

# Réplica y actualización del paper de Rodrik (2008), cómo usar la PWT con R

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En el documento de 2008 de Dani Rodrik ( *The Real Exchange Rate and Economic Growth* ), se vislumbra un análisis sobre los mecanismos que entran en juego para que una depreciación en el Tipo de Cambio Real ( *TCR*, en adelante) pueda mostrar un efecto positivo en el producto. La primera parte de la propuesta de Rodrik tiene un carácter puramente empírico.

Al utilizar los datos de Penn World Table 6.2, Rodrik encuentra una correlación estadísticamente significativa entre los países en desarrollo que muestran una constante subvaluación del TCR y un crecimiento en el producto. A lo largo de las siguientes secciones se realiza una revisión de los conceptos económicos y de la manipulación de los datos que permiten la réplica de dicho documento, así como un modesto intento por actualizar el documento con los datos más recientes de la *PWT* .

## Obtención de los datos

Una de las facilidades que brinda *R* como ambiente de trabajo para la manipulación de datos, es que su gran comunidad genera constantes desarrollos que benefician a una buena cantidad de personas. Tal es el caso de la librería “*pwt9*”, la cual permite una descarga automática al ambiente de trabajo de las versiones 5.6 hasta la 7.1, y en sus constantes actualizaciones permite contar con todas las últimas versiones de esta valiosa base de datos.

Las siguientes líneas de código presentan la manera de obtener los datos

## Efecto Balassa-Samuelson

Para Dani Rodrik el *TCR* está definido como el ratio entre los precios de los bienes comerciables con el extranjero con respecto a los precios domésticos (no comerciables), es decir:

$$P^T/P^{NT}$$

Esto se liga al razonamiento teórico que el autor propone sobre estos efectos, dado que su hipótesis es que este crecimiento a razón de la devaluación del *TCR*, está motivado por una expansión del sector comerciable dada la ventaja provocada mediante los precios relativos. En este sentido, las desviaciones del *TCR* que tienen injerencia sobre el crecimiento traen a colación el conocido *Efecto Balassa Samuelson*, que no es más que una correlación positiva entre el nivel de precios domésticos y el nivel de renta per cápita, lo que sugiere que una economía más desarrollada muestra factores estructurales que elevan el TCR. De esta manera, acorde a los datos, el logaritmo del TCR se obtiene del siguiente modo:

$$\ln RER_{i,t} = \ln(XRAT_{i,t}/PPP_{i,t})$$

Donde  $i$  es el índice del país en cuestión y  $t$  señala un quinquenio (esto es importante, en el documento los datos se trabajan como un panel quinquenal). Para ajustar por el efecto Balassa Samuelson, la siguiente

especificación permite realizar una aproximación a la magnitud del efecto, es decir, en que magnitud el nivel de precios de equilibrio está influenciado por el producto:

$$\ln RER_{i,t} = \alpha + \beta \ln RGDPCH_{i,t} + f_t + u_{i,t}$$

En la siguientes subsecciones el objetivo es realizar estas estimaciones con los datos utilizados por el autor y contrastar con los datos más recientes disponibles.

## PWT 6.2

La siguiente parte del código muestra las manipulaciones necesarias para realizar las especificaciones econométricas en la *PWT6.2*.

```
#La siguiente parte del código utiliza la libreria dplyr, hay abundantes recursos en la red acerca del '
pwt6.2 <- pwt6.2 %>%
  mutate( lnRER = log(p^-1), #Como el autor lo señala, 'p' es es una manera más completa de calcular ln
          lnRGDPCH = log(rgdpch))

pwt6.2$initial_Y = lag(pwt6.2$lnRGDPCH,5)
#Calcula la tasa de crecimiento promedio por quinquenio

pwt6.2 = pwt6.2 %>%
  group_by(country)%>%
  mutate(Delta_GDP = c(NA,NA,NA,NA,diff(lnRGDPCH,lag = 4)/4))

#Filtra unicamente los años pertenecientes a los años que terminan en 0 y 5, tal y como Rodrik delimita
pwt62q = pwt6.2 %>%
  filter(str_sub(year,4) %in% c("4", "9"))
#Realiza la regresión
reg1 <- lm(lnRER ~ lnRGDPCH + factor(year), data = pwt62q)
```

## PWT 9.1

```
pwt91 <- pwt9.1 %>%
  filter(str_sub(year,4) %in% c("4", "9"))%>%
  mutate(rgdpch = rgdpna/pop,
         lnRGDPCH = log(rgdpch),
         lnRER = log((p1_gdpo^-1)))
reg2 <- lm(lnRER ~ lnRGDPCH + factor(year), data = pwt91)
#summary(reg2)

stargazer('PWT 6.1' = reg1, "PWT 9.1" = reg2, title="PWT6.2", type="html", header = FALSE,
          digits = 2)
```

PWT6.2

Dependent variable:

lnRER

(1)

(2)

lnRGDPCH

-0.24\*\*\*

-0.20\*\*\*  
 (0.01)  
 (0.01)  
 factor(year)1959  
 0.17\*\*  
 0.03  
 (0.08)  
 (0.07)  
 factor(year)1964  
 0.16\*\*  
 -0.06  
 (0.08)  
 (0.07)  
 factor(year)1969  
 0.24\*\*\*  
 -0.11  
 (0.08)  
 (0.07)  
 factor(year)1974  
 0.05  
 -0.50\*\*\*  
 (0.07)  
 (0.06)  
 factor(year)1979  
 0.01  
 -0.90\*\*\*  
 (0.07)  
 (0.06)  
 factor(year)1984  
 0.28\*\*\*  
 -0.99\*\*\*  
 (0.07)  
 (0.06)  
 factor(year)1989  
 0.28\*\*\*  
 -1.16\*\*\*

```

(0.07)
(0.06)
factor(year)1994
0.48***
-1.16***
(0.07)
(0.06)
factor(year)1999
0.51***
-1.14***
(0.07)
(0.06)
factor(year)2004
0.35***
-1.27***
(0.08)
(0.06)
factor(year)2009
-1.45***
(0.06)
factor(year)2014
-1.54***
(0.06)
Constant
-2.20***
3.93***
(0.11)
(0.09)
Observations
1,402
1,898
R2
0.29
0.67
Adjusted R2
0.29

```

0.67

Residual Std. Error

0.48 (df = 1390)

0.44 (df = 1884)

F Statistic

51.89\*\*\* (df = 11; 1390)

290.93\*\*\* (df = 13; 1884)

