

prosperity

Xuhui Ying, Zach Ahearn, Pen Trainer, Jenny Yue, Leo Li

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- load libraries
- load data
- Full Model
- Reduced Model - backward elimination (stepAIC)
- Reduced Model - Remove ln_gni (p-value > 0.05)
- Reduced Model - Remove agriculture_value_added_percent_of (p-value > 0.05)
- Reduced Model - Remove services_etc_value_added_percent (p-value > 0.05)
- Reduced Model - Remove gross_capital_formation_percent_of_g (p-value > 0.05)
- Reduced Model - Remove internet_users_per_1_000_peopl (p-value > 0.05)
- Reduced Model - Remove gni_atlas_method_current_us (VIF > 10)
- Reduced Model - Remove gni_atlas_method_current_us (VIF > 5)
- Reduced Model - Remove merchandise_trade_percent_of_gdp (p-value > 0.05)
- Reduced Model - Remove co2_emissions_metric_tons_per (p-value > 0.05)
- Reduced Model - Remove official_development_assistance (p-value > 0.05)
- Reduced Model - Remove inflation_gdp_deflator_annual (p-value > 0.05)
- Reduced Model - Remove immunization_measles_percent_of_chi (p-value > 0.05)
- Reduced Model - take a log transformation
- predictions

load libraries

```
library(ggplot2)
library(corrplot)
library(MASS)
library(skimr)
library(readr)
#library(VIF)
#library(VIFCP)
library(fastDummies)
library(tidyverse)
library(janitor)
library(modelr)

options(scipen = 999) # turns off scientific notation
```

load data

```
df <- read_csv(file="WorldBank2002_2.csv") %>% clean_names()

head(df)
```

series	agricultural_land_percent_of_land_ar	agriculture_value_added_percent_of
<chr>	<dbl>	<dbl>
Angola	46	8
Benin	30	34
Botswana	46	3
Burkina Faso	39	31
Burundi	91	41
Cameroon	20	40

6 rows | 1-3 of 32 columns

```
#data <- df %>% dplyr::select(-1)
data <- df %>% select_if(is.numeric)

skim(data)
```

Data summary

Name	data
Number of rows	47
Number of columns	31

Column type frequency:

numeric	31
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Group variables	None
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Variable type: numeric

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	f
agricultural_land_percent_of_land_ar	0	1.00	48.51	21.38	8.00	31.00	47.00	64
agriculture_value_added_percent_of	1	0.98	28.17	16.72	3.00	14.00	29.50	40
co2_emissions_metric_tons_per	2	0.96	0.64	1.58	0.00	0.00	0.00	1
exports_of_goods_and_services	3	0.94	31.86	22.02	6.00	15.75	24.50	42
fertility_rate_total_births_p	2	0.96	5.31	1.43	2.00	4.00	6.00	6
fixed_line_and_mobile_phone_sub	1	0.98	86.83	153.97	3.00	13.00	25.00	76
foreign_direct_investment_net	1	0.98	206834044.17	396568909.33	1000.00	6500000.00	50000000.00	235500000
gdp_current_us	1	0.98	7737991443.48	17613042742.57	53552400.00	1063545000.00	3162625000.00	5772950000
gdp_growth_annual_percent	1	0.98	3.72	5.94	-13.00	1.25	4.00	5
gni_per_capita_atlas_method_c	2	0.96	772.89	1246.46	90.00	210.00	320.00	610
gni_atlas_method_current_us	2	0.96	7163487626.67	18215781408.29	47829200.00	968529000.00	2961280000.00	5504950000
gross_capital_formation_percent_of_g	3	0.94	19.52	9.78	5.00	13.75	19.00	23
immunization_measles_percent_of_chi	0	1.00	66.60	16.54	35.00	54.50	69.00	79
imports_of_goods_and_services	4	0.91	42.07	23.18	8.00	26.00	35.00	52
industry_value_added_percent_of_gdp	1	0.98	26.87	15.75	8.00	16.00	21.00	31
inflation_gdp_deflator_annual	1	0.98	12.98	26.79	-5.00	3.00	6.00	14
internet_users_per_1_000_peopl	1	0.98	16.52	28.17	1.00	2.00	4.50	16
life_expectancy_at_birth_total	0	1.00	48.66	8.89	36.00	43.00	46.00	54
long_term_debt_dod_current_us	1	0.98	3844400000.00	5106087600.81	209100000.00	932000000.00	1886600000.00	5019750000
merchandise_trade_percent_of_gdp	1	0.98	61.83	37.77	10.00	33.25	55.00	77
military_expenditure_percent_of_gdp	13	0.72	2.85	4.10	0.00	1.00	2.00	3
net_barter_terms_of_trade_2000	2	0.96	94.29	20.20	30.00	89.00	93.00	97
official_development_assistance	0	1.00	372511063.83	428705273.38	7850000.00	60170000.00	249600000.00	455944992
personal_computers_per_1_000_p	7	0.85	20.45	36.32	1.00	2.00	6.00	18
population_growth_annual_percent	0	1.00	2.30	0.91	0.00	2.00	2.00	3
population_total	0	1.00	14777598.98	21766503.13	83700.00	1879893.50	8613903.00	16299244
services/etc_value_added_percent	1	0.98	45.00	14.61	5.00	38.25	45.00	54
short_term_debt_outstanding_do	1	0.98	605421740.52	1336001268.89	4000000.00	32675000.00	151150000.00	668300032
surface_area_sq_km	0	1.00	516271.49	586630.53	460.00	46455.00	274000.00	812940
ln_gni	2	0.96	6.00	1.01	4.50	5.35	5.77	6
pop_area	0	1.00	75.08	104.75	2.38	14.20	38.31	93

```
#Missing Values
skim(data)
```

Data summary

Name	data
Number of rows	47
Number of columns	31
<hr/>	
Column type frequency:	
numeric	31
<hr/>	
Group variables	None

Variable type: numeric

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	f
agricultural_land_percent_of_land_ar	0	1.00	48.51	21.38	8.00	31.00	47.00	64
agriculture_value_added_percent_of	1	0.98	28.17	16.72	3.00	14.00	29.50	40
co2_emissions_metric_tons_per	2	0.96	0.64	1.58	0.00	0.00	0.00	1
exports_of_goods_and_services	3	0.94	31.86	22.02	6.00	15.75	24.50	42
fertility_rate_total_births_p	2	0.96	5.31	1.43	2.00	4.00	6.00	6
fixed_line_and_mobile_phone_sub	1	0.98	86.83	153.97	3.00	13.00	25.00	76
foreign_direct_investment_net	1	0.98	206834044.17	396568909.33	1000.00	6500000.00	50000000.00	235500000
gdp_current_us	1	0.98	7737991443.48	17613042742.57	53552400.00	1063545000.00	3162625000.00	5772950000
gdp_growth_annual_percent	1	0.98	3.72	5.94	-13.00	1.25	4.00	5
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immunization_measles_percent_of_chi	0	1.00	66.60	16.54	35.00	54.50	69.00	79
imports_of_goods_and_services	4	0.91	42.07	23.18	8.00	26.00	35.00	52
industry_value_added_percent_of_gdp	1	0.98	26.87	15.75	8.00	16.00	21.00	31
inflation_gdp_deflator_annual	1	0.98	12.98	26.79	-5.00	3.00	6.00	14
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merchandise_trade_percent_of_gdp	1	0.98	61.83	37.77	10.00	33.25	55.00	77
military_expenditure_percent_of_gdp	13	0.72	2.85	4.10	0.00	1.00	2.00	3
net_barter_terms_of_trade_2000	2	0.96	94.29	20.20	30.00	89.00	93.00	97
official_development_assistance	0	1.00	372511063.83	428705273.38	7850000.00	60170000.00	249600000.00	455944992
personal_computers_per_1_000_p	7	0.85	20.45	36.32	1.00	2.00	6.00	18
population_growth_annual_percent	0	1.00	2.30	0.91	0.00	2.00	2.00	3
population_total	0	1.00	14777598.98	21766503.13	83700.00	1879893.50	8613903.00	16299244
services/etc_value_added_percent	1	0.98	45.00	14.61	5.00	38.25	45.00	54
short_term_debt_outstanding_do	1	0.98	605421740.52	1336001268.89	4000000.00	32675000.00	151150000.00	668300032
surface_area_sq_km	0	1.00	516271.49	586630.53	460.00	46455.00	274000.00	812940
ln_gni	2	0.96	6.00	1.01	4.50	5.35	5.77	6

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	f
pop_area	0	1.00	75.08	104.75	2.38	14.20	38.31	93
<pre>nrow(data)</pre>								
<pre>## [1] 47</pre>								
<pre>#Missing Value Percentages by Column missing_values <- colMeans(is.na(data))*100 missing_values</pre>								
<pre>## agricultural_land_percent_of_land_ar agriculture_value_added_percent_of ## 0.000000 2.127660 ## co2_emissions_metric_tons_per exports_of_goods_and_services ## 4.255319 6.382979 ## fertility_rate_total_births_p fixed_line_and_mobile_phone_sub ## 4.255319 2.127660 ## foreign_direct_investment_net gdp_current_us ## 2.127660 2.127660 ## gdp_growth_annual_percent gni_per_capita_atlas_method_c ## 2.127660 4.255319 ## gni_atlas_method_current_us gross_capital_formation_percent_of_g ## 4.255319 6.382979 ## immunization_measles_percent_of_chi imports_of_goods_and_services ## 0.000000 8.510638 ## industry_value_added_percent_of_gdp inflation_gdp_deflator_annual ## 2.127660 2.127660 ## internet_users_per_1_000_peopl life_expectancy_at_birth_total ## 2.127660 0.000000 ## long_term_debt_dod_current_us merchandise_trade_percent_of_gdp ## 2.127660 2.127660 ## military_expenditure_percent_of_gdp net_barter_terms_of_trade_2000 ## 27.659574 4.255319 ## official_development_assistance personal_computers_per_1_000_p ## 0.000000 14.893617 ## population_growth_annual_percent population_total ## 0.000000 0.000000 ## services/etc_value_added_percent short_term_debt_outstanding_do ## 2.127660 2.127660 ## surface_area_sq_km ln_gni ## 0.000000 4.255319 ## pop_area 0.000000</pre>								
<pre>#Missing Value Percentages by Row rowSums(is.na(data))/47*100</pre>								
<pre>## [1] 0.000000 2.127660 0.000000 0.000000 0.000000 0.000000 0.000000 ## [8] 0.000000 4.255319 2.127660 4.255319 2.127660 2.127660 14.893617 ## [15] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 4.255319 ## [22] 0.000000 4.255319 8.510638 4.255319 0.000000 0.000000 6.382979 ## [29] 0.000000 0.000000 6.382979 0.000000 0.000000 2.127660 4.255319 ## [36] 0.000000 0.000000 2.127660 34.042553 0.000000 0.000000 2.127660 ## [43] 0.000000 2.127660 0.000000 2.127660 0.000000</pre>								

```

prosperity <- df %>%
  dplyr::select(-military_expenditure_percent_of_gdp, -personal_computers_per_1_000_p) %>%
  filter(series != "Somalia") %% #Initially Just Somalia but then added 3 more later due to outliers
  filter(series != "Angola") %>%
  filter(series != "South Africa") %>%
  filter(series != "Zimbabwe") %>%
  select_if(is.numeric)

#prosperity %>% select_if(is.numeric) %>% skim()

prosperity$co2_emissions_metric_tons_per[is.na(prosperity$co2_emissions_metric_tons_per)] <- median(prosperity$co2_emissions_metric_tons_per, na.rm=TRUE)
prosperity$exports_of_goods_and_services[is.na(prosperity$exports_of_goods_and_services)] <- median(prosperity$exports_of_goods_and_services, na.rm=TRUE)
prosperity$fertility_rate_total_births_p[is.na(prosperity$fertility_rate_total_births_p)] <- median(prosperity$fertility_rate_total_births_p, na.rm=TRUE)

prosperity$fixed_line_and_mobile_phone_sub[is.na(prosperity$fixed_line_and_mobile_phone_sub)] <- median(prosperity$fixed_line_and_mobile_phone_sub, na.rm=TRUE)
prosperity$foreign_direct_investment_net[is.na(prosperity$foreign_direct_investment_net)] <- median(prosperity$foreign_direct_investment_net, na.rm=TRUE)
prosperity$gni_per_capita_atlas_method_c[is.na(prosperity$gni_per_capita_atlas_method_c)] <- median(prosperity$gni_per_capita_atlas_method_c, na.rm=TRUE)

prosperity$gni_atlas_method_current_us[is.na(prosperity$gni_atlas_method_current_us)] <- median(prosperity$gni_atlas_method_current_us, na.rm=TRUE)
prosperity$gross_capital_formation_percent_of_g[is.na(prosperity$gross_capital_formation_percent_of_g)] <- median(prosperity$gross_capital_formation_percent_of_g, na.rm=TRUE)
prosperity$imports_of_goods_and_services[is.na(prosperity$imports_of_goods_and_services)] <- median(prosperity$imports_of_goods_and_services, na.rm=TRUE)

prosperity$internet_users_per_1_000_peopl[is.na(prosperity$internet_users_per_1_000_peopl)] <- median(prosperity$internet_users_per_1_000_peopl, na.rm=TRUE)
prosperity$long_term_debt_dod_current_us[is.na(prosperity$long_term_debt_dod_current_us)] <- median(prosperity$long_term_debt_dod_current_us, na.rm=TRUE)
prosperity$net_barter_terms_of_trade_2000[is.na(prosperity$net_barter_terms_of_trade_2000)] <- median(prosperity$net_barter_terms_of_trade_2000, na.rm=TRUE)

prosperity$short_term_debt_outstanding_do[is.na(prosperity$short_term_debt_outstanding_do)] <- median(prosperity$short_term_debt_outstanding_do, na.rm=TRUE)
prosperity$ln_gni[is.na(prosperity$ln_gni)] <- median(prosperity$ln_gni, na.rm=TRUE)

