

Analysis of Core PCA drivers for Currencies

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Abstract

Abstract to be written here. The abstract should not be too long and should provide the reader with a good understanding what you are writing about. Academic papers are not like novels where you keep the reader in suspense. To be effective in getting others to read your paper, be as open and concise about your findings here as possible. Ideally, upon reading your abstract, the reader should feel he / she must read your paper in entirety.

Keywords: PCA, Emerging Market, Developing Market

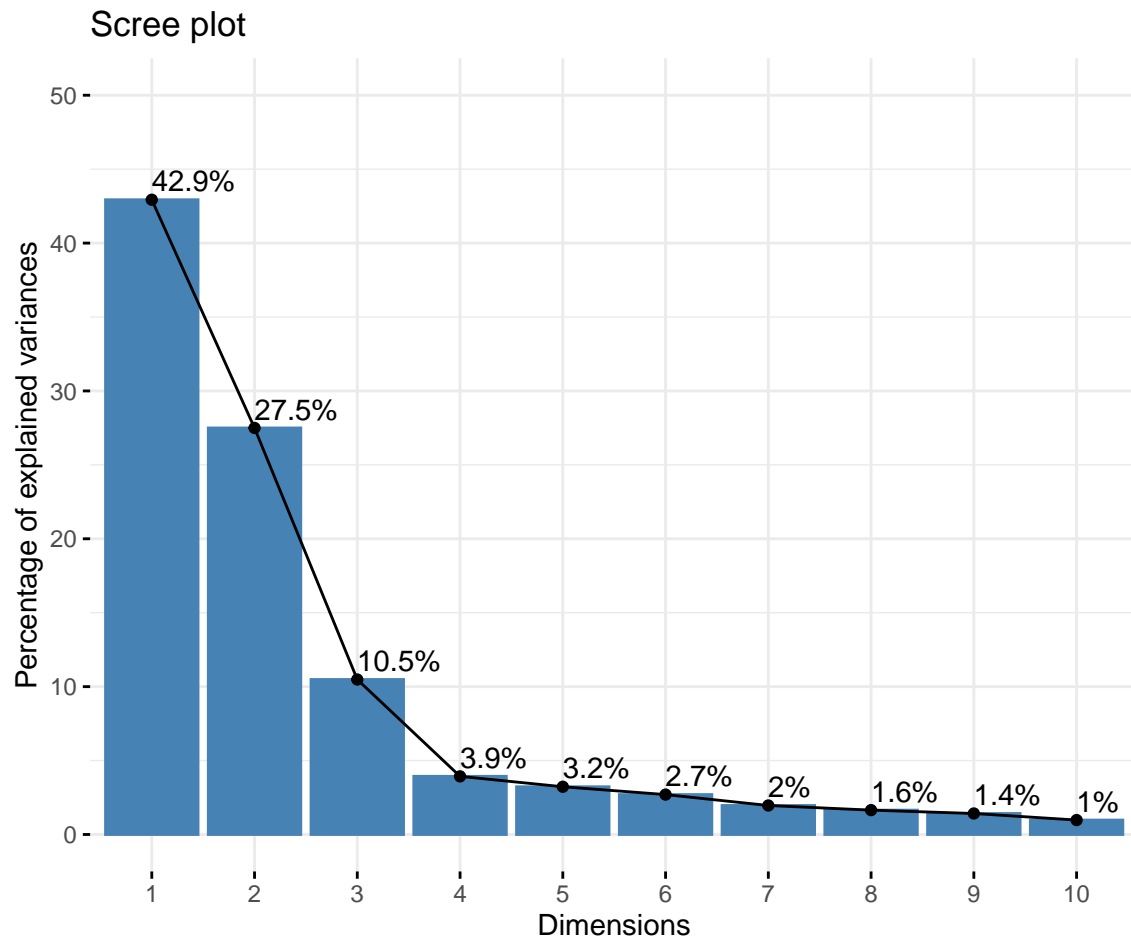
JEL classification L250, L100

1. Introduction

##	[1]	"date"	"Argentina"	"Australia"	"Bostwana"	"Brazil"
##	[6]	"Bulgaria"	"Canada"	"Chile"	"China"	"Columbia"
##	[11]	"Czech"	"Denmark"	"Egypt"	"EU"	"Ghana"
##	[16]	"HongKong"	"Hungary"	"India"	"Israel"	"Japan"
##	[21]	"Malaysia"	"Mexico"	"Nigeria"	"Norway"	"NZ"
##	[26]	"Peru"	"Philipines"	"Poland"	"Romania"	"Russia"
##	[31]	"Saudi"	"Singapore"	"SouthAfrica"	"SouthKorea"	"Sweden"
##	[36]	"Taiwan"	"Thailand"	"Turkey"	"UAE"	"Uganda"
##	[41]	"UK"	"Zambia"			

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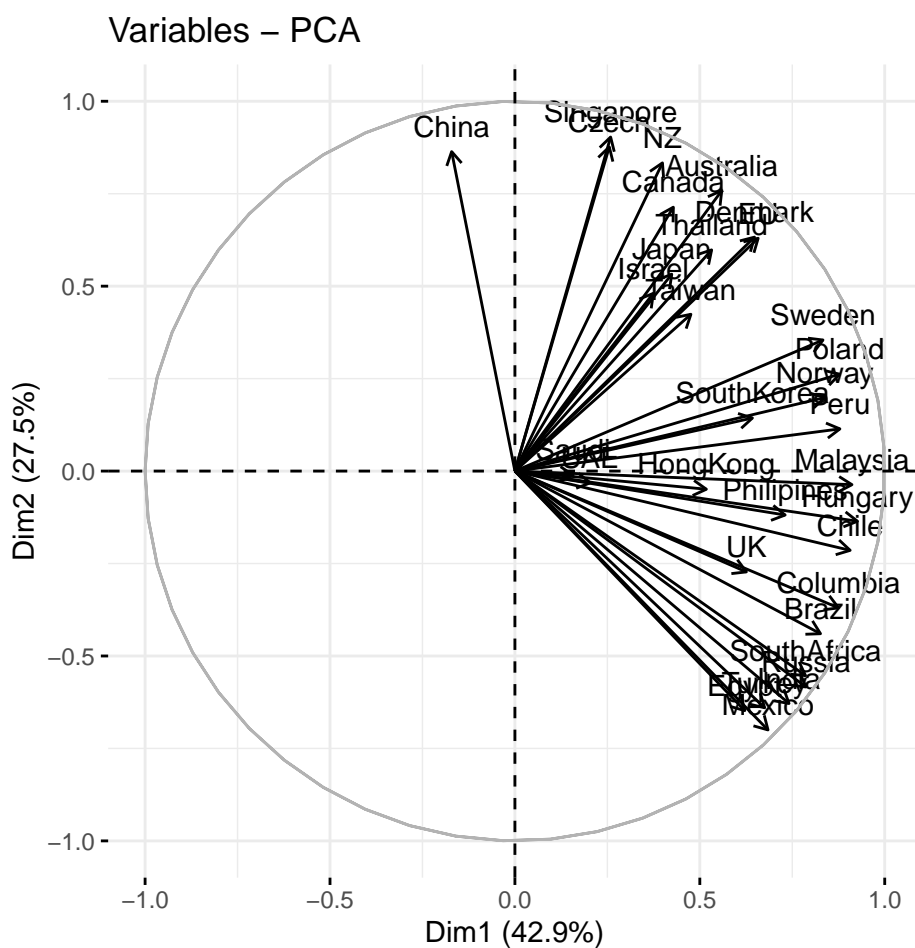


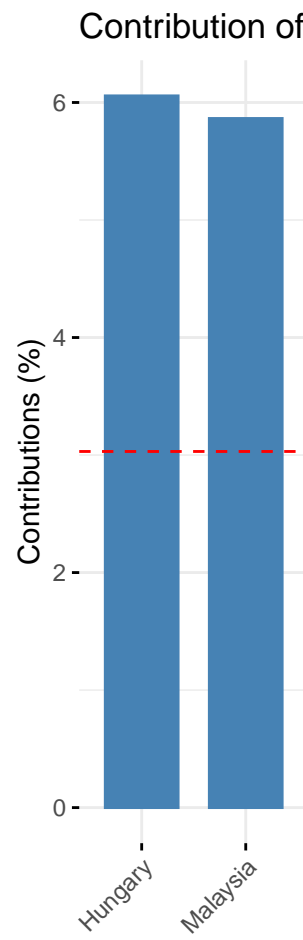
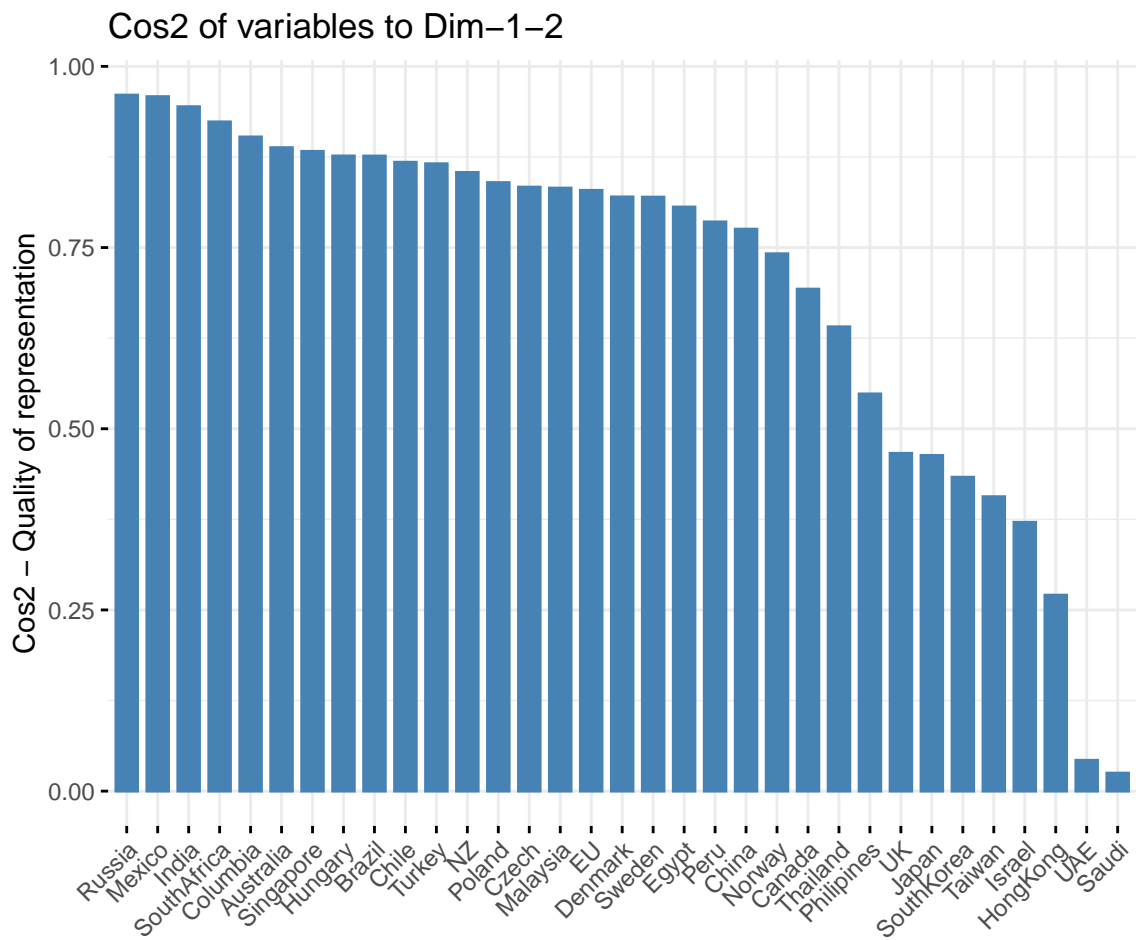
##		Dim.1	Dim.2	Dim.3	Dim.4	Dim.5
##	Australia	0.5593268	0.7583145	-0.200339138	-0.02443856	0.1029542
##	Brazil	0.8263736	-0.4398131	0.009592261	-0.11328249	0.1835456
##	Canada	0.4283742	0.7135617	-0.445483620	-0.09095485	0.1305308
##	Chile	0.9065261	-0.2144068	0.084330675	-0.03283048	0.1461784
##	China	-0.1710389	0.8638235	-0.083351897	-0.19386705	0.3370978
##	Columbia	0.8751020	-0.3699584	0.174043902	-0.08904073	0.1522791