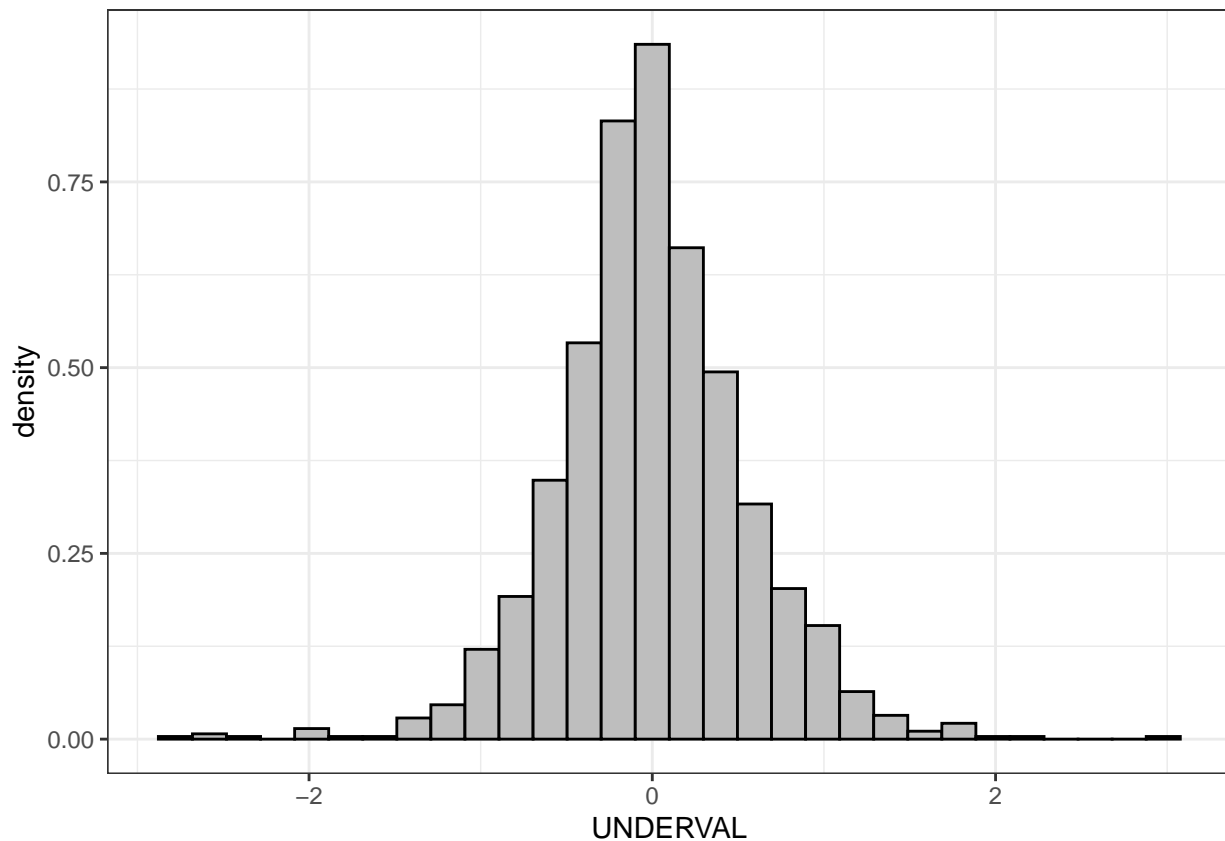
Note:

$p < 0.1$ ;  $p < 0.05$ ;  $p < 0.01$

## UNDERVAL

You can also embed plots, for example:

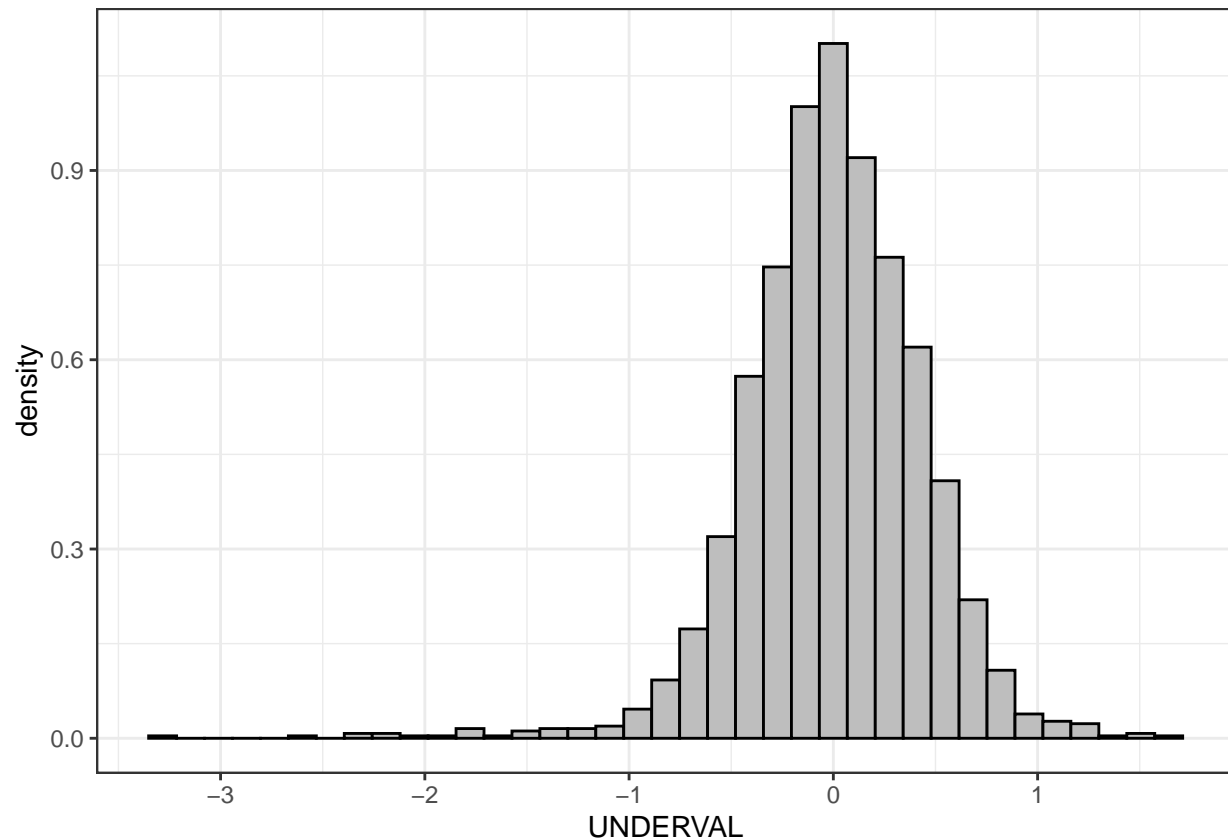
```
pwt62q$lnRERhat[!is.na(pwt62q$lnRER)] = reg1$fitted.values
pwt62q = pwt62q %>%
  mutate(UNDERVAL = lnRER - lnRERhat)
ggplot(pwt62q) +
  geom_histogram(aes(x=UNDERVAL, y=..density..),
    fill="gray", colour="black") +
  theme_bw()
```



```

pwt91$lnRERhat[!is.na(pwt91$lnRER)] = reg2$fitted.values
pwt91 = pwt91 %>%
  mutate(UNDERVAL = lnRER -lnRERhat)
ggplot(pwt91)+
  geom_histogram(aes(x=UNDERVAL, y=..density..),
                 fill="gray", colour="black", bins = 37)+
  theme_bw()

