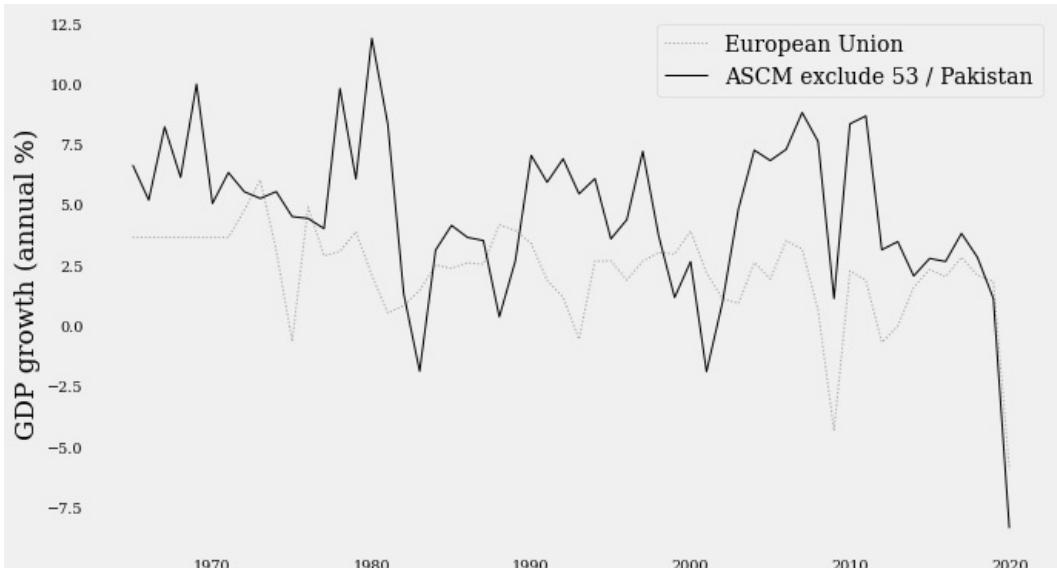
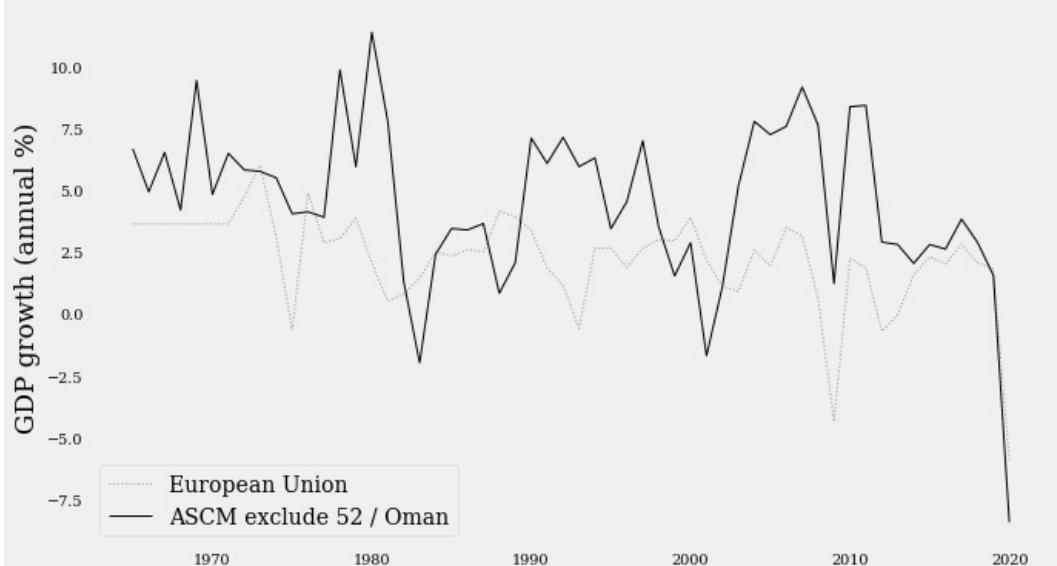


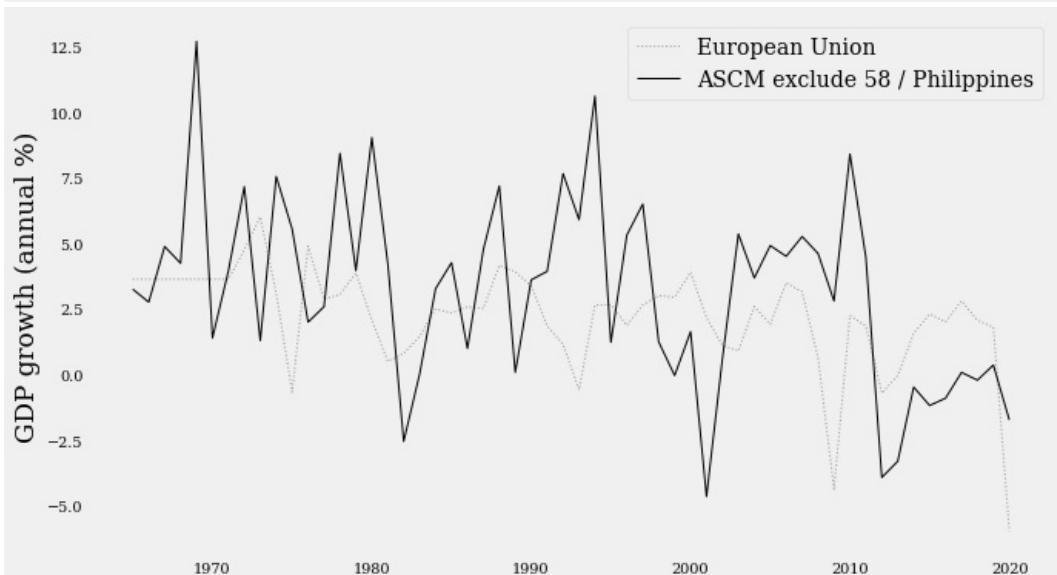
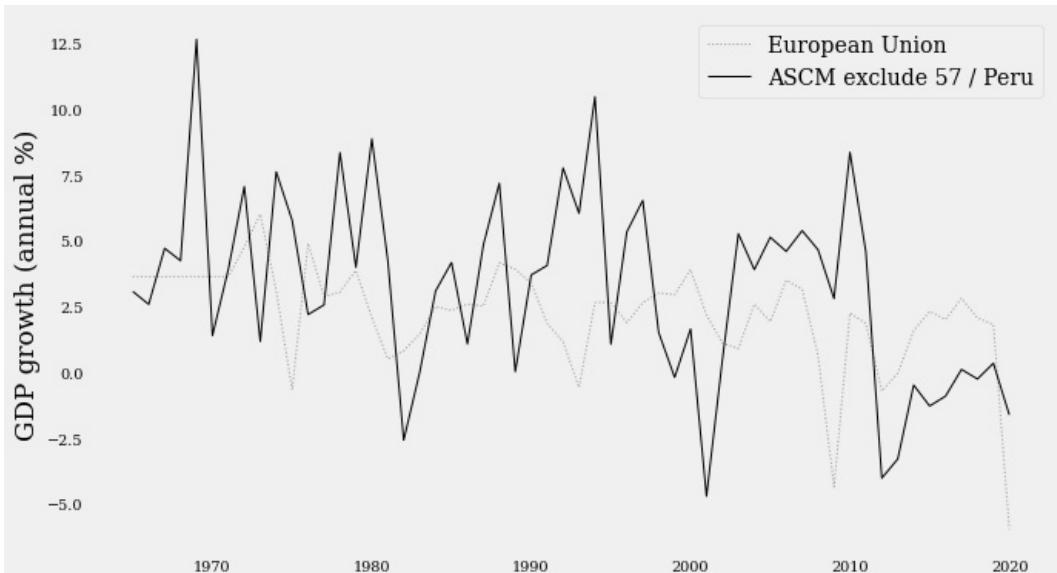
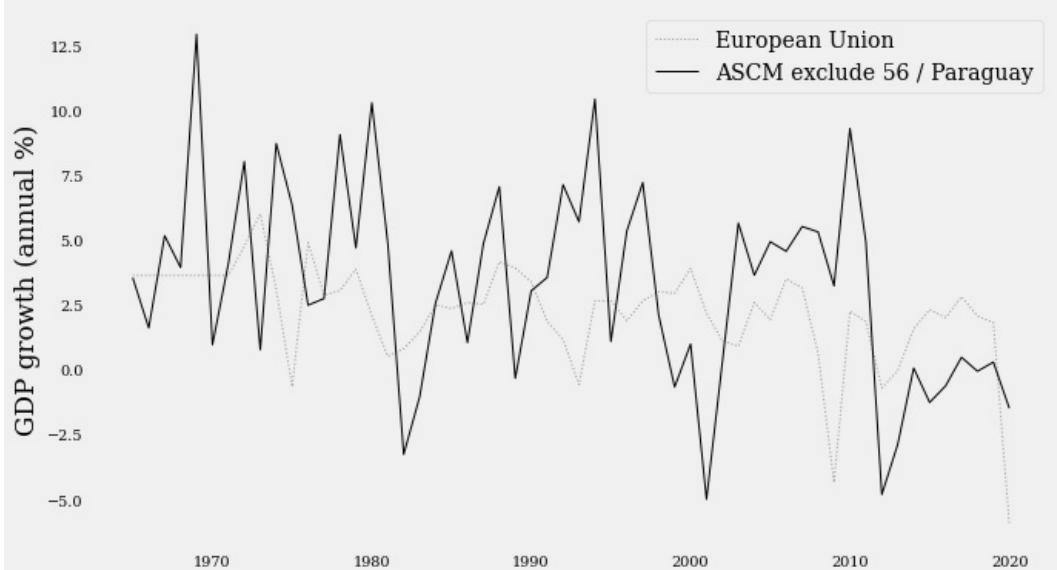
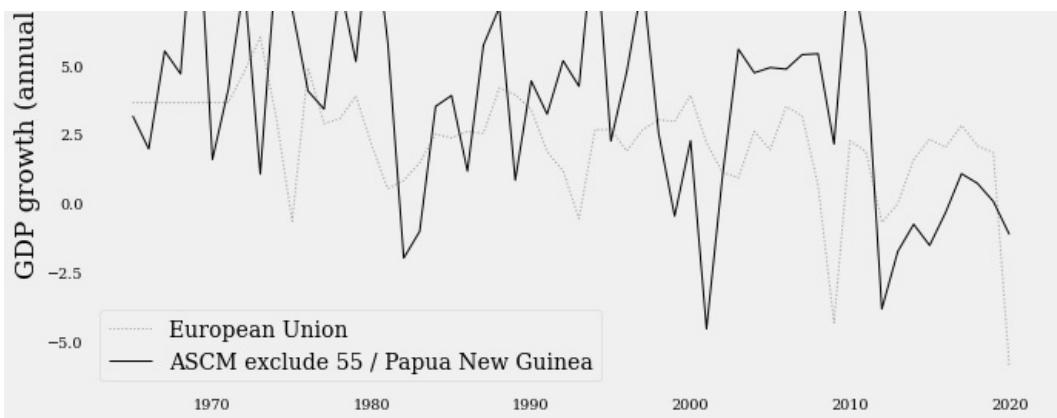


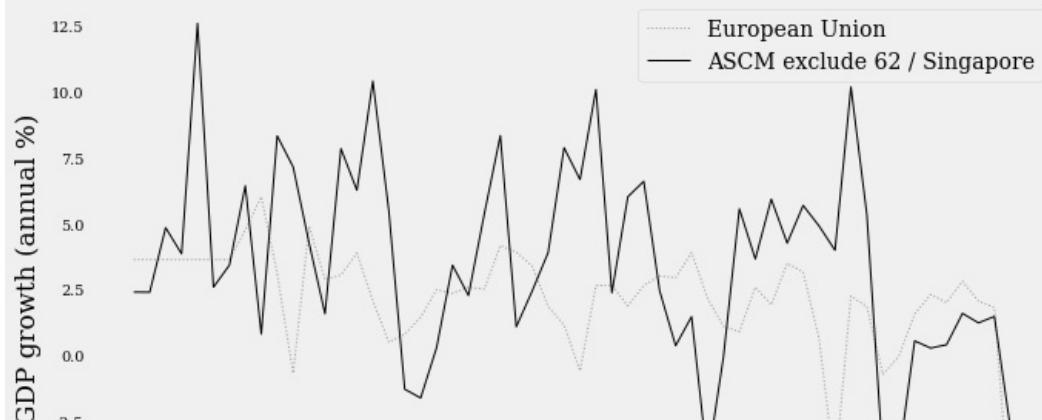
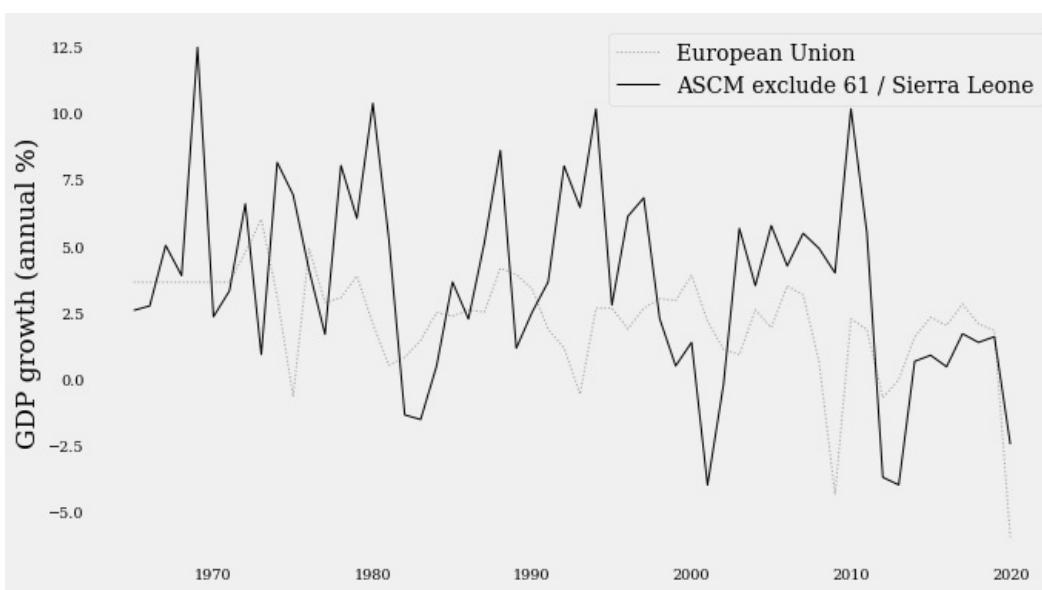
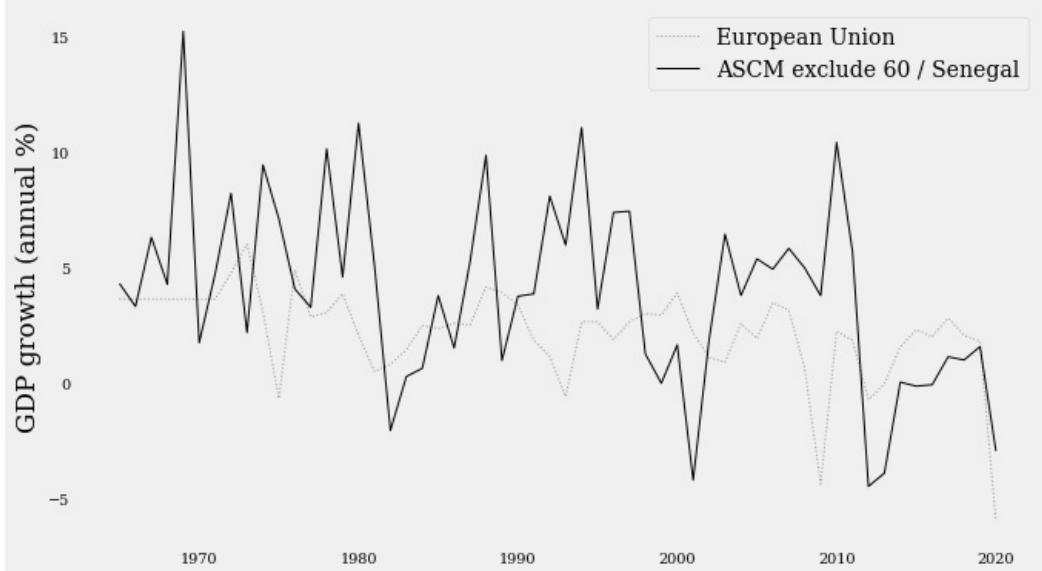
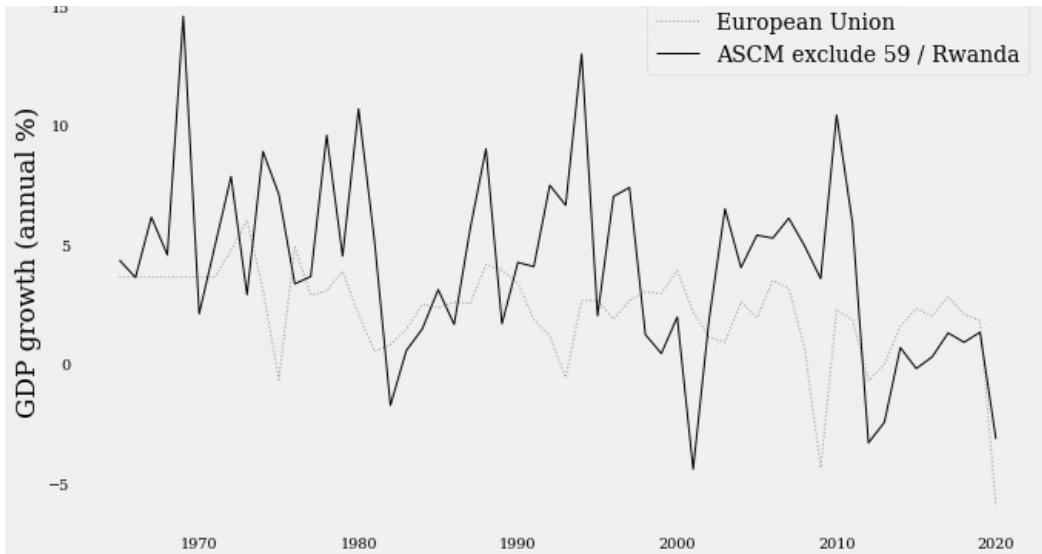


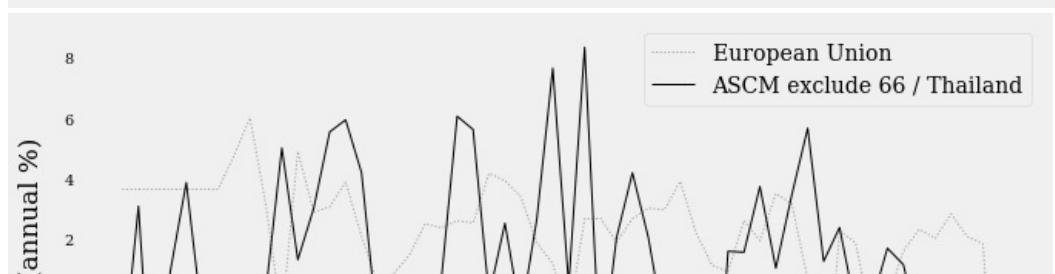
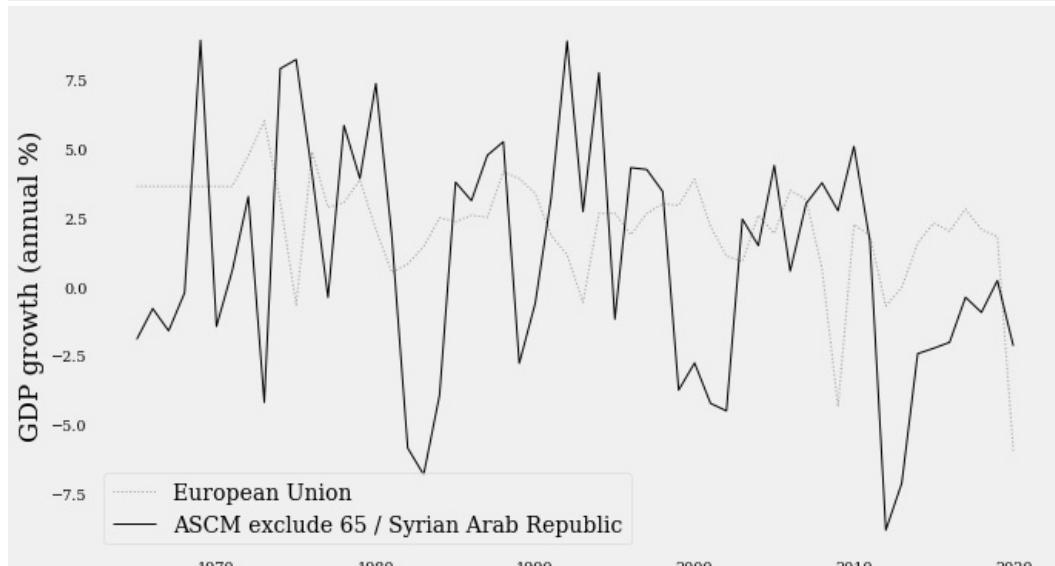
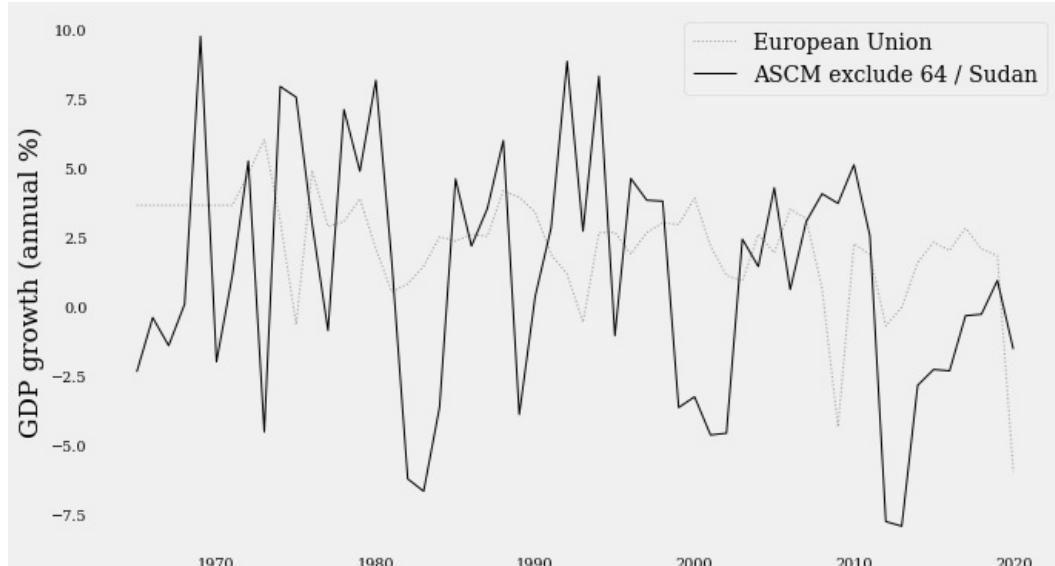
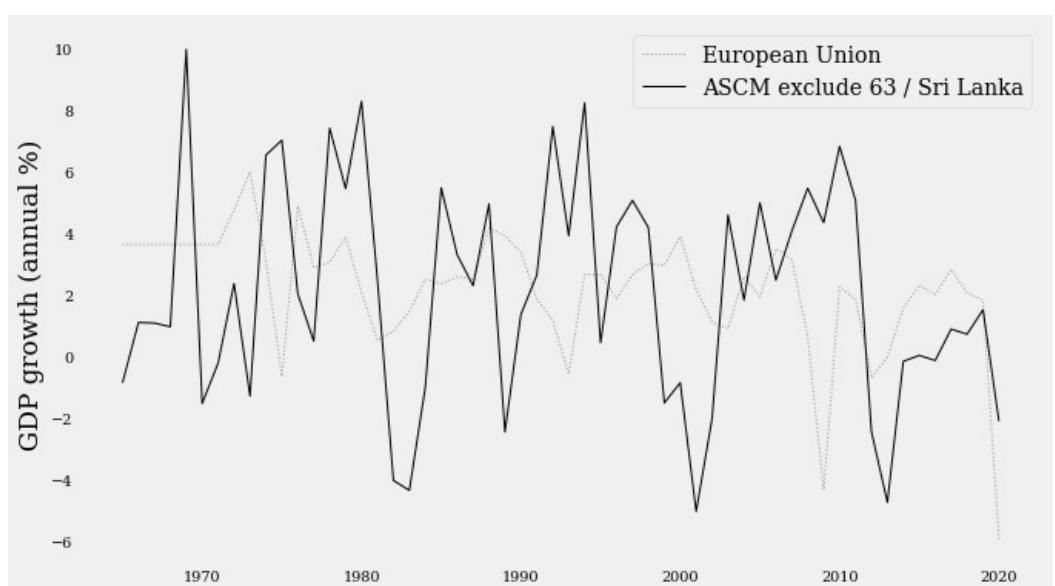


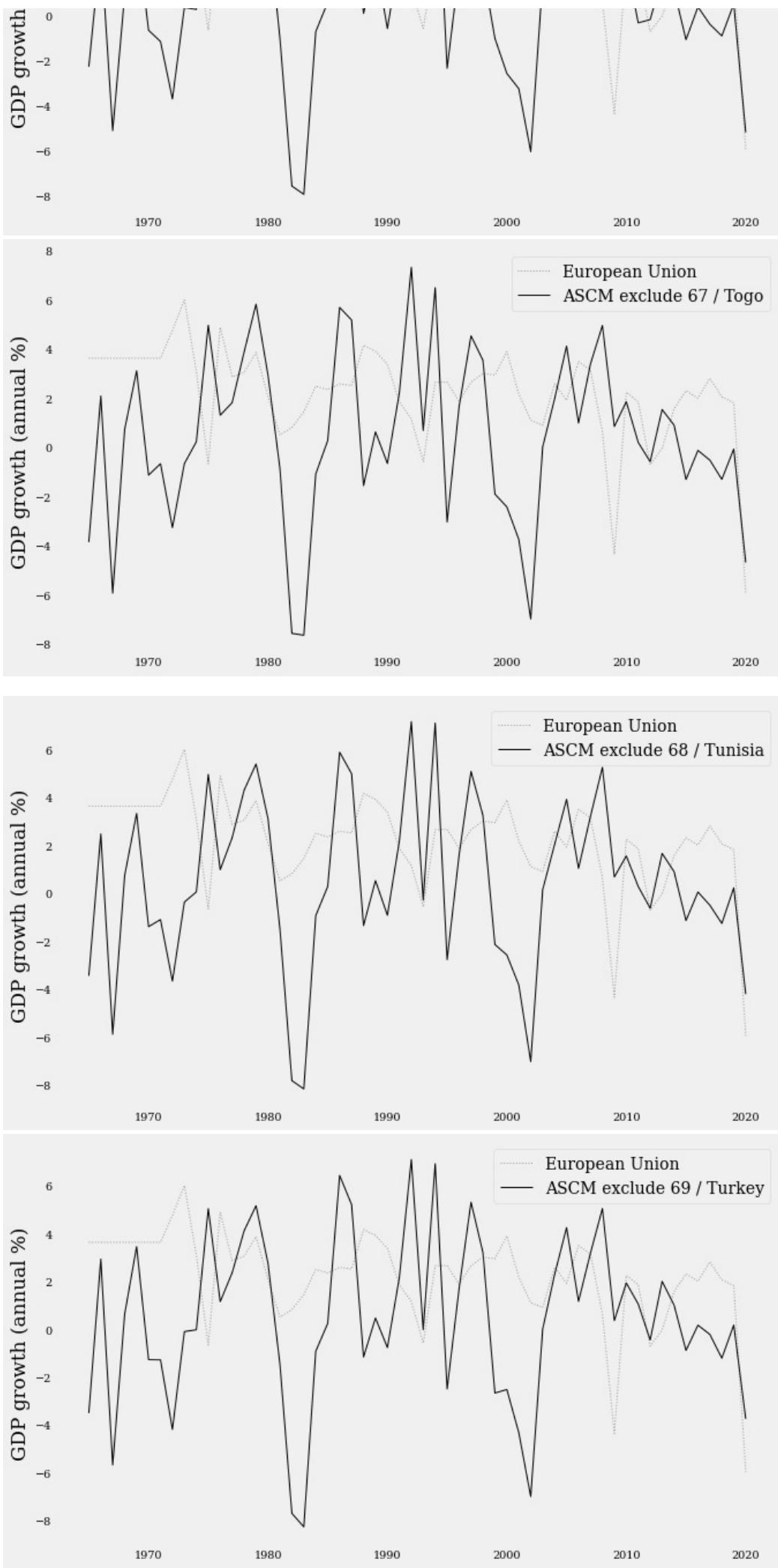


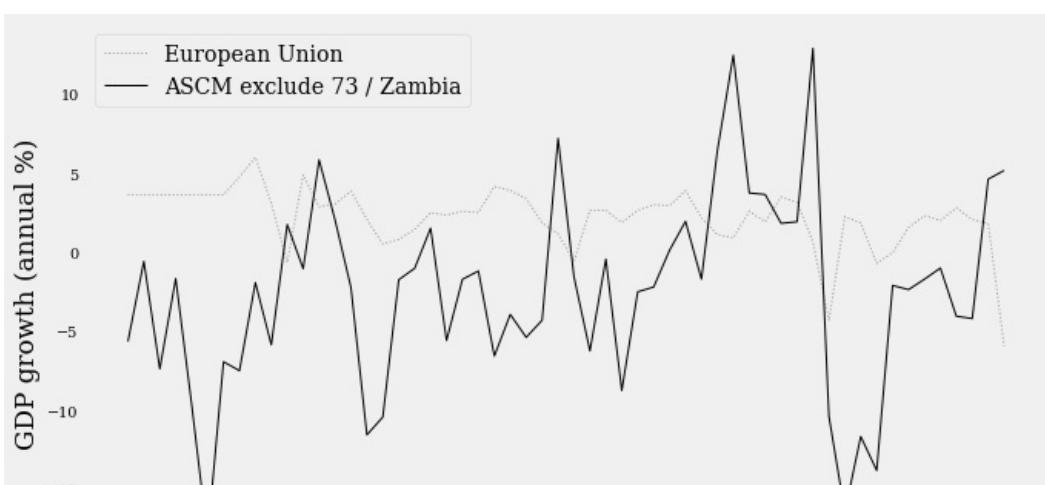
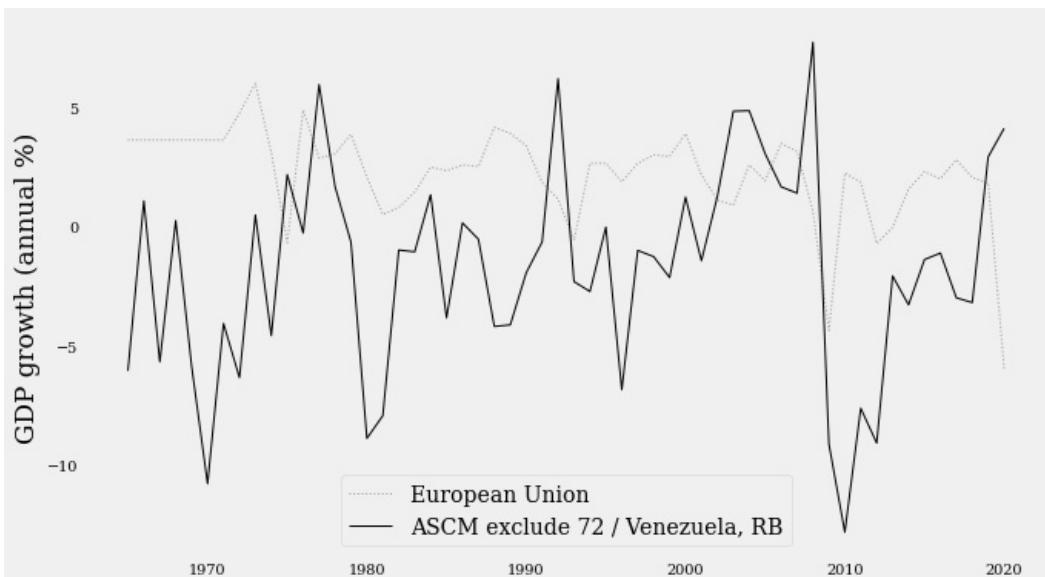
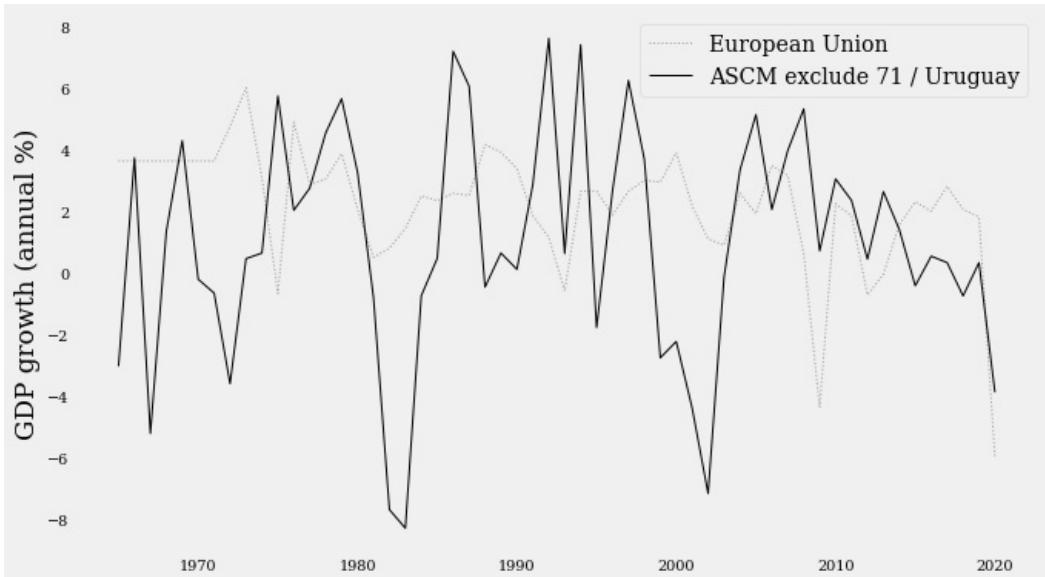
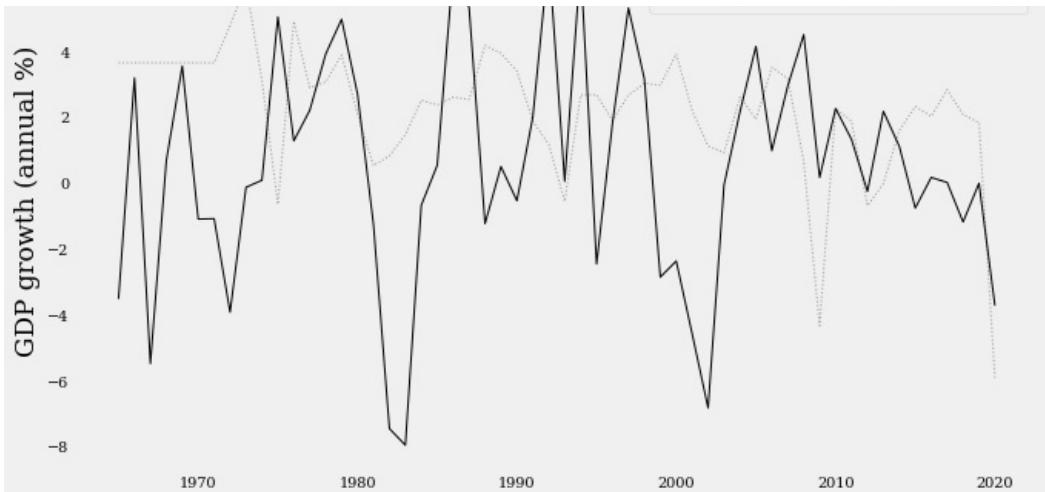


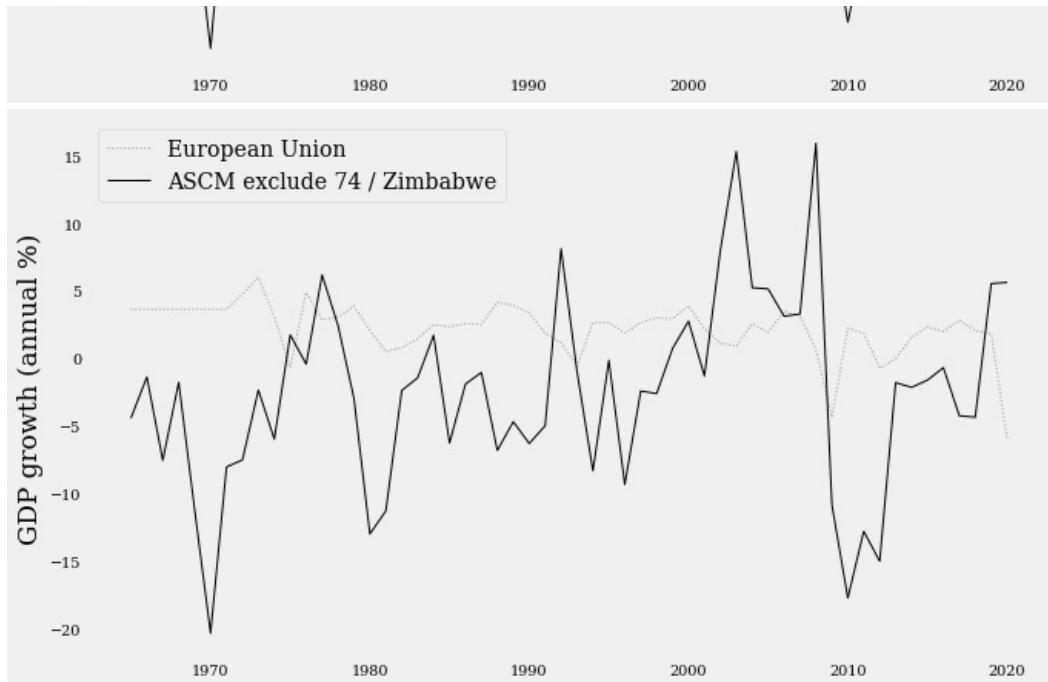






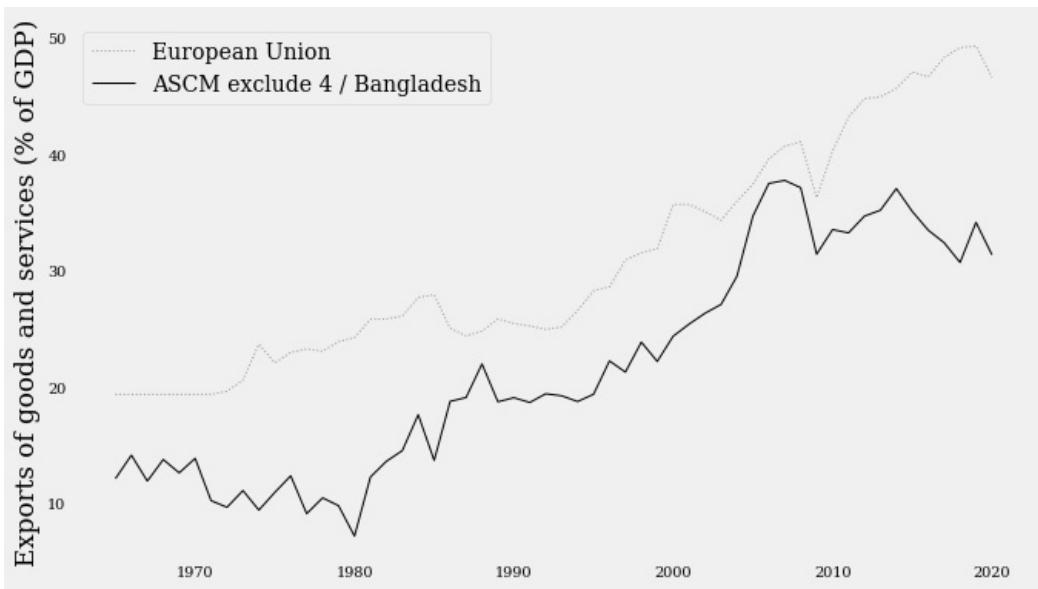
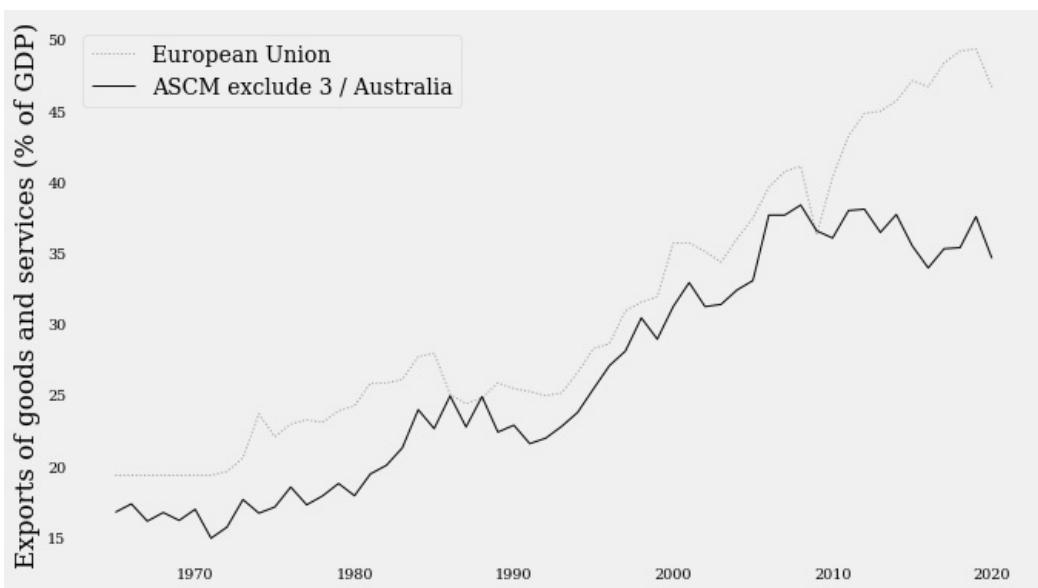
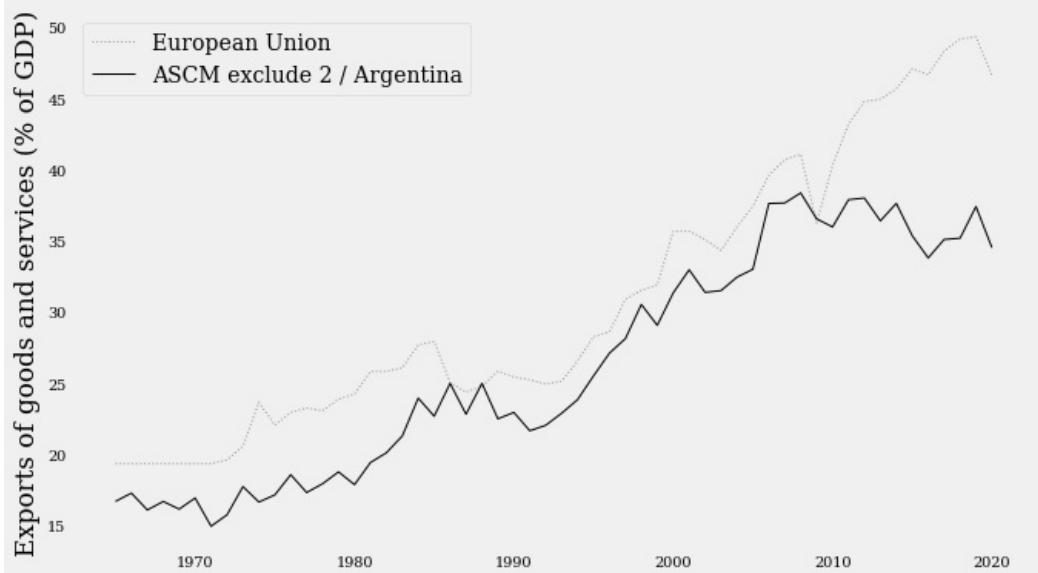
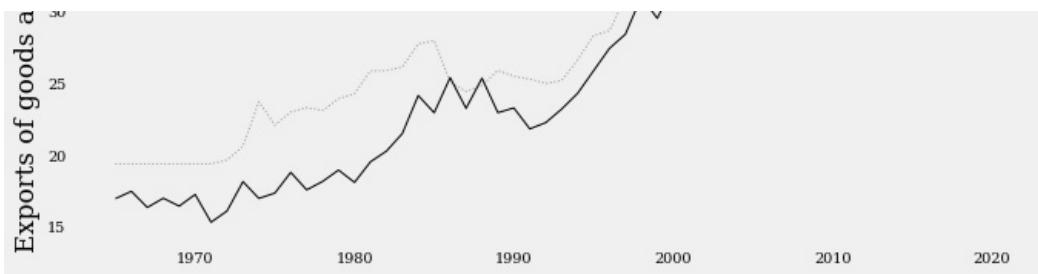


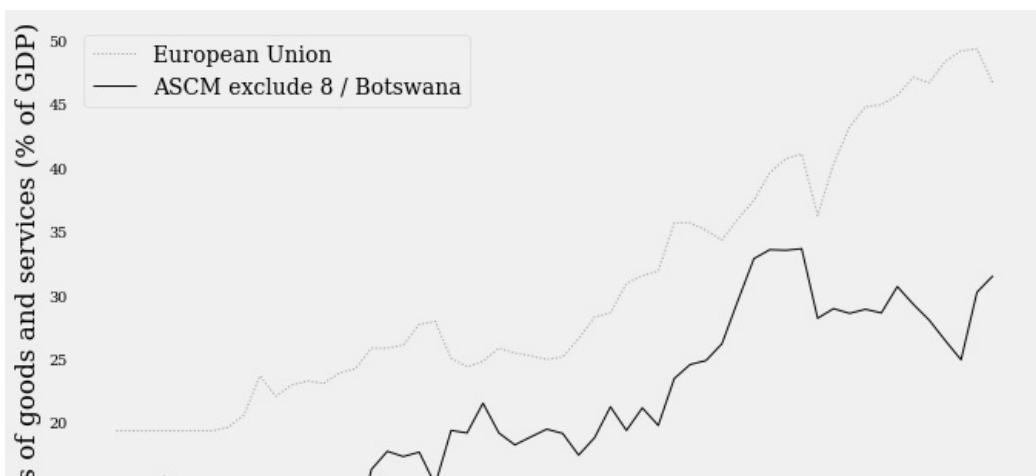
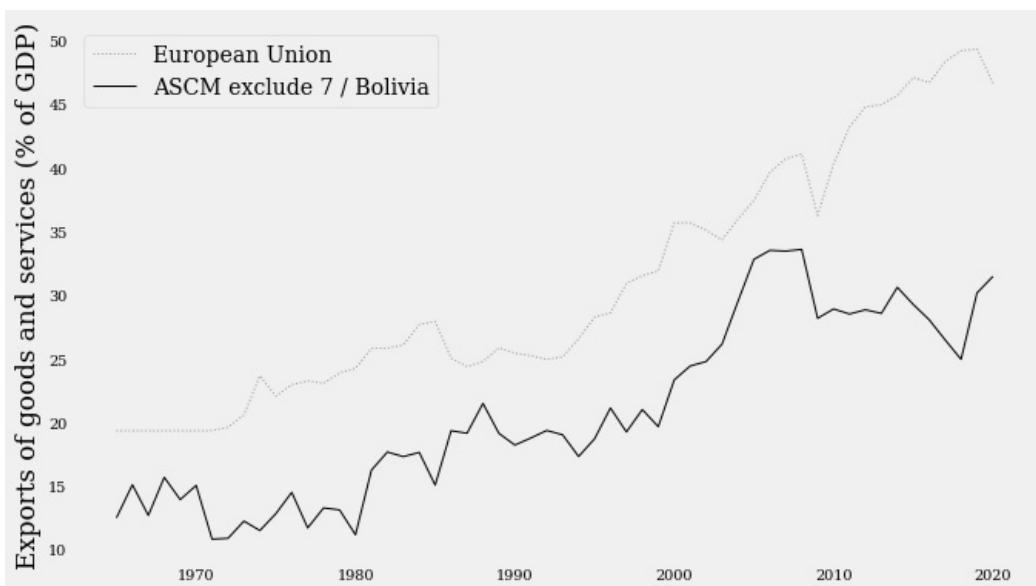
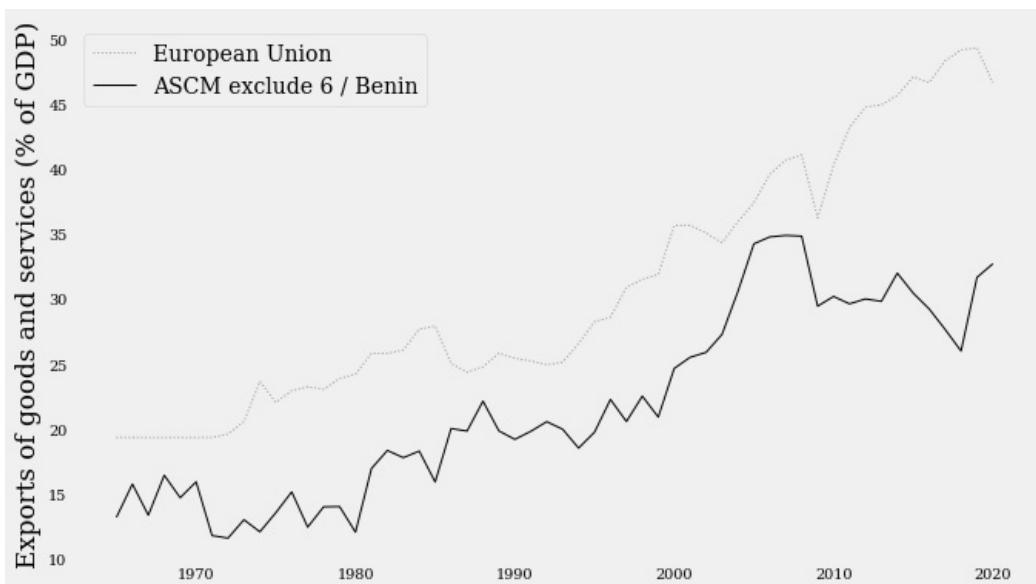
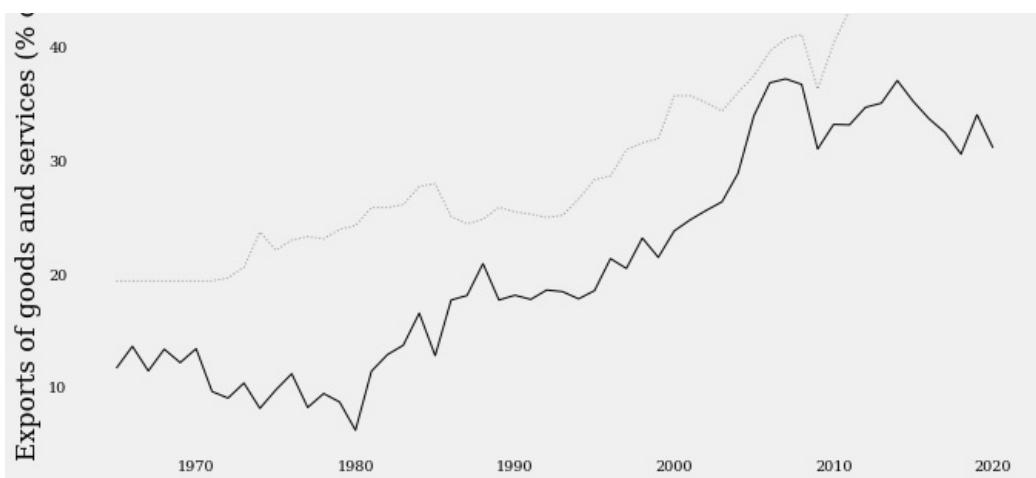


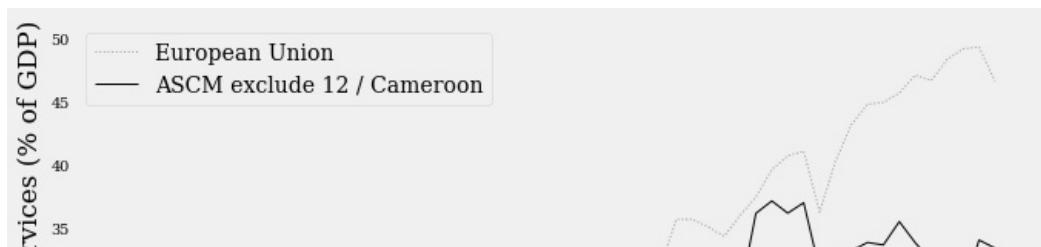
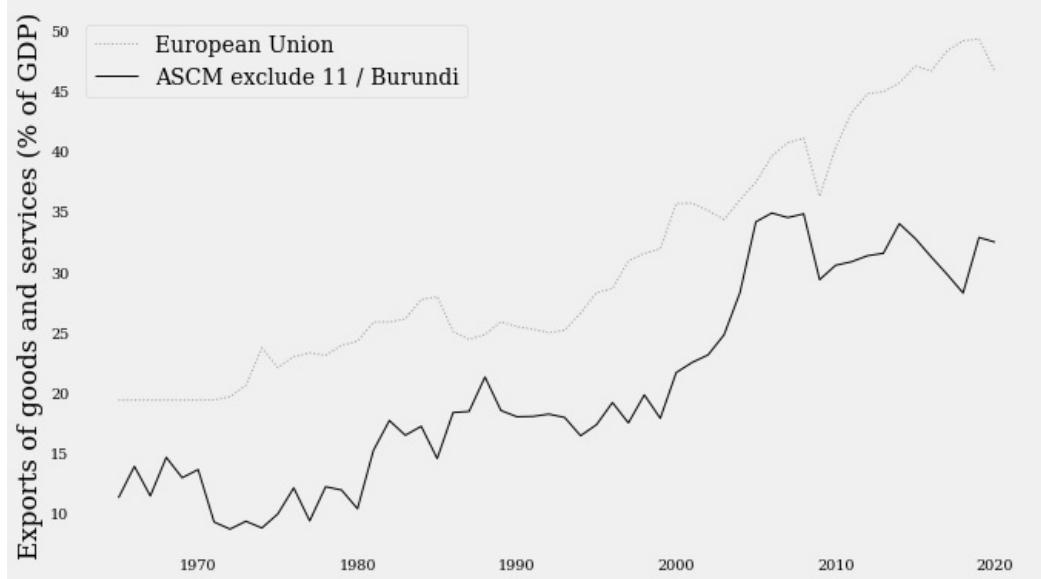
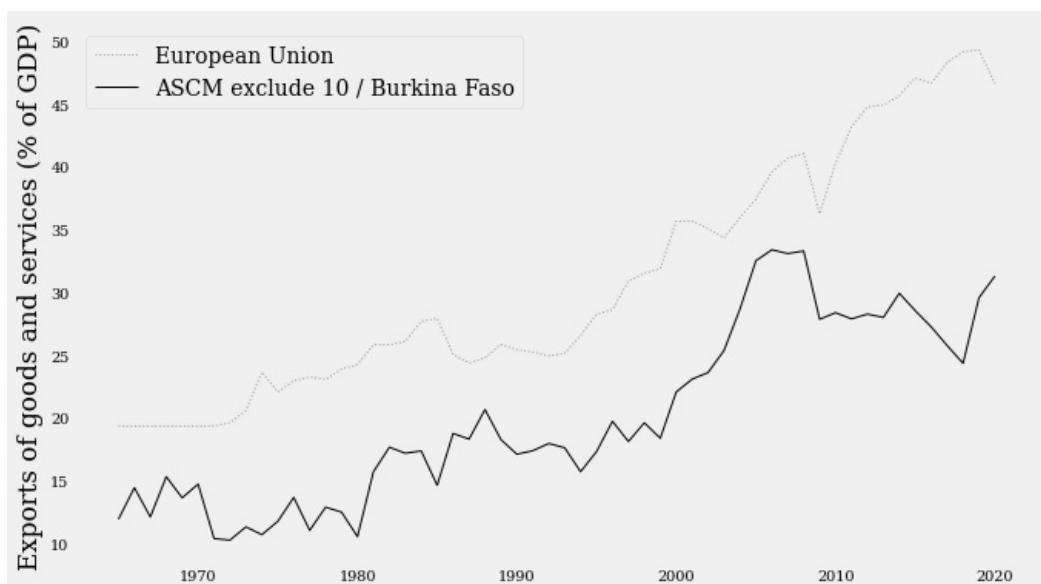
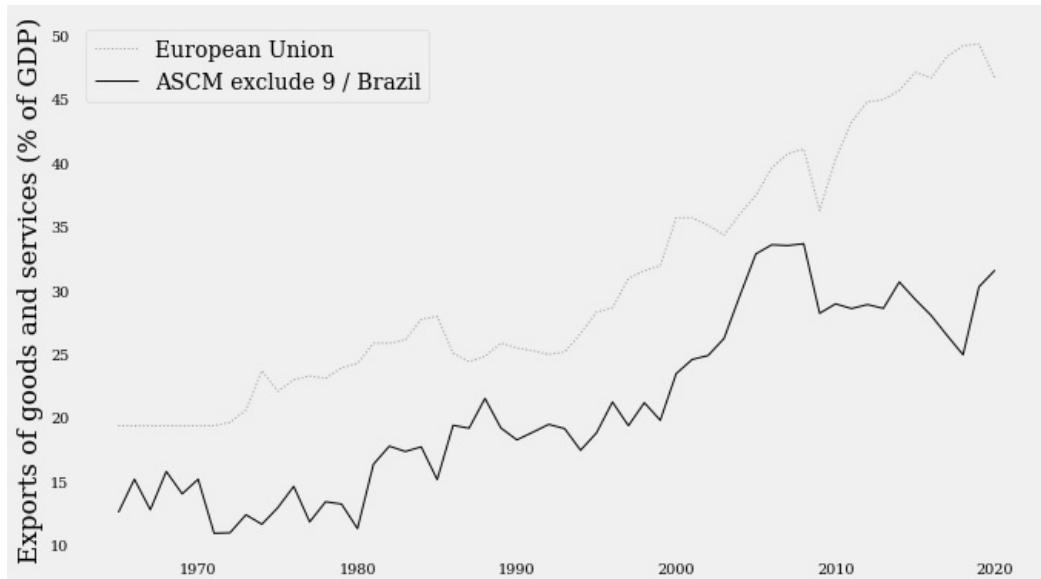


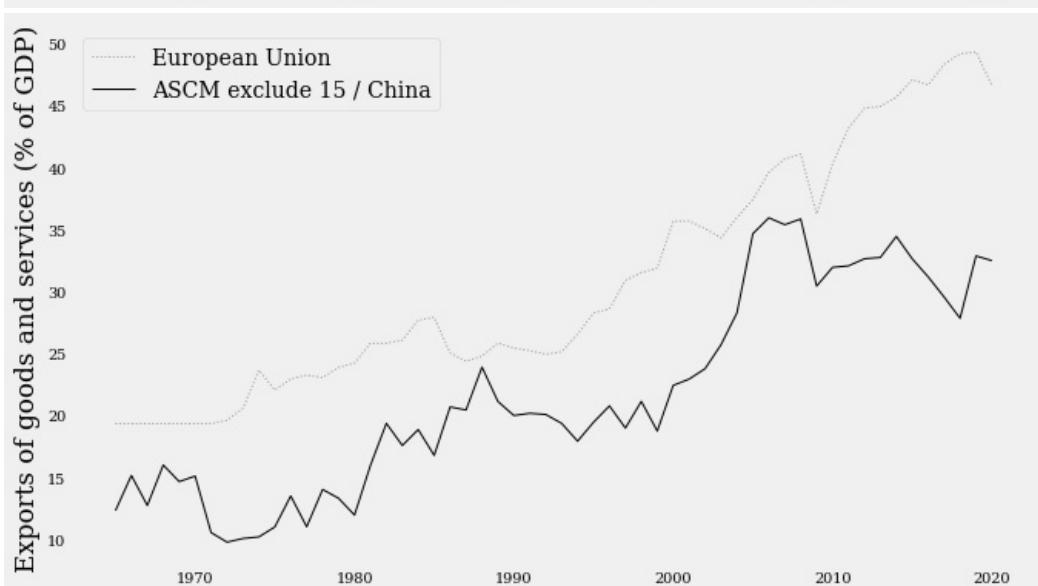
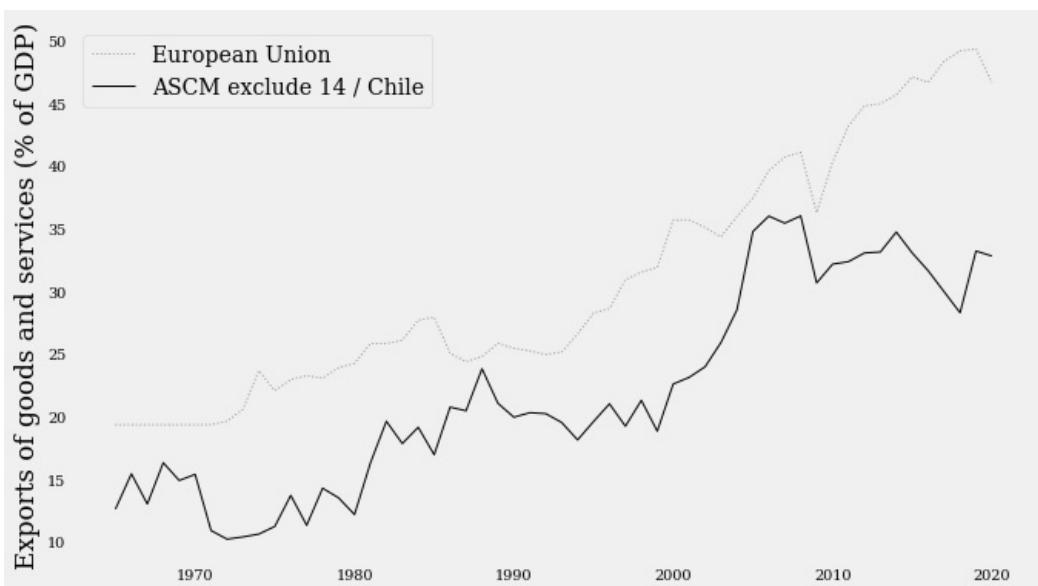
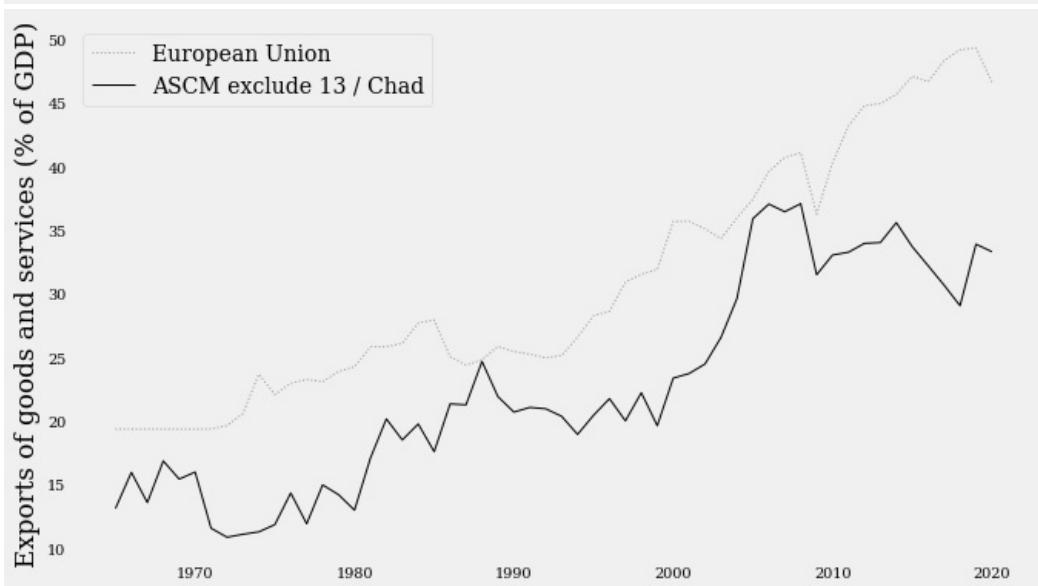
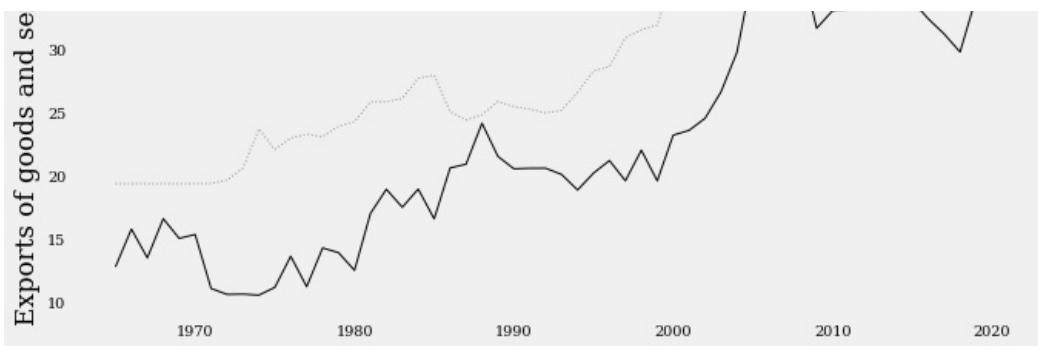
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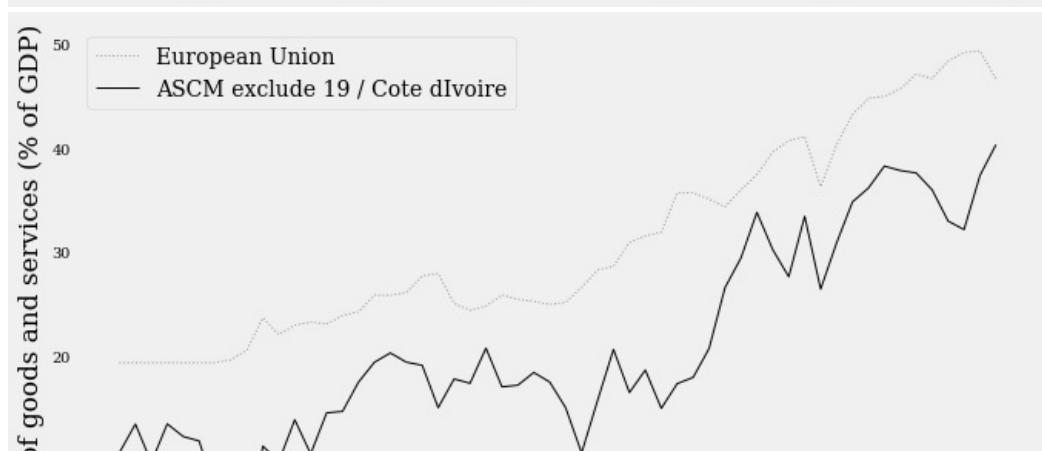
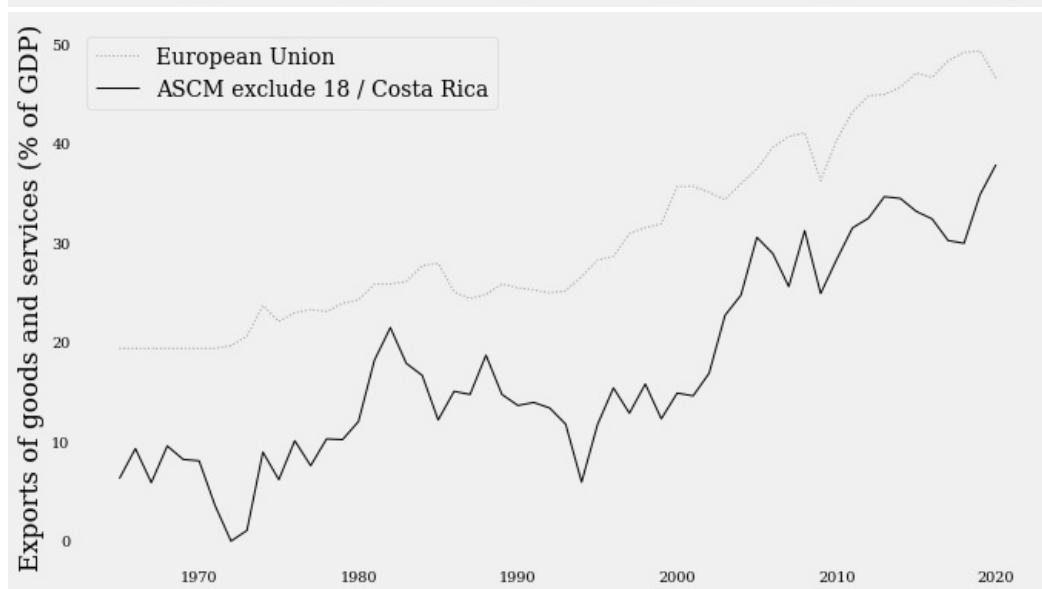
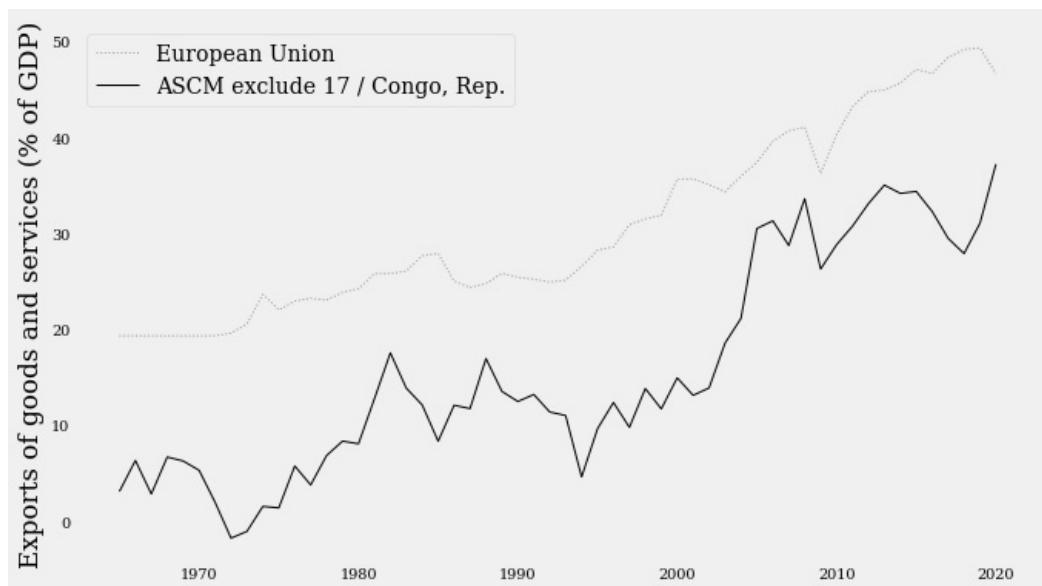
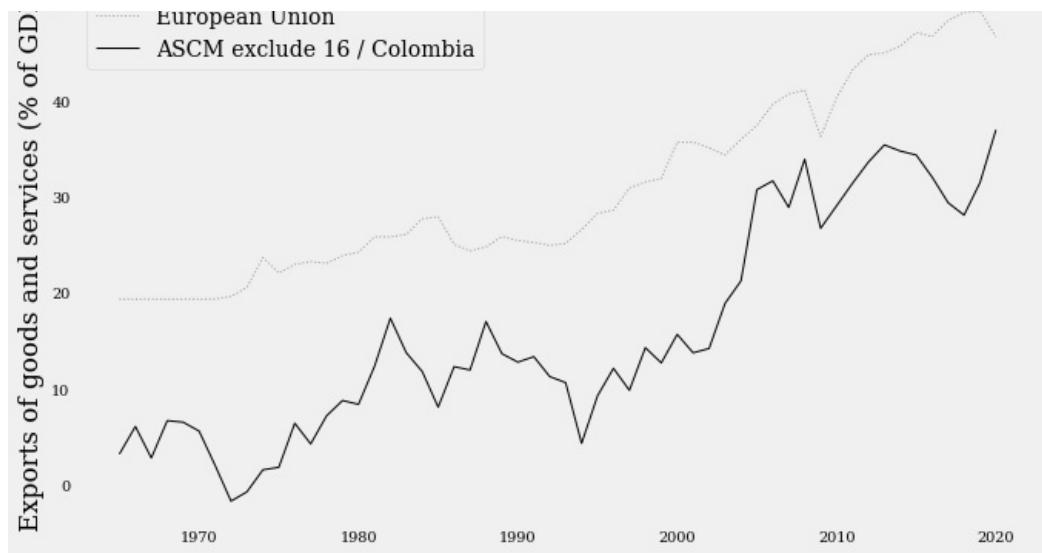


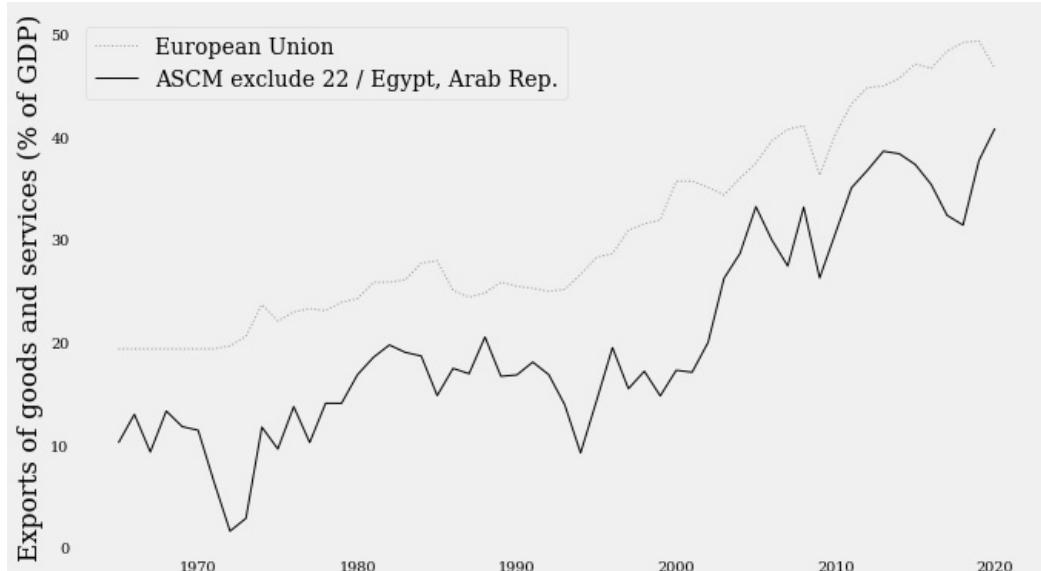
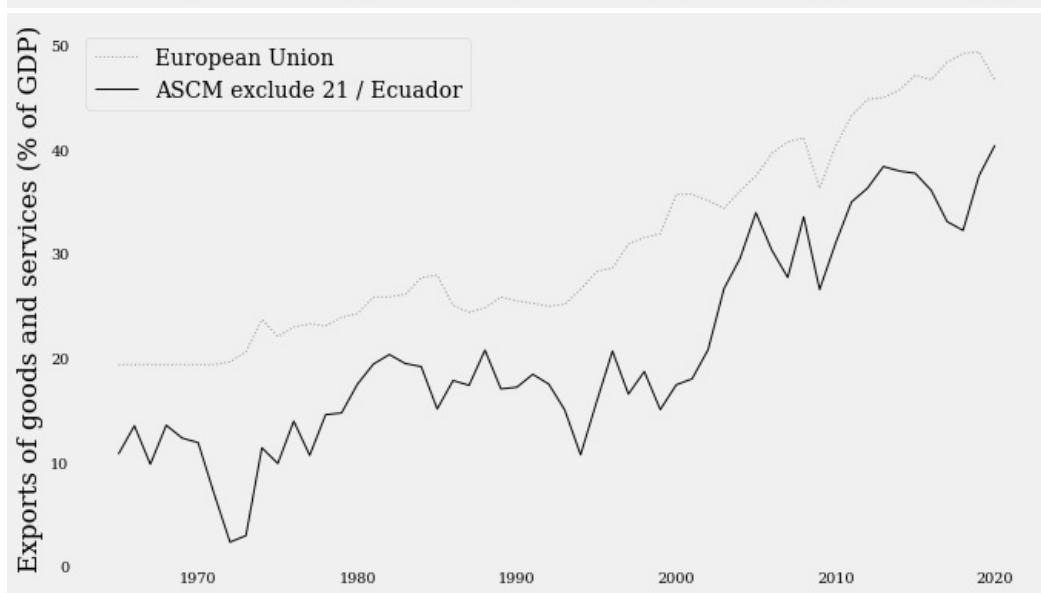
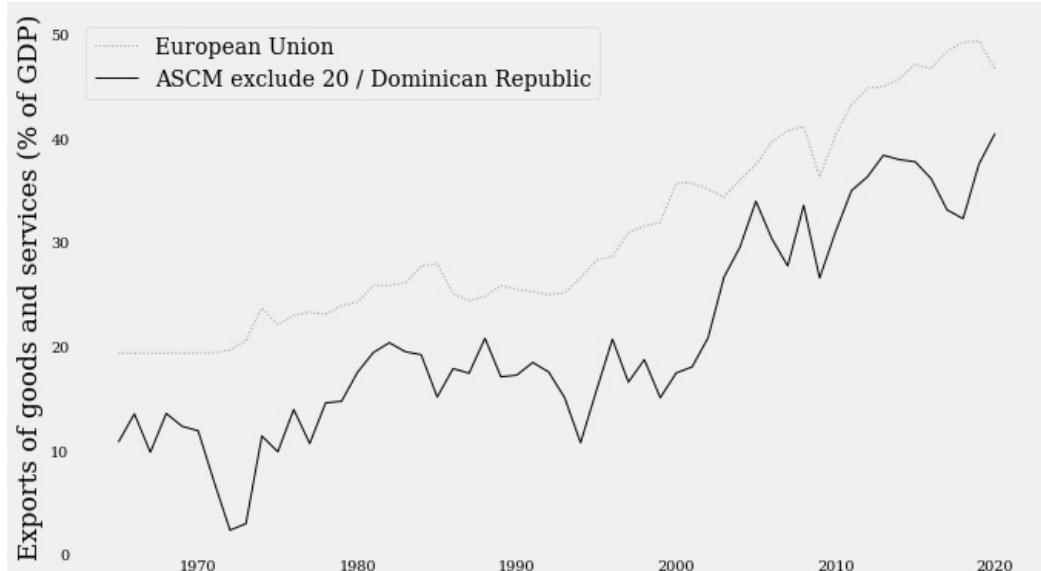