```

Full Model

```

#Fit multiple regression model

fullreg <- lm(gdp_current_us ~ ., prosperity)

fullreg

```

```

## 
## Call:
## lm(formula = gdp_current_us ~ ., data = prosperity)
## 

## Coefficients:
## (Intercept) agricultural_land_percent_of_land_ar
## -4756854099.21806 542982.95596
## agriculture_value_added_percent_of
## 38322207.95066 co2_emissions_metric_tons_per
## 289188058.78184
## exports_of_goods_and_services fertility_rate_total_births_p
## 217330.91267 153090099.95359
## fixed_line_and_mobile_phone_sub foreign_direct_investment_net
## 800730.25253 1.63028
## gdp_growth_annual_percent gni_per_capita_atlas_method_c
## 10726414.17803 -157520.57950
## gni_atlas_method_current_us gross_capital_formation_percent_of_g
## 1.03878 -8358938.38737
## immunization_measles_percent_of_chi imports_of_goods_and_services
## -13104111.59870 12357342.84701
## industry_value_added_percent_of_gdp inflation_gdp_deflator_annual
## 30731521.14540 33942055.11639
## internet_users_per_1_000_peopl life_expectancy_at_birth_total
## -7025311.30054 2945533.06990
## long_term_debt_dod_current_us merchandise_trade_percent_of_gdp
## 0.15440 -8986944.38787
## net_barter_terms_of_trade_2000 official_development_assistance
## -1237427.29536 -0.44083
## population_growth_annual_percent population_total
## -102910966.23426 -12.06492
## services/etc_value_added_percent short_term_debt_outstanding_do
## 40635601.86759 -0.03368
## surface_area_sq_km ln_gni
## -285.42598 188581573.21723
## pop_area
## -72271.47413

```

```
summary(fullreg)
```

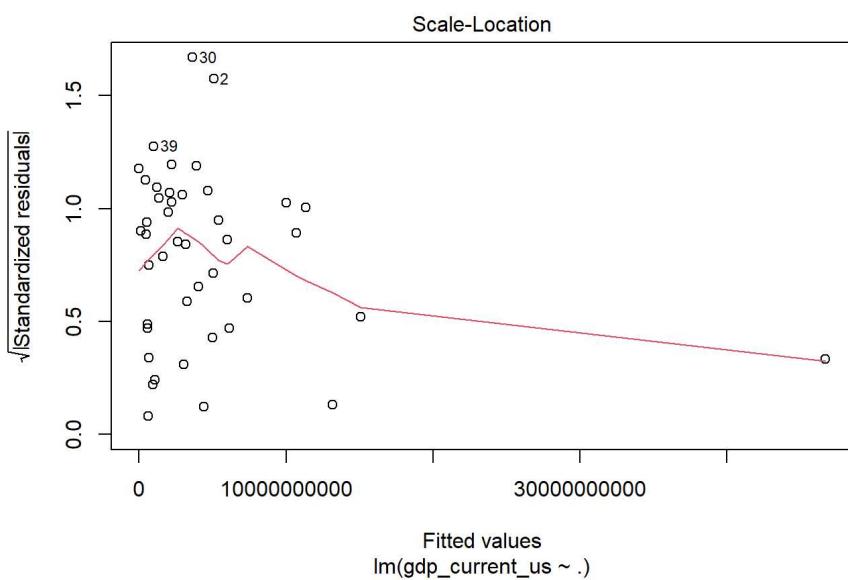
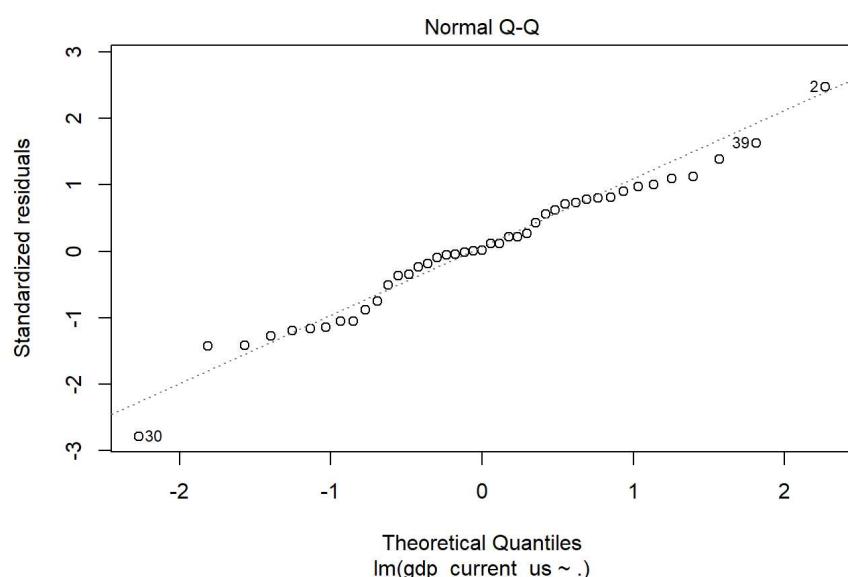
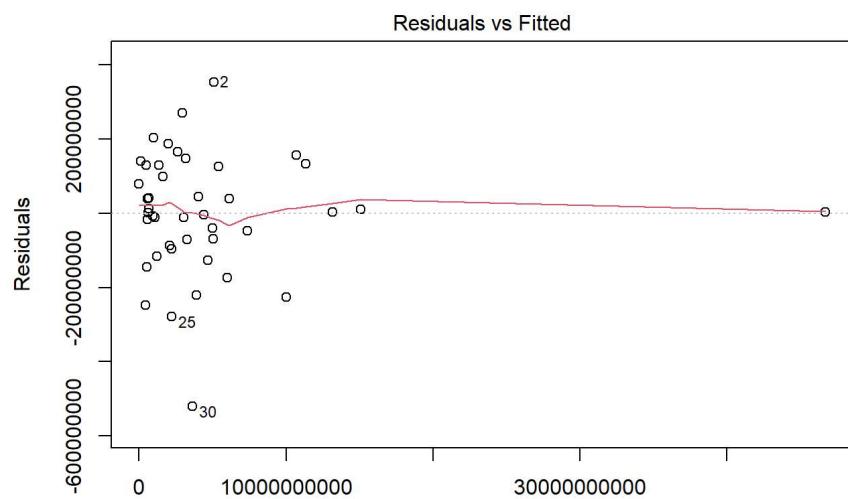
```

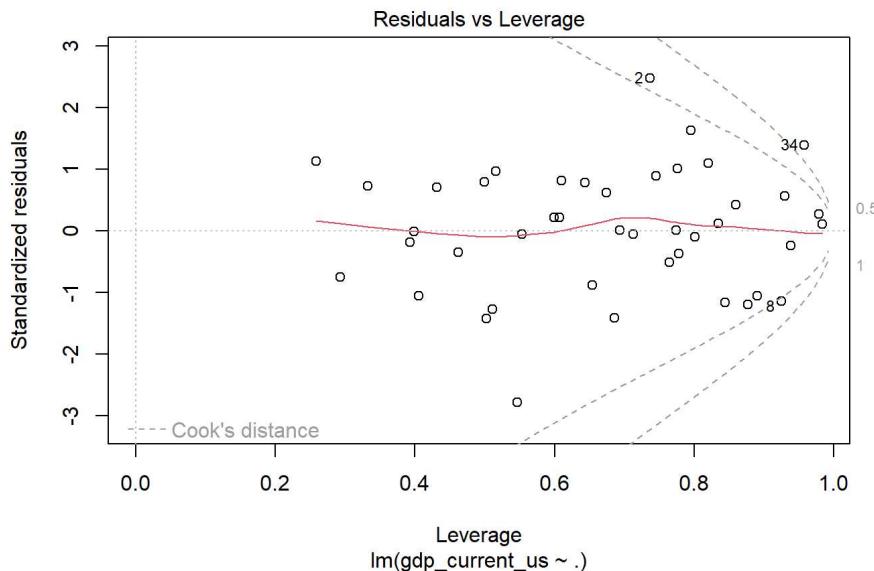
## 
## Call:
## lm(formula = gdp_current_us ~ ., data = prosperity)
## 
## Residuals:
##      Min       1Q   Median       3Q      Max 
## -520953406 -78864991  2599773  127252696  353015890 
## 
## Coefficients:
##                               Estimate Std. Error
## (Intercept)          -4756854099.21806 14625301016.33581
## agricultural_land_percent_of_land_ar    542982.95596  5626458.33007
## agriculture_value_added_percent_of     38322207.95066 143211676.67503
## co2_emissions_metric_tons_per        289188058.78184 218446058.24291
## exports_of_goods_and_services        217330.91267  7332499.88603
## fertility_rate_total_births_p        153090099.95359 100873311.81460
## fixed_line_and_mobile_phone_sub      800730.25253  2172599.97917
## foreign_direct_investment_net       1.63028   0.45689
## gdp_growth_annual_percent         10726414.17803 14193894.76564
## gni_per_capita_atlas_method_c      -157520.57950  345865.15523
## gni_atlas_method_current_us        1.03878   0.04152
## gross_capital_formation_percent_of_g -8358938.38737 11141026.25472
## immunization_measles_percent_of_chi -13104111.59870 6998045.47242
## imports_of_goods_and_services       12357342.84701  5792577.40817
## industry_value_added_percent_of_gdp 30731521.14540 144637982.41701
## inflation_gdp_deflator_annual      33942055.11639 10437140.03959
## internet_users_per_l_000_peopl     -7025311.30054 6338132.90932
## life_expectancy_at_birth_total      2945533.06990 13431268.81700
## long_term_debt_dod_current_us      0.15440   0.05160
## merchandise_trade_percent_of_gdp   -8986944.38787 2981806.38416
## net_barter_terms_of_trade_2000      -1237427.29536 3248617.59191
## official_development_assistance     -0.44083   0.19568
## population_growth_annual_percent   -102910966.23426 124582591.50406
## population_total                   -12.06492  10.79752
## services/etc_value_added_percent   40635601.86759 142952094.21841
## short_term_debt_outstanding_do     -0.03368   0.12663
## surface_area_sq_km                 -285.42598  195.46517
## ln_gni                            188581573.21723 323843024.25643
## pop_area                           -72271.47413  902463.09131
##                                     t value    Pr(>|t|) 
## (Intercept)                  -0.325    0.74980
## agricultural_land_percent_of_land_ar 0.097    0.92449
## agriculture_value_added_percent_of 0.268    0.79292
## co2_emissions_metric_tons_per    1.324    0.20677
## exports_of_goods_and_services    0.030    0.97677
## fertility_rate_total_births_p    1.518    0.15136
## fixed_line_and_mobile_phone_sub  0.369    0.71797
## foreign_direct_investment_net   3.568    0.00309 ** 
## gdp_growth_annual_percent       0.756    0.46235
## gni_per_capita_atlas_method_c   -0.455    0.65578
## gni_atlas_method_current_us    25.019 0.00000000000507 ***
## gross_capital_formation_percent_of_g -0.750    0.46551
## immunization_measles_percent_of_chi -1.873    0.08217 .
## imports_of_goods_and_services   2.133    0.05108 .
## industry_value_added_percent_of_gdp 0.212    0.83480
## inflation_gdp_deflator_annual   3.252    0.00579 ** 
## internet_users_per_l_000_peopl  -1.108    0.28636
## life_expectancy_at_birth_total   0.219    0.82958
## long_term_debt_dod_current_us   2.992    0.00970 ** 
## merchandise_trade_percent_of_gdp -3.014    0.00929 ** 
## net_barter_terms_of_trade_2000   -0.381    0.70899
## official_development_assistance -2.253    0.04083 *
## population_growth_annual_percent -0.826    0.42263
## population_total                -1.117    0.28264
## services/etc_value_added_percent 0.284    0.78037
## short_term_debt_outstanding_do  -0.266    0.79412
## surface_area_sq_km              -1.460    0.16630
## ln_gni                          0.582    0.56961
## pop_area                         -0.080    0.93731
## --- 