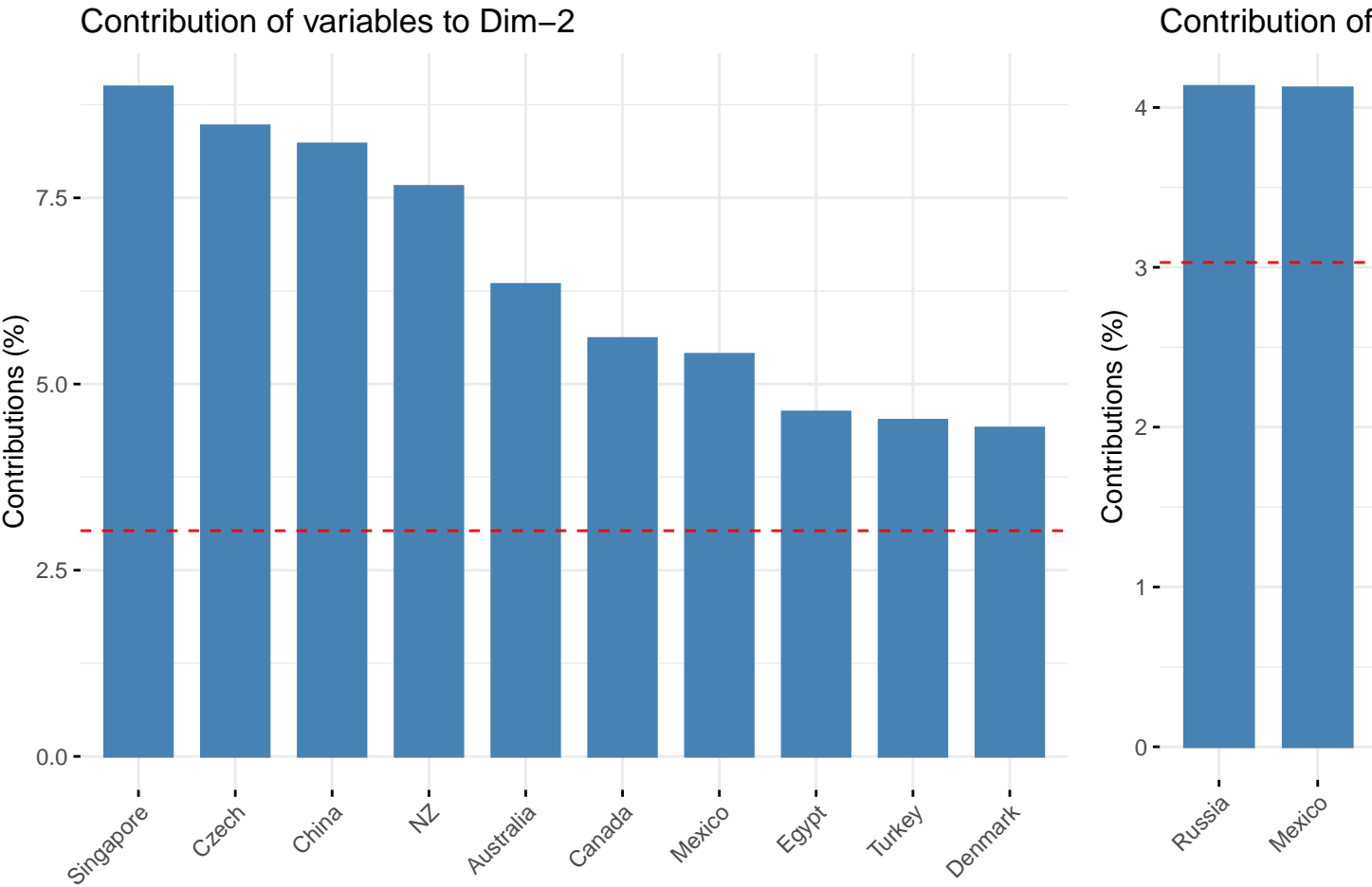
##		Dim.1	Dim.2	Dim.3	Dim.4	Dim.5
##	Australia	0.31284642	0.57504081	4.013577e-02	0.000597243	0.01059957
##	Brazil	0.68289330	0.19343552	9.201147e-05	0.012832924	0.03368897
##	Canada	0.18350446	0.50917035	1.984557e-01	0.008272786	0.01703828
##	Chile	0.82178957	0.04597028	7.111663e-03	0.001077840	0.02136812
##	China	0.02925431	0.74619111	6.947539e-03	0.037584435	0.11363495

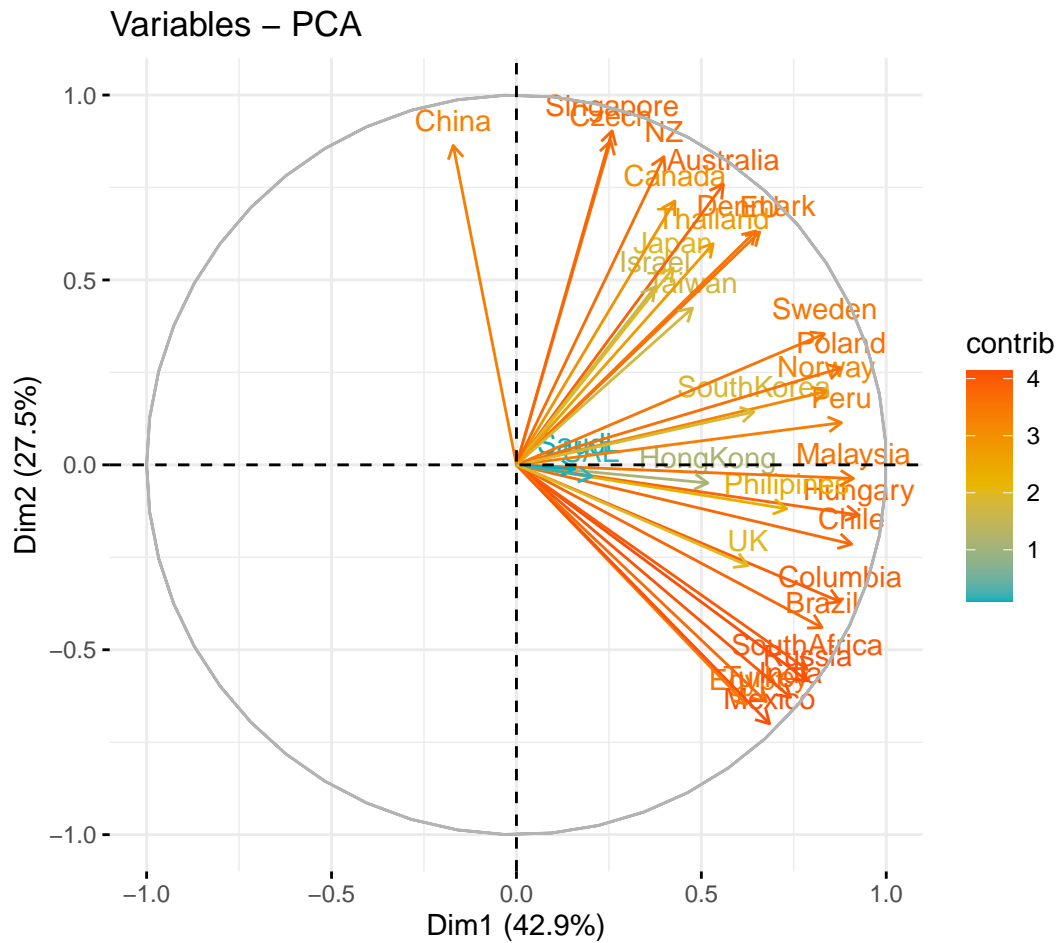
```
## Columbia 0.76580355 0.13686920 3.029128e-02 0.007928252 0.02318894
```

	Dim.1	Dim.2	Dim.3	Dim.4	Dim.5
## Australia	2.2082322	6.3375800	1.160355674	0.04603552	0.9951699
## Brazil	4.8202150	2.1318715	0.002660122	0.98916245	3.1629822
## Canada	1.2952696	5.6116154	5.737504097	0.63766675	1.5996865
## Chile	5.8006169	0.5066429	0.205603586	0.08308000	2.0062055
## China	0.2064921	8.2238440	0.200858637	2.89701027	10.6689322
## Columbia	5.4054386	1.5084486	0.875743967	0.61111012	2.1771578









##	eigenvalue	variance.percent	cumulative.variance.percent
## Dim.1	1.416728e+01	4.293115e+01	42.93115
## Dim.2	9.073508e+00	2.749548e+01	70.42663
## Dim.3	3.458920e+00	1.048157e+01	80.90820
## Dim.4	1.297352e+00	3.931371e+00	84.83957
## Dim.5	1.065101e+00	3.227580e+00	88.06715
## Dim.6	8.905998e-01	2.698787e+00	90.76594
## Dim.7	6.469714e-01	1.960519e+00	92.72646
## Dim.8	5.435703e-01	1.647183e+00	94.37364
## Dim.9	4.686178e-01	1.420054e+00	95.79369
## Dim.10	3.216611e-01	9.747306e-01	96.76843
## Dim.11	2.523428e-01	7.646751e-01	97.53310
## Dim.12	1.578015e-01	4.781864e-01	98.01129
## Dim.13	1.411304e-01	4.276678e-01	98.43895
## Dim.14	9.444195e-02	2.861877e-01	98.72514

```
## Dim.15 7.313397e-02    2.216181e-01    98.94676
## Dim.16 5.631938e-02    1.706648e-01    99.11743
## Dim.17 4.722861e-02    1.431170e-01    99.26054
## Dim.18 3.787017e-02    1.147581e-01    99.37530
## Dim.19 3.270062e-02    9.909278e-02    99.47439
## Dim.20 2.573922e-02    7.799764e-02    99.55239
## Dim.21 2.346249e-02    7.109846e-02    99.62349
## Dim.22 2.216602e-02    6.716976e-02    99.69066
## Dim.23 1.898825e-02    5.754014e-02    99.74820
## Dim.24 1.429372e-02    4.331430e-02    99.79151
## Dim.25 1.356502e-02    4.110611e-02    99.83262
## Dim.26 1.137767e-02    3.447778e-02    99.86710
## Dim.27 1.028807e-02    3.117598e-02    99.89827
## Dim.28 9.759032e-03    2.957282e-02    99.92785
## Dim.29 7.551014e-03    2.288186e-02    99.95073
## Dim.30 6.124398e-03    1.855878e-02    99.96929
## Dim.31 5.421204e-03    1.642789e-02    99.98571
## Dim.32 4.426782e-03    1.341449e-02    99.99913
## Dim.33 2.873993e-04    8.709068e-04    100.00000
```

```
## List of 5
```

```
## $ sdev      : num [1:41] 1133.6 351.6 138.5 35.3 30.2 ...
## $ rotation: num [1:41, 1:41] 1.37e-02 -4.84e-06 2.18e-03 9.28e-04 2.37e-04 ...
## ..- attr(*, "dimnames")=List of 2
## .. ..$ : chr [1:41] "Argentina" "Australia" "Bostwana" "Brazil" ...
## .. ..$ : chr [1:41] "PC1" "PC2" "PC3" "PC4" ...
## $ center   : Named num [1:41] 11.76 1.35 6.89 2.44 1.5 ...
## ..- attr(*, "names")= chr [1:41] "Argentina" "Australia" "Bostwana" "Brazil" ...
## $ scale    : logi FALSE
## $ x        : num [1:7198, 1:41] -1903 -1903 -1903 -1904 -1850 ...
## ..- attr(*, "dimnames")=List of 2
## .. ..$ : NULL
## .. ..$ : chr [1:41] "PC1" "PC2" "PC3" "PC4" ...
## - attr(*, "class")= chr "prcomp"
```

```
## [1] 1.133639e+03 3.515818e+02 1.384707e+02 3.529703e+01 3.020963e+01
## [6] 2.488644e+01 1.128311e+01 1.026757e+01 4.131377e+00 3.607870e+00
## [11] 2.485015e+00 2.085633e+00 1.221918e+00 1.004873e+00 7.757690e-01
```

```
## [16] 7.539155e-01 6.466729e-01 5.300286e-01 3.383720e-01 2.784178e-01
## [21] 2.472351e-01 2.006494e-01 1.765473e-01 1.437906e-01 1.390456e-01
## [26] 1.306680e-01 1.273685e-01 9.948012e-02 8.703992e-02 8.434453e-02
## [31] 7.456828e-02 6.738833e-02 4.895600e-02 3.193859e-02 2.065280e-02
## [36] 1.807700e-02 1.522462e-02 1.236953e-02 2.493938e-03 1.809048e-03
## [41] 4.736512e-04
```

##	PC1	PC2	PC3	PC4
## Argentina	1.372534e-02	2.821917e-03	2.963334e-02	3.625545e-02
## Australia	-4.835121e-06	4.399916e-04	-4.381128e-04	-2.796624e-03
## Bostwana	2.182364e-03	-1.733718e-03	-1.196885e-03	-4.257408e-03
## Brazil	9.283145e-04	8.340760e-04	7.774710e-04	-2.708799e-03
## Bulgaria	2.370700e-04	5.438276e-04	-1.878906e-03	-2.825907e-04
## Canada	-1.551300e-05	2.309600e-04	-1.842666e-04	-2.246723e-03
## Chile	8.155278e-02	1.273077e-01	-4.323504e-02	-8.867136e-01
## China	-4.873003e-04	1.406094e-03	7.303733e-04	-2.528453e-03
## Columbia	6.219628e-01	7.530175e-01	1.492866e-01	1.211282e-01
## Czech	-1.767117e-03	7.254601e-03	-1.060938e-02	-6.410304e-02
## Denmark	9.622968e-05	9.344271e-04	-1.893822e-03	-1.110831e-02
## Egypt	3.624513e-03	-2.361461e-03	5.185995e-03	1.271041e-02
## EU	1.388850e-05	1.280034e-04	-2.594719e-04	-1.477518e-03
## Ghana	1.484903e-03	-1.163399e-03	1.282476e-03	-1.678544e-03
## HongKong	1.193520e-05	1.882410e-05	-2.091355e-06	7.311069e-05
## Hungary	3.658674e-02	2.375877e-02	-1.093629e-01	-2.701687e-01
## India	1.033991e-02	-5.180488e-03	-5.376807e-03	-3.140661e-02
## Israel	2.234251e-05	8.829653e-04	-7.783208e-04	-2.220102e-04
## Japan	1.989834e-04	1.806938e-02	-6.415064e-03	-1.030213e-01
## Malaysia	3.500781e-04	6.239222e-04	-1.049640e-03	6.573081e-04
## Mexico	3.697158e-03	-1.665162e-03	-5.572675e-04	1.111597e-02
## Nigeria	9.271851e-02	-2.747152e-02	7.304933e-02	3.028610e-01
## Norway	5.549288e-04	9.601164e-04	-1.291988e-03	-1.195120e-02
## NZ	-5.278438e-05	5.000825e-04	-8.073786e-04	-2.907408e-03
## Peru	2.284619e-04	7.545047e-04	-3.388001e-04	-2.876540e-06
## Philipines	5.105273e-03	1.146547e-02	-1.178088e-02	3.174007e-02
## Poland	2.713315e-04	6.499096e-04	-1.502034e-03	-4.065117e-03
## Romania	1.000226e-03	2.143416e-04	-1.032577e-03	1.043895e-04
## Russia	1.762191e-02	-1.246843e-03	2.899481e-03	-2.523982e-02
## Saudi	1.840766e-07	6.495065e-08	-1.097189e-06	-8.656490e-06