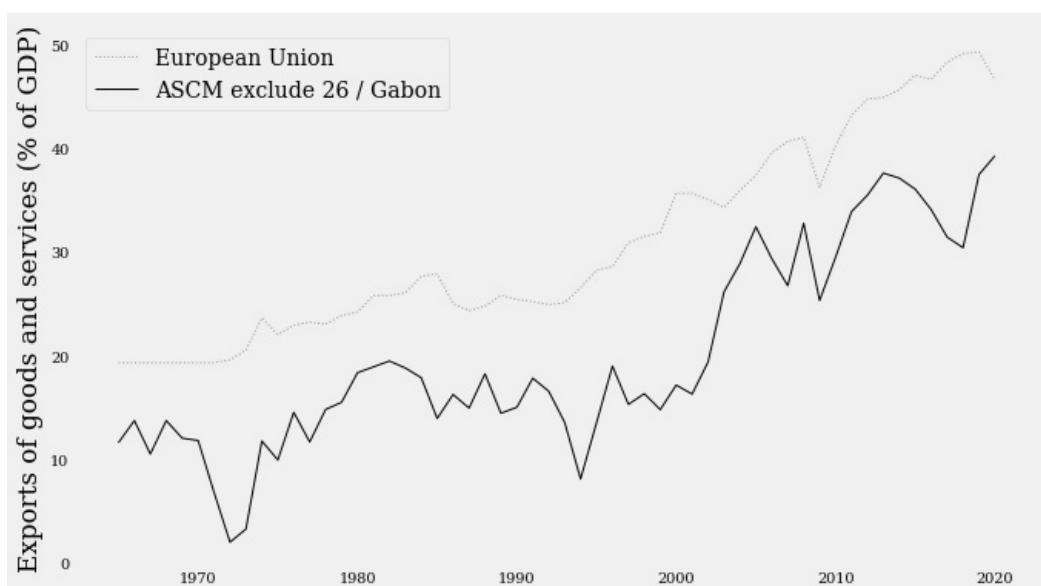
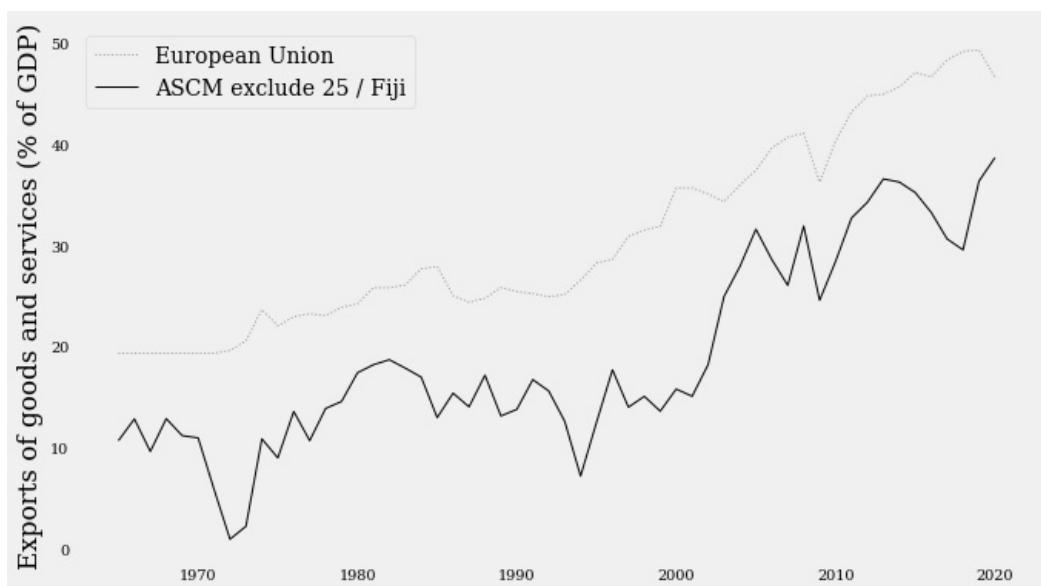
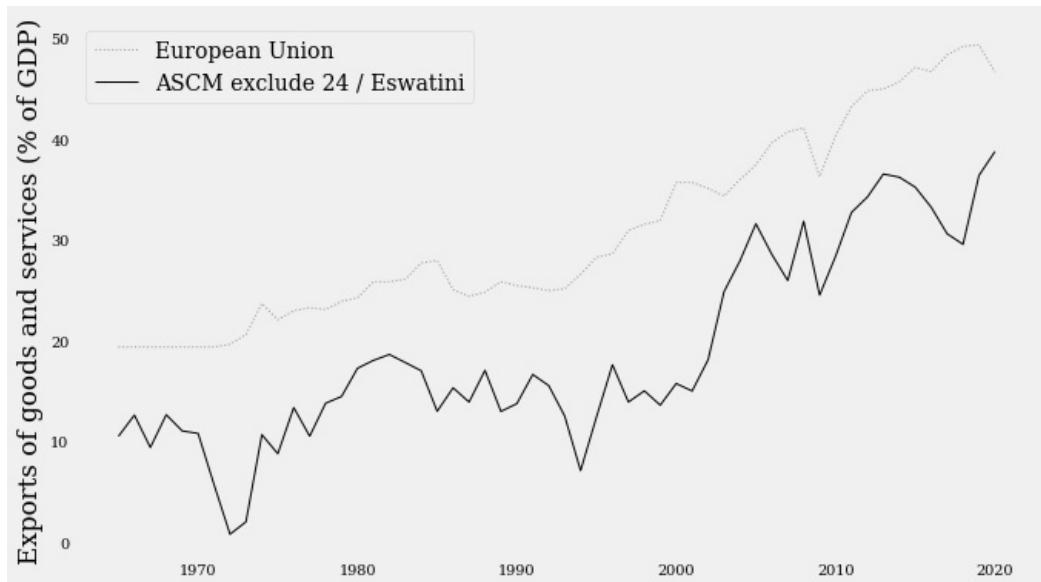
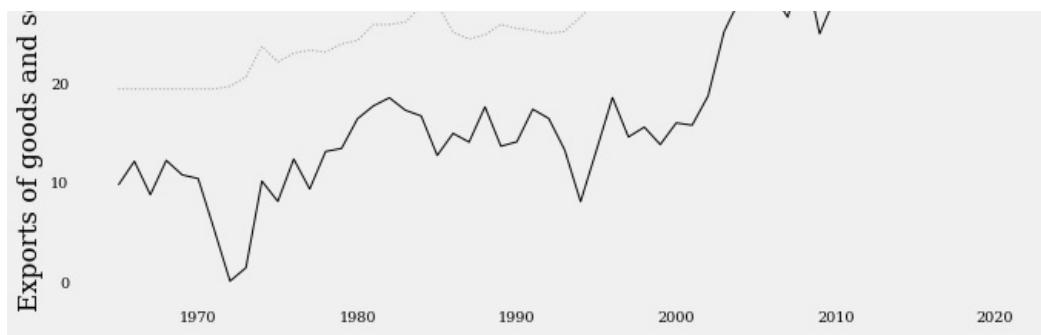


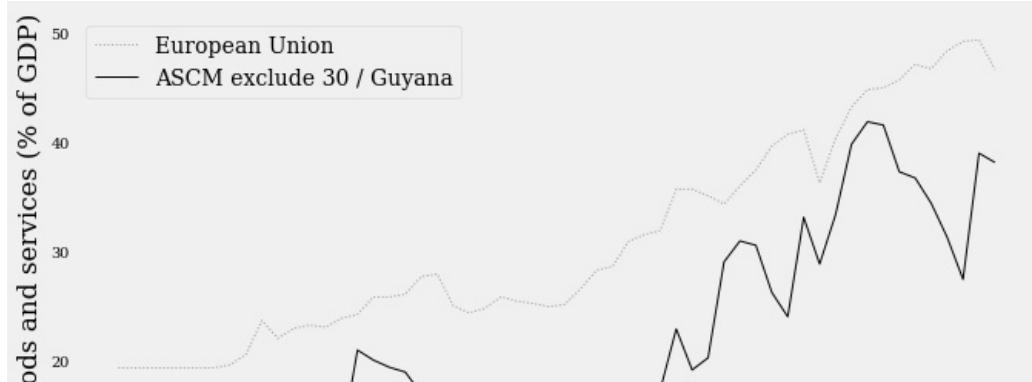
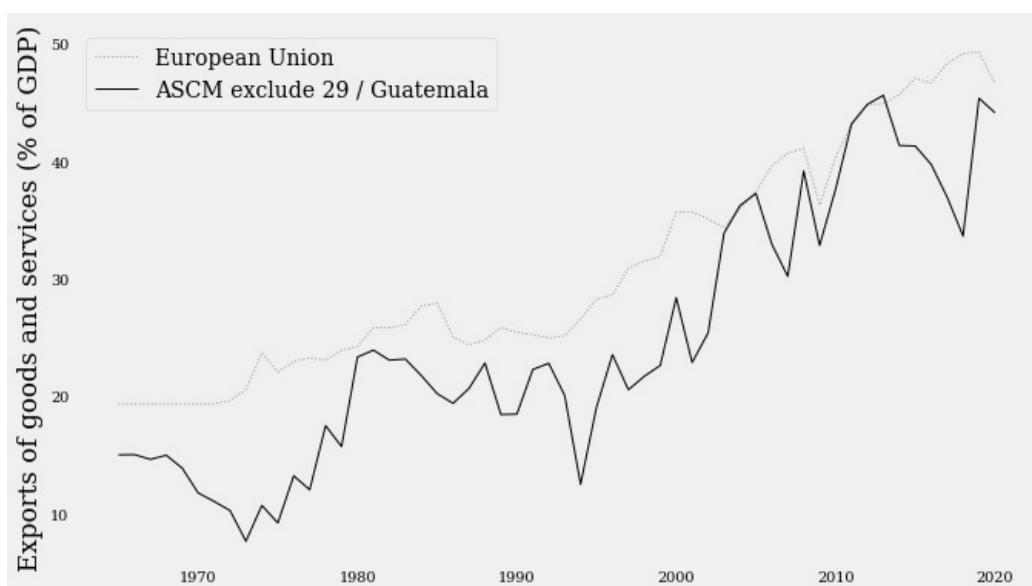
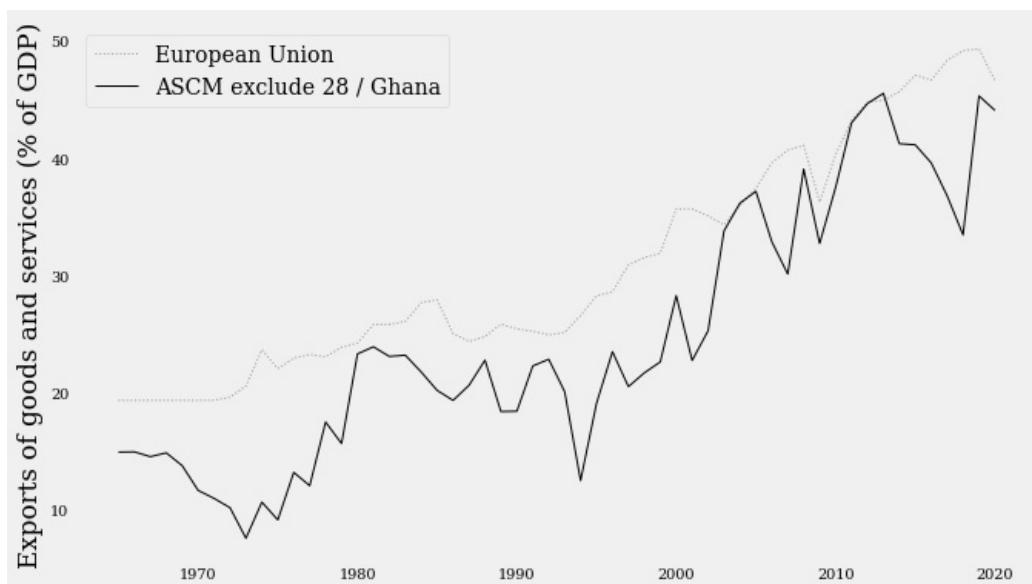
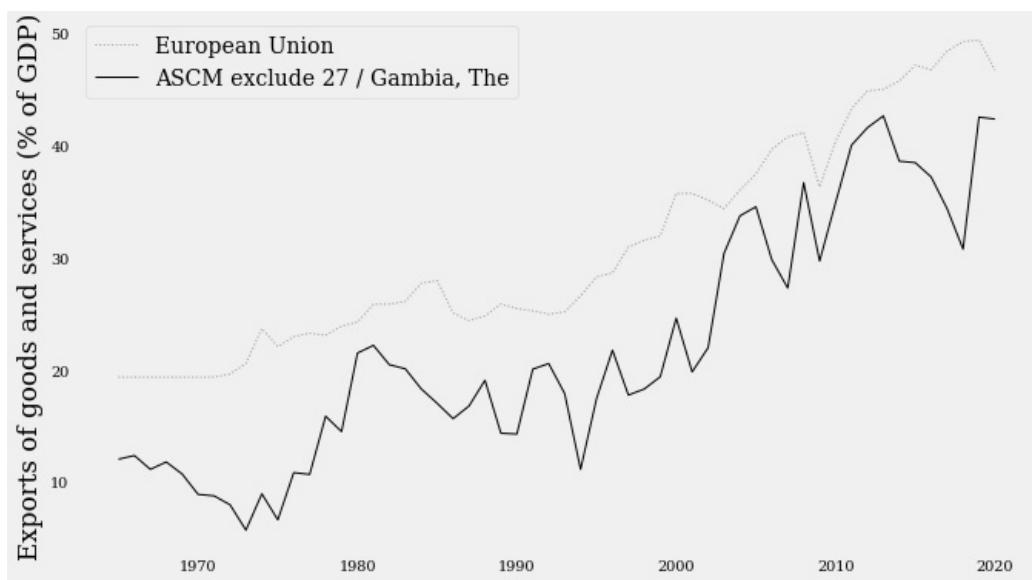


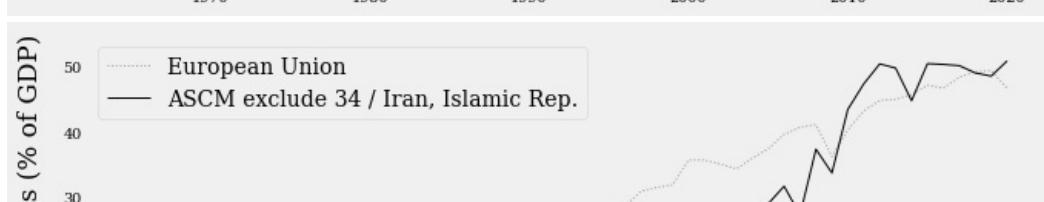
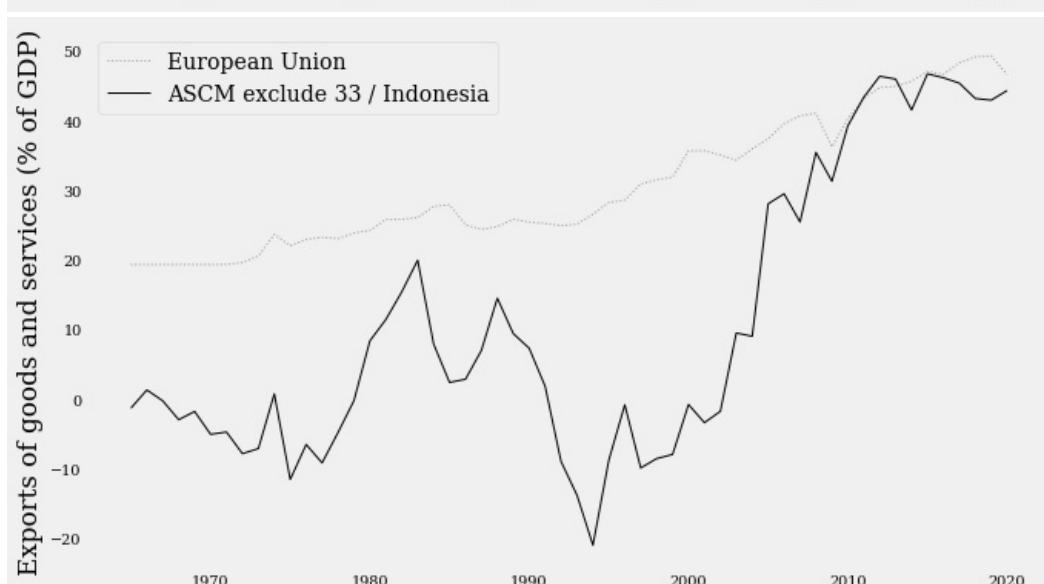
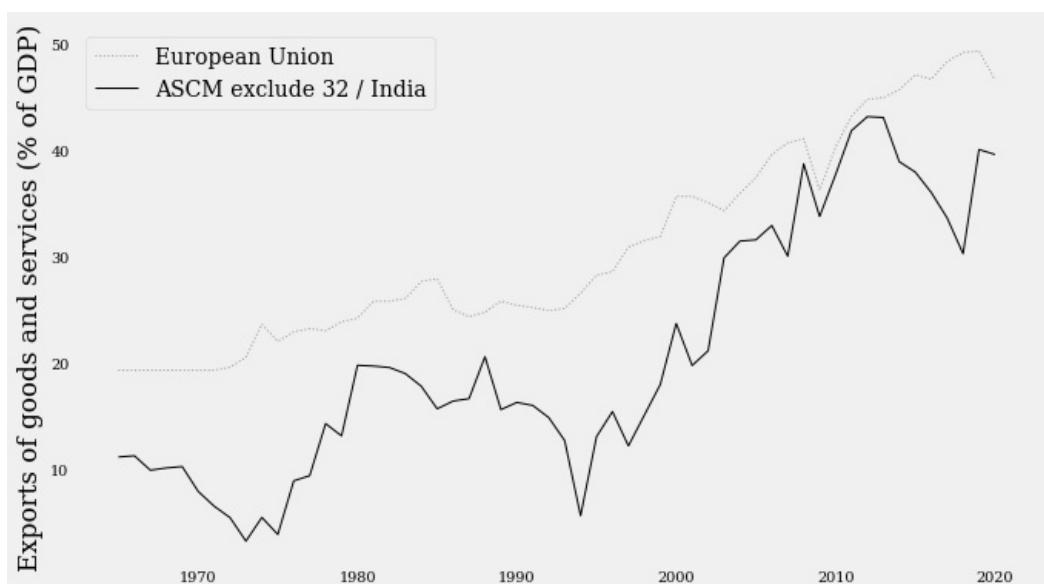
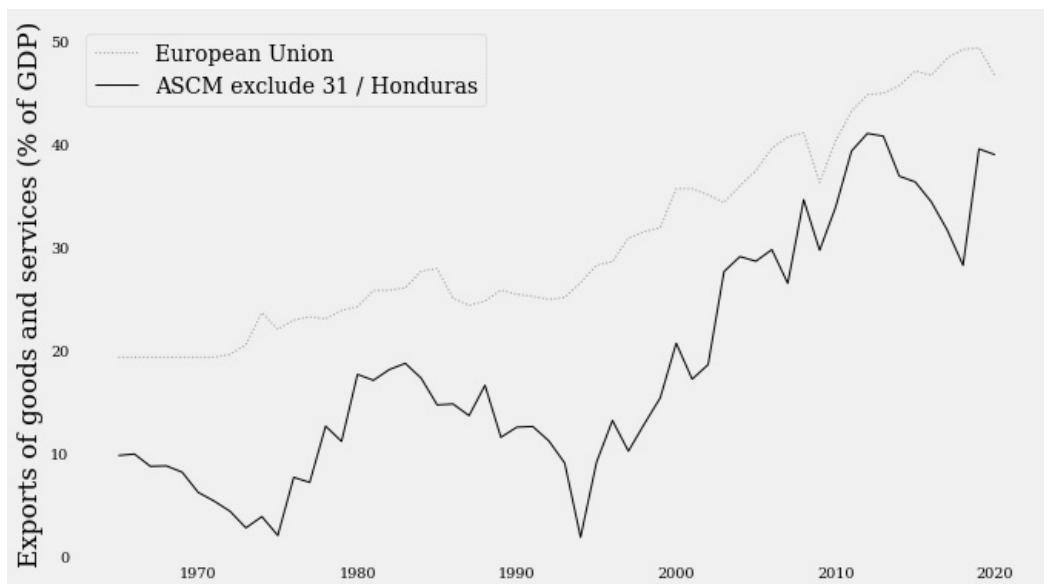


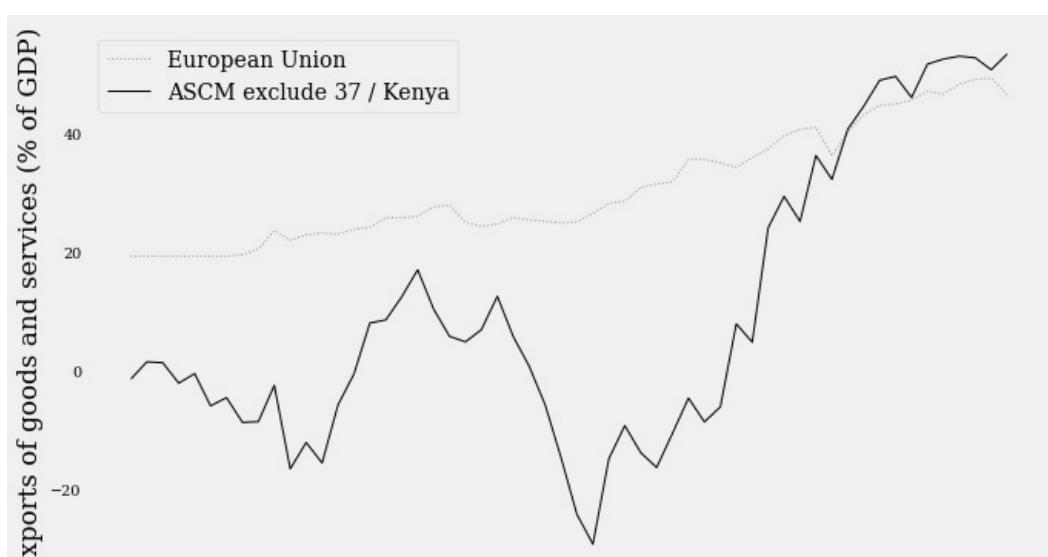
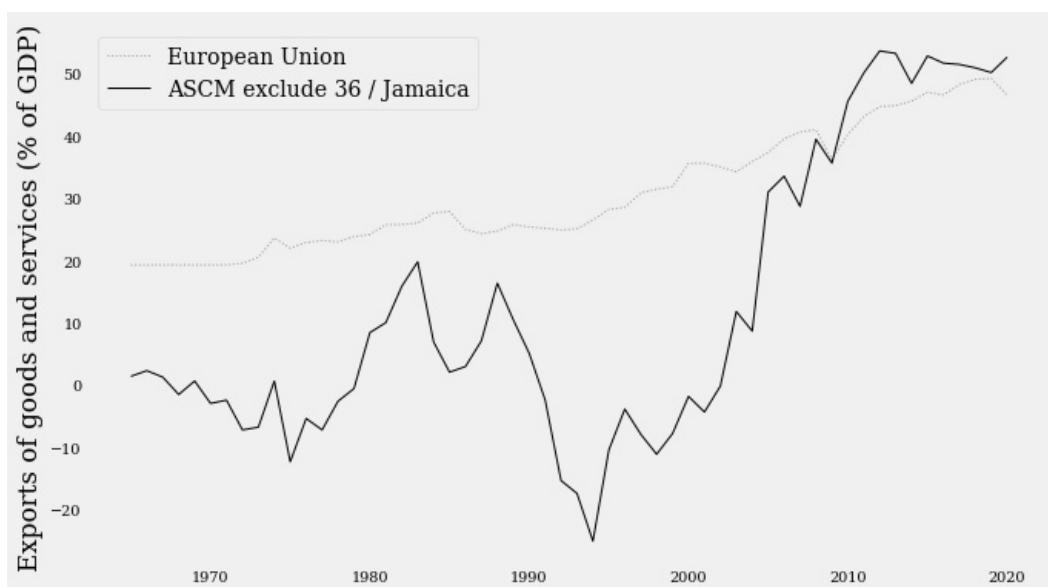
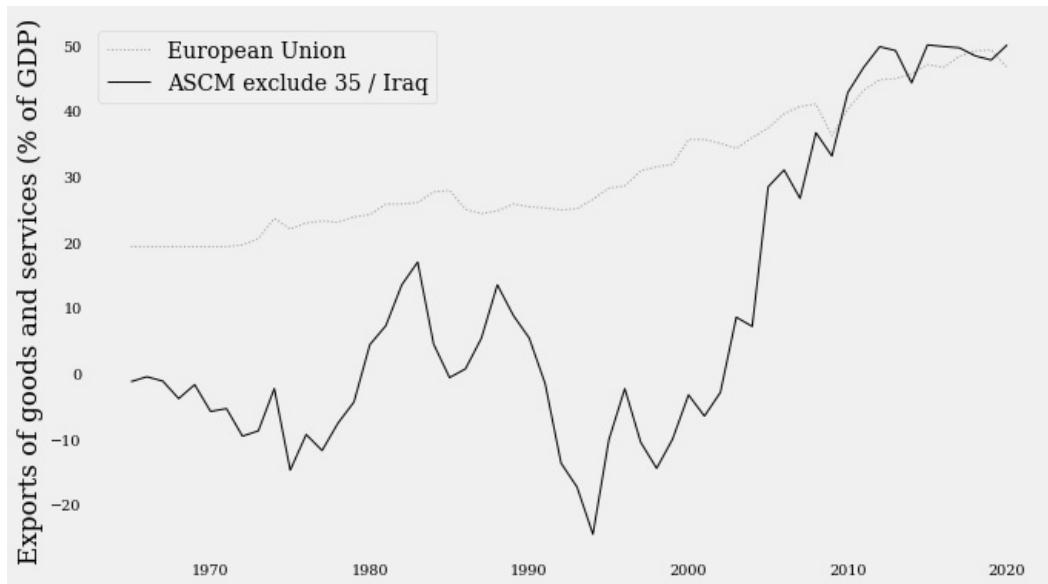
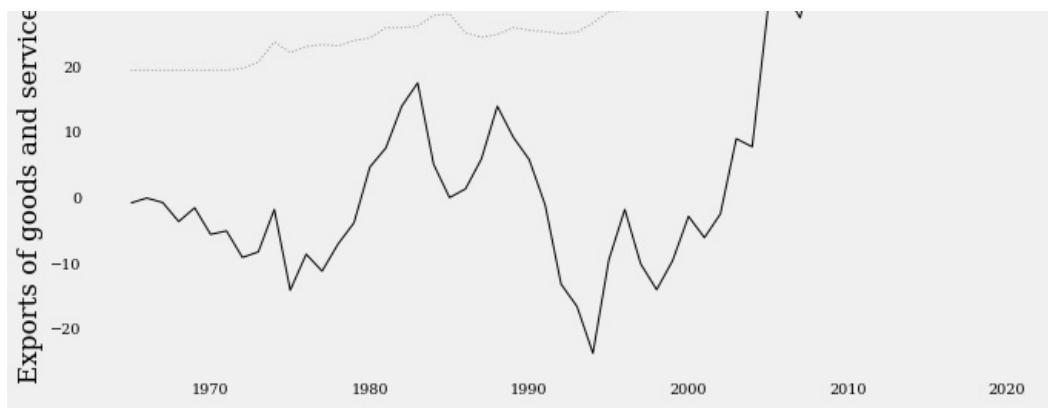












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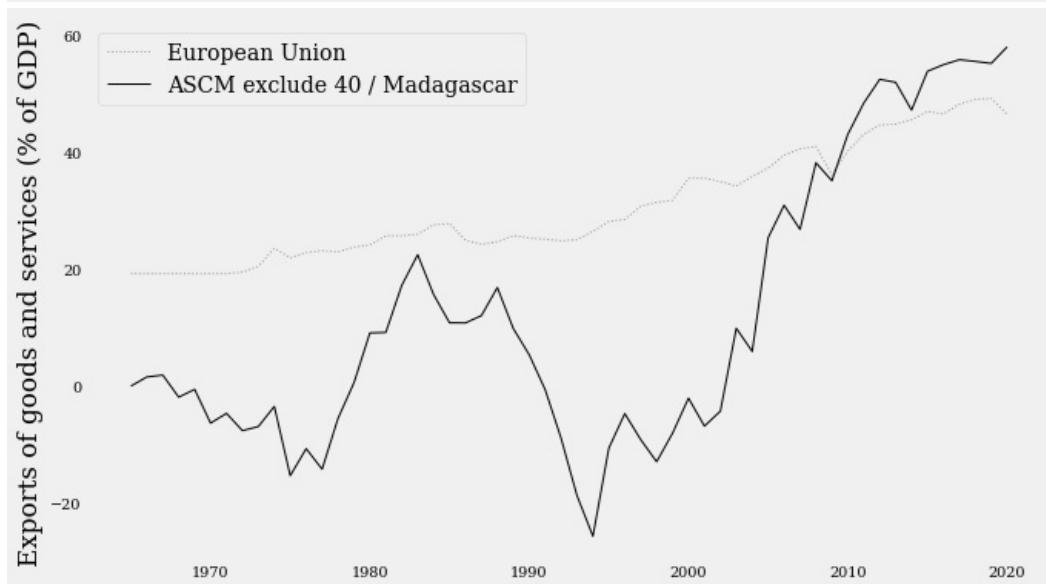
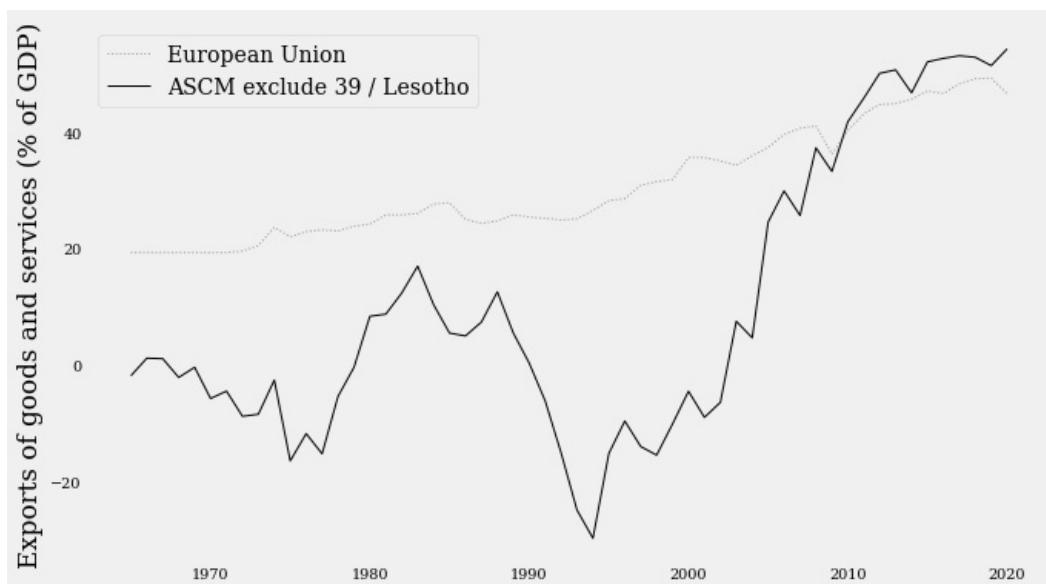
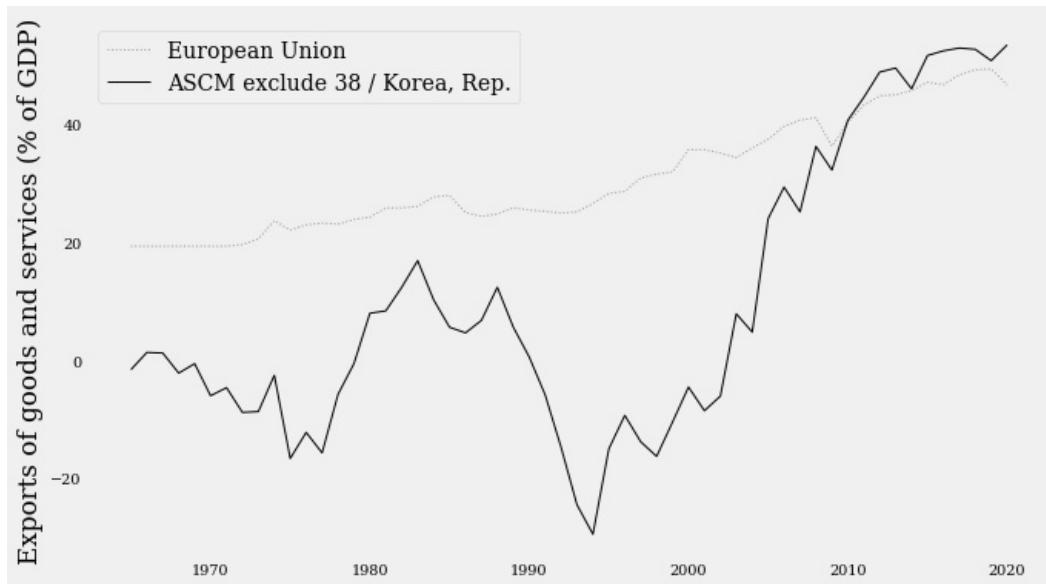
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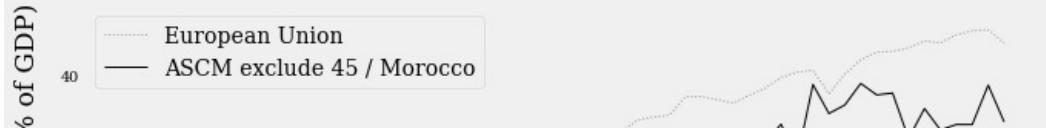
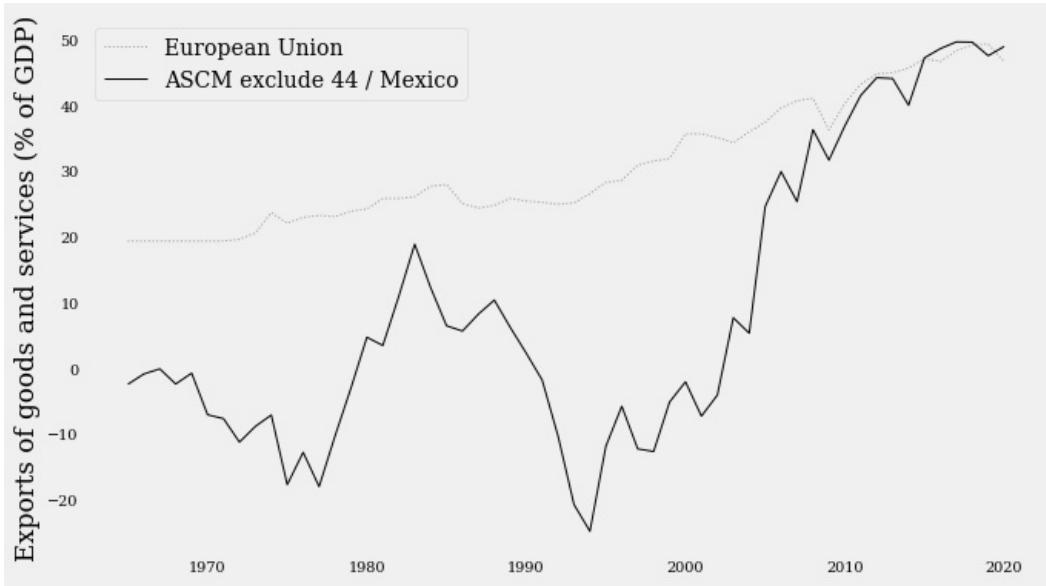
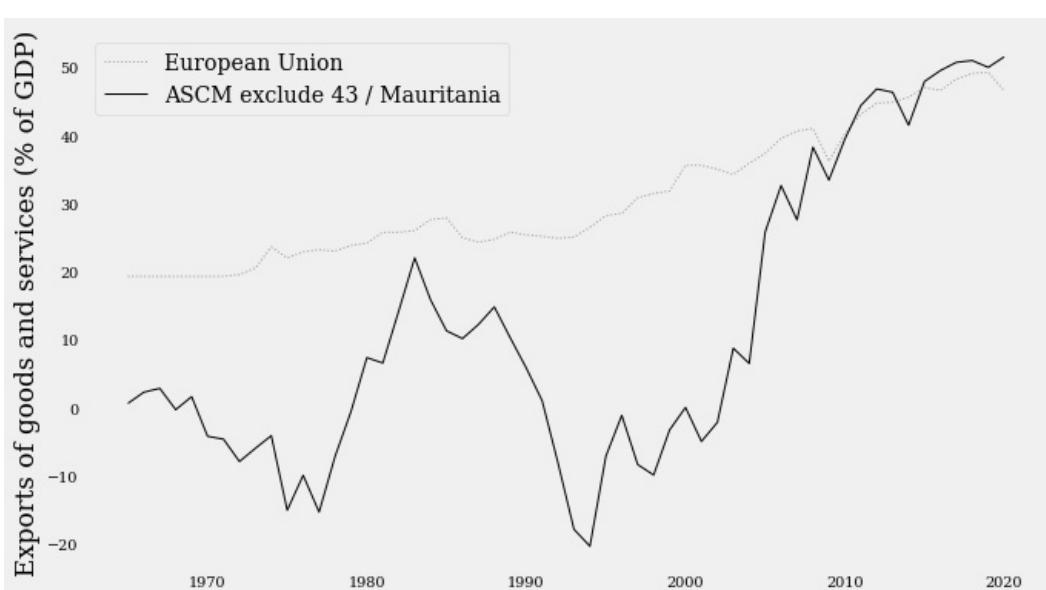
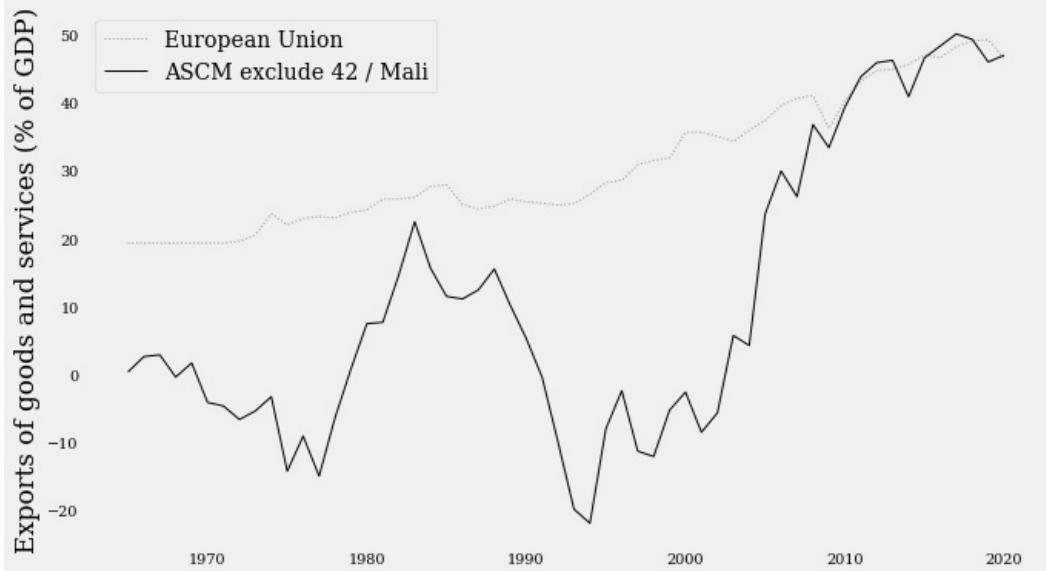
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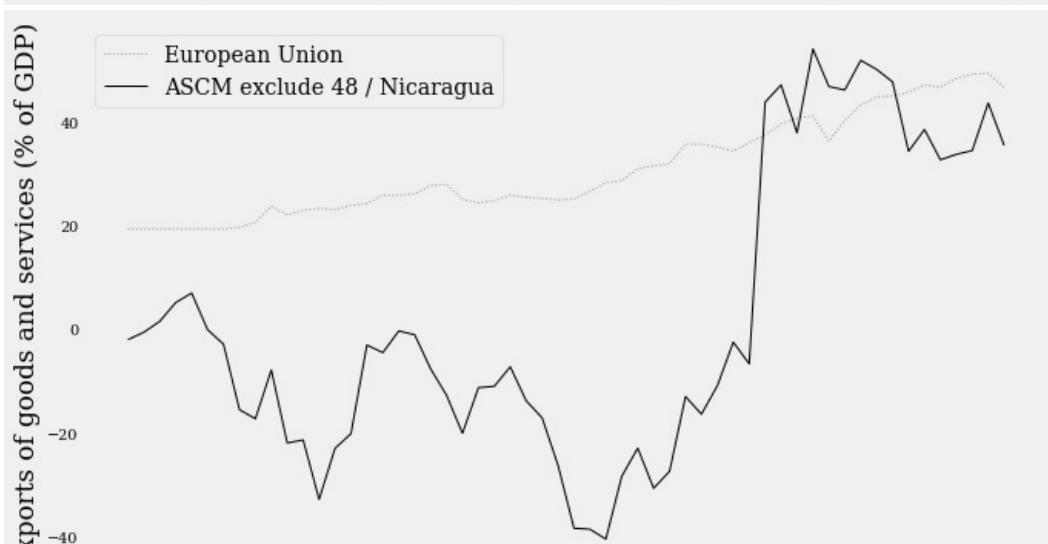
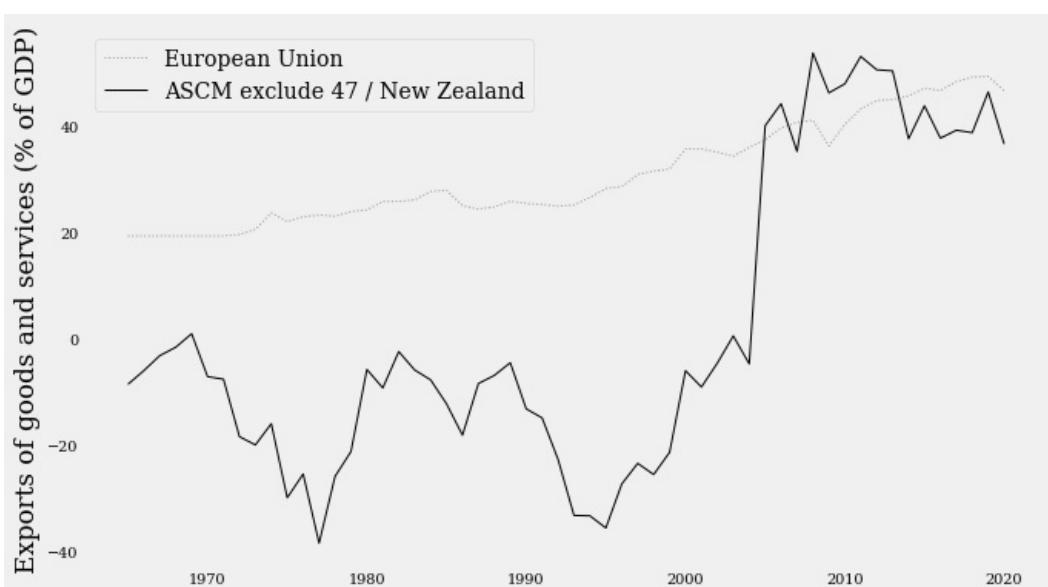
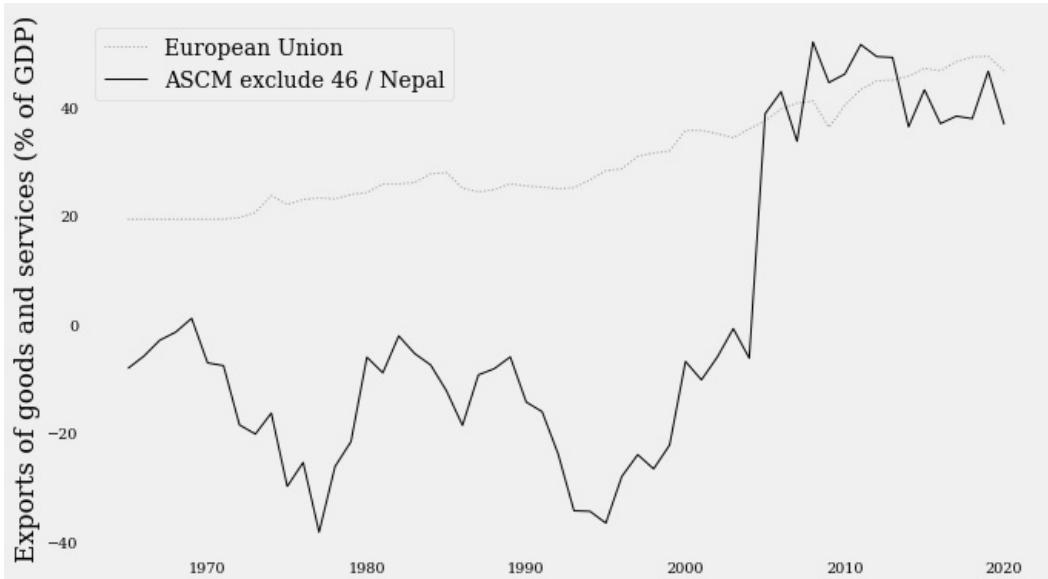
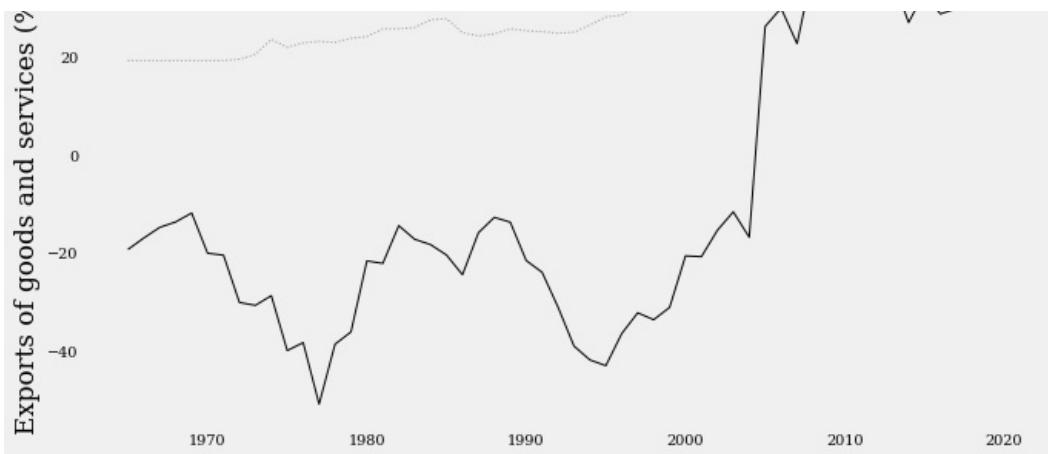
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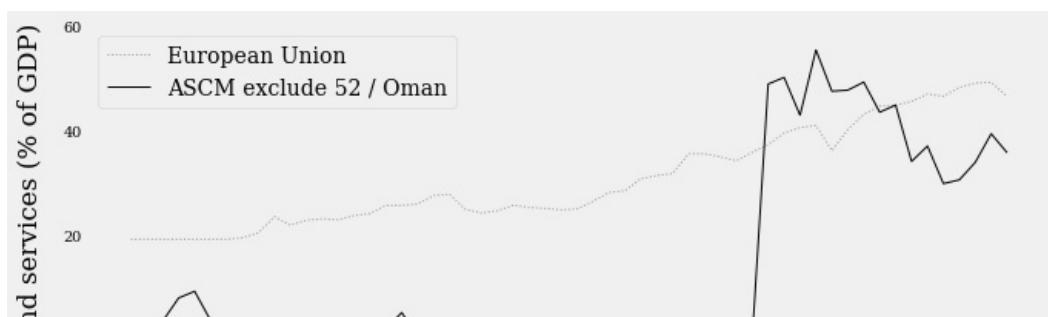
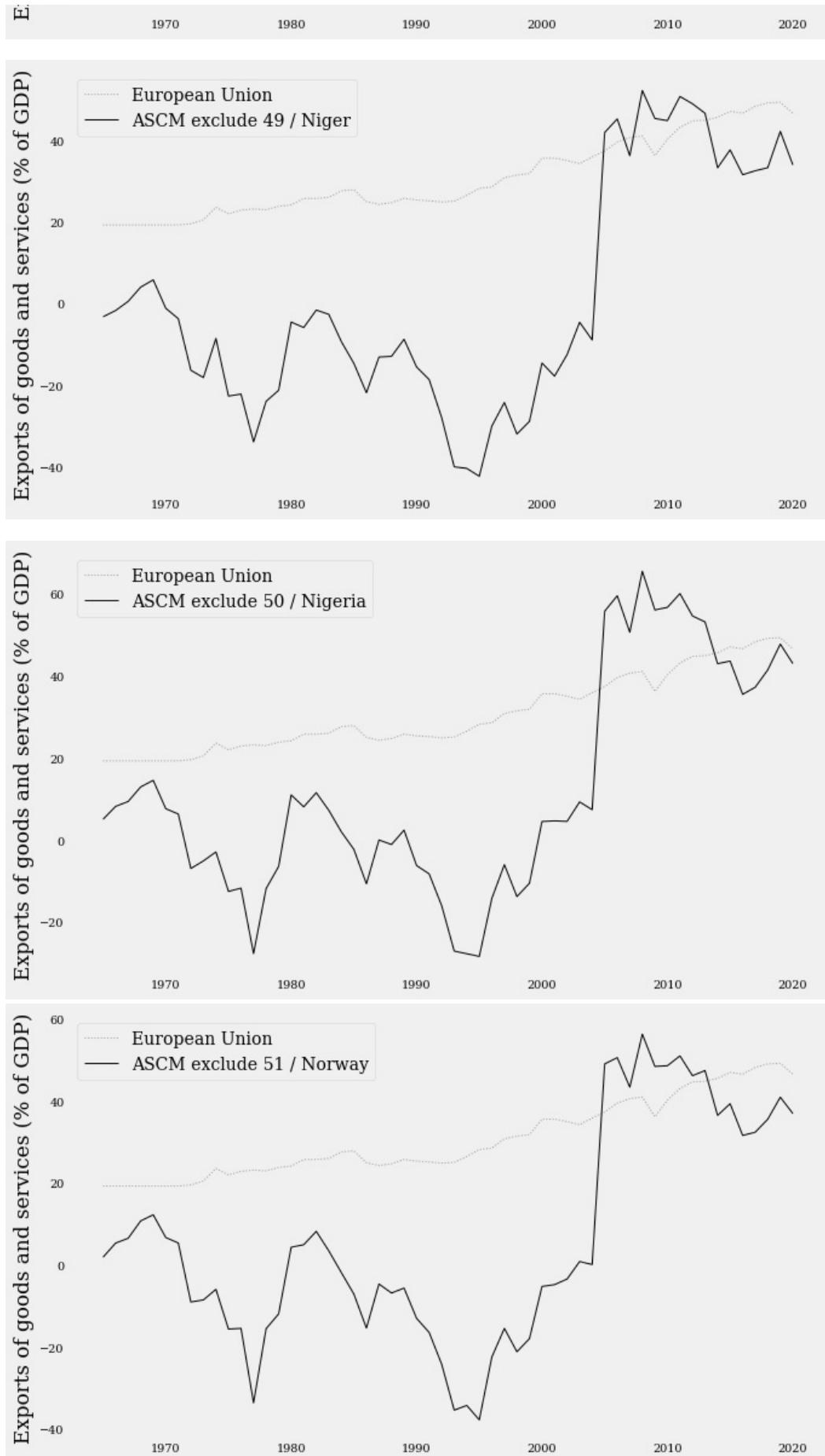
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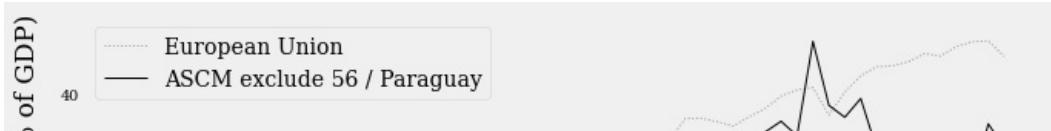
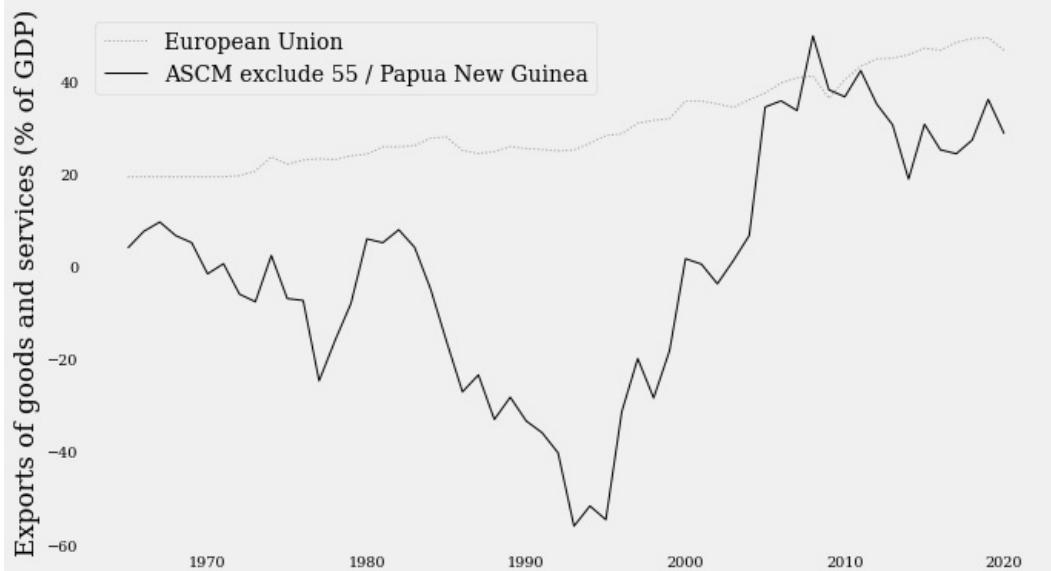
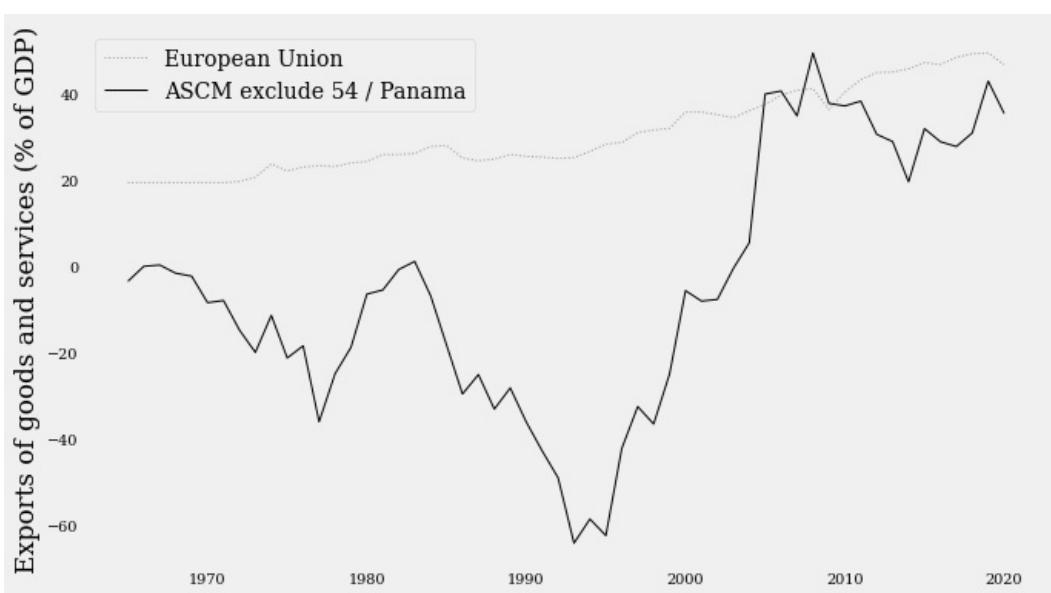
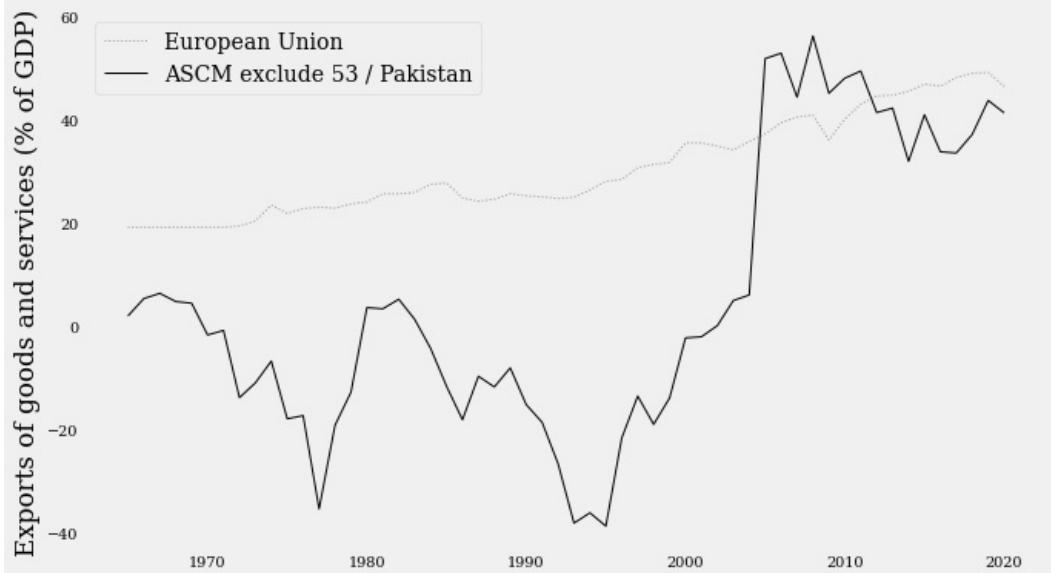
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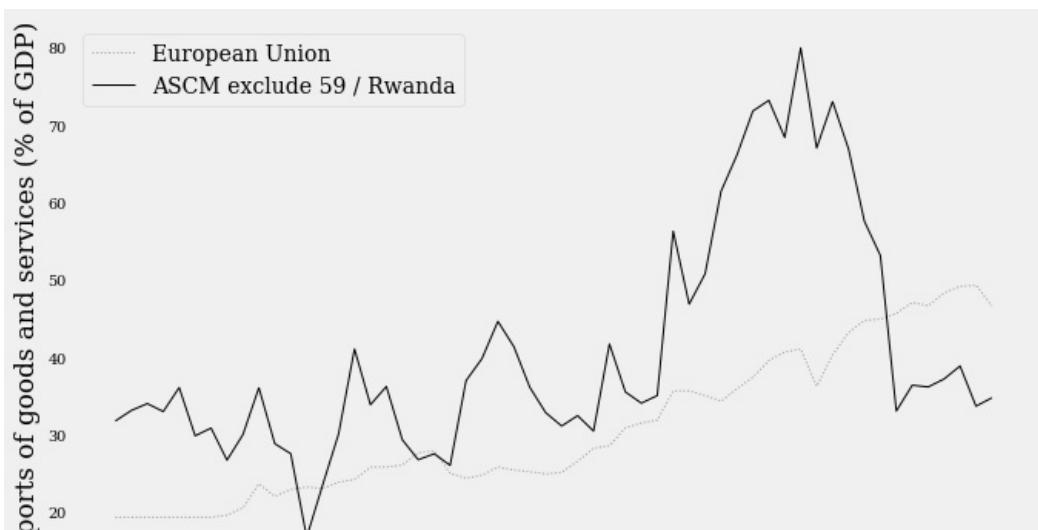
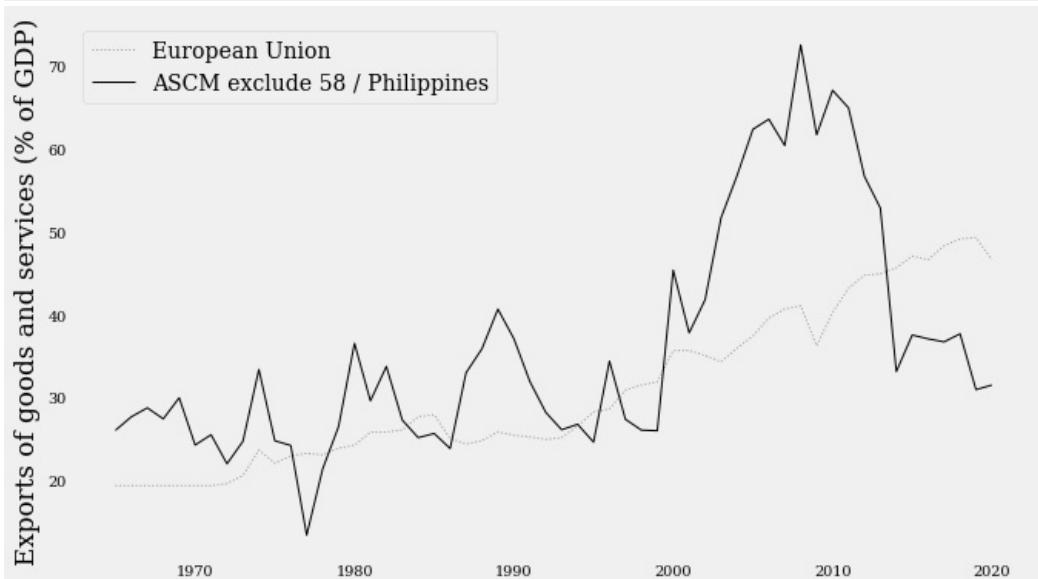
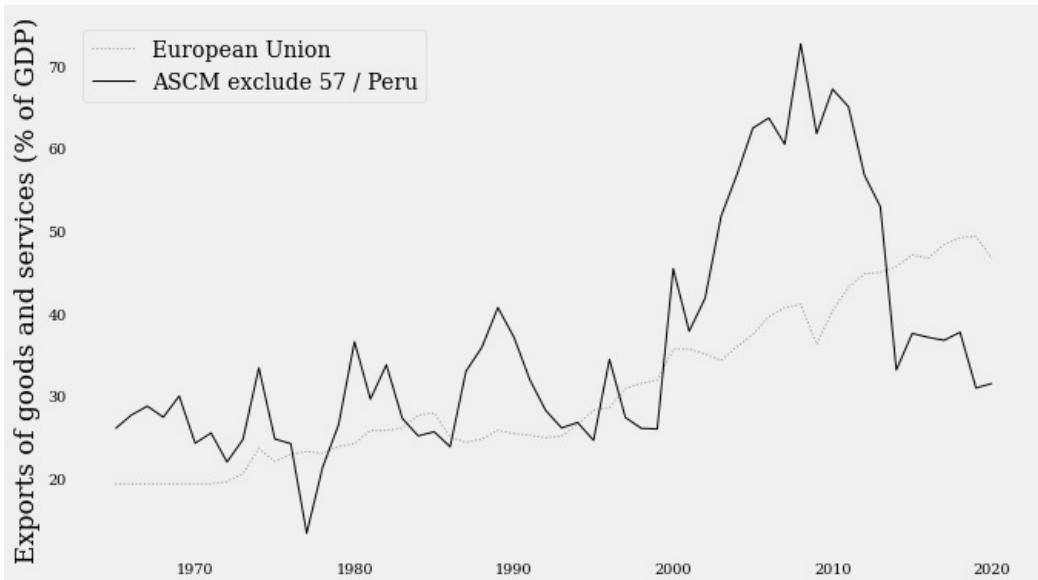
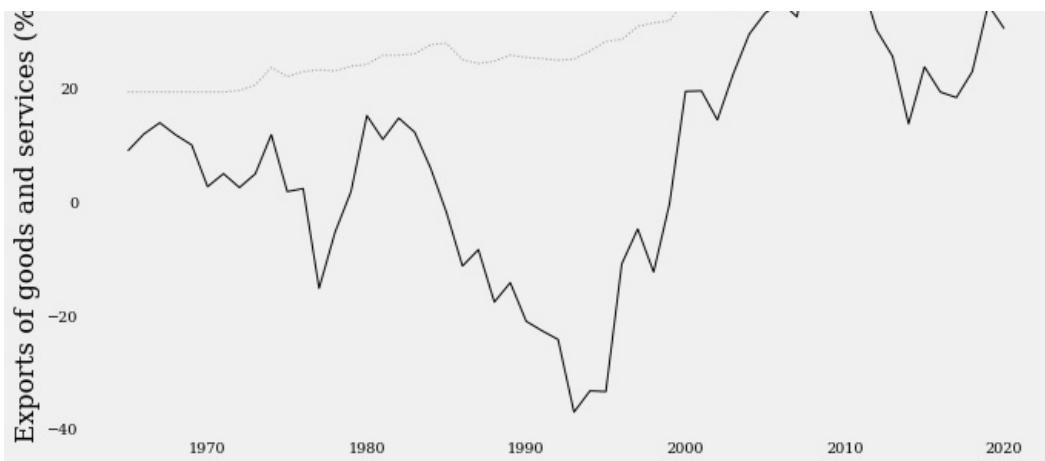






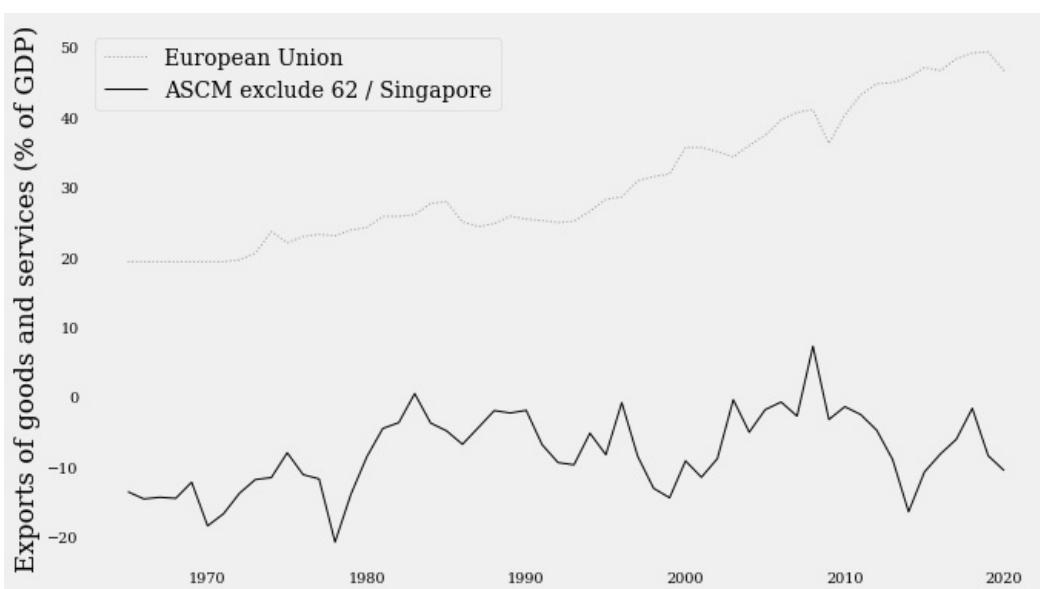
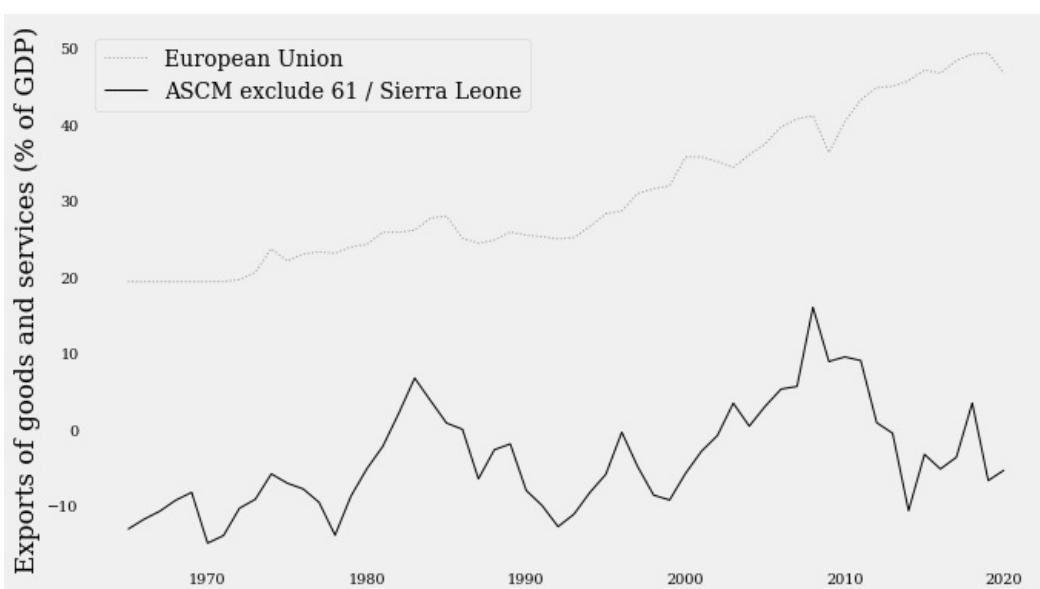
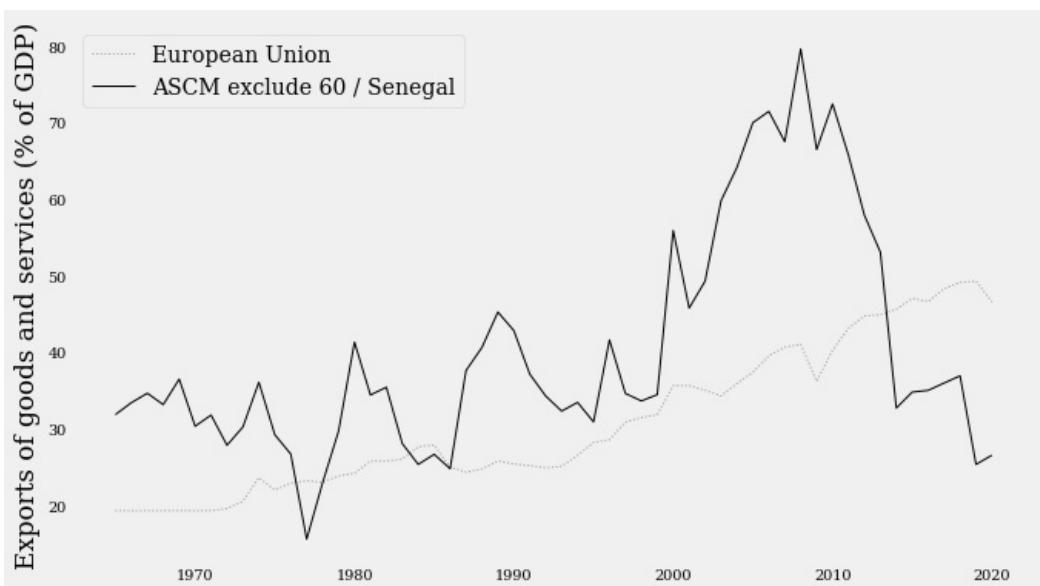