```



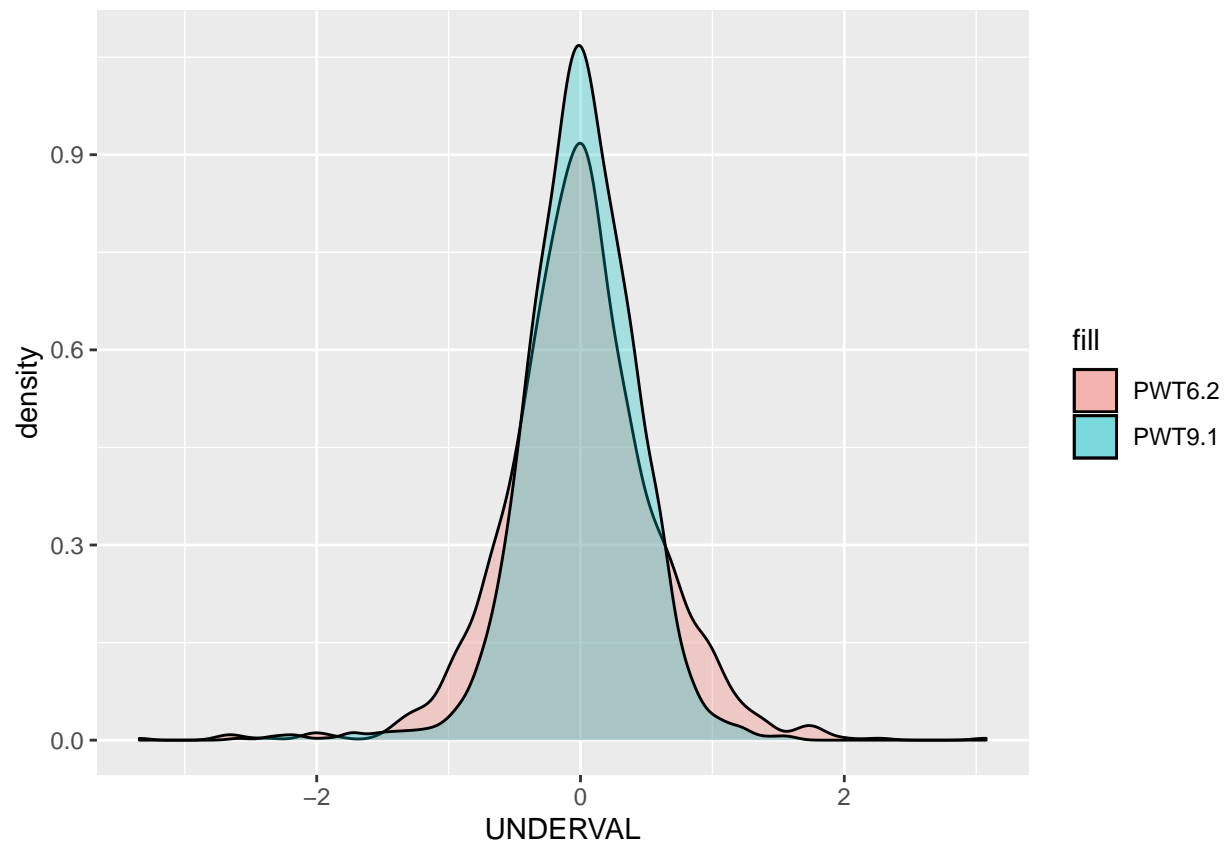
```

ggplot()+
  geom_density(data=pwt62q, aes(x=UNDERVAL, fill="PWT6.2"), alpha=0.3)+
  geom_density(data=pwt91, aes(x=UNDERVAL, fill="PWT9.1"), alpha=0.3)

```

```
## Warning: Removed 651 rows containing non-finite values (stat_density).
```

```
## Warning: Removed 468 rows containing non-finite values (stat_density).
```



## Crecimiento y subvaluación

```
pwt62q = pwt62q %>%
  filter(!(country %in% c('Iraq', 'Laos', 'Korea, Republic of')))
```

```
reg3 = lm(Delta_GDP~initial_Y+UNDERVAL+factor(country)+factor(year), data=pwt62q)
summary(reg3)
```

```
##
## Call:
## lm(formula = Delta_GDP ~ initial_Y + UNDERVAL + factor(country) +
##     factor(year), data = pwt62q)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.24774 -0.01417  0.00000  0.01395  0.34345
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    0.226493   0.031483   7.194 1.21e-12
## initial_Y     -0.030890   0.003467  -8.908 < 2e-16
## UNDERVAL       0.004342   0.003067   1.416 0.157187
## factor(country)Albania  0.074538   0.028820   2.586 0.009837
## factor(country)Algeria  0.069420   0.020022   3.467 0.000547
```

## factor(country)Antigua	0.123497	0.021985	5.617	2.49e-08
## factor(country)Argentina	0.091523	0.019387	4.721	2.67e-06
## factor(country)Australia	0.121383	0.020125	6.032	2.26e-09
## factor(country)Austria	0.123931	0.019682	6.297	4.49e-10
## factor(country)Azerbaijan	0.115476	0.038135	3.028	0.002522
## factor(country)Bahamas	0.120092	0.021885	5.487	5.13e-08
## factor(country)Bahrain	0.100140	0.022844	4.384	1.29e-05
## factor(country)Bangladesh	0.036781	0.021306	1.726	0.084590
## factor(country)Barbados	0.105479	0.020366	5.179	2.68e-07
## factor(country)Belgium	0.119637	0.019934	6.002	2.70e-09
## factor(country)Belize	0.078581	0.020663	3.803	0.000151
## factor(country)Benin	0.018586	0.019130	0.972	0.331509
## factor(country)Bermuda	0.134299	0.023576	5.696	1.60e-08
## factor(country)Bhutan	0.032066	0.021970	1.460	0.144730
## factor(country)Bolivia	0.043123	0.018759	2.299	0.021712
## factor(country)Bosnia and Herzegovina	0.155683	0.038183	4.077	4.91e-05
## factor(country)Botswana	0.099337	0.020562	4.831	1.56e-06
## factor(country)Brazil	0.087526	0.018826	4.649	3.77e-06
## factor(country)Brunei	0.112410	0.023795	4.724	2.63e-06
## factor(country)Bulgaria	0.066342	0.029134	2.277	0.022982
## factor(country)Burkina Faso	0.010615	0.018752	0.566	0.571479
## factor(country)Burundi	-0.001181	0.019746	-0.060	0.952302
## factor(country)Cambodia	-0.020955	0.021771	-0.962	0.336027
## factor(country)Cameroon	0.039545	0.019709	2.006	0.045077
## factor(country)Canada	0.121703	0.020151	6.040	2.15e-09
## factor(country)Cape Verde	0.072508	0.019664	3.687	0.000238
## factor(country)Central African Republic	0.011184	0.021483	0.521	0.602749
## factor(country)Chad	-0.012434	0.019735	-0.630	0.528797
## factor(country)Chile	0.091988	0.018968	4.850	1.43e-06
## factor(country)China	0.059947	0.018413	3.256	0.001168
## factor(country)Colombia	0.072177	0.018620	3.876	0.000113
## factor(country)Comoros	0.025353	0.019613	1.293	0.196422
## factor(country)Congo, Democratic Republic	-0.037345	0.020686	-1.805	0.071309
## factor(country)Congo, Republic of	0.027523	0.019767	1.392	0.164104
## factor(country)Costa Rica	0.080001	0.018884	4.236	2.47e-05
## factor(country)Cote d'Ivoire	0.047415	0.019683	2.409	0.016173
## factor(country)Croatia	0.099458	0.029217	3.404	0.000689
## factor(country)Cuba	0.080404	0.021632	3.717	0.000212
## factor(country)Cyprus	0.137866	0.021337	6.461	1.60e-10
## factor(country)Czech Republic	0.098916	0.029514	3.352	0.000833
## factor(country)Denmark	0.120981	0.019865	6.090	1.59e-09
## factor(country)Djibouti	0.050683	0.022923	2.211	0.027255
## factor(country)Dominica	0.099404	0.021652	4.591	4.95e-06
## factor(country)Dominican Republic	0.082445	0.018855	4.373	1.35e-05
## factor(country)Ecuador	0.063038	0.018484	3.410	0.000674
## factor(country)Egypt	0.061607	0.018319	3.363	0.000799
## factor(country)El Salvador	0.062502	0.018923	3.303	0.000989
## factor(country)Equatorial Guinea	0.067165	0.019668	3.415	0.000663
## factor(country)Eritrea	-0.019954	0.029113	-0.685	0.493253
## factor(country)Estonia	0.116811	0.029279	3.990	7.09e-05
## factor(country)Ethiopia	0.013237	0.018531	0.714	0.475216
## factor(country)Fiji	0.053917	0.021623	2.493	0.012807
## factor(country)Finland	0.115957	0.019847	5.843	6.88e-09
## factor(country)France	0.122579	0.019710	6.219	7.26e-10