```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 27760000 on 14 degrees of freedom
## Multiple R-squared:  0.9995, Adjusted R-squared:  0.9986
## F-statistic: 1095 on 28 and 14 DF,  p-value: < 0.000000000000022
```

```
plot(fullreg)
```





```
#check for multicollinearity
```

```
vifres_1 <- car::vif(fullreg)
vifres_1
```

```
## agricultural_land_percent_of_land_ar    agriculture_value_added_percent_of
##                      7.950162                  3009.891453
##      co2_emissions_metric_tons_per      exports_of_goods_and_services
##                      33.820207                  12.688997
##      fertility_rate_total_births_p     fixed_line_and_mobile_phone_sub
##                      10.571903                  58.481459
##      foreign_direct_investment_net     gdp_growth_annual_percent
##                      12.269187                  3.712604
##      gni_per_capita_atlas_method_c    gni_atlas_method_current_us
##                      100.882557                  39.035448
## gross_capital_formation_percent_of_g immunization_measles_percent_of_chi
##                      6.265330                  7.553008
##      imports_of_goods_and_services    industry_value_added_percent_of_gdp
##                      9.051617                  2604.546260
##      inflation_gdp_deflator_annual   internet_users_per_1_000_peopl
##                      3.911528                  16.896241
##      life_expectancy_at_birth_total   long_term_debt_dod_current_us
##                      7.988401                  33.141160
##      merchandise_trade_percent_of_gdp net_barter_terms_of_trade_2000
##                      6.798712                  2.444884
##      official_development_assistance population_growth_annual_percent
##                      4.160768                  6.736950
##      population_total                services_etc_value_added_percent
##                      31.462645                  2257.390932
##      short_term_debt_outstanding_do   surface_area_sq_km
##                      6.780344                  7.302057
##      ln_gni                         pop_area
##                      55.480442                  5.206288
```

Reduced Model - backward elimination (stepAIC)

```
# Try Stepwise Selection to reduce model

step <- stepAIC(fullreg, direction="both")
```

```

## Start: AIC=1681.72
## gdp_current_us ~ agricultural_land_percent_of_land_ar + agriculture_value_added_percent_of +
##   co2_emissions_metric_tons_per + exports_of_goods_and_services +
##   fertility_rate_total_births_p + fixed_line_and_mobile_phone_sub +
##   foreign_direct_investment_net + gdp_growth_annual_percent +
##   gni_per_capita_atlas_method_c + gni_atlas_method_current_us +
##   gross_capital_formation_percent_of_g + immunization_measles_percent_of_chi +
##   imports_of_goods_and_services + industry_value_added_percent_of_gdp +
##   inflation_gdp_deflator_annual + internet_users_per_1_000_peopl +
##   life_expectancy_at_birth_total + long_term_debt_dod_current_us +
##   merchandise_trade_percent_of_gdp + net_barter_terms_of_trade_2000 +
##   official_development_assistance + population_growth_annual_percent +
##   population_total + services/etc_value_added_percent + short_term_debt_outstanding_do +
##   surface_area_sq_km + ln_gni + pop_area
##
##                                     Df     Sum of Sq
## - exports_of_goods_and_services    1      67683168691712
## - pop_area                         1      494102137397376
## - agricultural_land_percent_of_land_ar 1      717536480664832
## - industry_value_added_percent_of_gdp 1      3478125188354944
## - life_expectancy_at_birth_total    1      3705403678203648
## - short_term_debt_outstanding_do   1      5451399661537280
## - agriculture_value_added_percent_of 1      5516784156386048
## - services/etc_value_added_percent 1      6225498803344640
## - fixed_line_and_mobile_phone_sub   1      10465373601236352
## - net_barter_terms_of_trade_2000    1      11178512180636032
## - gni_per_capita_atlas_method_c    1      15980957098284672
## - ln_gni                           1      26125897621261952
## - gross_capital_formation_percent_of_g 1      43370422981366656
## - gdp_growth_annual_percent        1      43999502652570752
## <none>
##                                     RSS     AIC
## - exports_of_goods_and_services    1078691090051139968 1679.7
## - pop_area                         1079117509019845632 1679.7
## - agricultural_land_percent_of_land_ar 1079340943363113088 1679.8
## - industry_value_added_percent_of_gdp 1082101532070803200 1679.9
## - life_expectancy_at_birth_total    1082328810560651904 1679.9
## - short_term_debt_outstanding_do   1084074806543985536 1679.9
## - agriculture_value_added_percent_of 1084140191038834304 1679.9
## - services/etc_value_added_percent 1084848905685792896 1680.0
## - fixed_line_and_mobile_phone_sub   1089088780483684608 1680.1
## - net_barter_terms_of_trade_2000    1089801919063084288 1680.2
## - gni_per_capita_atlas_method_c    1094604363980732928 1680.4
## - ln_gni                           1104749304503710208 1680.8
## - gross_capital_formation_percent_of_g 1121993829863814912 1681.4
## - gdp_growth_annual_percent        1122622909535019008 1681.4
## <none>
##                                     RSS     AIC
## - population_growth_annual_percent 113194910099178752 1681.8
## - internet_users_per_1_000_peopl   1173279868761444096 1683.3
## - population_total                 1174816194640172032 1683.4
## - co2_emissions_metric_tons_per   1213648377651573760 1684.8
## - surface_area_sq_km               1242905436120573184 1685.8
## - fertility_rate_total_births_p    1256076453081061120 1686.3
## - immunization_measles_percent_of_chi 1348772460594416640 1689.3
## - imports_of_goods_and_services    1429252787705184256 1691.8
## - official_development_assistance 1469649121554027008 1693.0

```

```

## - long_term_debt_dod_current_us      1768438037380264960 1701.0
## - merchandise_trade_percent_of_gdp 1778476736034951168 1701.2
## - inflation_gdp_deflator_annual    1893430971529925376 1703.9
## - foreign_direct_investment_net    2059551063414941440 1707.5
## - gni_atlas_method_current_us      49303881926816415744 1844.1
##
## Step: AIC=1679.73
## gdp_current_us ~ agricultural_land_percent_of_land_ar + agriculture_value_added_percent_of +
##   co2_emissions_metric_tons_per + fertility_rate_total_births_p +
##   fixed_line_and_mobile_phone_sub + foreign_direct_investment_net +
##   gdp_growth_annual_percent + gni_per_capita_atlas_method_c +
##   gni_atlas_method_current_us + gross_capital_formation_percent_of_g +
##   immunization_measles_percent_of_chi + imports_of_goods_and_services +
##   industry_value_added_percent_of_gdp + inflation_gdp_deflator_annual +
##   internet_users_per_1_000_peopl + life_expectancy_at_birth_total +
##   long_term_debt_dod_current_us + merchandise_trade_percent_of_gdp +
##   net_barter_terms_of_trade_2000 + official_development_assistance +
##   population_growth_annual_percent + population_total + services/etc_value_added_percent +
##   short_term_debt_outstanding_do + surface_area_sq_km + ln_gni +
##   pop_area
##
##                                     Df     Sum of Sq
## - pop_area                         1     493936958330368
## - agricultural_land_percent_of_land_ar 1     804696016299776
## - industry_value_added_percent_of_gdp 1     3696548011158528
## - life_expectancy_at_birth_total     1     3704530152563968
## - short_term_debt_outstanding_do    1     5394059989353344
## - agriculture_value_added_percent_of 1     5809317141355648
## - services/etc_value_added_percent  1     6494059400785152
## - fixed_line_and_mobile_phone_sub    1     10627561156038144
## - net_barter_terms_of_trade_2000     1     11129532756482816
## - gni_per_capita_atlas_method_c     1     18541700447105024
## - ln_gni                            1     48536562884124672
## - gdp_growth_annual_percent        1     49995864836953728
## <none>
## - gross_capital_formation_percent_of_g 1     51564598520437760
## - population_growth_annual_percent   1     64119325939120384
## - internet_users_per_1_000_peopl    1     96627628747108480
## - population_total                  1     103208356914837632
## + exports_of_goods_and_services     1     67683168689408
## - co2_emissions_metric_tons_per    1     141764962312347008
## - surface_area_sq_km               1     172376071317379200
## - fertility_rate_total_births_p    1     177807775195994240
## - immunization_measles_percent_of_chi 1     290800812427730816
## - imports_of_goods_and_services    1     433373563164571520
## - official_development_assistance 1     459024702953657984
## - long_term_debt_dod_current_us    1     692817063903696768
## - merchandise_trade_percent_of_gdp 1     749552262242079872
## - inflation_gdp_deflator_annual   1     842299858886421120
## - foreign_direct_investment_net   1     1012650821837339776
## - gni_atlas_method_current_us      1     54961872978698821632
##
##                                     RSS     AIC
## - pop_area                         1079185027009470336 1677.8
## - agricultural_land_percent_of_land_ar 1079495786067439744 1677.8
## - industry_value_added_percent_of_gdp 1082387638062298496 1677.9
## - life_expectancy_at_birth_total    1082395620203703936 1677.9
## - short_term_debt_outstanding_do   1084085150040493312 1677.9
## - agriculture_value_added_percent_of 1084500407192495616 1678.0
## - services/etc_value_added_percent 1085185149451925120 1678.0
## - fixed_line_and_mobile_phone_sub   1089318651207178112 1678.2
## - net_barter_terms_of_trade_2000    1089820622807622784 1678.2
## - gni_per_capita_atlas_method_c    1097232790498244992 1678.5
## - ln_gni                            1127227652935264640 1679.6
## - gdp_growth_annual_percent       1128686954888093696 1679.7
## <none>                           1078691090051139968 1679.7
## - gross_capital_formation_percent_of_g 1130255688571577728 1679.7
## - population_growth_annual_percent 1142810415990260352 1680.2
## - internet_users_per_1_000_peopl   1175318718798248448 1681.4
## - population_total                 1181899446965977600 1681.7
## + exports_of_goods_and_services    1078623406882450560 1681.7

```