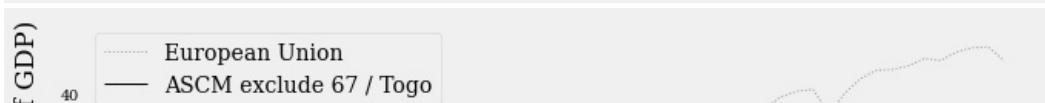
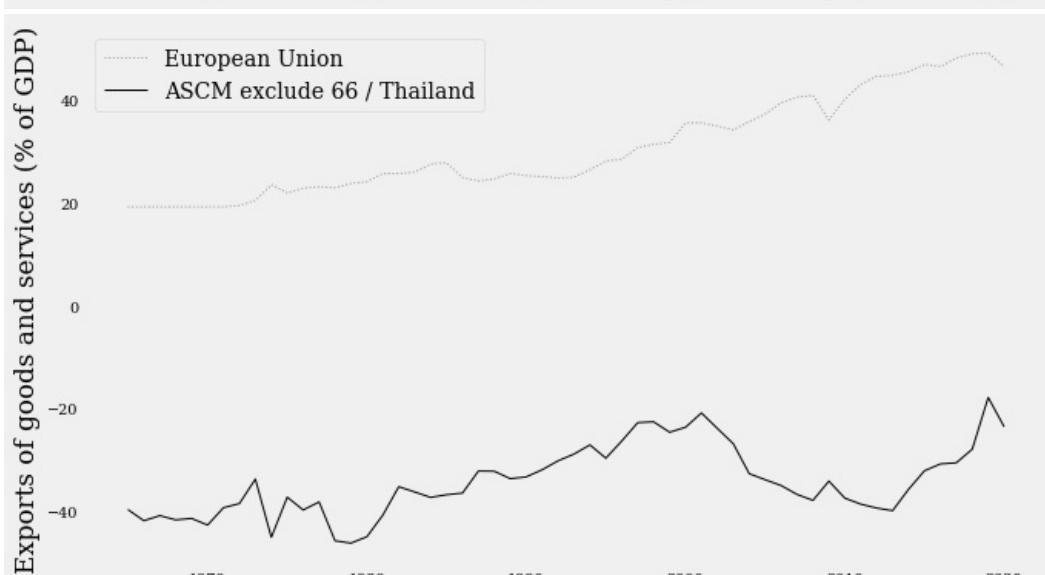
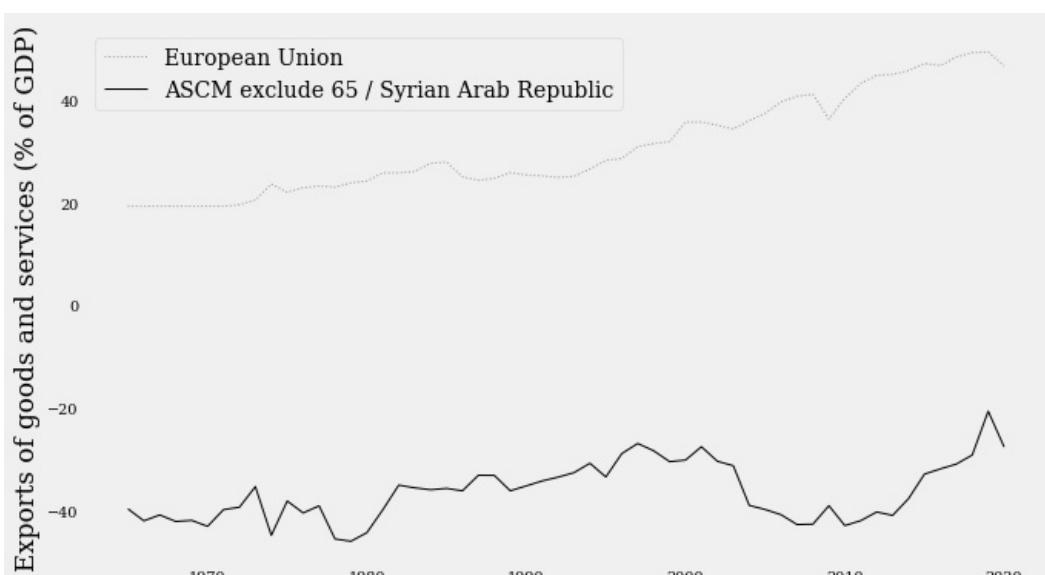
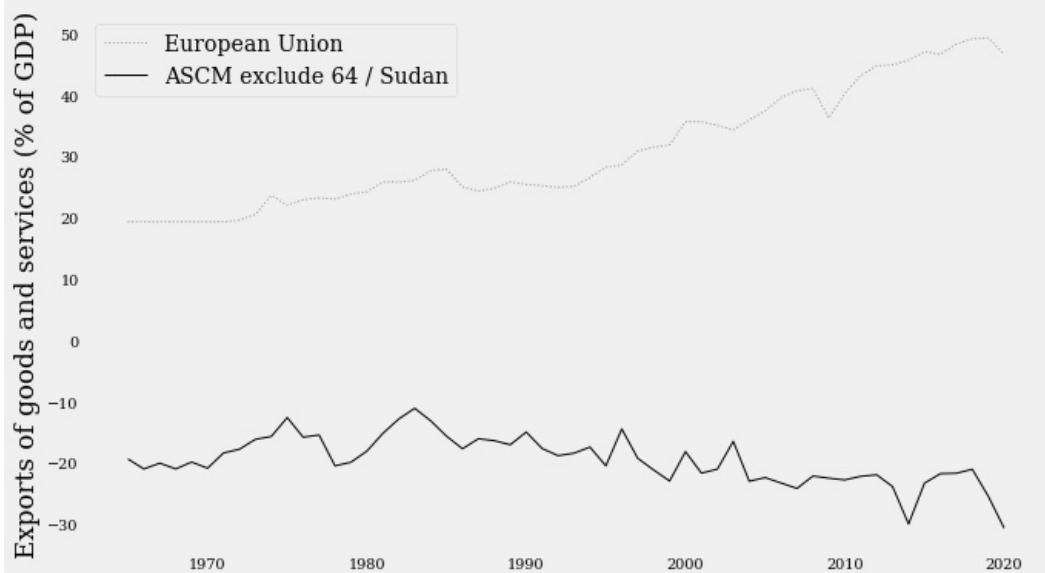
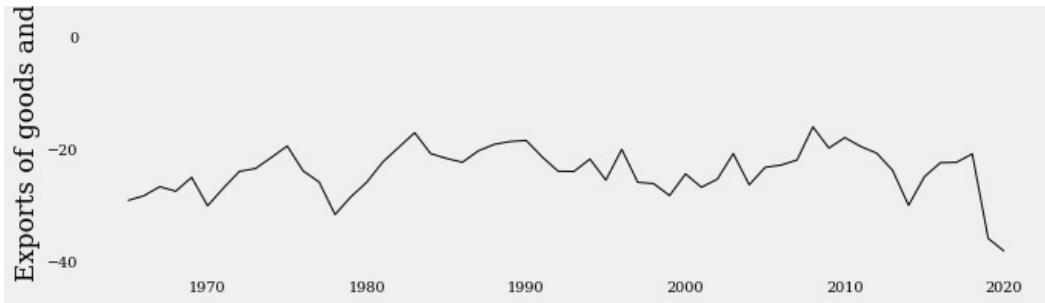


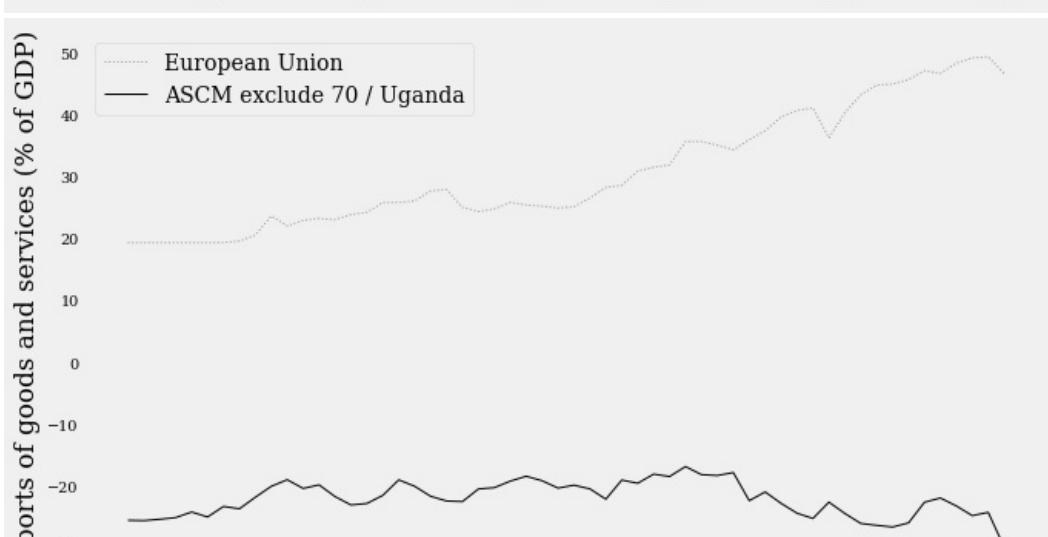
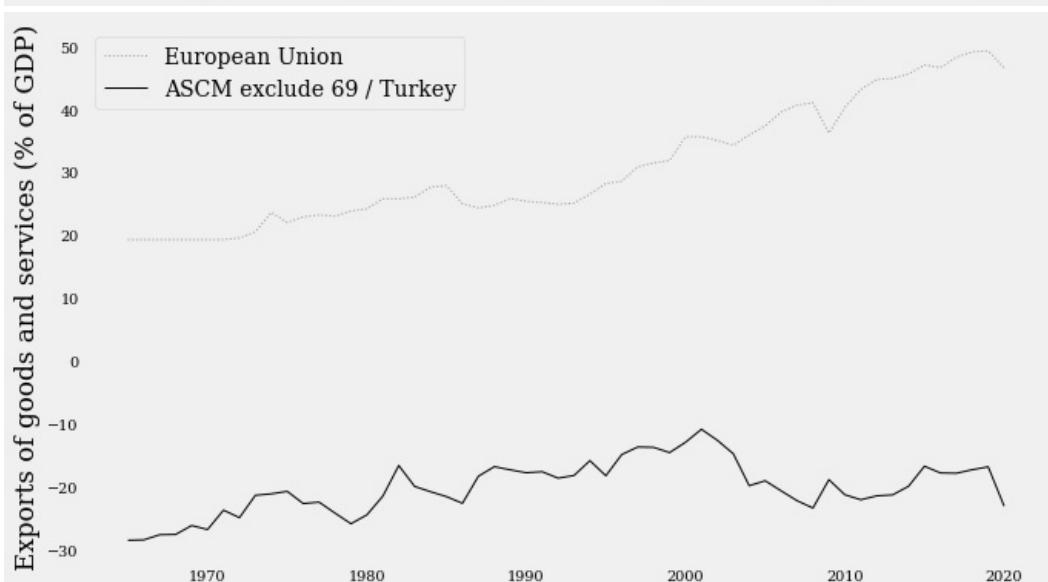
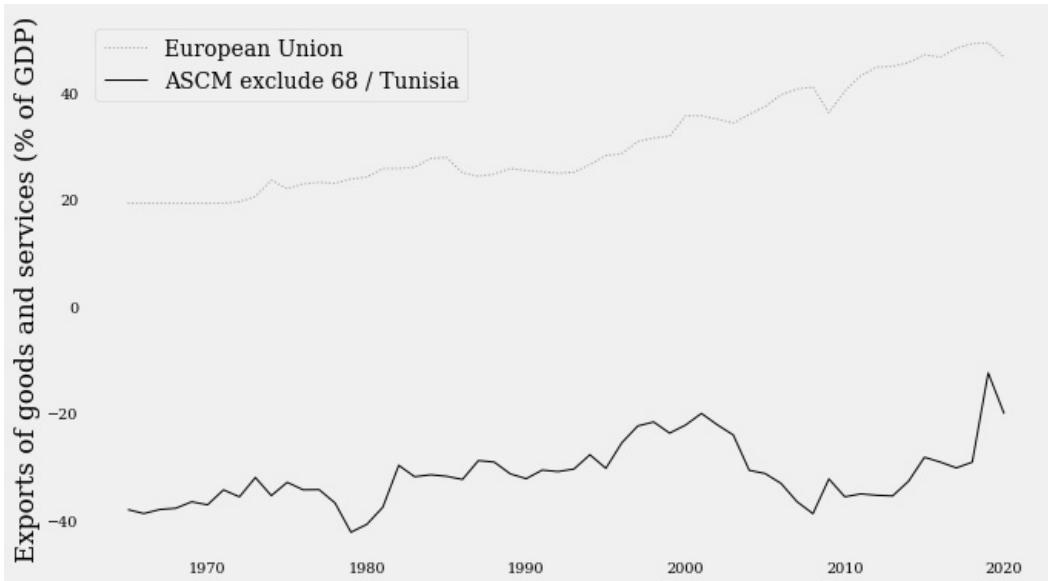
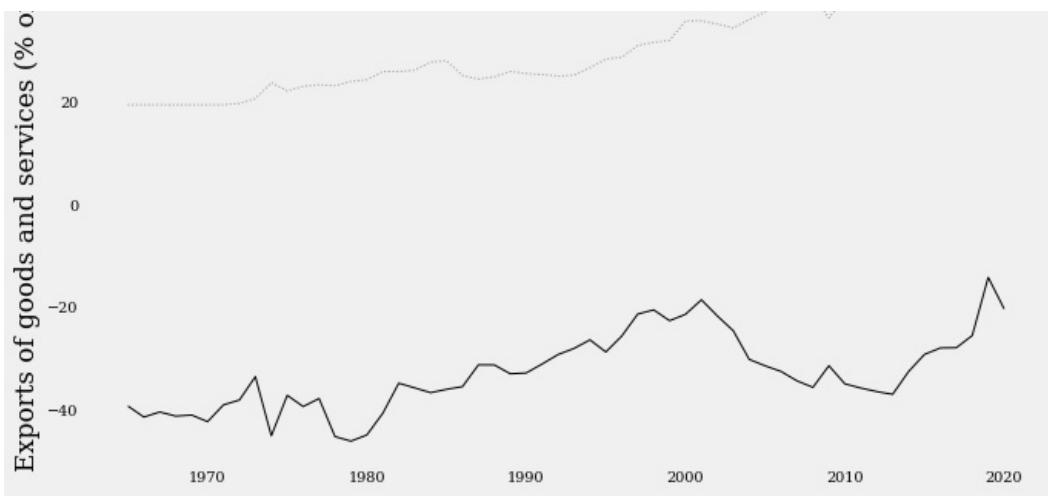


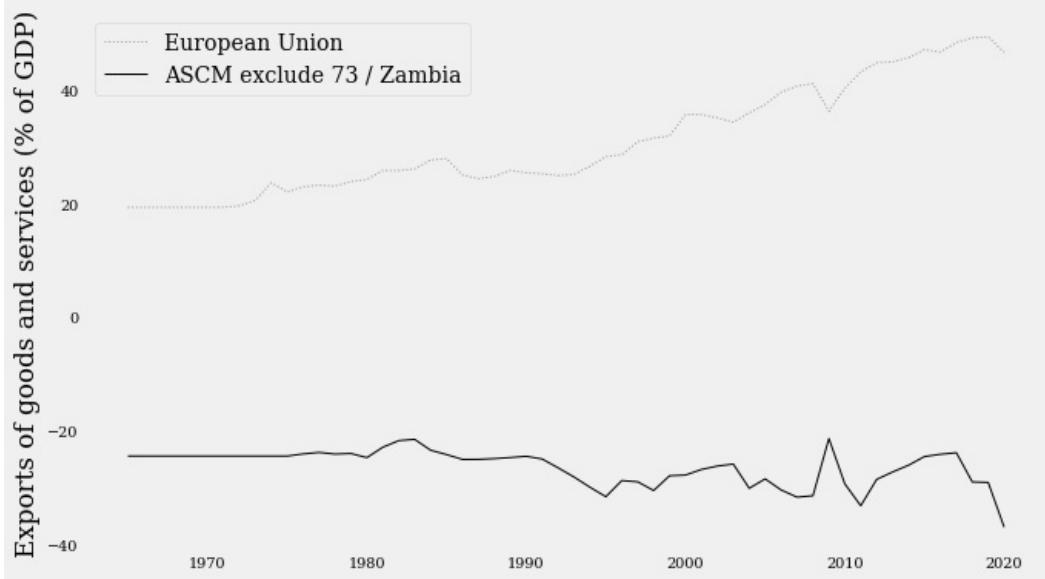
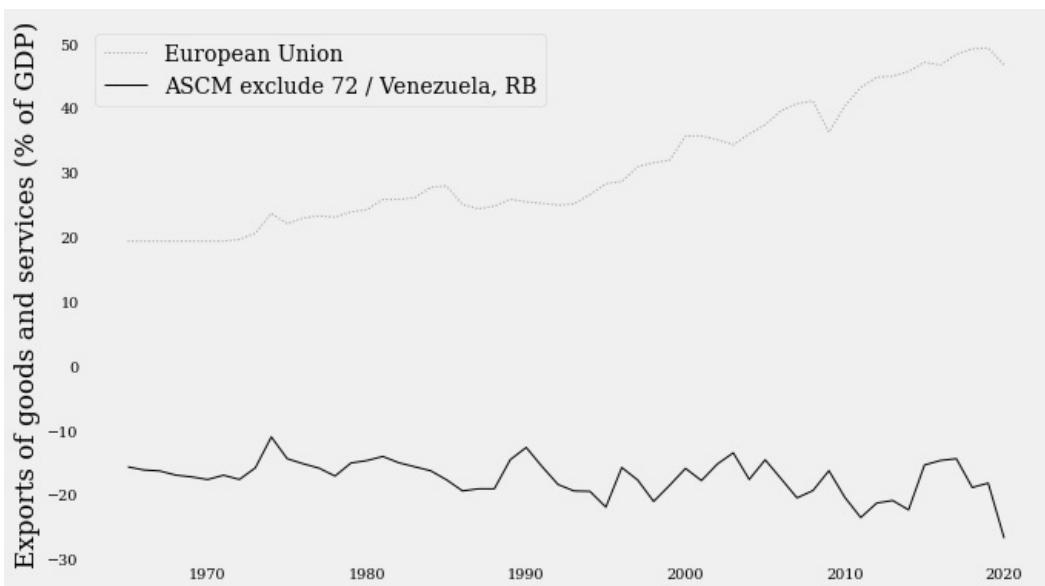
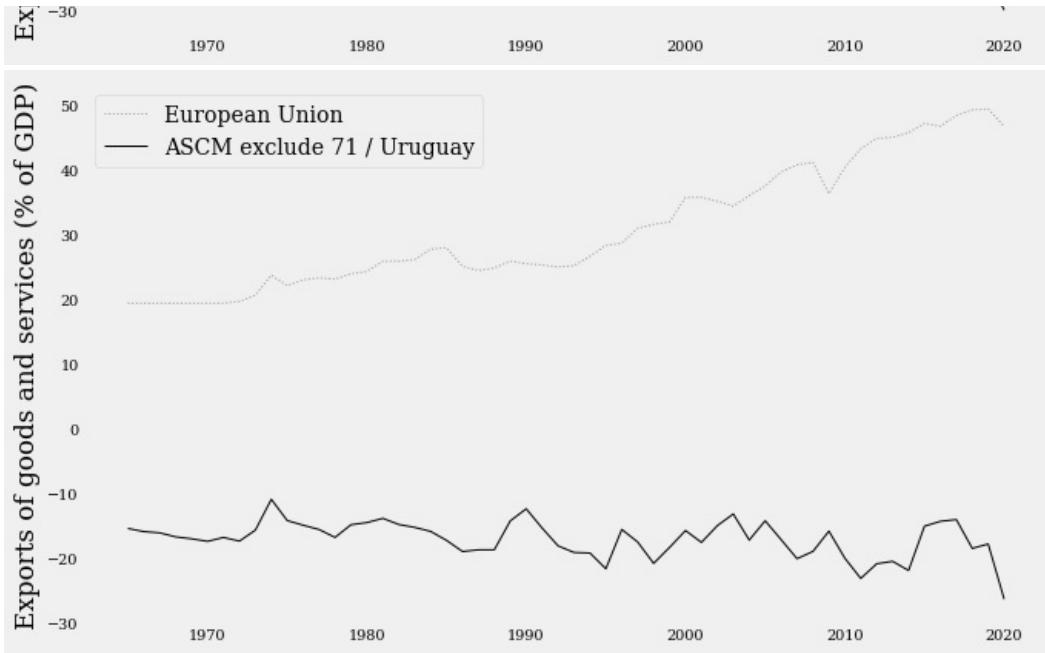
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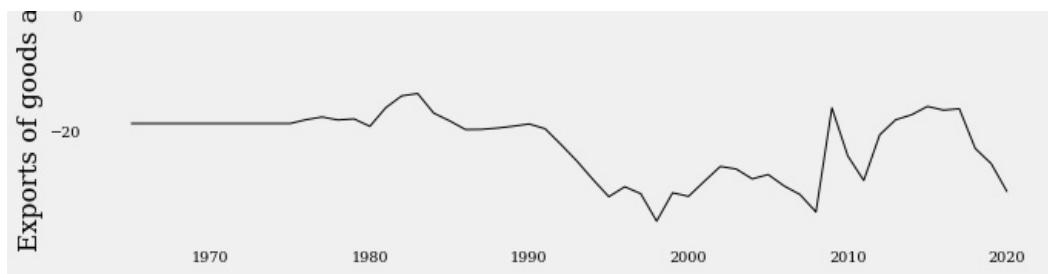
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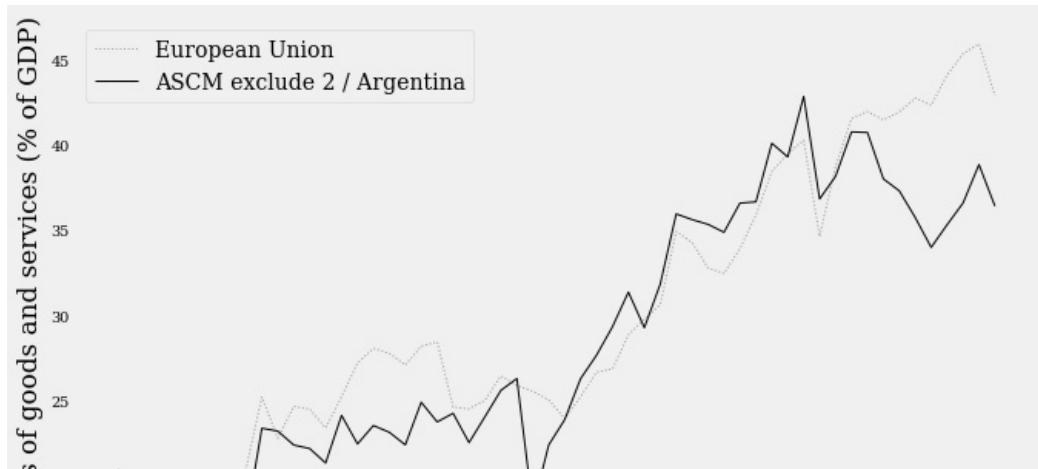
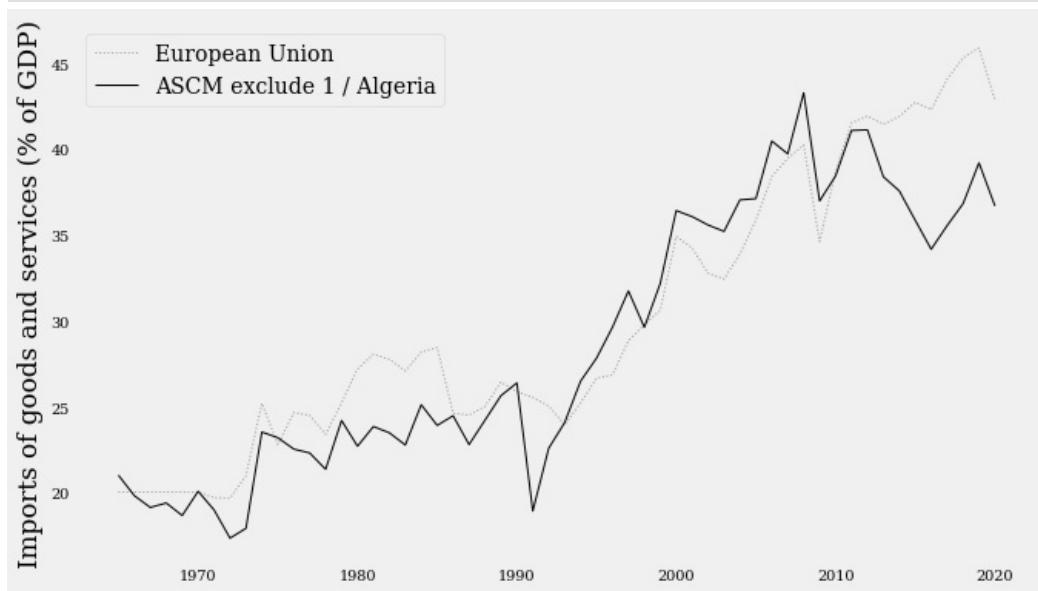


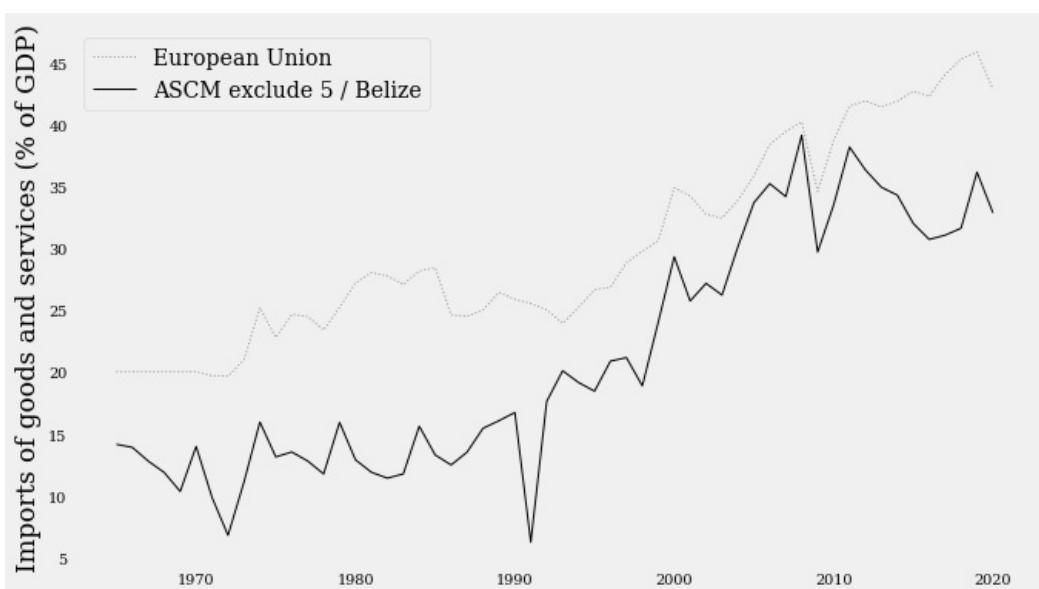
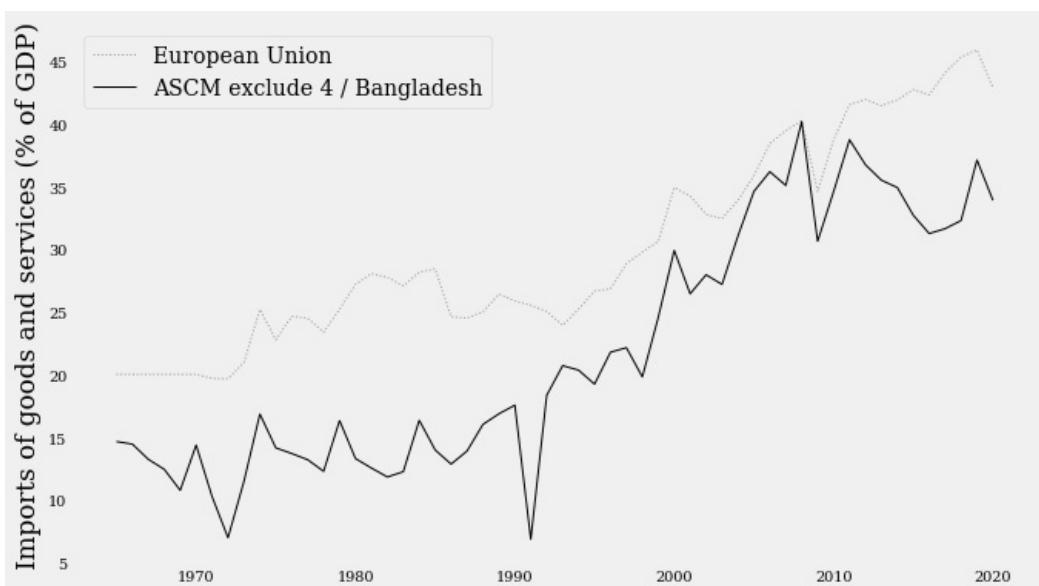
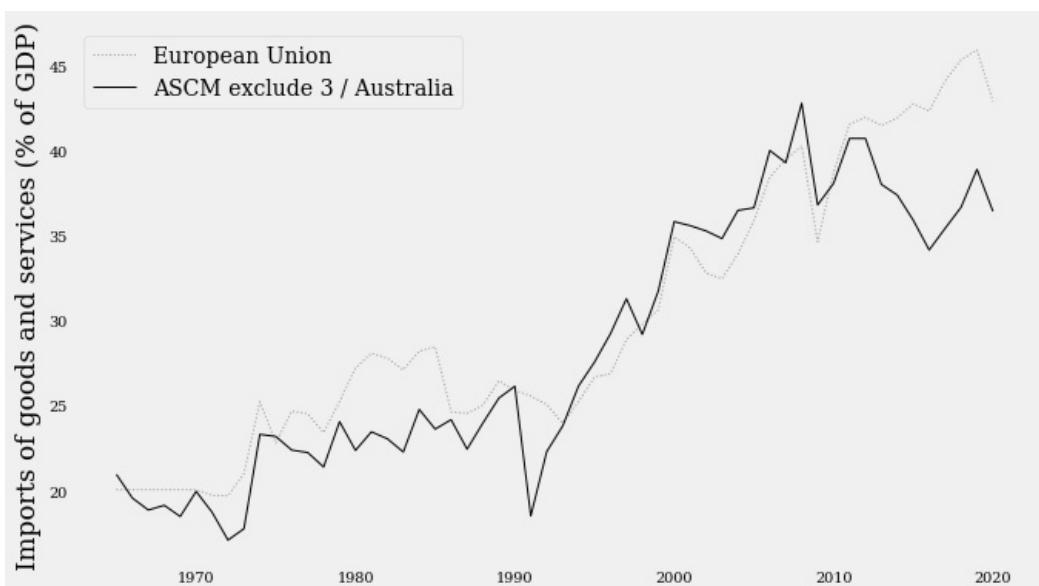


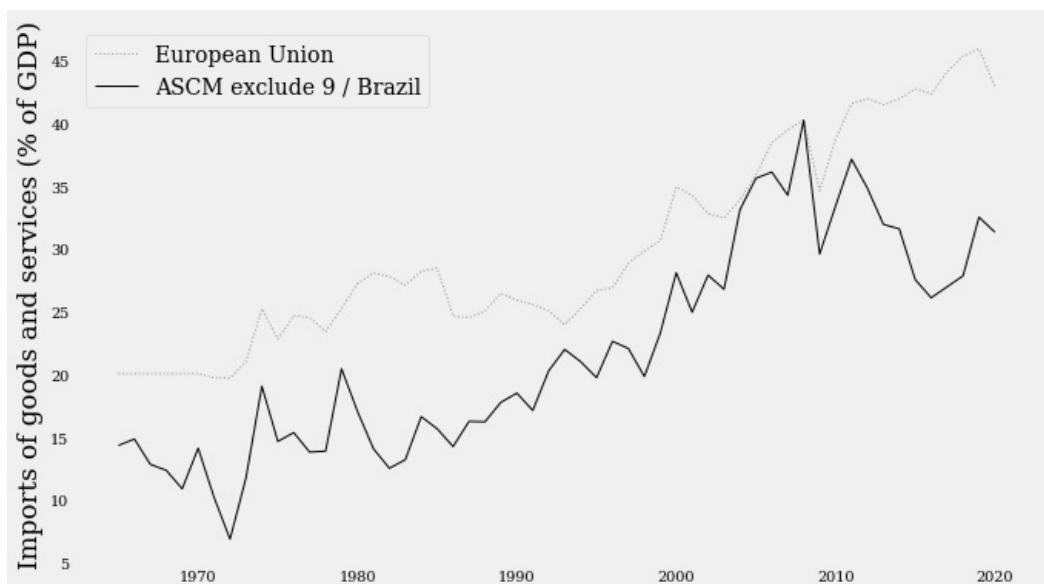
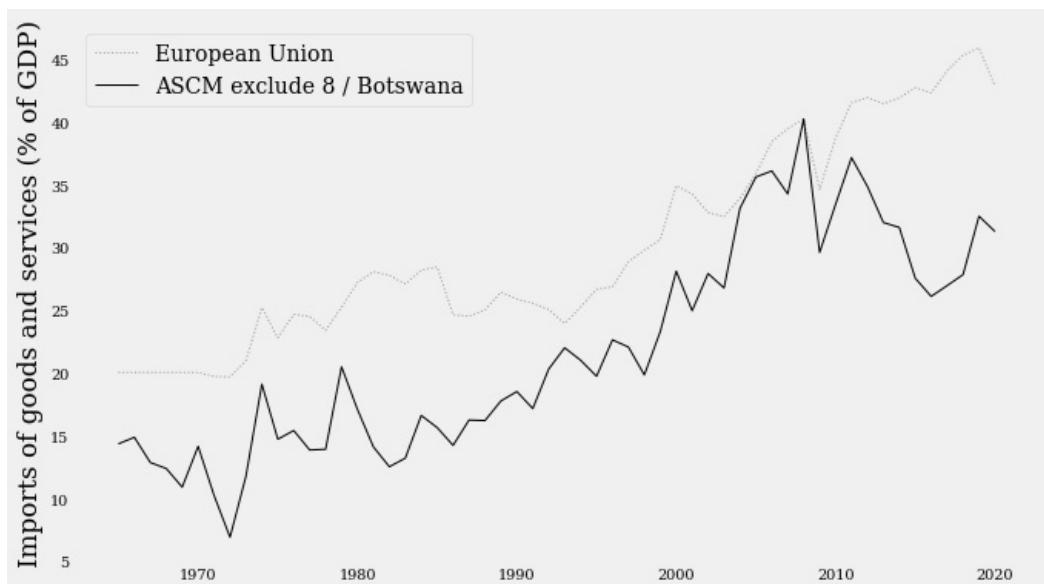
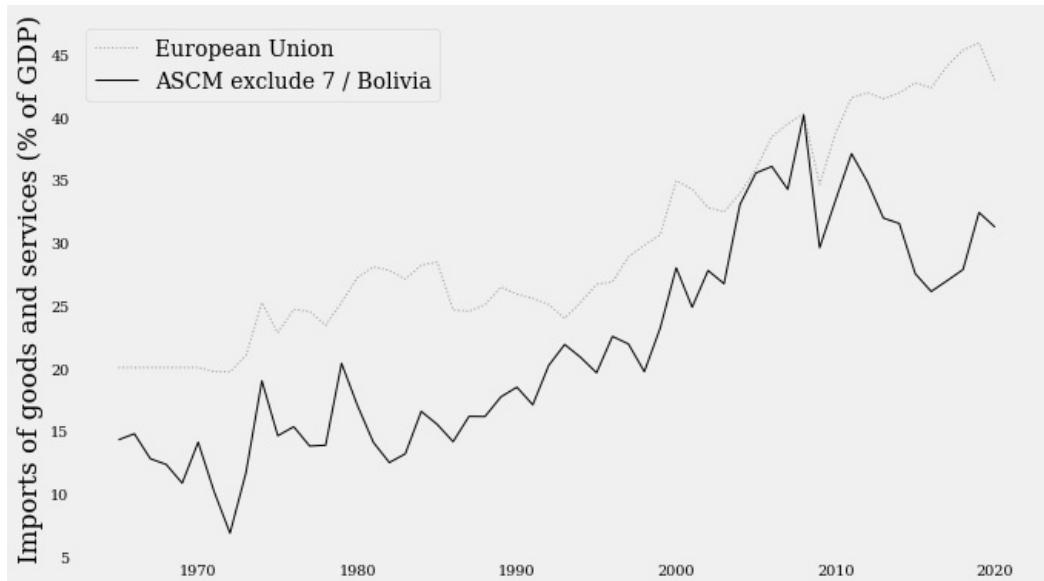
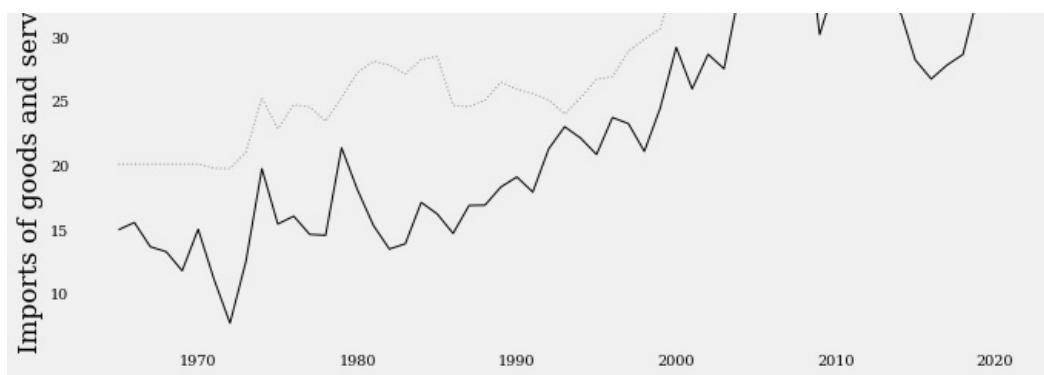


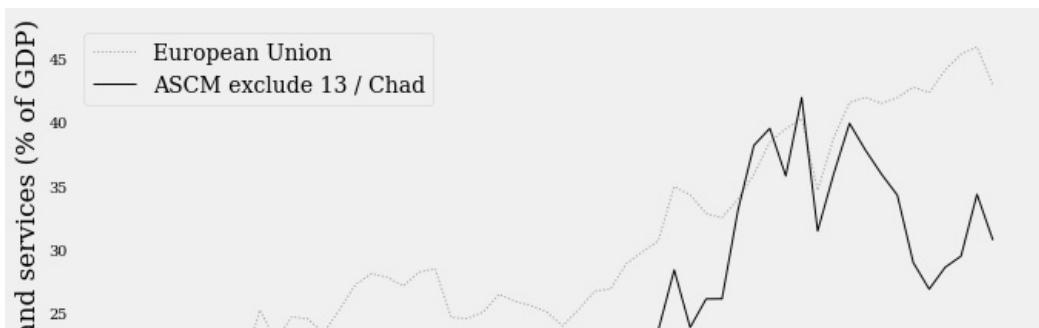
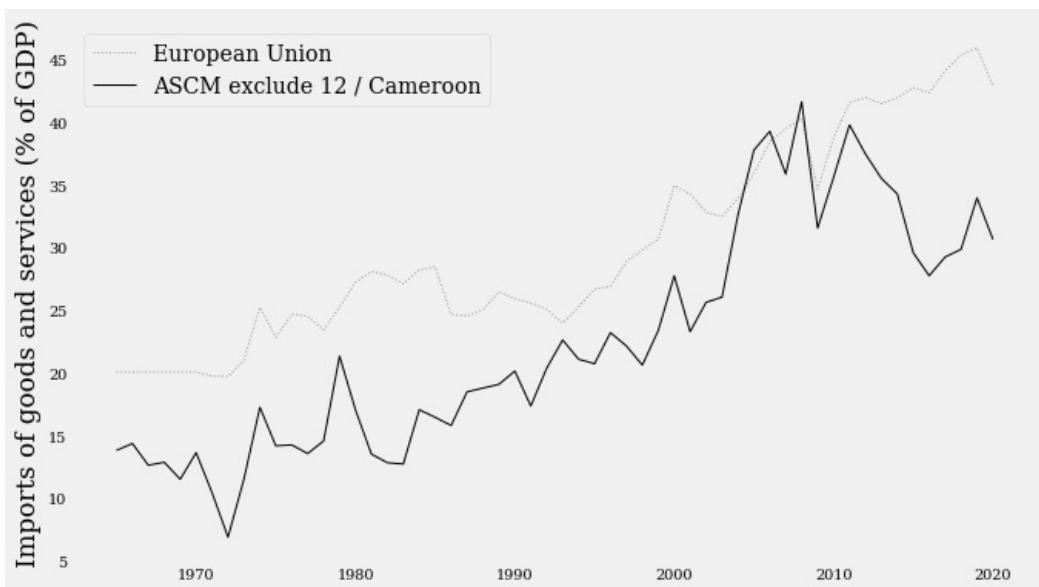
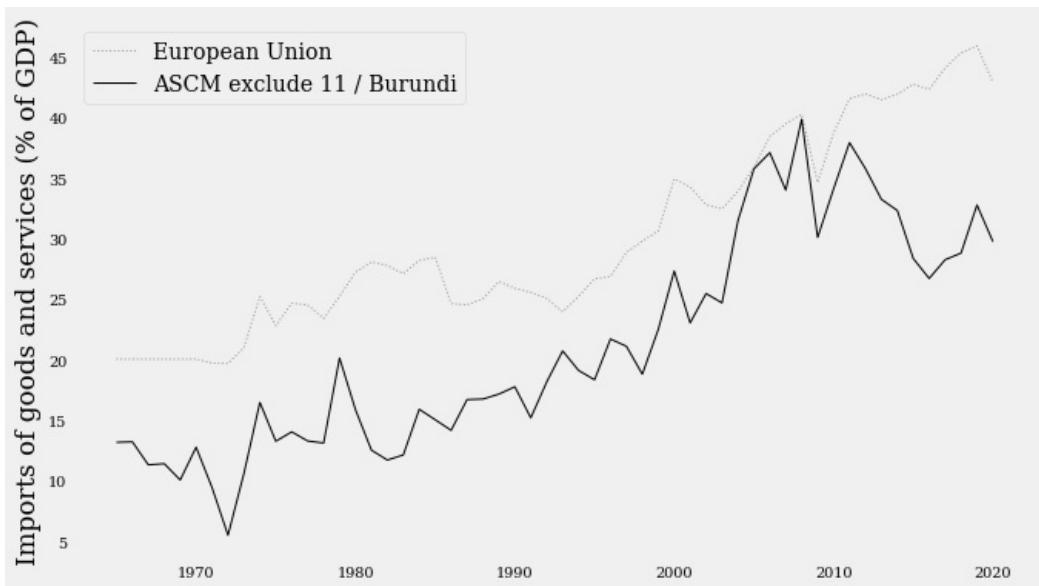
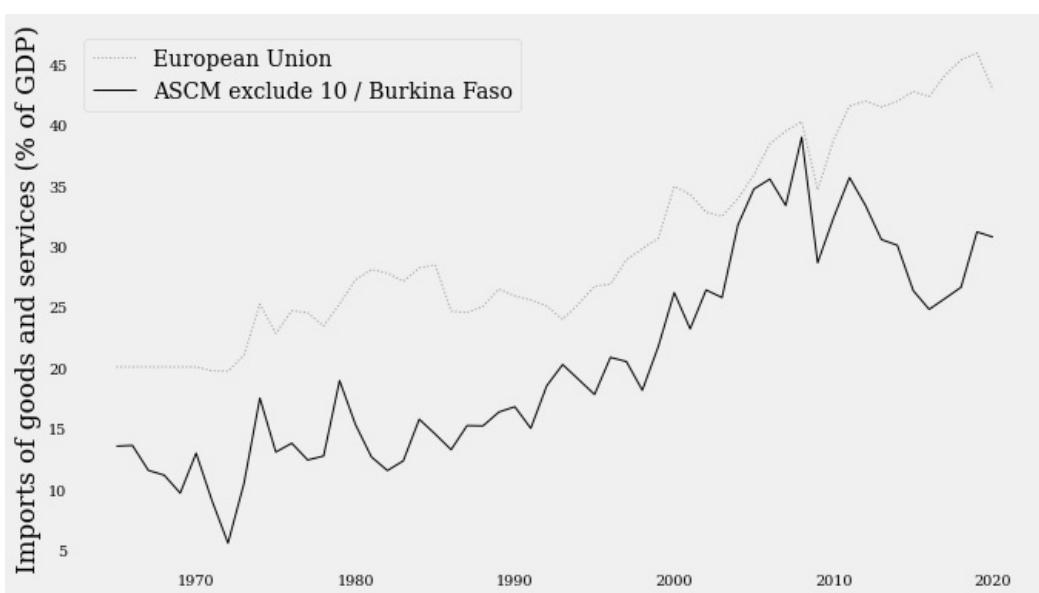


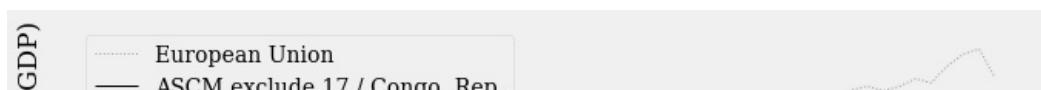
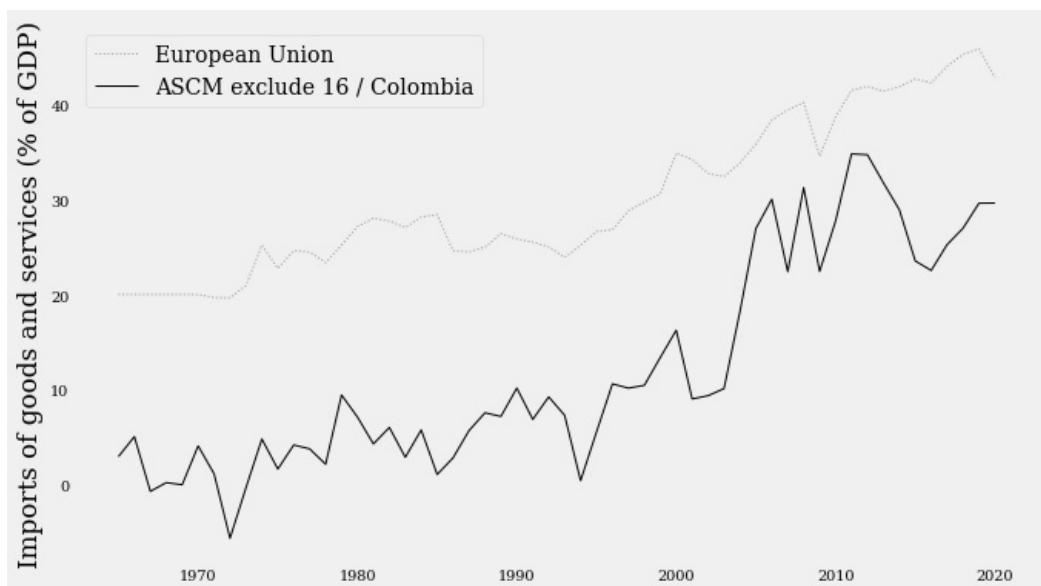
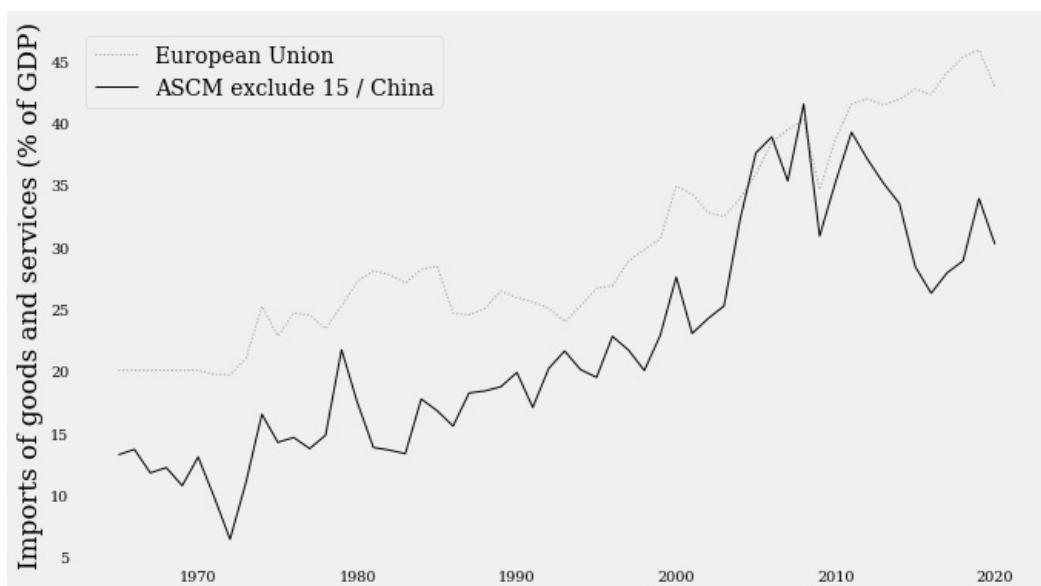
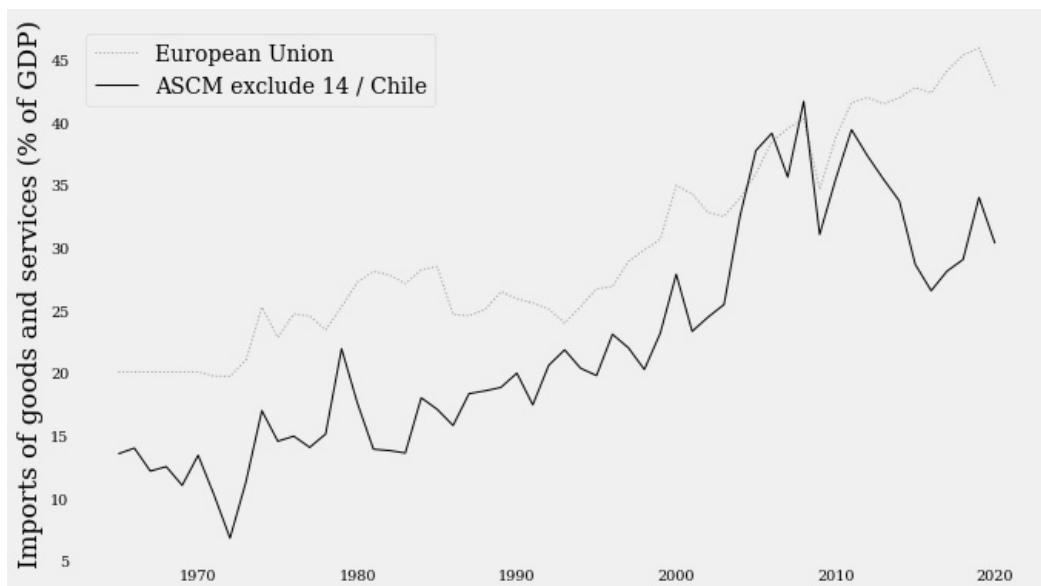
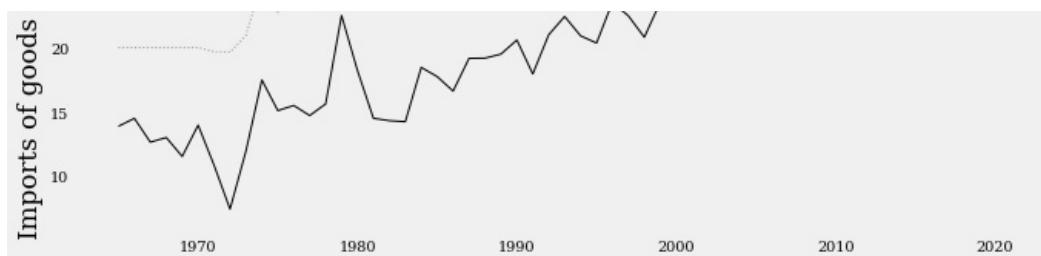
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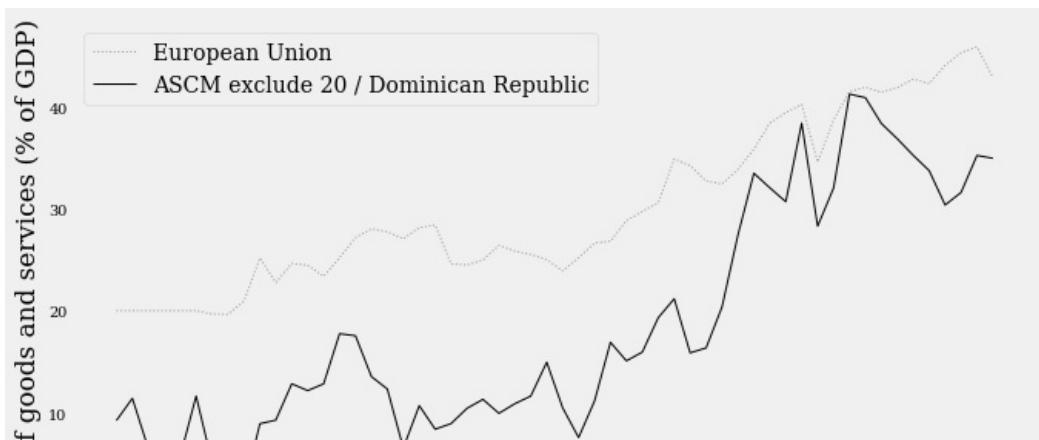
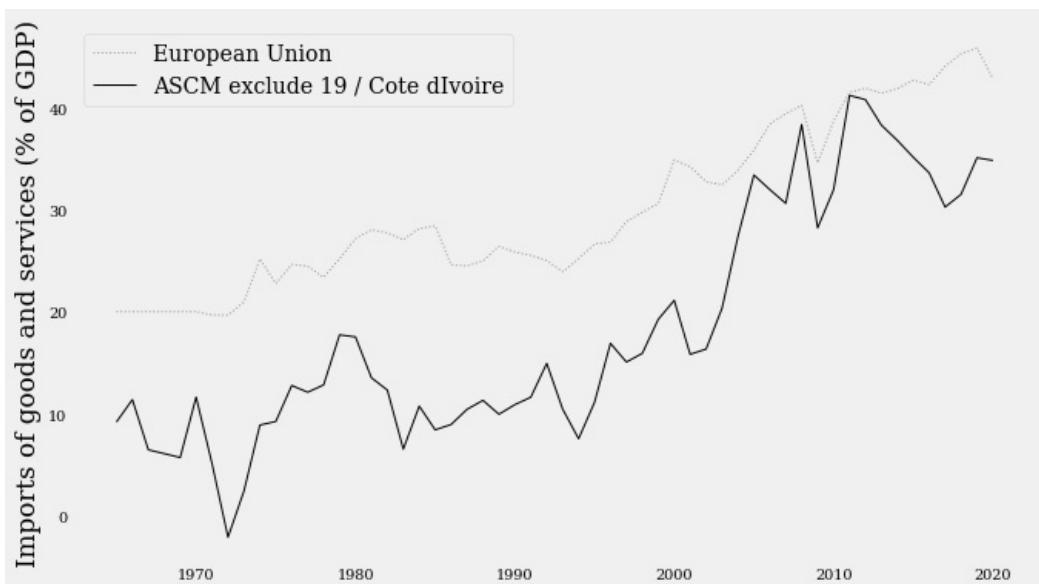
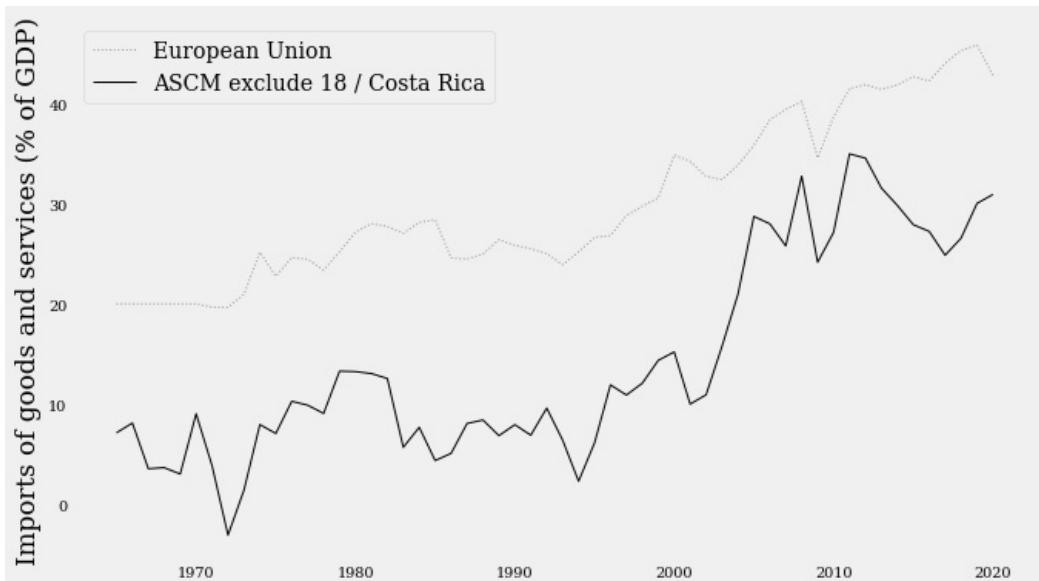
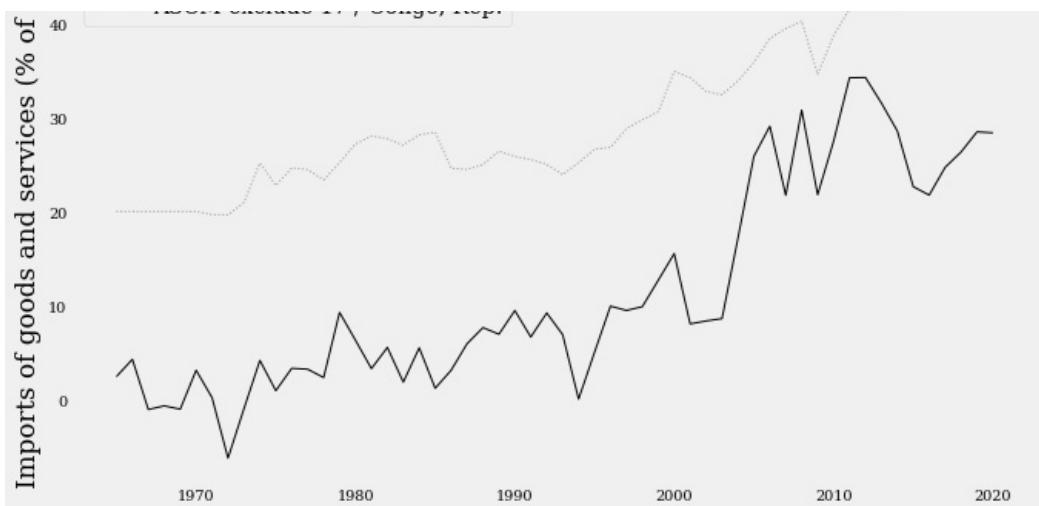


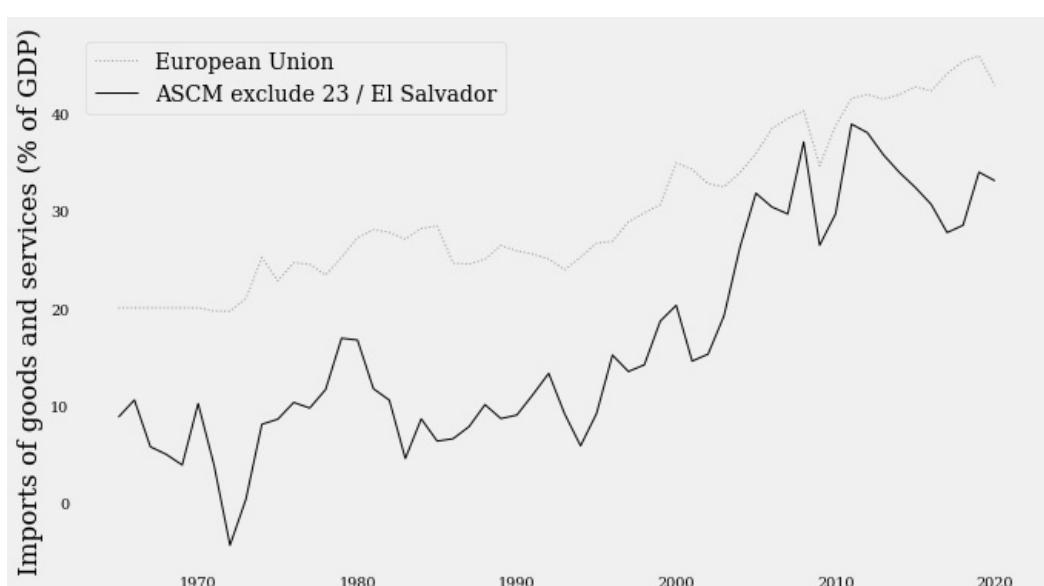
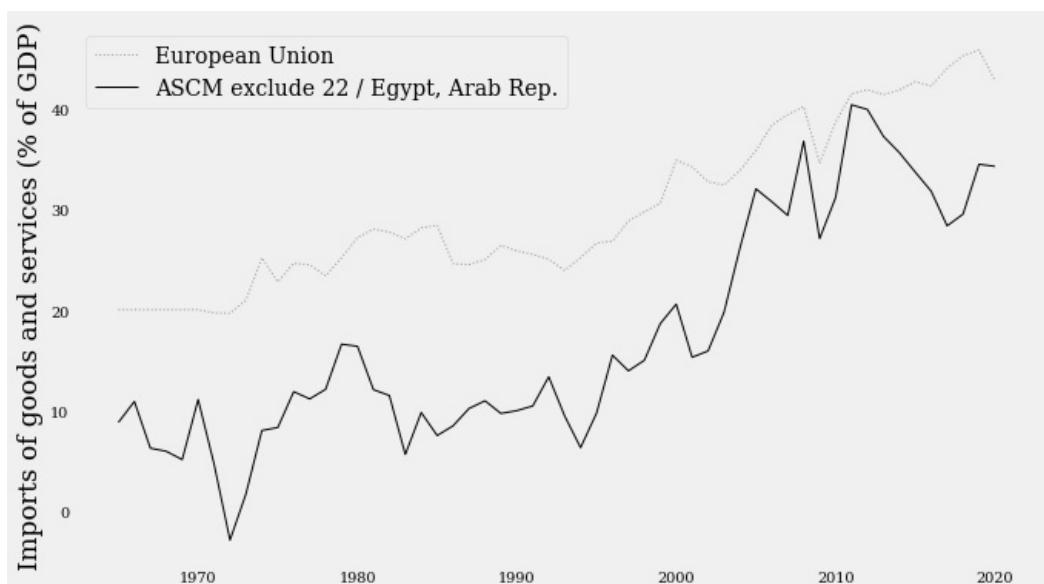
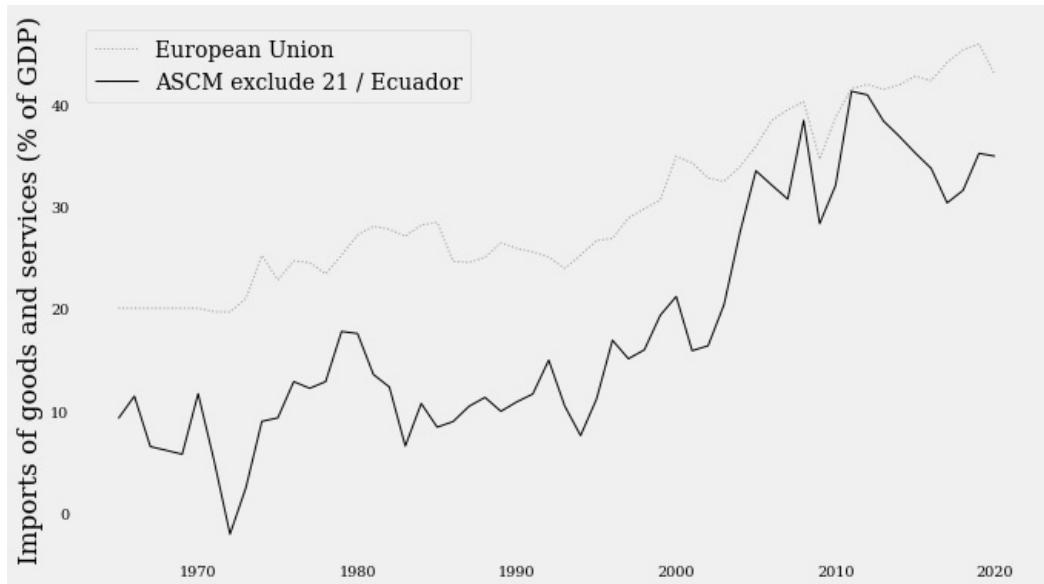


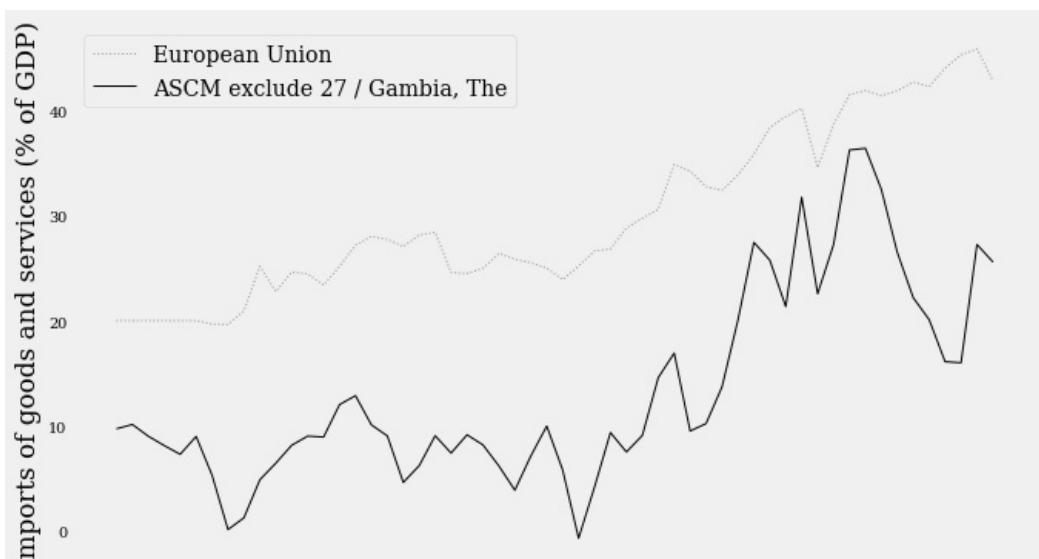
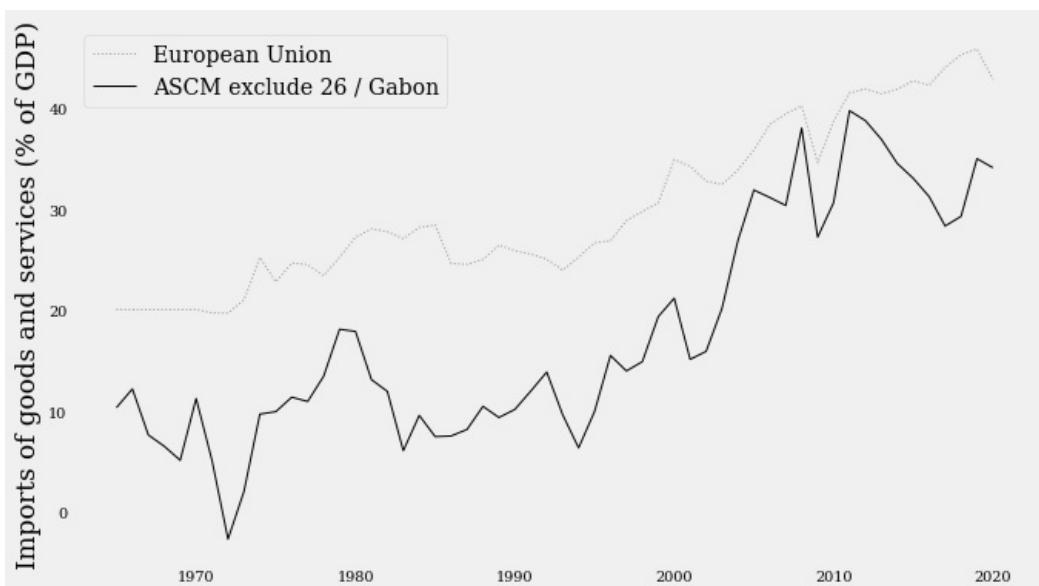
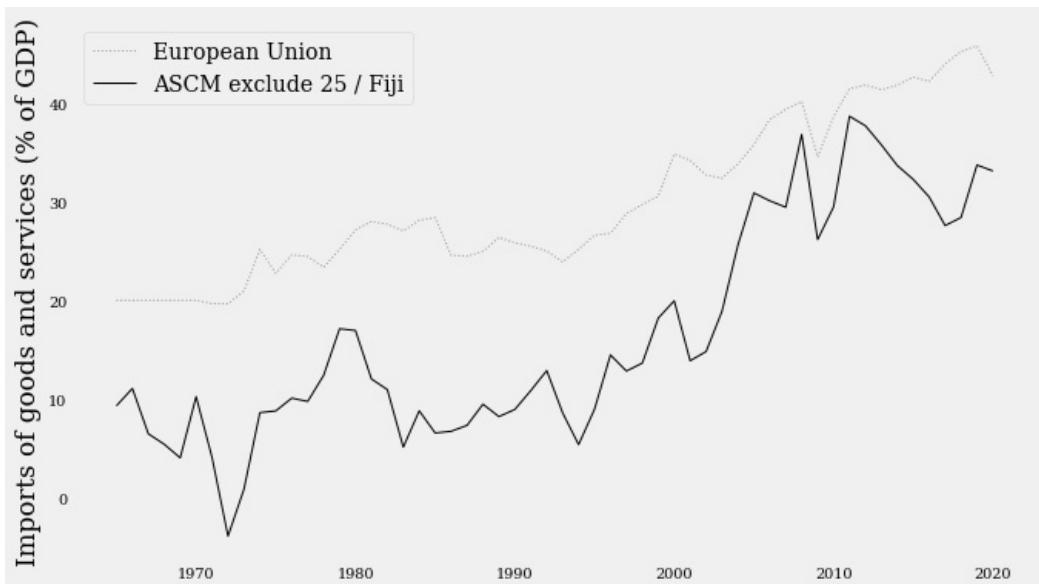
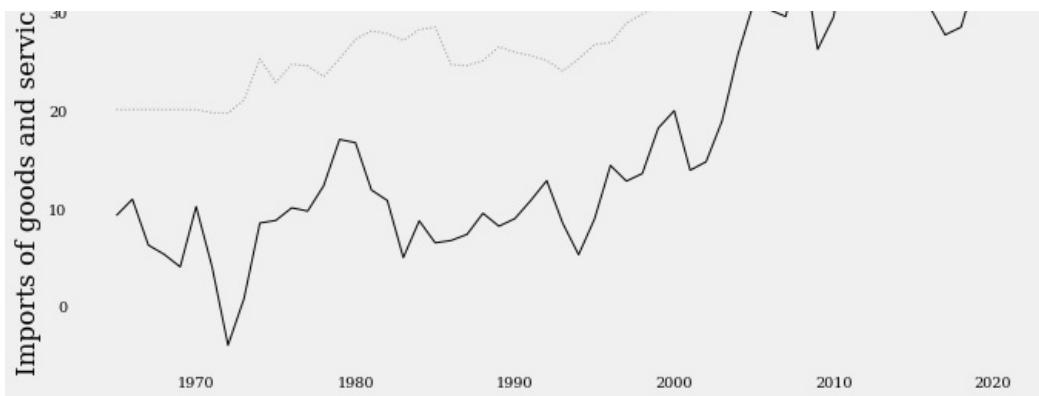


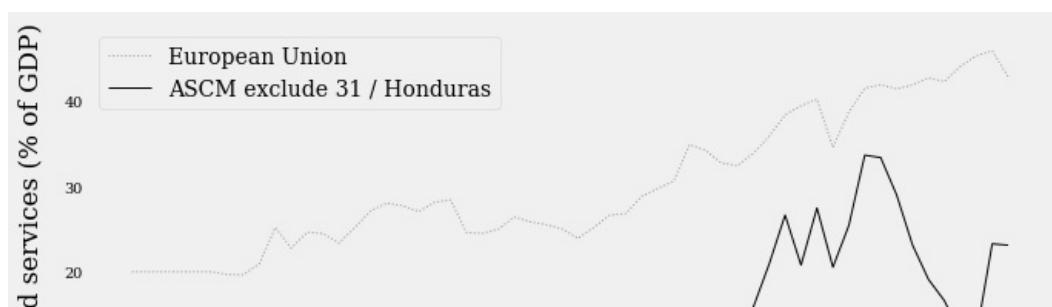
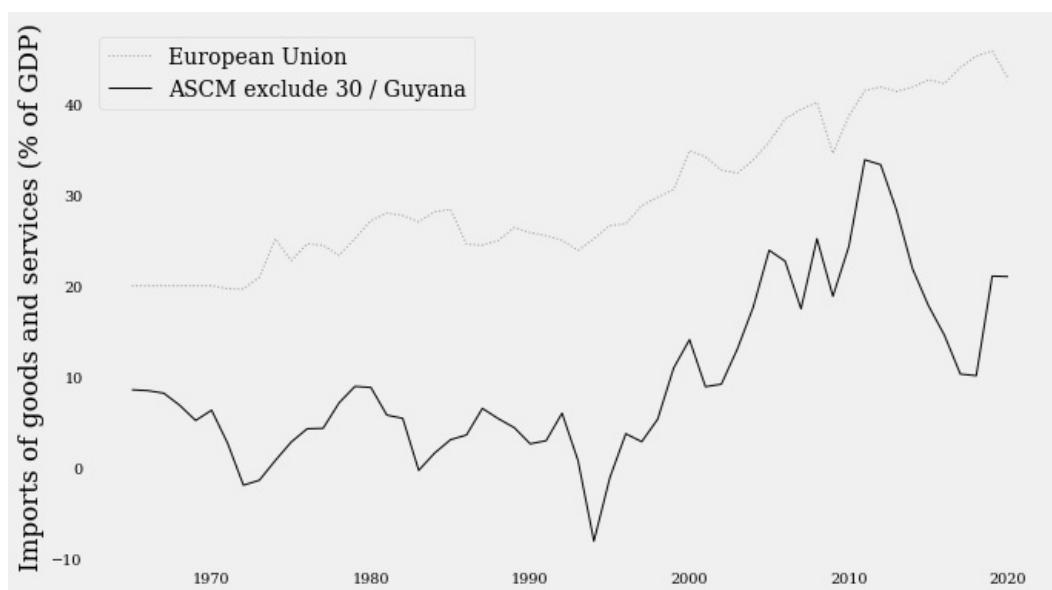
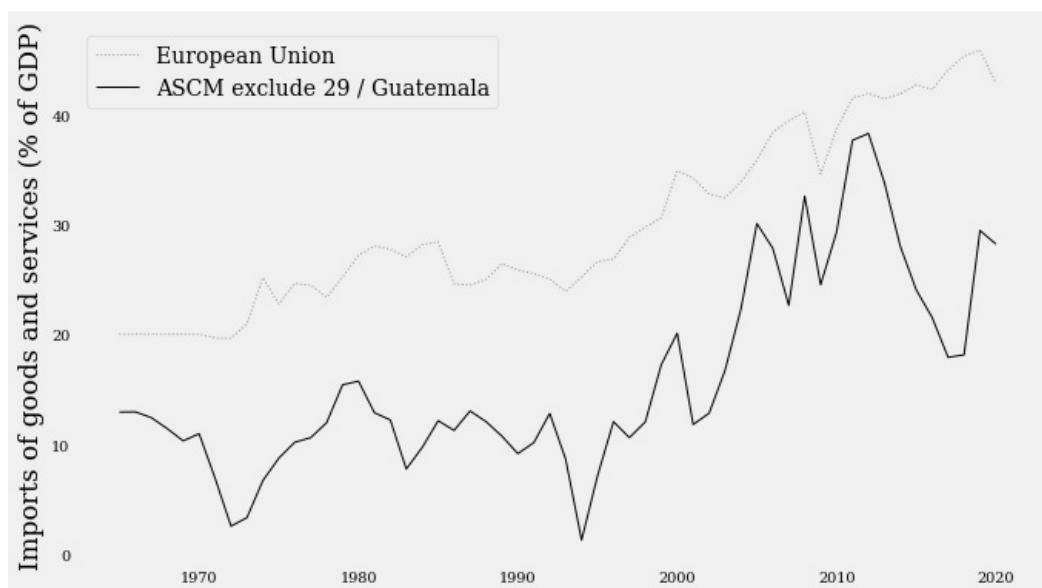
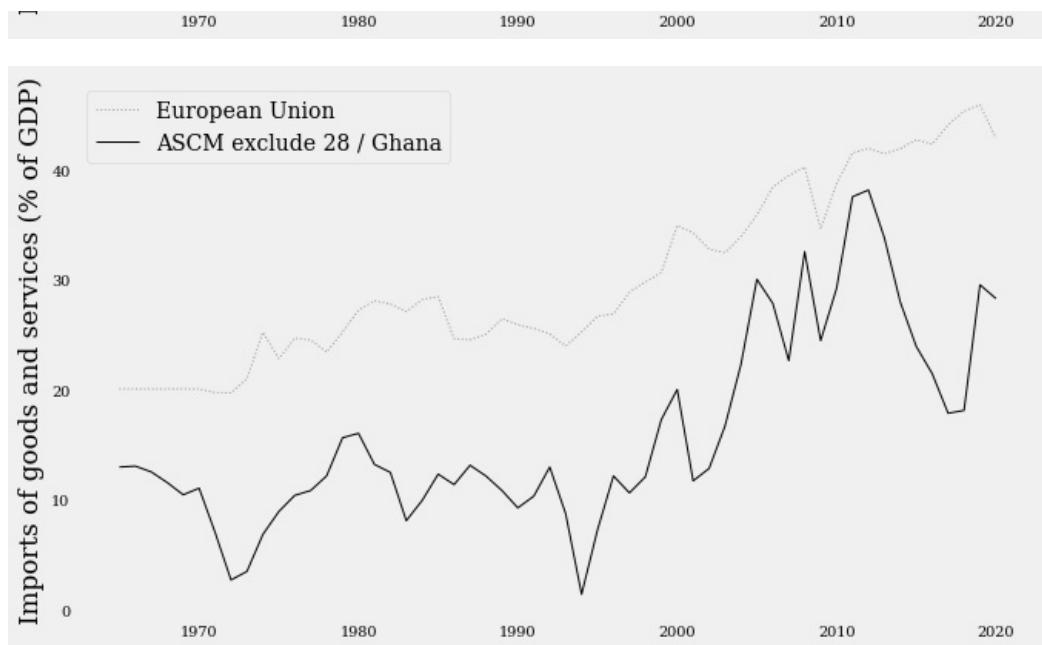