## factor(country)Gabon	0.079948	0.020455	3.909	9.89e-05
## factor(country)Gambia, The	0.008594	0.019804	0.434	0.664415
## factor(country)Georgia	0.124268	0.028881	4.303	1.85e-05
## factor(country)Germany	0.121189	0.022050	5.496	4.89e-08
## factor(country)Ghana	0.067328	0.019226	3.502	0.000482
## factor(country)Greece	0.110783	0.019259	5.752	1.16e-08
## factor(country)Grenada	0.071168	0.021563	3.300	0.000998
## factor(country)Guatemala	0.060587	0.018840	3.216	0.001341
## factor(country)Guinea	0.034815	0.018661	1.866	0.062370
## factor(country)Guinea-Bissau	0.001558	0.020055	0.078	0.938092
## factor(country)Haiti	0.021317	0.021331	0.999	0.317850
## factor(country)Honduras	0.040714	0.018261	2.230	0.025991
## factor(country)Hong Kong	0.132752	0.020403	6.506	1.20e-10
## factor(country)Hungary	0.100426	0.021165	4.745	2.38e-06
## factor(country>Iceland	0.122538	0.019809	6.186	8.89e-10
## factor(country)India	0.050826	0.018248	2.785	0.005446
## factor(country)Indonesia	0.066168	0.019045	3.474	0.000534
## factor(country)Iran	0.073726	0.019556	3.770	0.000173
## factor(country)Ireland	0.118120	0.019426	6.080	1.69e-09
## factor(country)Israel	0.114734	0.019476	5.891	5.19e-09
## factor(country)Italy	0.121520	0.019503	6.231	6.75e-10
## factor(country)Jamaica	0.067828	0.018978	3.574	0.000368
## factor(country)Japan	0.129386	0.019675	6.576	7.65e-11
## factor(country)Jordan	0.073805	0.019029	3.879	0.000112
## factor(country)Kazakhstan	0.047039	0.038432	1.224	0.221242
## factor(country)Kenya	0.024232	0.018631	1.301	0.193680
## factor(country)Kiribati	0.013287	0.021436	0.620	0.535483
## factor(country)Korea, Dem. Rep.	0.050616	0.021403	2.365	0.018220
## factor(country)Kuwait	0.130435	0.023702	5.503	4.71e-08
## factor(country)Kyrgyzstan	0.093162	0.038166	2.441	0.014814
## factor(country)Latvia	0.105746	0.038371	2.756	0.005956
## factor(country)Lebanon	0.113988	0.038304	2.976	0.002989
## factor(country)Lesotho	0.039804	0.019673	2.023	0.043298
## factor(country)Liberia	-0.027736	0.021362	-1.298	0.194432
## factor(country)Lithuania	0.116628	0.029241	3.988	7.12e-05
## factor(country)Luxembourg	0.134006	0.020090	6.670	4.15e-11
## factor(country)Macao	0.146769	0.021870	6.711	3.19e-11
## factor(country>Macedonia	0.070959	0.038252	1.855	0.063878
## factor(country)Madagascar	-0.002218	0.019123	-0.116	0.907703
## factor(country)Malawi	0.009530	0.018424	0.517	0.605079
## factor(country)Malaysia	0.102675	0.019416	5.288	1.51e-07
## factor(country)Maldives	0.084974	0.020393	4.167	3.35e-05
## factor(country>Mali	0.018945	0.019135	0.990	0.322376
## factor(country>Malta	0.131038	0.021323	6.146	1.14e-09
## factor(country>Mauritania	0.024857	0.021320	1.166	0.243933
## factor(country>Mauritius	0.097332	0.019091	5.098	4.07e-07
## factor(country>Mexico	0.085420	0.018630	4.585	5.09e-06
## factor(country>Micronesia, Fed. Sts.	0.057552	0.021550	2.671	0.007691
## factor(country>Moldova	0.032204	0.028794	1.118	0.263643
## factor(country>Mongolia	0.034063	0.021606	1.577	0.115199
## factor(country>Morocco	0.071484	0.018744	3.814	0.000145
## factor(country>Mozambique	0.027717	0.019666	1.409	0.159018
## factor(country>Namibia	0.069452	0.021717	3.198	0.001426
## factor(country>Nepal	0.022564	0.019702	1.145	0.252365