## Singapore	-4.952103e-05	4.003432e-04	-2.584096e-04	-6.750520e-04
## SouthAfrica	3.012492e-03	-5.975656e-04	-1.509030e-03	-1.834267e-02
## SouthKorea	5.512172e-02	1.365570e-01	-9.769029e-01	1.149756e-01
## Sweden	4.215333e-04	1.222256e-03	-2.011928e-03	-1.293934e-02
## Taiwan	2.980613e-04	4.022811e-03	-8.000949e-03	-1.797854e-03
## Thailand	3.992506e-04	1.082596e-02	-1.870773e-02	-5.736138e-03
## Turkey	1.584985e-03	-8.649269e-05	1.907571e-03	2.338484e-03
## UAE	1.053453e-07	1.063344e-07	-5.231810e-07	-3.398088e-07
## Uganda	7.699610e-01	-6.293552e-01	-5.016182e-02	-3.579109e-02
## UK	4.314721e-05	-4.836783e-05	-7.446384e-05	-6.049889e-04
## Zambia	3.767958e-03	1.082028e-04	3.753056e-03	3.115367e-03
##	PC5	PC6	PC7	PC8
## Argentina	-3.250019e-01	3.368722e-02	8.760559e-01	6.672614e-03
## Australia	-1.530422e-03	3.135810e-03	-1.381440e-03	3.389202e-03
## Bostwana	-1.067013e-03	8.466634e-04	9.385801e-03	3.771563e-03
## Brazil	-4.230257e-03	-8.711130e-04	1.533833e-02	1.250558e-03
## Bulgaria	2.091534e-03	7.978417e-03	-9.608984e-03	7.114169e-04
## Canada	-1.325999e-03	2.232252e-03	5.429394e-04	3.964633e-03
## Chile	-2.841748e-01	-3.169349e-01	-6.503455e-02	-4.308561e-02
## China	-3.348469e-03	5.120777e-03	-4.487121e-03	1.208998e-02
## Columbia	9.066739e-02	1.784989e-02	1.551046e-02	-3.638434e-03
## Czech	-2.655282e-02	1.318112e-01	-1.558764e-02	5.997858e-02
## Denmark	-3.327547e-03	1.916490e-02	-8.592799e-03	5.001374e-03
## Egypt	-4.270821e-02	-4.745508e-03	-2.191250e-02	7.867269e-02
## EU	-4.310568e-04	2.598257e-03	-1.201132e-03	6.034019e-04
## Ghana	-1.029384e-02	2.753830e-04	2.316031e-02	1.293255e-02
## HongKong	-7.138249e-05	6.310644e-05	-1.238828e-03	2.011207e-04
## Hungary	-8.006078e-02	9.149126e-01	-5.623643e-02	-2.055327e-01
## India	-2.697509e-02	3.386884e-02	9.144889e-02	3.661761e-02
## Israel	5.874938e-03	1.740905e-03	-1.633375e-02	-2.468944e-03
## Japan	7.536821e-03	1.687302e-01	-4.073588e-03	9.677960e-01
## Malaysia	2.116952e-05	3.346025e-03	-5.502891e-03	1.128169e-02
## Mexico	-1.022306e-02	-3.040819e-04	1.823102e-02	5.631925e-03
## Nigeria	-8.839268e-01	6.733789e-03	-3.230988e-01	3.324031e-02
## Norway	-1.064532e-02	2.074085e-02	9.148869e-03	1.631567e-02
## NZ	-1.709672e-03	4.297664e-03	-2.806555e-03	-6.643248e-04
## Peru	-4.213124e-04	4.171988e-03	-3.539136e-03	1.277928e-03
## Philipines	4.315772e-02	-2.677484e-02	-2.519317e-01	-1.106245e-02
## Poland	8.457215e-05	1.078841e-02	-3.934896e-03	-2.458489e-03

## Romania	5.934593e-03	-3.302915e-03	-1.925224e-02	-1.789347e-02
## Russia	-1.421968e-02	4.847956e-02	7.120000e-02	5.252725e-03
## Saudi	-5.558785e-06	-7.506549e-07	2.244815e-05	-3.794462e-06
## Singapore	3.009318e-05	1.367765e-03	-3.153157e-03	2.271110e-03
## SouthAfrica	-8.493094e-03	4.279523e-03	2.069901e-02	1.967536e-02
## SouthKorea	-4.596407e-02	-8.626600e-02	1.965659e-02	1.836147e-02
## Sweden	-1.006622e-02	1.589897e-02	-9.237862e-03	8.083133e-03
## Taiwan	2.520330e-02	-2.078840e-03	-6.548166e-02	3.291412e-02
## Thailand	3.622062e-02	4.082849e-02	-1.341563e-01	6.029773e-02
## Turkey	-2.043144e-02	-8.262446e-04	4.369484e-02	2.900329e-03
## UAE	-1.580089e-07	-5.087079e-06	-5.035623e-06	-7.029559e-06
## Uganda	7.702969e-02	-2.073620e-02	1.696755e-02	1.066521e-02
## UK	-9.645604e-04	5.203784e-04	1.957667e-04	-3.662848e-04
## Zambia	-3.537425e-02	1.581499e-03	1.236730e-01	-7.242527e-03
##	PC9	PC10	PC11	PC12
## Argentina	2.235333e-01	-1.096209e-01	-1.885825e-01	4.208941e-02
## Australia	-1.567049e-03	1.664050e-02	-1.029888e-02	-9.783545e-03
## Bostwana	-6.381096e-02	-1.128139e-01	1.137251e-01	3.772449e-02
## Brazil	-1.884638e-03	-6.866876e-03	-9.285252e-03	-3.217983e-02
## Bulgaria	1.189090e-02	-2.096002e-02	-8.802374e-03	1.967480e-02
## Canada	-4.720744e-03	2.096433e-02	-7.856533e-03	-1.612932e-02
## Chile	1.884938e-02	-1.488670e-02	-4.929630e-03	2.468975e-02
## China	1.656712e-02	6.926042e-02	-5.095445e-02	-3.045742e-02
## Columbia	-1.270936e-03	1.446547e-02	1.131643e-02	-4.388110e-03
## Czech	-2.329086e-02	5.699823e-01	-4.118533e-01	-4.952367e-01
## Denmark	3.731392e-03	6.718248e-02	-5.832174e-02	-3.370917e-02
## Egypt	6.480737e-02	1.534389e-01	5.070460e-02	-9.588178e-02
## EU	4.809283e-04	8.804439e-03	-7.531154e-03	-4.271288e-03
## Ghana	-1.781094e-02	-1.235676e-02	1.737427e-02	-2.790307e-02
## HongKong	1.286903e-03	3.443556e-05	-1.541892e-03	2.262458e-03
## Hungary	5.246179e-02	-5.981227e-02	7.579009e-02	9.823081e-02
## India	-1.070368e-01	-3.873629e-01	3.961469e-01	-7.940064e-01
## Israel	9.863617e-03	-2.451212e-02	-1.419786e-02	8.654976e-03
## Japan	1.357575e-02	-3.967699e-02	4.730636e-02	1.027394e-01
## Malaysia	-5.684837e-03	2.926078e-03	-2.811136e-02	-1.942402e-02
## Mexico	-8.291136e-02	-4.840062e-02	1.875834e-01	4.644289e-02
## Nigeria	-4.527873e-02	6.725124e-03	3.029338e-02	4.713861e-03
## Norway	-3.372660e-02	1.092574e-01	-5.752324e-02	-5.685760e-02
## NZ	-9.648061e-04	1.985932e-02	-1.550142e-02	-1.811987e-03

## Peru	-2.560408e-03	-5.970629e-03	-1.665291e-02	4.728448e-03
## Philipines	4.052326e-01	-5.537015e-01	-4.020109e-01	-2.833265e-02
## Poland	1.556892e-03	2.969443e-02	-1.359950e-02	-3.137179e-02
## Romania	1.878622e-02	-6.746617e-02	9.423785e-03	2.673380e-02
## Russia	-8.400480e-01	-2.763273e-01	-4.146490e-01	6.024176e-02
## Saudi	-3.949563e-05	1.883873e-05	2.272666e-05	-1.299028e-04
## Singapore	2.289423e-03	6.064609e-03	-1.377220e-02	-4.762151e-03
## SouthAfrica	-9.804514e-02	-6.684635e-02	1.351746e-01	-2.664203e-02
## SouthKorea	-1.401995e-02	1.298262e-02	4.928835e-03	1.372840e-03
## Sweden	-1.190677e-02	8.015666e-02	-6.586040e-02	-3.861097e-03
## Taiwan	1.918027e-03	-1.198623e-01	-1.173416e-02	1.281211e-01
## Thailand	1.826237e-01	-1.679155e-01	-4.562700e-01	-2.390736e-01
## Turkey	2.068477e-02	-3.044965e-02	-5.895621e-03	4.590029e-04
## UAE	1.523782e-06	-9.025589e-07	-7.909831e-05	-7.114775e-05
## Uganda	1.766839e-02	1.000040e-02	-8.484131e-03	3.511699e-03
## UK	-1.482477e-03	8.099868e-03	1.065841e-03	-3.248803e-03
## Zambia	-3.447847e-02	-4.429830e-02	-3.945479e-02	8.033251e-03
##	PC13	PC14	PC15	PC16
## Argentina	-3.536874e-02	2.853776e-03	-2.882851e-02	0.0713460607
## Australia	-1.883292e-02	-1.737610e-03	4.351156e-02	0.0217290377
## Bostwana	9.543194e-02	5.494606e-02	3.248710e-01	0.1747301691
## Brazil	1.208054e-02	-9.724730e-04	-1.173231e-02	-0.0764899339
## Bulgaria	3.116022e-02	-3.691656e-03	-7.681329e-03	-0.0072906728
## Canada	-1.841427e-02	6.804879e-03	9.091350e-03	-0.0047963655
## Chile	4.466298e-03	1.054717e-02	-1.762542e-02	-0.0041155157
## China	-8.393851e-02	4.391316e-02	1.080383e-02	-0.0427883828
## Columbia	1.386055e-03	-2.616060e-03	1.150390e-03	0.0022864148
## Czech	-1.379154e-01	-1.112513e-01	1.067049e-01	-0.2006941559
## Denmark	-1.542395e-02	-5.997679e-02	1.239598e-01	0.0576060080
## Egypt	-5.084597e-01	5.790679e-01	7.750374e-05	0.3666818576
## EU	-1.876329e-03	-6.908277e-03	1.539697e-02	0.0072631849
## Ghana	-3.396669e-02	4.260978e-02	7.755342e-03	0.0336086535
## HongKong	-3.270752e-03	-3.572926e-03	2.186704e-03	0.0077018769
## Hungary	-1.072647e-02	1.524414e-02	-1.659263e-02	0.0147707472
## India	-2.526375e-02	-1.014734e-01	-7.436540e-02	-0.0269284662
## Israel	-5.269643e-03	-2.602020e-02	-3.798689e-02	-0.0347360400
## Japan	7.687023e-03	-6.825672e-02	-2.289025e-02	-0.0289144164
## Malaysia	2.505374e-03	6.666531e-02	-6.982248e-03	-0.0063830141
## Mexico	-1.170205e-01	6.081329e-01	-1.815733e-01	-0.4102649227