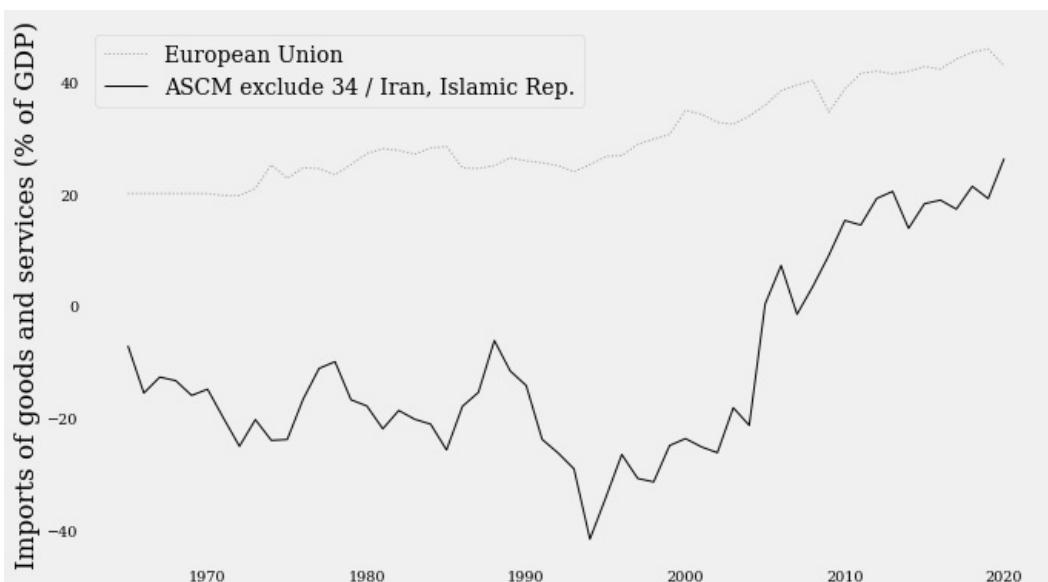
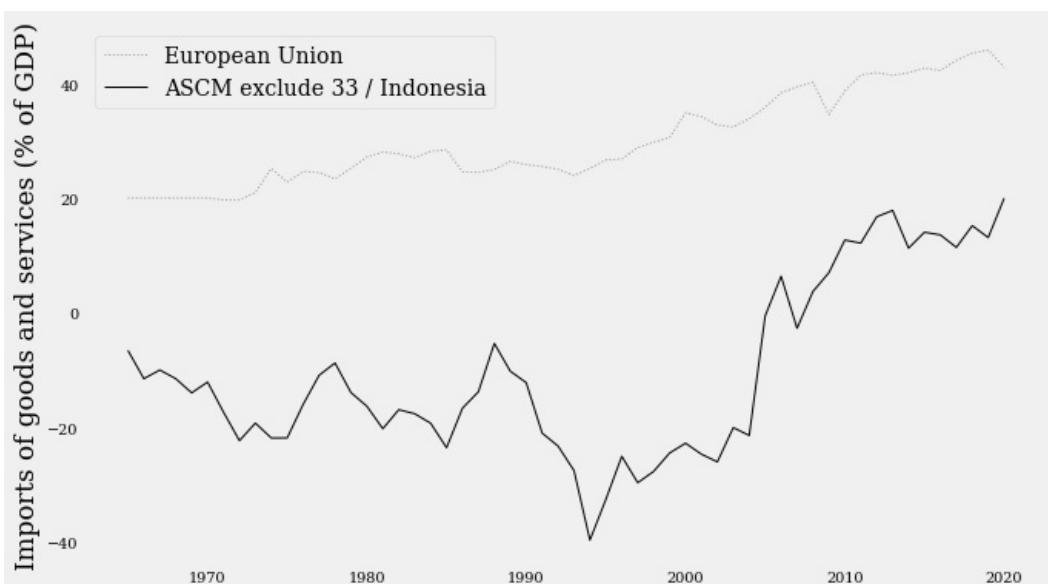
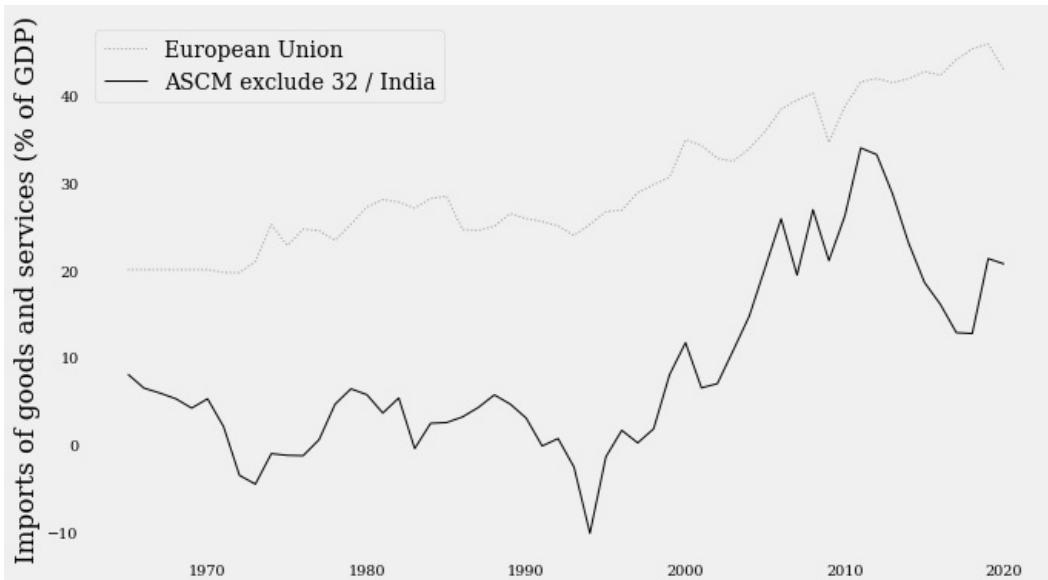
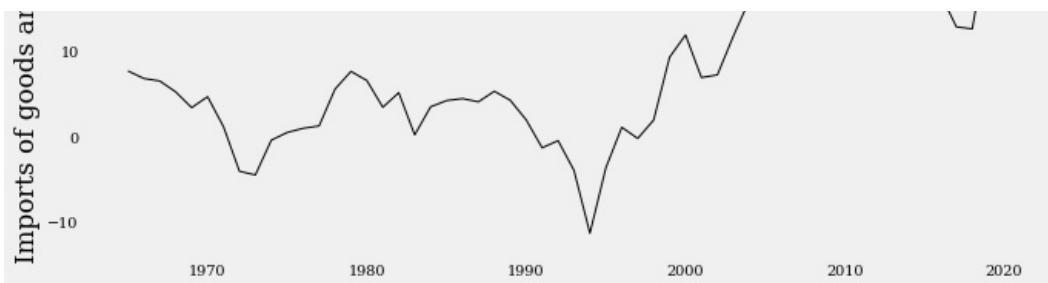


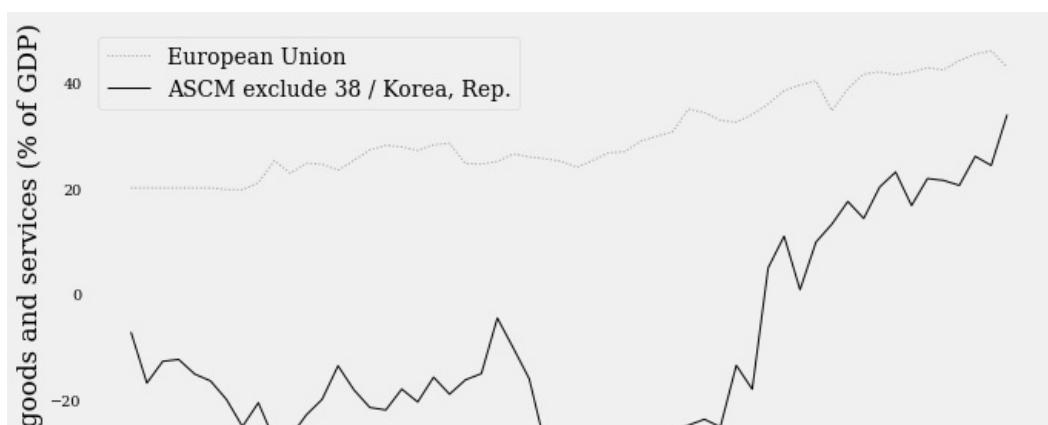
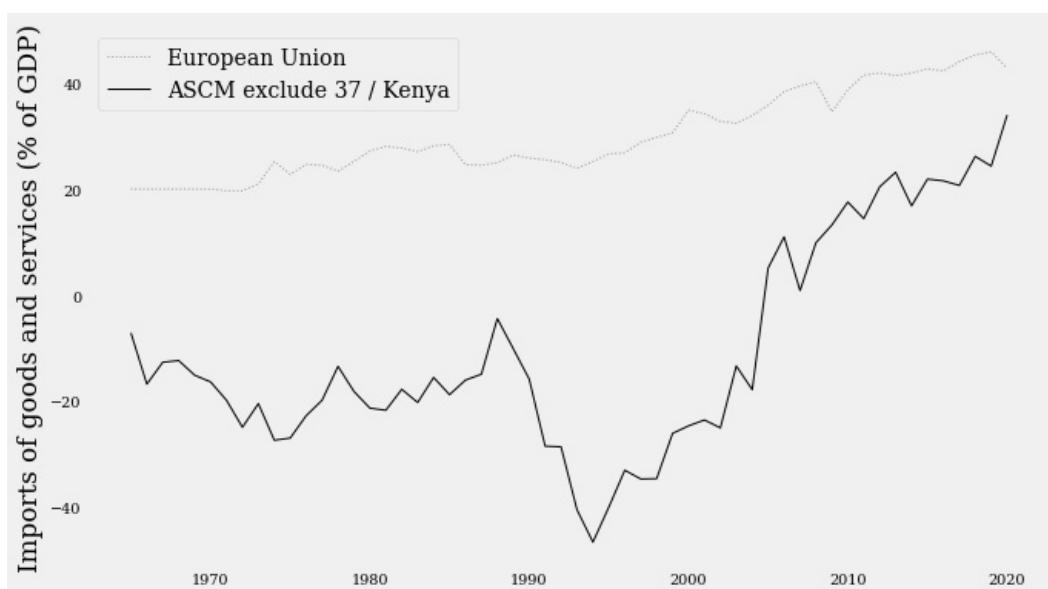
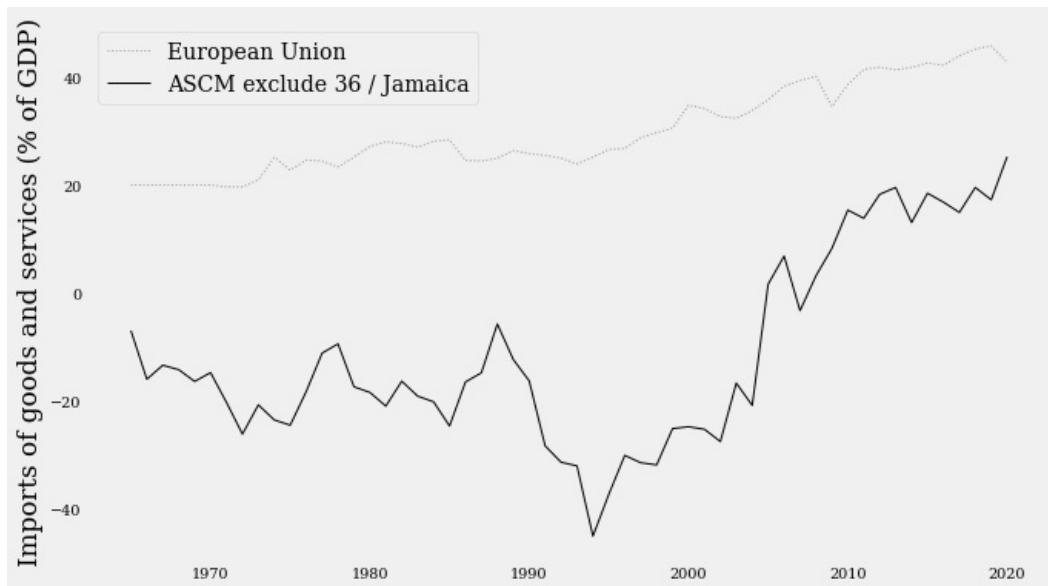
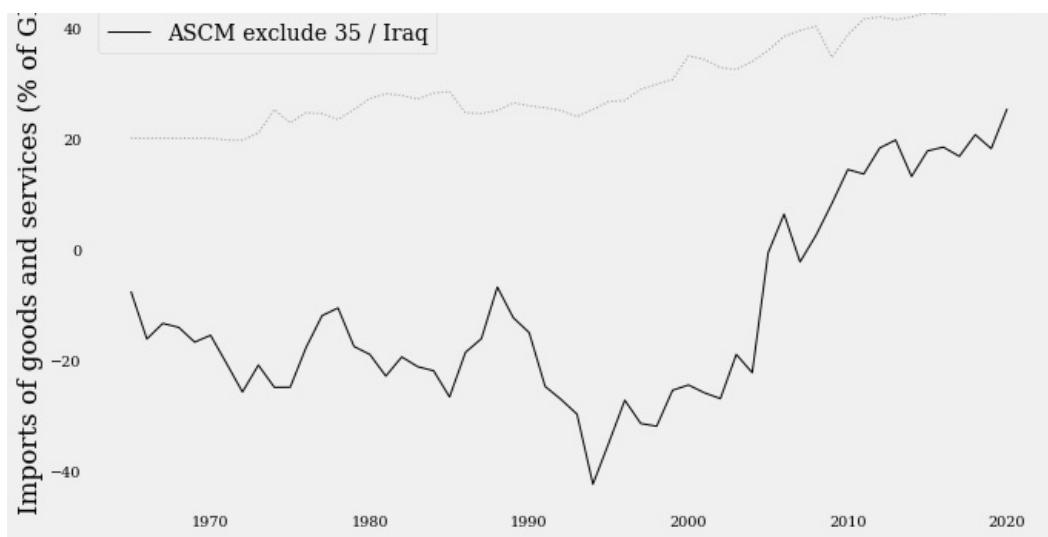


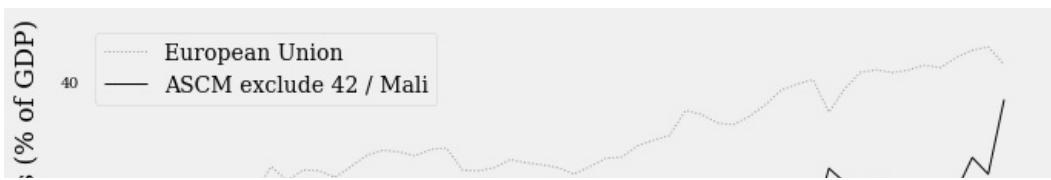
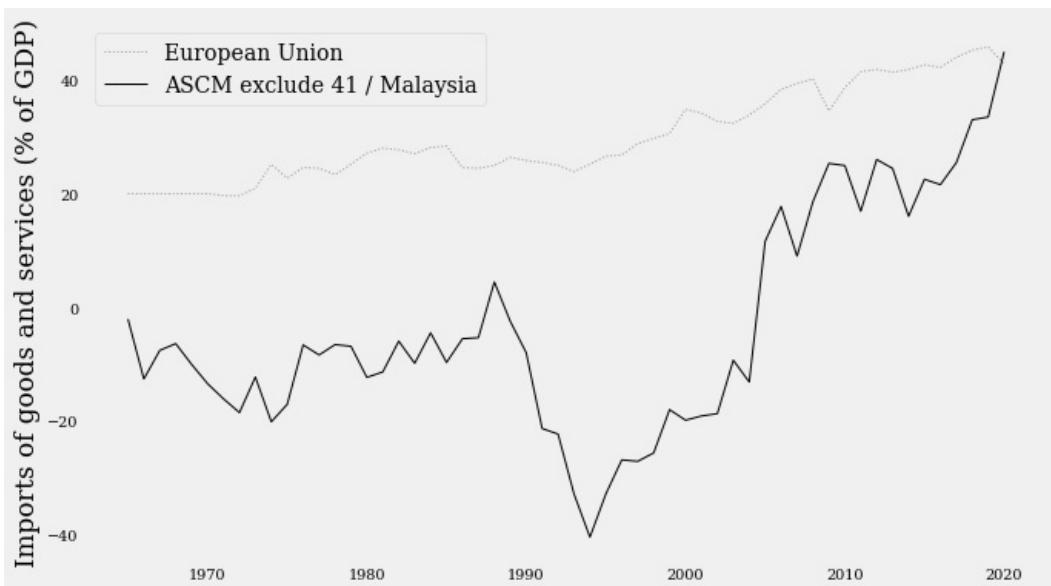
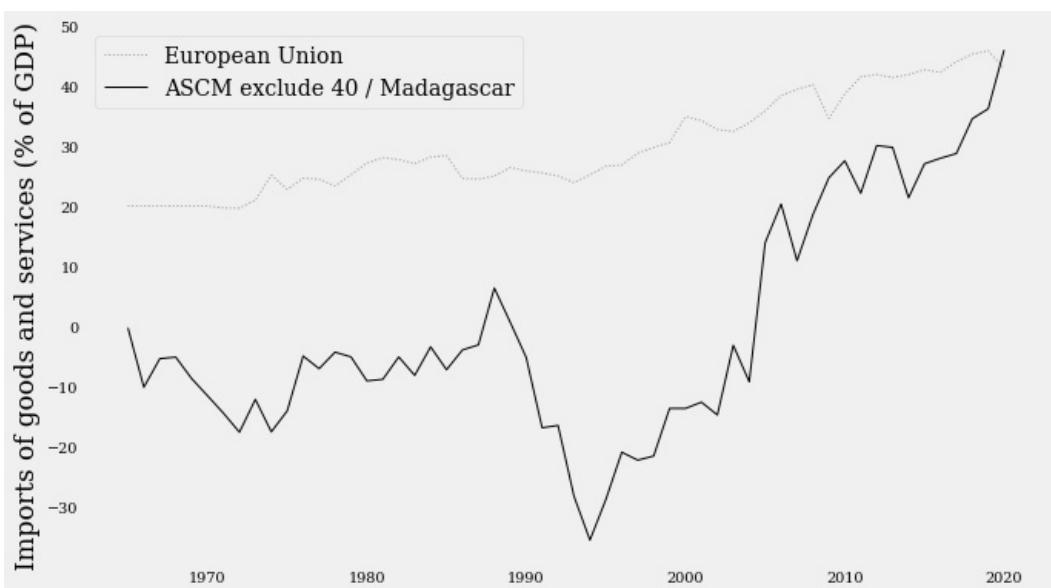
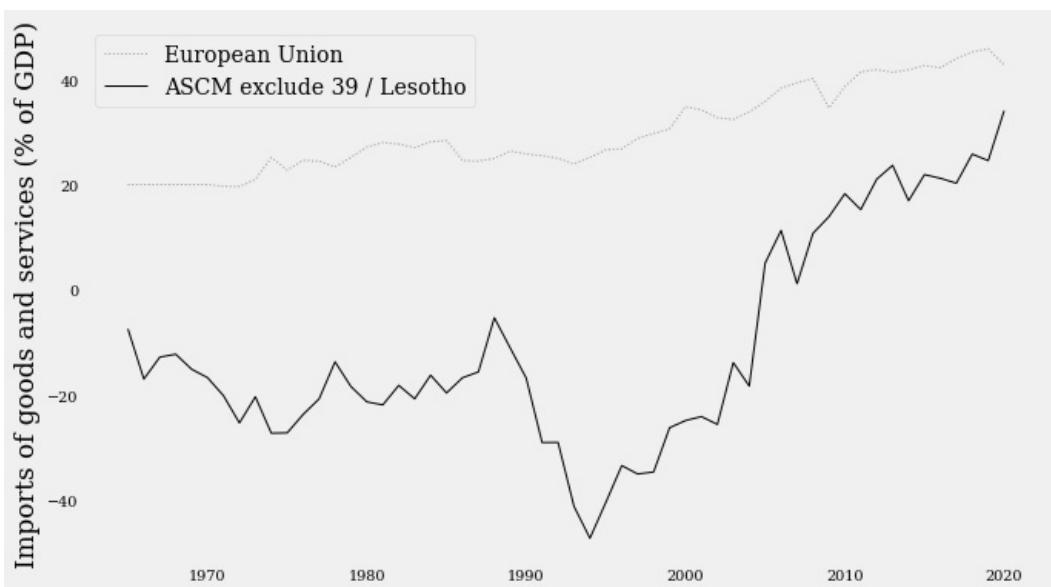


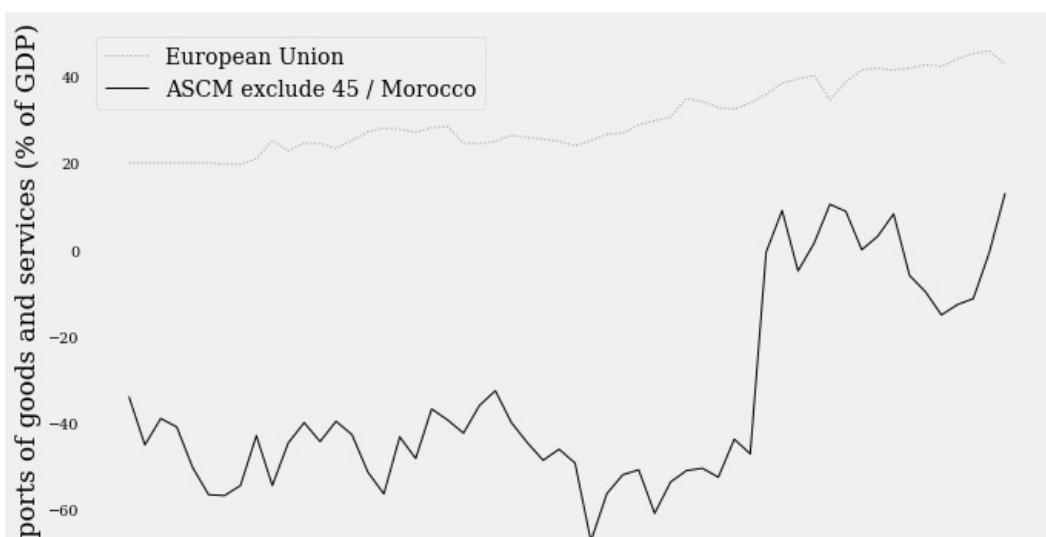
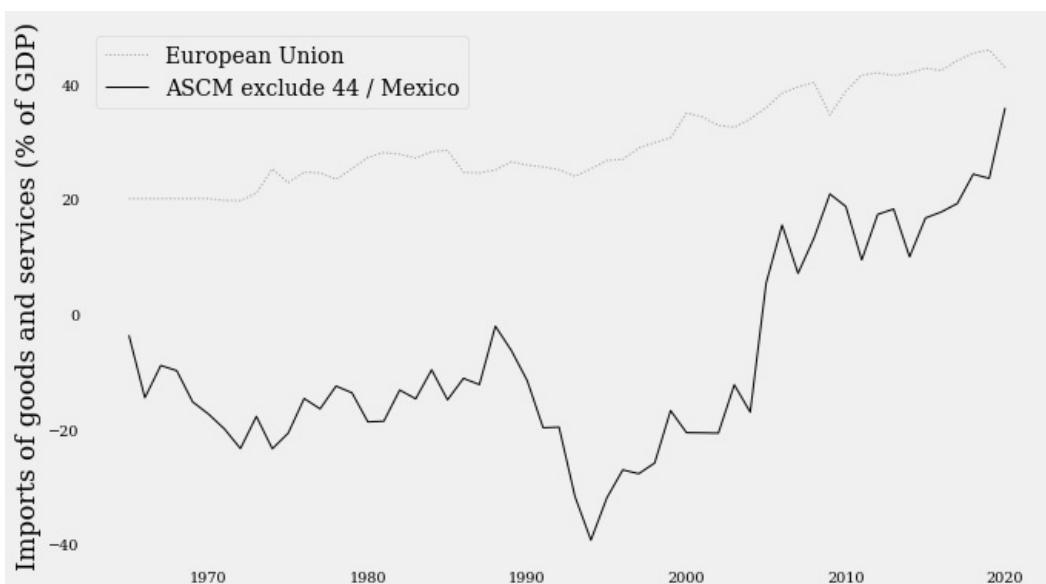
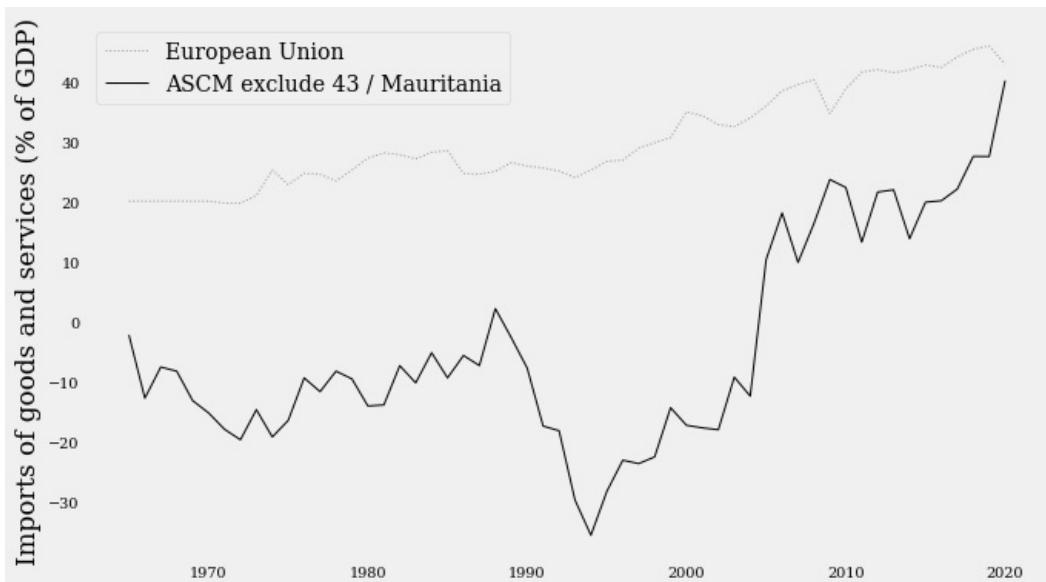
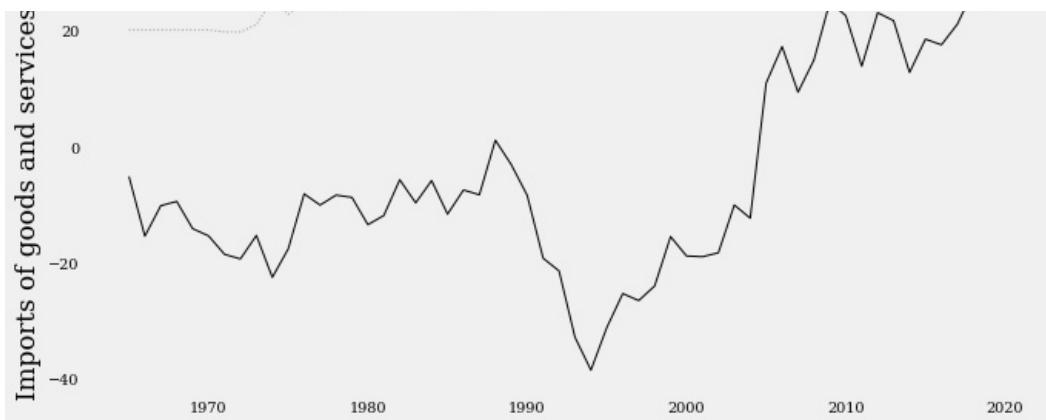


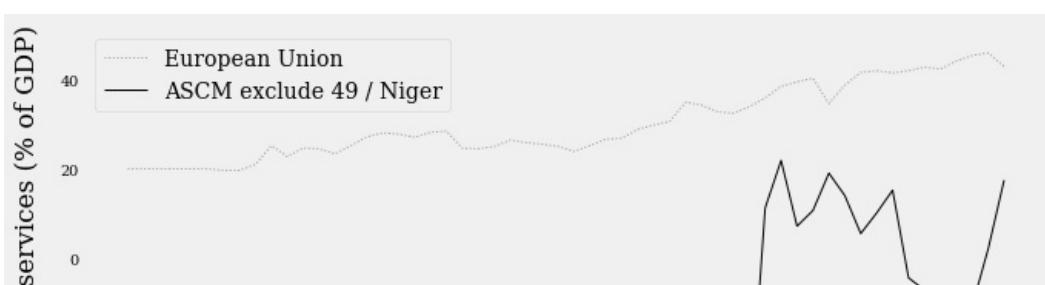
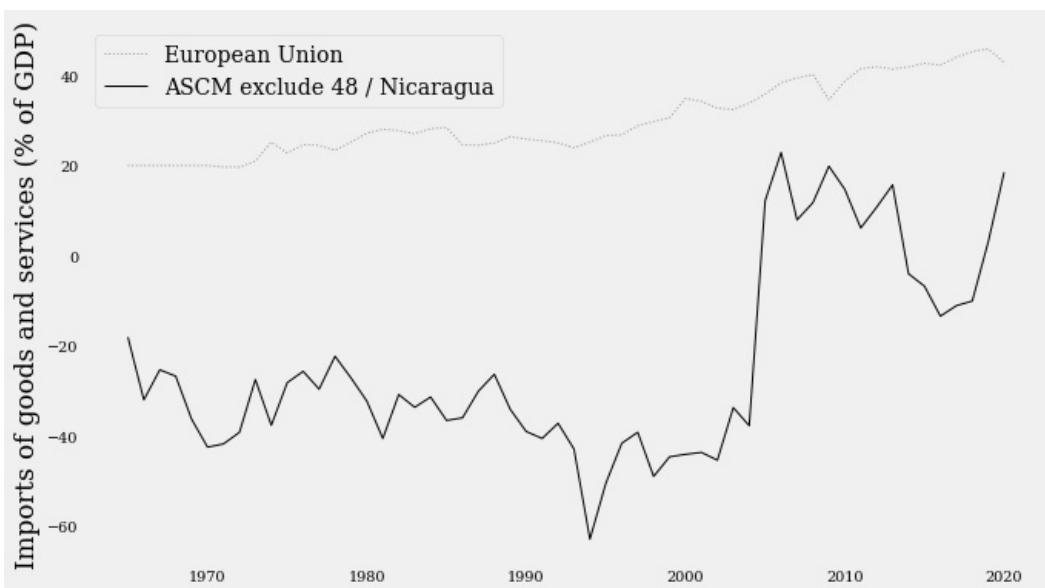
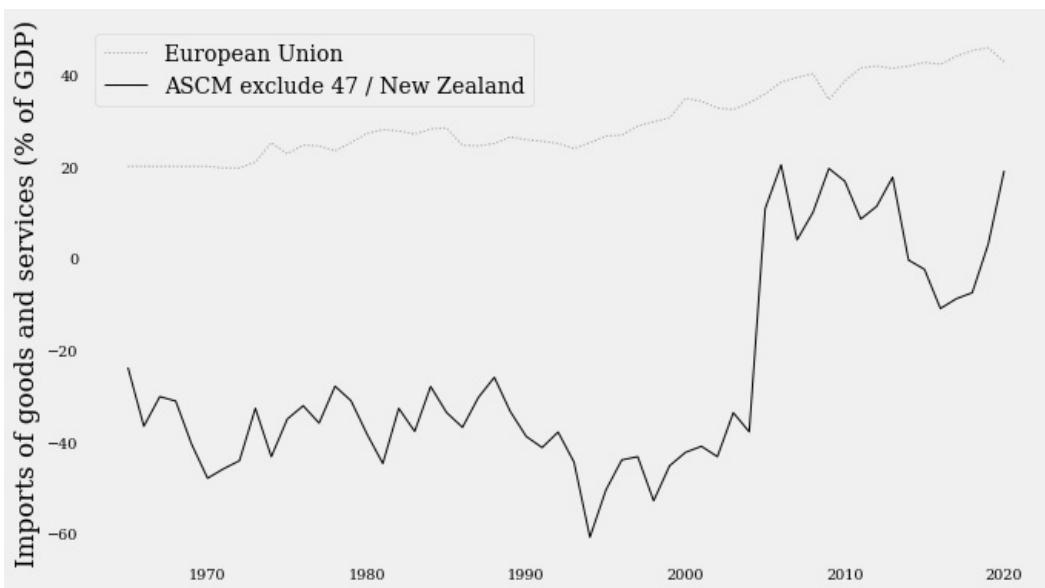
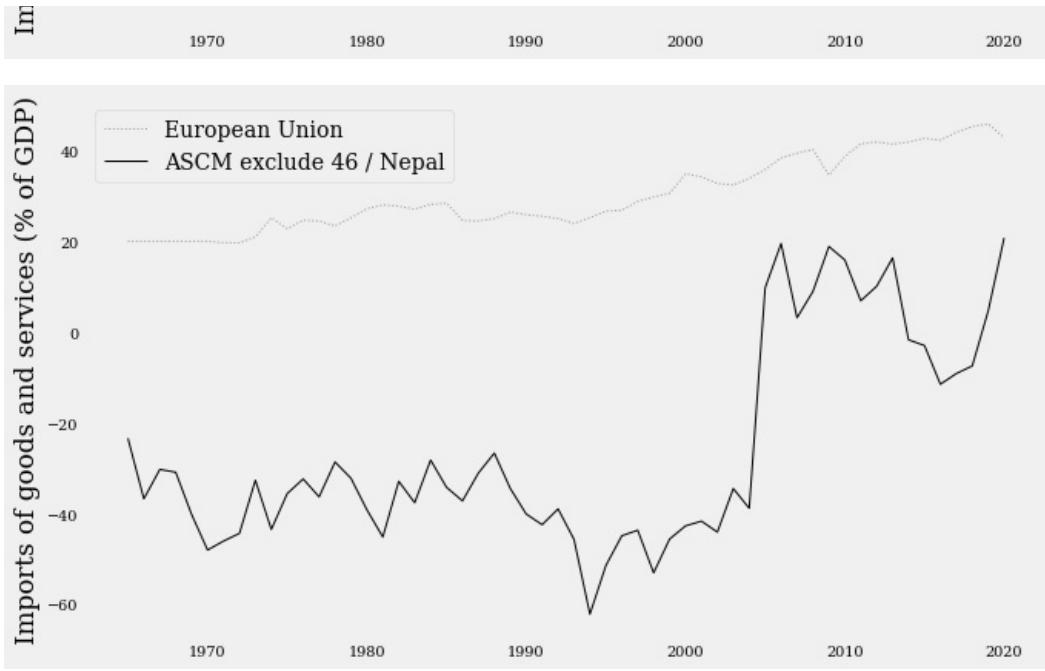


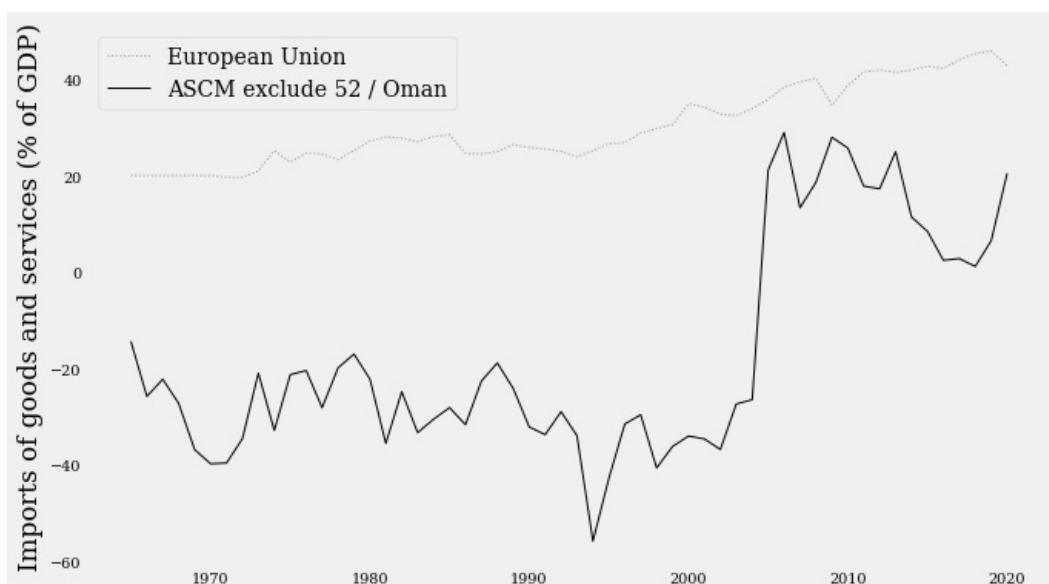
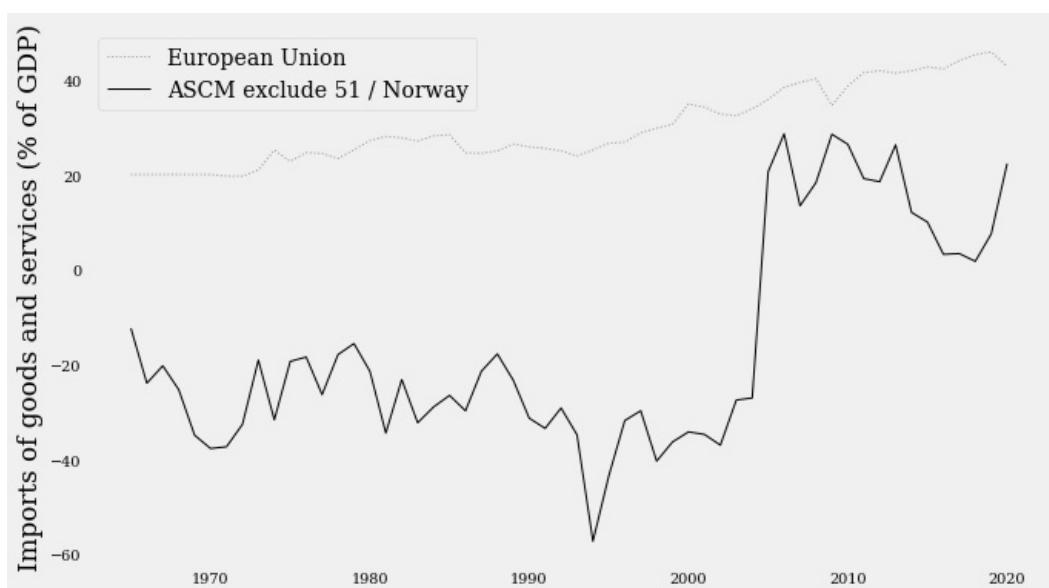
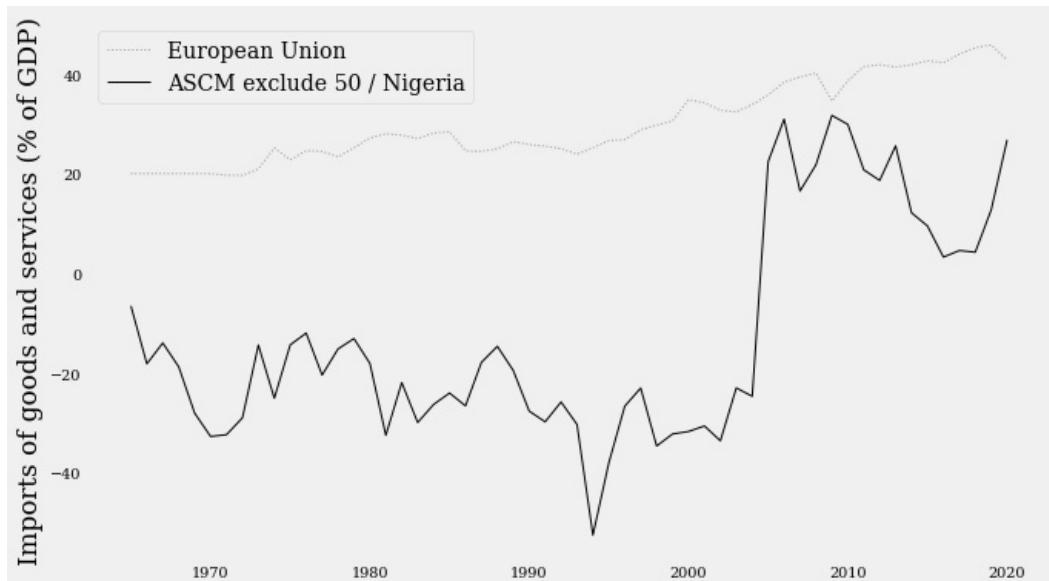
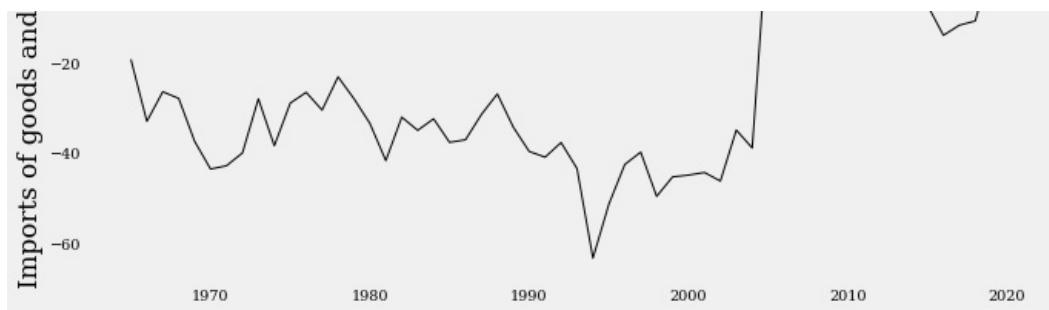


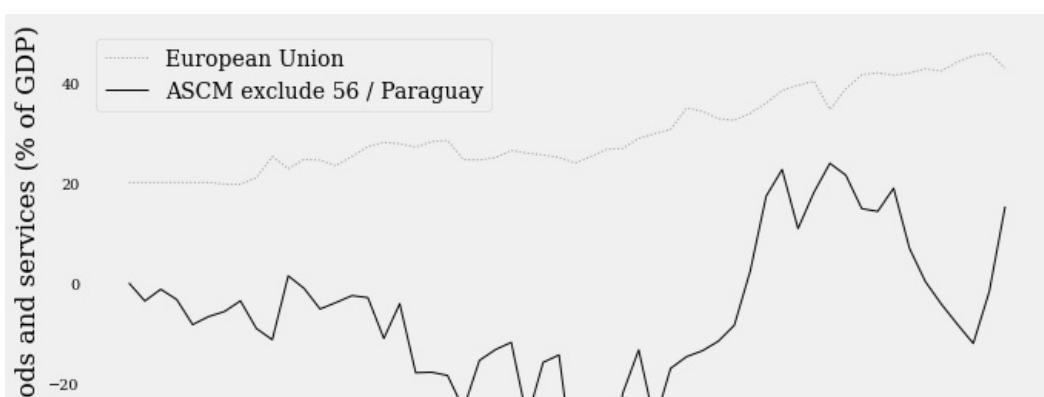
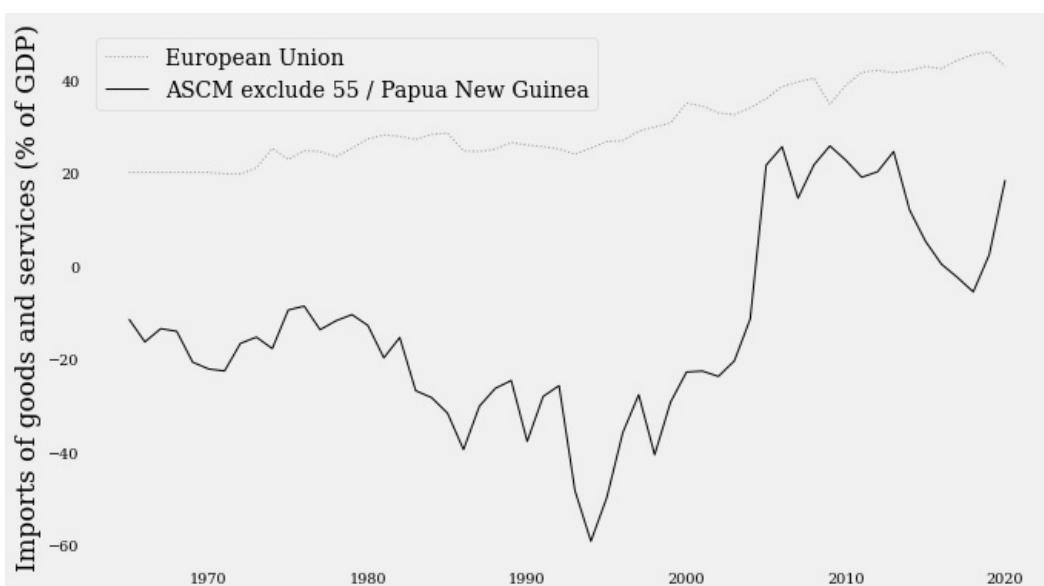
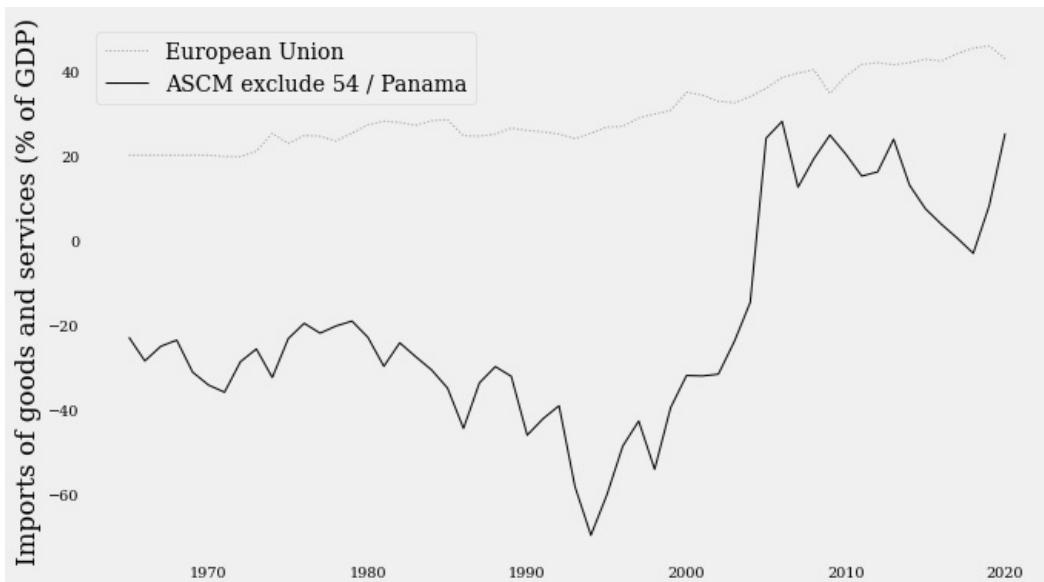
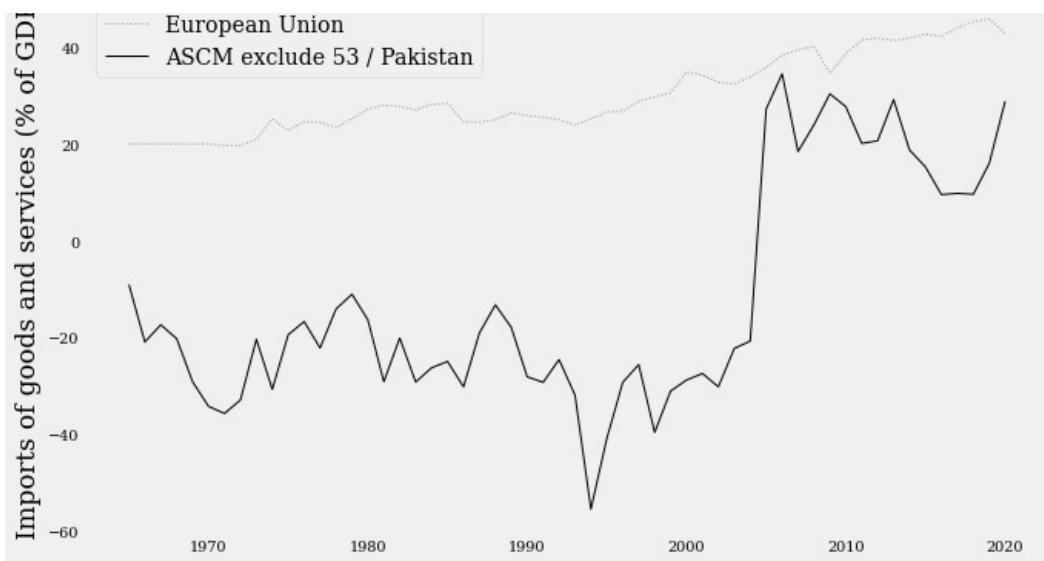


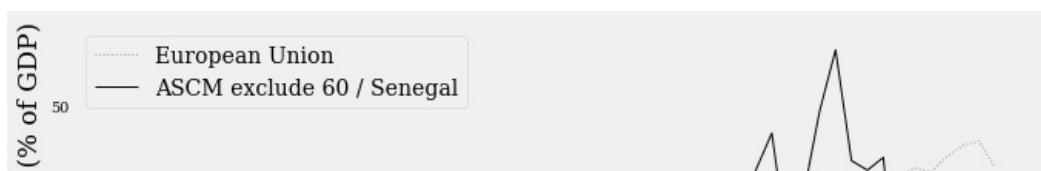
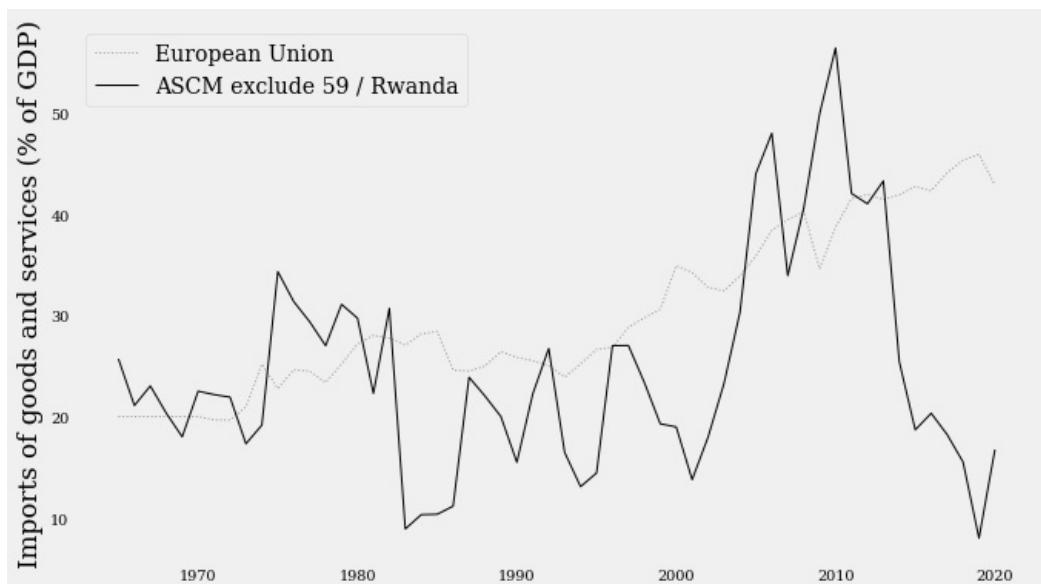
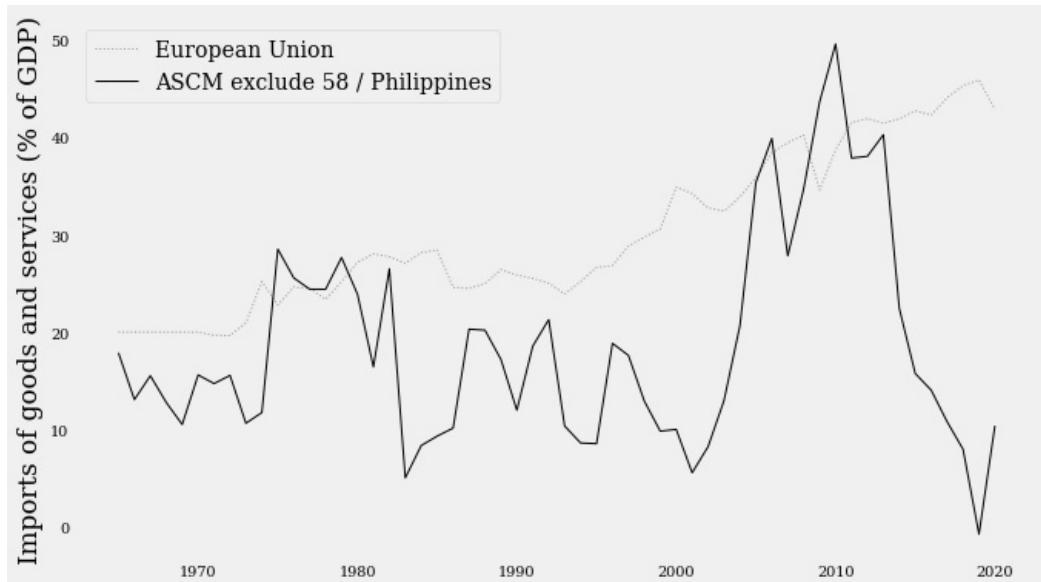
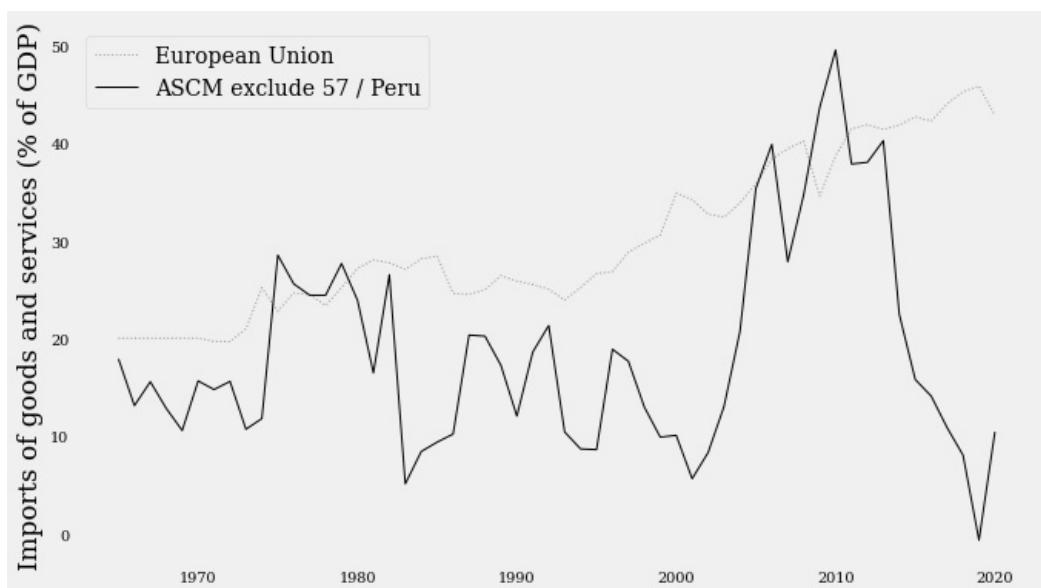
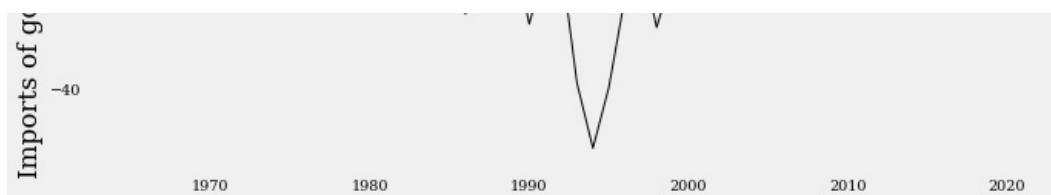


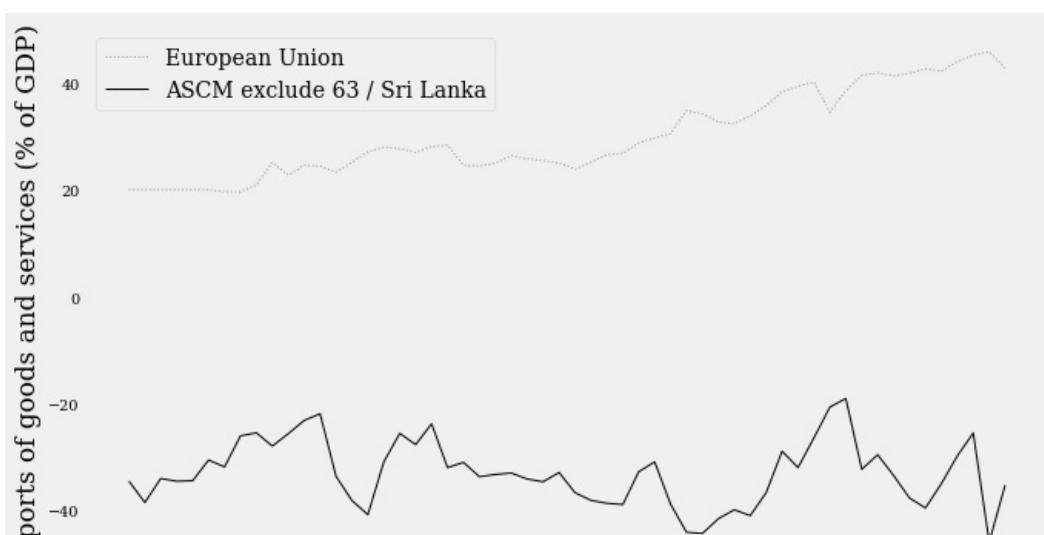
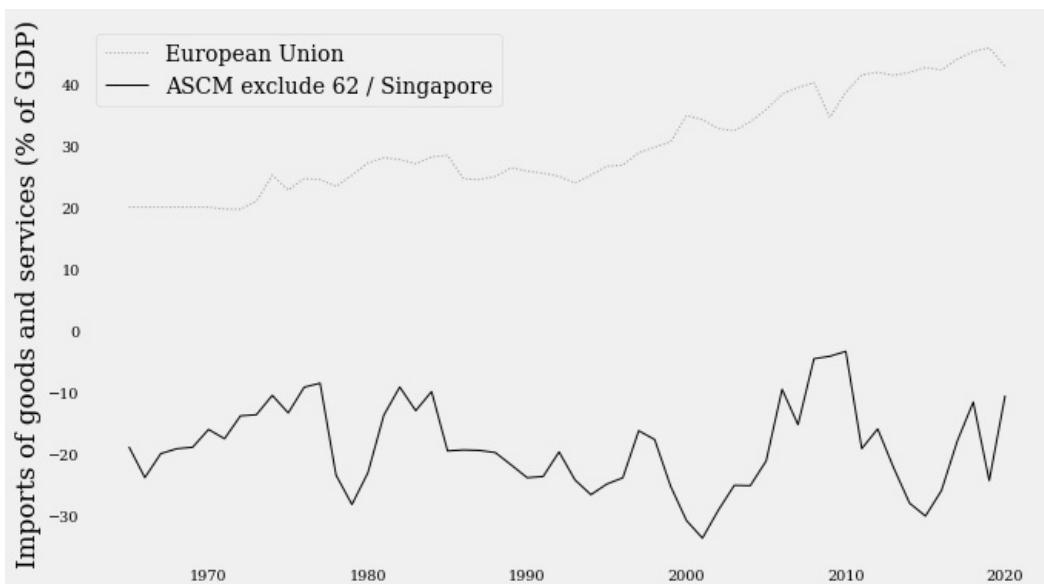
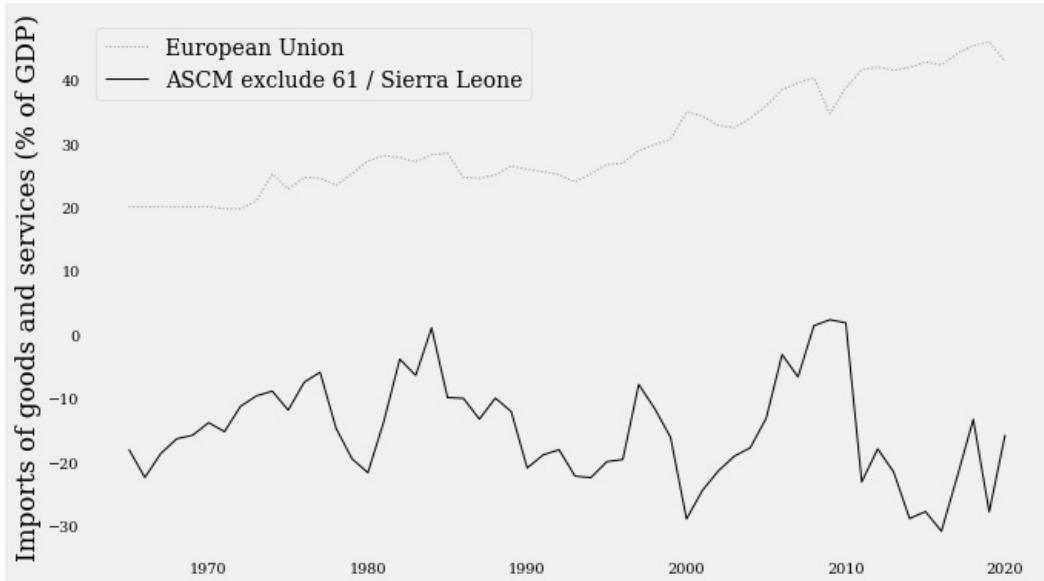
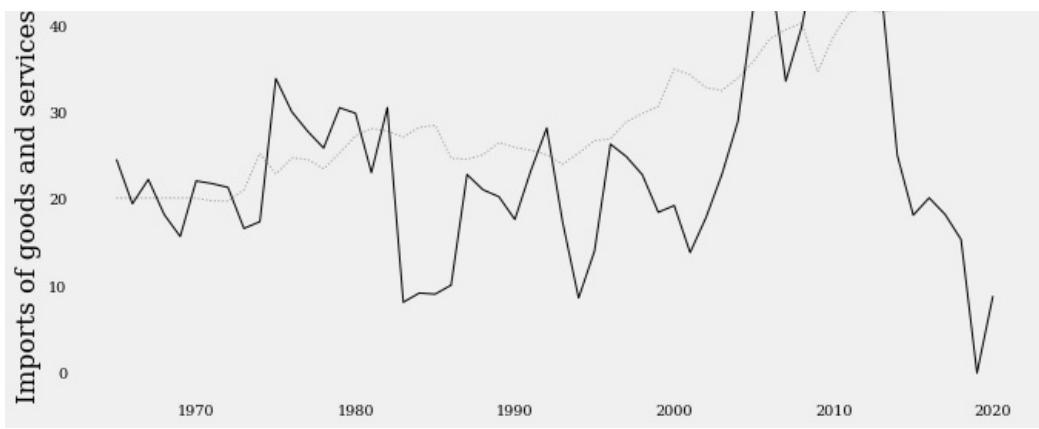


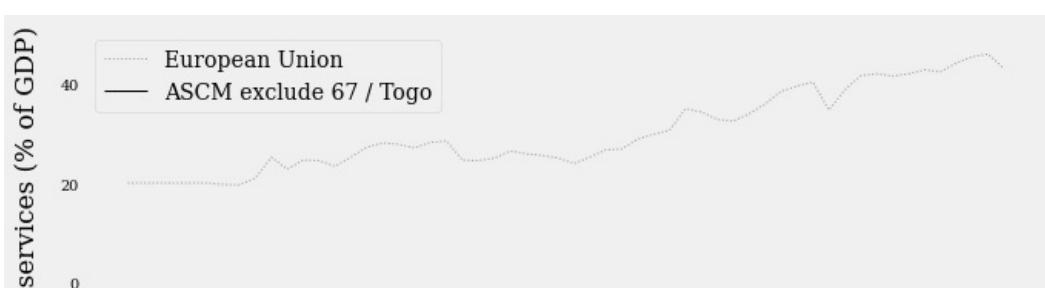
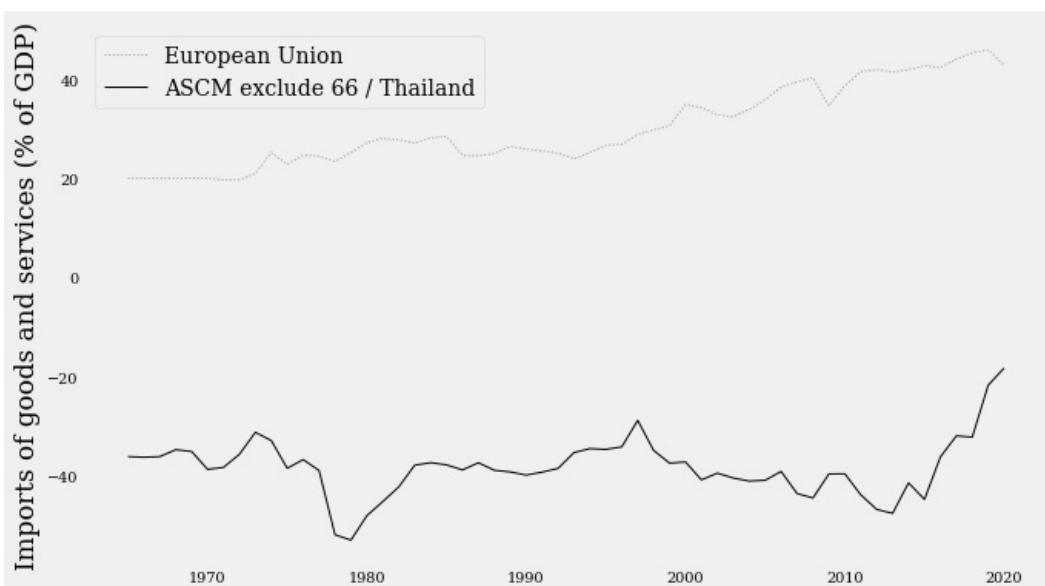
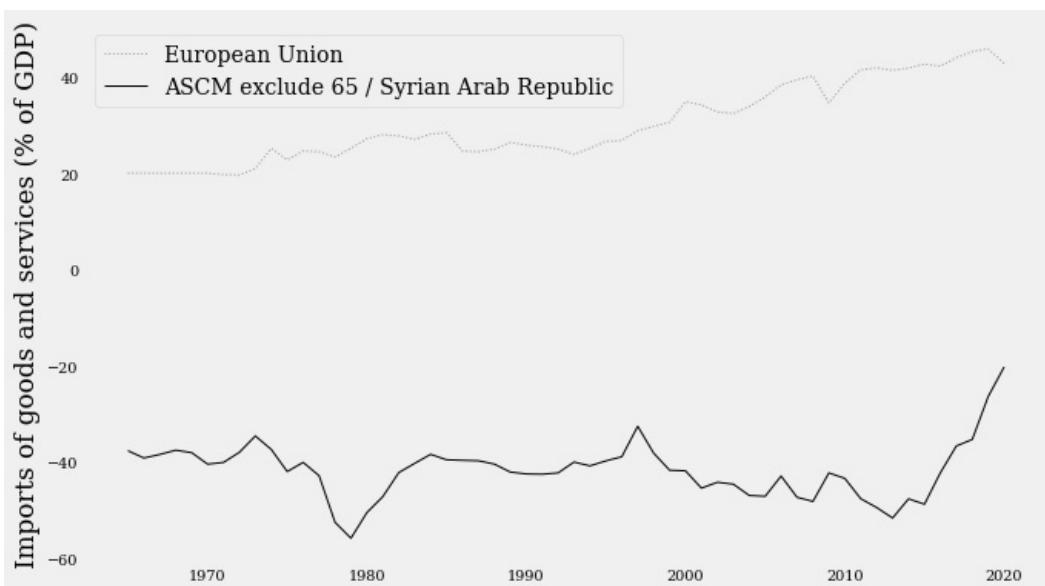
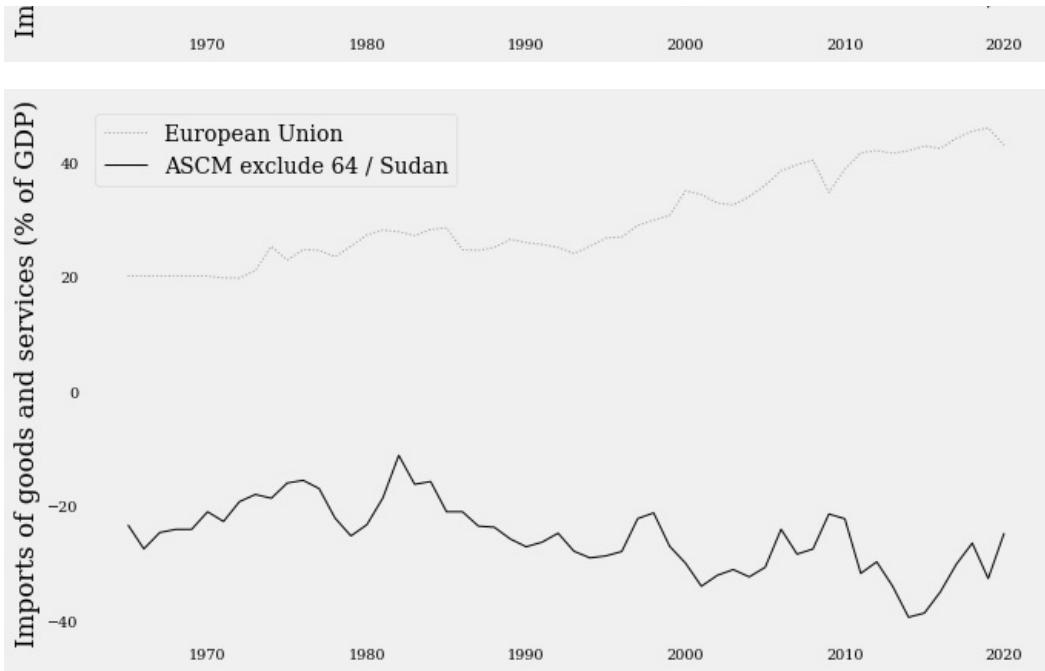


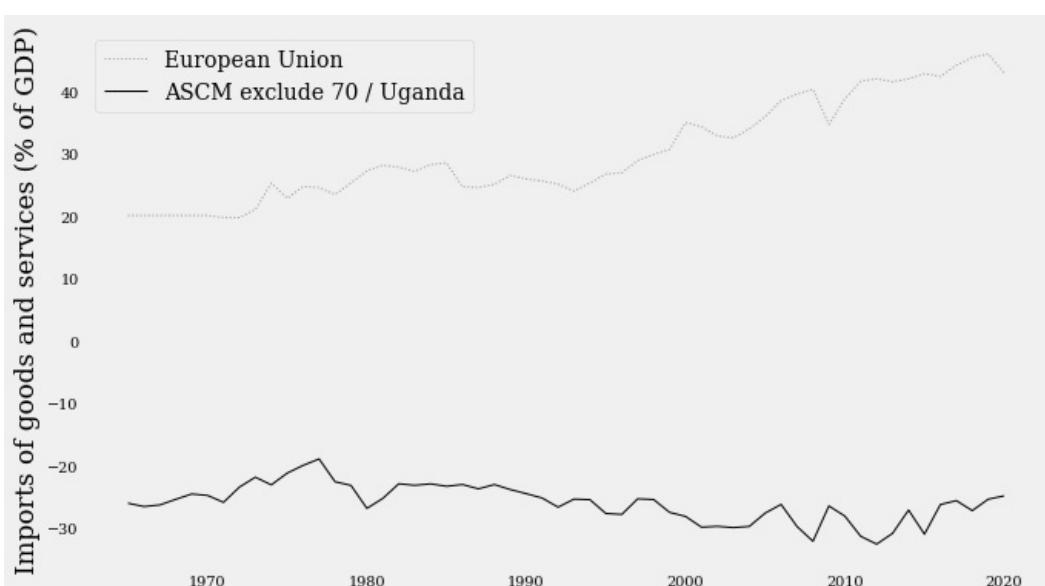
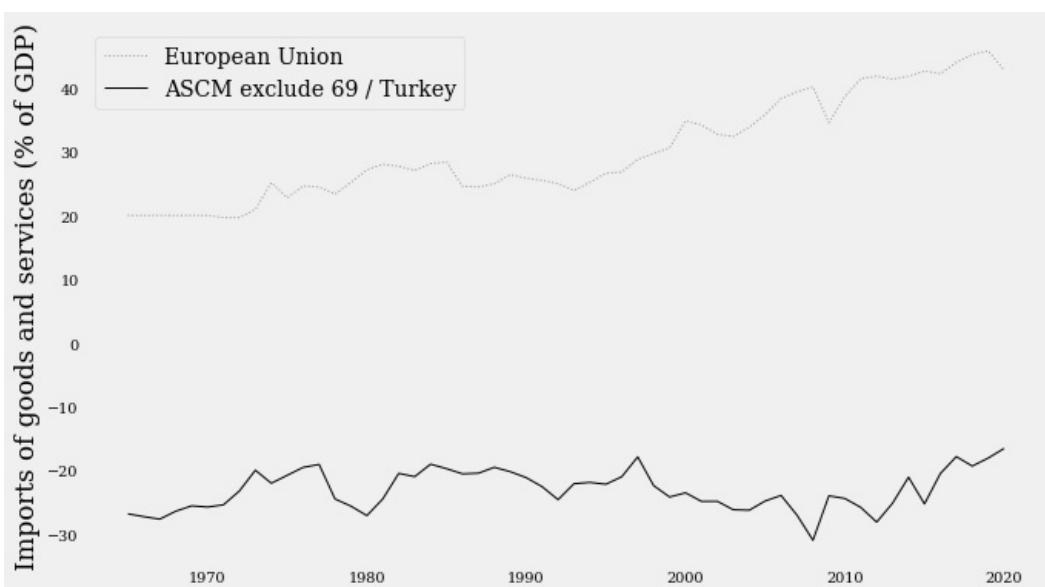
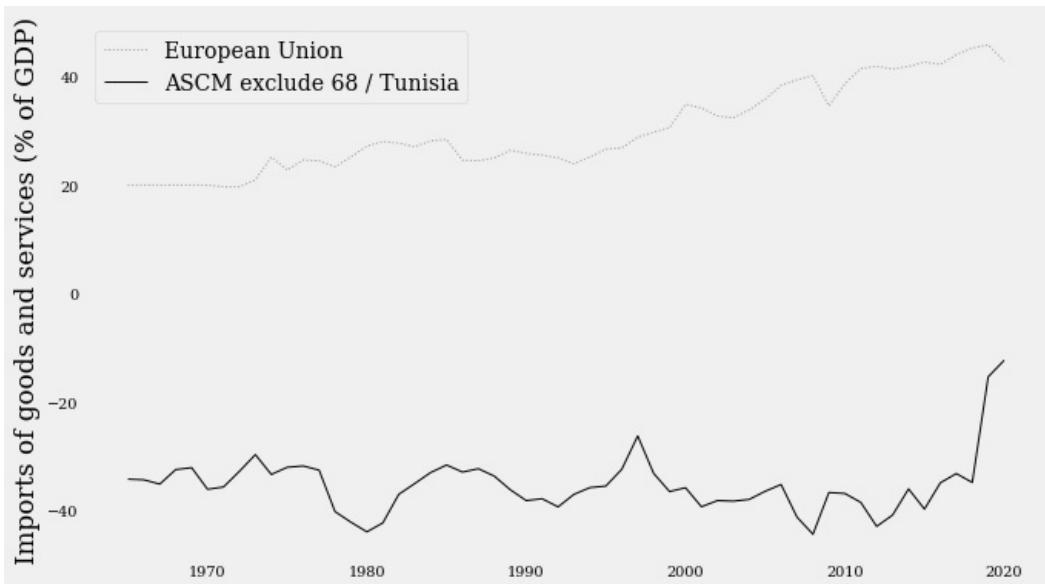
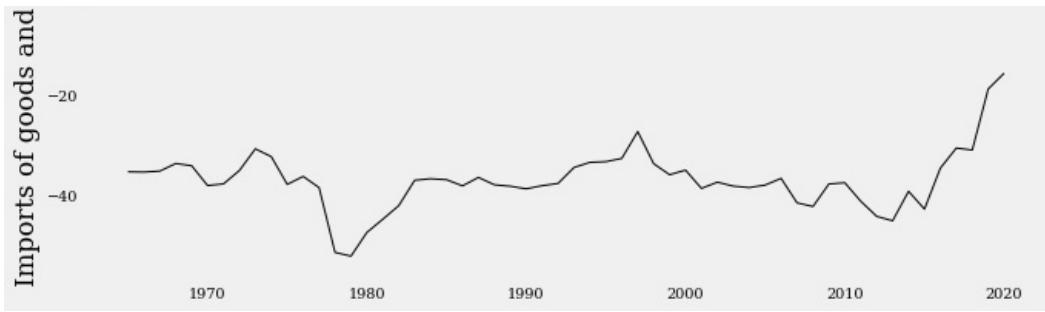