## factor(country)Netherlands	0.117690	0.020092	5.858	6.31e-09
## factor(country)Netherlands Antilles	0.100906	0.022587	4.468	8.79e-06
## factor(country)New Zealand	0.113329	0.020027	5.659	1.97e-08
## factor(country)Nicaragua	0.057086	0.018499	3.086	0.002084
## factor(country)Niger	-0.009754	0.019095	-0.511	0.609610
## factor(country)Nigeria	0.017930	0.018028	0.995	0.320184
## factor(country)Norway	0.117910	0.019534	6.036	2.20e-09
## factor(country)Oman	0.111910	0.022444	4.986	7.22e-07
## factor(country)Pakistan	0.043244	0.018191	2.377	0.017627
## factor(country)Palau	0.090836	0.025527	3.558	0.000390
## factor(country)Panama	0.077319	0.019060	4.057	5.35e-05
## factor(country)Papua New Guinea	0.086348	0.021486	4.019	6.28e-05
## factor(country)Paraguay	0.064750	0.018914	3.423	0.000643
## factor(country)Peru	0.056234	0.018966	2.965	0.003097
## factor(country)Philippines	0.056868	0.018344	3.100	0.001987
## factor(country)Poland	0.085503	0.020825	4.106	4.35e-05
## factor(country)Portugal	0.110473	0.018856	5.859	6.27e-09
## factor(country)Puerto Rico	0.123549	0.022430	5.508	4.58e-08
## factor(country)Qatar	0.106471	0.024116	4.415	1.12e-05
## factor(country)Romania	0.086643	0.019357	4.476	8.45e-06
## factor(country)Russia	0.067623	0.038510	1.756	0.079389
## factor(country)Rwanda	0.002598	0.019656	0.132	0.894863
## factor(country)Samoa	0.042941	0.021495	1.998	0.046008
## factor(country)Sao Tome and Principe	0.018786	0.020316	0.925	0.355329
## factor(country)Saudi Arabia	0.074833	0.023180	3.228	0.001285
## factor(country)Senegal	0.017261	0.019667	0.878	0.380339
## factor(country)Serbia and Montenegro	0.003988	0.038460	0.104	0.917432
## factor(country)Sierra Leone	-0.025550	0.021322	-1.198	0.231080
## factor(country)Singapore	0.136495	0.020418	6.685	3.78e-11
## factor(country)Slovak Republic	0.084780	0.025604	3.311	0.000961
## factor(country)Slovenia	0.123316	0.029704	4.151	3.58e-05
## factor(country)Solomon Islands	0.049009	0.021349	2.296	0.021896
## factor(country)Somalia	-0.012133	0.020382	-0.595	0.551779
## factor(country)South Africa	0.073596	0.018463	3.986	7.19e-05
## factor(country)Spain	0.117556	0.019141	6.142	1.16e-09
## factor(country)Sri Lanka	0.055476	0.018261	3.038	0.002441
## factor(country)St. Kitts & Nevis	0.120832	0.021873	5.524	4.19e-08
## factor(country)St. Lucia	0.093202	0.021680	4.299	1.88e-05
## factor(country)St. Vincent & Grenadines	0.098728	0.021530	4.586	5.08e-06
## factor(country)Sudan	0.006582	0.021423	0.307	0.758716
## factor(country)Suriname	0.081400	0.021576	3.773	0.000171
## factor(country)Swaziland	0.086198	0.021016	4.102	4.43e-05
## factor(country)Sweden	0.116333	0.019799	5.876	5.68e-09
## factor(country)Switzerland	0.124654	0.020338	6.129	1.26e-09
## factor(country)Syria	0.044851	0.020008	2.242	0.025197
## factor(country)Taiwan	0.119738	0.018840	6.355	3.11e-10
## factor(country)Tajikistan	0.009341	0.038165	0.245	0.806692
## factor(country)Tanzania	0.006942	0.020028	0.347	0.728938
## factor(country)Thailand	0.078828	0.018702	4.215	2.72e-05
## factor(country)Togo	0.008205	0.019038	0.431	0.666593
## factor(country)Tonga	0.075125	0.021368	3.516	0.000458
## factor(country)Trinidad & Tobago	0.102066	0.019672	5.188	2.55e-07
## factor(country)Tunisia	0.082000	0.019309	4.247	2.36e-05
## factor(country)Turkey	0.077568	0.018407	4.214	2.73e-05

## factor(country)Turkmenistan	0.073821	0.038595	1.913	0.056060
## factor(country)Uganda	0.014973	0.018619	0.804	0.421473
## factor(country)Ukraine	0.023172	0.038453	0.603	0.546909
## factor(country)United Arab Emirates	0.088768	0.023624	3.758	0.000181
## factor(country)United Kingdom	0.118267	0.019985	5.918	4.43e-09
## factor(country)United States of America	0.128379	0.020232	6.345	3.32e-10
## factor(country)Uruguay	0.086791	0.018943	4.582	5.18e-06
## factor(country)Uzbekistan	0.065652	0.038154	1.721	0.085603
## factor(country)Vanuatu	0.066687	0.021492	3.103	0.001969
## factor(country)Venezuela	0.080481	0.019286	4.173	3.26e-05
## factor(country)Vietnam	0.060653	0.028801	2.106	0.035455
## factor(country)Yemen	0.023099	0.029006	0.796	0.426021
## factor(country)Zambia	0.006908	0.019149	0.361	0.718364
## factor(country)Zimbabwe	0.051875	0.018765	2.765	0.005802
## factor(year)1959	-0.043508	0.009267	-4.695	3.03e-06
## factor(year)1964	-0.025041	0.009030	-2.773	0.005652
## factor(year)1969	-0.023443	0.008554	-2.741	0.006235
## factor(year)1974	-0.018976	0.008430	-2.251	0.024592
## factor(year)1979	-0.015943	0.008106	-1.967	0.049486
## factor(year)1984	-0.034466	0.007994	-4.311	1.78e-05
## factor(year)1989	-0.024983	0.007986	-3.128	0.001808
## factor(year)1994	-0.034254	0.007952	-4.307	1.81e-05
## factor(year)1999	-0.014942	0.007925	-1.885	0.059643
## factor(year)2004	-0.014166	0.008411	-1.684	0.092466
##				
## (Intercept)	***			
## initial_Y	***			
## UNDERVAL				
## factor(country)Albania	**			
## factor(country)Algeria	***			
## factor(country)Antigua	***			
## factor(country)Argentina	***			
## factor(country)Australia	***			
## factor(country)Austria	***			
## factor(country)Azerbaijan	**			
## factor(country)Bahamas	***			
## factor(country)Bahrain	***			
## factor(country)Bangladesh	.			
## factor(country)Barbados	***			
## factor(country)Belgium	***			
## factor(country)Belize	***			
## factor(country)Benin				
## factor(country)Bermuda	***			
## factor(country)Bhutan				
## factor(country)Bolivia	*			
## factor(country)Bosnia and Herzegovina	***			
## factor(country)Botswana	***			
## factor(country)Brazil	***			
## factor(country)Brunei	***			
## factor(country)Bulgaria	*			
## factor(country)Burkina Faso				
## factor(country)Burundi				
## factor(country)Cambodia				
## factor(country)Cameroon	*			

```

## factor(country)Canada          ***
## factor(country)Cape Verde      ***
## factor(country)Central African Republic
## factor(country)Chad
## factor(country)Chile           ***
## factor(country)China           **
## factor(country)Colombia        ***
## factor(country)Comoros
## factor(country)Congo, Democratic Republic .
## factor(country)Congo, Republic of
## factor(country)Costa Rica      ***
## factor(country)Cote d'Ivoire   *
## factor(country)Croatia         ***
## factor(country)Cuba            ***
## factor(country)Cyprus           ***
## factor(country)Czech Republic  ***
## factor(country)Denmark         ***
## factor(country)Djibouti        *
## factor(country)Dominica        ***
## factor(country)Dominican Republic ***
## factor(country)Ecuador         ***
## factor(country)Egypt           ***
## factor(country)El Salvador     ***
## factor(country)Equatorial Guinea ***
## factor(country)Eritrea
## factor(country)Estonia         ***
## factor(country)Ethiopia
## factor(country)Fiji            *
## factor(country)Finland         ***
## factor(country)France          ***
## factor(country)Gabon           ***
## factor(country)Gambia, The
## factor(country)Georgia         ***
## factor(country)Germany         ***
## factor(country)Ghana           ***
## factor(country)Greece          ***
## factor(country)Grenada         ***
## factor(country)Guatemala       **
## factor(country)Guinea          .
## factor(country)Guinea-Bissau
## factor(country)Haiti
## factor(country)Honduras        *
## factor(country)Hong Kong       ***
## factor(country)Hungary         ***
## factor(country)Iceland         ***
## factor(country)India           **
## factor(country)Indonesia       ***
## factor(country)Iran            ***
## factor(country)Ireland         ***
## factor(country)Israel          ***
## factor(country)Italy           ***
## factor(country)Jamaica         ***
## factor(country)Japan           ***
## factor(country)Jordan          ***