```

## - co2_emissions_metric_tons_per      1220456052363486976 1683. 0
## - surface_area_sq_km                1251067161368519168 1684. 1
## - fertility_rate_total_births_p     1256498865247134208 1684. 3
## - immunization_measles_percent_of_chi 1369491902478870784 1688. 0
## - imports_of_goods_and_services     1512064653215711488 1692. 2
## - official_development_assistance   1537715793004797952 1693. 0
## - long_term_debt_dod_current_us    1771508153954836736 1699. 1
## - merchandise_trade_percent_of_gdp 1828243352293219840 1700. 4
## - inflation_gdp_deflator_annual    1920990948937561088 1702. 5
## - foreign_direct_investment_net    2091341911888479744 1706. 2
## - gni_atlas_method_current_us       56040564068749959178 1847. 6
##
## Step:  AIC=1677. 75
## gdp_current_us ~ agricultural_land_percent_of_land_ar + agriculture_value_added_percent_of +
##   co2_emissions_metric_tons_per + fertility_rate_total_births_p +
##   fixed_line_and_mobile_phone_sub + foreign_direct_investment_net +
##   gdp_growth_annual_percent + gni_per_capita_atlas_method_c +
##   gni_atlas_method_current_us + gross_capitalFormation_percent_of_g +
##   immunization_measles_percent_of_chi + imports_of_goods_and_services +
##   industry_value_added_percent_of_gdp + inflation_gdp_deflator_annual +
##   internet_users_per_1_000_peopl + life_expectancy_at_birth_total +
##   long_term_debt_dod_current_us + merchandise_trade_percent_of_gdp +
##   net_barter_terms_of_trade_2000 + official_development_assistance +
##   population_growth_annual_percent + population_total + services/etc_value_added_percent +
##   short_term_debt_outstanding_do + surface_area_sq_km + ln_gni
##
##                                     Df     Sum of Sq
## - agricultural_land_percent_of_land_ar 1  316801989527808
## - life_expectancy_at_birth_total      1  3218357757320448
## - industry_value_added_percent_of_gdp 1  4067385547167104
## - short_term_debt_outstanding_do     1  5101515991363584
## - agriculture_value_added_percent_of 1  6248456223720320
## - services/etc_value_added_percent   1  7018493585830528
## - fixed_line_and_mobile_phone_sub    1  11428845546888832
## - net_barter_terms_of_trade_2000     1  11571783150454016
## - gni_per_capita_atlas_method_c     1  18424299498867072
## - ln_gni                            1  48048574891808256
## <none>
##                                     Df     Sum of Sq
## - gdp_growth_annual_percent         1  55084286393314048
## - gross_capitalFormation_percent_of_g 1  59142061273557632
## - population_growth_annual_percent 1  63995319167584256
## - internet_users_per_1_000_peopl   1  98005405444960896
## - pop_area                           1  493936958330368
## - exports_of_goods_and_services     1  67517989622528
## - population_total                 1  119977793570429568
## - co2_emissions_metric_tons_per    1  141304786240654720
## - surface_area_sq_km               1  174042089717257856
## - fertility_rate_total_births_p    1  178112810194809216
## - immunization_measles_percent_of_chi 1  317331440830004608
## - official_development_assistance 1  476699138418326400
## - imports_of_goods_and_services    1  512706320077859456
## - long_term_debt_dod_current_us   1  694910801331410560
## - merchandise_trade_percent_of_gdp 1  753421740182491008
## - inflation_gdp_deflator_annual   1  860668692731452800
## - foreign_direct_investment_net   1  1115105028713353600
## - gni_atlas_method_current_us      1  55882946167207395338
##
##                                     RSS     AIC
## - agricultural_land_percent_of_land_ar 1079501828998998144 1675. 8
## - life_expectancy_at_birth_total      1082403384766790784 1675. 9
## - industry_value_added_percent_of_gdp 1083252412556637440 1675. 9
## - short_term_debt_outstanding_do     1084286543000833920 1676. 0
## - agriculture_value_added_percent_of 1085433483233190656 1676. 0
## - services/etc_value_added_percent   1086203520595300864 1676. 0
## - fixed_line_and_mobile_phone_sub    1090613872556359168 1676. 2
## - net_barter_terms_of_trade_2000     1090756810159924352 1676. 2
## - gni_per_capita_atlas_method_c     1097609326508337408 1676. 5
## - ln_gni                            1127233601901278592 1677. 6
## <none>                                1079185027009470336 1677. 8
## - gdp_growth_annual_percent         1134269313402784384 1677. 9
## - gross_capitalFormation_percent_of_g 1138327088283027968 1678. 0

```

```

## - population_growth_annual_percent      1143180346177054592 1678.2
## - internet_users_per_1_000_peopl       1177190432454431232 1679.5
## + pop_area                            1078691090051139968 1679.7
## + exports_of_goods_and_services        1079117509019847808 1679.7
## - population_total                     1199162820579899904 1680.3
## - co2_emissions_metric_tons_per       1220489813250125056 1681.0
## - surface_area_sq_km                  1253227116726728192 1682.2
## - fertility_rate_total_births_p       1257297837204279552 1682.3
## - immunization_measles_percent_of_chi 1396516467839474944 1686.8
## - official_development_assistance    1555884165427796736 1691.5
## - imports_of_goods_and_services       1591891347087329792 1692.5
## - long_term_debt_dod_current_us     1774095828340880896 1697.1
## - merchandise_trade_percent_of_gdp   1832606767191961344 1698.5
## - inflation_gdp_deflator_annual     1939853719740923136 1701.0
## - foreign_direct_investment_net     2194290055722823936 1706.3
## - gni_atlas_method_current_us       56962131194216865792 1846.3
##
## Step: AIC=1675.76
## gdp_current_us ~ agriculture_value_added_percent_of + co2_emissions_metric_tons_per +
##   fertility_rate_total_births_p + fixed_line_and_mobile_phone_sub +
##   foreign_direct_investment_net + gdp_growth_annual_percent +
##   gni_per_capita_atlas_method_c + gni_atlas_method_current_us +
##   gross_capitalFormation_percent_of_g + immunization_measles_percent_of_chi +
##   imports_of_goods_and_services + industry_value_added_percent_of_gdp +
##   inflation_gdp_deflator_annual + internet_users_per_1_000_peopl +
##   life_expectancy_at_birth_total + long_term_debt_dod_current_us +
##   merchandise_trade_percent_of_gdp + net_barter_terms_of_trade_2000 +
##   official_development_assistance + population_growth_annual_percent +
##   population_total + services/etc_value_added_percent + short_term_debt_outstanding_do +
##   surface_area_sq_km + ln_gni
##
##                                     Df   Sum of Sq
## - life_expectancy_at_birth_total      1   2901601559424512
## - industry_value_added_percent_of_gdp 1   3862037500951168
## - short_term_debt_outstanding_do     1   4790922262568576
## - agriculture_value_added_percent_of 1   6003833774493056
## - services/etc_value_added_percent   1   6773984483812096
## - fixed_line_and_mobile_phone_sub    1   11217752426583808
## - net_barter_terms_of_trade_2000     1   13360162965402496
## - gni_per_capita_atlas_method_c      1   18370928395883008
## - ln_gni                            1   47927924534021376
## <none>
## - gdp_growth_annual_percent         1   58792009571137792
## - population_growth_annual_percent   1   64024621037401984
## - gross_capitalFormation_percent_of_g 1   65349370775055616
## - internet_users_per_1_000_peopl    1   99550331597266304
## + agricultural_land_percent_of_land_ar 1   316801989537536
## + exports_of_goods_and_services      1   141580207463552
## + pop_area                          1   6042931558400
## - population_total                  1   125405833072198016
## - co2_emissions_metric_tons_per     1   141930219898873472
## - fertility_rate_total_births_p      1   186646361091160704
## - surface_area_sq_km                1   188875716889275264
## - immunization_measles_percent_of_chi 1   396246370227288192
## - official_development_assistance   1   476387225500387968
## - imports_of_goods_and_services      1   549422313779570560
## - long_term_debt_dod_current_us     1   697933615598495872
## - merchandise_trade_percent_of_gdp 1   756228354673292672
## - inflation_gdp_deflator_annual    1   874926541301923712
## - foreign_direct_investment_net    1   1245205528077489152
## - gni_atlas_method_current_us       1   56007302335459598336
##
##                                     RSS   AIC
## - life_expectancy_at_birth_total    1082403430558422656 1673.9
## - industry_value_added_percent_of_gdp 1083363866499949312 1673.9
## - short_term_debt_outstanding_do    1084292751261566720 1674.0
## - agriculture_value_added_percent_of 1085505662773491200 1674.0
## - services/etc_value_added_percent 1086275813482810240 1674.0
## - fixed_line_and_mobile_phone_sub   1090719581425581952 1674.2
## - net_barter_terms_of_trade_2000    1092861991964400640 1674.3
## - gni_per_capita_atlas_method_c     1097872757394881152 1674.5

```

```

## - ln_gni                      1127429753533019520 1675. 6
## <none>                         1079501828998998144 1675. 8
## - gdp_growth_annual_percent   1138293838570135936 1676. 0
## - population_growth_annual_percent 1143526450036400128 1676. 2
## - gross_capital_formation_percent_of_g 1144851199774053760 1676. 3
## - internet_users_per_1_000_peopl 1179052160596264448 1677. 5
## + agricultural_land_percent_of_land_ar 1079185027009460608 1677. 8
## + exports_of_goods_and_services 1079360248791534592 1677. 8
## + pop_area                      1079495786067439744 1677. 8
## - population_total              1204907662071196160 1678. 5
## - co2_emissions_metric_tons_per 1221432048897871616 1679. 1
## - fertility_rate_total_births_p 1266148190090158848 1680. 6
## - surface_area_sq_km            1268377545888273408 1680. 7
## - immunization_measles_percent_of_chi 1475748199226286336 1687. 2
## - official_development_assistance 1555889054499386112 1689. 5
## - imports_of_goods_and_services 1628924142778568704 1691. 5
## - long_term_debt_dod_current_us 1777435444897494016 1695. 2
## - merchandise_trade_percent_of_gdp 1835730183672290816 1696. 6
## - inflation_gdp_deflator_annual 1954428370300921856 1699. 3
## - foreign_direct_investment_net 2324707357076487168 1706. 7
## - gni_atlas_method_current_us    57086804164458594304 1844. 4
##
## Step: AIC=1673. 87
## gdp_current_us ~ agriculture_value_added_percent_of + co2_emissions_metric_tons_per +
##     fertility_rate_total_births_p + fixed_line_and_mobile_phone_sub +
##     foreign_direct_investment_net + gdp_growth_annual_percent +
##     gni_per_capita_atlas_method_c + gni_atlas_method_current_us +
##     gross_capital_formation_percent_of_g + immunization_measles_percent_of_chi +
##     imports_of_goods_and_services + industry_value_added_percent_of_gdp +
##     inflation_gdp_deflator_annual + internet_users_per_1_000_peopl +
##     long_term_debt_dod_current_us + merchandise_trade_percent_of_gdp +
##     net_barter_terms_of_trade_2000 + official_development_assistance +
##     population_growth_annual_percent + population_total + services/etc_value_added_percent +
##     short_term_debt_outstanding_do + surface_area_sq_km + ln_gni
##
##                                         Df      Sum of Sq
## - short_term_debt_outstanding_do  1      2416275956320512
## - industry_value_added_percent_of_gdp 1      3355856544182016
## - agriculture_value_added_percent_of 1      5358396184233728
## - services/etc_value_added_percent 1      6162081720762112
## - net_barter_terms_of_trade_2000    1      11923267962011392
## - fixed_line_and_mobile_phone_sub  1      14257311796930304
## - gni_per_capita_atlas_method_c    1      24681571577910656
## <none>
## - gdp_growth_annual_percent       1      55925347029538944
## - gross_capital_formation_percent_of_g 1      66965636854427520
## - ln_gni                          1      69663243931470848
## - population_growth_annual_percent 1      74259685211446400
## - internet_users_per_1_000_peopl  1      98827129604920960
## + life_expectancy_at_birth_total  1      2901601559422848
## + exports_of_goods_and_services   1      55660025127168
## + pop_area                        1      3551532130816
## + agricultural_land_percent_of_land_ar 1      45791641600
## - population_total                1      136642659650093440
## - co2_emissions_metric_tons_per   1      140103813334689920
## - fertility_rate_total_births_p   1      184672016504117888
## - surface_area_sq_km              1      272178724391993472
## - immunization_measles_percent_of_chi 1      430239292659028608
## - official_development_assistance 1      483144513726968960
## - imports_of_goods_and_services   1      552284231895700608
## - long_term_debt_dod_current_us   1      707194912195434880
## - merchandise_trade_percent_of_gdp 1      789437579799696256
## - inflation_gdp_deflator_annual  1      999527720319979392
## - foreign_direct_investment_net  1      1263224209880087040
## - gni_atlas_method_current_us    1      61164248487761158144
##                                         RSS      AIC
## - short_term_debt_outstanding_do 1084819706514743168 1672. 0
## - industry_value_added_percent_of_gdp 1085759287102604672 1672. 0
## - agriculture_value_added_percent_of 1087761826742656384 1672. 1
## - services/etc_value_added_percent 1088565512279184768 1672. 1

```