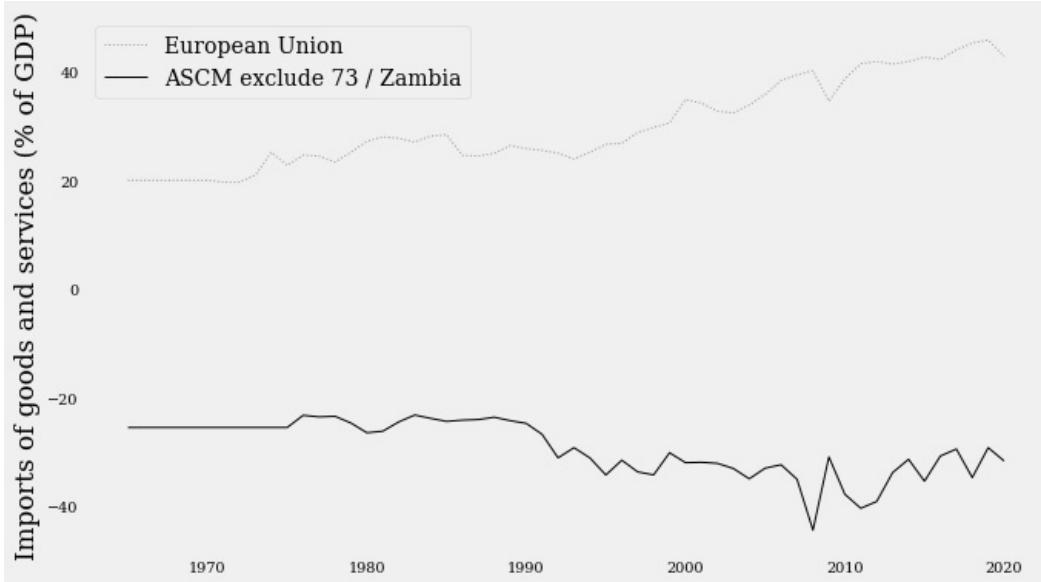
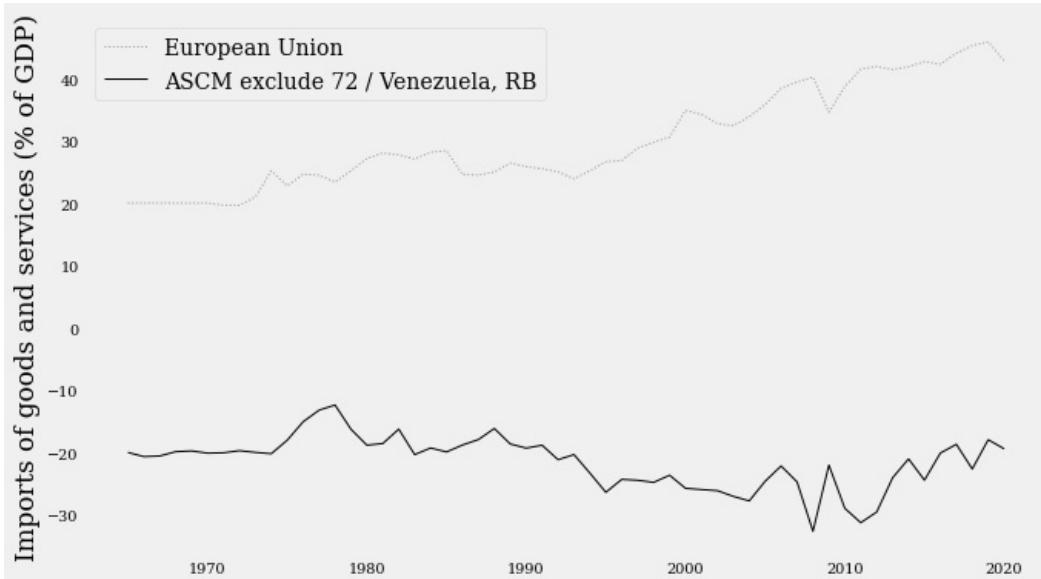
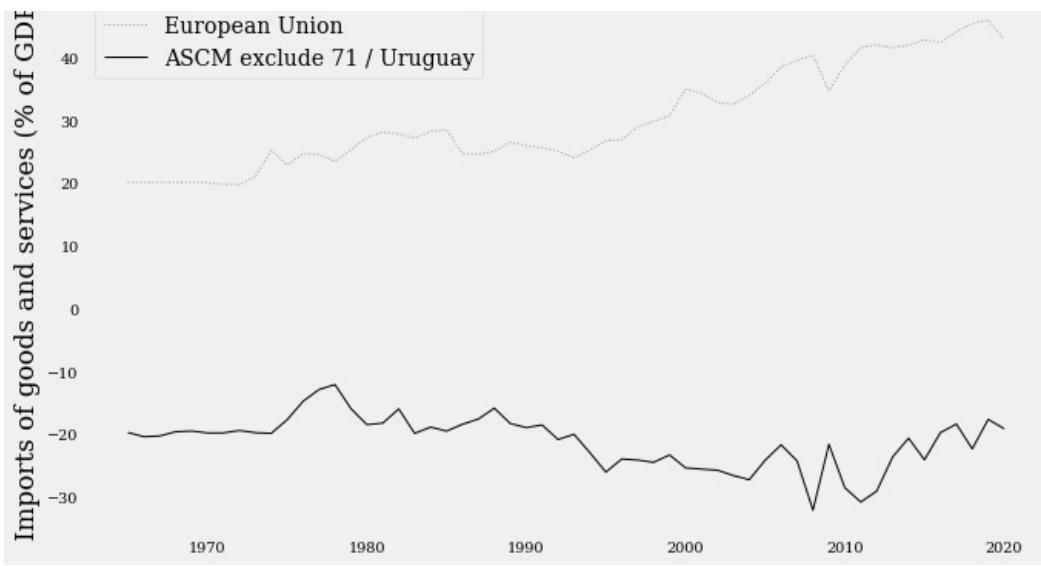






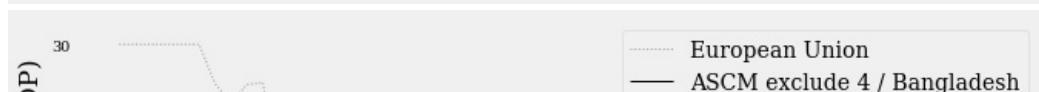
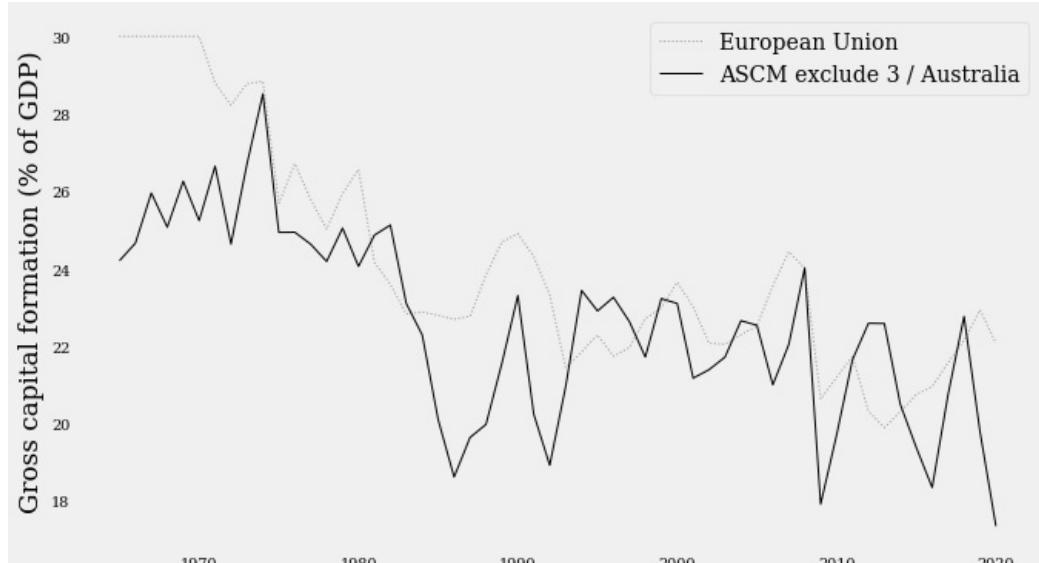
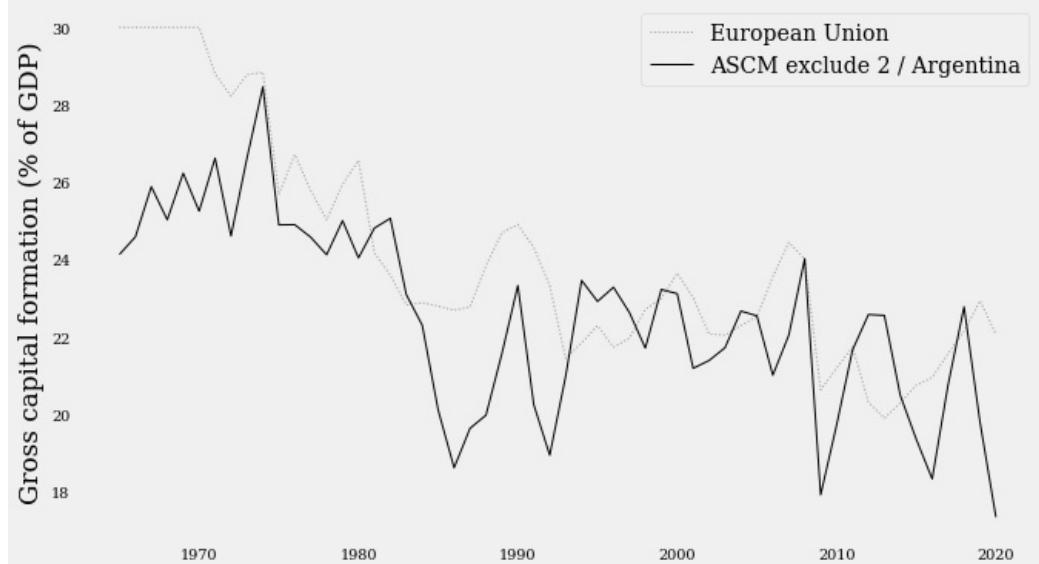
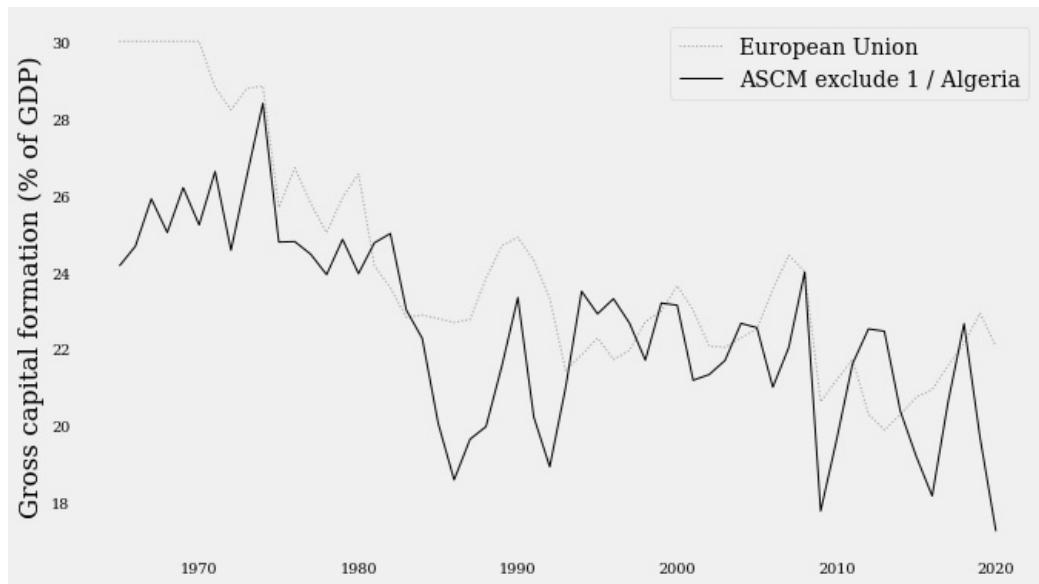


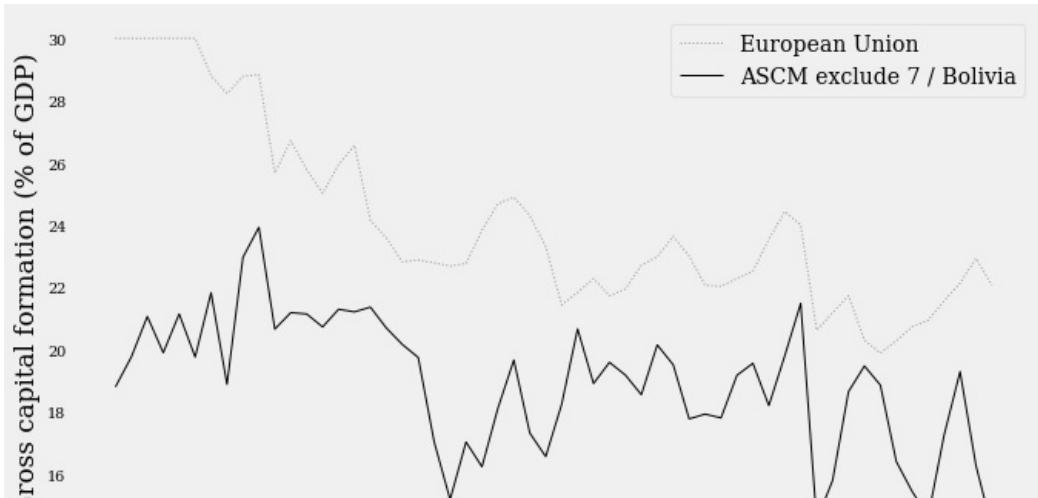
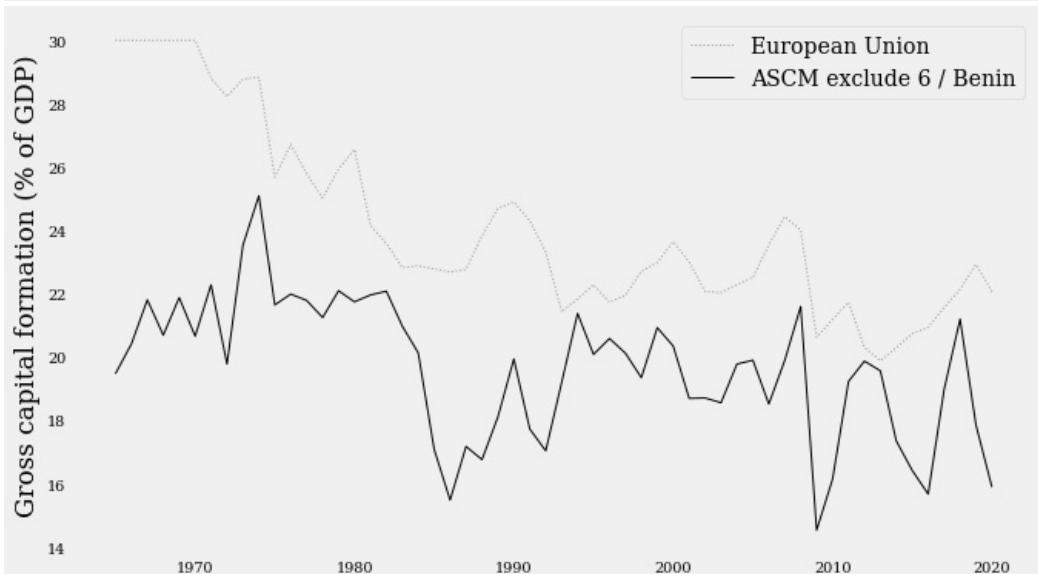
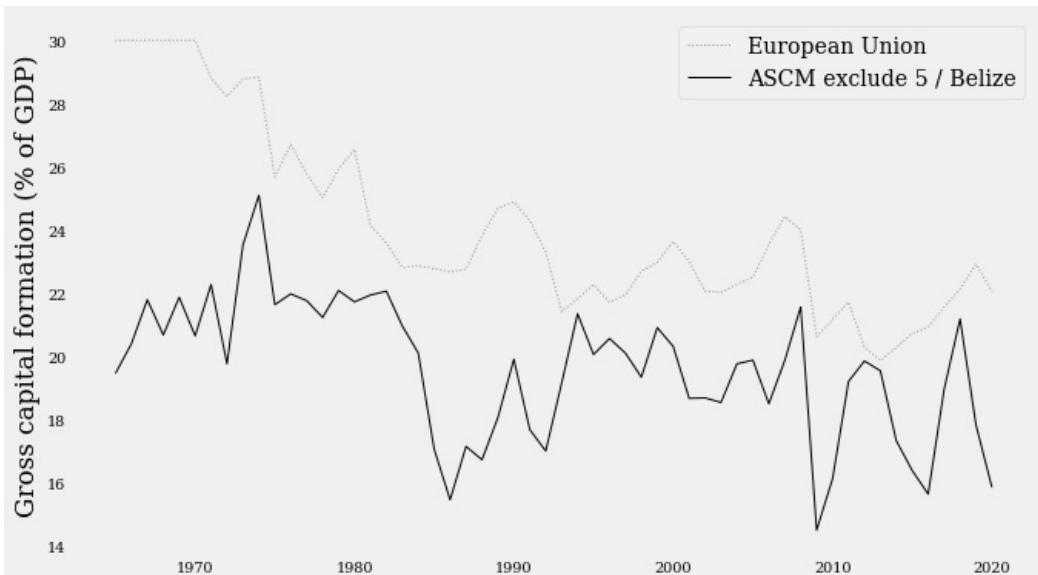
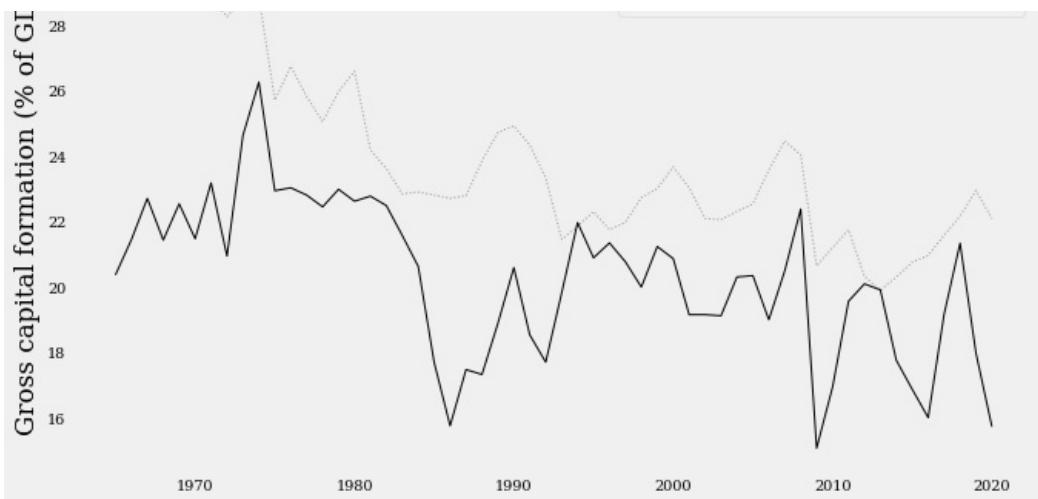


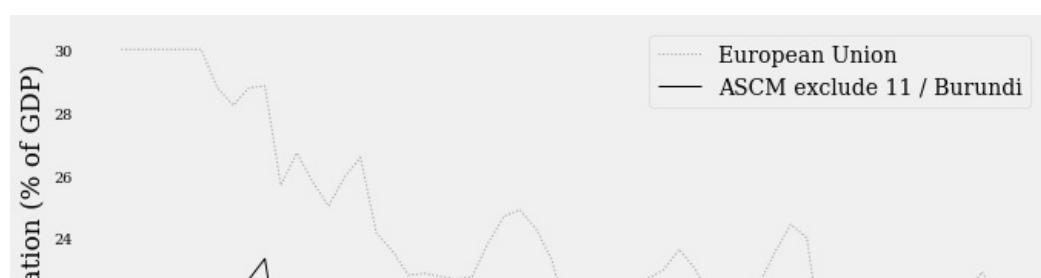
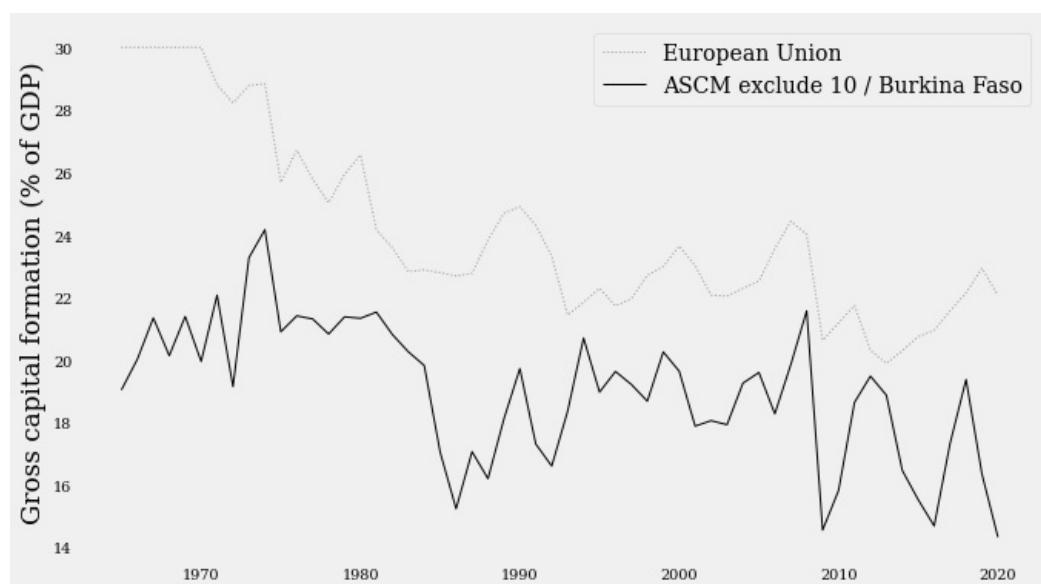
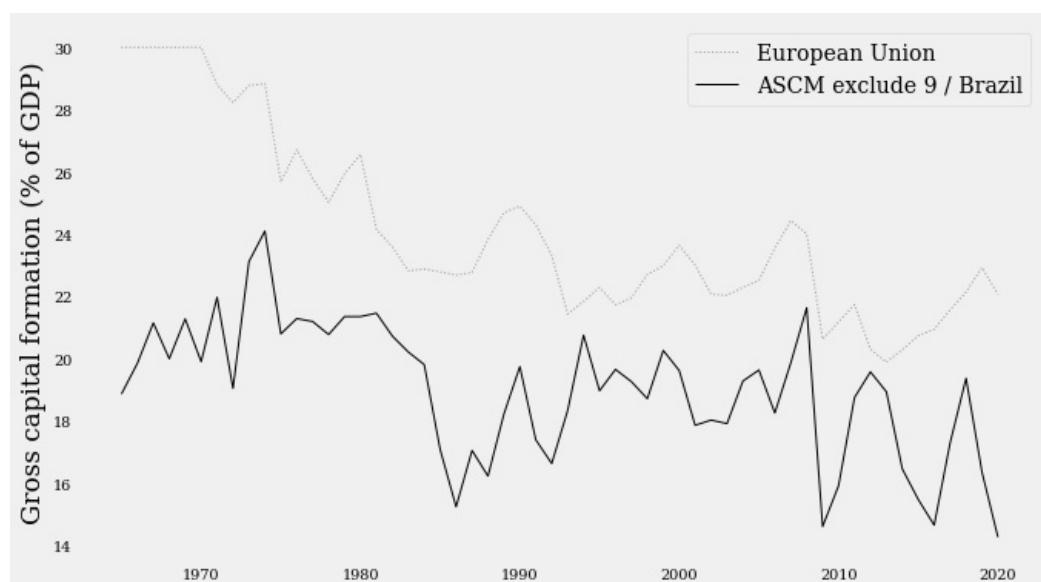
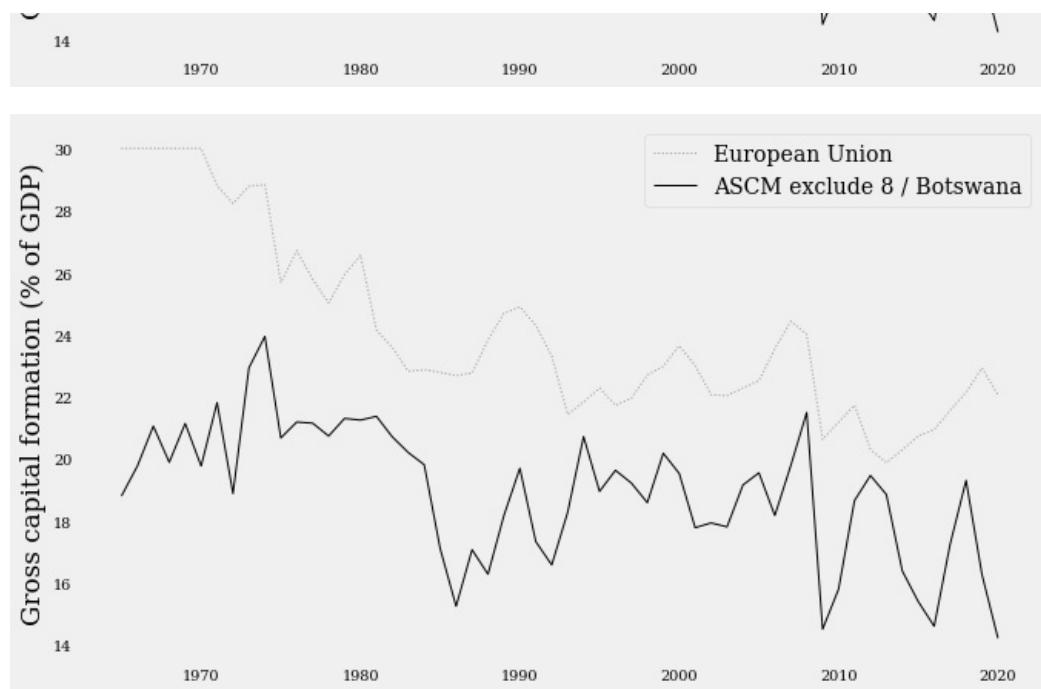


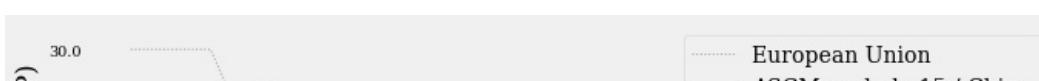
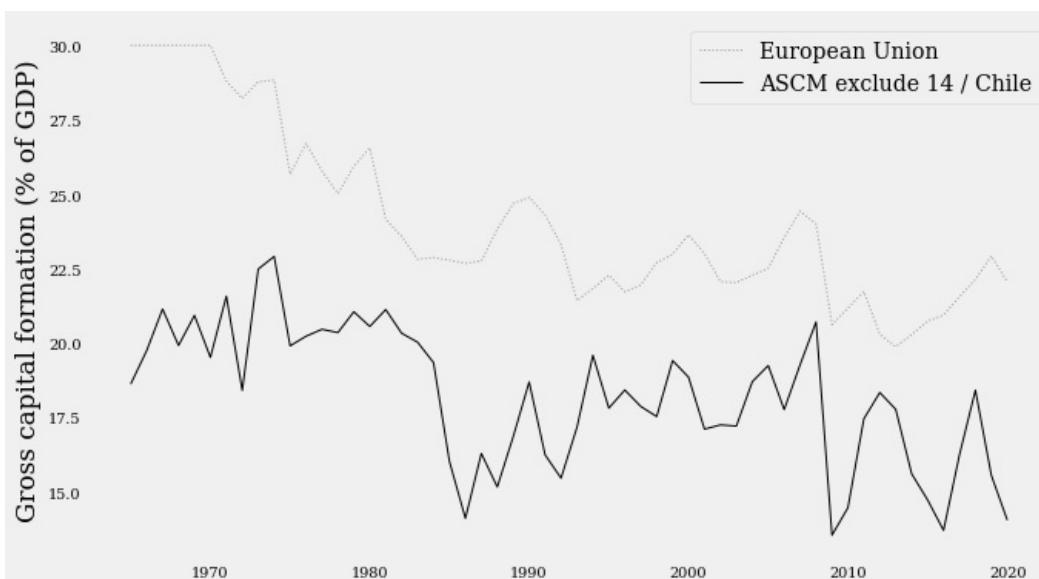
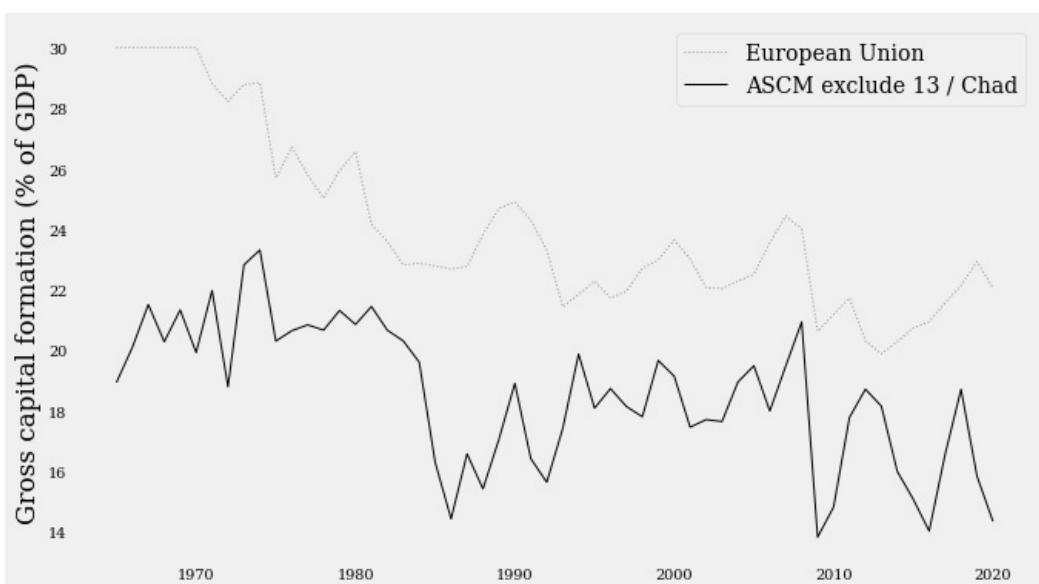
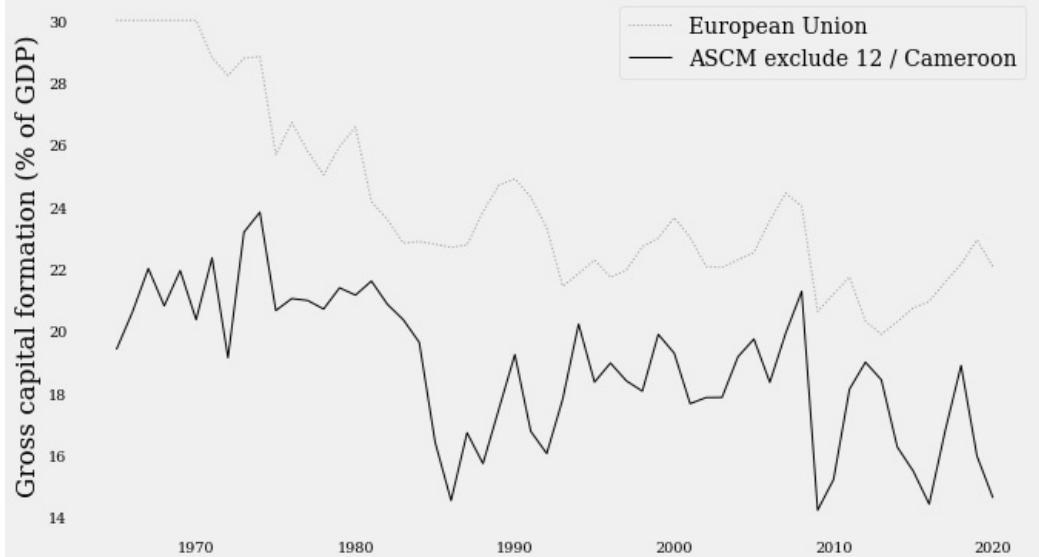
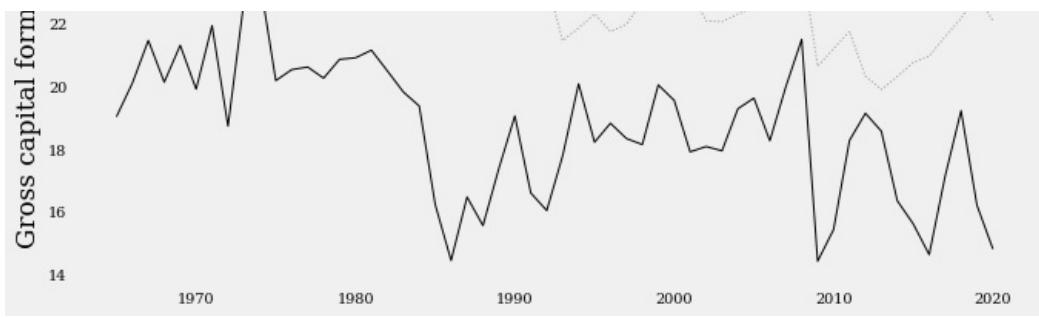


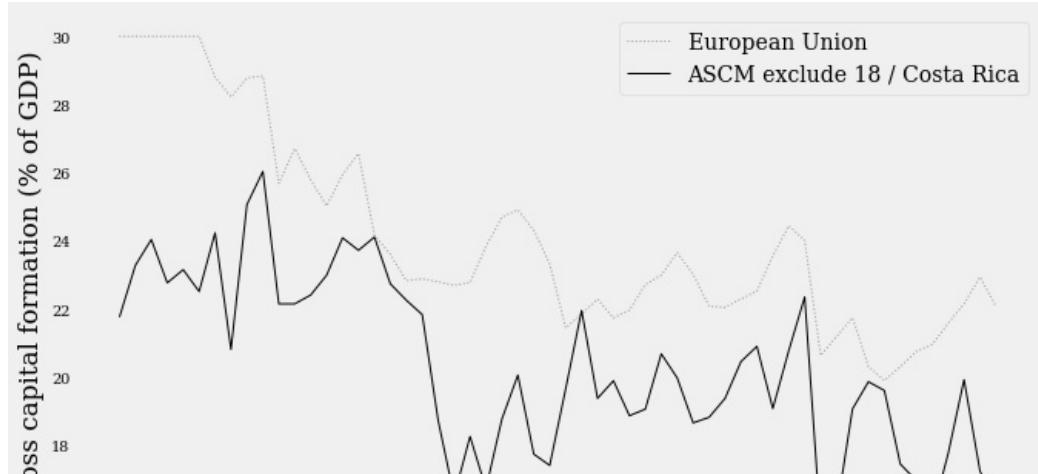
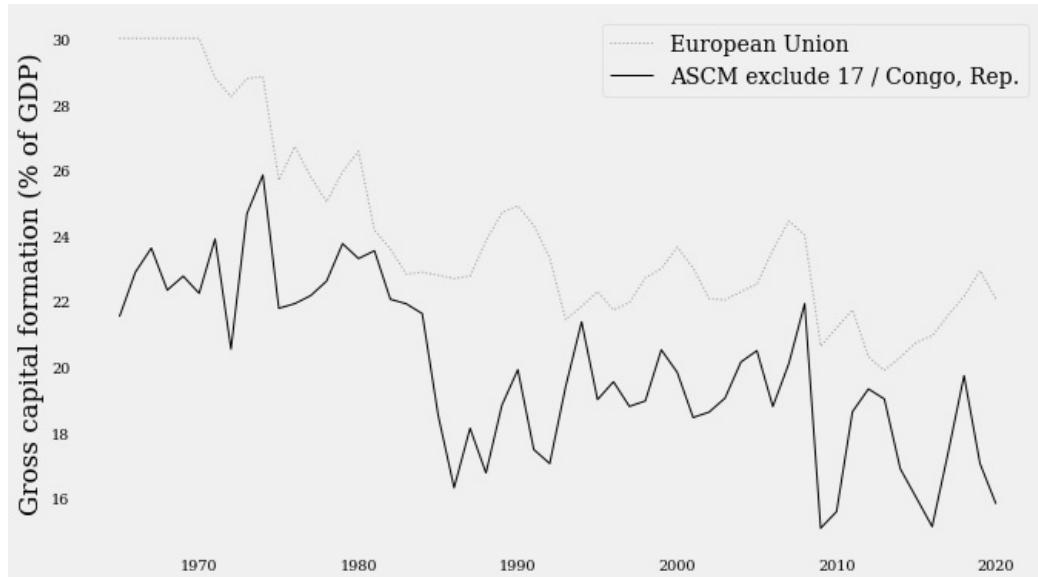
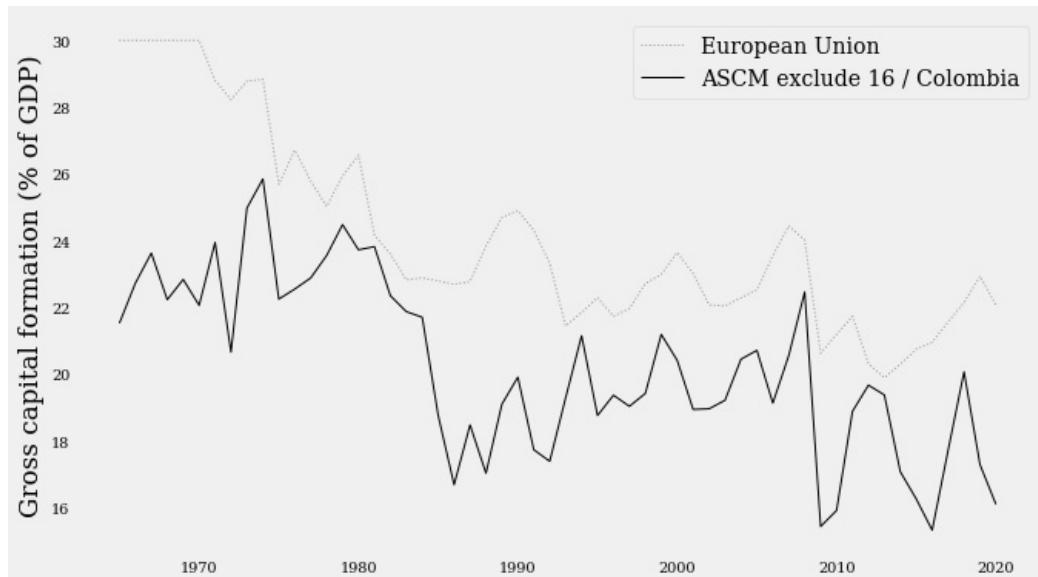
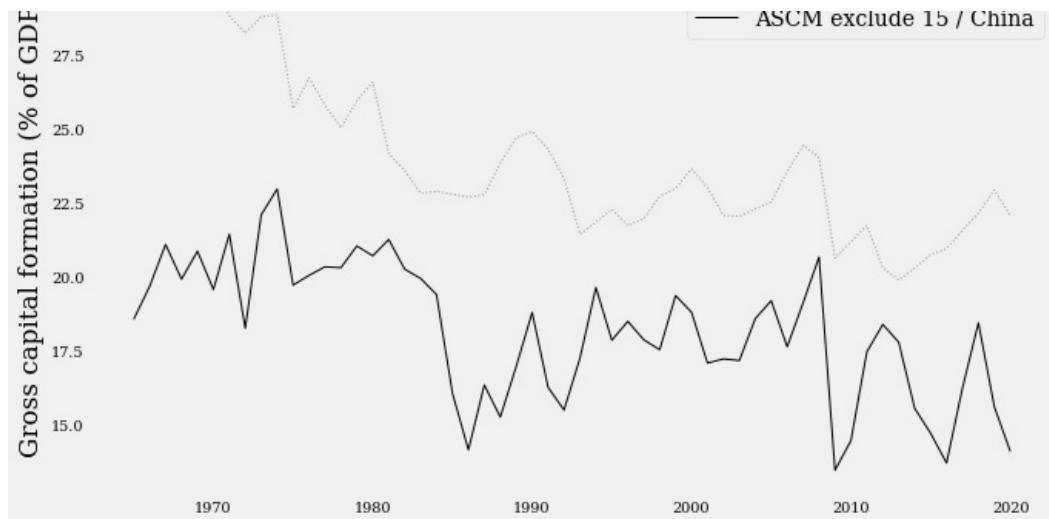
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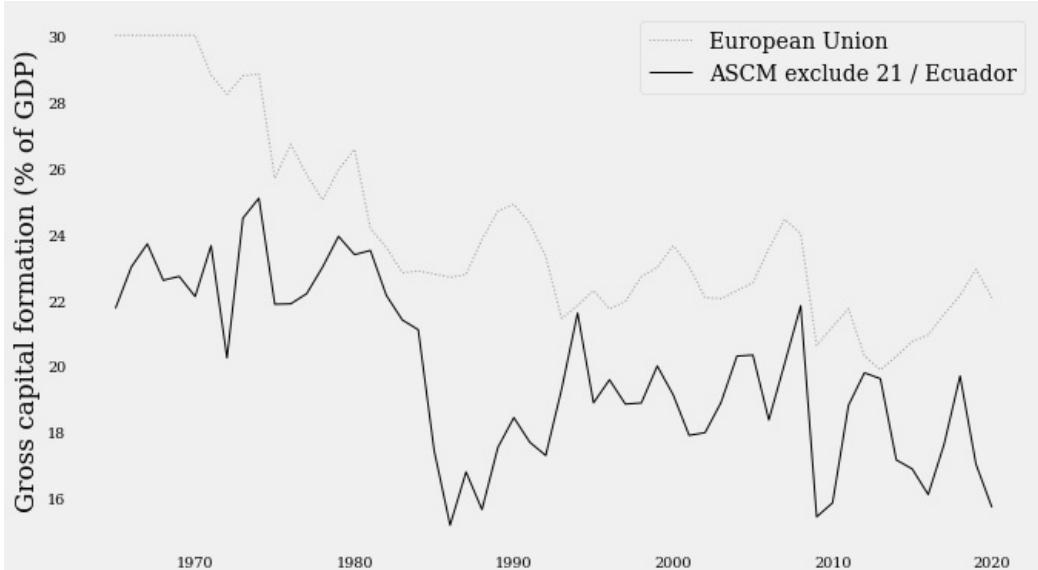
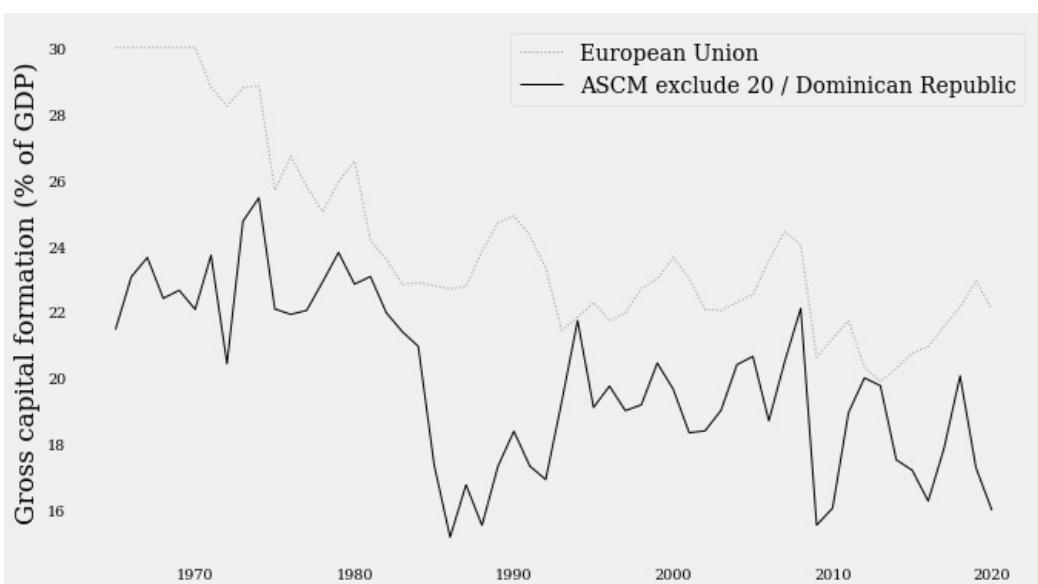
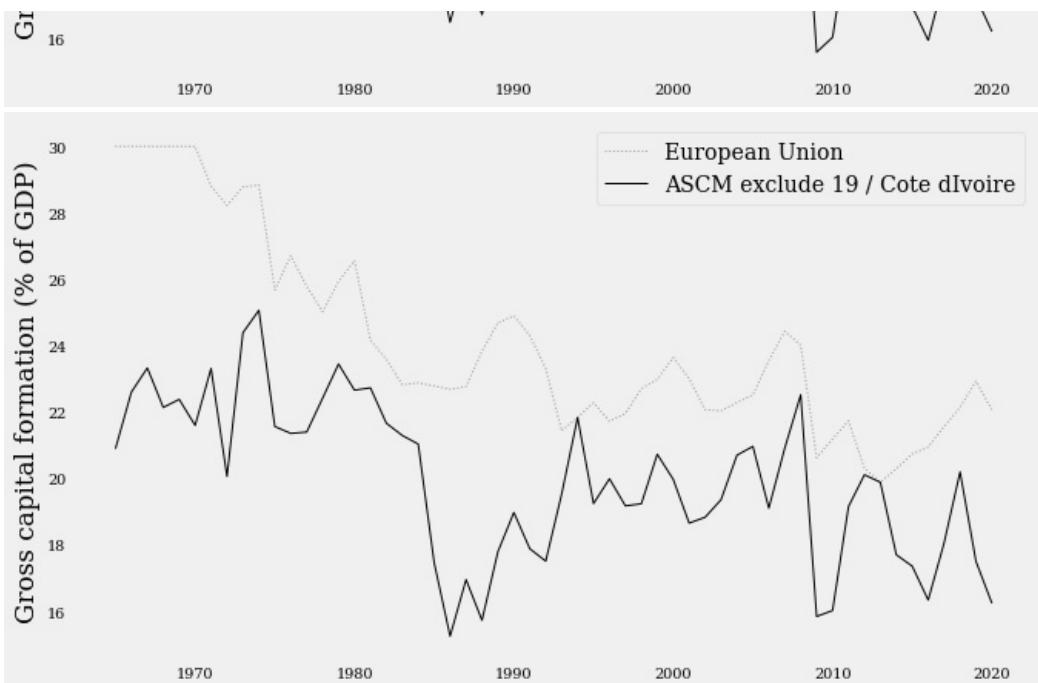


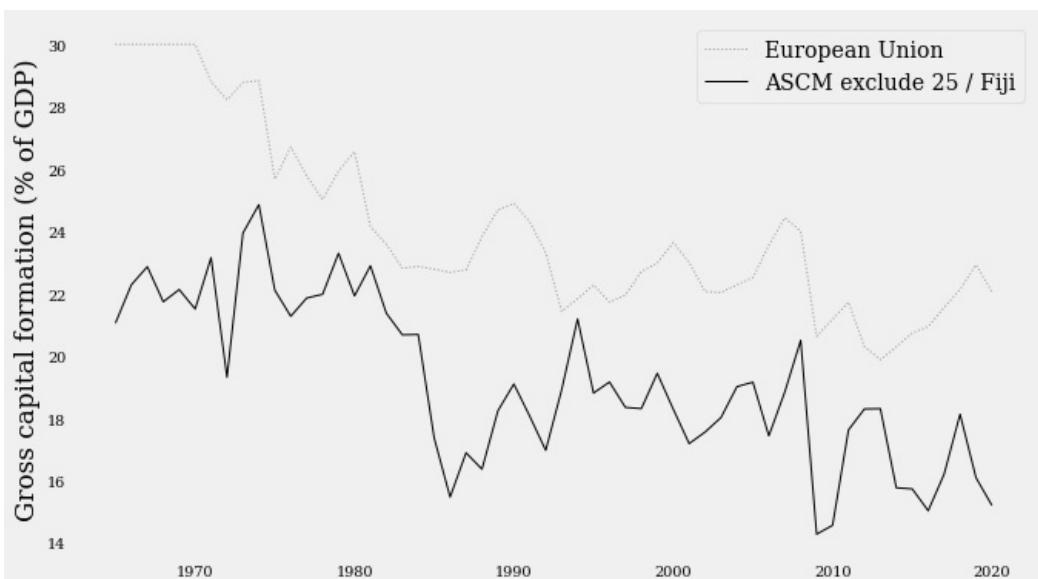
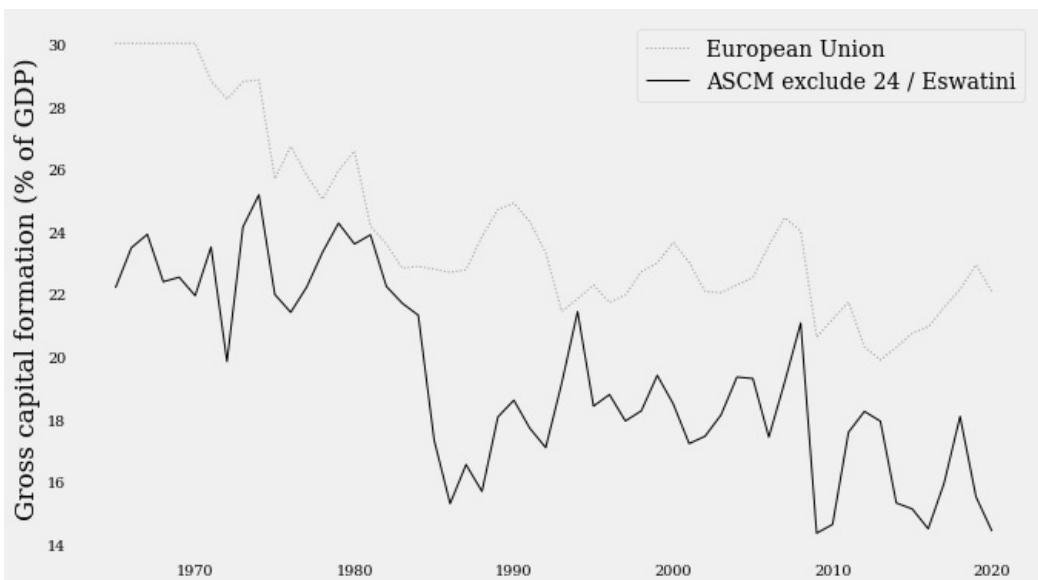
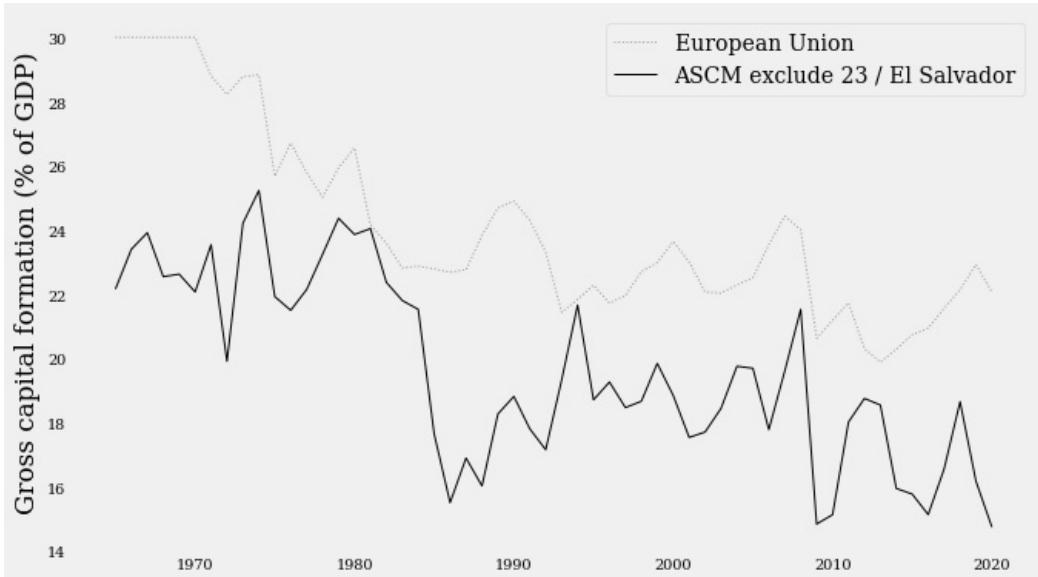
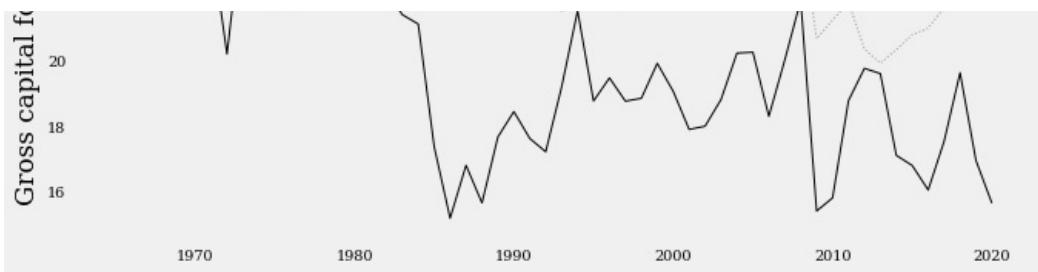


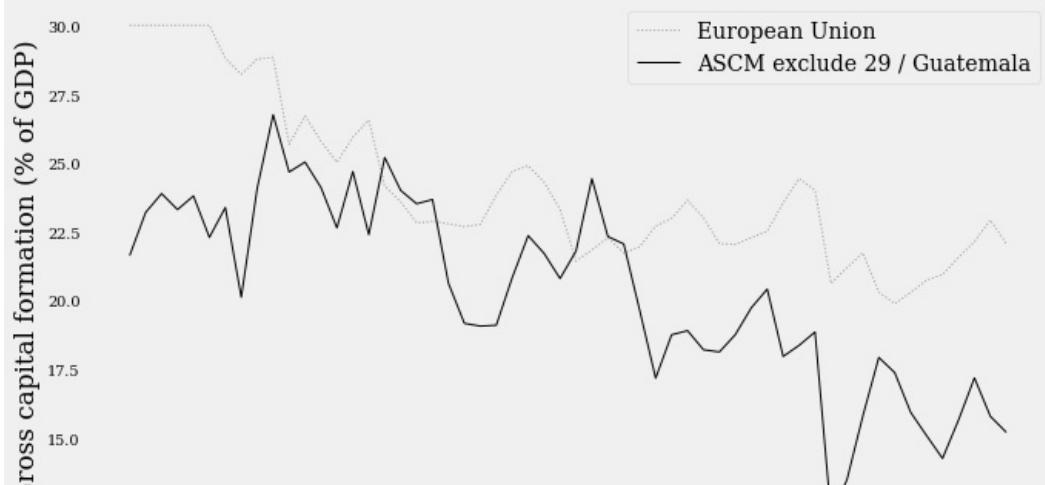
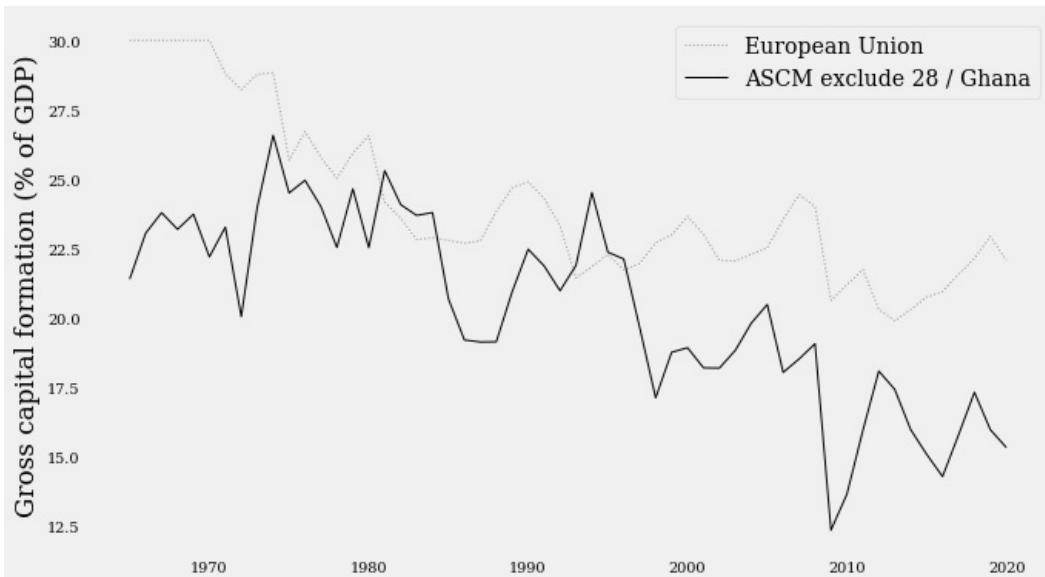
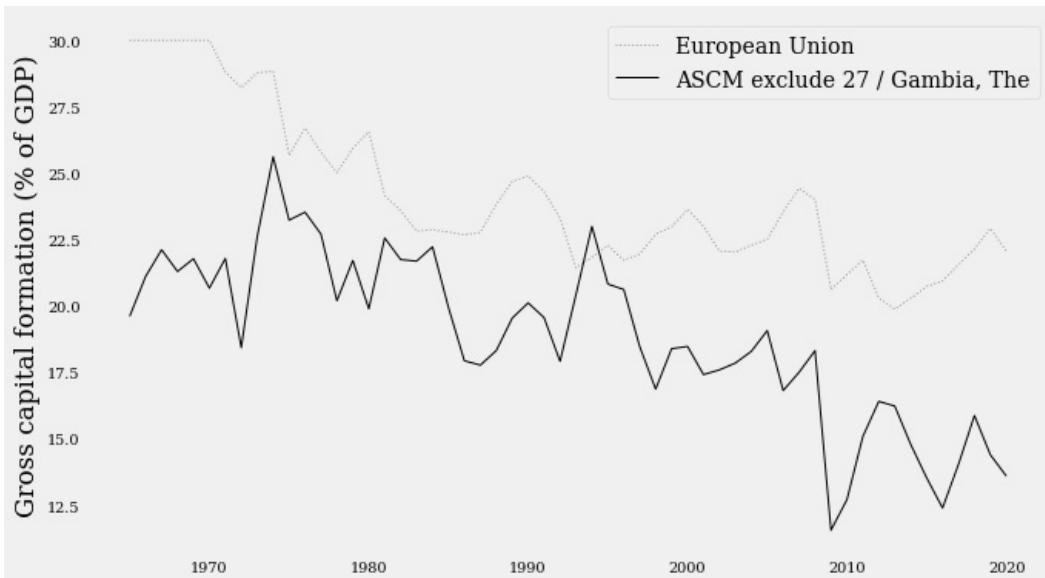
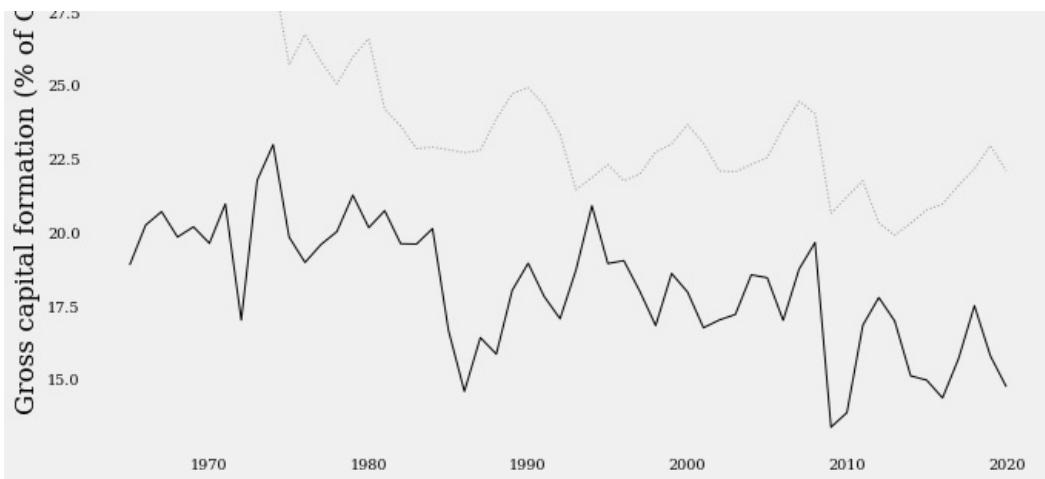


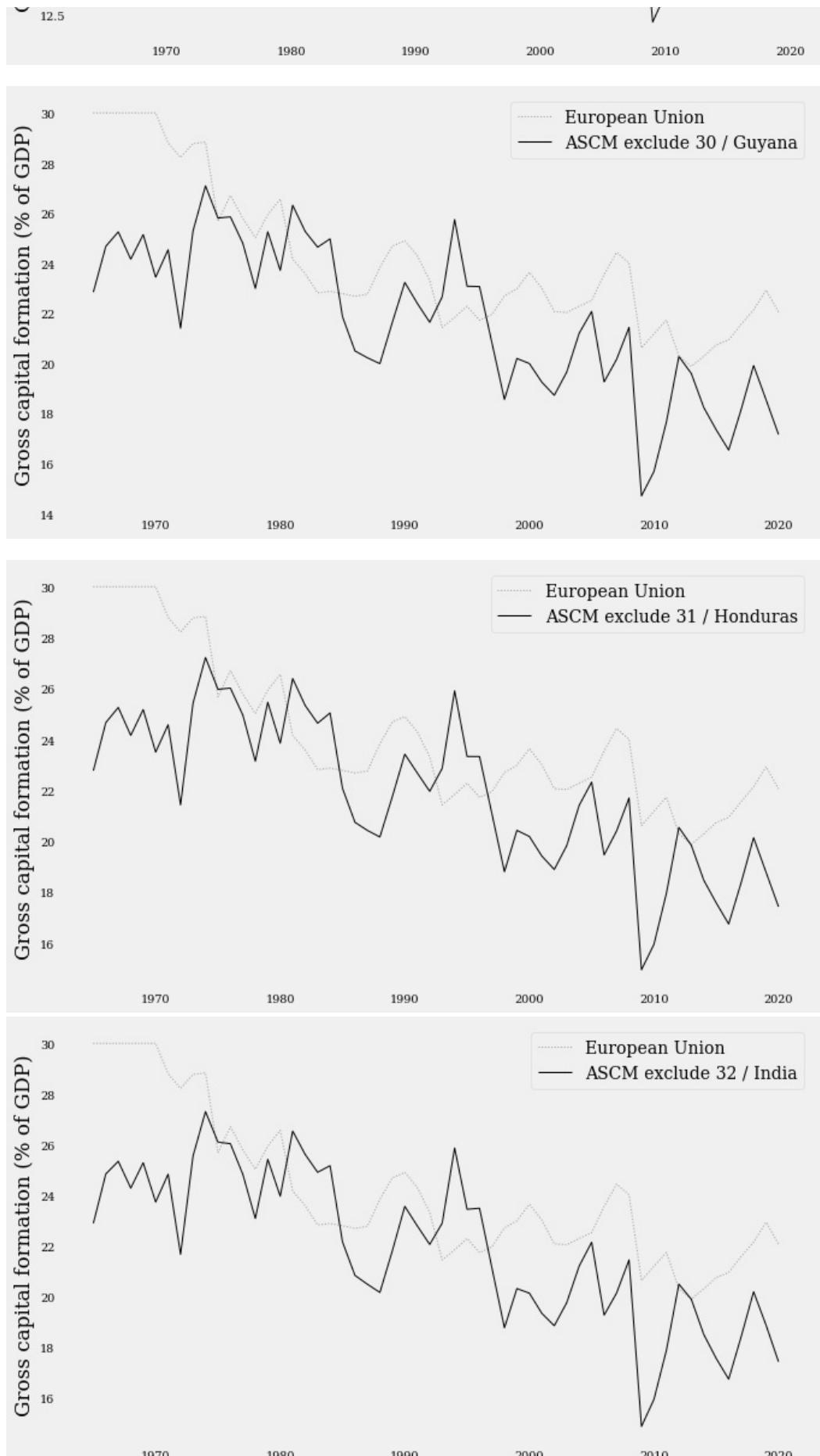


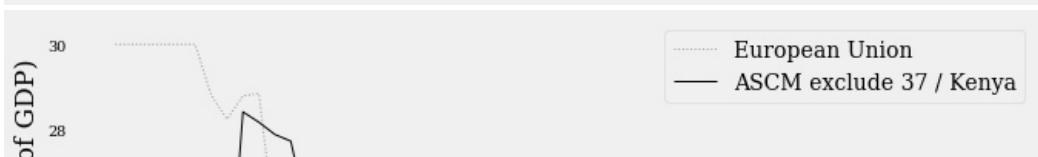
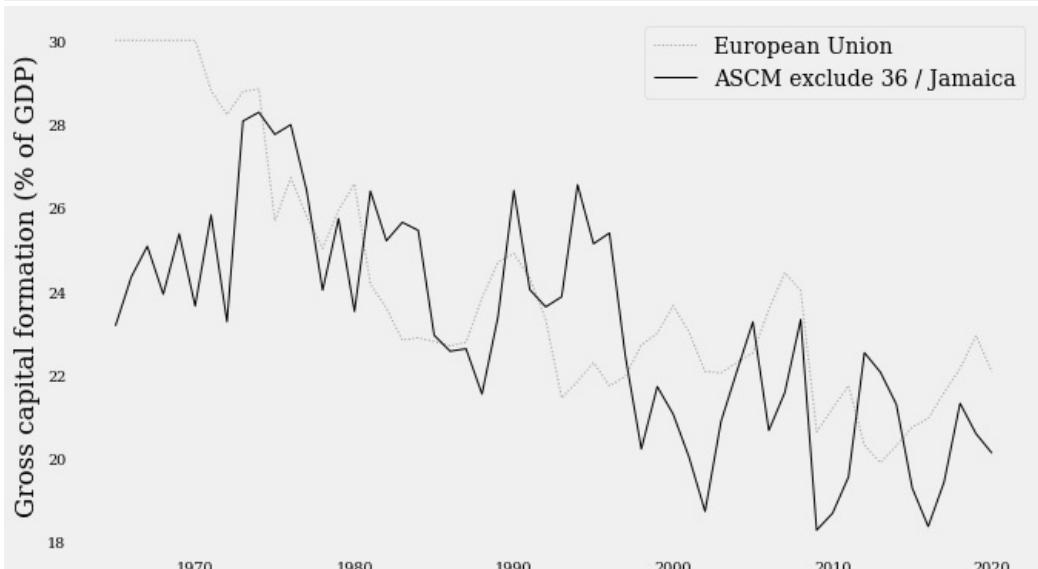
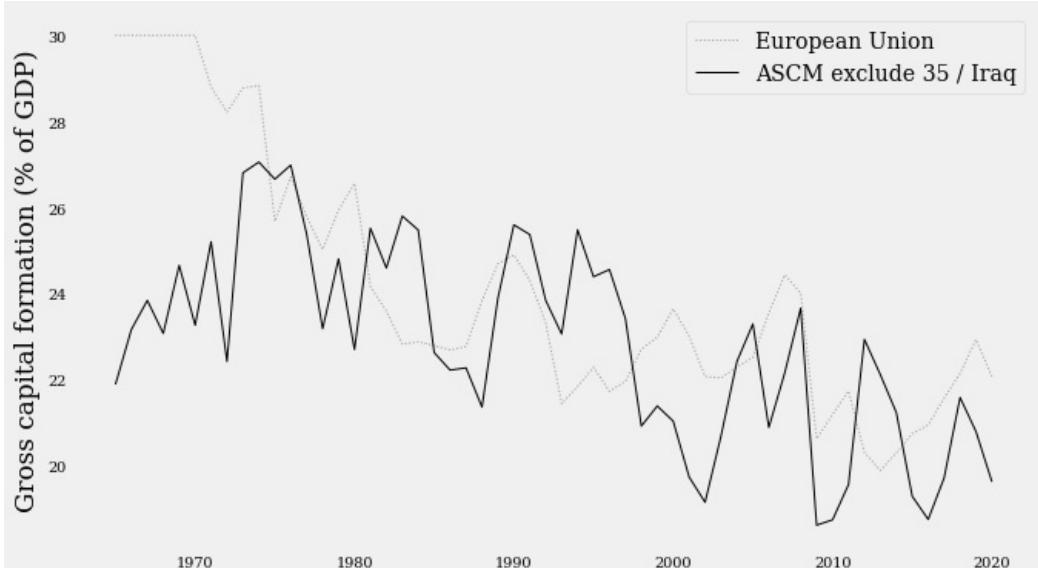
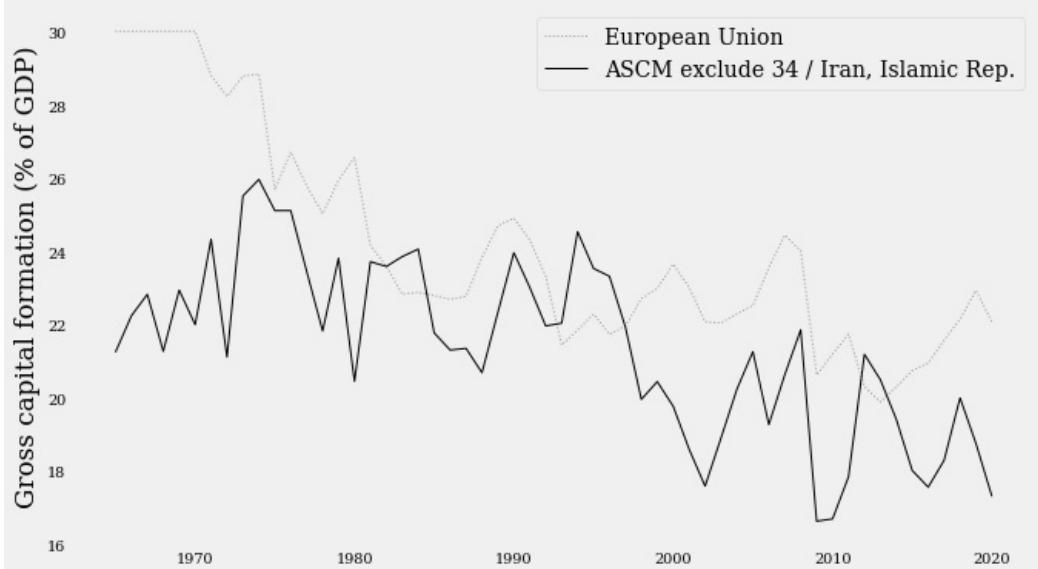
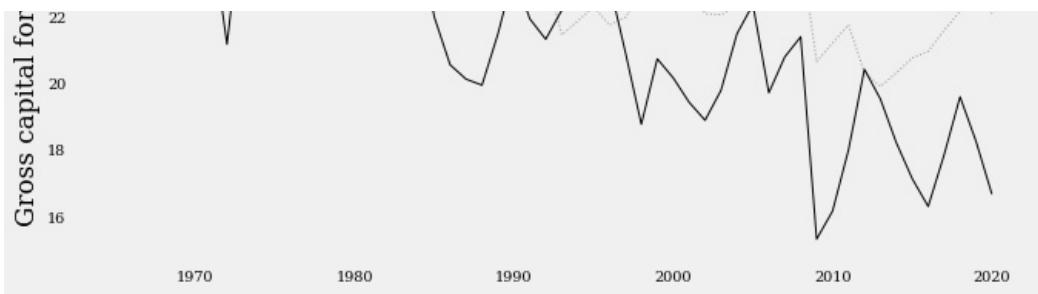


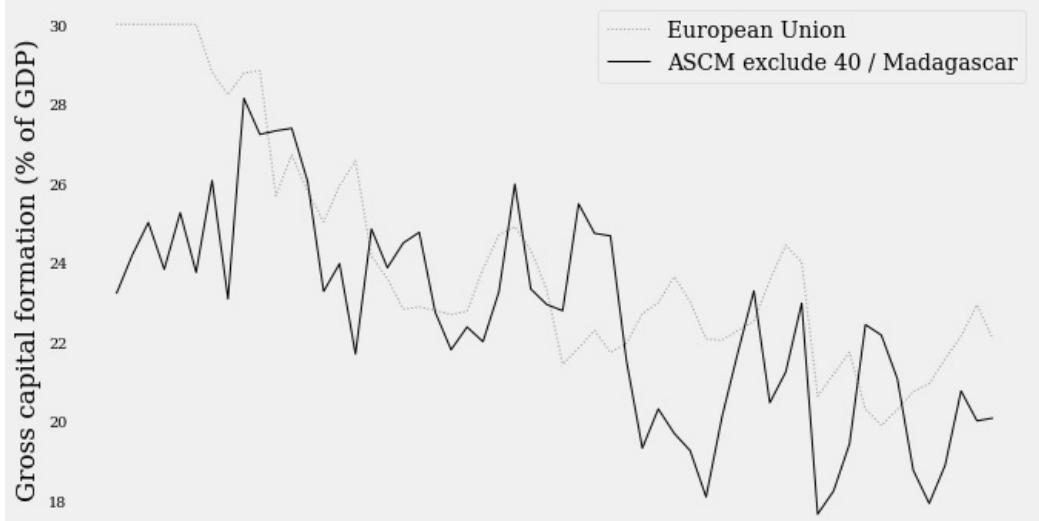
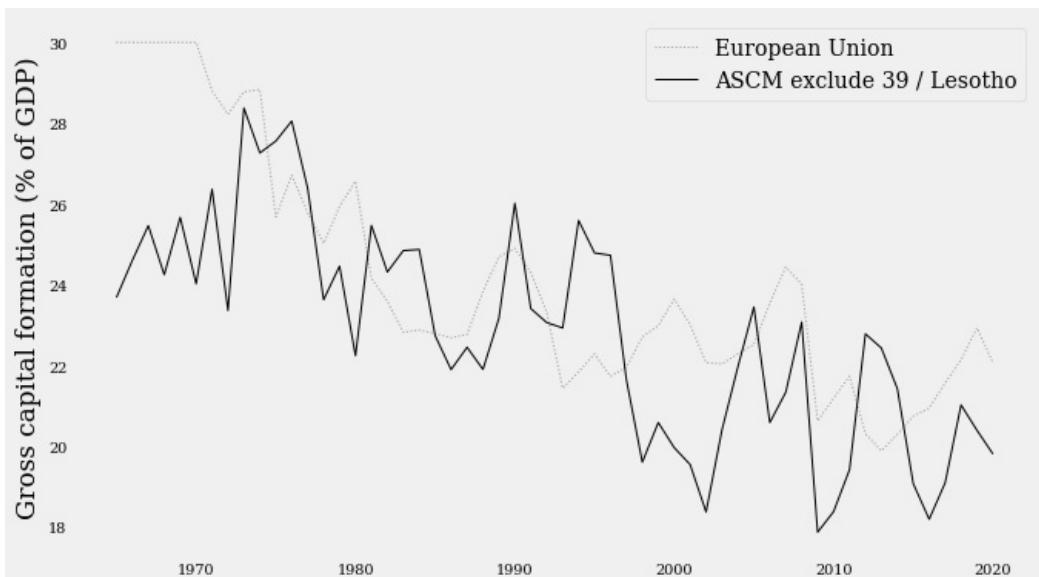
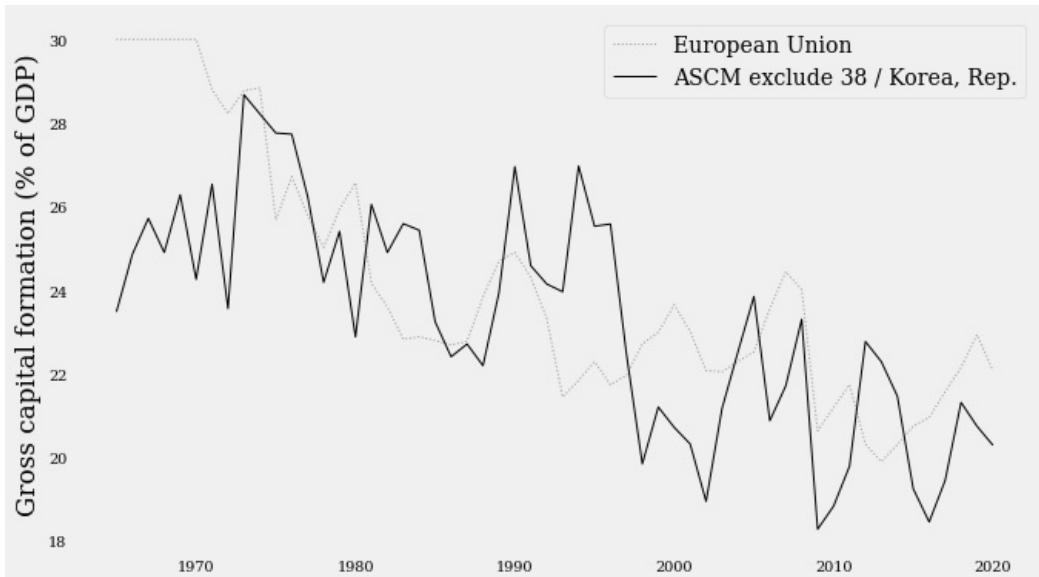
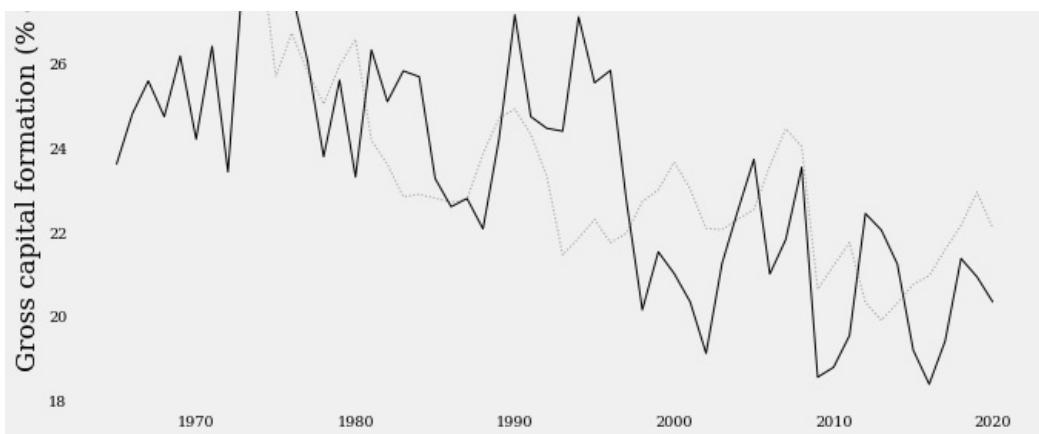