```

```

## factor(country)Kazakhstan
## factor(country)Kenya
## factor(country)Kiribati
## factor(country)Korea, Dem. Rep.      *
## factor(country)Kuwait                ***
## factor(country)Kyrgyzstan            *
## factor(country)Latvia                 **
## factor(country)Lebanon                **
## factor(country)Lesotho                *
## factor(country)Liberia
## factor(country)Lithuania              ***
## factor(country)Luxembourg             ***
## factor(country)Macao                  ***
## factor(country)Macedonia              .
## factor(country)Madagascar
## factor(country)Malawi
## factor(country)Malaysia               ***
## factor(country)Maldives               ***
## factor(country)Mali
## factor(country)Malta                  ***
## factor(country)Mauritania
## factor(country)Mauritius              ***
## factor(country)Mexico                 ***
## factor(country)Micronesia, Fed. Sts.  **
## factor(country)Moldova
## factor(country)Mongolia
## factor(country)Morocco                ***
## factor(country)Mozambique
## factor(country)Namibia                **
## factor(country)Nepal
## factor(country)Netherlands            ***
## factor(country)Netherlands Antilles   ***
## factor(country)New Zealand            ***
## factor(country)Nicaragua              **
## factor(country)Niger
## factor(country)Nigeria
## factor(country)Norway                 ***
## factor(country)Oman                   ***
## factor(country)Pakistan               *
## factor(country)Palau                  ***
## factor(country)Panama                 ***
## factor(country)Papua New Guinea        ***
## factor(country)Paraguay                ***
## factor(country)Peru                   **
## factor(country)Philippines            **
## factor(country)Poland                 ***
## factor(country)Portugal               ***
## factor(country)Puerto Rico           ***
## factor(country)Qatar                  ***
## factor(country)Romania                ***
## factor(country)Russia                 .
## factor(country)Rwanda
## factor(country)Samoa                  *
## factor(country)Sao Tome and Principe

```

```

## factor(country)Saudi Arabia      **
## factor(country)Senegal
## factor(country)Serbia and Montenegro
## factor(country)Sierra Leone
## factor(country)Singapore        ***
## factor(country)Slovak Republic   ***
## factor(country)Slovenia          ***
## factor(country)Solomon Islands   *
## factor(country)Somalia
## factor(country)South Africa      ***
## factor(country)Spain             ***
## factor(country)Sri Lanka         **
## factor(country)St. Kitts & Nevis ***
## factor(country)St. Lucia         ***
## factor(country)St. Vincent & Grenadines ***
## factor(country)Sudan
## factor(country)Suriname          ***
## factor(country)Swaziland         ***
## factor(country)Sweden            ***
## factor(country)Switzerland       ***
## factor(country)Syria             *
## factor(country)Taiwan            ***
## factor(country)Tajikistan
## factor(country)Tanzania
## factor(country)Thailand          ***
## factor(country)Togo
## factor(country)Tonga             ***
## factor(country)Trinidad & Tobago ***
## factor(country)Tunisia           ***
## factor(country)Turkey            ***
## factor(country)Turkmenistan      .
## factor(country)Uganda
## factor(country)Ukraine
## factor(country)United Arab Emirates ***
## factor(country)United Kingdom    ***
## factor(country)United States of America ***
## factor(country)Uruguay           ***
## factor(country)Uzbekistan        .
## factor(country)Vanuatu           **
## factor(country)Venezuela         ***
## factor(country)Vietnam           *
## factor(country)Yemen
## factor(country)Zambia
## factor(country)Zimbabwe          **
## factor(year)1959                 ***
## factor(year)1964                 **
## factor(year)1969                 **
## factor(year)1974                 *
## factor(year)1979                 *
## factor(year)1984                 ***
## factor(year)1989                 **
## factor(year)1994                 ***
## factor(year)1999                 .
## factor(year)2004                 .

```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.03516 on 1032 degrees of freedom
## (812 observations deleted due to missingness)
## Multiple R-squared:  0.3484, Adjusted R-squared:  0.2285
## F-statistic: 2.905 on 190 and 1032 DF,  p-value: < 2.2e-16

reg4 = lm(Delta_GDP~initial_Y+UNDERVAL+factor(country)+factor(year), data=pwt62q[pwt62q$rgdpch<6000,])
summary(reg4)