## Nigeria	4.837915e-02	-3.189183e-02	-3.286053e-03	-0.0160878093
## Norway	-1.173873e-01	3.189621e-02	1.610996e-01	-0.0052286520
## NZ	-1.587782e-02	-2.151240e-02	7.284298e-02	0.0357197847
## Peru	8.497787e-03	-1.316490e-02	-3.515802e-02	-0.0073709744
## Philipines	-4.665715e-01	-1.073889e-01	1.194707e-01	-0.1131426162
## Poland	-1.688270e-02	-2.151740e-03	-6.684210e-02	-0.0605484365
## Romania	1.597537e-02	-7.666583e-02	2.301968e-02	0.0168460650
## Russia	-1.365875e-01	1.738680e-02	-7.783531e-02	0.0712303817
## Saudi	-2.777581e-04	-3.583444e-06	6.746606e-05	-0.0000698606
## Singapore	-7.436194e-03	-1.186686e-03	7.056299e-03	-0.0049470845
## SouthAfrica	8.209420e-02	1.155751e-01	7.271730e-01	0.2285960212
## SouthKorea	-3.862506e-03	-6.150460e-03	-8.153539e-04	0.0008621910
## Sweden	-1.199891e-01	-3.505539e-02	2.396551e-01	0.1052547711
## Taiwan	5.203172e-03	1.206798e-02	1.177146e-01	-0.2077342444
## Thailand	6.319271e-01	4.320561e-01	-7.467671e-02	0.1947041421
## Turkey	-2.714675e-02	1.031571e-02	2.828777e-02	0.0638931980
## UAE	-7.200861e-06	-1.123435e-04	1.197312e-04	0.0000831636
## Uganda	1.900463e-03	-1.380345e-03	-2.174530e-04	-0.0006075561
## UK	-7.604932e-03	2.825992e-03	1.163154e-02	0.0031829807
## Zambia	1.121213e-01	1.720753e-01	3.983873e-01	-0.6584314457
##	PC17	PC18	PC19	PC20
## Argentina	-1.060234e-01	2.410307e-02	-0.0320521374	1.082834e-02
## Australia	-3.028025e-02	8.800904e-03	0.0830799612	3.903359e-03
## Bostwana	-4.798430e-02	1.059026e-01	0.0368560581	1.610724e-01
## Brazil	6.017318e-02	-3.197233e-02	-0.2057180861	-3.211292e-01
## Bulgaria	9.033898e-03	7.362235e-03	-0.1323706971	-1.141230e-01
## Canada	-1.169736e-02	5.238831e-03	0.0034754402	-2.048641e-02
## Chile	4.316233e-03	-4.022828e-04	-0.0004993973	4.219983e-03
## China	-1.079969e-01	-6.578504e-03	0.0128432896	-8.557209e-02
## Columbia	2.630090e-04	-2.162590e-05	0.0009099323	2.265740e-04
## Czech	-1.454628e-01	8.889527e-02	-0.2274523652	3.704691e-02
## Denmark	-9.916346e-03	1.700223e-02	0.1589809530	-2.518845e-01
## Egypt	2.052416e-01	-4.125799e-01	-0.0406571419	1.039200e-02
## EU	-1.286830e-03	1.749088e-03	0.0187264720	-3.551865e-02
## Ghana	3.176523e-02	8.899772e-02	0.1560193016	2.711771e-01
## HongKong	-2.072964e-03	-3.246727e-03	-0.0133117225	1.838402e-03
## Hungary	2.662985e-02	-1.809687e-02	0.0042007450	9.464925e-03
## India	-3.779369e-02	-8.609848e-02	0.0898812257	-1.487530e-02
## Israel	-5.464483e-02	-7.564293e-02	-0.0674772106	-3.646468e-01

## Japan	3.952148e-02	3.611065e-02	0.0019994739	-1.107087e-02
## Malaysia	-5.029033e-02	-1.428969e-02	0.0416372392	1.794227e-01
## Mexico	-2.921495e-01	4.853123e-01	-0.0266805501	-1.398946e-01
## Nigeria	-1.924616e-03	3.814775e-03	0.0009422567	1.643587e-03
## Norway	-8.564075e-02	1.745568e-01	0.4006494741	2.586448e-01
## NZ	-3.109623e-02	-8.414114e-04	0.1145006596	3.782648e-02
## Peru	-1.214357e-03	-6.915318e-03	-0.0737623624	2.338321e-02
## Philipines	3.275174e-02	1.745600e-01	-0.0781204729	4.831251e-02
## Poland	-2.628611e-02	-3.589684e-02	-0.1426258059	-1.463875e-01
## Romania	6.627401e-02	-7.125995e-02	-0.0302087385	-3.711256e-01
## Russia	3.887407e-02	-2.451534e-02	-0.0230739571	-8.361962e-03
## Saudi	9.565328e-05	7.628855e-04	0.0004912052	9.647827e-05
## Singapore	-1.405249e-02	-1.212353e-02	0.0079789497	-1.126142e-02
## SouthAfrica	-1.094771e-01	2.052225e-01	-0.4053585975	-4.678211e-02
## SouthKorea	5.138712e-03	1.445339e-03	-0.0007550397	-5.020559e-04
## Sweden	-1.713702e-01	6.635186e-02	0.6394464691	-4.112623e-01
## Taiwan	-7.225806e-01	-5.884269e-01	-0.0269044955	1.054281e-01
## Thailand	-2.025554e-02	-3.953863e-02	0.0969461573	-3.176611e-02
## Turkey	1.875440e-02	-4.102990e-02	-0.0003272758	-3.324260e-01
## UAE	-2.210120e-05	-6.206012e-05	0.0002444718	2.700914e-04
## Uganda	-2.324746e-03	7.698682e-04	-0.0005577222	2.049396e-05
## UK	-8.350993e-03	3.450878e-03	0.0307189620	-1.670169e-02
## Zambia	4.801513e-01	-2.932350e-01	0.1440836627	1.776207e-02
##	PC21	PC22	PC23	PC24
## Argentina	7.374111e-03	0.0450835934	6.395502e-03	-3.703707e-02
## Australia	-1.227728e-01	-0.0861771503	-5.370801e-02	-5.417835e-02
## Bostwana	4.788313e-01	0.1370083375	-3.641530e-01	-5.951750e-02
## Brazil	-4.218231e-02	-0.2527222446	7.787899e-02	2.710369e-03
## Bulgaria	2.511580e-01	0.3053509020	-2.176053e-01	5.976465e-01
## Canada	-1.066714e-01	-0.0255253797	2.272238e-02	1.491186e-04
## Chile	-6.291453e-04	0.0019890616	-2.705150e-03	5.108029e-04
## China	-4.080112e-01	0.1834558289	2.759079e-01	2.753485e-01
## Columbia	6.511198e-04	-0.0002558955	-2.791594e-05	-2.218514e-05
## Czech	1.956164e-01	-0.0519327693	-5.128680e-02	-6.419051e-02
## Denmark	7.733302e-02	0.2529064148	-5.117071e-02	-9.200137e-02
## Egypt	4.052526e-02	0.0486508541	-2.068023e-02	-4.286545e-02
## EU	8.315951e-03	0.0304878112	-4.205805e-03	-1.510813e-02
## Ghana	3.855837e-01	-0.2202439735	6.434569e-01	3.567503e-01
## HongKong	-3.236989e-03	-0.0167286934	-1.209821e-02	9.864037e-03

## Hungary	-1.821290e-02	-0.0090170860	9.608254e-03	1.417510e-03
## India	-3.774107e-02	0.0252246350	-1.697202e-02	3.454889e-03
## Israel	-1.080009e-01	0.3146305998	4.731792e-02	2.169886e-01
## Japan	-5.792617e-03	0.0016339433	-9.604177e-04	-9.331958e-03
## Malaysia	-1.178952e-01	0.1934720905	-8.080546e-02	2.665146e-01
## Mexico	8.580353e-02	-0.0112202865	-4.004455e-02	-9.034610e-02
## Nigeria	-4.193187e-03	-0.0005277549	2.358135e-03	7.259974e-04
## Norway	-1.201746e-01	0.1216937462	-1.098570e-01	2.239605e-01
## NZ	-1.590087e-01	-0.1008093806	-1.857779e-01	-9.319254e-02
## Peru	-5.366168e-02	0.0916114273	-2.025543e-01	4.268067e-02
## Philipines	1.145571e-02	-0.0083458055	-2.202321e-02	-2.640489e-02
## Poland	2.927134e-02	0.1891116658	2.278469e-02	7.676767e-02
## Romania	4.165437e-01	0.2035583920	2.743682e-01	-1.979090e-01
## Russia	-1.176881e-02	0.0037628970	2.341707e-03	-1.184889e-02
## Saudi	-5.119803e-04	0.0006736224	-4.067283e-04	1.033582e-04
## Singapore	-5.596006e-02	0.0315137114	-1.078909e-02	7.525345e-03
## SouthAfrica	-2.194167e-01	-0.0308944140	1.901788e-01	1.658452e-02
## SouthKorea	-4.499513e-04	-0.0000248677	6.066268e-04	1.283984e-04
## Sweden	-1.926789e-03	-0.0476496744	6.375284e-02	-6.429624e-02
## Taiwan	9.299067e-02	-0.0686073734	2.200542e-02	-1.004875e-02
## Thailand	-3.013139e-02	-0.0054027898	3.051934e-02	-1.202134e-02
## Turkey	7.133726e-02	-0.6359827954	-3.126946e-01	4.181446e-01
## UAE	3.386613e-05	0.0002147522	-1.917710e-04	-1.004699e-04
## Uganda	-6.920768e-04	0.0002129141	-4.361742e-04	-2.275253e-04
## UK	-1.377875e-02	-0.0036992296	8.432227e-03	-6.469592e-02
## Zambia	-1.225794e-02	0.0157337809	-1.590067e-02	2.104575e-02
##	PC25	PC26	PC27	PC28
## Argentina	-0.0113303166	-4.435479e-03	-1.134460e-02	-3.900172e-04
## Australia	-0.1510990145	7.158406e-04	-3.837385e-02	2.338002e-02
## Bostwana	0.0130640936	4.894643e-01	1.517981e-01	1.013791e-01
## Brazil	-0.1321662681	4.850659e-01	-6.606527e-01	1.978470e-01
## Bulgaria	-0.2958713894	-4.305654e-01	-2.602808e-01	1.762184e-01
## Canada	-0.1043567115	9.524907e-03	-4.667740e-04	-5.102539e-02
## Chile	0.0003675392	-3.441564e-04	1.501274e-03	5.618303e-04
## China	0.2492107021	1.399322e-01	2.089745e-01	3.081476e-01
## Columbia	-0.0002517897	-3.145529e-04	4.304271e-04	1.023917e-04
## Czech	-0.0327717784	1.953604e-02	7.668797e-02	2.446497e-02
## Denmark	0.3000945645	-9.680724e-02	6.958662e-02	4.154497e-01
## Egypt	-0.0217589710	-1.083347e-02	-3.575677e-02	-7.829470e-03

## EU	0.0327617881	-1.669892e-02	8.634206e-03	5.321251e-02
## Ghana	-0.1401568013	1.137434e-01	8.764110e-02	9.729862e-03
## HongKong	-0.0133419687	-3.465224e-02	-5.797810e-03	1.689974e-02
## Hungary	0.0011279469	2.995627e-03	-2.507010e-03	2.568355e-03
## India	-0.0030958899	-3.541918e-02	-4.983172e-03	1.365914e-02
## Israel	-0.0604317769	3.601799e-01	1.777820e-01	-2.188696e-01
## Japan	0.0024588909	-1.600201e-03	3.682399e-03	-3.550994e-03
## Malaysia	-0.0135345195	3.191522e-01	7.477070e-02	2.018377e-01
## Mexico	0.0124075771	-4.522910e-02	3.130971e-02	4.137712e-02
## Nigeria	0.0016412864	7.734652e-04	-1.036465e-03	-5.453352e-04
## Norway	0.4283644267	2.919563e-02	-5.012210e-01	-3.612875e-01
## NZ	-0.1554858903	-3.390656e-02	-2.437661e-02	5.263073e-02
## Peru	-0.1954292420	7.147450e-02	1.173404e-02	-1.610336e-01
## Philipines	-0.01711111605	1.027128e-02	2.137584e-02	9.196479e-03
## Poland	-0.0767682353	9.920308e-02	1.444432e-01	-6.030735e-01
## Romania	0.3594610040	-9.282819e-02	-1.526257e-01	-1.150116e-01
## Russia	0.0040565301	-1.889810e-02	5.352322e-03	7.959965e-03
## Saudi	0.0013908834	1.804293e-04	-9.498467e-04	-6.544616e-04
## Singapore	0.0063864517	5.455501e-02	2.295608e-03	-1.749666e-02
## SouthAfrica	-0.0198650435	-1.665338e-01	-1.388315e-02	-8.967188e-02
## SouthKorea	0.0003749411	6.264035e-04	6.447683e-04	4.996516e-04
## Sweden	-0.4231794691	-2.781704e-02	5.094822e-02	-3.868030e-02
## Taiwan	0.0344272389	-4.161250e-02	-6.822497e-02	8.380047e-03
## Thailand	0.0137301107	-2.135243e-02	-2.799450e-02	-3.848502e-02
## Turkey	0.3447976612	-2.194661e-02	2.432825e-01	-8.143978e-02
## UAE	0.0003702596	5.841784e-04	1.443075e-04	2.600946e-04
## Uganda	-0.0002768298	-1.090008e-05	4.852745e-06	-3.650162e-05
## UK	0.0263622647	-2.130738e-02	3.649281e-02	-1.513792e-03
## Zambia	-0.0246067806	-1.516807e-02	6.411578e-02	-7.466054e-03
##	PC29	PC30	PC31	PC32
## Argentina	-0.0030641561	-4.528664e-03	-4.399387e-03	-0.0058543642
## Australia	0.1193429688	-6.153854e-02	-1.397715e-01	0.0249236312
## Bostwana	-0.2001510855	-5.693878e-03	1.827873e-01	0.0889991789
## Brazil	0.0730153579	5.987386e-02	1.710702e-01	0.0007091046
## Bulgaria	-0.1008077224	2.613346e-03	5.502550e-02	-0.0266264380
## Canada	0.1332079186	1.734489e-02	2.192929e-02	0.0005492856
## Chile	-0.0009690818	-4.511219e-04	-7.310368e-05	-0.0004411869
## China	-0.3005340293	1.983736e-01	2.276245e-01	0.3209872878
## Columbia	-0.0001230886	-1.998334e-04	9.742514e-05	-0.0002233273