```

## - net_barter_terms_of_trade_2000      1094326698520434048 1672.3
## - fixed_line_and_mobile_phone_sub    1096660742355352960 1672.4
## - gni_per_capita_atlas_method_c     1107085002136333312 1672.8
## <none>                                1082403430558422656 1673.9
## - gdp_growth_annual_percent        1138328777587961600 1674.0
## - gross_capital_formation_percent_of_g 1149369067412850176 1674.5
## - ln_gni                                1152066674489893504 1674.6
## - population_growth_annual_percent    1156663115769869056 1674.7
## - internet_users_per_1_000_peopl       1181230560163343616 1675.6
## + life_expectancy_at_birth_total       1079501828998999808 1675.8
## + exports_of_goods_and_services        1082347770533295488 1675.9
## + pop_area                               1082399879026291840 1675.9
## + agricultural_land_percent_of_land_ar 1082403384766781056 1675.9
## - population_total                      1219046090208516096 1677.0
## - co2_emissions_metric_tons_per        1222507243893112576 1677.1
## - fertility_rate_total_births_p         1267075447062540544 1678.7
## - surface_area_sq_km                   1354582154950416128 1681.5
## - immunization_measles_percent_of_chi  1512642723217451264 1686.3
## - official_development_assistance     1565547944285391616 1687.7
## - imports_of_goods_and_services        1634687662454123264 1689.6
## - long_term_debt_dod_current_us       1789598342753857536 1693.5
## - merchandise_trade_percent_of_gdp   1871841010358118912 1695.4
## - inflation_gdp_deflator_annual       2081931150878402048 1700.0
## - foreign_direct_investment_net       2345627640438509568 1705.1
## - gni_atlas_method_current_us         62246651918319583232 1846.1
## 

## Step: AIC=1671.97

## gdp_current_us ~ agriculture_value_added_percent_of + co2_emissions_metric_tons_per +
##   fertility_rate_total_births_p + fixed_line_and_mobile_phone_sub +
##   foreign_direct_investment_net + gdp_growth_annual_percent +
##   gni_per_capita_atlas_method_c + gni_atlas_method_current_us +
##   gross_capital_formation_percent_of_g + immunization_measles_percent_of_chi +
##   imports_of_goods_and_services + industry_value_added_percent_of_gdp +
##   inflation_gdp_deflator_annual + internet_users_per_1_000_peopl +
##   long_term_debt_dod_current_us + merchandise_trade_percent_of_gdp +
##   net_barter_terms_of_trade_2000 + official_development_assistance +
##   population_growth_annual_percent + population_total + services/etc_value_added_percent +
##   surface_area_sq_km + ln_gni