##
## Call:
## lm(formula = Delta_GDP ~ initial_Y + UNDERVAL + factor(country) +
##     factor(year), data = pwt62q[pwt62q$rgdpch < 6000, ])
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.24067 -0.01777 -0.00080  0.01650  0.34032
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)      0.316998   0.049407   6.416 2.90e-10
## initial_Y       -0.038740   0.005345  -7.247 1.36e-12
## UNDERVAL        0.011467   0.004472   2.564 0.010592
## factor(country)Albania    0.079191   0.032844   2.411 0.016214
## factor(country)Algeria    0.081452   0.023056   3.533 0.000444
## factor(country)Antigua    0.084633   0.043608   1.941 0.052772
## factor(country)Austria    0.117482   0.045753   2.568 0.010486
## factor(country)Azerbaijan 0.121975   0.043287   2.818 0.004999
## factor(country)Bangladesh 0.036860   0.024121   1.528 0.127027
## factor(country)Belize     0.088956   0.024865   3.578 0.000376
## factor(country)Benin      0.020163   0.021704   0.929 0.353277
## factor(country)Bhutan     0.027924   0.025288   1.104 0.269953
## factor(country)Bolivia    0.049340   0.021361   2.310 0.021248
## factor(country)Bosnia and Herzegovina 0.158007   0.043308   3.648 0.000288
## factor(country)Botswana   0.112699   0.026082   4.321 1.83e-05
## factor(country)Brazil     0.104887   0.025360   4.136 4.06e-05
## factor(country)Burkina Faso 0.008099   0.021341   0.379 0.704466
## factor(country)Burundi    -0.002957   0.022478  -0.132 0.895396
## factor(country)Cambodia   -0.026576   0.025006  -1.063 0.288334
## factor(country)Cameroon   0.047281   0.022404   2.110 0.035249
## factor(country)Cape Verde 0.078490   0.022312   3.518 0.000469
## factor(country)Central African Republic 0.012904   0.024394   0.529 0.597025
## factor(country)Chad       -0.012958   0.022435  -0.578 0.563765
## factor(country)Chile      0.072135   0.029433   2.451 0.014546
## factor(country)China      0.059412   0.020937   2.838 0.004703
## factor(country)Colombia   0.079219   0.021718   3.648 0.000288
## factor(country)Comoros    0.026767   0.022223   1.204 0.228901
## factor(country)Congo, Democratic Republic -0.036049   0.023562  -1.530 0.126574
## factor(country)Congo, Republic of 0.035261   0.022473   1.569 0.117189
## factor(country)Costa Rica 0.082156   0.029392   2.795 0.005358
## factor(country)Cote d'Ivoire 0.054187   0.022344   2.425 0.015606
## factor(country)Cuba       0.094452   0.026378   3.581 0.000371
## factor(country)Djibouti   0.061611   0.026180   2.353 0.018936
```

## factor(country)Dominica	0.102090	0.028615	3.568	0.000390
## factor(country)Dominican Republic	0.087679	0.022032	3.980	7.78e-05
## factor(country)Ecuador	0.069237	0.021125	3.277	0.001110
## factor(country)Egypt	0.062909	0.020787	3.026	0.002585
## factor(country)El Salvador	0.069549	0.021658	3.211	0.001395
## factor(country)Equatorial Guinea	0.071075	0.022291	3.188	0.001507
## factor(country)Eritrea	-0.026150	0.033189	-0.788	0.431067
## factor(country)Ethiopia	0.006993	0.021293	0.328	0.742715
## factor(country)Fiji	0.066801	0.024828	2.691	0.007338
## factor(country)Gambia, The	0.009473	0.022522	0.421	0.674191
## factor(country)Georgia	0.123504	0.032837	3.761	0.000186
## factor(country)Ghana	0.069354	0.021849	3.174	0.001582
## factor(country)Greece	0.131093	0.033591	3.903	0.000106
## factor(country)Grenada	0.083231	0.024694	3.371	0.000800
## factor(country)Guatemala	0.068167	0.021521	3.167	0.001619
## factor(country)Guinea	0.037122	0.021170	1.754	0.080032
## factor(country)Guinea-Bissau	0.002381	0.022923	0.104	0.917291
## factor(country)Haiti	0.022590	0.024155	0.935	0.350062
## factor(country)Honduras	0.044448	0.020703	2.147	0.032210
## factor(country)India	0.049690	0.020689	2.402	0.016629
## factor(country)Indonesia	0.067440	0.021562	3.128	0.001850
## factor(country)Iran	0.086482	0.024000	3.603	0.000341
## factor(country)Ireland	0.089594	0.044354	2.020	0.043845
## factor(country)Israel	0.085515	0.045813	1.867	0.062461
## factor(country)Italy	0.118525	0.045463	2.607	0.009367
## factor(country)Jamaica	0.077719	0.021803	3.565	0.000394
## factor(country)Japan	0.122920	0.043934	2.798	0.005316
## factor(country)Jordan	0.084624	0.021913	3.862	0.000125
## factor(country)Kenya	0.025536	0.021119	1.209	0.227115
## factor(country)Kiribati	0.020633	0.024347	0.847	0.397102
## factor(country)Korea, Dem. Rep.	0.052803	0.024265	2.176	0.029952
## factor(country)Kyrgyzstan	0.093971	0.043282	2.171	0.030326
## factor(country)Lesotho	0.039738	0.022327	1.780	0.075627
## factor(country)Liberia	-0.030308	0.024249	-1.250	0.211854
## factor(country)Macedonia	0.085033	0.043635	1.949	0.051810
## factor(country)Madagascar	-0.001415	0.021674	-0.065	0.947966
## factor(country)Malawi	0.003410	0.021090	0.162	0.871622
## factor(country)Malaysia	0.101903	0.024637	4.136	4.05e-05
## factor(country)Maldives	0.091303	0.023158	3.943	9.04e-05
## factor(country)Mali	0.013183	0.021809	0.604	0.545766
## factor(country)Mauritania	0.025075	0.024144	1.039	0.299447
## factor(country)Mauritius	0.081904	0.027103	3.022	0.002622
## factor(country)Mexico	0.096050	0.025395	3.782	0.000171
## factor(country)Micronesia, Fed. Sts.	0.069642	0.024666	2.823	0.004914
## factor(country)Moldova	0.031721	0.032697	0.970	0.332379
## factor(country)Mongolia	0.042411	0.024619	1.723	0.085474
## factor(country)Morocco	0.078238	0.021335	3.667	0.000268
## factor(country)Mozambique	0.028115	0.022310	1.260	0.208100
## factor(country)Namibia	0.084005	0.025045	3.354	0.000848
## factor(country)Nepal	0.015324	0.022551	0.680	0.497066
## factor(country)Nicaragua	0.057641	0.021946	2.626	0.008856
## factor(country)Niger	-0.010662	0.021645	-0.493	0.622492
## factor(country)Nigeria	0.014372	0.020508	0.701	0.483724
## factor(country)Pakistan	0.042768	0.020587	2.077	0.038202



## factor(country)Panama	0.078186	0.023808	3.284	0.001085
## factor(country)Papua New Guinea	0.093317	0.024459	3.815	0.000151
## factor(country)Paraguay	0.071425	0.021638	3.301	0.001023
## factor(country)Peru	0.064690	0.021756	2.973	0.003067
## factor(country)Philippines	0.060680	0.020854	2.910	0.003756
## factor(country)Poland	0.056720	0.043816	1.295	0.196006
## factor(country)Portugal	0.097295	0.029248	3.327	0.000935
## factor(country)Romania	0.098413	0.024774	3.973	8.01e-05
## factor(country)Rwanda	0.001068	0.022326	0.048	0.961862
## factor(country)Samoa	0.053706	0.024529	2.190	0.028957
## factor(country)Sao Tome and Principe	0.015940	0.022985	0.693	0.488276
## factor(country)Senegal	0.021516	0.022290	0.965	0.334814
## factor(country)Serbia and Montenegro	0.019869	0.043948	0.452	0.651361
## factor(country)Sierra Leone	-0.027038	0.024165	-1.119	0.263648
## factor(country)Singapore	0.137723	0.043841	3.141	0.001767
## factor(country)Solomon Islands	0.052792	0.024190	2.182	0.029482
## factor(country)Somalia	-0.015501	0.023107	-0.671	0.502594
## factor(country)South Africa	0.044894	0.028862	1.555	0.120372
## factor(country)Spain	0.101411	0.033823	2.998	0.002831
## factor(country)Sri Lanka	0.053605	0.020716	2.588	0.009906
## factor(country)St. Kitts & Nevis	0.080802	0.043470	1.859	0.063560
## factor(country)St. Lucia	0.102477	0.033041	3.101	0.002019
## factor(country)St. Vincent & Grenadines	0.115027	0.028425	4.047	5.90e-05
## factor(country)Sudan	0.007901	0.024301	0.325	0.745186
## factor(country)Suriname	0.056297	0.026359	2.136	0.033113
## factor(country)Swaziland	0.082018	0.033160	2.473	0.013667
## factor(country)Syria	0.054870	0.022873	2.399	0.016758
## factor(country)Taiwan	0.108698	0.024747	4.392	1.33e-05
## factor(country)Tajikistan	0.007713	0.043275	0.178	0.858606
## factor(country)Tanzania	0.004040	0.022962	0.176	0.860412
## factor(country)Thailand	0.078159	0.022348	3.497	0.000506
## factor(country)Togo	0.005291	0.021582	0.245	0.806426
## factor(country)Tonga	0.081263	0.024230	3.354	0.000849
## factor(country)Trinidad & Tobago	0.153523	0.044204	3.473	0.000553
## factor(country)Tunisia	0.087033	0.023492	3.705	0.000232
## factor(country)Turkey	0.087847	0.021240	4.136	4.06e-05
## factor(country)Uganda	0.009765	0.021239	0.460	0.645833
## factor(country)Ukraine	0.028323	0.043798	0.647	0.518099
## factor(country)Uruguay	0.074840	0.034484	2.170	0.030388
## factor(country)Uzbekistan	0.070531	0.043299	1.629	0.103873
## factor(country)Vanuatu	0.077388	0.024523	3.156	0.001684
## factor(country)Vietnam	0.061495	0.032635	1.884	0.060016
## factor(country)Yemen	0.031601	0.032992	0.958	0.338538
## factor(country)Zambia	0.009305	0.021727	0.428	0.668622
## factor(country)Zimbabwe	0.056852	0.021364	2.661	0.008004
## factor(year)1959	-0.074842	0.015616	-4.793	2.09e-06
## factor(year)1964	-0.059100	0.015358	-3.848	0.000132
## factor(year)1969	-0.060183	0.014936	-4.029	6.34e-05
## factor(year)1974	-0.056131	0.014747	-3.806	0.000156
## factor(year)1979	-0.050972	0.014296	-3.566	0.000393
## factor(year)1984	-0.062824	0.014163	-4.436	1.10e-05
## factor(year)1989	-0.064017	0.014184	-4.513	7.73e-06
## factor(year)1994	-0.079291	0.014243	-5.567	3.96e-08
## factor(year)1999	-0.052718	0.014414	-3.657	0.000278