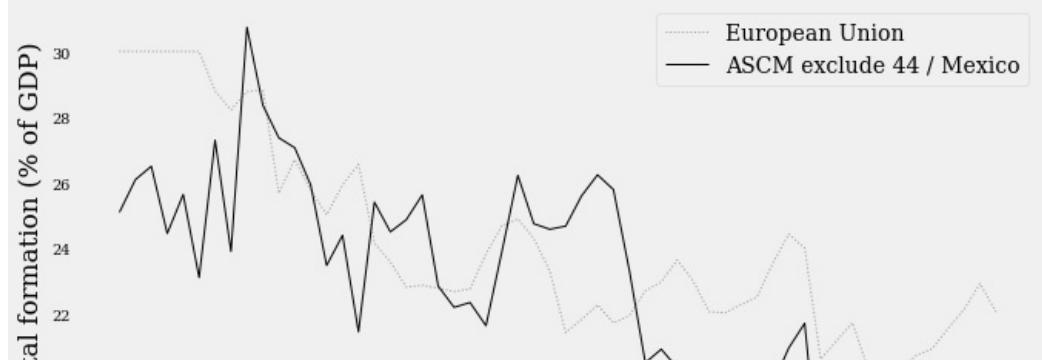
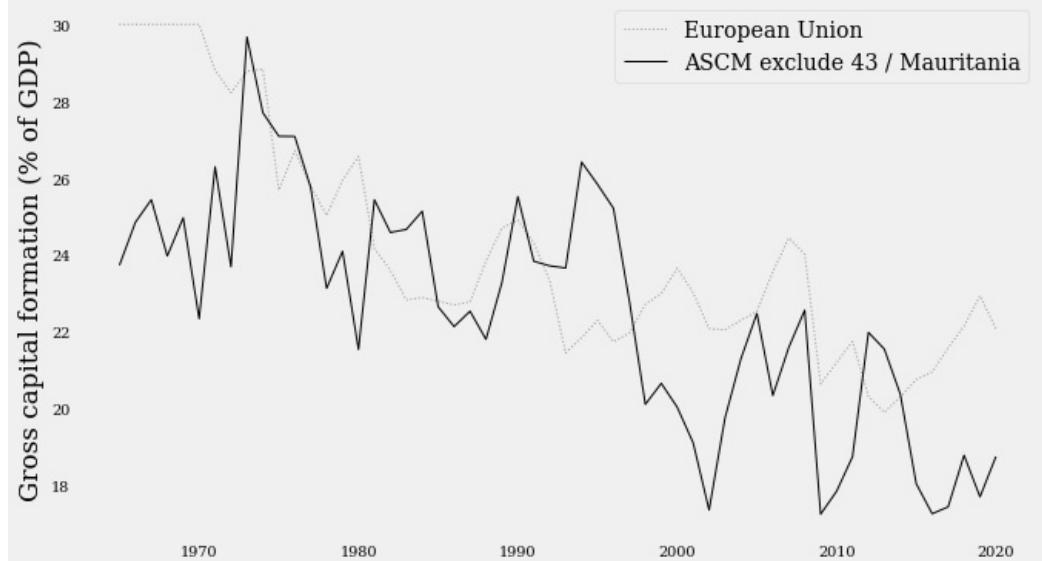
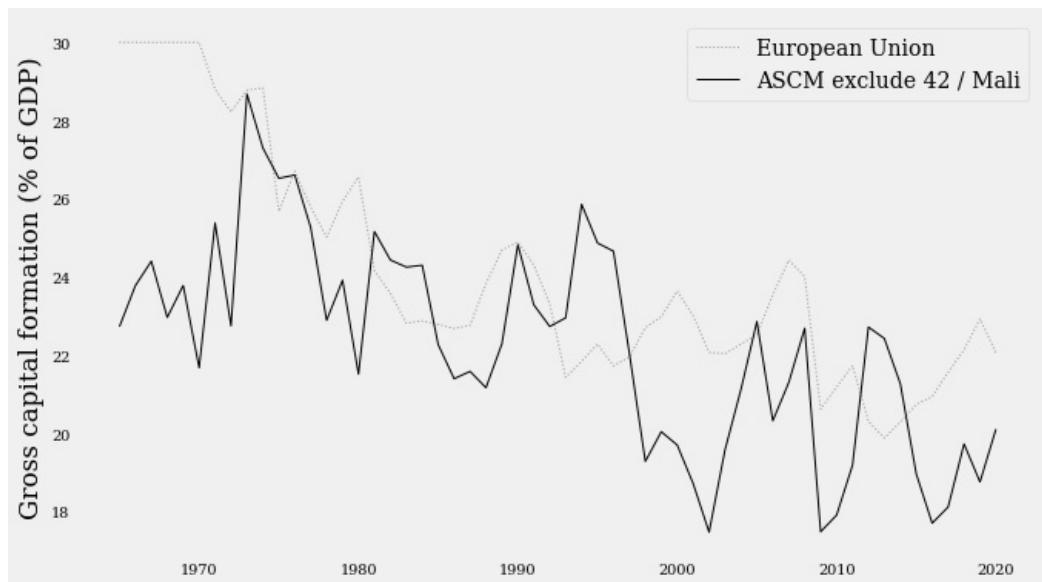
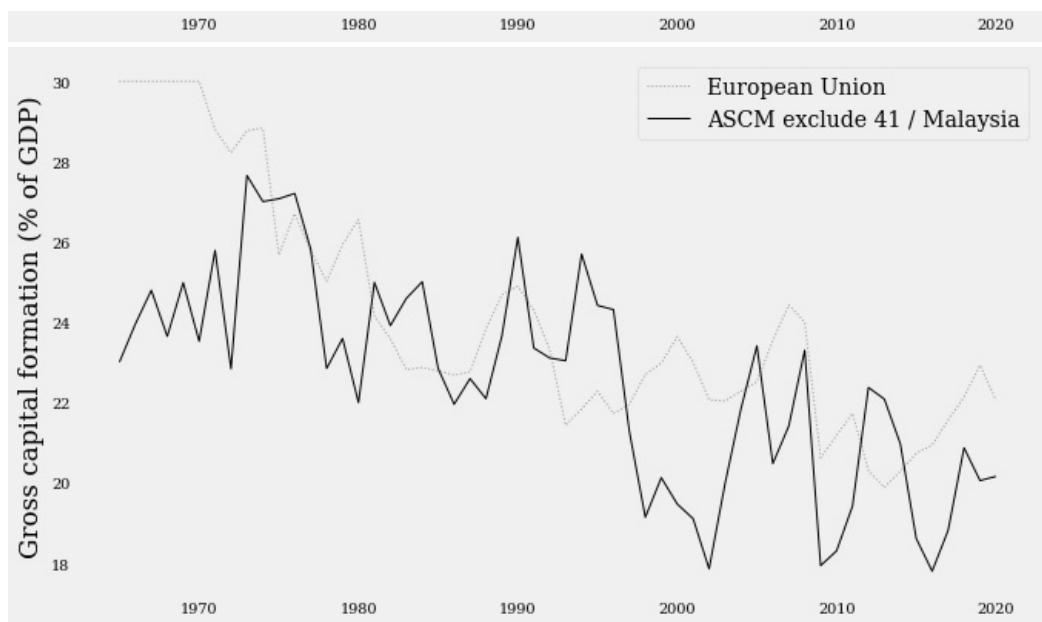


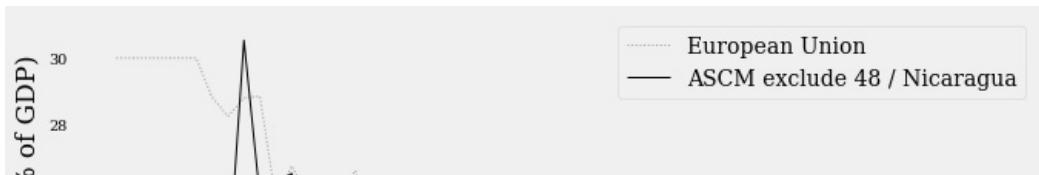
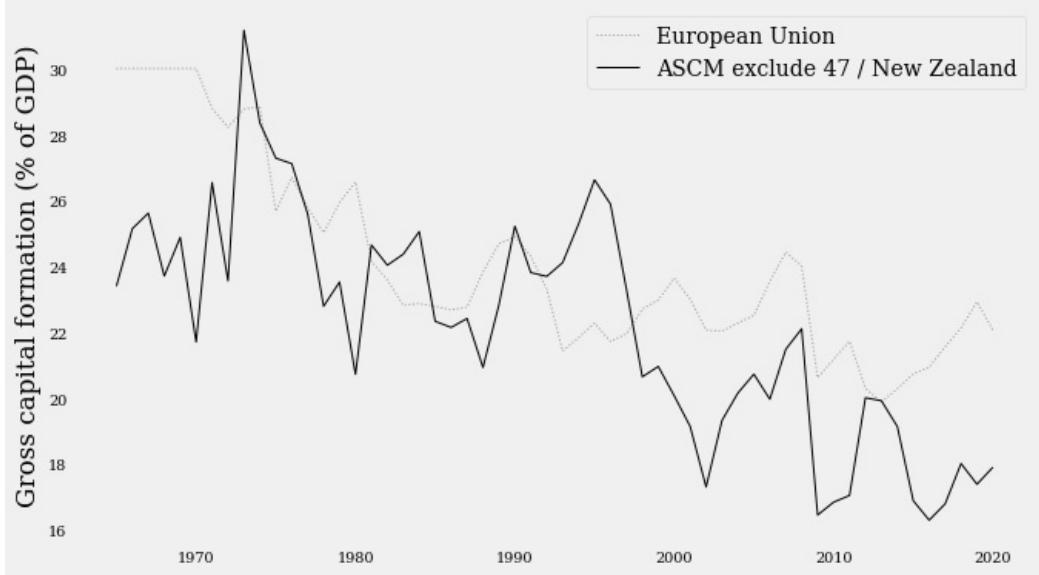
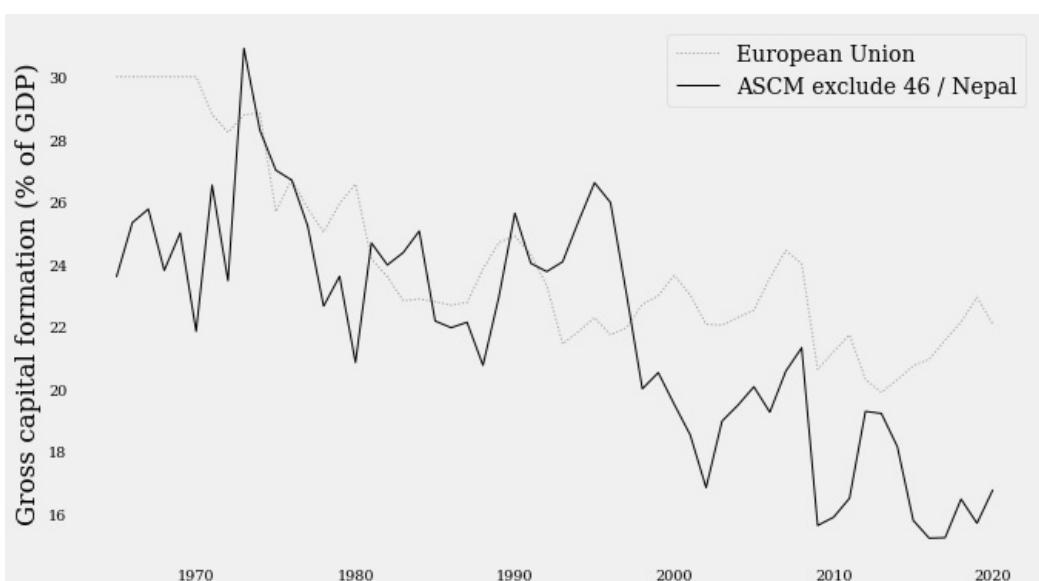
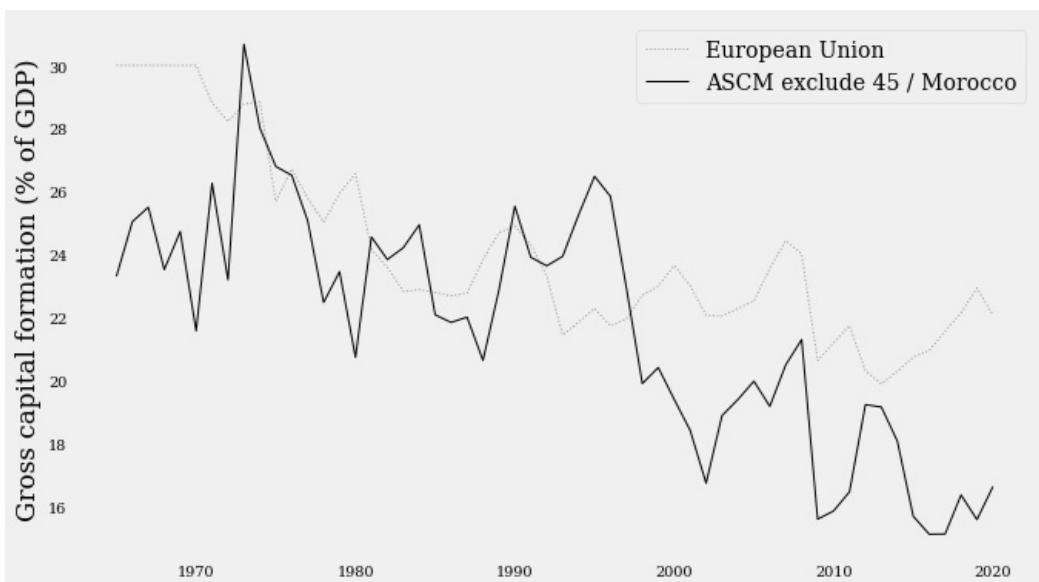


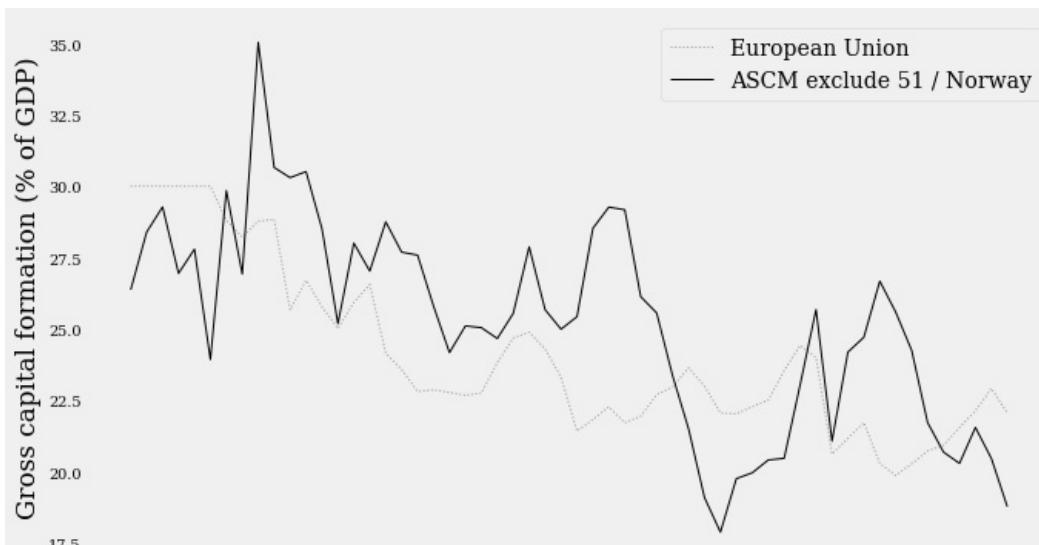
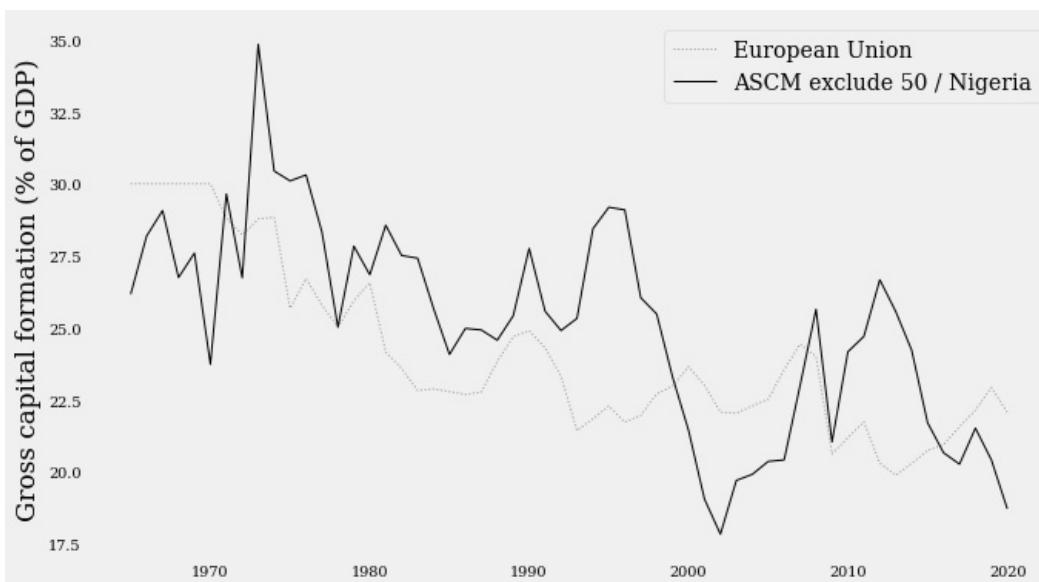
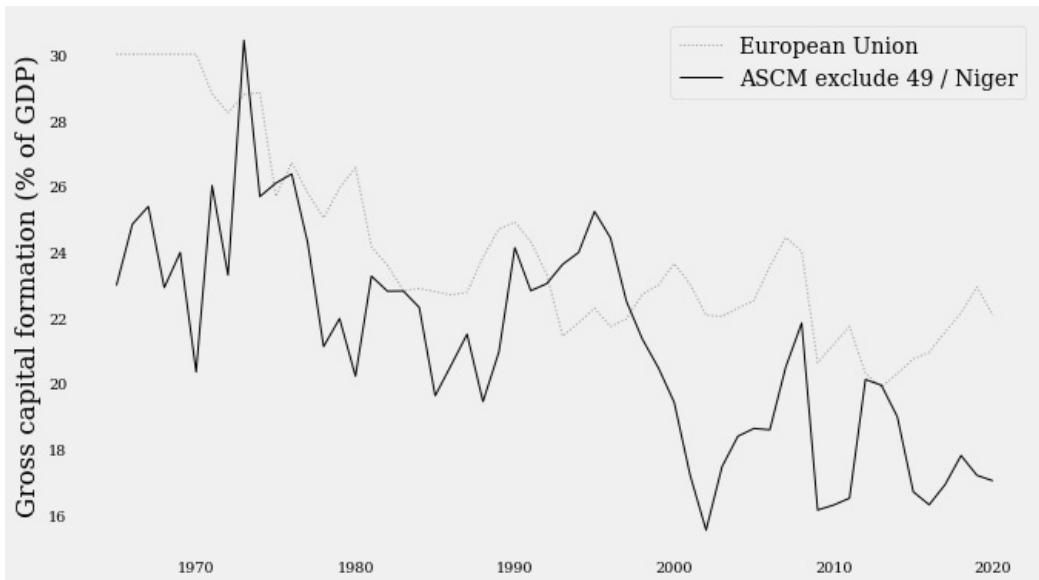
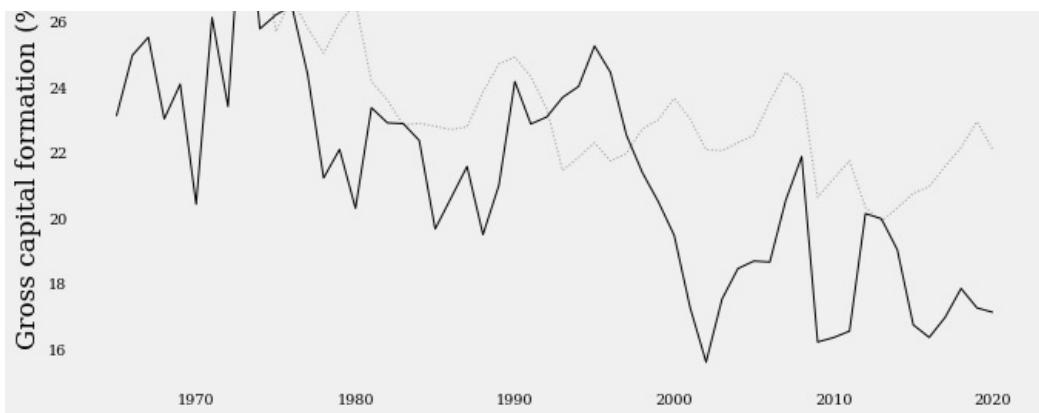




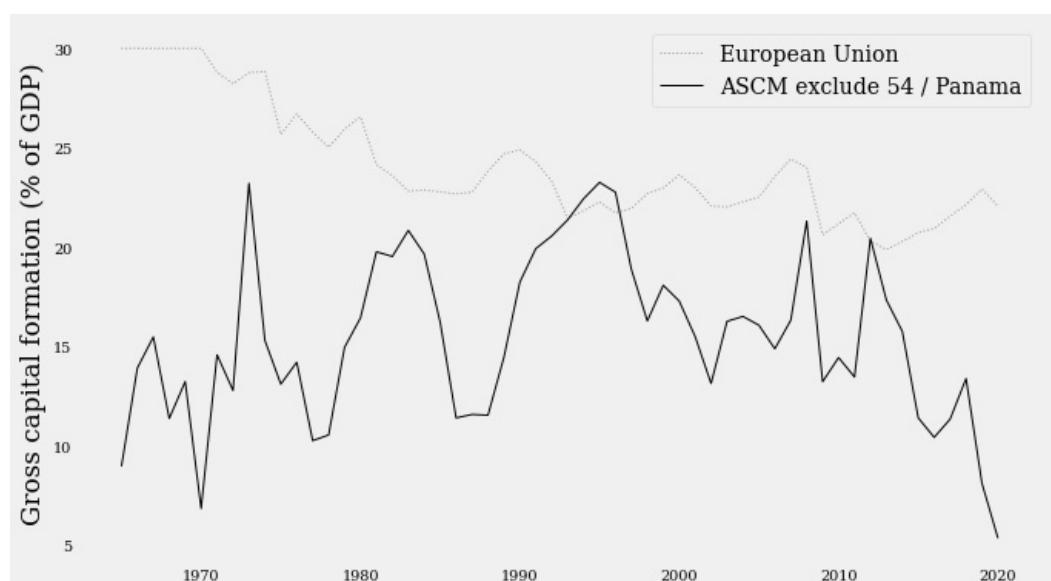
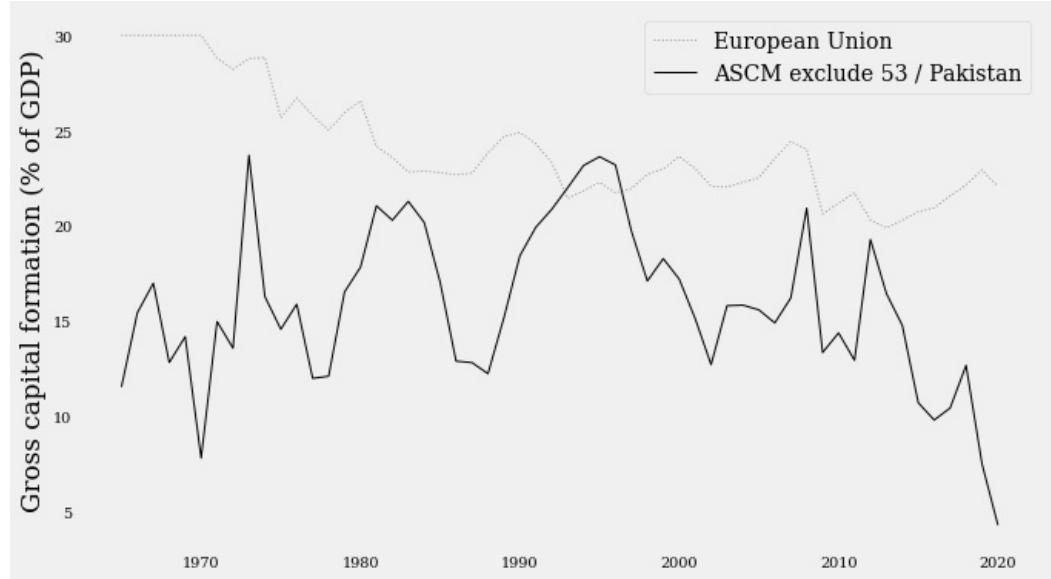
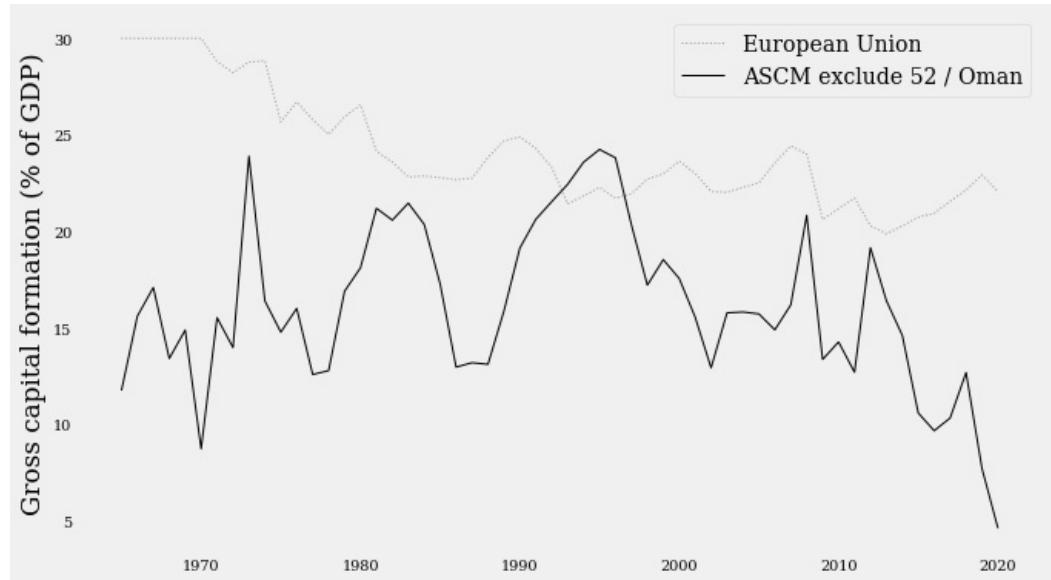


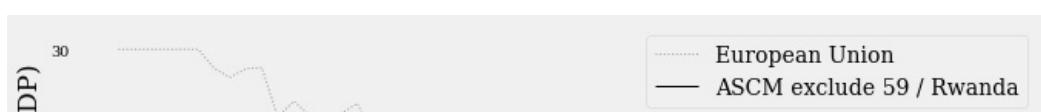
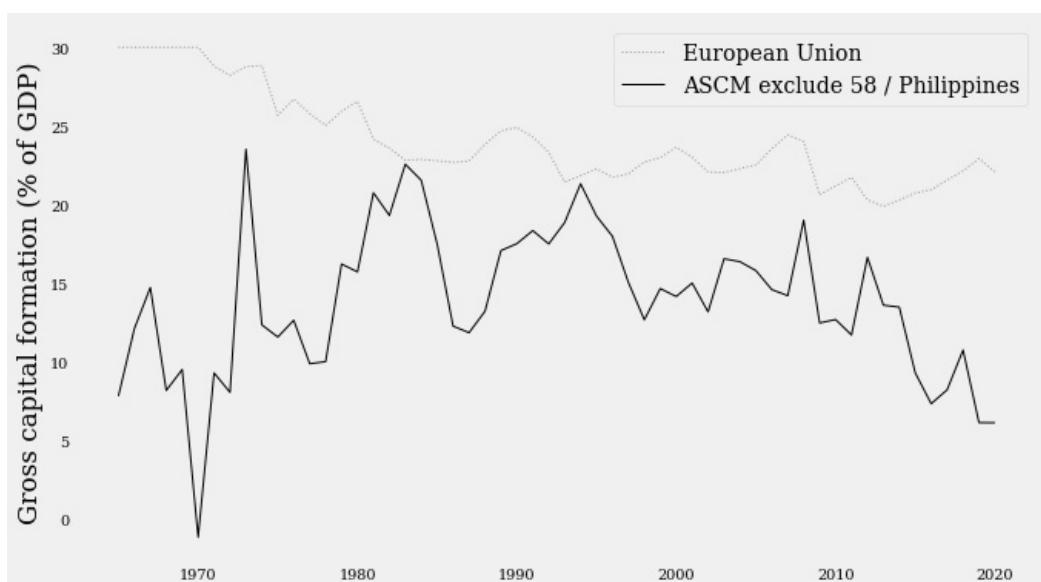
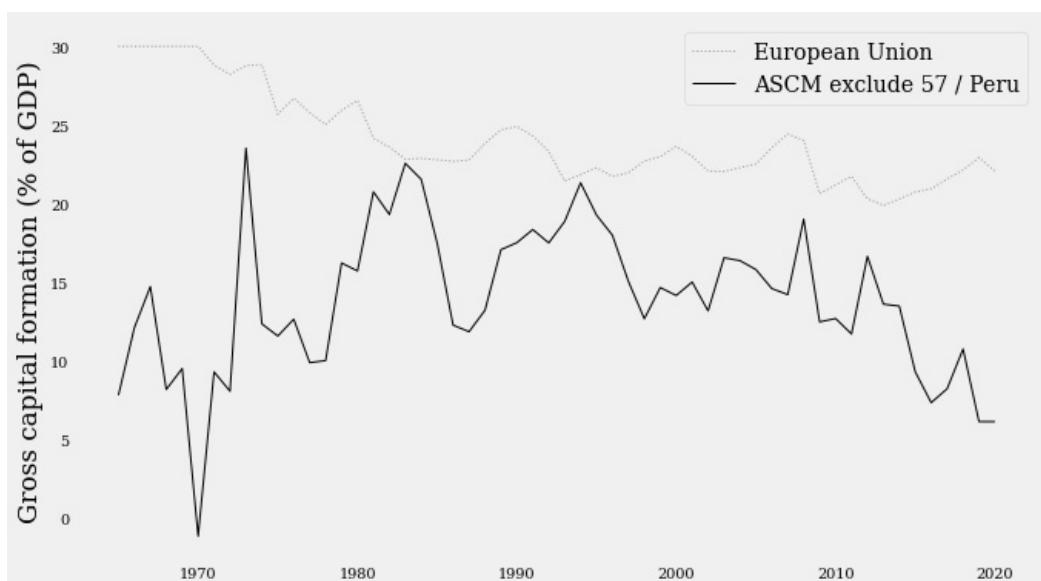
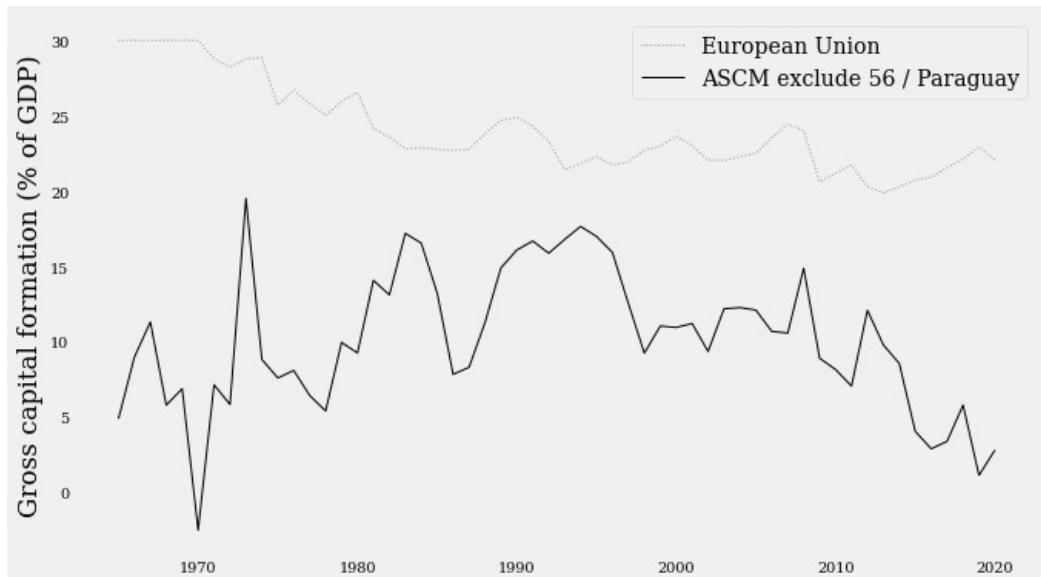
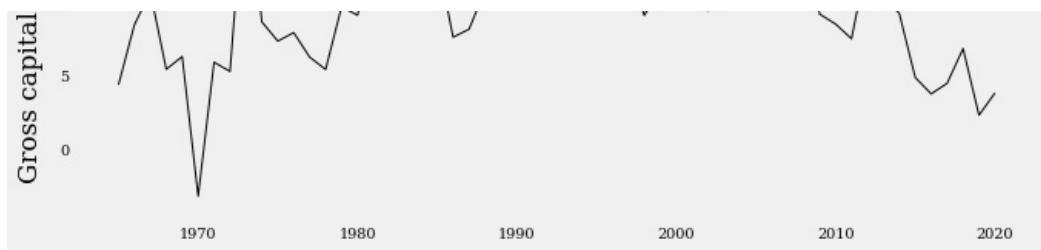


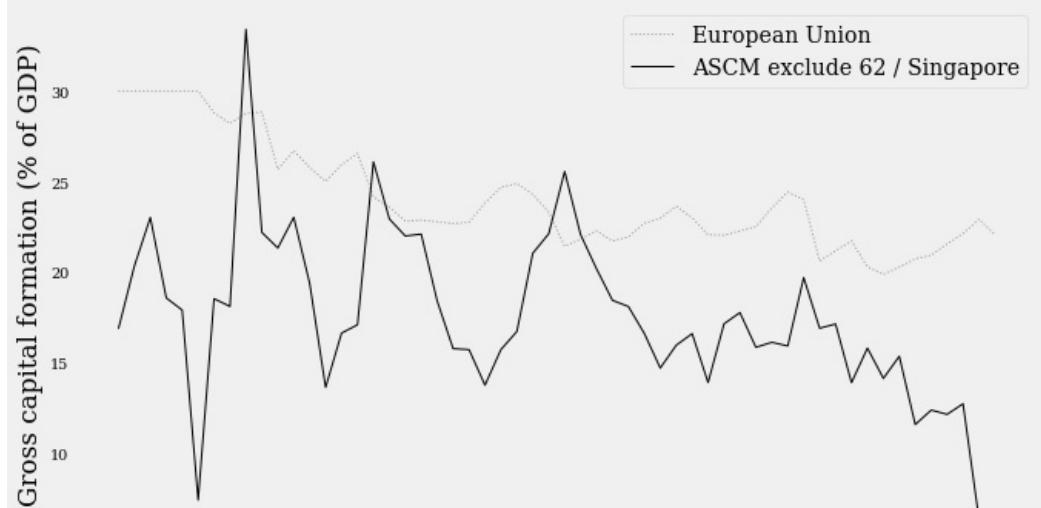
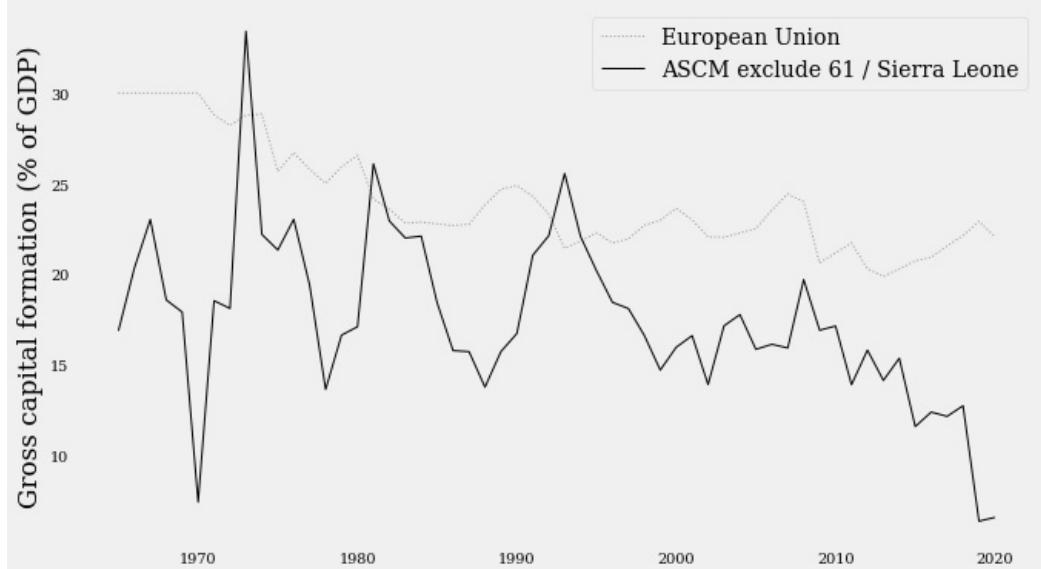
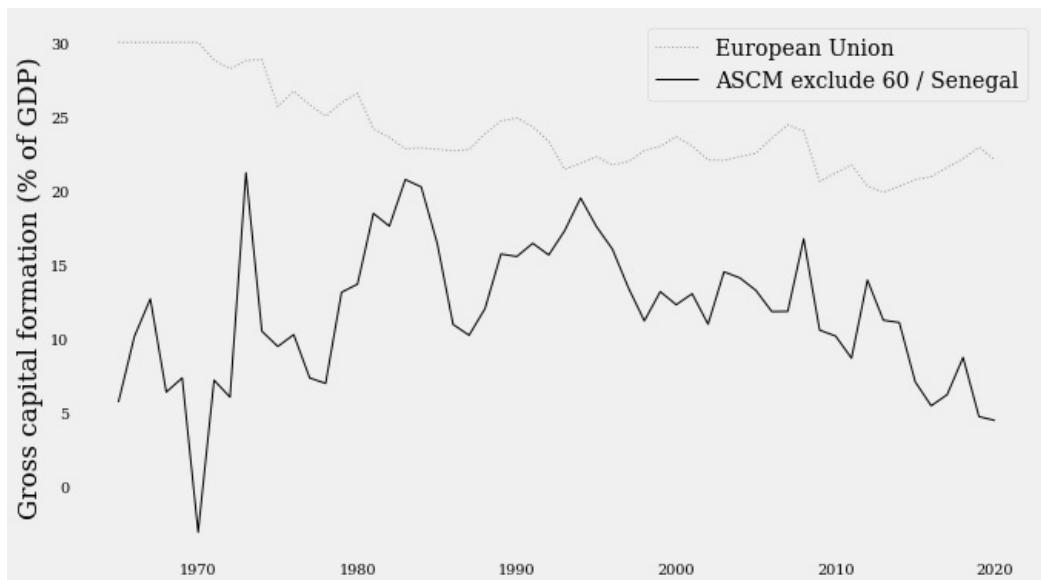
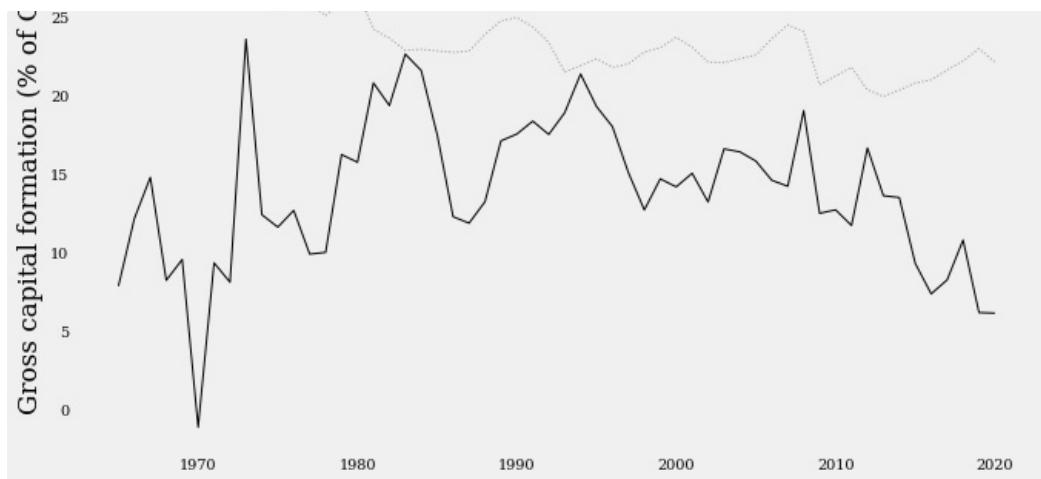


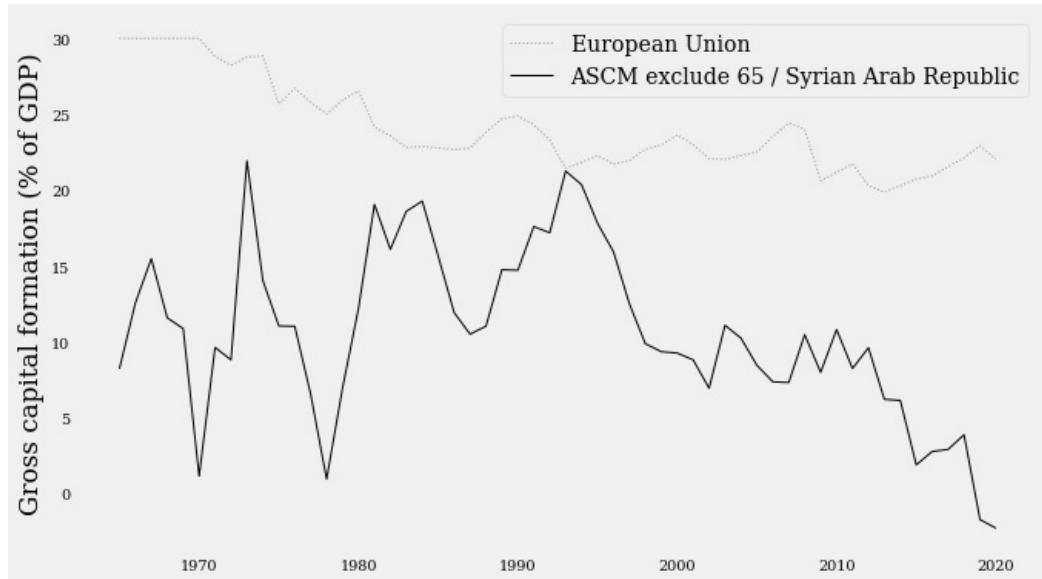
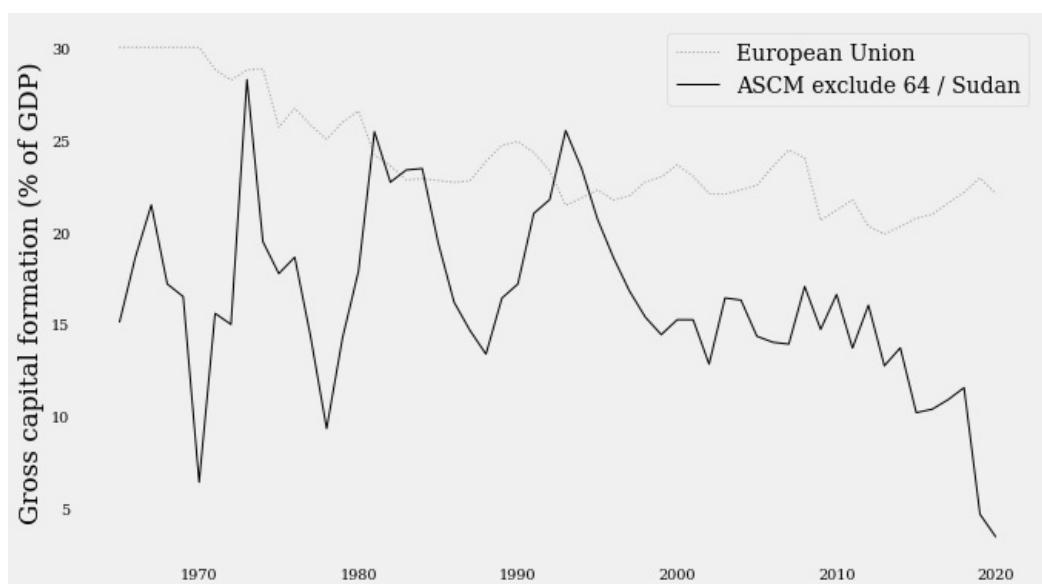
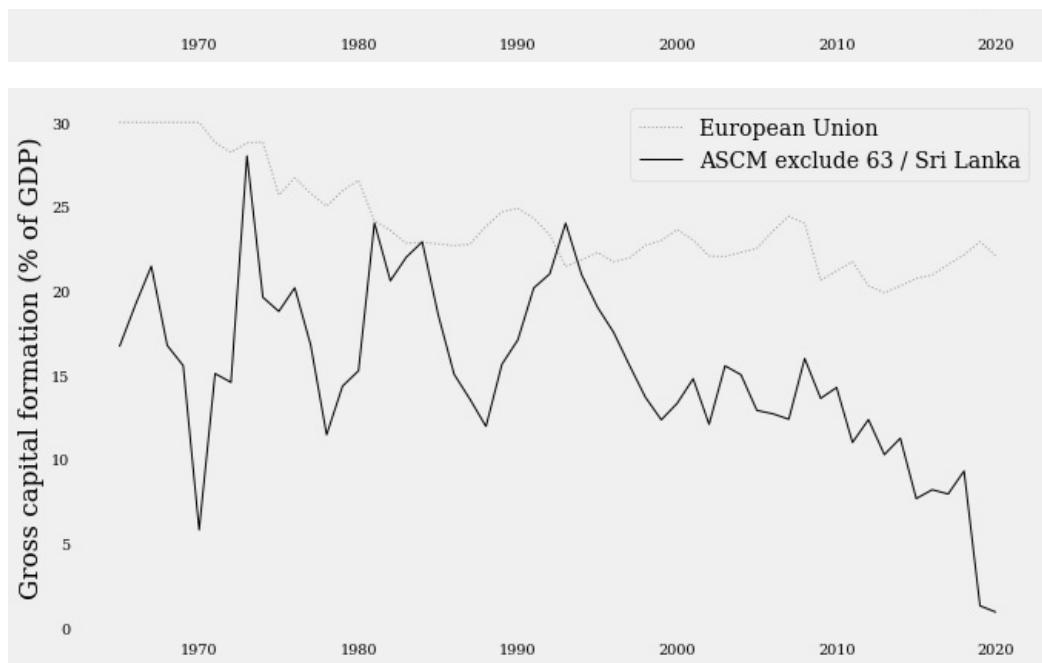


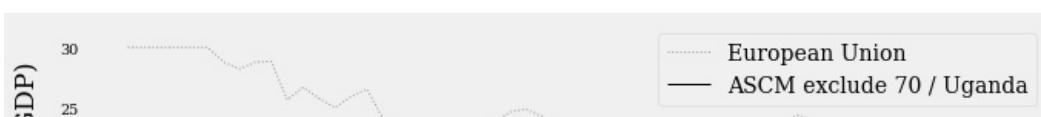
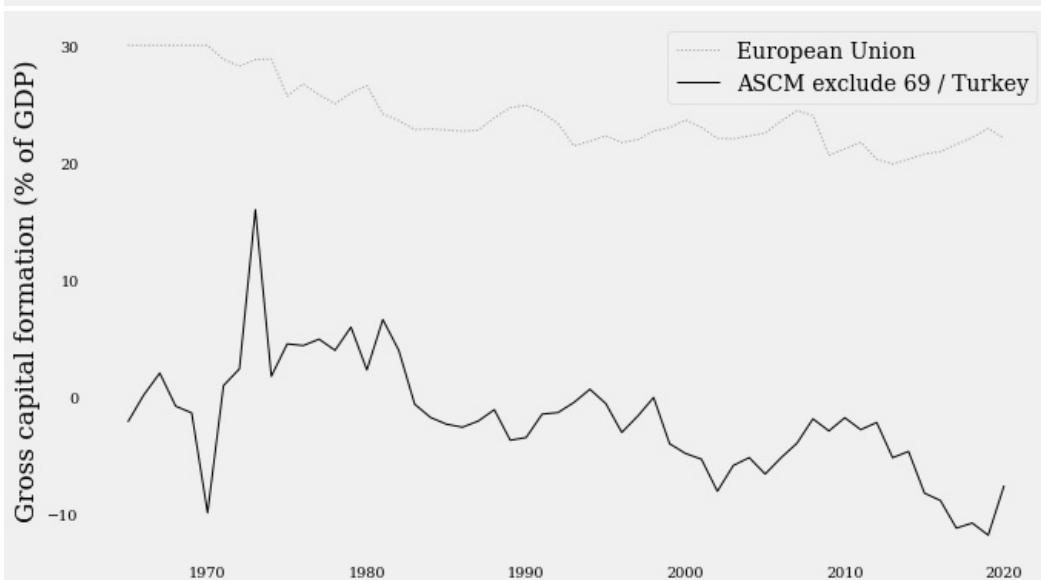
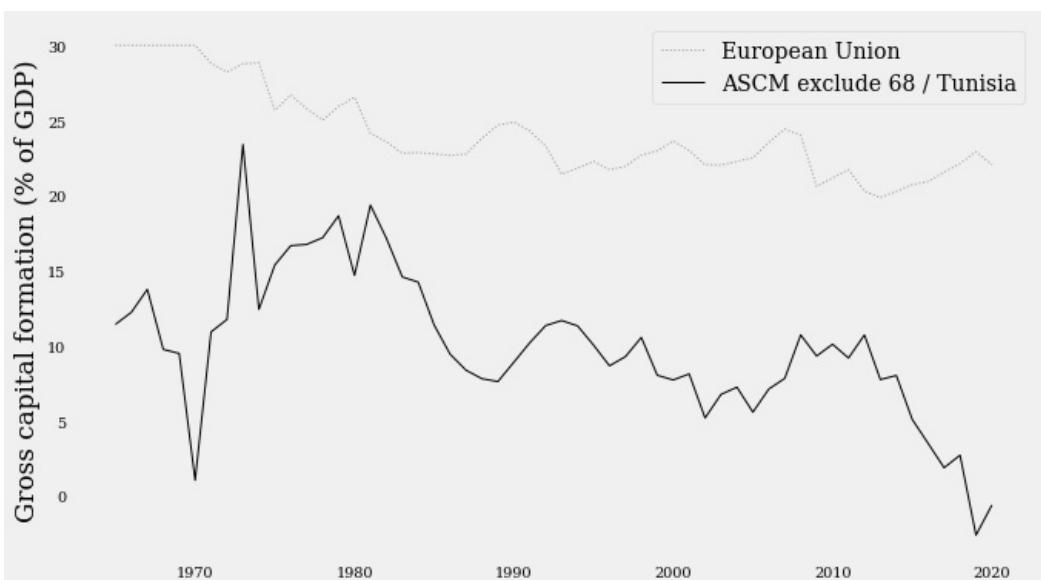
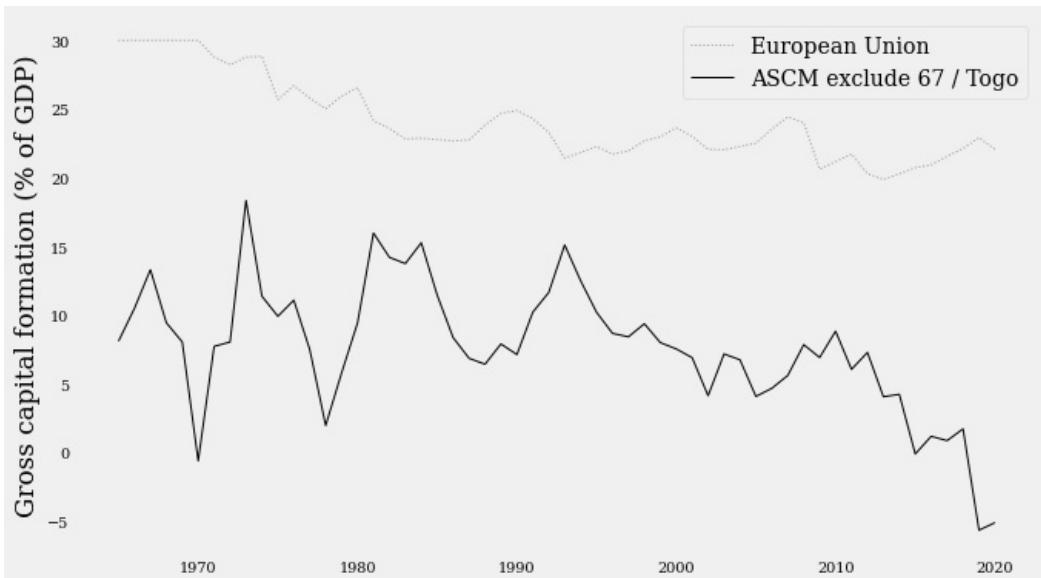
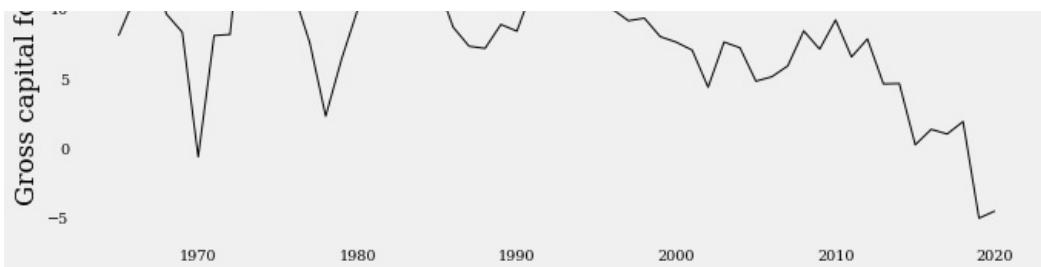
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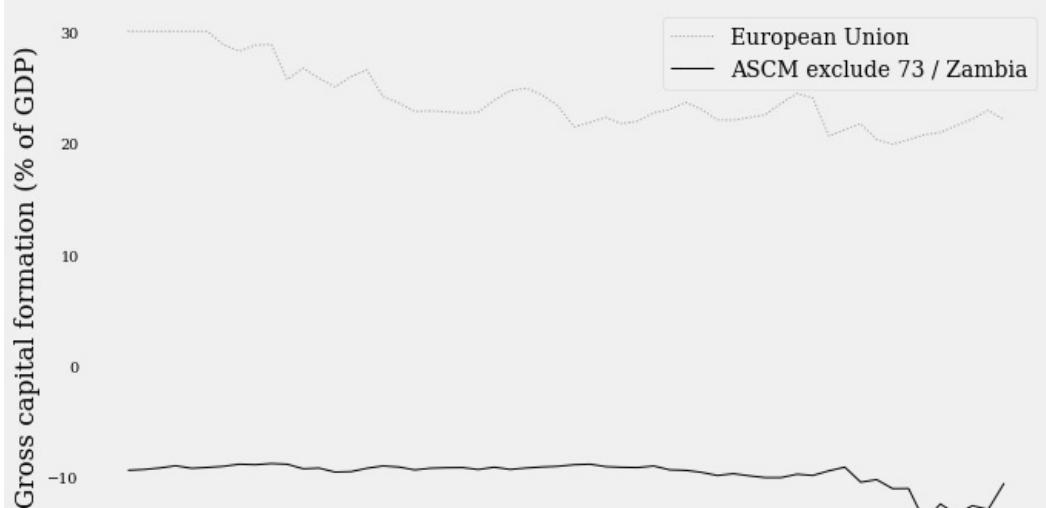
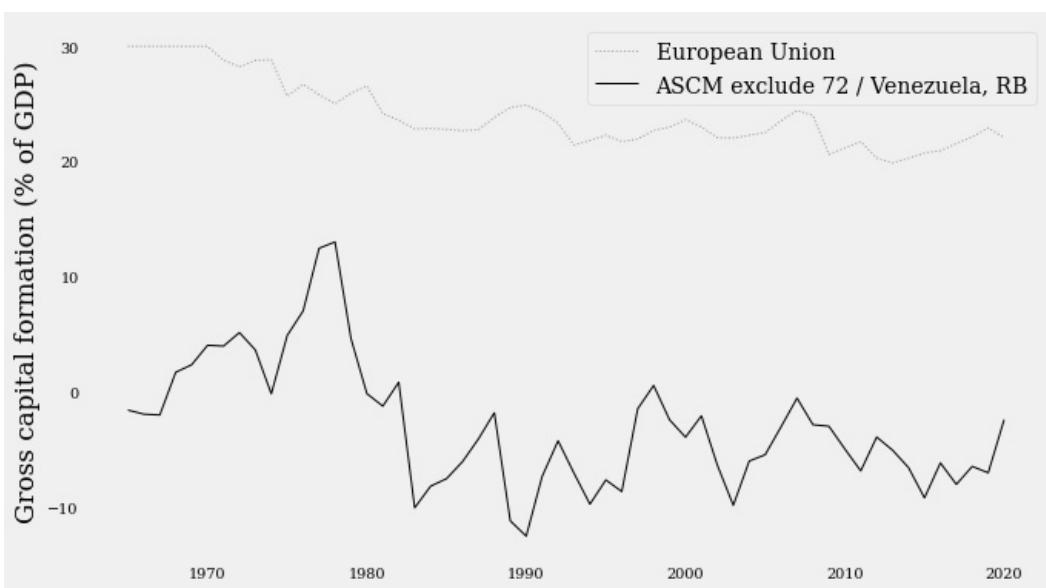
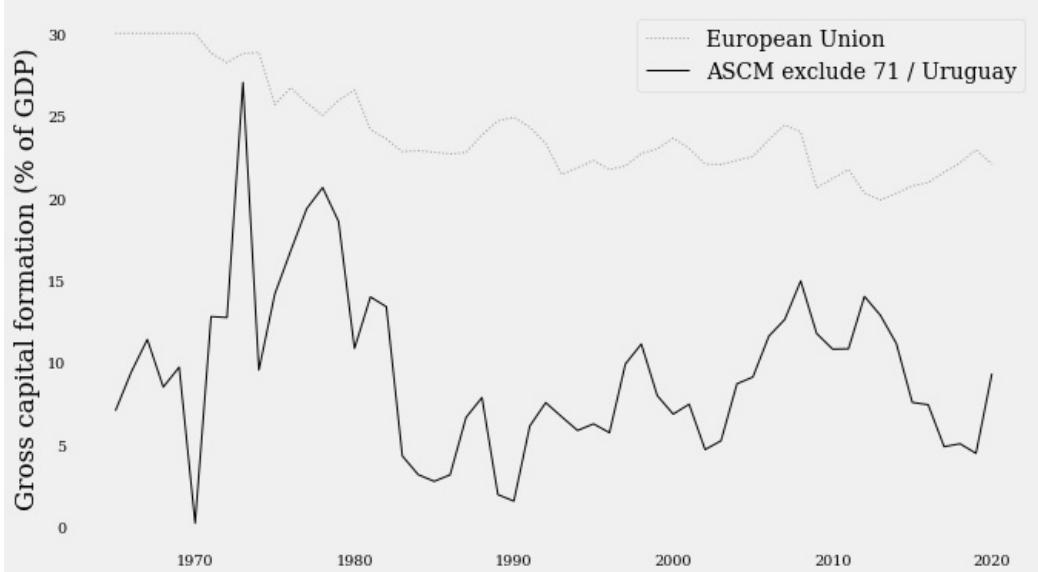
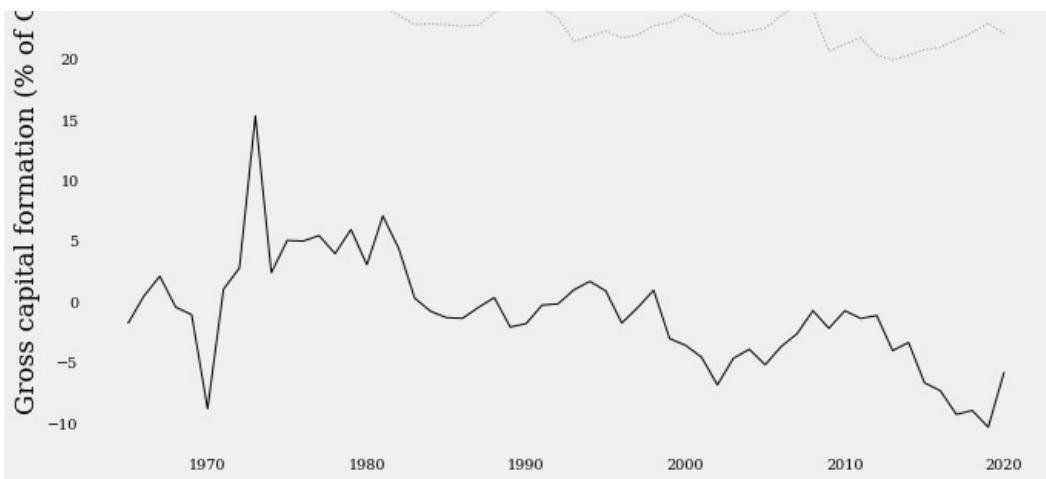


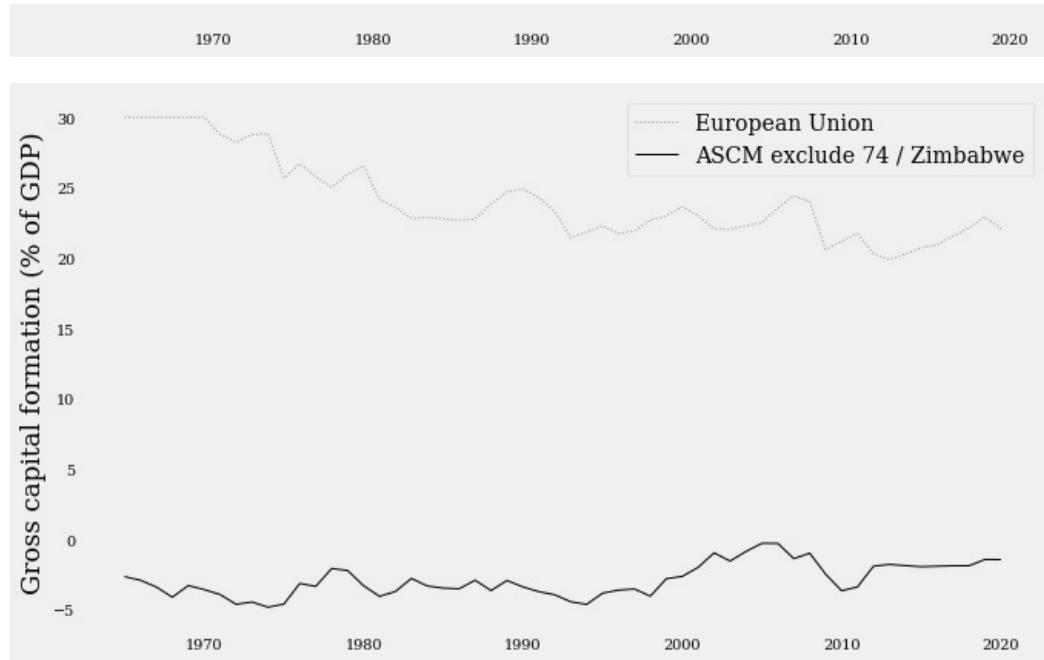




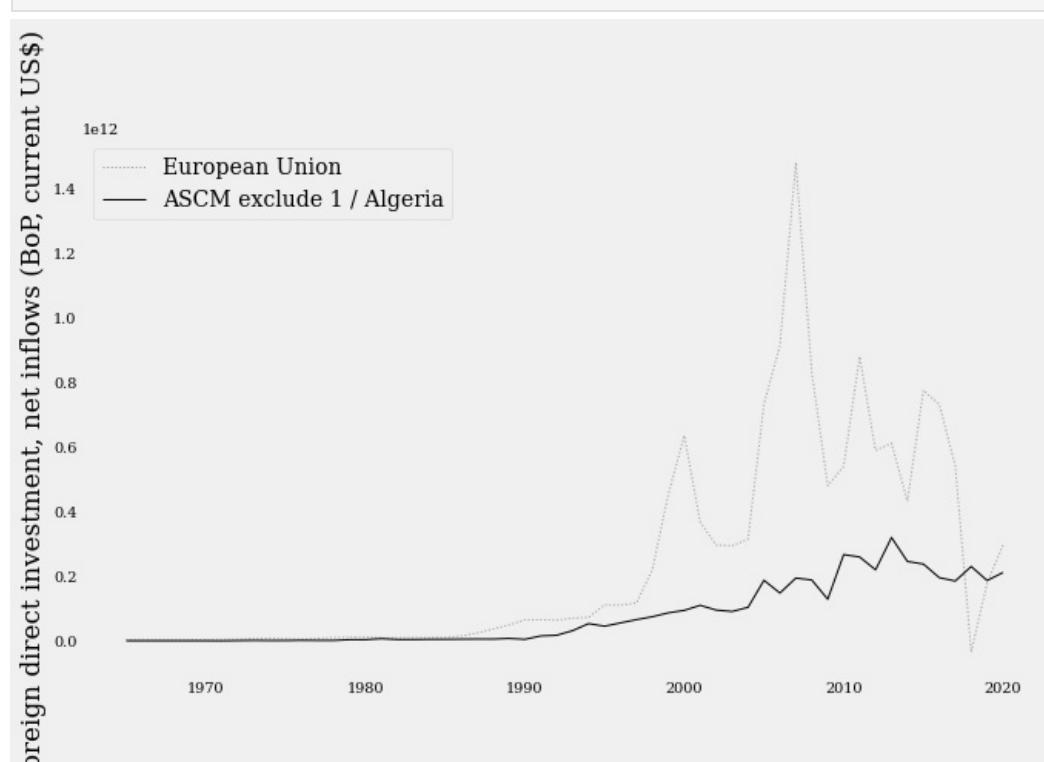


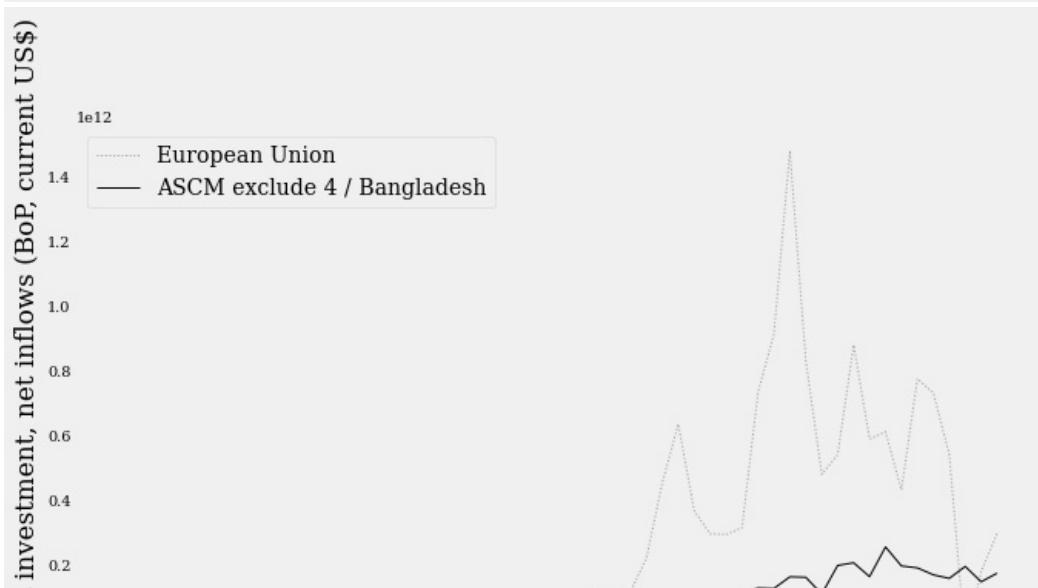
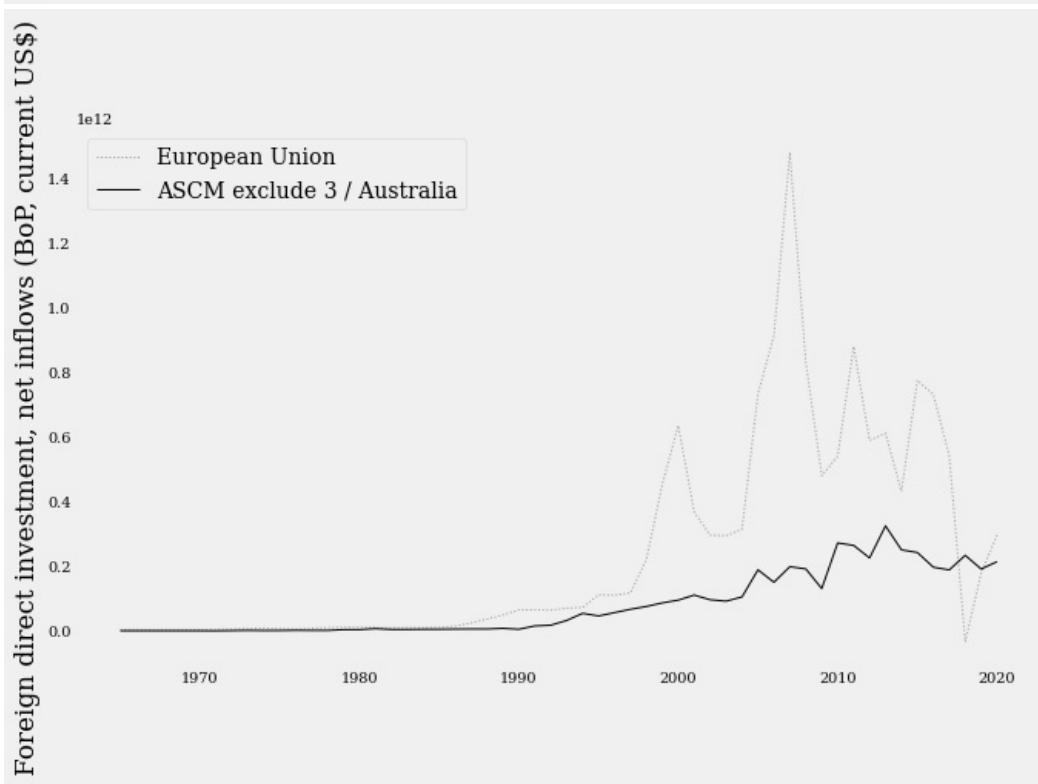
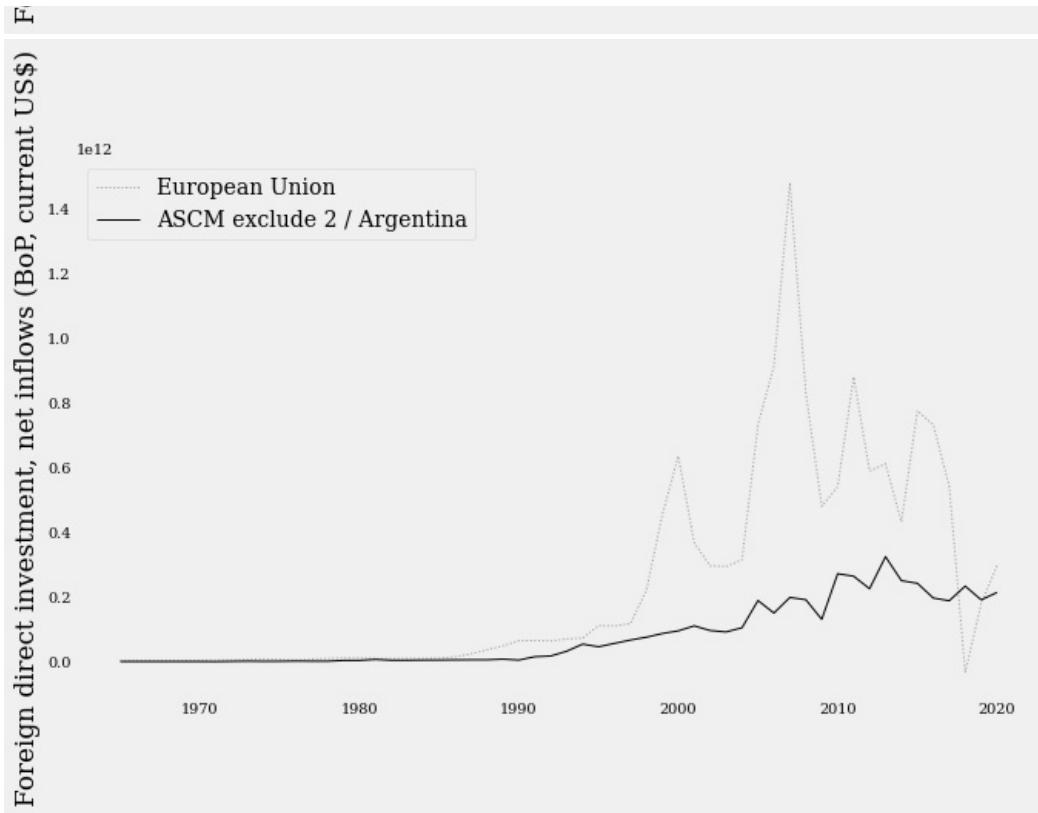