## 

##                                     Df   Sum of Sq
## - industry_value_added_percent_of_gdp  1   4673530928760448
## - agriculture_value_added_percent_of   1   6980825410038400
## - services/etc_value_added_percent    1   7854870828990208
## - net_barter_terms_of_trade_2000       1   11534731331444096
## - fixed_line_and_mobile_phone_sub     1   13913751460602624
## - gni_per_capita_atlas_method_c      1   23615311909029376
## <none>
## - gdp_growth_annual_percent          1   53807910283575040
## - gross_capital_formation_percent_of_g 1   66661695964154752
## - population_growth_annual_percent    1   73785353986294656
## - ln_gni                                1   87967376508903808
## - internet_users_per_1_000_peopl       1   98510632633282176
## + short_term_debt_outstanding_do      1   2416275956321280
## + life_expectancy_at_birth_total       1   526955253175296
## + pop_area                               1   44862086080512
## + exports_of_goods_and_services        1   16667629653888
## + agricultural_land_percent_of_land_ar 1   9212528002944
## - co2_emissions_metric_tons_per        1   137796686618816080
## - population_total                      1   162061810250615168
## - fertility_rate_total_births_p         1   254807699132524928
## - immunization_measles_percent_of_chi  1   444153155138798464
## - official_development_assistance     1   487556944657567104
## - imports_of_goods_and_services        1   555920778933244544
## - surface_area_sq_km                   1   565035391016593792
## - long_term_debt_dod_current_us       1   755494641233360512
## - merchandise_trade_percent_of_gdp   1   896762615807665536
## - inflation_gdp_deflator_annual      1   1179069692338170880
## - foreign_direct_investment_net      1   1268702525175948800
## - gni_atlas_method_current_us         1   64047178690117632000
## 

```

RSS AIC

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## - industry_value_added_percent_of_gdp 1089493237443503616 1670.2
## - agriculture_value_added_percent_of 1091800531924781568 1670.2
## - services_etc_value_added_percent 1092674577343733376 1670.3
## - net_barter_terms_of_trade_2000 1096354437846187264 1670.4
## - fixed_line_and_mobile_phone_sub 1098733457975345792 1670.5
## - gni_per_capita_atlas_method_c 1108435018423772544 1670.9
## <none> 1084819706514743168 1672.0
## - gdp_growth_annual_percent 1138627616798318208 1672.0
## - gross_capital_formation_percent_of_g 1151481402478897920 1672.5
## - population_growth_annual_percent 1158605060501037824 1672.8
## - ln_gni 1172787083023646976 1673.3
## - internet_users_per_l_000_peopl 1183330339148025344 1673.7
## + short_term_debt_outstanding_do 1082403430558421888 1673.9
## + life_expectancy_at_birth_total 1084292751261567872 1674.0
## + pop_area 1084774844428662656 1674.0
## + exports_of_goods_and_services 1084803038885089280 1674.0
## + agricultural_land_percent_of_land_ar 1084810493986740224 1674.0
## - co2_emissions_metric_tons_per 1222616393133589248 1675.1
## - population_total 1246881516765358336 1676.0
## - fertility_rate_total_births_p 1339627405647268096 1679.0
## - immunization_measles_percent_of_chi 1528972861653541632 1684.7
## - official_development_assistance 1572376651172310272 1685.9
## - imports_of_goods_and_services 1640740485447987712 1687.8
## - surface_area_sq_km 1649855097531336960 1688.0
## - long_term_debt_dod_current_us 1840314347748103680 1692.7
## - merchandise_trade_percent_of_gdp 1981582322322408704 1695.9
## - inflation_gdp_deflator_annual 2263889398852913920 1701.6
## - foreign_direct_investment_net 2353522231690692096 1703.3
## - gni_atlas_method_current_us 65131998396632375296 1846.1
##
## Step: AIC=1670.45
## gdp_current_us ~ agriculture_value_added_percent_of + co2_emissions_metric_tons_per +
##     fertility_rate_total_births_p + fixed_line_and_mobile_phone_sub +
##     foreign_direct_investment_net + gdp_growth_annual_percent +
##     gni_per_capita_atlas_method_c + gni_atlas_method_current_us +
##     gross_capital_formation_percent_of_g + immunization_measles_percent_of_chi +
##     imports_of_goods_and_services + inflation_gdp_deflator_annual +
##     internet_users_per_l_000_peopl + long_term_debt_dod_current_us +
##     merchandise_trade_percent_of_gdp + net_barter_terms_of_trade_2000 +
##     official_development_assistance + population_growth_annual_percent +
##     population_total + services_etc_value_added_percent + surface_area_sq_km +
##     ln_gni
##
##                                     Df   Sum of Sq
## - net_barter_terms_of_trade_2000  1    8223123674870784
## - fixed_line_and_mobile_phone_sub 1    11274702289502976
## - gni_per_capita_atlas_method_c  1    21343811032461440
## - gdp_growth_annual_percent  1    50536085683374464
## <none>
## - gross_capital_formation_percent_of_g 1    65390903750624256
## - population_growth_annual_percent  1    69646968238682112
## - ln_gni 1    86972396978053888
## - internet_users_per_l_000_peopl 1    95433501992459776
## + industry_value_added_percent_of_gdp 1    4673530928760576
## + short_term_debt_outstanding_do 1    3733950340898432
## + pop_area 1    364805143362304
## + life_expectancy_at_birth_total 1    130611856925568
## + agricultural_land_percent_of_land_ar 1    94599095382016
## + exports_of_goods_and_services 1    42053025392128
## - co2_emissions_metric_tons_per 1    133851727673719552
## - services_etc_value_added_percent 1    134414631255804672
## - agriculture_value_added_percent_of 1    146888041059233536
## - population_total 1    158537469859214592
## - fertility_rate_total_births_p 1    250370072238498560
## - immunization_measles_percent_of_chi 1    486318818719090432
## - imports_of_goods_and_services 1    569697726464924672
## - surface_area_sq_km 1    571789061757212160
## - official_development_assistance 1    673627780979876608
## - long_term_debt_dod_current_us 1    752161693066239232
## - merchandise_trade_percent_of_gdp 1    930749792681523200

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## - inflation_gdp_deflator_annual      1 1197129860633508096
## - foreign_direct_investment_net    1 1325755848646173184
## - gni_atlas_method_current_us      1 64115612031367282698
##                                     RSS   AIC
## - net_barter_terms_of_trade_2000    1097716361118374400 1668.5
## - fixed_line_and_mobile_phone_sub   1100767939733006592 1668.6
## - gni_per_capita_atlas_method_c    1110837048475965056 1669.0
## - gdp_growth_annual_percent       1140029323126878080 1670.1
## <none>                            1089493237443503616 1670.2
## - gross_capitalFormation_percent_of_g 1154884141194127872 1670.7
## - populationGrowth_annual_percent  1159140205682185728 1670.8
## - ln_gni                           1176465634421557504 1671.5
## - internetUsers_per_1_000_peopl     1184926739435963392 1671.8
## + industryValue_added_percent_of_gdp 1084819706514743040 1672.0
## + shortTerm_debt_outstanding_do    1085759287102605184 1672.0
## + pop_area                          1089128432300141312 1672.1
## + lifeExpectancy_at_birth_total    1089362625586578048 1672.2
## + agriculturalLand_percent_of_land_ar 1089398638348121600 1672.2
## + exportsOf_goods_and_services     1089451184418111488 1672.2
## - co2_emissionsMetric_tons_per     1223344965117223168 1673.1
## - servicesEtc_value_added_percent 1223907868699308288 1673.2
## - agricultureValue_added_percent_of 1236381278502737152 1673.6
## - populationTotal                 1248030707302718208 1674.0
## - fertilityRate_totalBirths_p      1339863309682002176 1677.0
## - immunizationMeasles_percent_of_chi 1575812056162594048 1684.0
## - importsOf_goods_and_services     1659190963908428288 1686.2
## - surfaceArea_sq_km                1661282299200715776 1686.3
## - officialDevelopmentAssistance   1763121018423380224 1688.8
## - longTerm_debt_dod_current_us    1841654930509742848 1690.7
## - merchandiseTrade_percent_of_gdp 2020243030125026816 1694.7
## - inflationGdp_deflator_annual    2286623098077011712 1700.0
## - foreignDirect_investment_net    2415249086089676800 1702.4
## - gni_atlas_method_current_us      65205105268810784778 1844.1
## 

## Step: AIC=1668.48

## gdp_current_us ~ agricultureValue_added_percent_of + co2_emissionsMetric_tons_per +
##   fertilityRate_totalBirths_p + fixedLineAndMobilePhoneSub +
##   foreignDirect_investment_net + gdpGrowth_annual_percent +
##   gniPerCapita_atlasMethod_c + gni_atlas_method_current_us +
##   grossCapitalFormation_percent_of_g + immunizationMeasles_percent_of_chi +
##   importsOf_goods_and_services + inflationGdp_deflator_annual +
##   internetUsers_per_1_000_peopl + longTerm_debt_dod_current_us +
##   merchandiseTrade_percent_of_gdp + officialDevelopmentAssistance +
##   populationGrowth_annual_percent + populationTotal + servicesEtc_value_added_percent +
##   surfaceArea_sq_km + ln_gni

## 

##                               Df      Sum of Sq
## - fixedLineAndMobilePhoneSub      1 10879675015511296
## - gniPerCapita_atlasMethod_c     1 15894618735720320
## - gdpGrowth_annual_percent       1 49892198452883712
## <none>
## - populationGrowth_annual_percent 1 61433764454582016
## - grossCapitalFormation_percent_of_g 1 79552719998885632
## - ln_gni                         1 84731482496784128
## + netBarterTerms_of_trade_2000    1 8223123674870400
## + shortTerm_debt_outstanding_do  1 2676325925356416
## + industryValue_added_percent_of_gdp 1 1361923272186752
## + agriculturalLand_percent_of_land_ar 1 387746862478848
## + lifeExpectancy_at_birth_total   1 43146990234880
## + pop_area                        1 1670751468032
## + exportsOf_goods_and_services    1 202712028672
## - internetUsers_per_1_000_peopl  1 118507138984184064
## - co2_emissionsMetric_tons_per   1 125635078701227008
## - servicesEtc_value_added_percent 1 134013535679627008
## - populationTotal                 1 150384899176676608
## - agricultureValue_added_percent_of 1 152396046744413952
## - fertilityRate_totalBirths_p     1 244475523202481408
## - immunizationMeasles_percent_of_chi 1 525977833932805120
## - importsOf_goods_and_services    1 561508374620960000
## - surfaceArea_sq_km               1 595535535441054464

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## - official_development_assistance      1   670779119159345664
## - long_term_debt_dod_current_us       1   764729532228553216
## - merchandise_trade_percent_of_gdp   1   923040190099342592
## - inflation_gdp_deflator_annual     1   1189200211587013632
## - foreign_direct_investment_net    1   1429967700956758528
## - gni_atlas_method_current_us       1   64118059905848885258
##
##                                     RSS   AIC
## - fixed_line_and_mobile_phone_sub   1108596036133885696 1666.9
## - gni_per_capita_atlas_method_c   1113610979854094720 1667.1
## - gdp_growth_annual_percent      1147608559571258112 1668.4
## <none>                            1097716361118374400 1668.5
## - population_growth_annual_percent 1159150125572956416 1668.8
## - gross_capital_formation_percent_of_g 1177269081117260032 1669.5
## - ln_gni                           1182447843615158528 1669.7
## + net_barter_terms_of_trade_2000   1089493237443504000 1670.2
## + short_term_debt_outstanding_do  1095040035193017984 1670.4
## + industry_value_added_percent_of_gdp 1096354437846187648 1670.4
## + agricultural_land_percent_of_land_ar 1097328614255895552 1670.5
## + life_expectancy_at_birth_total   1097673214128139520 1670.5
## + pop_area                          1097714690366906368 1670.5
## + exports_of_goods_and_services    1097716158406345728 1670.5
## - internet_users_per_l_000_peopl  1216223500102558464 1670.9
## - co2_emissions_metric_tons_per   1223351439819601408 1671.1
## - services/etc_value_added_percent 1231729896798001408 1671.4
## - population_total                 1248101260295051008 1672.0
## - agriculture_value_added_percent_of 1250112407862788352 1672.1
## - fertility_rate_total_births_p    1342191884320855808 1675.1
## - immunization_measles_percent_of_chi 1623694195051179520 1683.3
## - imports_of_goods_and_services    1659224735739334400 1684.2
## - surface_area_sq_km              1693251896559428864 1685.1
## - official_development_assistance 1768495480277720064 1687.0
## - long_term_debt_dod_current_us   1862445893346927616 1689.2
## - merchandise_trade_percent_of_gdp 2020756551217716992 1692.7
## - inflation_gdp_deflator_annual   2286916572705388032 1698.0
## - foreign_direct_investment_net   2527684062075132928 1702.3
## - gni_atlas_method_current_us     65215776266967261184 1842.1
##
## Step:  AIC=1666.9
## gdp_current_us ~ agriculture_value_added_percent_of + co2_emissions_metric_tons_per +
##   fertility_rate_total_births_p + foreign_direct_investment_net +
##   gdp_growth_annual_percent + gni_per_capita_atlas_method_c +
##   gni_atlas_method_current_us + gross_capital_formation_percent_of_g +
##   immunization_measles_percent_of_chi + imports_of_goods_and_services +
##   inflation_gdp_deflator_annual + internet_users_per_l_000_peopl +
##   long_term_debt_dod_current_us + merchandise_trade_percent_of_gdp +
##   official_development_assistance + population_growth_annual_percent +
##   population_total + services/etc_value_added_percent + surface_area_sq_km +
##   ln_gni
##
##                                     Df   Sum of Sq
## - gni_per_capita_atlas_method_c   1   5289127515952896
## - gdp_growth_annual_percent      1   46082507500284160
## <none>
## - population_growth_annual_percent 1   65244499241242624
## - ln_gni                         1   83354414077619408
## + fixed_line_and_mobile_phone_sub 1   10879675015490176
## - gross_capital_formation_percent_of_g 1   97373367618391552
## + net_barter_terms_of_trade_2000   1   7828096400878848
## + short_term_debt_outstanding_do  1   1987296432272640
## + life_expectancy_at_birth_total   1   906940025526272
## + pop_area                        1   693866863428480
## + industry_value_added_percent_of_gdp 1   271168580429824
## + agricultural_land_percent_of_land_ar 1   119945416329472
## + exports_of_goods_and_services    1   69788553163520
## - co2_emissions_metric_tons_per   1   116259293825027840
## - internet_users_per_l_000_peopl  1   119868909057723648
## - services/etc_value_added_percent 1   129479275943166464
## - agriculture_value_added_percent_of 1   141851858935455488
## - population_total                 1   146312663213373184
## - fertility_rate_total_births_p    1   250128869588531456

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## - immunization_measles_percent_of_chi    1   516425530503304704
## - imports_of_goods_and_services          1   556251650515319808
## - surface_area_sq_km                   1   597981727118689280
## - official_development_assistance      1   664436129857569536
## - long_term_debt_dod_current_us        1   775247180327102208
## - merchandise_trade_percent_of_gdp     1   916405872140583168
## - inflation_gdp_deflator_annual       1   1179307144516760576
## - foreign_direct_investment_net        1   1549521404336030976
## - gni_atlas_method_current_us          1   66027766557238083584
##                                         RSS   AIC
## - gni_per_capita_atlas_method_c        1113885163649838592 1665.1
## - gdp_growth_annual_percent           1154678543634169856 1666.7
## <none>                                1108596036133885696 1666.9
## - population_growth_annual_percent    1173840535375128320 1667.4
## - ln_gni                               1191950450211535104 1668.0
## + fixed_line_and_mobile_phone_sub      1097716361118395520 1668.5
## - gross_capitalFormation_percent_of_g 1205969403752277248 1668.5
## + net_barter_terms_of_trade_2000       1100767939733006848 1668.6
## + short_term_debt_outstanding_do      1106608739701613056 1668.8
## + life_expectancy_at_birth_total       1107689096108359424 1668.9
## + pop_area                            1107902169270457216 1668.9
## + industry_value_added_percent_of_gdp 1108324867553455872 1668.9
## + agricultural_land_percent_of_land_ar 1108476090717556224 1668.9
## + exports_of_goods_and_services        1108526247580722176 1668.9
## - co2_emissions_metric_tons_per       1224855329958913536 1669.2
## - internet_users_per_1_000_peopl      1228464945191609344 1669.3
## - services/etc_value_added_percent    1238075312077052160 1669.7
## - agriculture_value_added_percent_of 1250447895069341184 1670.1
## - population_total                    1254908699347258880 1670.2
## - fertility_rate_total_births_p       1358724905722417152 1673.7
## - immunization_measles_percent_of_chi 1625021566637190400 1681.3
## - imports_of_goods_and_services        1664847686649205504 1682.4
## - surface_area_sq_km                  1706577763252574976 1683.5
## - official_development_assistance     1773032165991455232 1685.1
## - long_term_debt_dod_current_us       1883843216460987904 1687.7
## - merchandise_trade_percent_of_gdp   2025001908274468864 1690.8
## - inflation_gdp_deflator_annual      2287903180650646272 1696.1
## - foreign_direct_investment_net      2658117440469916672 1702.5
## - gni_atlas_method_current_us         67136362593371971584 1841.4
##
## Step: AIC=1665.11
## gdp_current_us ~ agriculture_value_added_percent_of + co2_emissions_metric_tons_per +
##     fertility_rate_total_births_p + foreign_direct_investment_net +
##     gdp_growth_annual_percent + gni_atlas_method_current_us +
##     gross_capitalFormation_percent_of_g + immunization_measles_percent_of_chi +
##     imports_of_goods_and_services + inflation_gdp_deflator_annual +
##     internet_users_per_1_000_peopl + long_term_debt_dod_current_us +
##     merchandise_trade_percent_of_gdp + official_development_assistance +
##     population_growth_annual_percent + population_total + services/etc_value_added_percent +
##     surface_area_sq_km + ln_gni
##
##                                         Df   Sum of Sq
## - gdp_growth_annual_percent          1   44938157314167808
## <none>
## - population_growth_annual_percent  1   67252489349150976
## - ln_gni                            1   84820943873047552
## - gross_capitalFormation_percent_of_g 1   92296414360607232
## + gni_per_capita_atlas_method_c     1   5289127515954176
## + net_barter_terms_of_trade_2000    1   3043133138485248
## + life_expectancy_at_birth_total    1   2177757552028288
## + short_term_debt_outstanding_do   1   1718108539606656
## + industry_value_added_percent_of_gdp 1   731577952941056
## + pop_area                          1   676626464619904
## + exports_of_goods_and_services     1   463490928815744
## + fixed_line_and_mobile_phone_sub   1   274183795729280
## + agricultural_land_percent_of_land_ar 1   38489222471040
## - services/etc_value_added_percent  1   125445555896308224
## - agriculture_value_added_percent_of 1   137475446912978432
## - internet_users_per_1_000_peopl   1   138905030634032384
## - co2_emissions_metric_tons_per     1   164060756445106688