```

## factor(year)2004          -0.044644    0.016128   -2.768  0.005820
##
## (Intercept)              ***
## initial_Y                 ***
## UNDERVAL                  *
## factor(country)Albania     *
## factor(country)Algeria     ***
## factor(country)Antigua     .
## factor(country)Austria     *
## factor(country)Azerbaijan  **
## factor(country)Bangladesh  ***
## factor(country)Belize      ***
## factor(country)Benin
## factor(country)Bhutan
## factor(country)Bolivia     *
## factor(country)Bosnia and Herzegovina ***
## factor(country)Botswana    ***
## factor(country)Brazil      ***
## factor(country)Burkina Faso
## factor(country)Burundi
## factor(country)Cambodia
## factor(country)Cameroon    *
## factor(country)Cape Verde  ***
## factor(country)Central African Republic
## factor(country)Chad
## factor(country)Chile       *
## factor(country)China       **
## factor(country)Colombia    ***
## factor(country)Comoros
## factor(country)Congo, Democratic Republic
## factor(country)Congo, Republic of
## factor(country)Costa Rica  **
## factor(country)Cote d'Ivoire *
## factor(country)Cuba        ***
## factor(country)Djibouti    *
## factor(country)Dominica    ***
## factor(country)Dominican Republic ***
## factor(country)Ecuador     **
## factor(country)Egypt       **
## factor(country)El Salvador **
## factor(country)Equatorial Guinea **
## factor(country)Eritrea
## factor(country)Ethiopia
## factor(country)Fiji        **
## factor(country)Gambia, The
## factor(country)Georgia     ***
## factor(country)Ghana       **
## factor(country)Greece      ***
## factor(country)Grenada     ***
## factor(country)Guatemala   **
## factor(country)Guinea      .
## factor(country)Guinea-Bissau
## factor(country)Haiti
## factor(country)Honduras    *

```

## factor(country)India	*
## factor(country)Indonesia	**
## factor(country)Iran	***
## factor(country)Ireland	*
## factor(country)Israel	.
## factor(country)Italy	**
## factor(country)Jamaica	***
## factor(country)Japan	**
## factor(country)Jordan	***
## factor(country)Kenya	
## factor(country)Kiribati	
## factor(country)Korea, Dem. Rep.	*
## factor(country)Kyrgyzstan	*
## factor(country)Lesotho	.
## factor(country)Liberia	
## factor(country)Macedonia	.
## factor(country)Madagascar	
## factor(country)Malawi	
## factor(country)Malaysia	***
## factor(country)Maldives	***
## factor(country)Mali	
## factor(country)Mauritania	
## factor(country)Mauritius	**
## factor(country)Mexico	***
## factor(country)Micronesia, Fed. Sts.	**
## factor(country)Moldova	
## factor(country)Mongolia	.
## factor(country)Morocco	***
## factor(country)Mozambique	
## factor(country)Namibia	***
## factor(country)Nepal	
## factor(country)Nicaragua	**
## factor(country)Niger	
## factor(country)Nigeria	
## factor(country)Pakistan	*
## factor(country)Panama	**
## factor(country)Papua New Guinea	***
## factor(country)Paraguay	**
## factor(country)Peru	**
## factor(country)Philippines	**
## factor(country)Poland	
## factor(country)Portugal	***
## factor(country)Romania	***
## factor(country)Rwanda	
## factor(country)Samoa	*
## factor(country)Sao Tome and Principe	
## factor(country)Senegal	
## factor(country)Serbia and Montenegro	
## factor(country)Sierra Leone	
## factor(country)Singapore	**
## factor(country)Solomon Islands	*
## factor(country)Somalia	
## factor(country)South Africa	
## factor(country)Spain	**

```

## factor(country)Sri Lanka          **
## factor(country)St. Kitts & Nevis  .
## factor(country)St. Lucia          **
## factor(country)St. Vincent & Grenadines ***
## factor(country)Sudan
## factor(country)Suriname           *
## factor(country)Swaziland          *
## factor(country)Syria               *
## factor(country)Taiwan              ***
## factor(country)Tajikistan
## factor(country)Tanzania
## factor(country)Thailand            ***
## factor(country)Togo
## factor(country)Tonga               ***
## factor(country)Trinidad & Tobago   ***
## factor(country)Tunisia             ***
## factor(country)Turkey              ***
## factor(country)Uganda
## factor(country)Ukraine
## factor(country)Uruguay             *
## factor(country)Uzbekistan
## factor(country)Vanuatu              **
## factor(country)Vietnam             .
## factor(country)Yemen
## factor(country)Zambia
## factor(country)Zimbabwe            **
## factor(year)1959                  ***
## factor(year)1964                  ***
## factor(year)1969                  ***
## factor(year)1974                  ***
## factor(year)1979                  ***
## factor(year)1984                  ***
## factor(year)1989                  ***
## factor(year)1994                  ***
## factor(year)1999                  ***
## factor(year)2004                  **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.03974 on 581 degrees of freedom
## (775 observations deleted due to missingness)
## Multiple R-squared:  0.36, Adjusted R-squared:  0.2047
## F-statistic: 2.318 on 141 and 581 DF, p-value: 3.385e-12

```