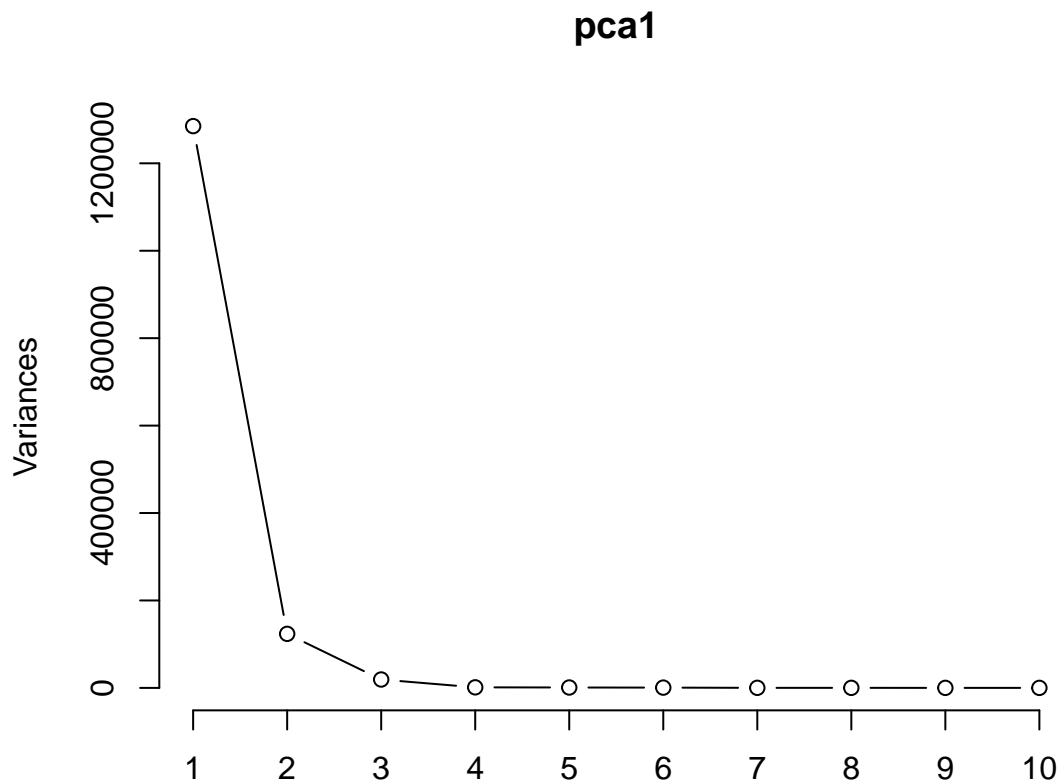
## Czech	-0.0756868345	-2.357580e-02	-7.902132e-02	-0.0021611346
## Denmark	0.6173038583	-1.594619e-01	2.664519e-01	-0.0173515324
## Egypt	-0.0057473566	-2.998140e-02	4.029806e-03	0.0082716152
## EU	0.0803259479	-1.815492e-02	3.114433e-02	-0.0022418973
## Ghana	0.2703098317	-1.359088e-01	-3.829915e-04	0.0970015656
## HongKong	0.0255089312	-1.555132e-02	3.832198e-02	0.0072533520
## Hungary	-0.0031523052	8.558482e-04	8.230261e-04	-0.0012968561
## India	-0.0053983074	3.987045e-03	5.358147e-03	0.0091092818
## Israel	-0.0433517717	-6.250588e-01	-2.654549e-01	-0.0833952200
## Japan	-0.0029887867	4.224563e-03	-2.243119e-03	-0.0033602825
## Malaysia	0.2225013587	4.883604e-01	-4.545959e-01	-0.3688715306
## Mexico	0.0412425682	-1.582131e-02	-4.774398e-02	0.0061875236
## Nigeria	-0.0006899479	-4.777236e-04	1.361034e-03	-0.0013440618
## Norway	-0.0045229657	-1.160606e-01	8.460346e-03	0.0332297203
## NZ	0.3003524427	-1.080570e-01	-2.303632e-01	-0.0257565133
## Peru	0.2931948310	1.408962e-01	-1.725861e-01	0.8241359804
## Philipines	0.0031100753	-3.443400e-03	1.724140e-02	-0.0165814063
## Poland	0.2882694567	3.398967e-01	4.613515e-01	-0.1909376830
## Romania	-0.0663936088	2.701092e-01	-4.266848e-01	0.1156991361
## Russia	-0.0064078751	-1.901021e-03	9.305987e-03	-0.0057970513
## Saudi	-0.0016461607	-8.302753e-04	8.058484e-04	-0.0037437074
## Singapore	0.0207189743	5.492371e-02	-1.047407e-01	-0.0211196232
## SouthAfrica	0.0611006854	1.048495e-02	-8.093898e-02	-0.0375741611
## SouthKorea	-0.0004592285	-3.055563e-04	1.988975e-04	0.0004626275
## Sweden	-0.1741344574	1.913332e-01	1.908494e-02	-0.0136021172
## Taiwan	0.0412443833	-2.739071e-02	2.579215e-02	0.0130781567
## Thailand	-0.0082698951	-1.400459e-02	2.139677e-02	0.0168261279
## Turkey	0.0417340367	5.696210e-02	-6.598688e-02	0.0120405028
## UAE	0.0003693843	-1.393984e-04	-1.105020e-03	-0.0012379447
## Uganda	-0.0002735877	-9.845072e-06	-2.037193e-04	0.0002047440
## UK	0.0125686427	8.248764e-03	4.080232e-02	-0.0263616225
## Zambia	-0.0092337738	-3.628764e-03	8.214106e-03	0.0144983730
##	PC33	PC34	PC35	PC36
## Argentina	-1.497435e-03	-1.053685e-03	-1.189474e-03	-1.008202e-03
## Australia	-3.252619e-01	-5.992642e-01	6.262269e-01	1.937038e-01
## Bostwana	-1.781643e-01	-8.174046e-02	-3.974046e-02	-2.828003e-03
## Brazil	4.402754e-03	5.280689e-02	-3.331882e-03	2.223314e-02
## Bulgaria	-1.205391e-01	-3.136070e-02	-2.722250e-02	6.426214e-02
## Canada	-4.190901e-02	-6.628825e-01	-6.739053e-01	-1.808771e-01

## Chile	1.967473e-04	2.312598e-04	5.049210e-05	-8.757958e-05
## China	-3.222179e-01	1.884893e-04	-6.114962e-03	-1.274167e-02
## Columbia	1.685408e-04	-2.146799e-05	-4.153910e-05	-1.219063e-05
## Czech	-3.611653e-03	-3.711810e-05	-3.124169e-03	-4.819999e-03
## Denmark	1.464151e-01	-8.931811e-03	4.901681e-02	6.755661e-03
## Egypt	6.702327e-03	8.331129e-03	1.523787e-03	-2.900159e-04
## EU	2.353991e-02	-2.541355e-02	2.156123e-02	-1.756736e-03
## Ghana	-6.344314e-02	3.298921e-02	-1.214538e-03	3.375673e-02
## HongKong	-2.092966e-02	-8.782464e-02	1.286773e-01	-5.302416e-01
## Hungary	3.510132e-03	-2.295739e-04	-6.851920e-04	1.828830e-04
## India	3.522541e-03	6.145608e-03	5.965833e-04	-2.362126e-03
## Israel	5.580374e-02	6.864115e-03	-6.212882e-03	-9.612986e-03
## Japan	-4.200749e-03	1.484265e-03	-1.159178e-04	-3.205569e-04
## Malaysia	1.835098e-01	-9.044170e-03	2.136975e-02	-3.736211e-02
## Mexico	-1.542127e-02	7.263758e-03	2.038434e-03	-7.738047e-03
## Nigeria	-2.624443e-04	-4.099426e-04	1.395965e-04	-1.478758e-04
## Norway	1.552483e-02	-1.818452e-02	-7.955323e-03	-7.637787e-03
## NZ	-7.097459e-01	3.842819e-01	-2.273066e-01	-8.629873e-02
## Peru	2.170440e-01	5.697674e-02	8.635200e-03	2.192241e-02
## Philipines	9.462309e-03	-1.583339e-03	-1.079000e-03	1.872266e-03
## Poland	-2.049227e-01	4.617231e-02	9.960156e-02	9.493336e-03
## Romania	-2.298756e-01	-7.669656e-02	-3.153723e-02	-4.113810e-02
## Russia	-7.265117e-03	6.981024e-04	1.479570e-03	1.285841e-03
## Saudi	9.165164e-04	-2.850313e-03	-7.727279e-04	6.628624e-03
## Singapore	-9.969143e-03	8.867185e-02	-3.908240e-02	3.767678e-01
## SouthAfrica	8.933258e-02	4.099027e-02	1.875713e-02	2.804369e-03
## SouthKorea	-6.116481e-05	3.903658e-05	1.272587e-04	-3.641360e-05
## Sweden	1.531061e-01	7.566954e-02	-3.669719e-03	-3.657536e-02
## Taiwan	2.481614e-02	-5.220346e-03	-4.551849e-03	1.321481e-03
## Thailand	-1.329176e-02	1.518267e-03	-3.914419e-03	-2.214599e-03
## Turkey	1.437613e-02	-2.769754e-02	-3.720704e-03	9.838222e-03
## UAE	-2.537649e-04	6.416092e-04	-2.001247e-03	1.886705e-03
## Uganda	-2.969895e-05	3.462109e-06	1.175928e-05	1.317500e-05
## UK	-1.245547e-02	-7.640240e-02	-2.582253e-01	6.984312e-01
## Zambia	-2.043967e-03	-4.227381e-03	5.471434e-03	-3.826153e-03
##	PC37	PC38	PC39	PC40
## Argentina	-1.355709e-04	-2.829375e-04	-5.303543e-05	-3.731263e-05
## Australia	1.010841e-03	-4.835100e-02	-2.348499e-02	-2.777743e-03
## Bostwana	2.950652e-02	9.228488e-03	5.961847e-03	-4.979777e-05

## Brazil	-2.438403e-02	1.296426e-02	-8.843878e-05	1.420467e-05
## Bulgaria	9.232956e-03	7.581923e-03	3.360413e-04	-5.482857e-04
## Canada	1.401350e-01	-7.590366e-02	-2.621729e-03	-1.381878e-03
## Chile	-3.582780e-05	-4.814576e-06	-1.074344e-06	-5.837314e-06
## China	-8.243508e-03	-8.221335e-03	3.561119e-03	1.109282e-03
## Columbia	3.555764e-05	-4.676315e-06	3.355325e-06	8.561677e-09
## Czech	-6.260188e-03	-2.617279e-04	-4.356761e-04	1.185357e-04
## Denmark	4.797633e-02	-3.076385e-02	-1.255234e-01	-6.608331e-03
## Egypt	8.521853e-04	-4.000771e-03	-4.608782e-04	1.646692e-04
## EU	-2.727970e-02	-8.168179e-03	9.895095e-01	5.263539e-02
## Ghana	1.360108e-02	2.055497e-02	2.391073e-03	1.277448e-03
## HongKong	-7.213779e-02	8.270251e-01	-4.438457e-03	1.040691e-03
## Hungary	2.470925e-04	1.611606e-05	-1.794841e-04	-7.454724e-06
## India	1.911688e-03	1.616738e-03	3.171154e-04	-5.977303e-05
## Israel	-5.125005e-02	1.846494e-02	1.479138e-05	-6.399470e-04
## Japan	-1.441650e-03	1.273533e-04	3.087513e-06	-1.433182e-05
## Malaysia	-1.174519e-01	1.861598e-03	-4.983917e-03	-1.574236e-04
## Mexico	9.219915e-03	2.668960e-03	-7.047016e-04	-1.399383e-04
## Nigeria	9.746661e-05	-3.843331e-04	4.632375e-06	1.126011e-06
## Norway	-1.872227e-02	5.929944e-03	4.413060e-03	-1.651862e-03
## NZ	-5.258661e-02	-1.051203e-02	1.211328e-02	3.537405e-03
## Peru	-5.118992e-02	1.435350e-02	-2.911525e-03	3.733876e-03
## Philipines	-2.916909e-03	-3.463231e-03	1.558930e-04	-2.299767e-04
## Poland	-4.365259e-03	-1.412460e-02	4.992352e-04	-5.311984e-05
## Romania	-2.239794e-02	3.428784e-03	-2.797561e-03	6.609776e-04
## Russia	-5.611850e-05	-1.176310e-03	-1.192996e-04	-5.432104e-05
## Saudi	3.717818e-03	3.002713e-03	-5.189582e-02	9.965795e-01
## Singapore	8.421144e-01	3.388558e-01	3.330902e-02	-4.949771e-03
## SouthAfrica	-1.292205e-02	-6.327727e-03	-2.560727e-03	1.340958e-05
## SouthKorea	3.821441e-05	-1.277285e-05	9.330228e-06	-1.879526e-06
## Sweden	-6.302488e-03	-7.610517e-04	-2.406558e-03	3.645728e-04
## Taiwan	-6.596130e-04	-7.513403e-03	-1.683843e-04	5.648579e-04
## Thailand	1.563000e-04	1.643979e-03	-2.987210e-04	1.407898e-04
## Turkey	1.345481e-03	-7.060742e-03	8.463084e-04	1.691118e-04
## UAE	4.124095e-03	1.248264e-03	-1.879010e-02	6.260194e-02
## Uganda	4.371097e-05	-3.235187e-07	3.280097e-06	1.298237e-06
## UK	-4.879468e-01	4.360860e-01	-1.025250e-02	-5.209039e-03
## Zambia	-1.292301e-03	3.887301e-03	-8.145542e-05	1.698841e-04
##	PC41			