```

```

## - population_total 1 170856790366916096
## - fertility_rate_total_births_p 1 247945213239250176
## - immunization_measles_percent_of_chi 1 511311845569327104
## - imports_of_goods_and_services 1 565396668409730048
## - surface_area_sq_km 1 593975547070087936
## - official_development_assistance 1 708822815311496704
## - long_term_debt_dod_current_us 1 827066103966026752
## - merchandise_trade_percent_of_gdp 1 918322330802100480
## - inflation_gdp_deflator_annual 1 1176124891449844224
## - foreign_direct_investment_net 1 1569562509085733888
## - gni_atlas_method_current_us 1 66249627417851658240
##
##          RSS      AIC
## - gdp_growth_annual_percent 1158823320964006400 1664.8
## <none>                      1113885163649838592 1665.1
## - population_growth_annual_percent 1181137652998989568 1665.6
## - ln_gni                      1198706107522886144 1666.3
## - gross_capital_formation_percent_of_g 120618157801044824 1666.5
## + gni_per_capita_atlas_method_c 1108596036133884416 1666.9
## + net_barter_terms_of_trade_2000 1110842030511353344 1667.0
## + life_expectancy_at_birth_total 1111707406097810304 1667.0
## + short_term_debt_outstanding_do 1112167055110231936 1667.0
## + industry_value_added_percent_of_gdp 1113153585696897536 1667.1
## + pop_area                     1113208537185218688 1667.1
## + exports_of_goods_and_services 1113421672721022848 1667.1
## + fixed_line_and_mobile_phone_sub 1113610979854109312 1667.1
## + agricultural_land_percent_of_land_ar 1113846674427367552 1667.1
## - services/etc_value_added_percent 1239330719546146816 1667.7
## - agriculture_value_added_percent_of 1251360610562817024 1668.1
## - internet_users_per_1_000_peopl 1252790194283870976 1668.2
## - co2_emissions_metric_tons_per 1277945920094945280 1669.0
## - population_total              1284741954016754688 1669.2
## - fertility_rate_total_births_p 1361830376889088768 1671.8
## - immunization_measles_percent_of_chi 1625197009219165696 1679.3
## - imports_of_goods_and_services 1679281832059568640 1680.8
## - surface_area_sq_km            1707860710719926528 1681.5
## - official_development_assistance 1822707978961335296 1684.3
## - long_term_debt_dod_current_us 1940951267615865344 1687.0
## - merchandise_trade_percent_of_gdp 2032207494451939072 1689.0
## - inflation_gdp_deflator_annual 2290010055099682816 1694.1
## - foreign_direct_investment_net 2683447672735572480 1700.9
## - gni_atlas_method_current_us    67363512581501493258 1839.5
##
## Step:  AIC=1664.81
## gdp_current_us ~ agriculture_value_added_percent_of + co2_emissions_metric_tons_per +
##   fertility_rate_total_births_p + foreign_direct_investment_net +
##   gni_atlas_method_current_us + gross_capital_formation_percent_of_g +
##   immunization_measles_percent_of_chi + imports_of_goods_and_services +
##   inflation_gdp_deflator_annual + internet_users_per_1_000_peopl +
##   long_term_debt_dod_current_us + merchandise_trade_percent_of_gdp +
##   official_development_assistance + population_growth_annual_percent +
##   population_total + services/etc_value_added_percent + surface_area_sq_km +
##   ln_gni
##
##          Df     Sum of Sq
## - population_growth_annual_percent 1  42075373666004992
## <none>
## + gdp_growth_annual_percent       1  44938157314169856
## - services/etc_value_added_percent 1  80519731997257216
## - gross_capital_formation_percent_of_g 1  80612270524322560
## - internet_users_per_1_000_peopl 1  98903413434597888
## + exports_of_goods_and_services    1  4532161306723072
## + gni_per_capita_atlas_method_c   1  4144777329837056
## + net_barter_terms_of_trade_2000  1  3072270136065536
## + agricultural_land_percent_of_land_ar 1  2587893598101760
## + pop_area                        1  1743140265646080
## + life_expectancy_at_birth_total  1  509956805466112
## + fixed_line_and_mobile_phone_sub 1  89392495070976
## + short_term_debt_outstanding_do 1  87112540612864
## + industry_value_added_percent_of_gdp 1  14075770961664
## - co2_emissions_metric_tons_per   1  120532021107666688

```

```

## - agriculture_value_added_percent_of    1   122410145781033216
## - ln_gni                                1   136343634217487360
## - population_total                      1   183339963530344960
## - fertility_rate_total_births_p          1   281867089497119232
## - immunization_measles_percent_of_chi    1   468456454085087232
## - imports_of_goods_and_services          1   556146683508982272
## - surface_area_sq_km                     1   571269491651483904
## - official_development_assistance       1   664038599791798528
## - long_term_debt_dod_current_us         1   843586548055708416
## - merchandise_trade_percent_of_gdp      1   932732121954476544
## - inflation_gdp_deflator_annual        1   1131956487336028416
## - foreign_direct_investment_net        1   1586787785396675584
## - gni_atlas_method_current_us           1   66318970309552963584
##                                     RSS     AIC
## - population_growth_annual_percent     1200898694630011392 1664.3
## <none>                                 1158823320964006400 1664.8
## + gdp_growth_annual_percent           1113885163649836544 1665.1
## - services/etc_value_added_percent     1239343052961263616 1665.7
## - gross_capital_formation_percent_of_g 1239435591488328960 1665.7
## - internet_users_per_1_000_peopl       1257726734398604288 1666.3
## + exports_of_goods_and_services        1154291159657283328 1666.6
## + gni_per_capita_atlas_method_c       1154678543634169344 1666.7
## + net_barter_terms_of_trade_2000       1155751050827940864 1666.7
## + agricultural_land_percent_of_land_ar 1156235427365904640 1666.7
## + pop_area                            1157080180698360320 1666.7
## + life_expectancy_at_birth_total      1158313364158540288 1666.8
## + fixed_line_and_mobile_phone_sub     1158733928468935424 1666.8
## + short_term_debt_outstanding_do     1158736208423393536 1666.8
## + industry_value_added_percent_of_gdp 1158809245193044736 1666.8
## - co2_emissions_metric_tons_per      1279355342071673088 1667.1
## - agriculture_value_added_percent_of 1281233466745039616 1667.1
## - ln_gni                                1295166955181493760 1667.6
## - population_total                      1342163284494351360 1669.1
## - fertility_rate_total_births_p        1440690410461125632 1672.2
## - immunization_measles_percent_of_chi 1627279775049093632 1677.4
## - imports_of_goods_and_services        1714970004472988672 1679.7
## - surface_area_sq_km                   1730092812615490304 1680.0
## - official_development_assistance     1822861920755804928 1682.3
## - long_term_debt_dod_current_us       2002409869019714816 1686.3
## - merchandise_trade_percent_of_gdp    2091555442918482944 1688.2
## - inflation_gdp_deflator_annual      2290779808300034816 1692.1
## - foreign_direct_investment_net      2745611106360681984 1699.9
## - gni_atlas_method_current_us         67477793630516969472 1837.6
##
## Step:  AIC=1664.34
## gdp_current_us ~ agriculture_value_added_percent_of + co2_emissions_metric_tons_per +
##     fertility_rate_total_births_p + foreign_direct_investment_net +
##     gni_atlas_method_current_us + gross_capital_formation_percent_of_g +
##     immunization_measles_percent_of_chi + imports_of_goods_and_services +
##     inflation_gdp_deflator_annual + internet_users_per_1_000_peopl +
##     long_term_debt_dod_current_us + merchandise_trade_percent_of_gdp +
##     official_development_assistance + population_total + services/etc_value_added_percent +
##     surface_area_sq_km + ln_gni
##
##                                     Df     Sum of Sq
## <none>
## - services/etc_value_added_percent     1   58884146077415168
## + population_growth_annual_percent    1   42075373666004992
## - gross_capital_formation_percent_of_g 1   80861495394739200
## - co2_emissions_metric_tons_per       1   89480363655401984
## - internet_users_per_1_000_peopl      1   90487719035214336
## + gdp_growth_annual_percent          1   19761041631023360
## + exports_of_goods_and_services       1   11730309435210496
## + gni_per_capita_atlas_method_c      1   5983867477020160
## + life_expectancy_at_birth_total     1   5844999173437440
## + agricultural_land_percent_of_land_ar 1   2386236942694656
## + pop_area                           1   1212500656382208
## + net_barter_terms_of_trade_2000      1   334581338067456
## + short_term_debt_outstanding_do     1   188183899747840
## + fixed_line_and_mobile_phone_sub    1   182925211776000

```

```

## + industry_value_added_percent_of_gdp 1 10987410320896
## - agriculture_value_added_percent_of 1 125302697539593728
## - population_total 1 158108475841022976
## - ln_gni 1 177014010715320064
## - fertility_rate_total_births_p 1 239884122559337216
## - immunization_measles_percent_of_chi 1 513691687622270464
## - imports_of_goods_and_services 1 522276316700178176
## - surface_area_sq_km 1 609183272629523456
## - official_development_assistance 1 626492479896983040
## - long_term_debt_dod_current_us 1 801516132245993216
## - merchandise_trade_percent_of_gdp 1 890753388910528768
## - inflation_gdp_deflator_annual 1 1295775698209354752
## - foreign_direct_investment_net 1 1544861312935375360
## - gni_atlas_method_current_us 1 68886257931335802880
##          RSS      AIC
## <none> 1200898694630011392 1664.3
## - services/etc_value_added_percent 1259782840707426560 1664.4
## + population/growth/annual_percent 1158823320964006400 1664.8
## - gross_capital/formation/percent_of_g 1281760190024750592 1665.1
## - co2_emissions/metric_tons_per 1290379058285413376 1665.4
## - internet_users/per_1_000_peopl 1291386413665225728 1665.5
## + gdp/growth/annual_percent 1181137652998988032 1665.6
## + exports/of_goods_and_services 1189168385194800896 1665.9
## + gni/per_capita/atlas/method_c 1194914827152991232 1666.1
## + life_expectancy/at_birth_total 1195053695456573952 1666.1
## + agricultural/land/percent_of_land_ar 1198512457687316736 1666.3
## + pop_area 1199686193973629184 1666.3
## + net_barter/terms/of_trade_2000 1200564113291943936 1666.3
## + short_term/debt/outstanding/do 1200710510730263552 1666.3
## + fixed_line/and/mobile_phone/sub 1200715769418235392 1666.3
## + industry/value_added/percent/of_gdp 1200887707219690496 1666.3
## - agriculture/value_added/percent/of 1326201392169605120 1666.6
## - population/total 1359007170471034368 1667.7
## - ln_gni 1377912705345331456 1668.2
## - fertility_rate/total/births_p 1440782817189348608 1670.2
## - immunization/measles/percent/of_chi 1714590382252281856 1677.7
## - imports/of_goods_and_services 1723175011330189568 1677.9
## - surface_area/sq_km 1810081967259534848 1680.0
## - official/development/assistance 1827391174526994432 1680.4
## - long_term/debt/dod/current/us 2002414826876004608 1684.3
## - merchandise/trade/percent/of_gdp 2091652083540540160 1686.2
## - inflation/gdp/deflator/annual 2496674392839366144 1693.8
## - foreign/direct/investment/net 2745760007565386752 1697.9
## - gni/atlas/method/current/us 70087156625965817856 1837.2

```

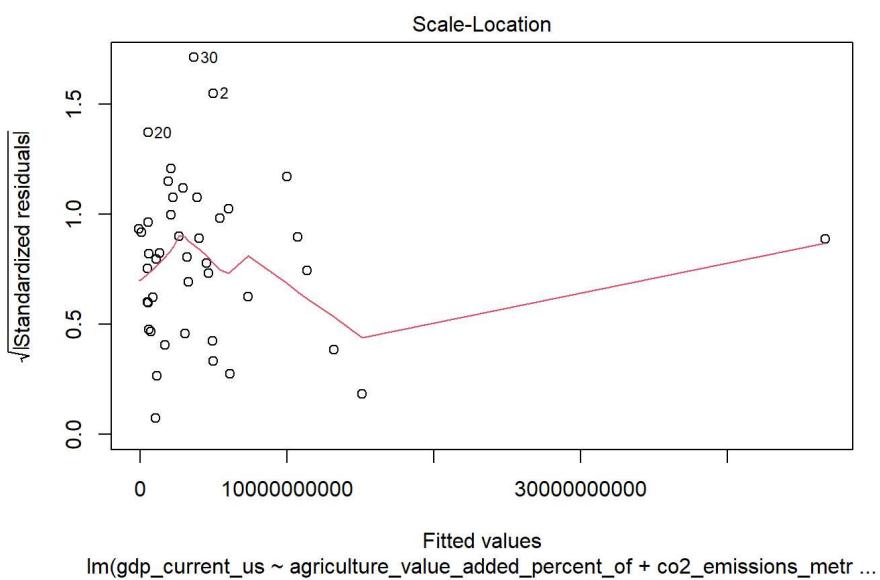
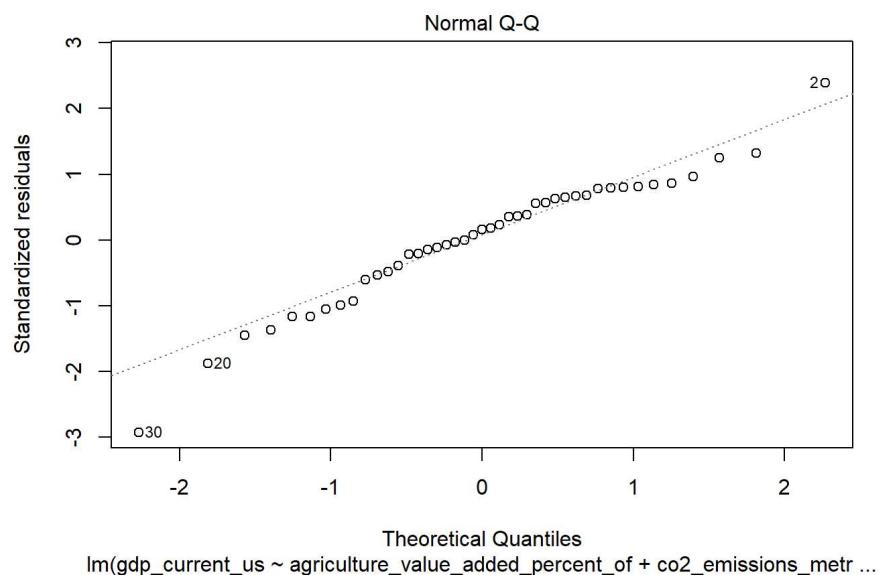
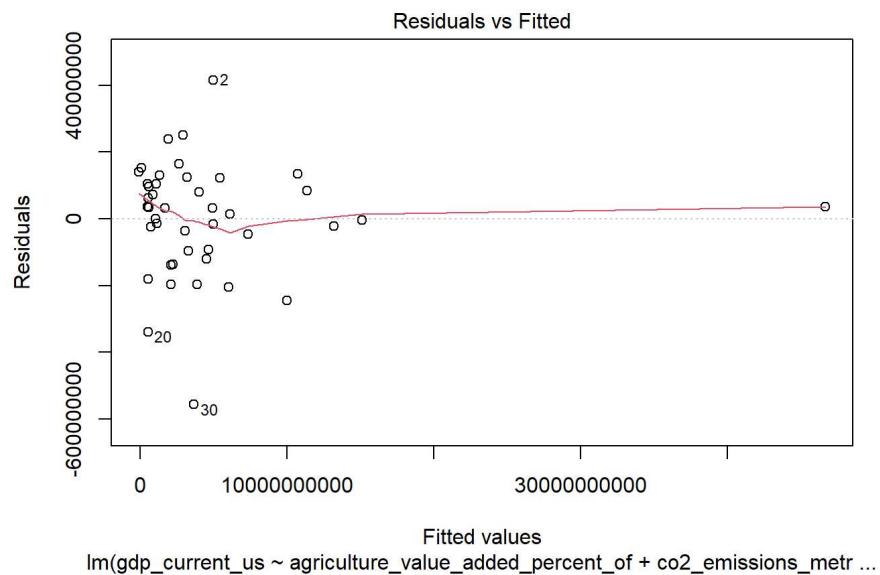
```
summary(step)
```