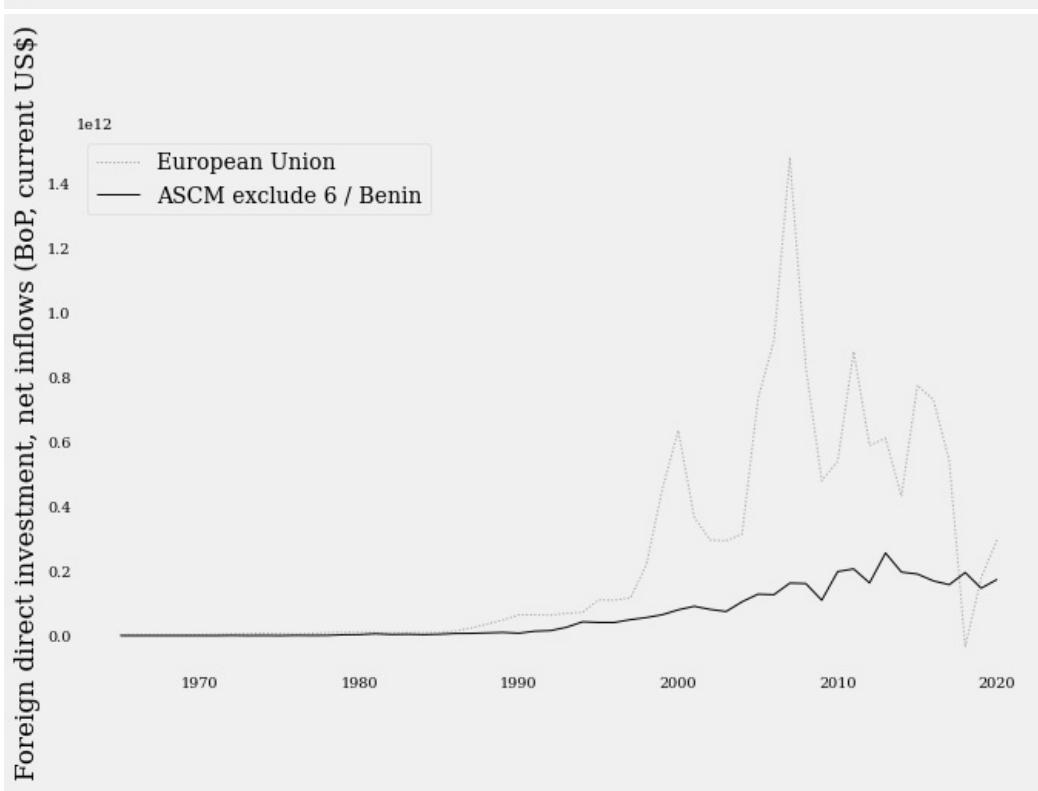
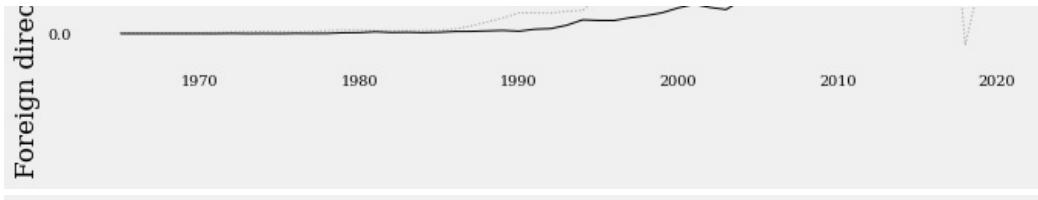


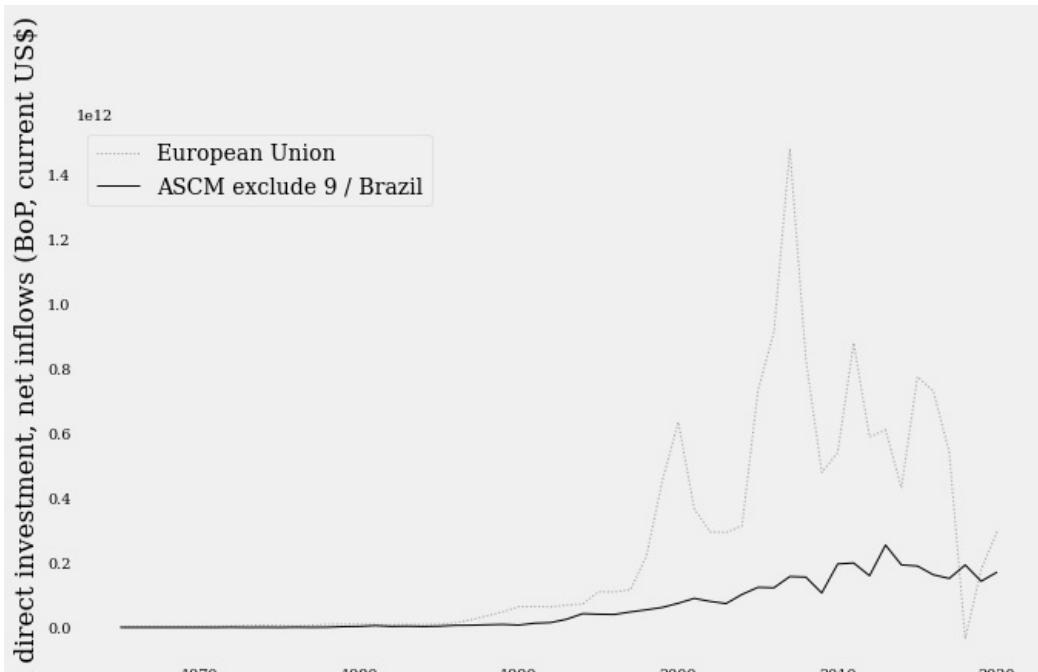
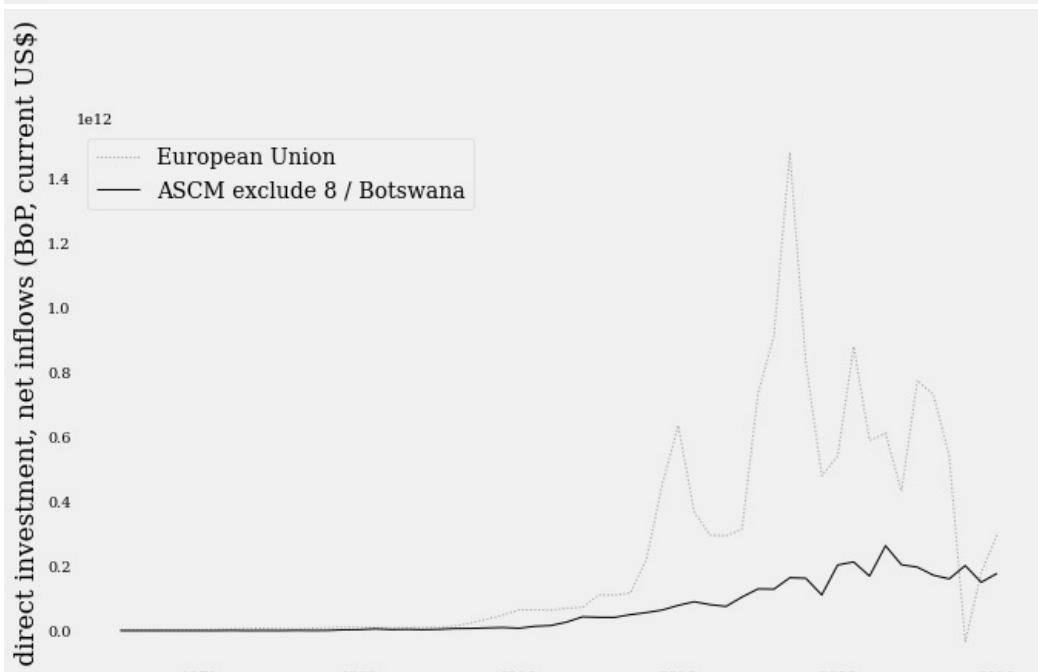
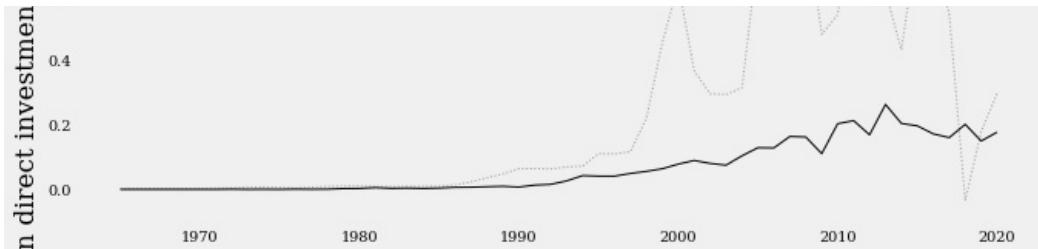


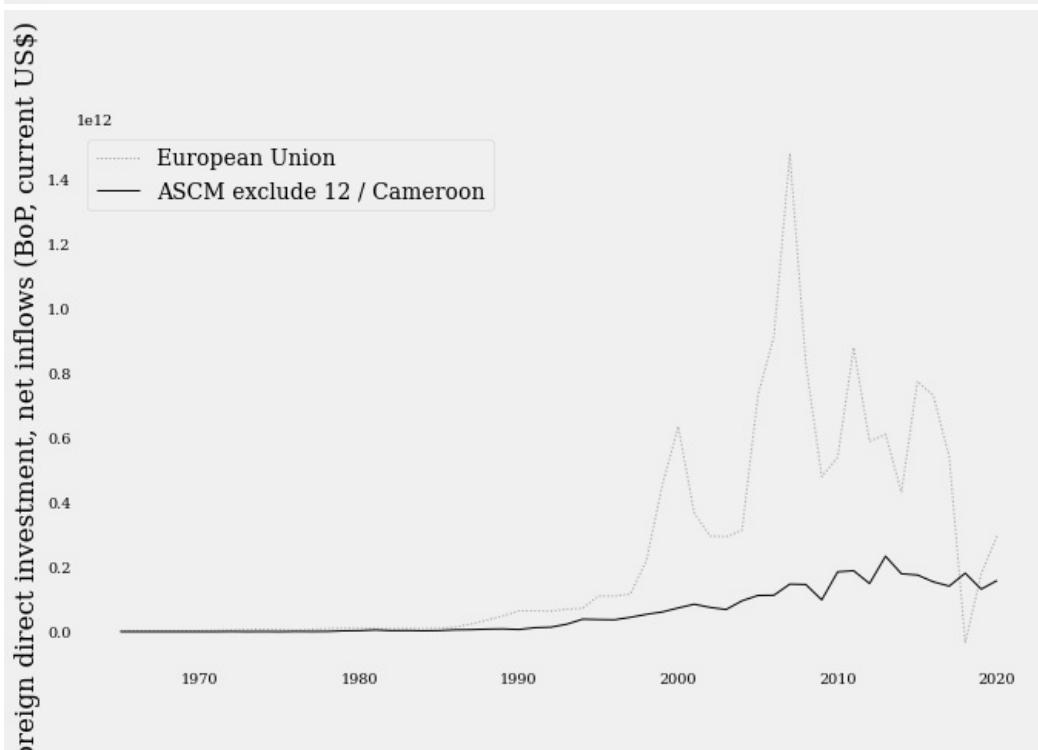
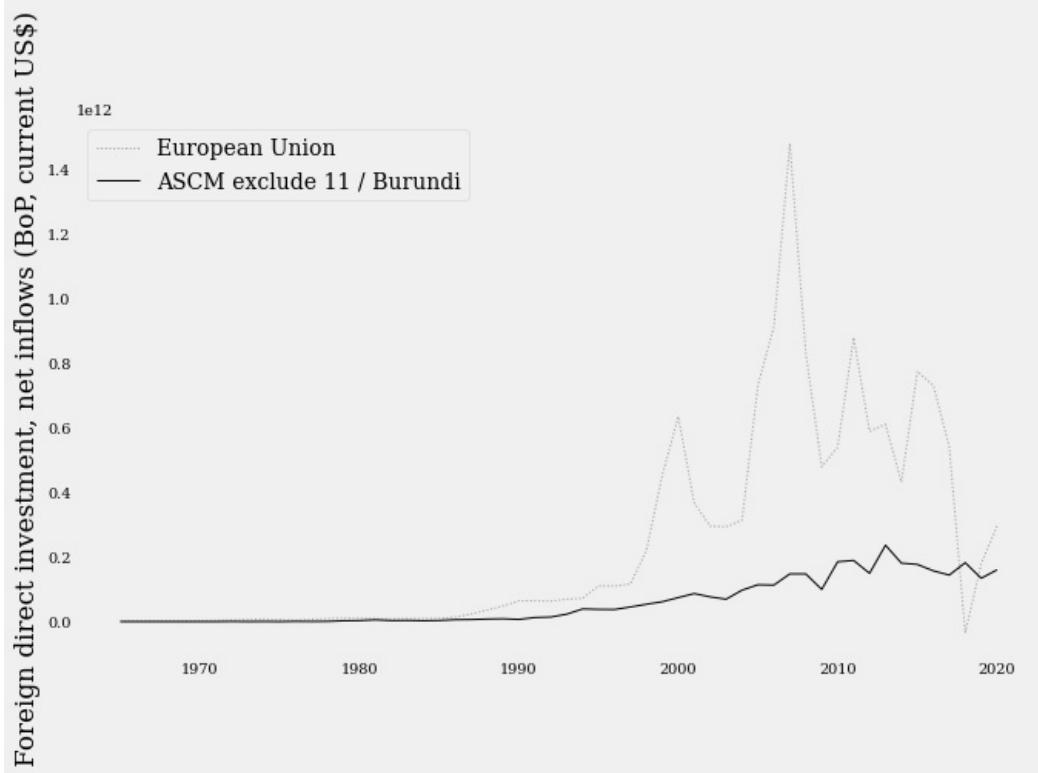
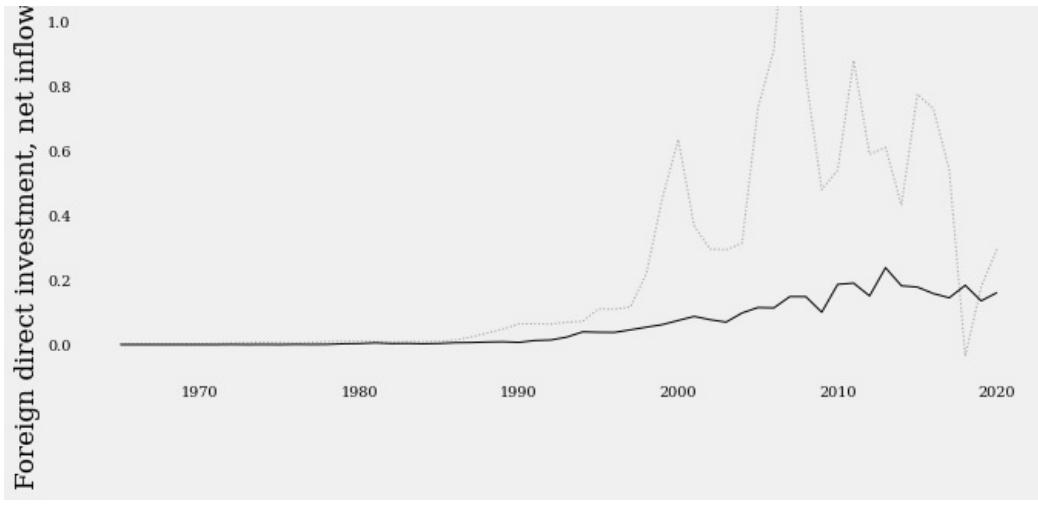
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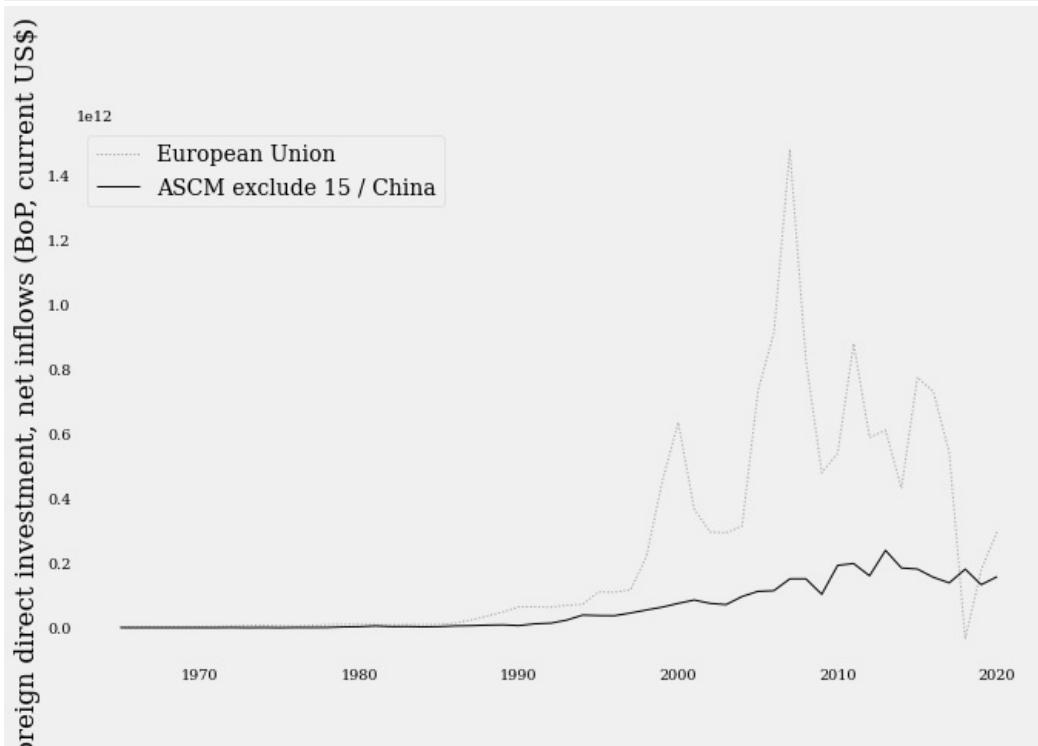
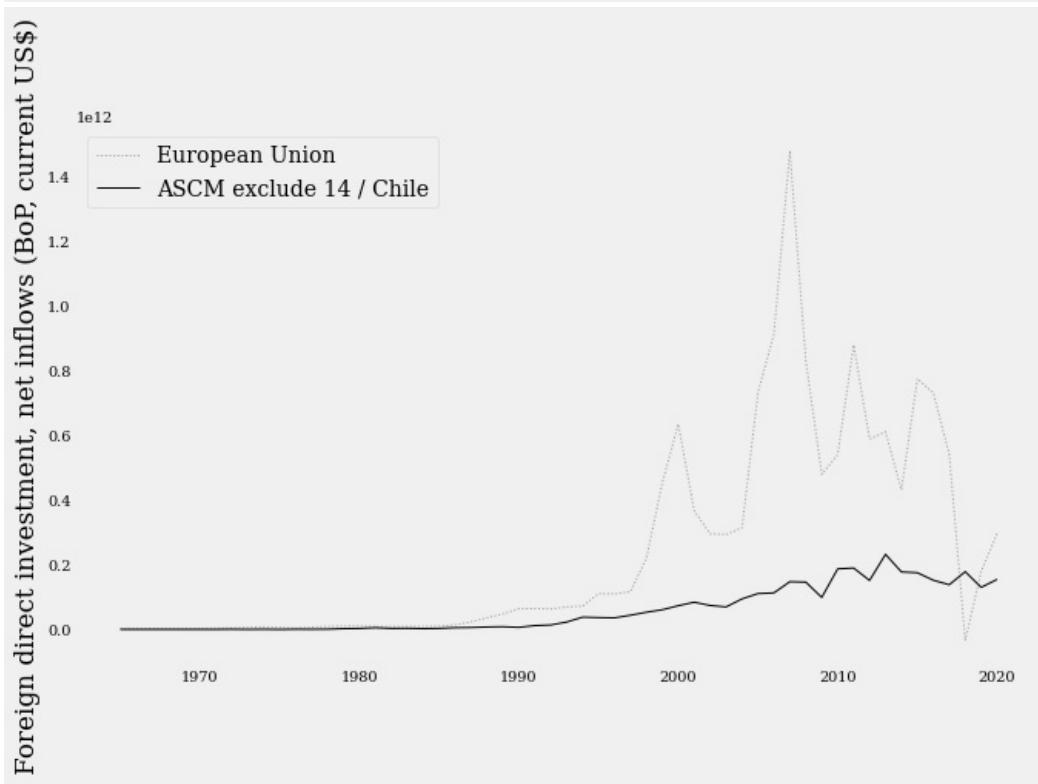
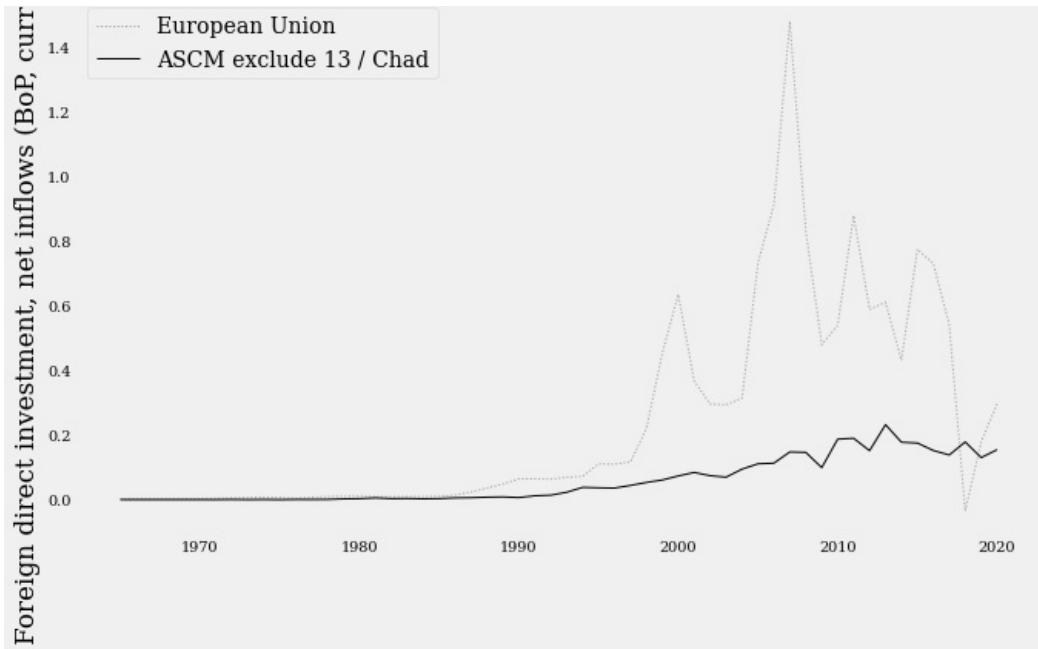


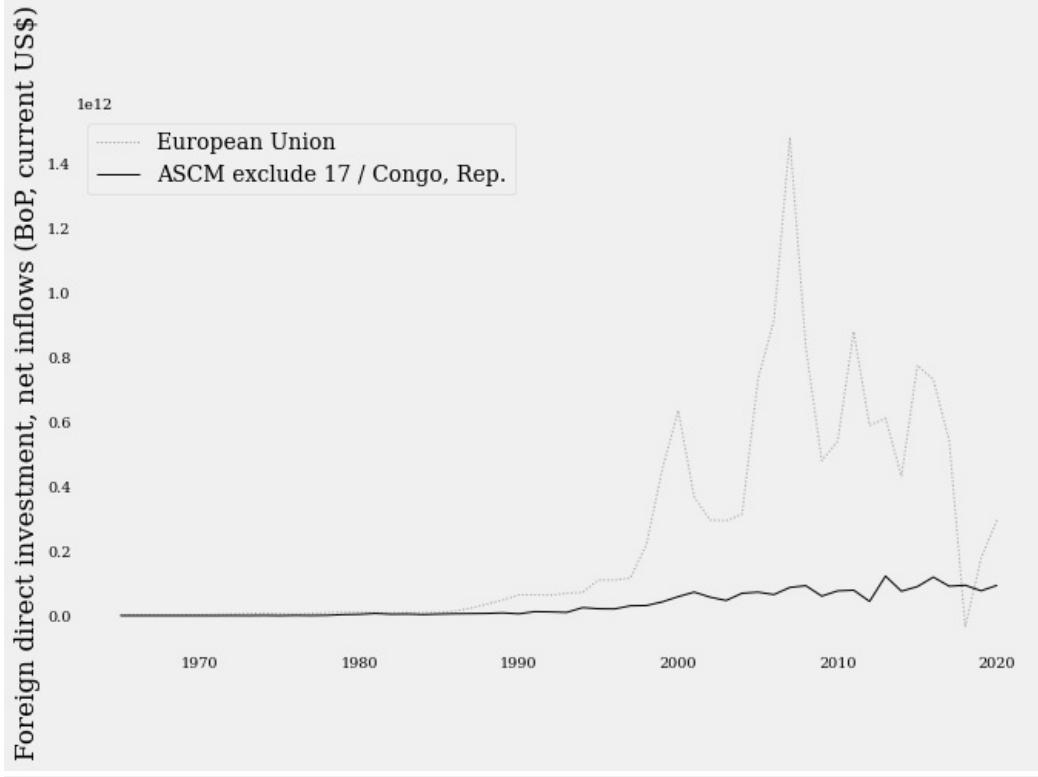
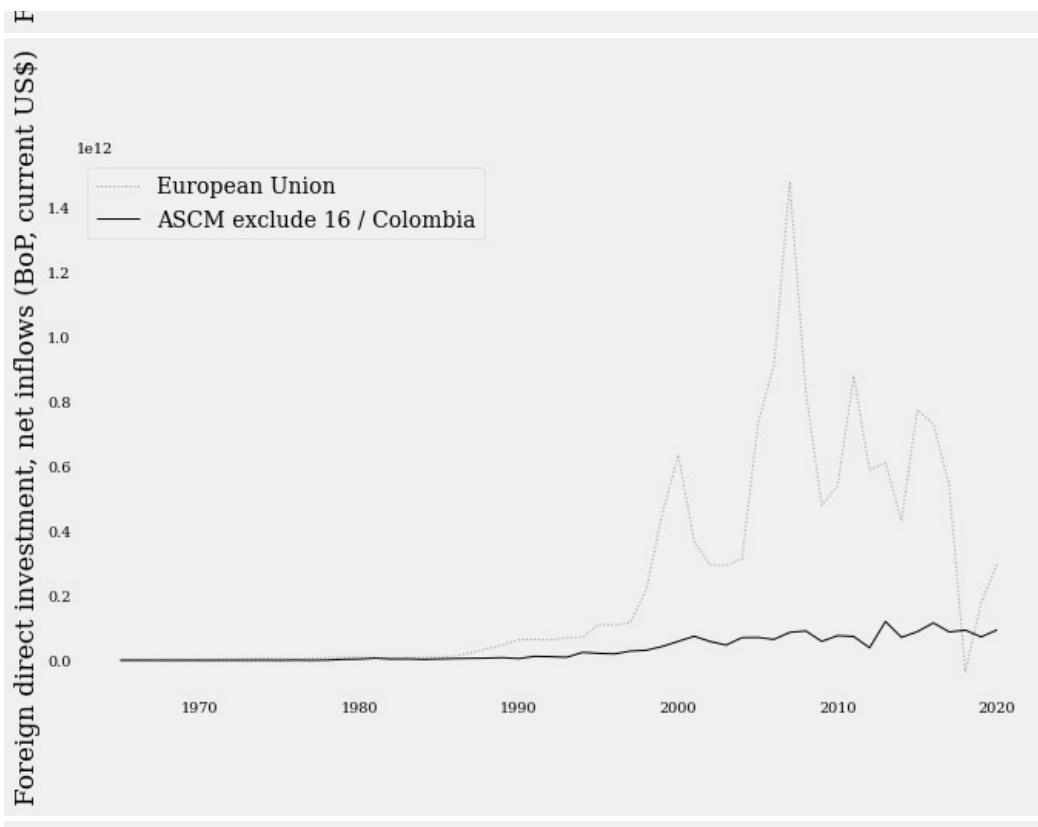


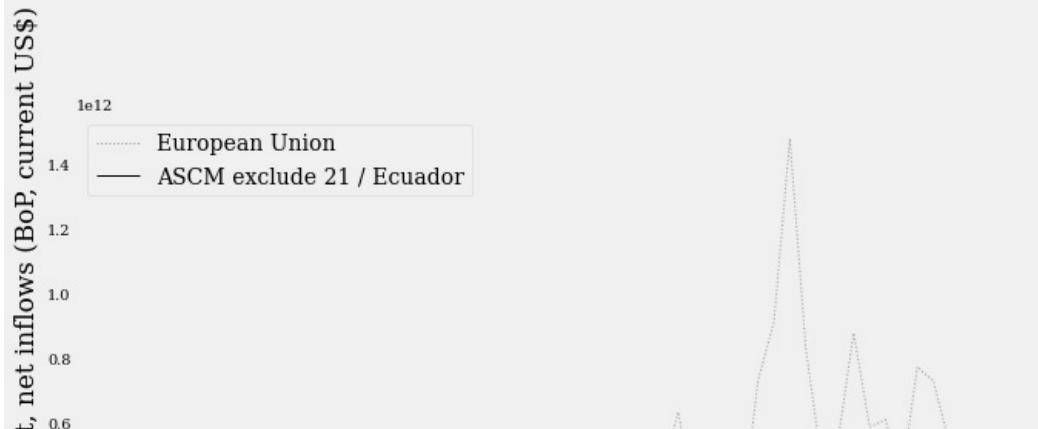
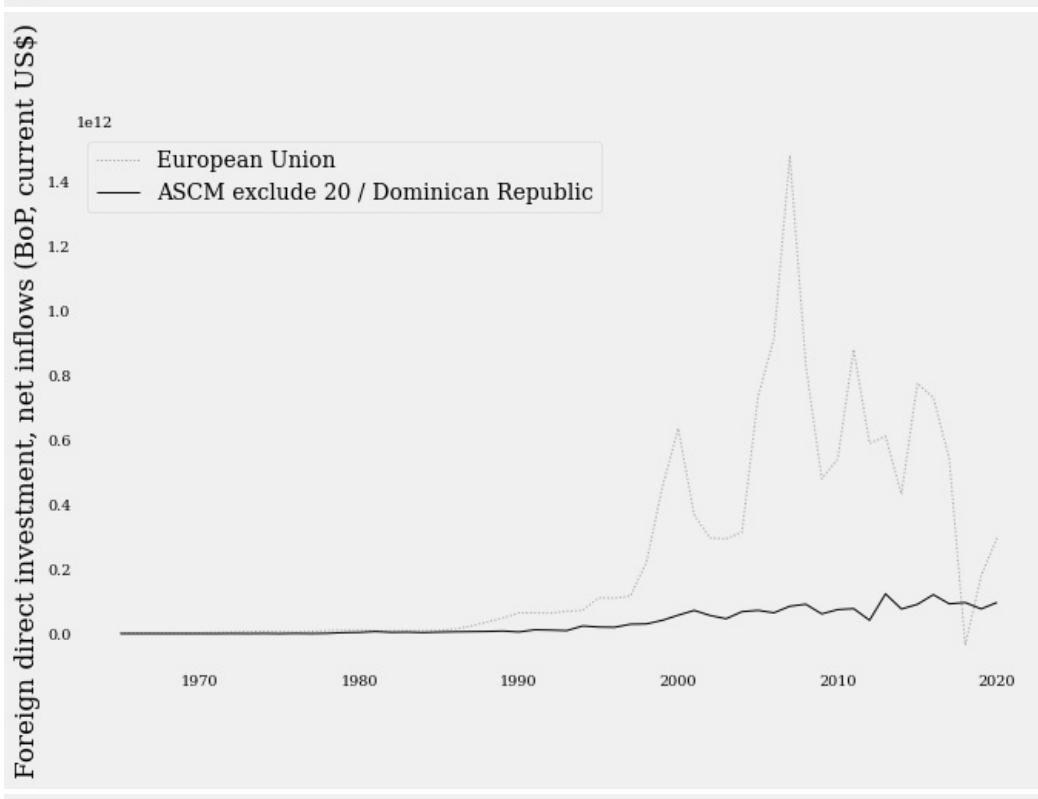
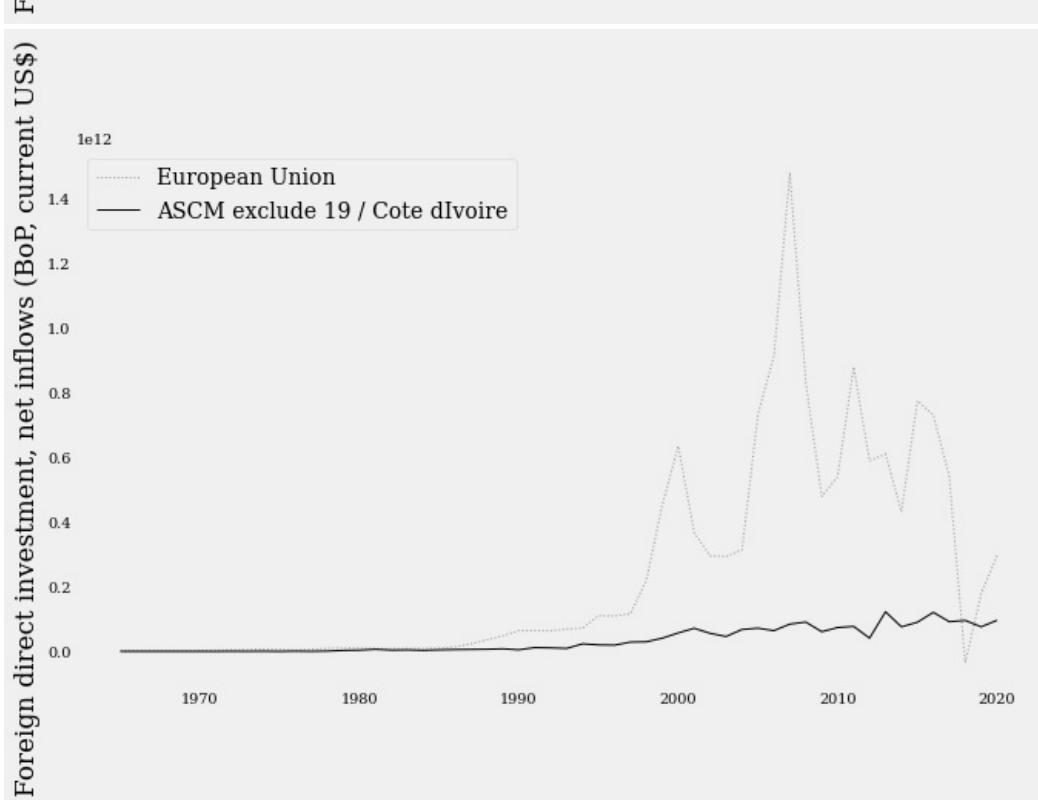
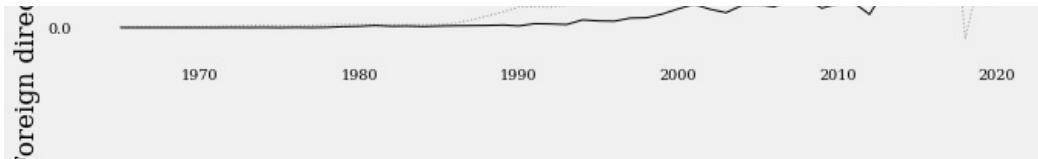


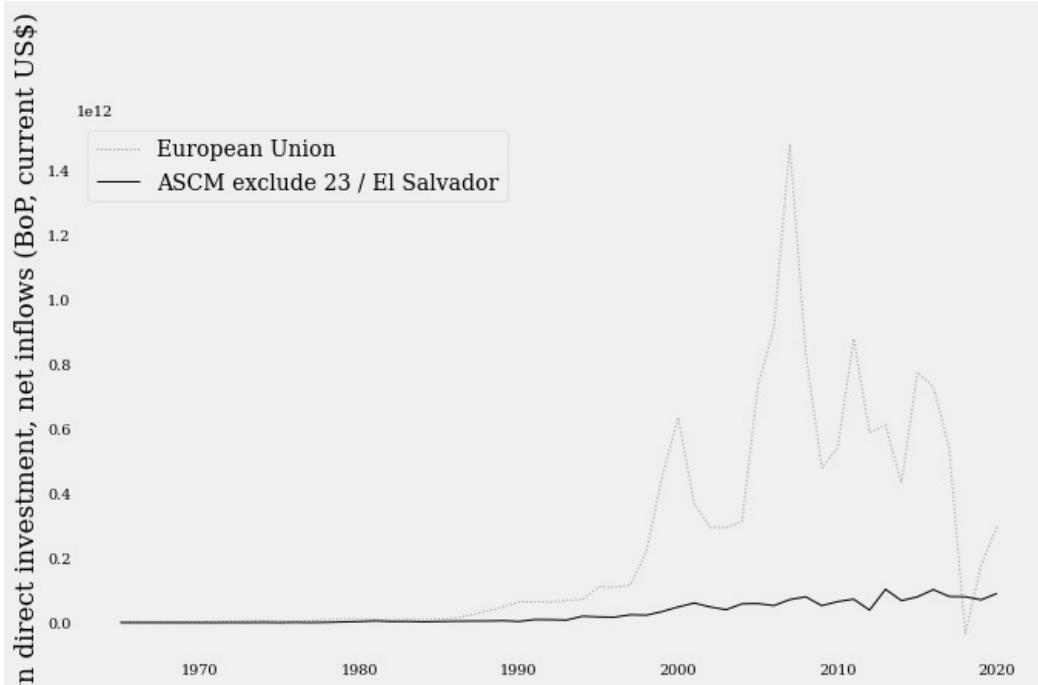
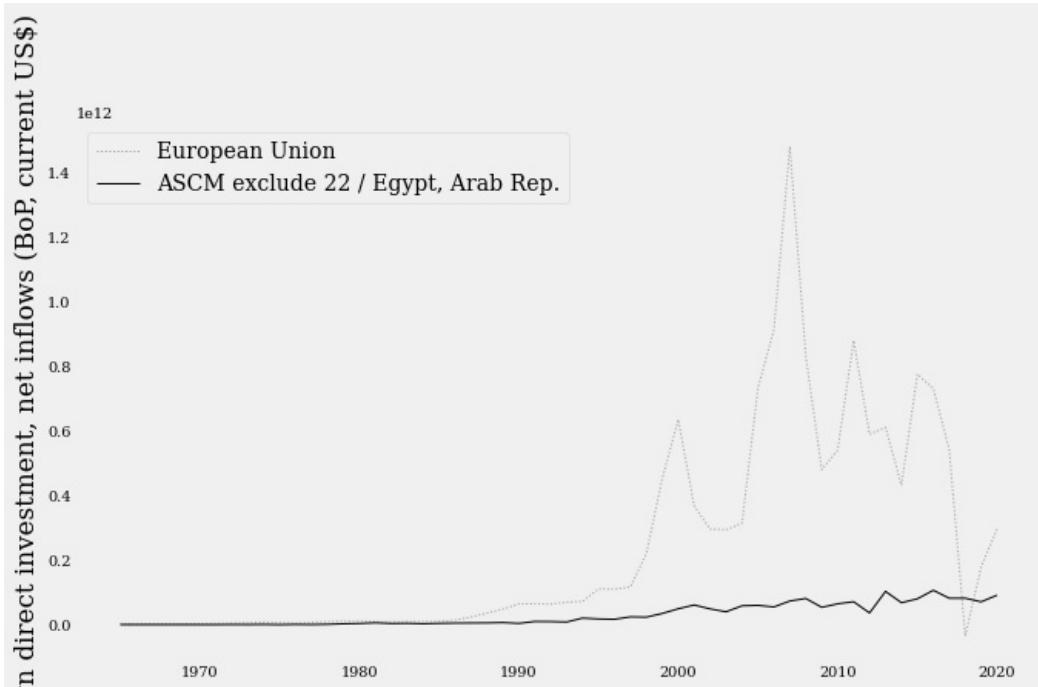
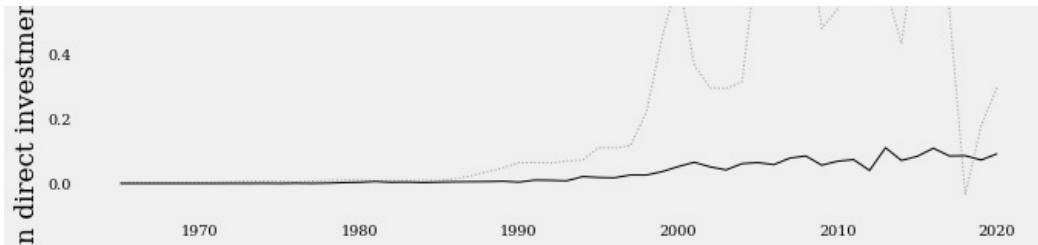


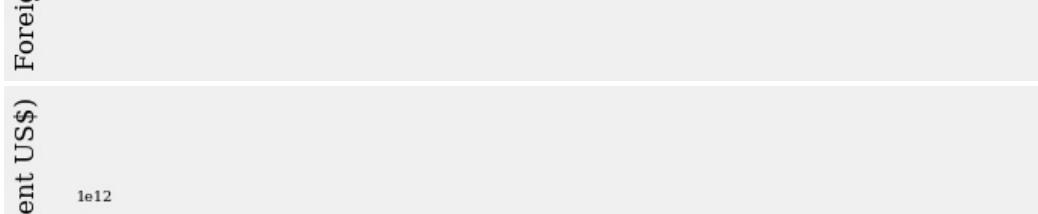
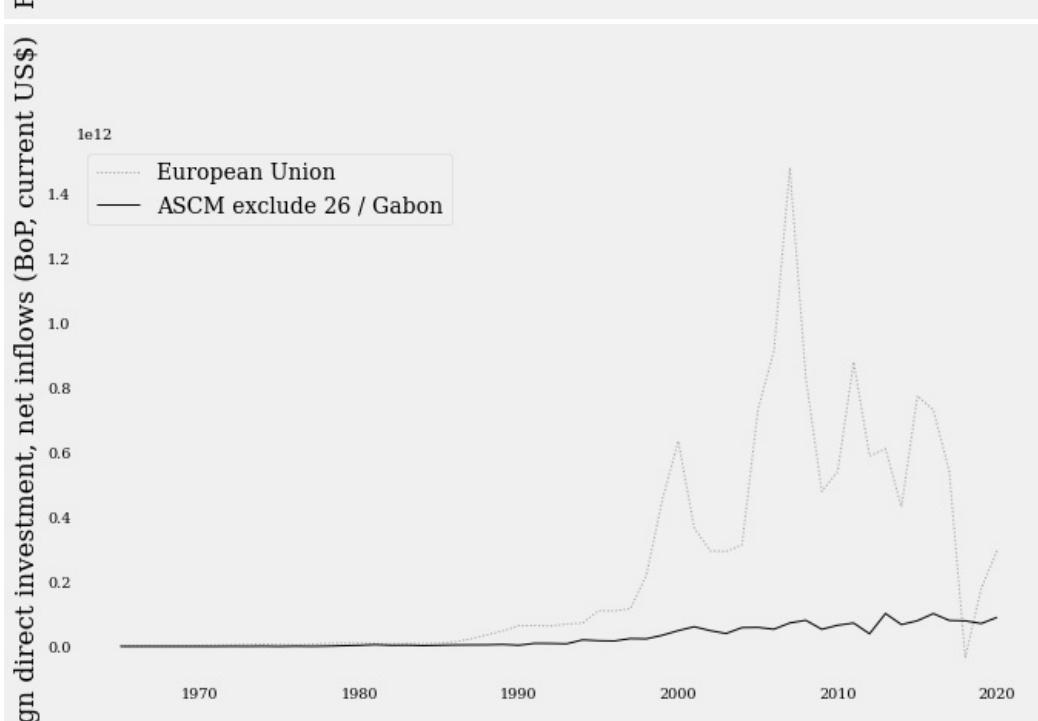
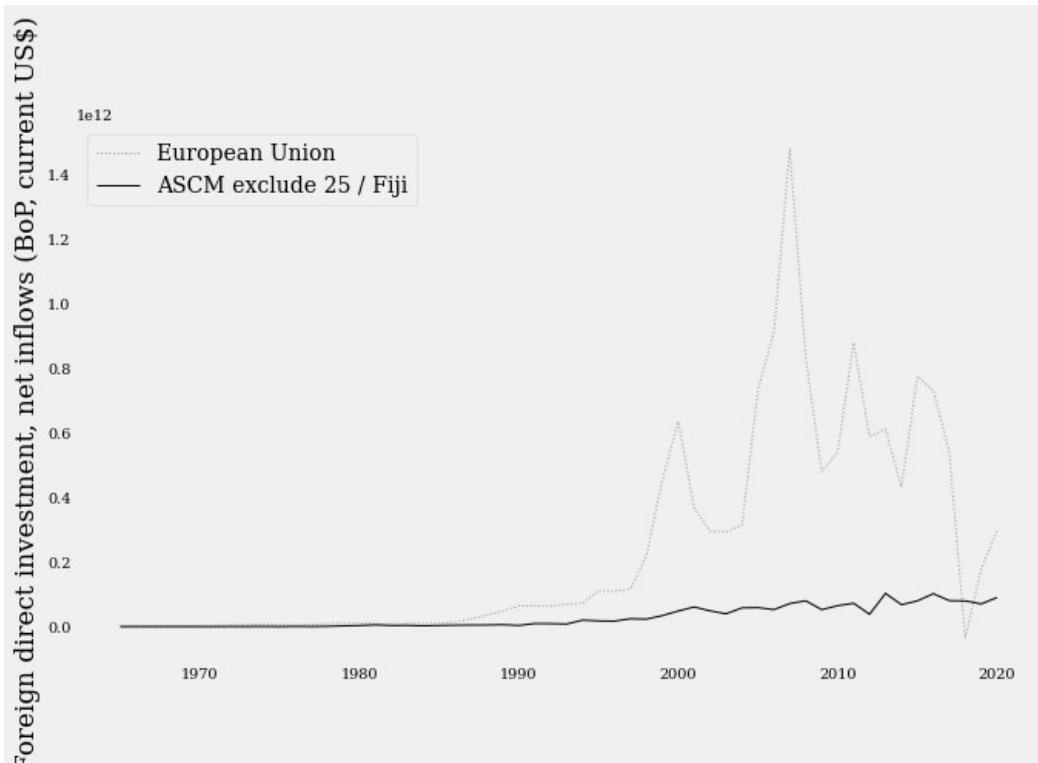
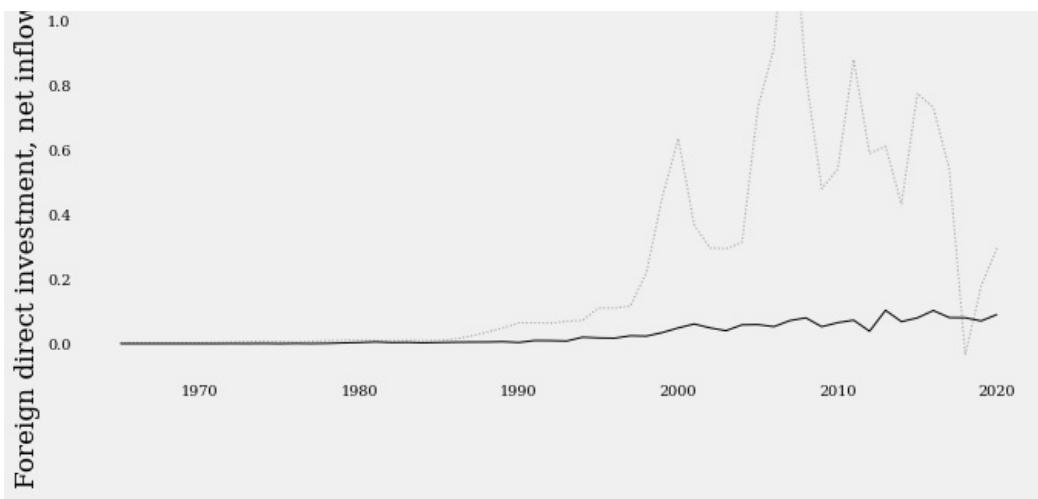


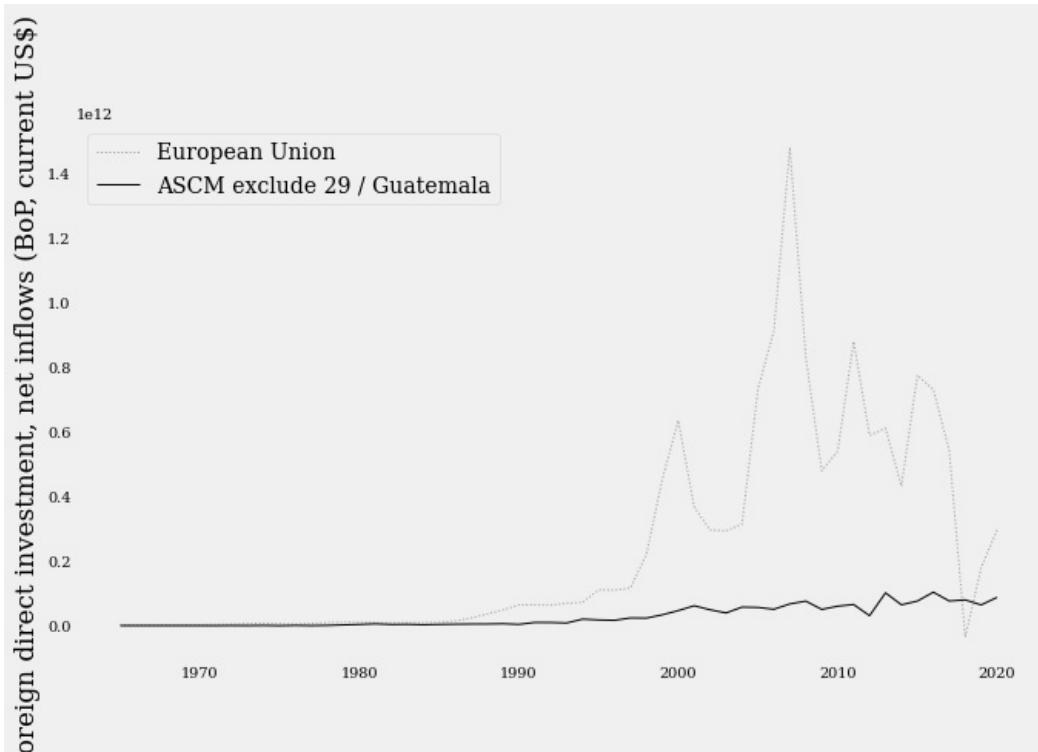
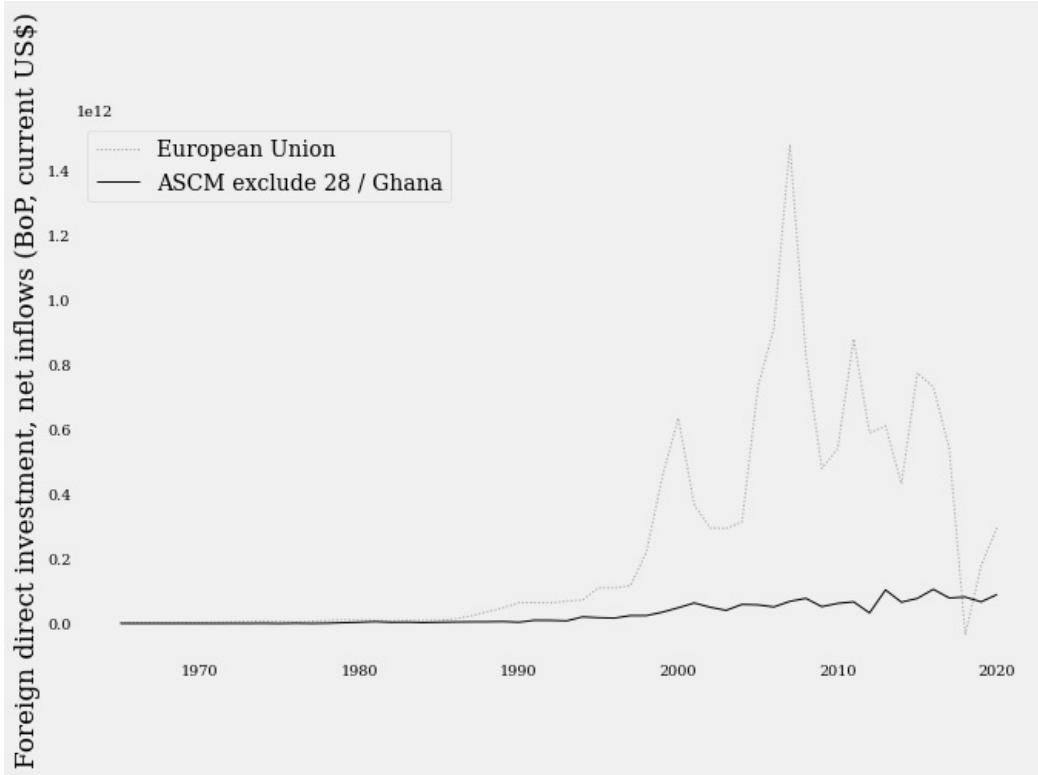
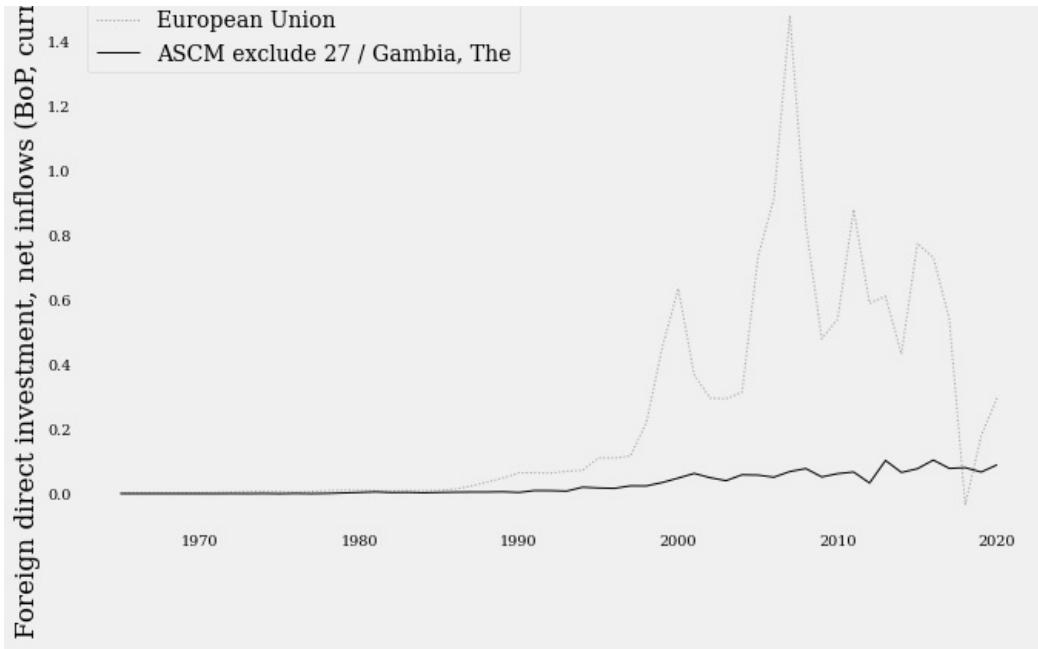


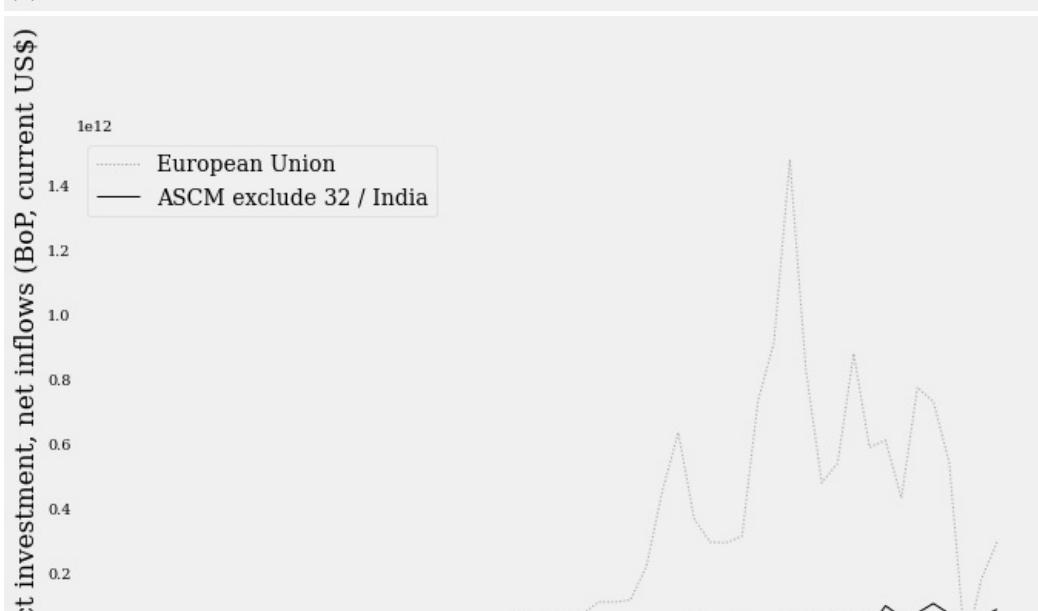
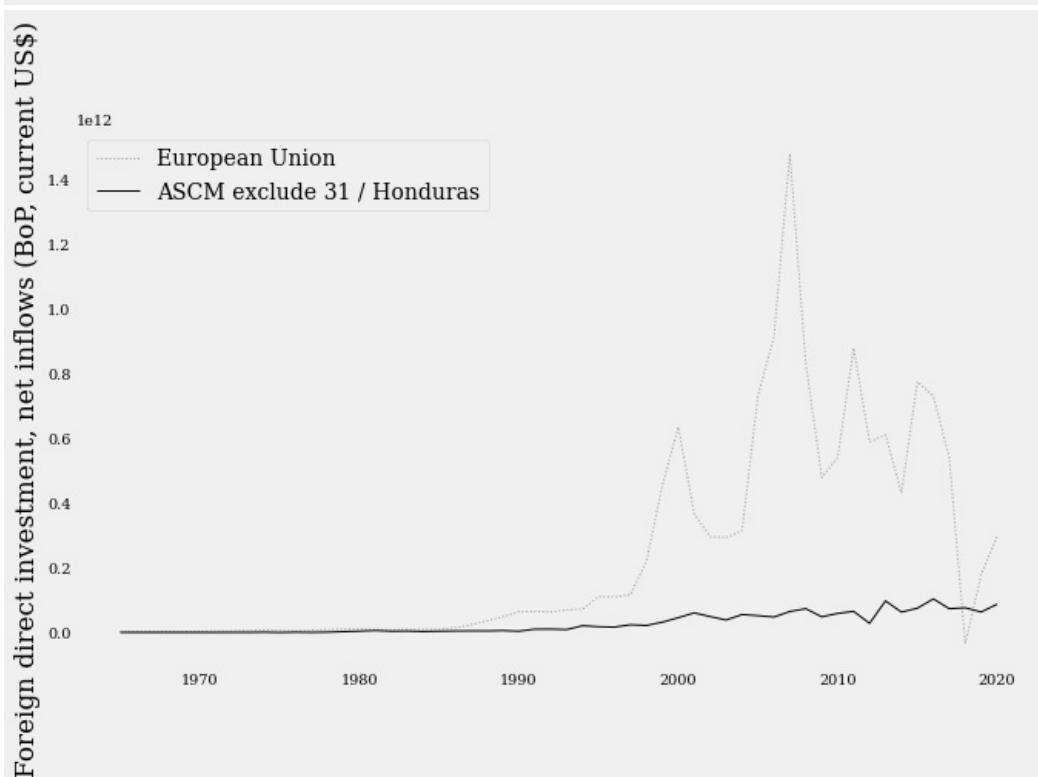
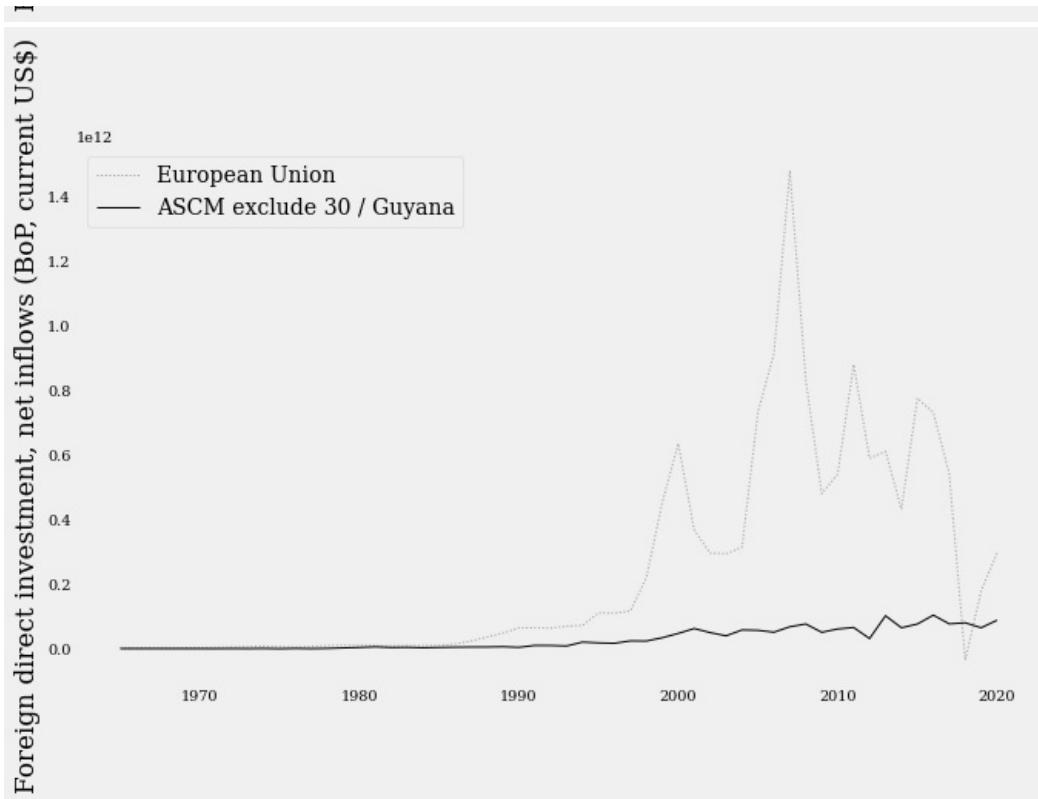


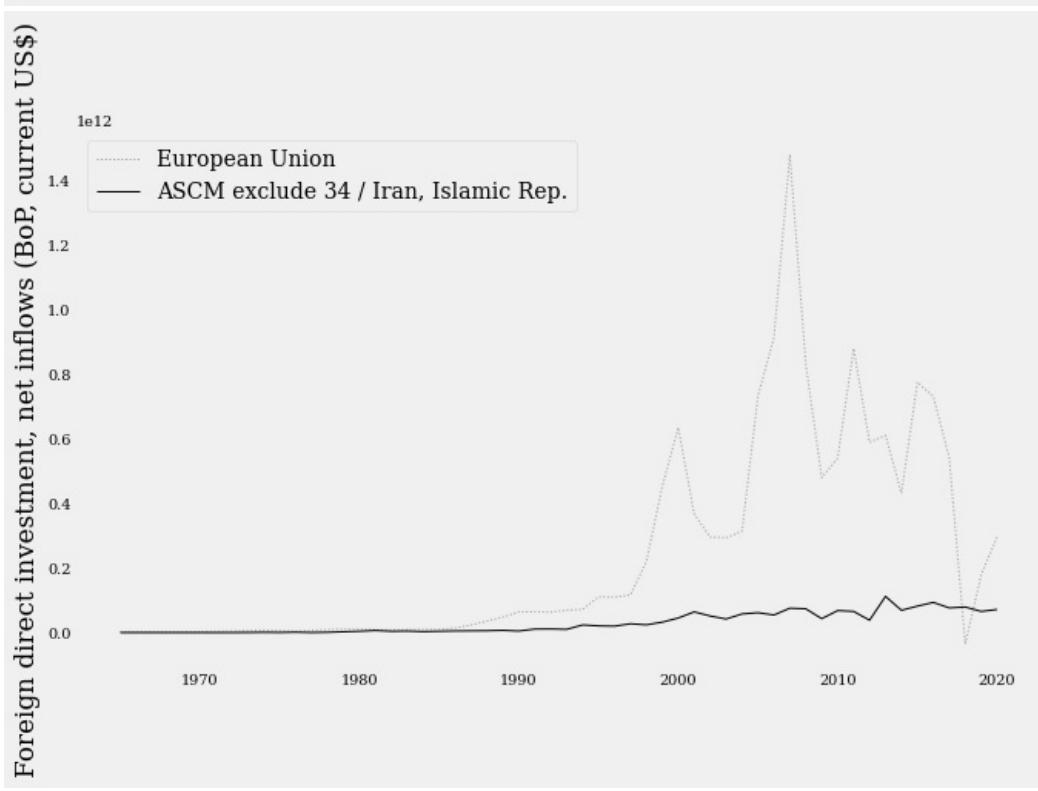
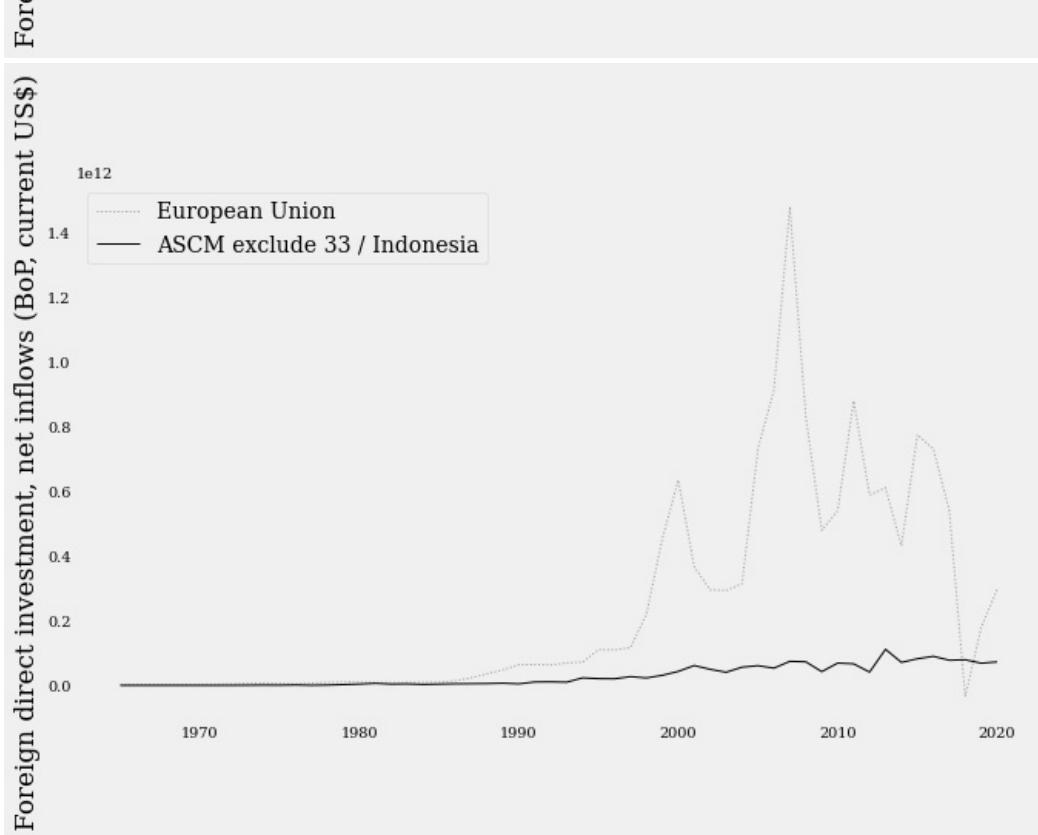


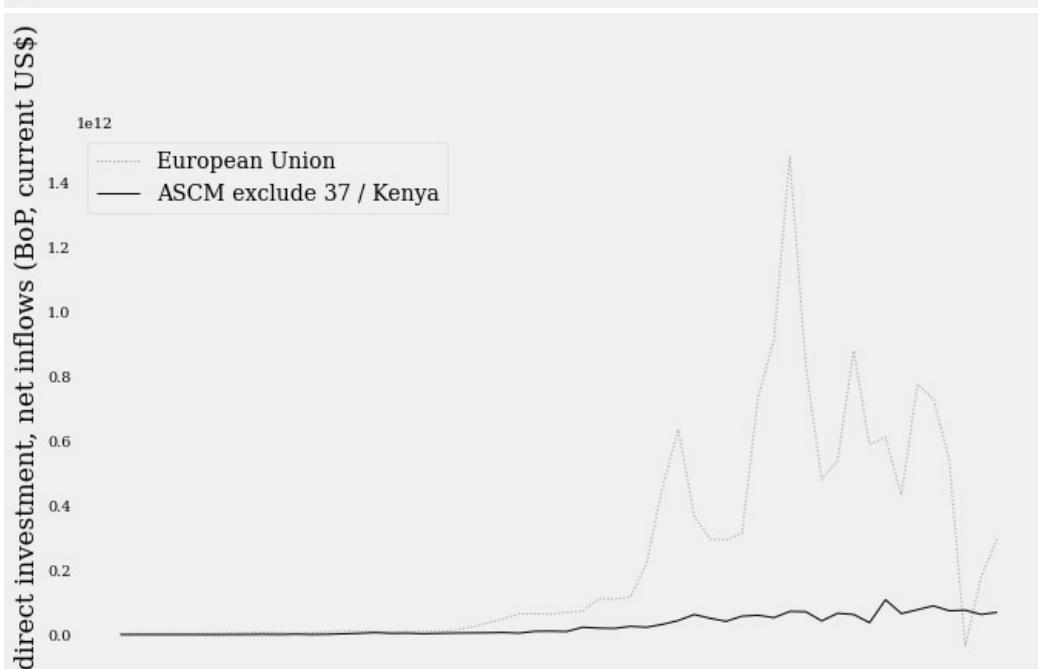
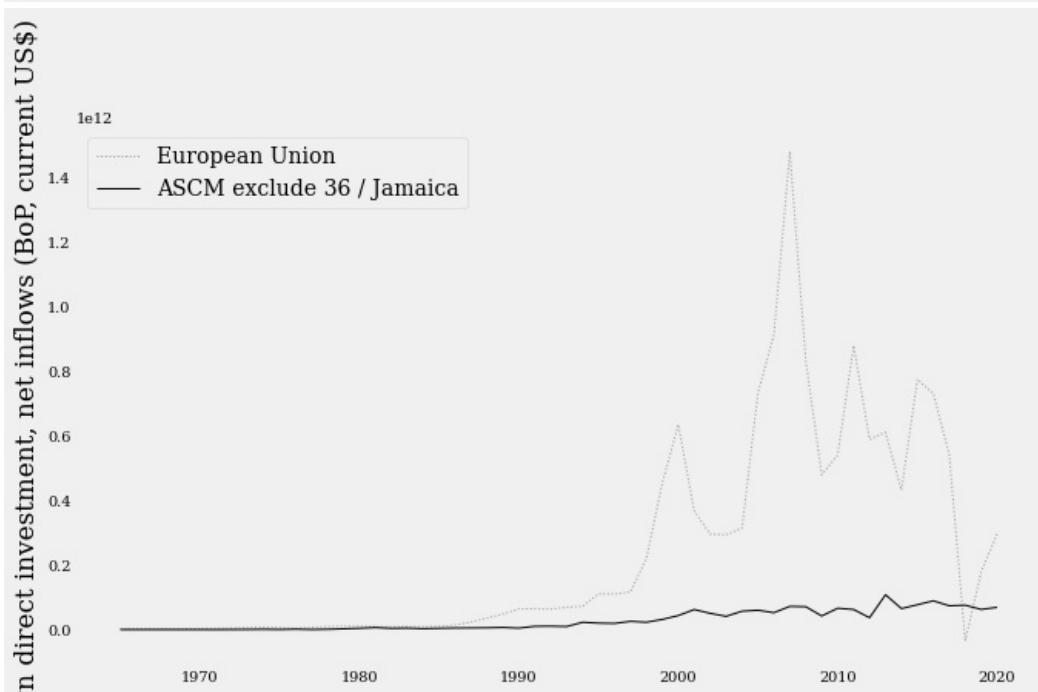
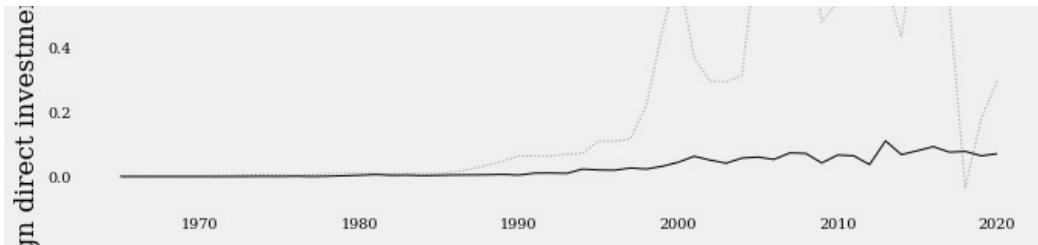