## Argentina	-1.959143e-05
## Australia	8.356689e-04
## Bostwana	-2.425697e-04
## Brazil	1.936815e-04
## Bulgaria	2.357346e-04
## Canada	-9.998064e-04
## Chile	5.784251e-07
## China	5.487568e-04
## Columbia	-1.816629e-07
## Czech	-1.094945e-04
## Denmark	-2.210180e-03
## Egypt	1.121305e-05
## EU	1.549652e-02
## Ghana	-1.606378e-04
## HongKong	4.915781e-04
## Hungary	1.193835e-05
## India	-1.497224e-05
## Israel	-3.011017e-04
## Japan	2.108133e-05
## Malaysia	-7.370673e-04
## Mexico	1.009037e-04
## Nigeria	3.495744e-07
## Norway	9.325768e-05
## NZ	-9.022361e-04
## Peru	6.735739e-04
## Philipines	-2.147599e-05
## Poland	5.215510e-04
## Romania	-2.247367e-04
## Russia	-3.399863e-06
## Saudi	-6.353470e-02
## Singapore	-3.997385e-03
## SouthAfrica	1.048758e-04
## SouthKorea	4.174290e-07
## Sweden	2.057845e-04
## Taiwan	-3.063207e-05
## Thailand	2.299982e-05
## Turkey	5.694109e-06
## UAE	9.978465e-01
## Uganda	-4.569047e-07

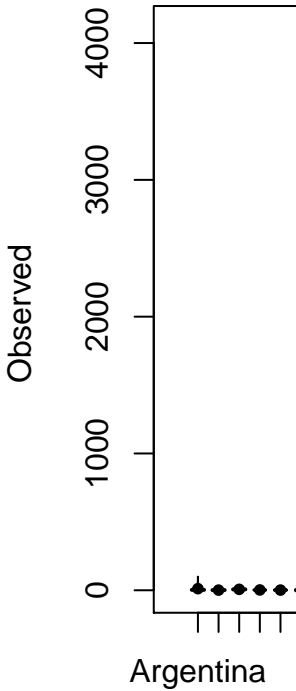
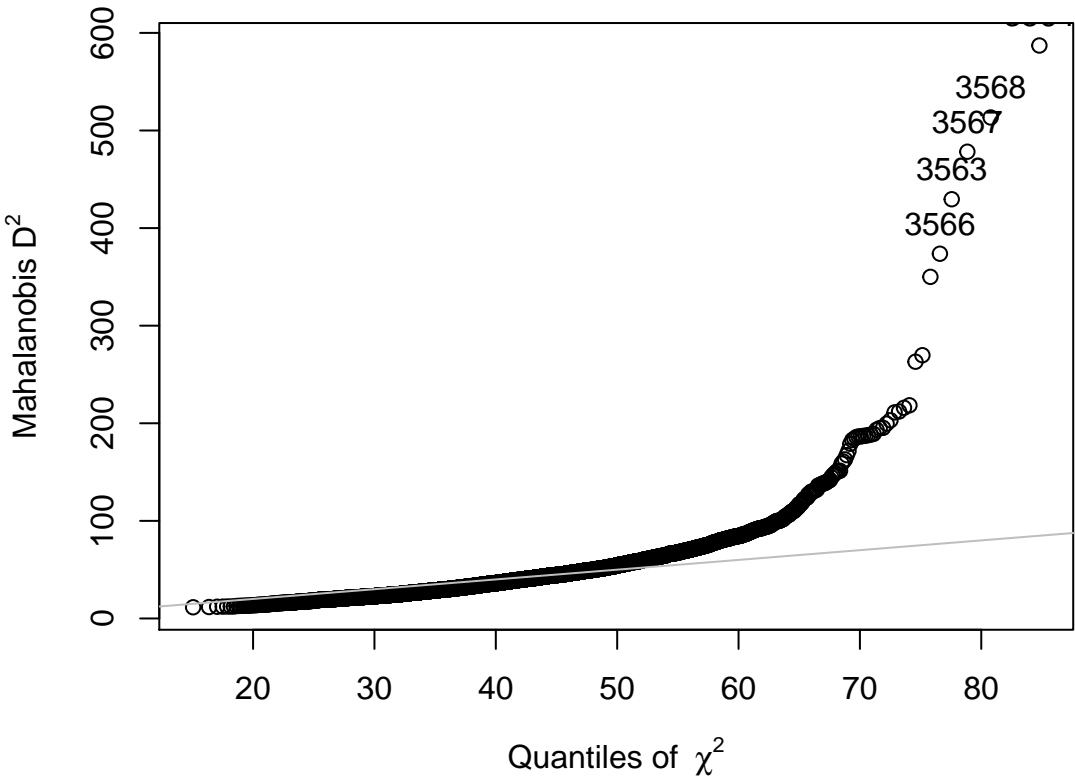
```
## UK          -1.889629e-04
## Zambia      2.304514e-05
```

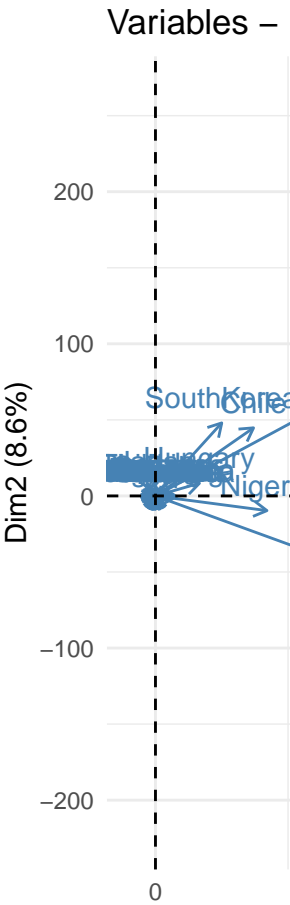
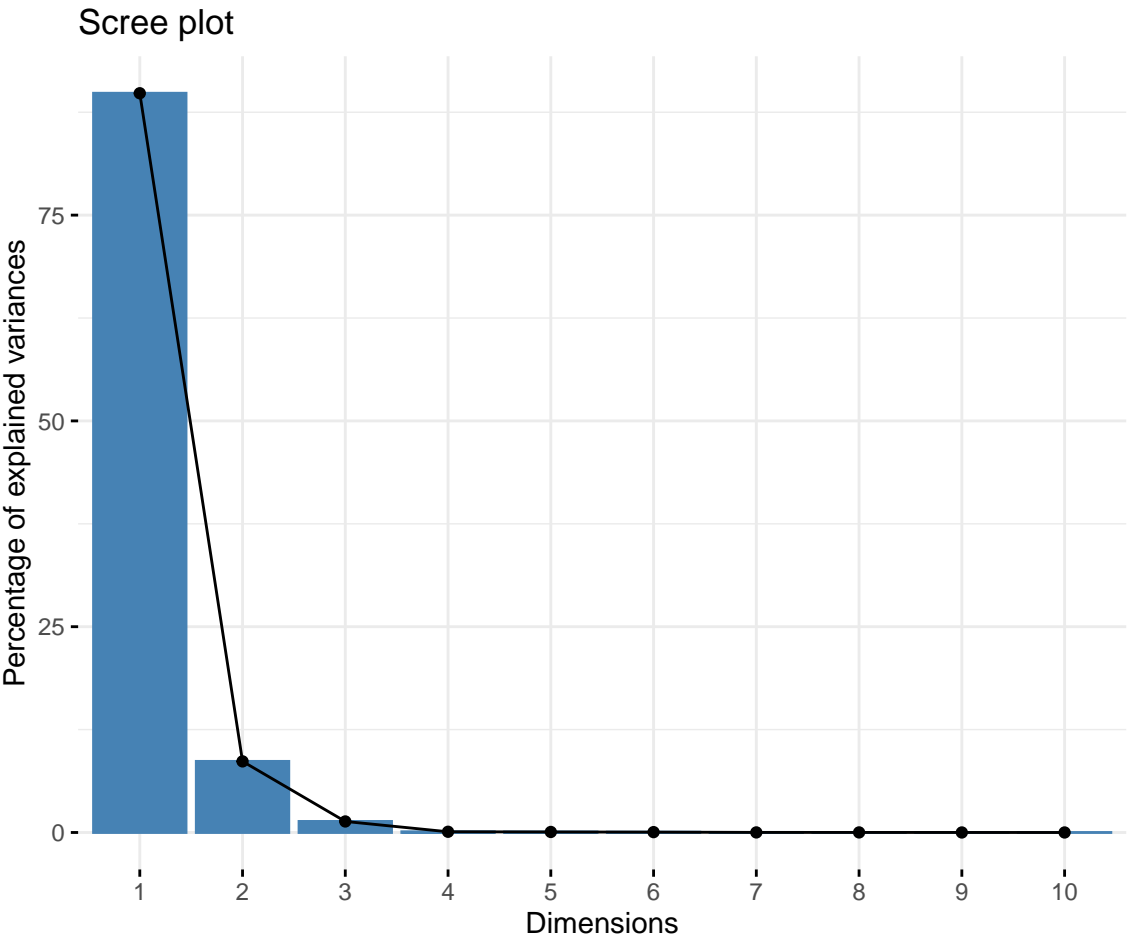


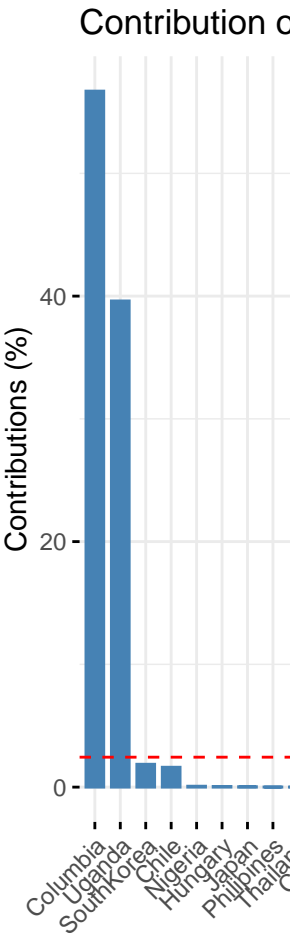
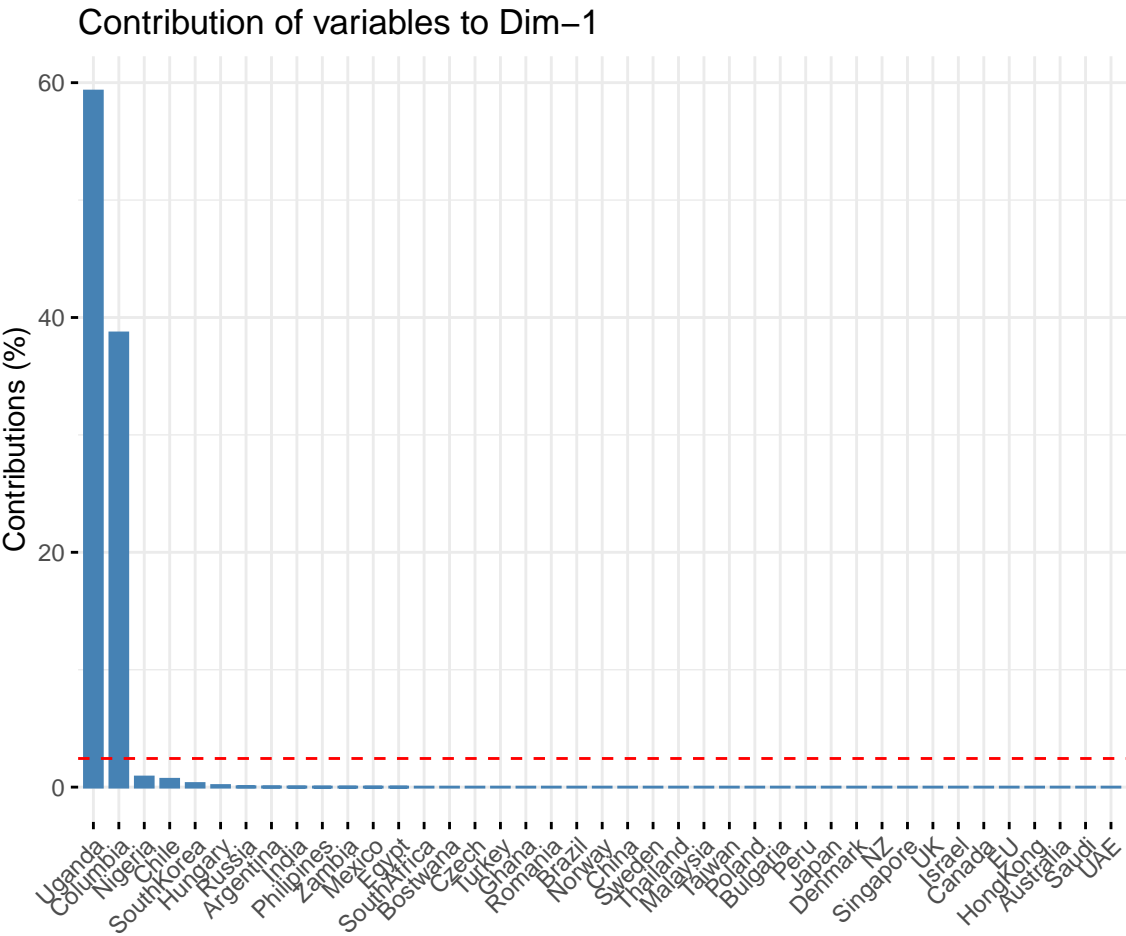
```
## Importance of components:
##
##          PC1      PC2      PC3      PC4      PC5      PC6
## Standard deviation 1133.6391 351.58183 138.4707 35.29703 30.20963 24.88644
## Proportion of Variance 0.8981 0.08638 0.0134 0.00087 0.00064 0.00043
## Cumulative Proportion 0.8981 0.98447 0.9979 0.99874 0.99937 0.99981
##
##          PC7      PC8      PC9      PC10  PC11  PC12  PC13
## Standard deviation 11.28311 10.26757 4.13138 3.60787 2.485 2.086 1.222
## Proportion of Variance 0.00009 0.00007 0.00001 0.00001 0.000 0.000 0.000
## Cumulative Proportion 0.99989 0.99997 0.99998 0.99999 1.000 1.000 1.000
##
##          PC14  PC15  PC16  PC17  PC18  PC19  PC20  PC21
## Standard deviation 1.005 0.7758 0.7539 0.6467 0.53 0.3384 0.2784 0.2472
## Proportion of Variance 0.000 0.0000 0.0000 0.0000 0.00 0.0000 0.0000 0.0000
```

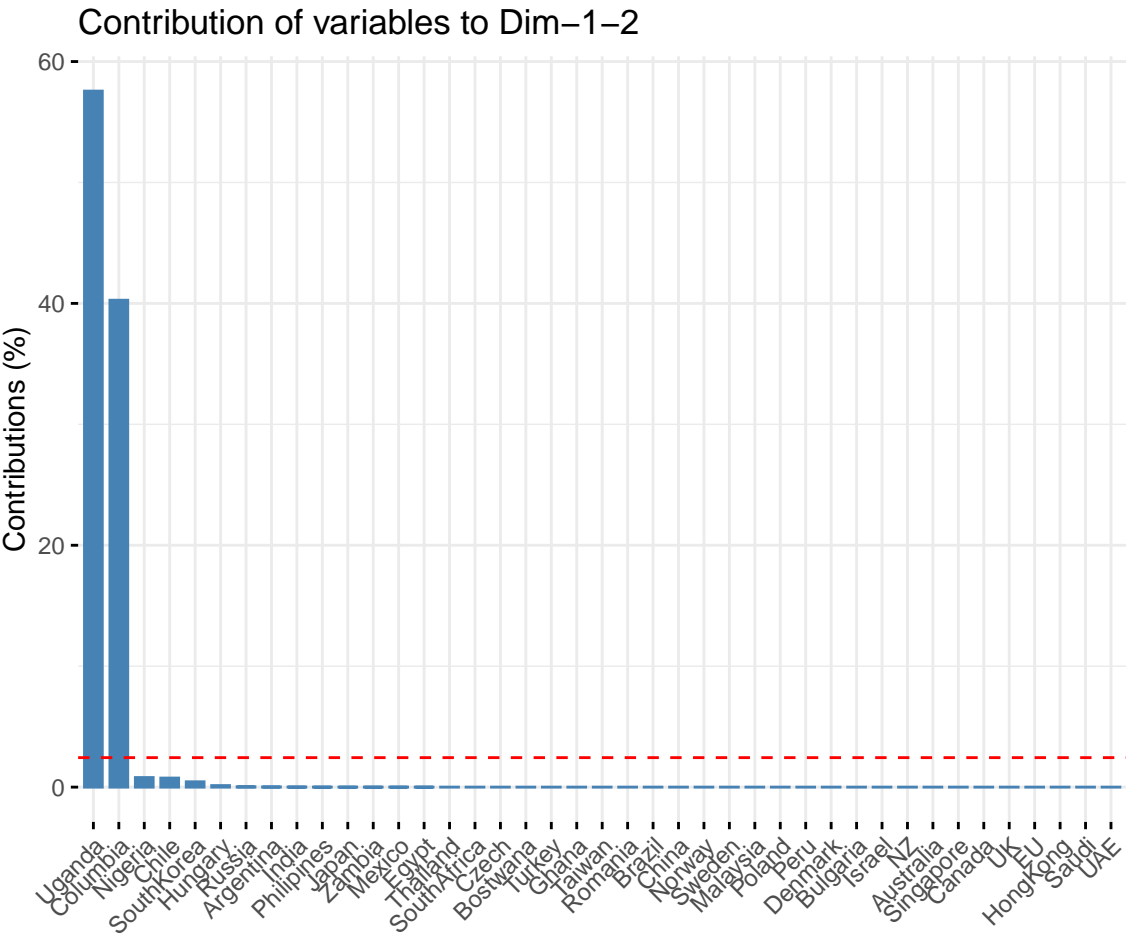
```
## Cumulative Proportion  1.000 1.0000 1.0000 1.0000 1.00 1.0000 1.0000 1.0000
##                        PC22  PC23  PC24  PC25  PC26  PC27  PC28  PC29
## Standard deviation    0.2006 0.1765 0.1438 0.139 0.1307 0.1274 0.09948 0.08704
## Proportion of Variance 0.0000 0.0000 0.0000 0.000 0.0000 0.0000 0.00000 0.00000
## Cumulative Proportion  1.0000 1.0000 1.0000 1.000 1.0000 1.0000 1.00000 1.00000
##                        PC30  PC31  PC32  PC33  PC34  PC35  PC36
## Standard deviation    0.08434 0.07457 0.06739 0.04896 0.03194 0.02065 0.01808
## Proportion of Variance 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
## Cumulative Proportion  1.00000 1.00000 1.00000 1.00000 1.00000 1.00000 1.00000
##                        PC37  PC38  PC39  PC40  PC41
## Standard deviation    0.01522 0.01237 0.002494 0.001809 0.0004737
## Proportion of Variance 0.00000 0.00000 0.000000 0.000000 0.0000000
## Cumulative Proportion  1.00000 1.00000 1.000000 1.000000 1.0000000
```

Q-Q plot of Mahalanobis D^2 vs. quantiles of χ^2_{nvar}









2. PCA Analysis

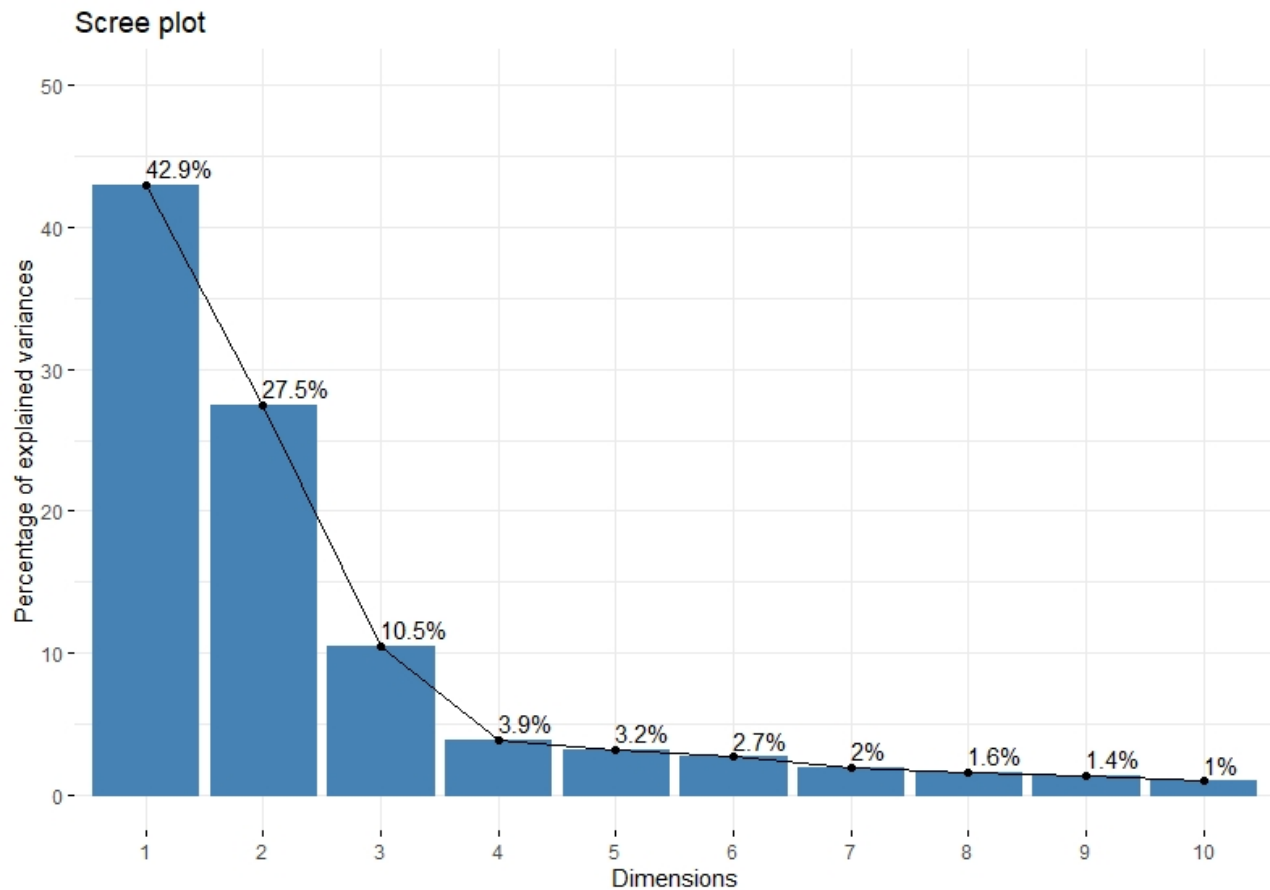


Figure 2.1: Scree plot

3. Identifying Common Drivers

The principal component is used to analyse the driving forces. By comparing the eigenvalues of the variance-covariance matrix in the previous section, I determined that the first three principal components explain the majority of the total variance of the currency rates. In this section, I examine the correlation between the first three principal component and the currency rates, as well as provide economic interpretations around the core driving factors that affect currency rates.

Table 5.2 in the appendix shows the correlation and p-value for the first principal component (PC1). The country that has the highest positive correlation with PC1 is Hungary (HUF), which is a net importer of crude petroleum. Saudi Arabia (SAR) and the United Arab Emirates (AED) are two of the top exporting countries. China (CNY) is the only country with a negative correlation with PC1, with its top import being refined petroleum. Therefore, one would expect that the oil price is one of

the core PCA drivers for currencies.

Oil is an extremely important, non-renewable resource. The demand and price for oil tend to drastically increase with world economic development [Li & Ma \(2015\)](#). Crude oil is quoted in the U.S dollar, therefore there is a direct relationship between the two. Theoretically, an appreciation in the US dollar should cause a decrease in the price of oil. However, empirical research has found contradicting results, indicating a bi-directional causality relationship between oil and exchange rates [Beckmann, Czudaj & Arora \(2020\)](#). Fluctuations in the oil prices are diverse and unique, depending on whether a country is a net importing or net exporting country. For oil-importing countries, [Castro & Jimenez-Rodriguez \(2020\)](#) found that an oil price shock leads to depreciation of the home currency in the short run, however, the long-run effects are diverse.

For oil-exporting countries, it has been empirically proven that instability in the oil price does not have a significant effect on economic growth. Table 5.2 supports the results of [Candila, Maximov, Mikhaylov, Moiseev, Senjyu & Tryndina \(2021\)](#) who found a much stronger correlation for oil-importing countries. China is a unique case as it is one of the largest importers and exporters of oil. [Li & Ma \(2015\)](#) found a non-linear causality between the oil price and the RMB exchange rate. This indicates that movement in the price of oil can cause co-movement of RMB with a one-month lag. Since the relationship between the oil price and exchange rates are diverse and unique, policymakers should react with caution when examining exchange rate pressure.

Table 5.3 in the appendix displays the correlation and the p-value for the second principal component (PC2). The countries that have the highest correlation with PC2 are, amongst others, Singapore (SGD), New Zealand (NZD), Australia (AUD) and Canada (CAD), all developing market economies. The countries with the lowest correlation with PC2 are Turkey (TRY), Egypt (EGP) and Mexico (MXN). This suggests that the PC2 is related to political stability. Countries with a high political stability and absence of violence/terrorism ranking are highly correlated with PC2, whereas countries with a low ranking are often negatively correlated with PC2.