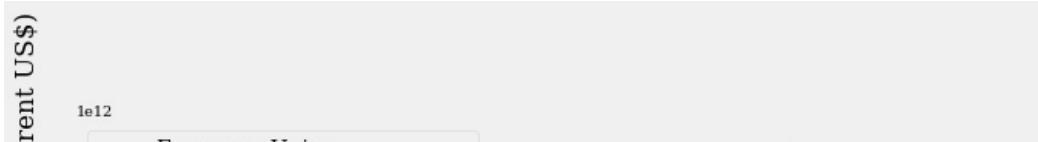
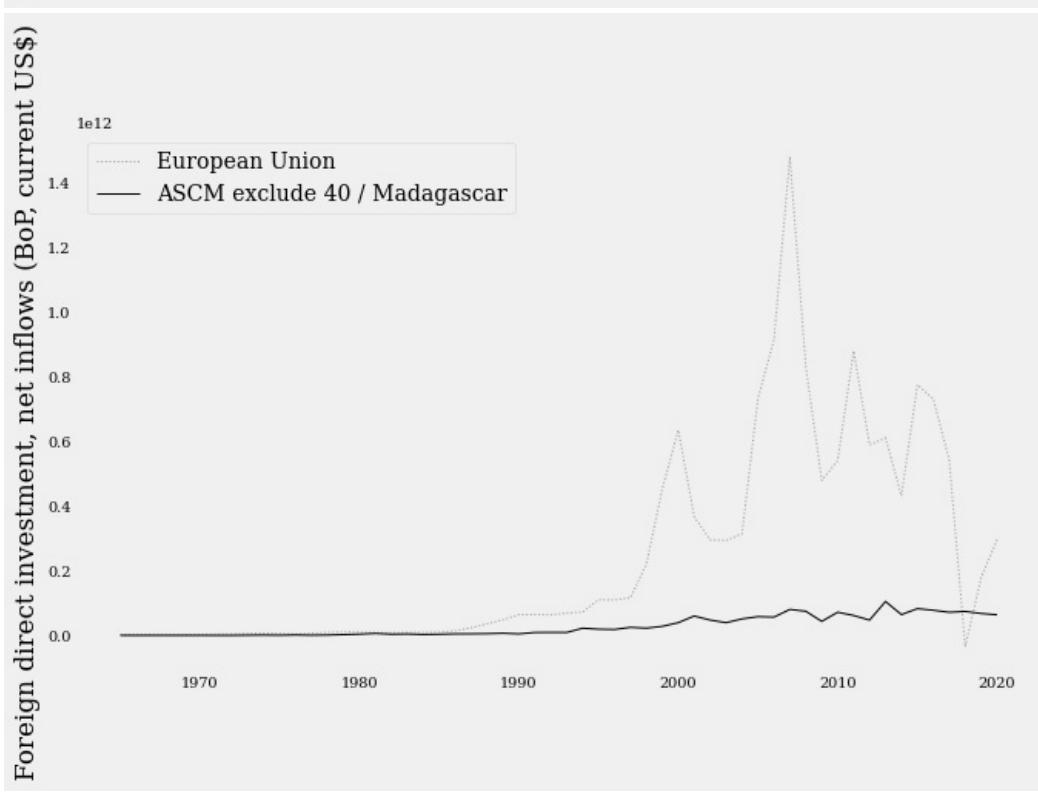
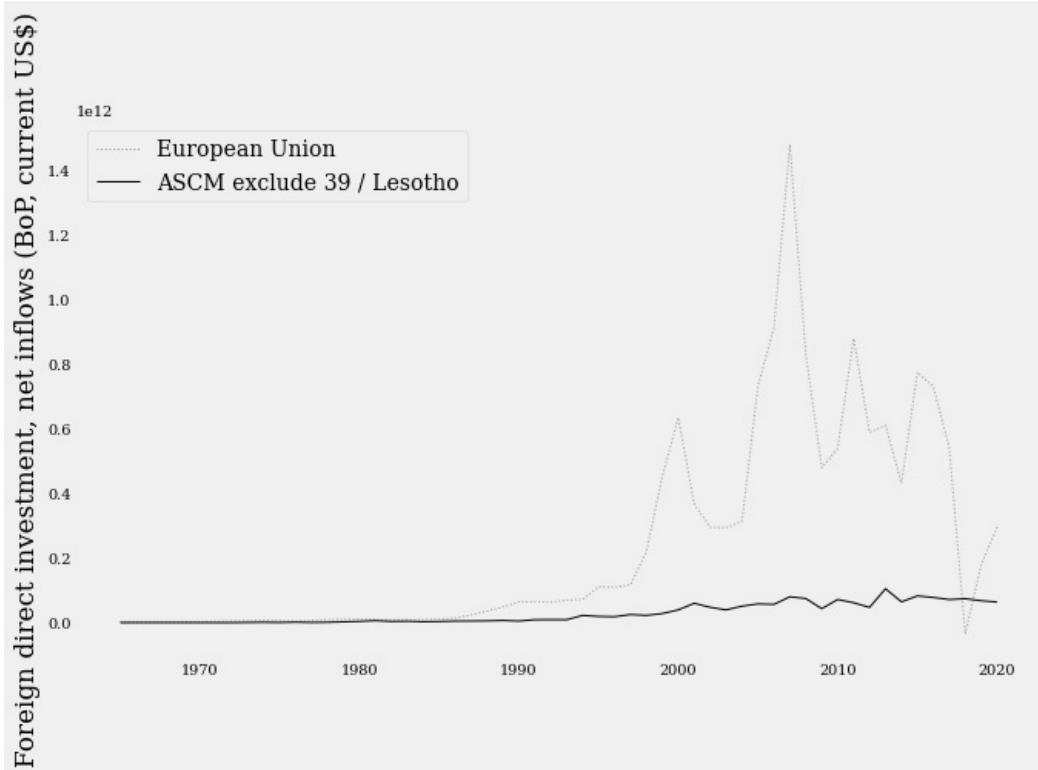
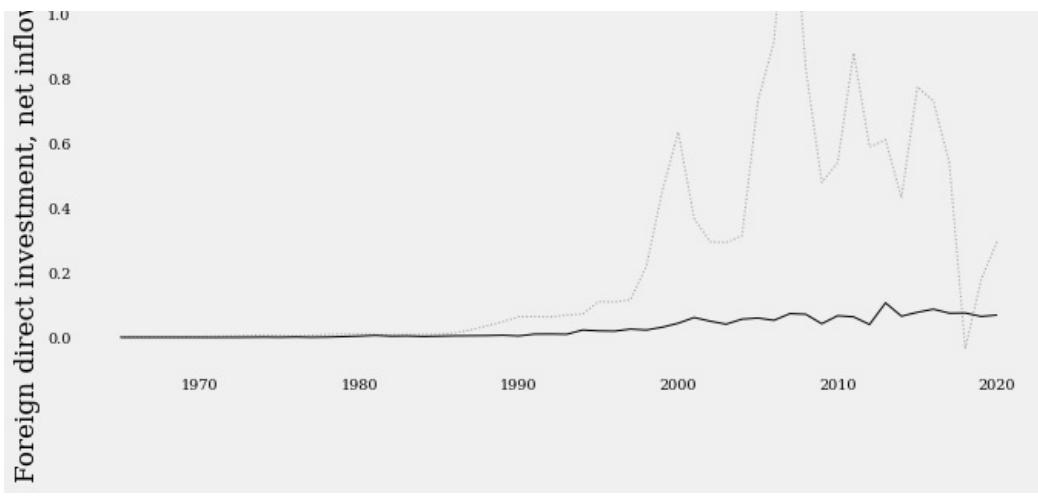


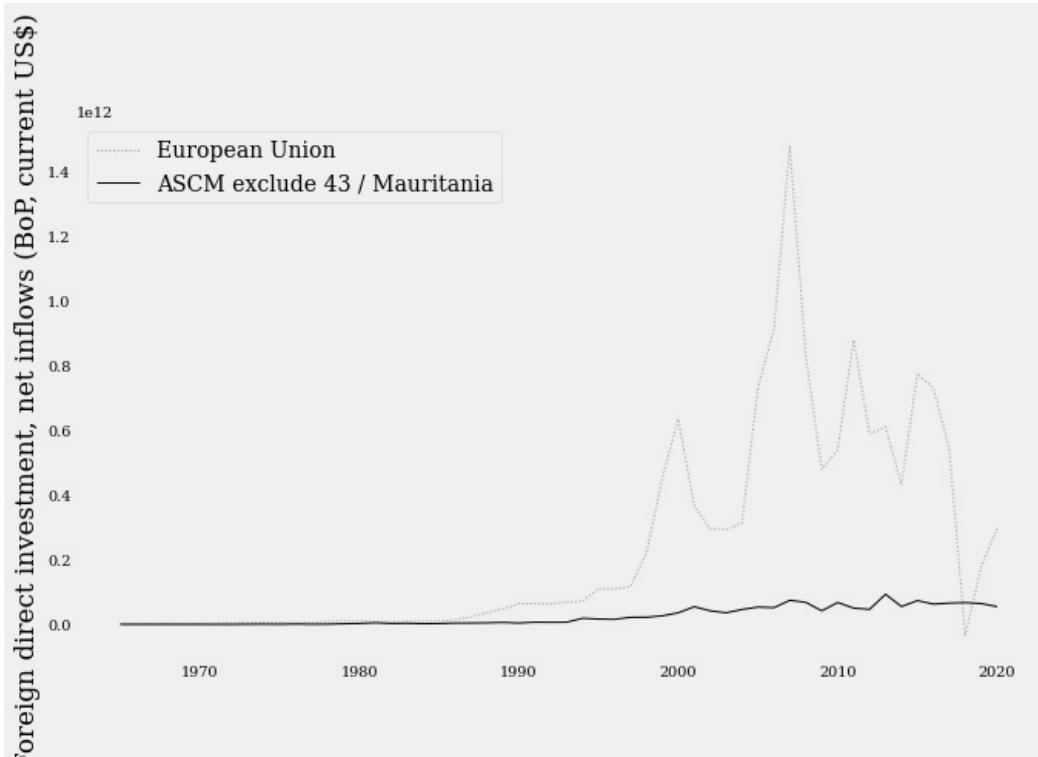
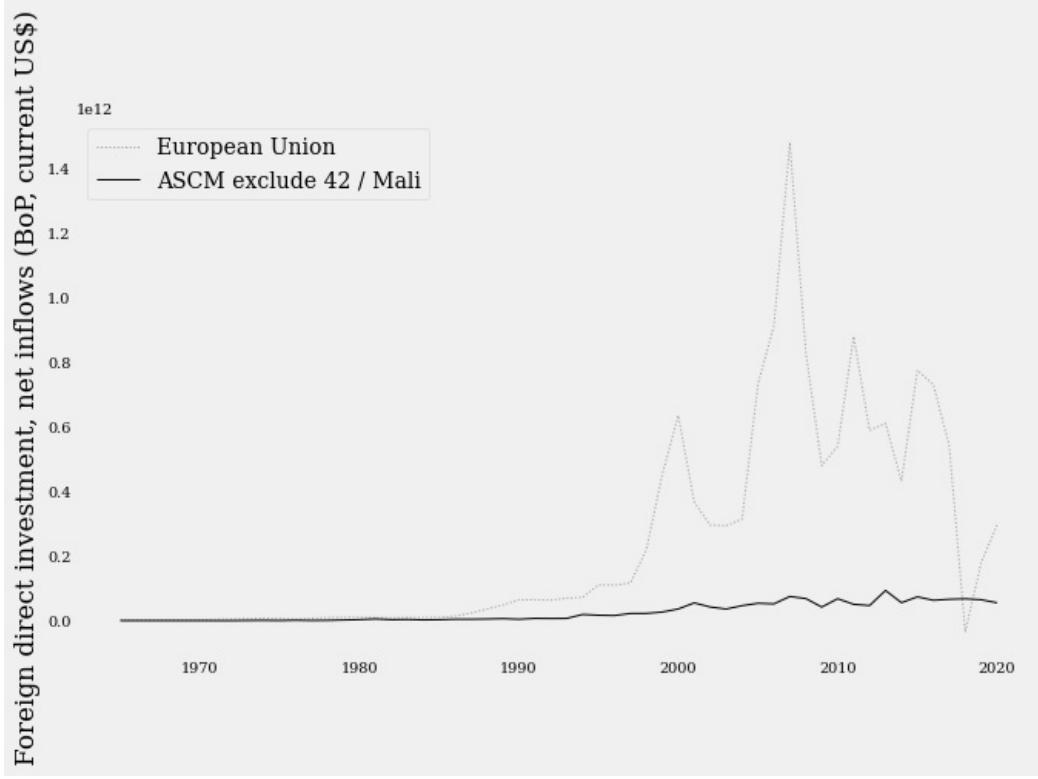
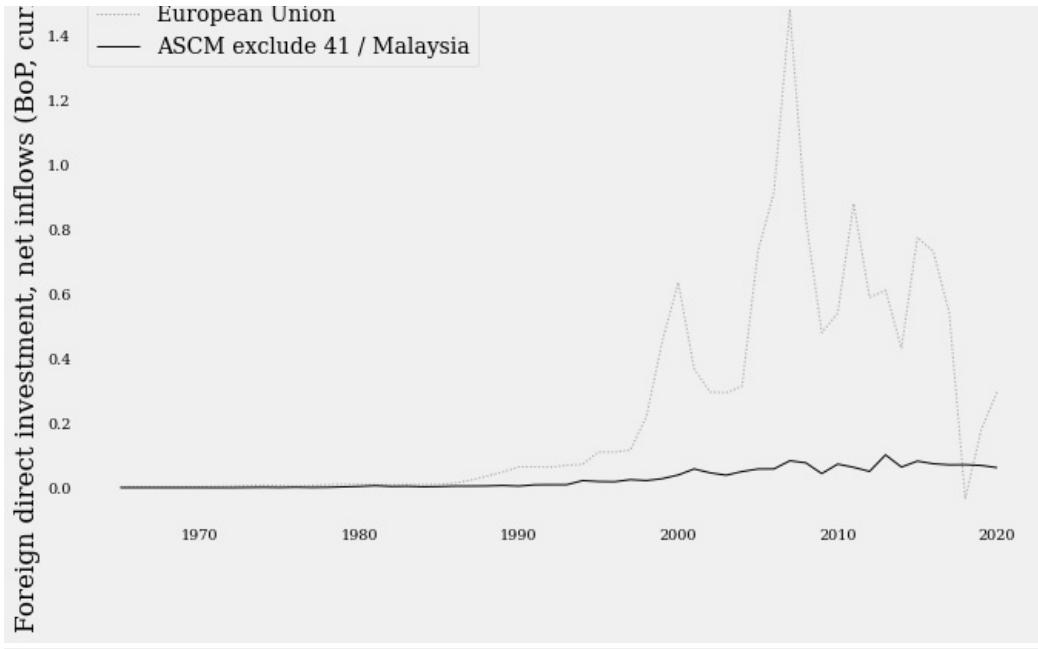


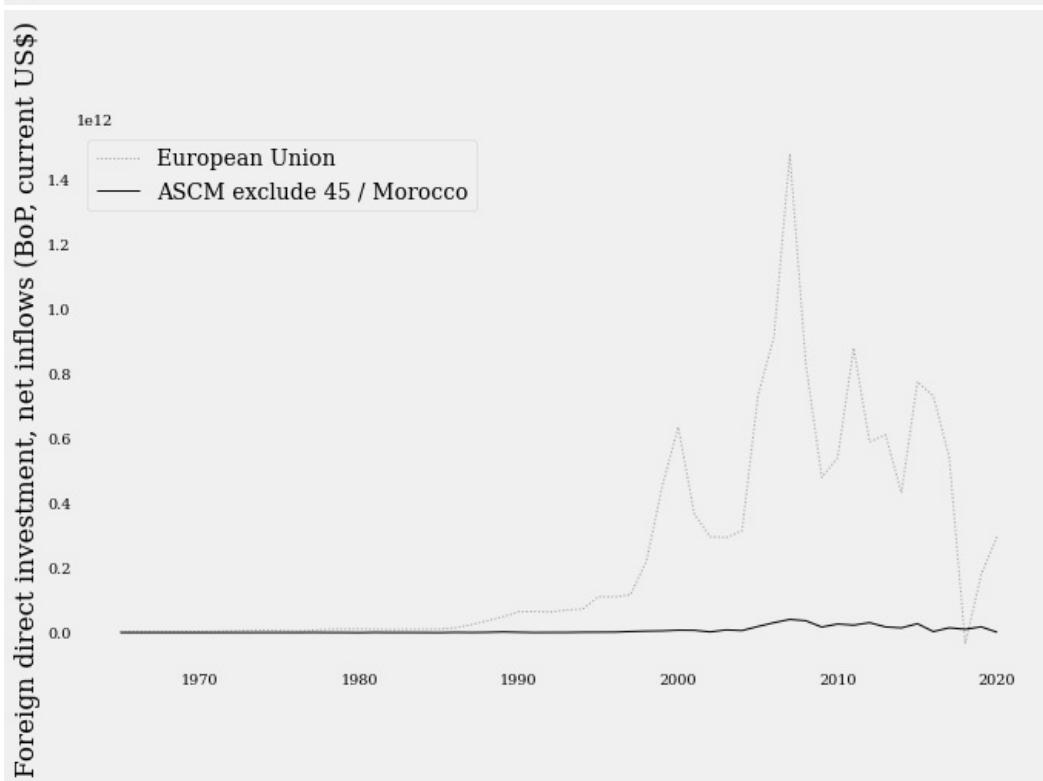
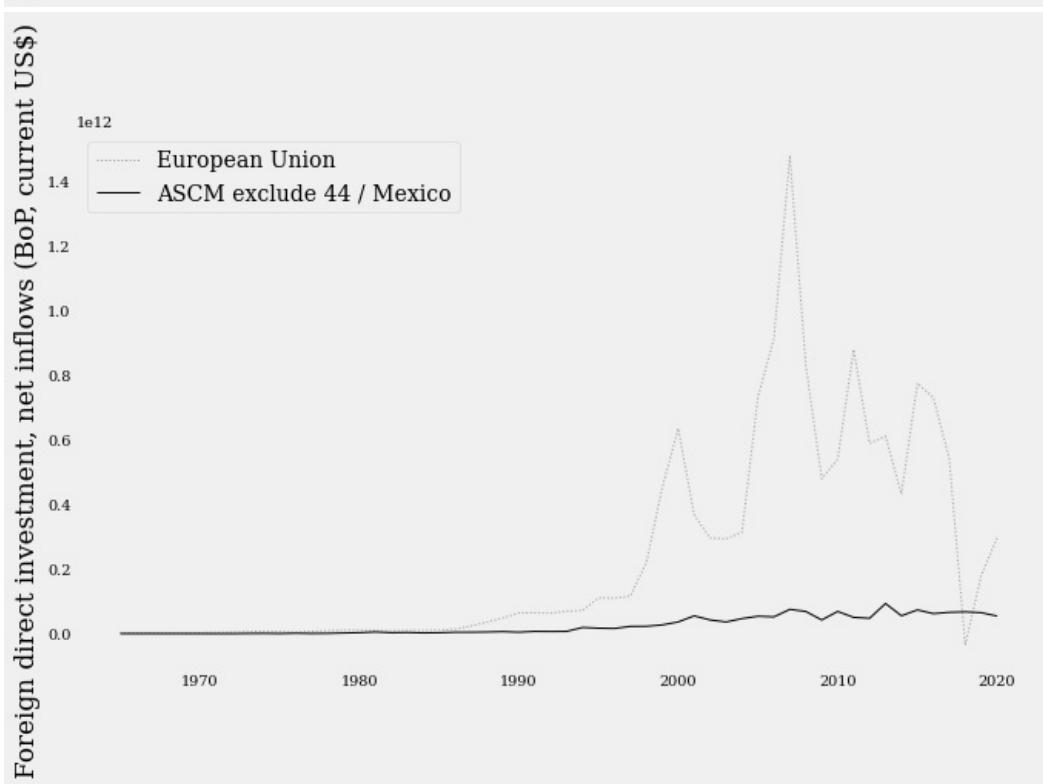


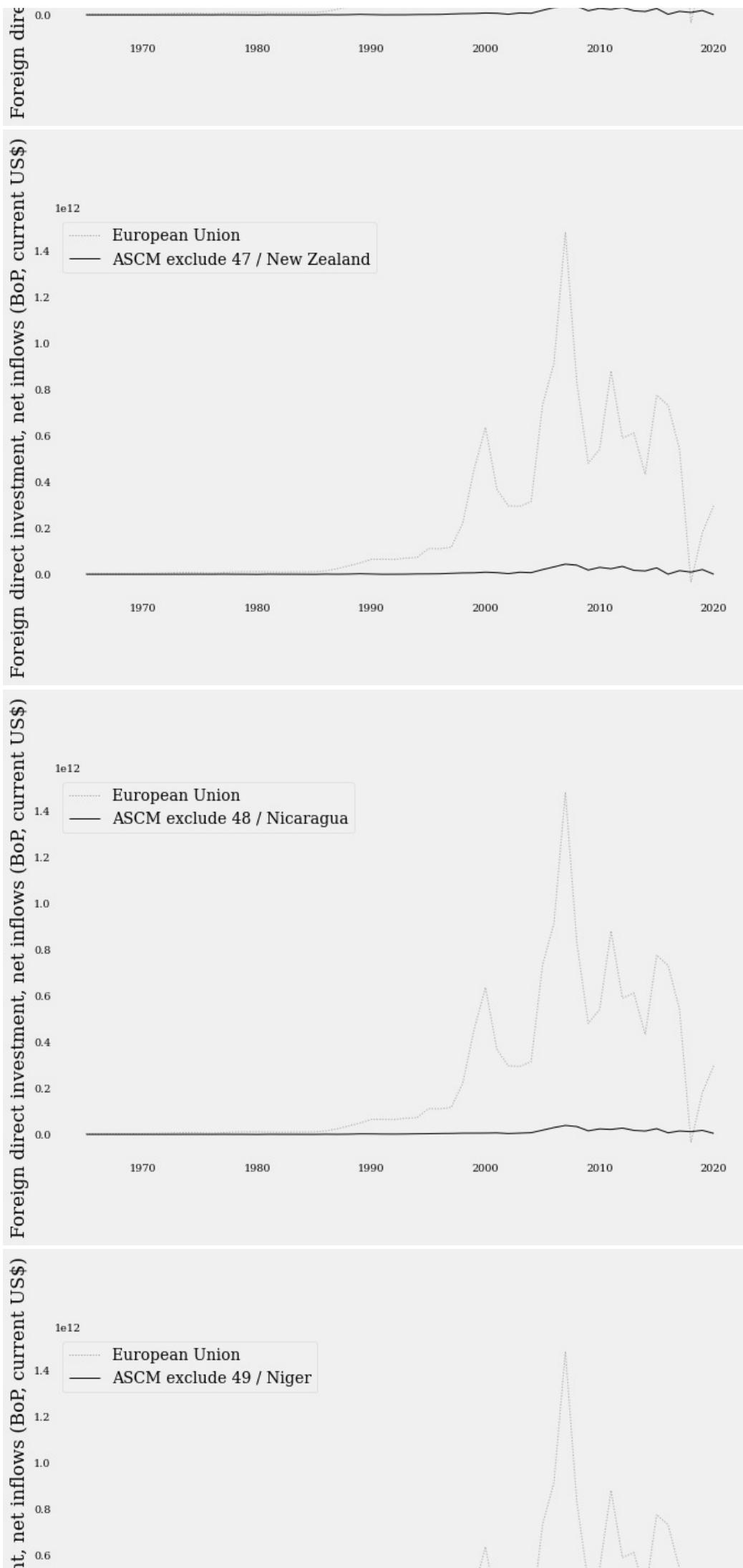


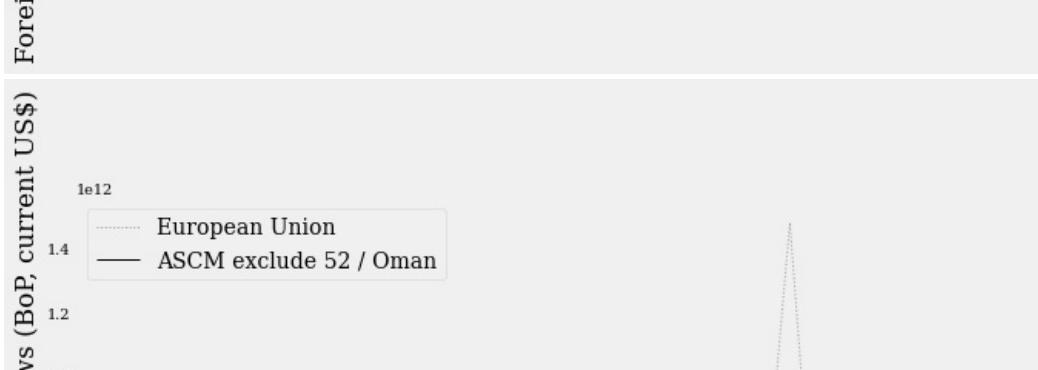
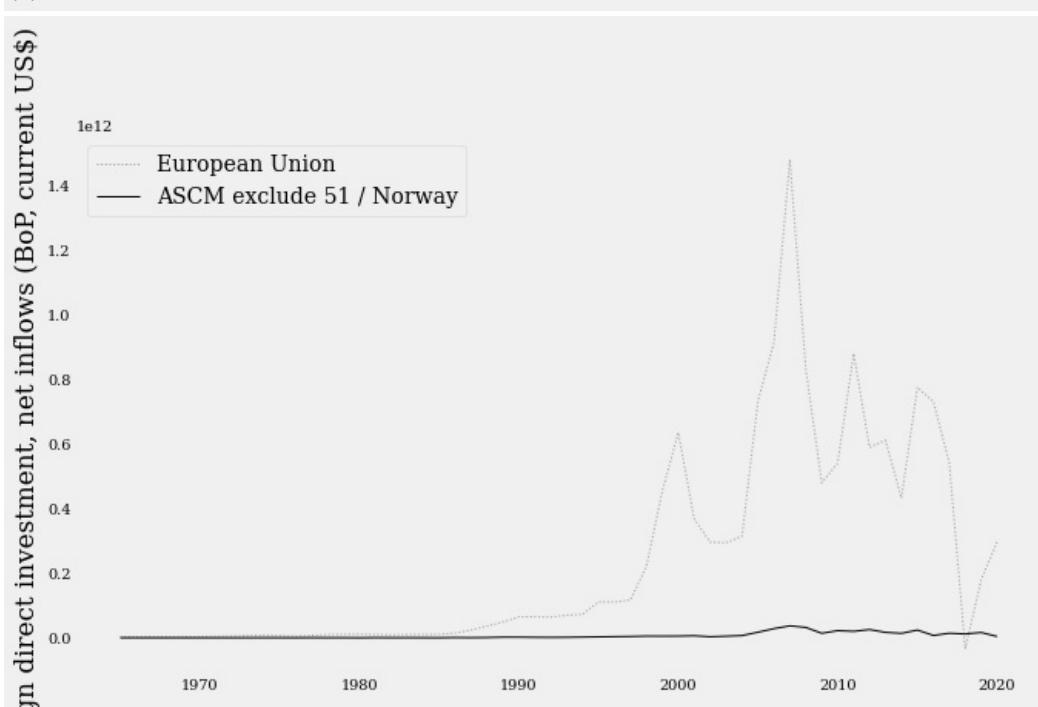
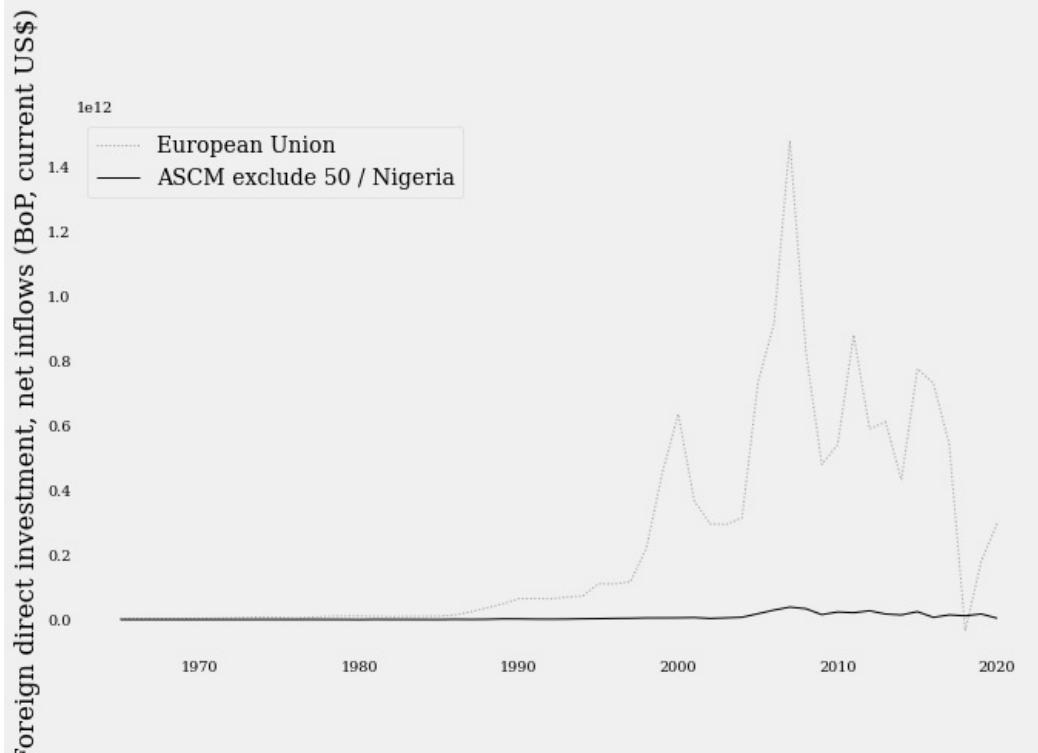
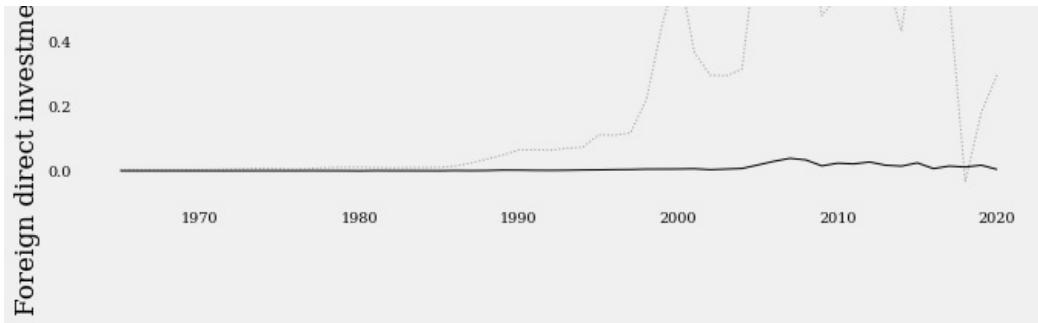


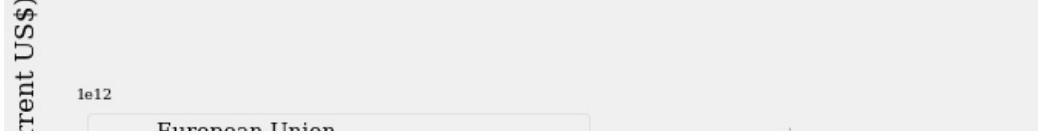
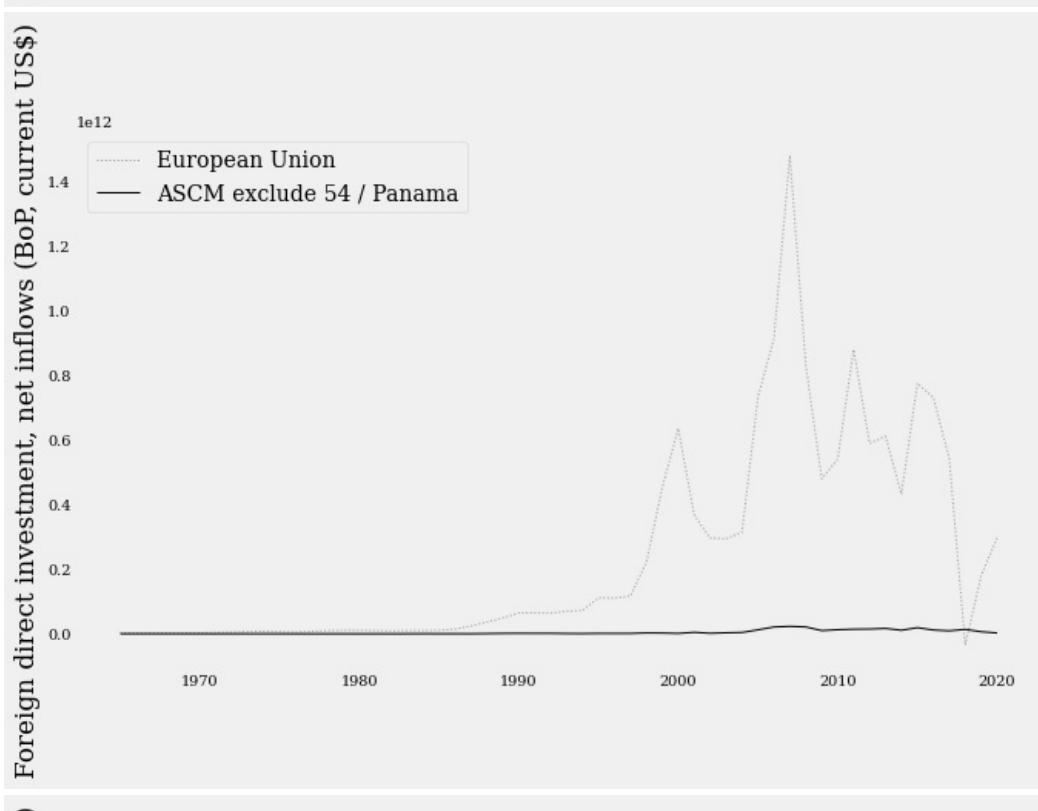
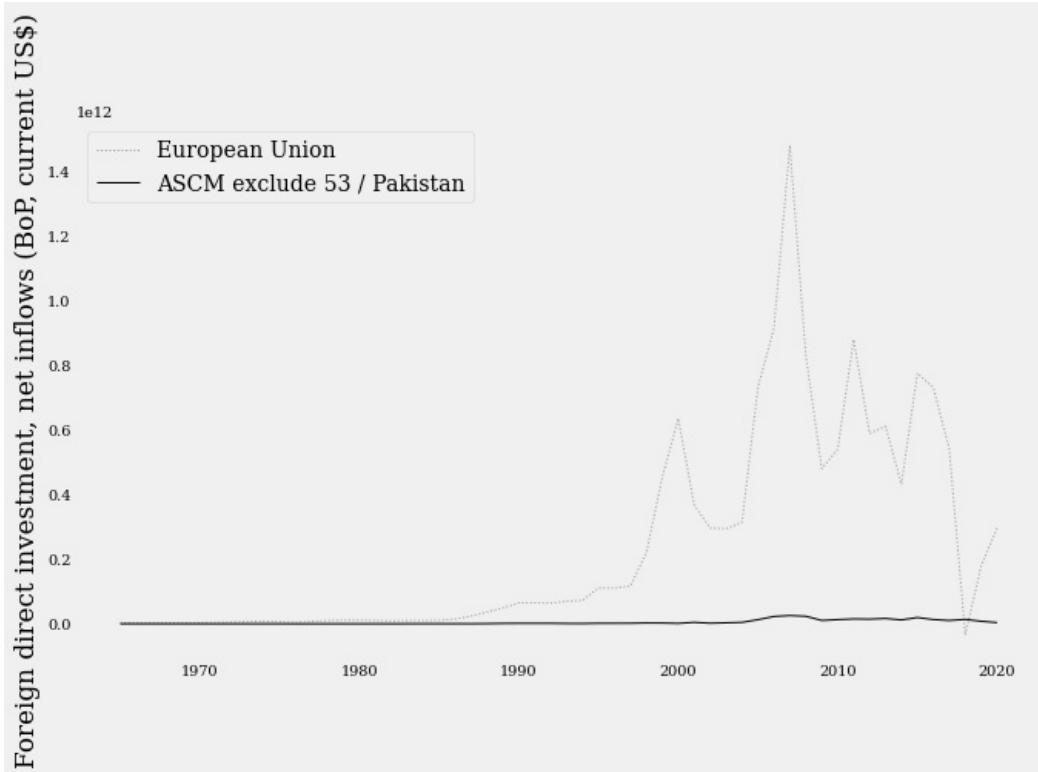
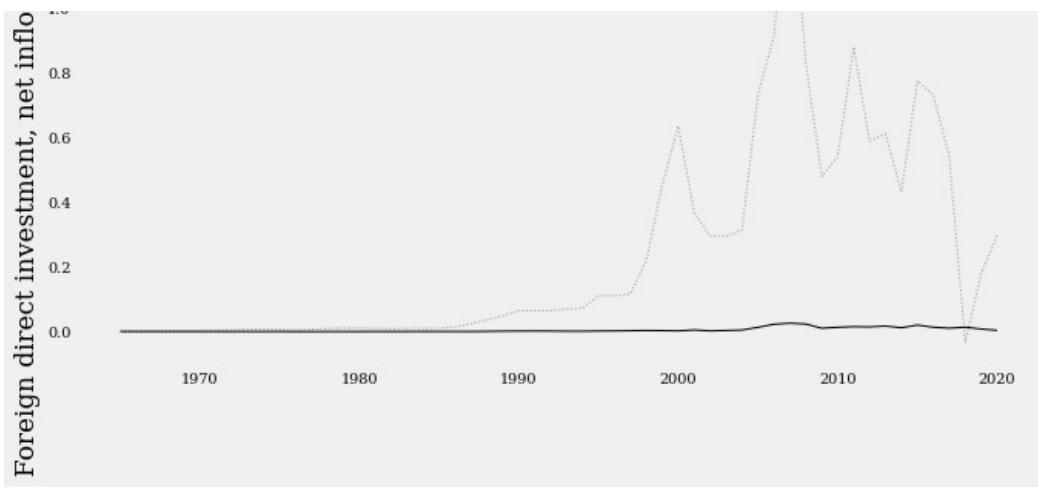


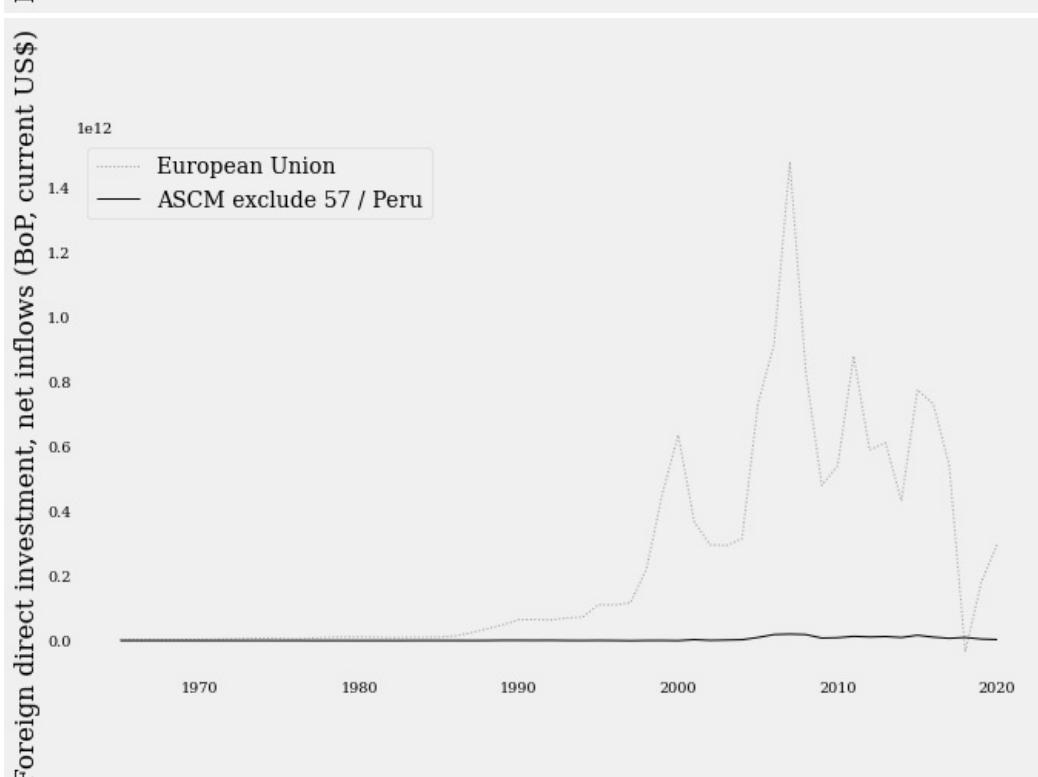
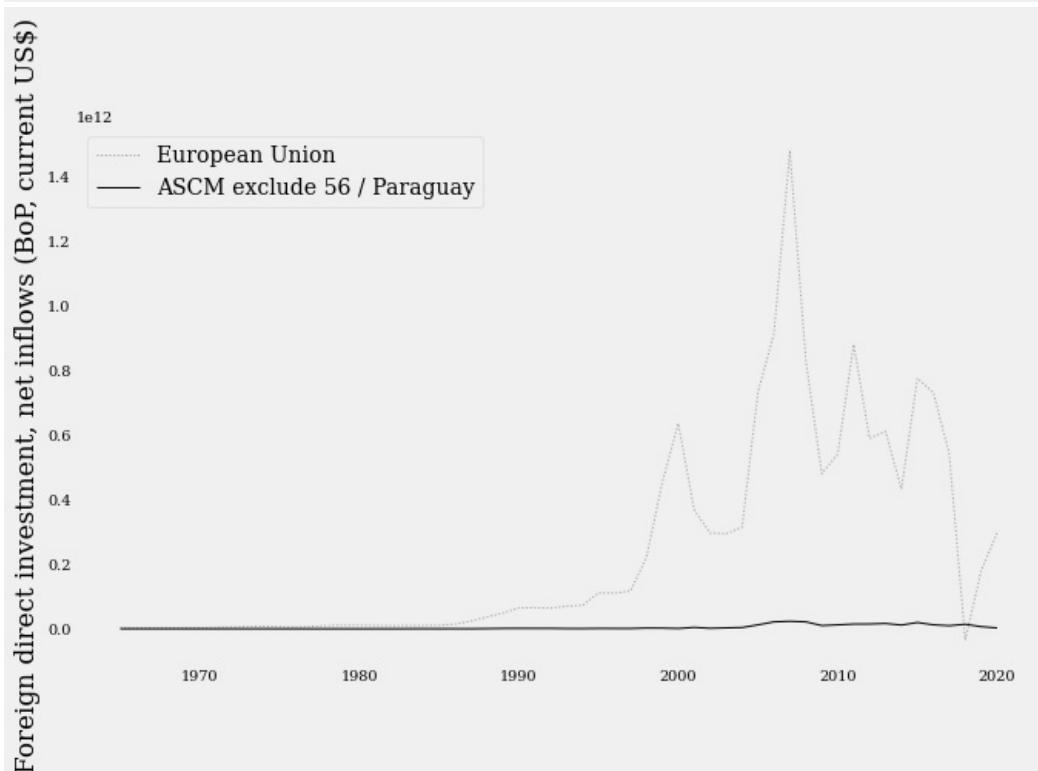
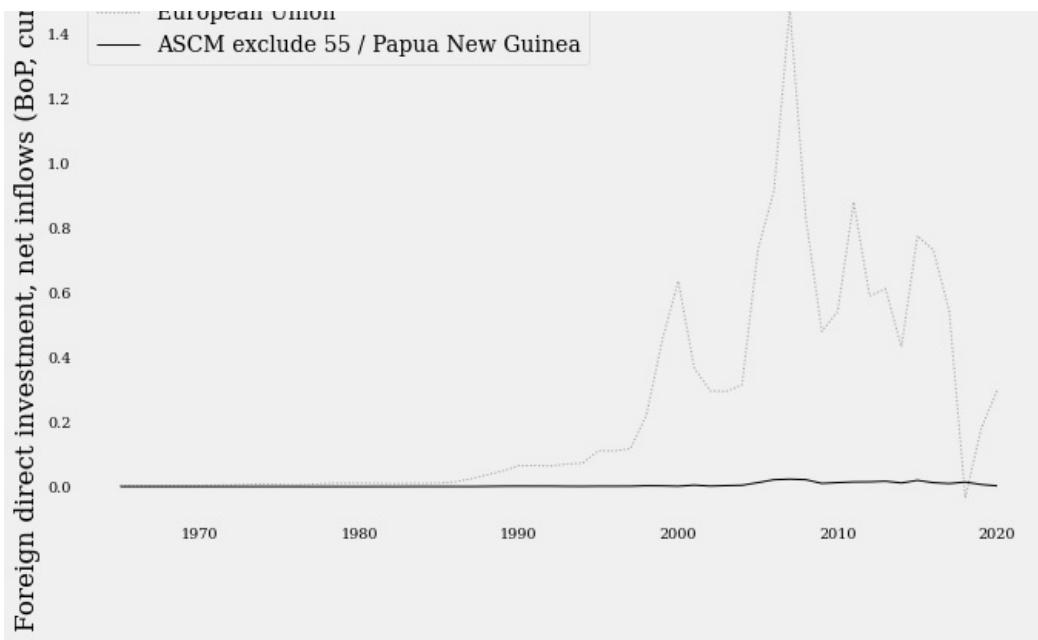


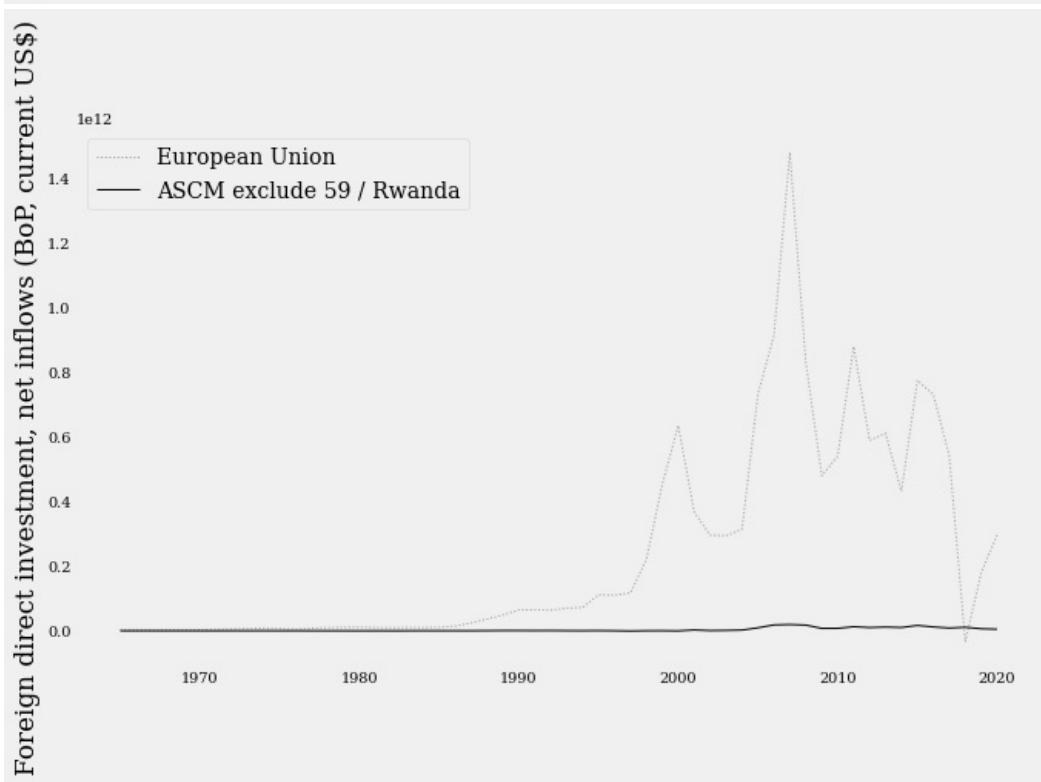
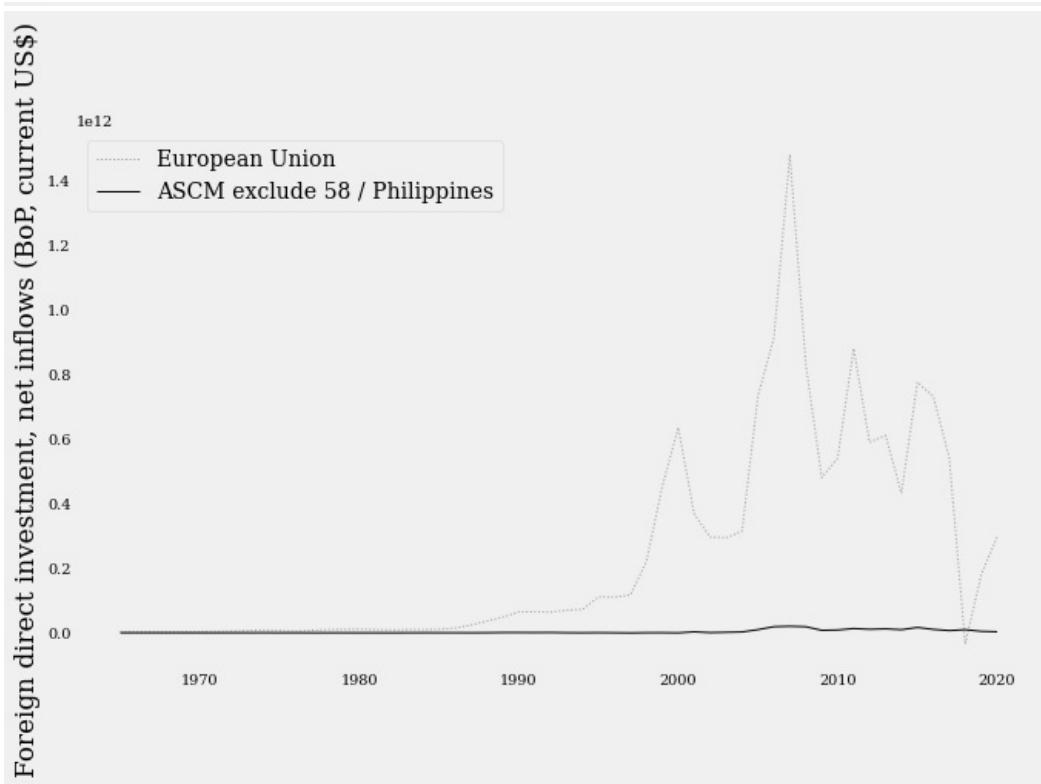


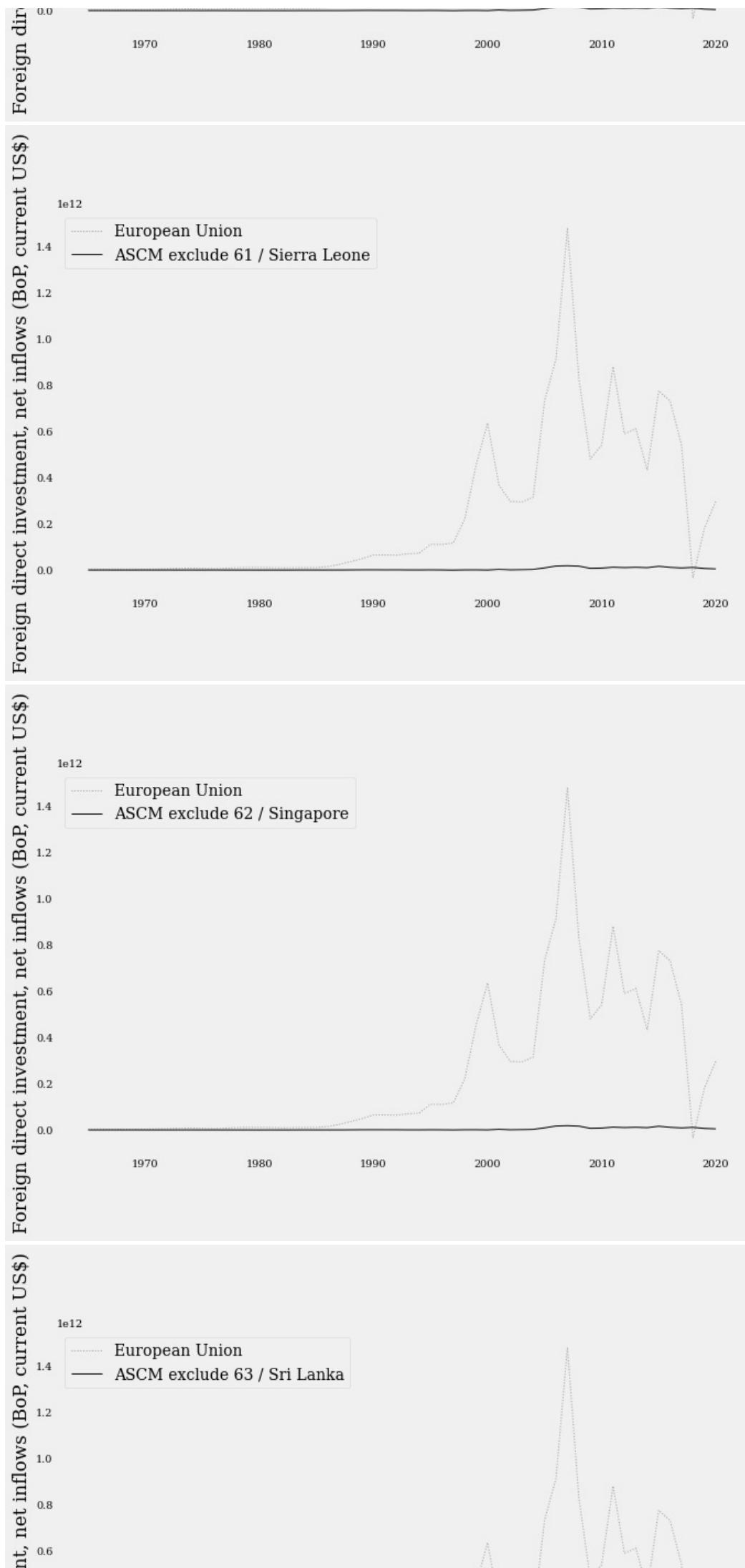


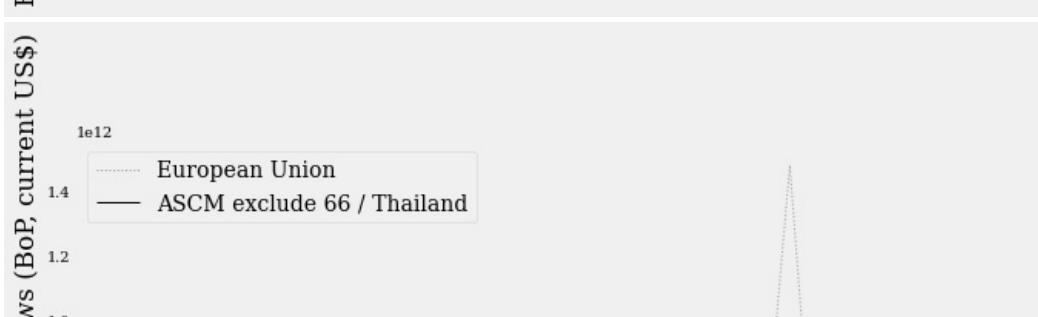
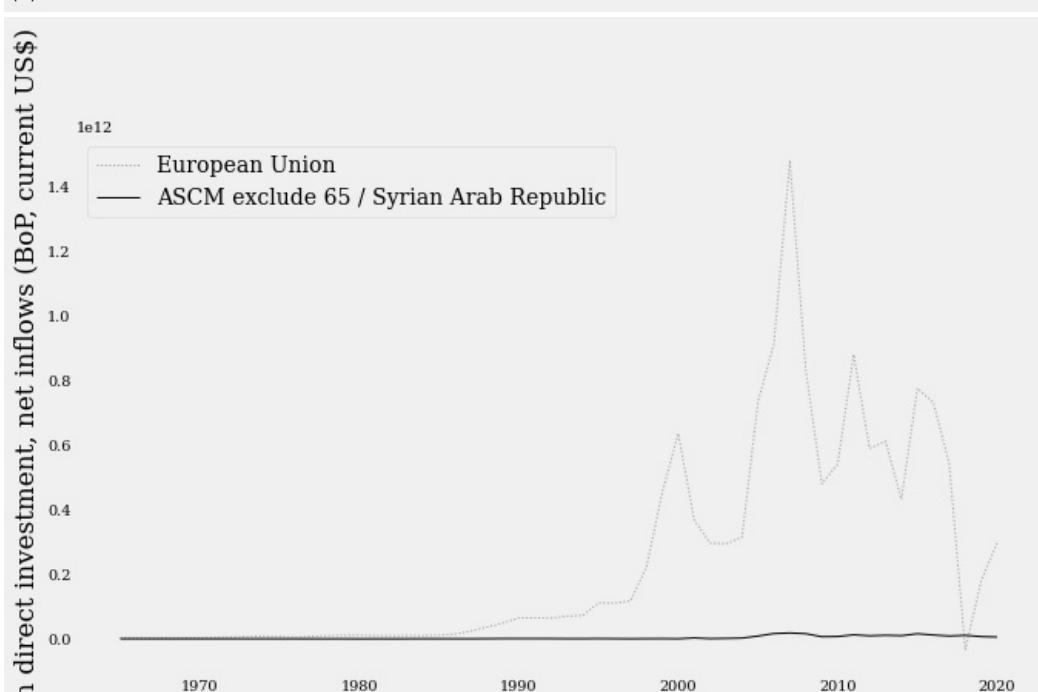
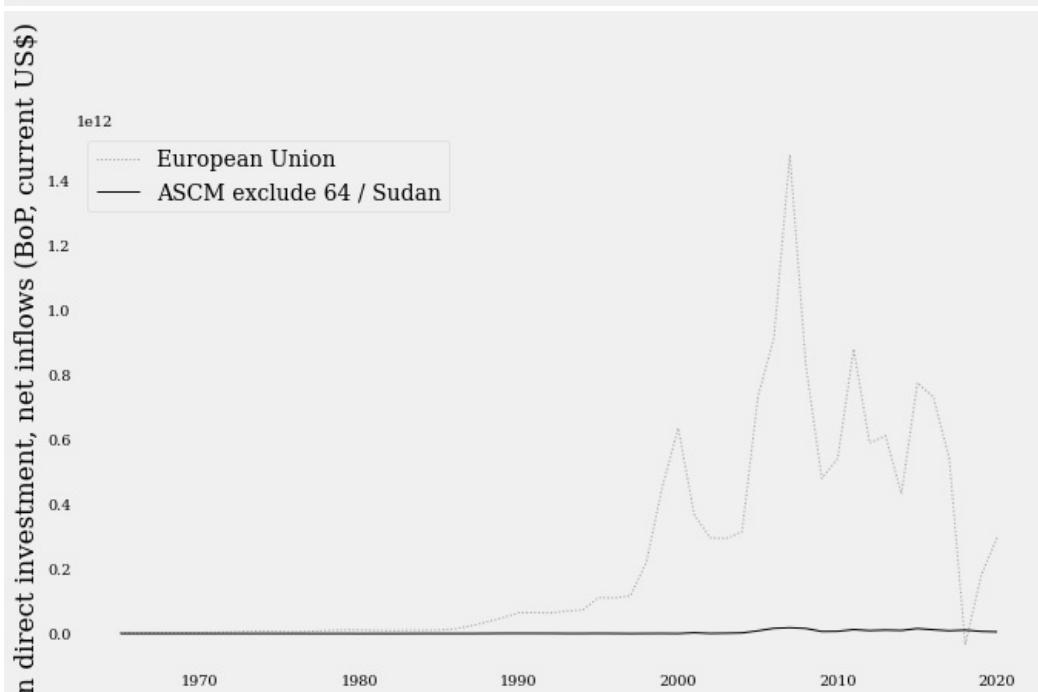
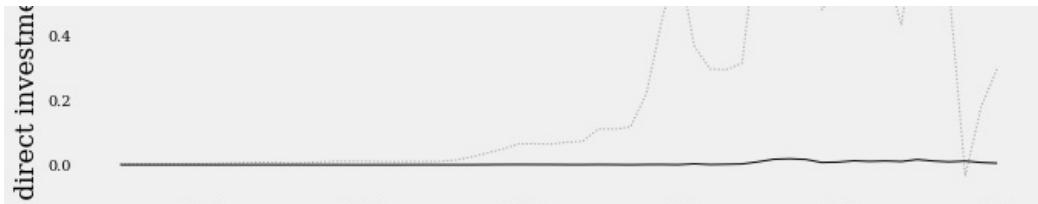


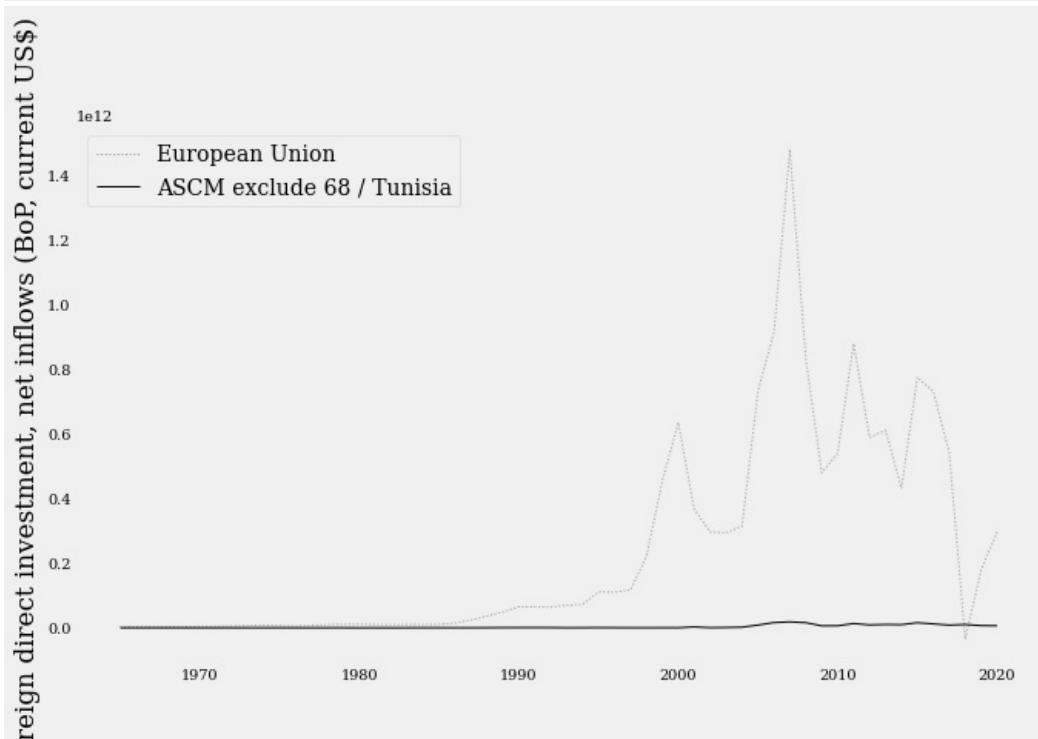
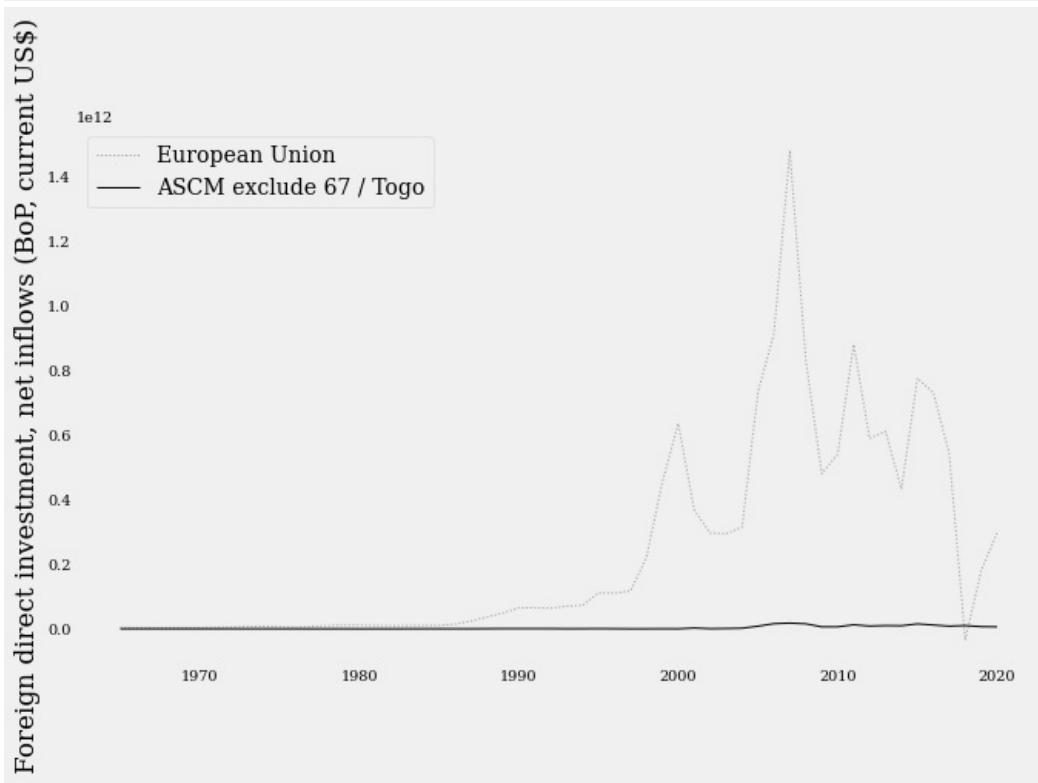
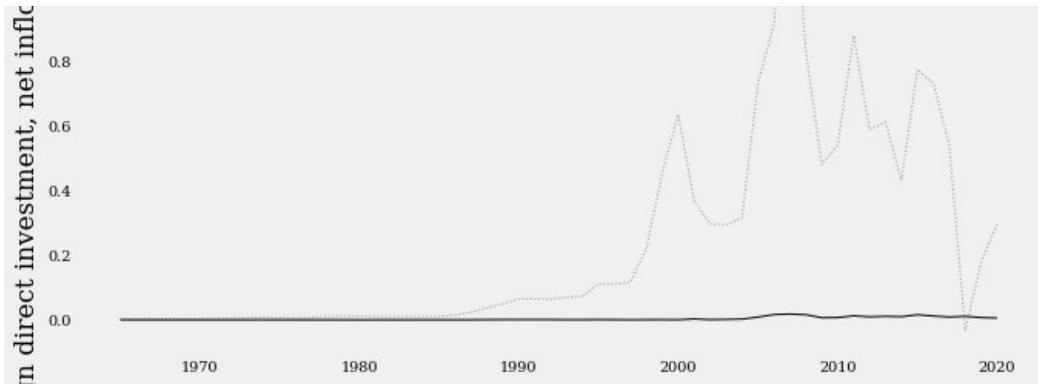


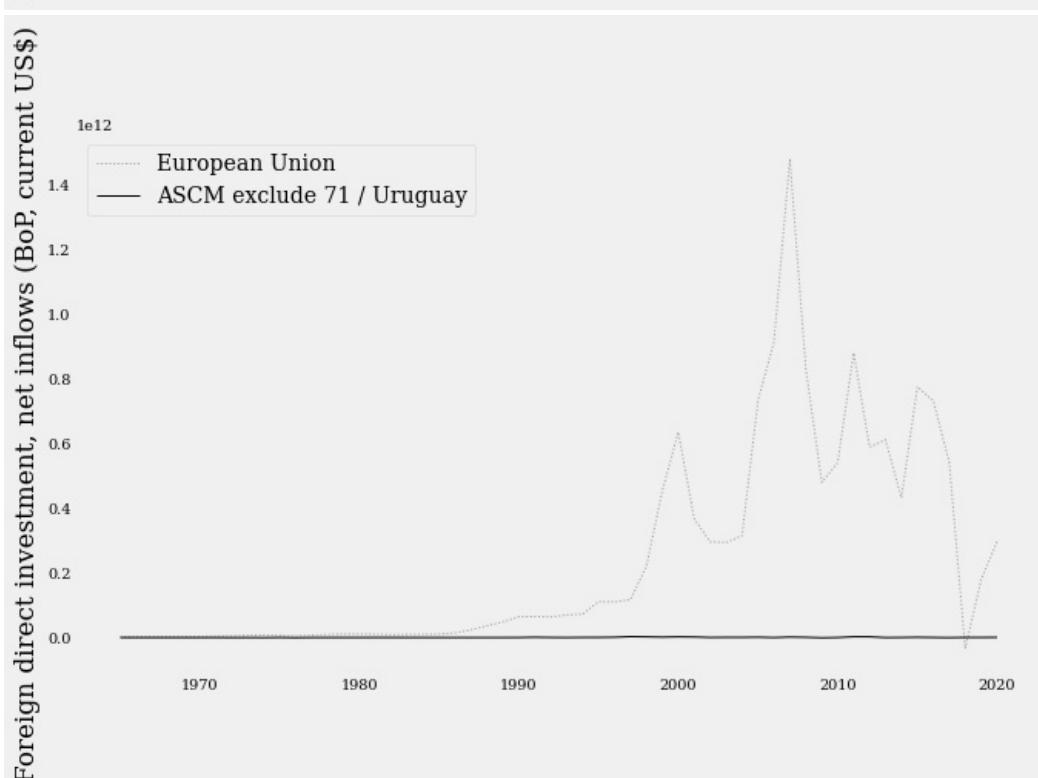
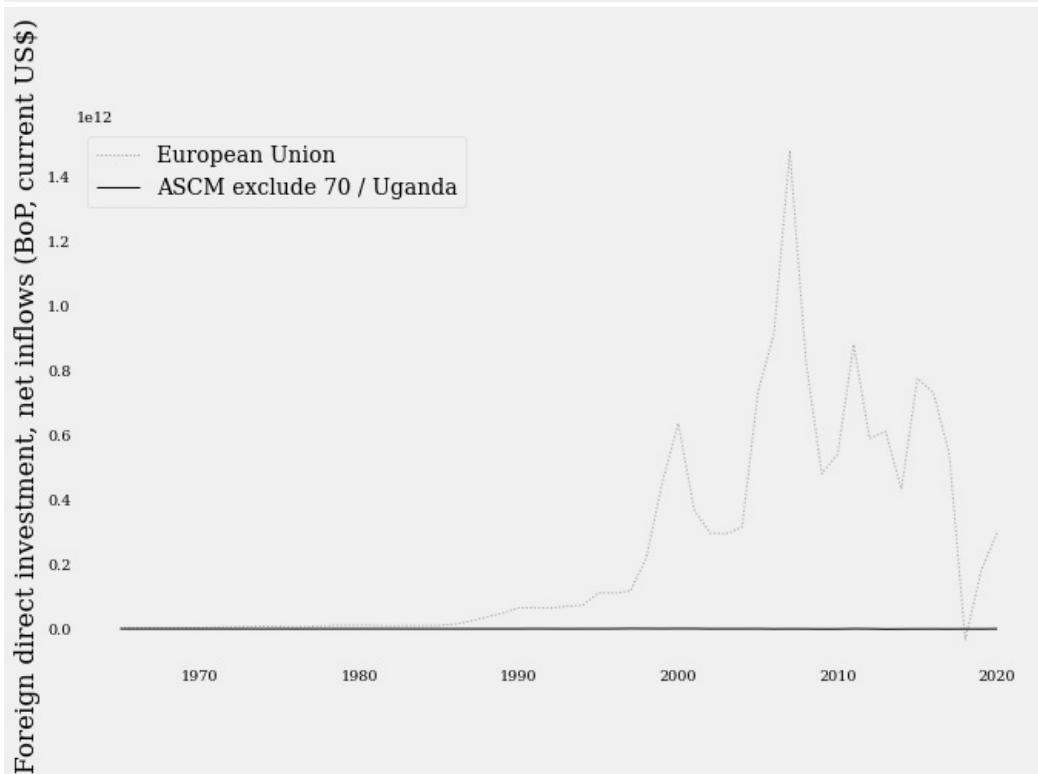
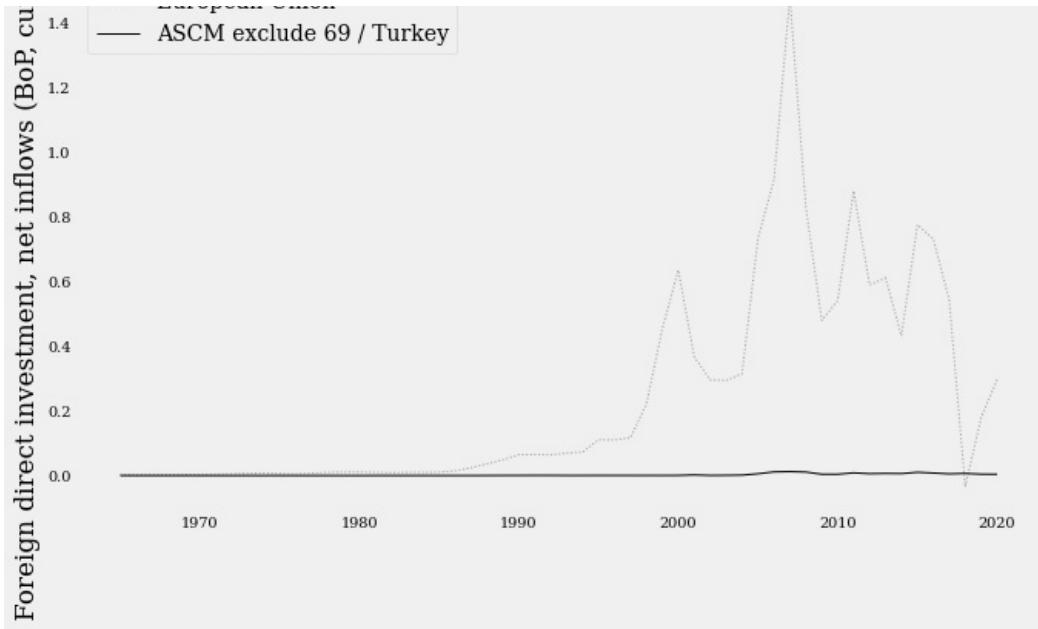


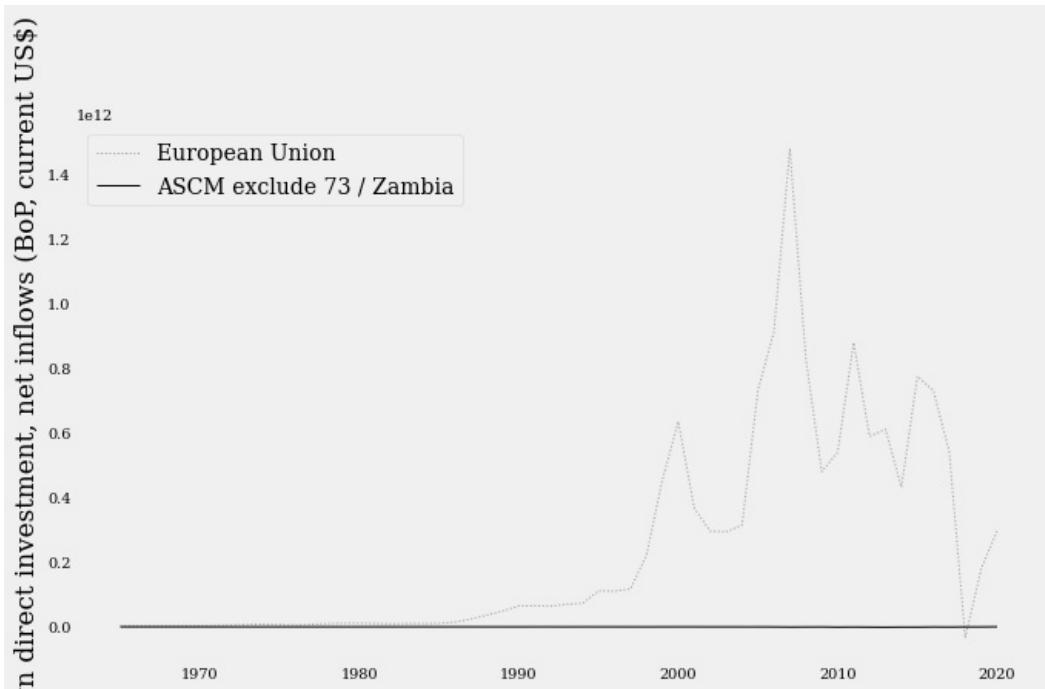
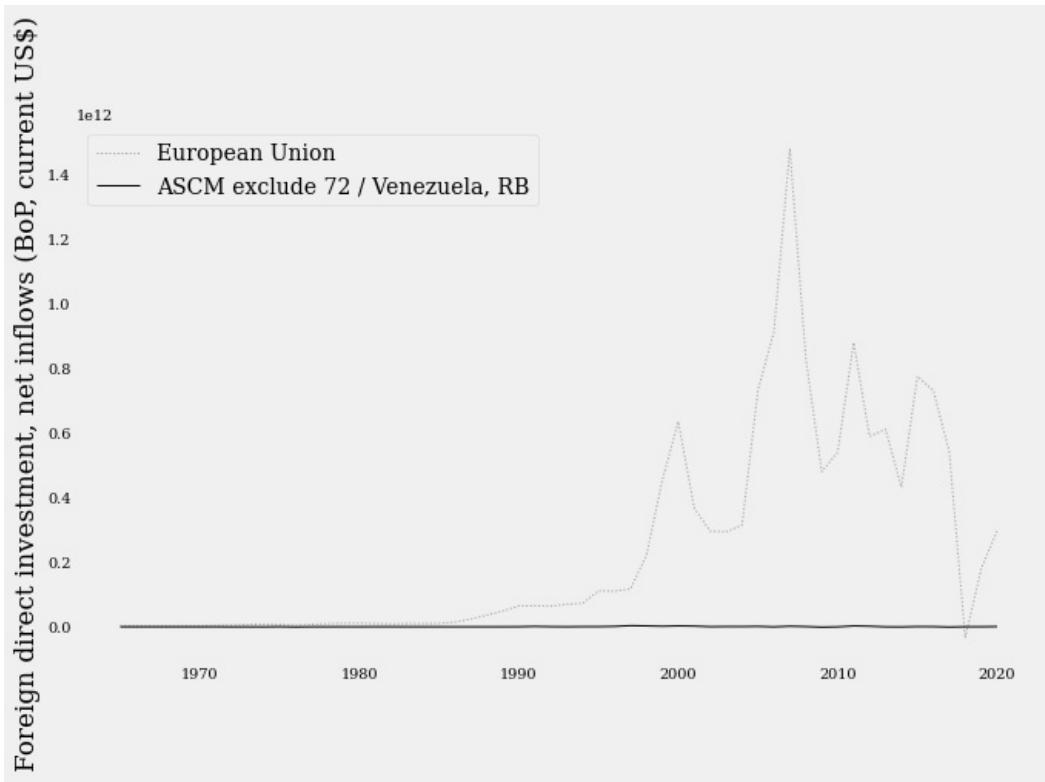














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