A country with a high political stability ranking offers much more safe and attractive investment opportunity for foreign investors. This implies that political stability has a significant effect on currency rates. Political unrest, such as a serious allegation into government conduct can contribute to the destabilization of an economy, which will weaken currency rates. Changes in currency rates are known as *exchange rate risk* which accounts for uncertainty in movement in the exchange rate between the home and receiver country [Higgins, Hysenbegasi & Pozo \(2004\)](#).

Although the effect of political instability is profound, [Levis \(1979\)](#) found that the relationship between political instability in developed countries and foreign direct investment are highly significant in the short run, but not the long run. This would suggest that foreign investors adjust quickly to new developments and that political stability should be considered in conjunction with numerous other relevant factors.

The correlation and the p-value for the third principal component is represented in Table 5.4 in the appendix. The countries with the largest correlation all appear in Asia and the countries with the lowest correlation are all developed market. This implies that the third principal component is an Asia-specific factor. Over the past few areas, Asian countries have experienced phenomenal growth, which has created profitable opportunities for foreign investors.

4. Forecasting

Forecasting currency rates is important to many fields such as international business and monetary policy. However, it is challenging to obtain accurate forecasts due to the fluctuations caused by political instability, shocks to commodity prices and economic events. From an investing point of view, an accurate forecast reduces risk related to international investments as well as maximizes returns. Monetary policy also depends on an accurate forecast of currency rates, as changes in the interest rate can either appreciate or depreciate the home currency. Changes in currency rate affect trade, which affects economic growth. Therefore, an accurate currency forecast can assist authorities to implement effective policies that boost economic growth [Shen, Lee, Liu, Chang & Yang \(2021\)](#). In this section, I attempt to forecast the three most traded currencies: the Euro (EU), the Pound sterling (GBP) and the Japanese yen (JPY). Figure 4.1 displays the currency rate for the three currencies, all relative to USD.

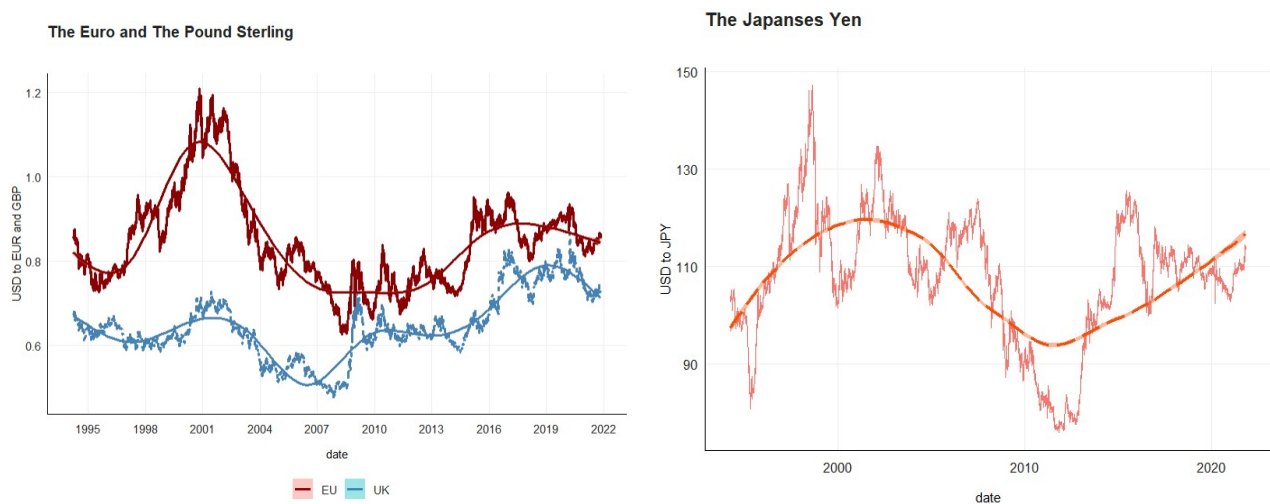


Figure 4.1: The three most traded currencies

I employ the 30 periods ahead Autoregressive Integrated Moving Average (ARIMA) model to forecast currency rates. [Akincilar, TEMIZ & Sahin \(2011\)](#) found that the ARIMA model performs relatively well when compared to other forecasting methods. Figure 4.2 and figure 4.3 show the forecasting results for the selected currencies with a 95 per cent upper and lower bound. The forecast results

indicate that the USD/GBP rate is forecasted to decrease, implying that the Pound sterling is going to strengthen. However, the actual data shows the opposite effect, the GBP currency rate weakened.

The forecast results indicate that the USD/EU rate is forecasted to increase slightly, implying that the euro is going to decrease. Actual data support this forecast. The forecast results indicate that the USD/JPY rate is forecasted to decrease slightly, implying that the Pound sterling is going to strengthen. Actual data shows that the currency rate remained relatively stable, making the forecast results mostly accurate. The results should be further investigated to conclude on the forecast accuracy, however, this was out of the scope of this paper.

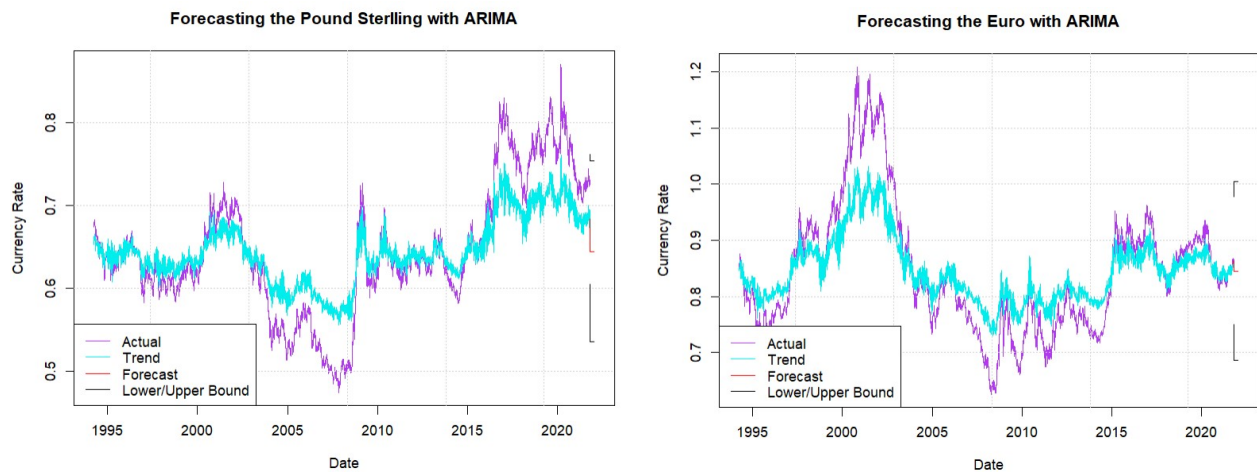


Figure 4.2: Forecasting Results (1)

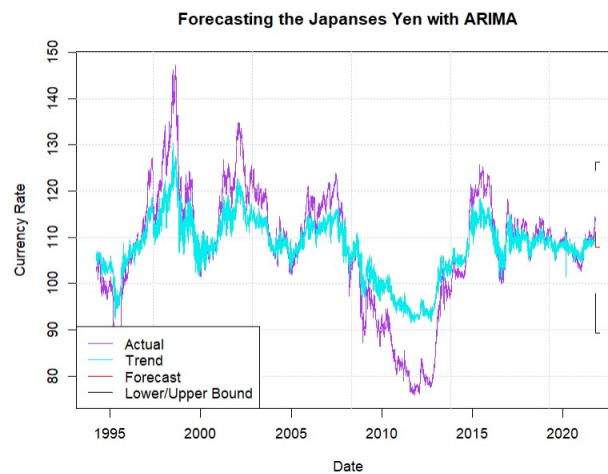


Figure 4.3: Forecasting Results (2)

5. Conclusion

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Appendix

Emerging Market		Developed Market	
Currency	ISO Code	Currency	ISO Code
Sol	PEN	Japanese Yen	JPY
Saudi riyal	SAR	Hong Kong dollar	HKD
New Taiwan dollar	TWD	Canadian dollar	CAD
Czech koruna	CZK	Danish krone	DKK
South Korean won	KRW	Euro	EUR
Renminbi	CNY	Australian dollar	AUD
Indian rupee	INR	New Zealand dollar	NZD
Brazilian real	BRL	Singapore dollar	SGD
Turkish lira	TRY	Swedish Krona	SEK
Russian ruble	RUB	Norwegian krone	NOK
South African rand	ZAR	Israeli Shekel	ILS
Mexican peso	MXN	Pound sterling	GBP
Columbian peso	COP		
Egyptian pound	EGP		
Chilean peso	CLP		
Hungarian forint	HUF		
Malaysian ringgit	MYR		
Phillipine peso	PHP		
Thai bath	THB		
United Arab Emirates dirham	AED		
Polish zloty	PLN		

Table 5.1: Description of currencies

	Correlation	P-value
HUF	0.9262878	0.000000e+00
MYR	0.9114497	0.000000e+00
CLP	0.9065261	0.000000e+00
PEN	0.8988561	0.000000e+00
PLN	0.8780890	0.000000e+00
COP	0.8751020	0.000000e+00
NOK	0.8378328	0.000000e+00
SEK	0.8330755	0.000000e+00
BRL	0.8263736	0.000000e+00
RUB	0.7871421	0.000000e+00
ZAR	0.7857282	0.000000e+00
INR	0.7411845	0.000000e+00
PHP	0.7307233	0.000000e+00
MXN	0.6843628	0.000000e+00
TRY	0.6753067	0.000000e+00
EUR	0.6577914	0.000000e+00
DKK	0.6479256	0.000000e+00
KRW	0.6422958	0.000000e+00
GBP	0.6259090	0.000000e+00
EGP	0.6216001	0.000000e+00
AUD	0.5593268	0.000000e+00
THB	0.5319724	0.000000e+00
HKD	0.5177139	0.000000e+00
TWD	0.4758927	0.000000e+00
CAD	0.4283742	3.557371e-319
JPY	0.4241386	2.822415e-319
NZD	0.3989511	3.069525e-273
ILS	0.3742421	4.183071e-238
SGD	0.2588114	1.665786e-110
CZK	0.2551624	2.320584e-107
AED	0.2038677	2.137731e-68
SAR	0.1573449	3.994842e-41
CNY	-0.1710389	2.206939e-48

Table 5.2: Correlation and P-value for the first principal component

	Correlation	P-value
SGD	0.90321526	0.000000e+00
CZK	0.87653914	0.000000e+00
CNY	0.86382354	0.000000e+00
NZD	0.83337067	0.000000e+00
AUD	0.75831445	0.000000e+00
CAD	0.71356174	0.000000e+00
DKK	0.63254705	0.000000e+00
EUR	0.62951387	0.000000e+00
THB	0.59809540	0.000000e+00
JPY	0.53230115	0.000000e+00
ILS	0.48051271	0.000000e+00
TWD	0.42403389	4.168569e-312
SEK	0.35444999	4.308577e-212
PLN	0.26203282	2.533385e-113
NOK	0.19878697	4.705671e-65
KRW	0.14350307	1.991097e-34
PEN	0.11407789	2.773568e-22
AED	-0.03178834	6.993189e-03
MYR	-0.03679994	1.792246e-03
HKD	-0.04911994	3.056982e-05
PHP	-0.11881763	4.754379e-24
HUF	-0.13573551	6.020449e-31
CLP	-0.21440682	1.272391e-75
GBP	-0.27266672	6.567991e-123
COP	-0.36995837	2.561588e-232
BRL	-0.43981305	0.000000e+00
ZAR	-0.55307034	0.000000e+00
RUB	-0.58376817	0.000000e+00
INR	-0.62851292	0.000000e+00
TRY	-0.64001397	0.000000e+00
EGP	-0.64775485	0.000000e+00
MXN	-0.69994979	0.000000e+00

Table 5.3: Correlation and P-value for the second principal component

	Correlation	P-value
ILS	0.69659804	0.000000e+00
TWD	0.68427216	0.000000e+00
PHP	0.61977923	0.000000e+00
THB	0.53049506	0.000000e+00
HKD	0.30858474	1.310000e-158
KRW	0.28839441	6.692788e-138
PEN	0.28634486	6.840019e-136
SGD	0.22758825	3.214148e-85
MYR	0.22365740	2.722457e-82
COP	0.17404390	4.636722e-50
AED	0.09417778	1.179695e-15
CLP	0.08433068	7.709335e-13
RUB	-0.02629516	2.568733e-02
PLN	-0.04475238	1.458206e-04
HUF	-0.07070644	1.909999e-09
CNY	-0.08335190	1.413117e-12
INF	-0.09077720	1.198224e-14
ZAR	-0.10617861	1.681325e-19
NZD	-0.14852069	8.807498e-37
TRY	-0.15874418	7.742415e-42
EGP	-0.18399169	7.806200e-56
AUD	-0.20033914	4.582160e-66
SAR	-0.25871186	2.032612e-110
EUR	-0.29838703	6.100743e-148
DKK	-0.31163124	7.020576e-162
SEK	-0.32101610	3.342782e-172
CZK	-0.34533690	1.002528e-200
CAD	-0.44548362	0.000000e+00
NOK	-0.47271370	0.000000e+00
GBP	-0.61500908	0.000000e+00

Table 5.4: Correlation and P-value for the third principal component