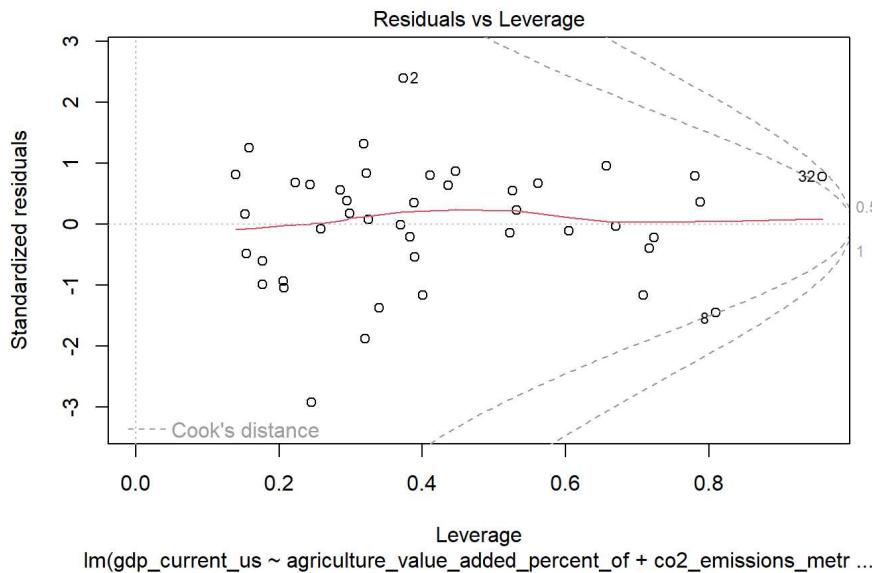
```

## 
## Call:
## lm(formula = gdp_current_us ~ agriculture_value_added_percent_of +
##     co2_emissions_metric_tons_per + fertility_rate_total_births_p +
##     foreign_direct_investment_net + gni_atlas_method_current_us +
##     gross_capital_formation_percent_of_g + immunization_measles_percent_of_chi +
##     imports_of_goods_and_services + inflation_gdp_deflator_annual +
##     internet_users_per_1_000_peopl + long_term_debt_dod_current_us +
##     merchandise_trade_percent_of_gdp + official_development_assistance +
##     population_total + services/etc_value_added_percent + surface_area_sq_km +
##     ln_gni, data = prosperity)
## 
## Residuals:
##      Min        1Q     Median        3Q       Max 
## -557135866 -93835138  32999451  104536897  415329881 
## 
## Coefficients:
##                               Estimate Std. Error
## (Intercept)             -1932762607.67321 1104135691.40491
## agriculture_value_added_percent_of    6308406.20813   3905913.50854
## co2_emissions_metric_tons_per        122980997.39147   90106749.38408
## fertility_rate_total_births_p        129509386.36076   57954034.59868
## foreign_direct_investment_net        1.66971     0.29443
## gni_atlas_method_current_us         1.03515     0.02734
## gross_capital_formation_percent_of_g -8573085.69731   6607687.00088
## immunization_measles_percent_of_chi -11539435.15837   3528714.02918
## imports_of_goods_and_services        11134920.06937   3376914.92524
## inflation_gdp_deflator_annual       33593254.98863   6468005.09250
## internet_users_per_1_000_peopl      -4446594.89214   3239783.03086
## long_term_debt_dod_current_us       0.14250     0.03488
## merchandise_trade_percent_of_gdp    -8390528.47327   1948470.14541
## official_development_assistance     -0.40561     0.11231
## population_total                   -9.68322     5.33734
## services/etc_value_added_percent    5118698.90472   4623209.51519
## surface_area_sq_km                  -326.72699    91.74749
## ln_gni                            255404899.76663  133048071.99416
##                               t value Pr(>|t|)    
## (Intercept)             -1.750   0.092301 .
## agriculture_value_added_percent_of  1.615   0.118843
## co2_emissions_metric_tons_per      1.365   0.184463
## fertility_rate_total_births_p      2.235   0.034613 *
## foreign_direct_investment_net     5.671   0.00000664 ***
## gni_atlas_method_current_us       37.869 < 0.0000000000000002 ***
## gross_capital_formation_percent_of_g -1.297   0.206325
## immunization_measles_percent_of_chi -3.270   0.003127 **
## imports_of_goods_and_services      3.297   0.002924 **
## inflation_gdp_deflator_annual     5.194   0.00002259 ***
## internet_users_per_1_000_peopl     -1.372   0.182098
## long_term_debt_dod_current_us     4.085   0.000398 ***
## merchandise_trade_percent_of_gdp   -4.306   0.000225 ***
## official_development_assistance   -3.611   0.001334 **
## population_total                  -1.814   0.081661 .
## services/etc_value_added_percent   1.107   0.278758
## surface_area_sq_km                 -3.561   0.001514 **
## ln_gni                           1.920   0.066385 .
## --- 
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 21920000 on 25 degrees of freedom
## Multiple R-squared:  0.9995, Adjusted R-squared:  0.9991
## F-statistic:  2892 on 17 and 25 DF,  p-value: < 0.0000000000000022

```

```
plot(step)
```





```
# check reduced model for multicollinearity

vifres_2 <- car::vif(step)
vifres_2
```

```
##   agriculture_value_added_percent_of      co2_emissions_metric_tons_per
##            3.590994                      9.229495
##   fertility_rate_total_births_p          foreign_direct_investment_net
##            5.596847                      8.171882
##   gni_atlas_method_current_us gross_capitalFormation_percent_of_g
##            27.136619                     3.534825
##   immunization_measles_percent_of_chi imports_of_goods_and_services
##            3.080171                      4.933989
##   inflation_gdp_deflator_annual      internet_users_per_1_000_peopl
##            2.409348                      7.080676
##   long_term_debt_dod_current_us     merchandise_trade_percent_of_gdp
##            24.294951                     4.656191
##   official_development_assistance population_total
##            2.198518                      12.330285
##   services/etc_value_added_percent surface_area_sq_km
##            3.786939                      2.580301
##   ln_gni
##            15.019775
```

Reduced Model - Remove ln_gni (p-value > 0.05)

```
model_3 <- lm(gdp_current_us ~ agriculture_value_added_percent_of +
  co2_emissions_metric_tons_per + fertility_rate_total_births_p +
  foreign_direct_investment_net + gni_atlas_method_current_us +
  gross_capitalFormation_percent_of_g + immunization_measles_percent_of_chi +
  imports_of_goods_and_services + inflation_gdp_deflator_annual +
  internet_users_per_1_000_peopl + long_term_debt_dod_current_us +
  merchandise_trade_percent_of_gdp + official_development_assistance +
  population_total + services/etc_value_added_percent + surface_area_sq_km, data = prosperity)

model_3
```

```

## 
## Call:
## lm(formula = gdp_current_us ~ agriculture_value_added_percent_of +
##     co2_emissions_metric_tons_per + fertility_rate_total_births_p +
##     foreign_direct_investment_net + gni_atlas_method_current_us +
##     gross_capital_formation_percent_of_g + immunization_measles_percent_of_chi +
##     imports_of_goods_and_services + inflation_gdp_deflator_annual +
##     internet_users_per_1_000_peopl + long_term_debt_dod_current_us +
##     merchandise_trade_percent_of_gdp + official_development_assistance +
##     population_total + services/etc_value_added_percent + surface_area_sq_km,
##     data = prosperity)
## 
## Coefficients:
##                               (Intercept)      agriculture_value_added_percent_of
##                               -14206074.1853                  3182233.1709
##                               co2_emissions_metric_tons_per    fertility_rate_total_births_p
##                               238722283.6433                  56375250.7989
##                               foreign_direct_investment_net   gni_atlas_method_current_us
##                               1.5966                           1.0559
##                               gross_capital_formation_percent_of_g  immunization_measles_percent_of_chi
##                               -9954166.6276                  -11782035.9501
##                               imports_of_goods_and_services   inflation_gdp_deflator_annual
##                               10054698.3251                  30916156.5144
##                               internet_users_per_1_000_peopl  long_term_debt_dod_current_us
##                               -6123354.2210                  0.1388
##                               merchandise_trade_percent_of_gdp official_development_assistance
##                               -7343926.3453                  -0.4119
##                               population_total                services/etc_value_added_percent
##                               -14.1563                      6947560.3936
##                               surface_area_sq_km
##                               -289.6902

```

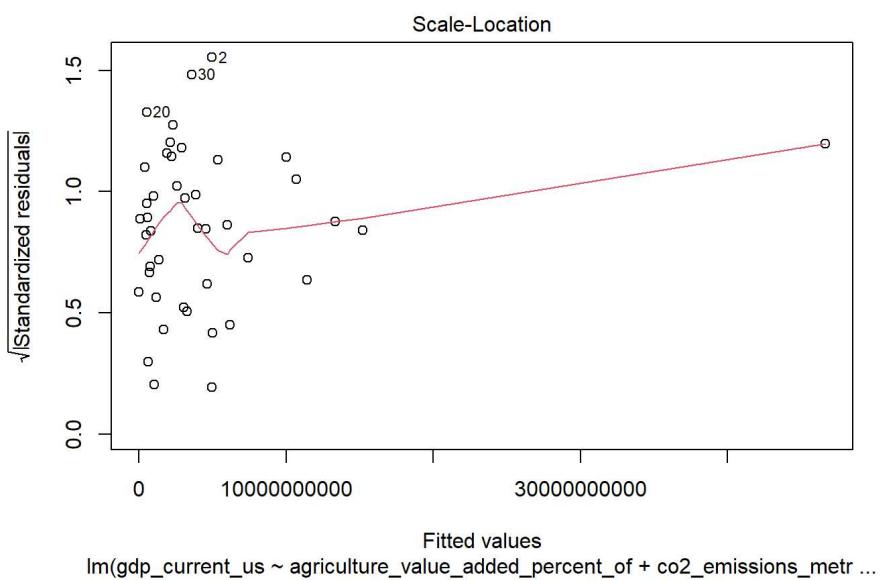
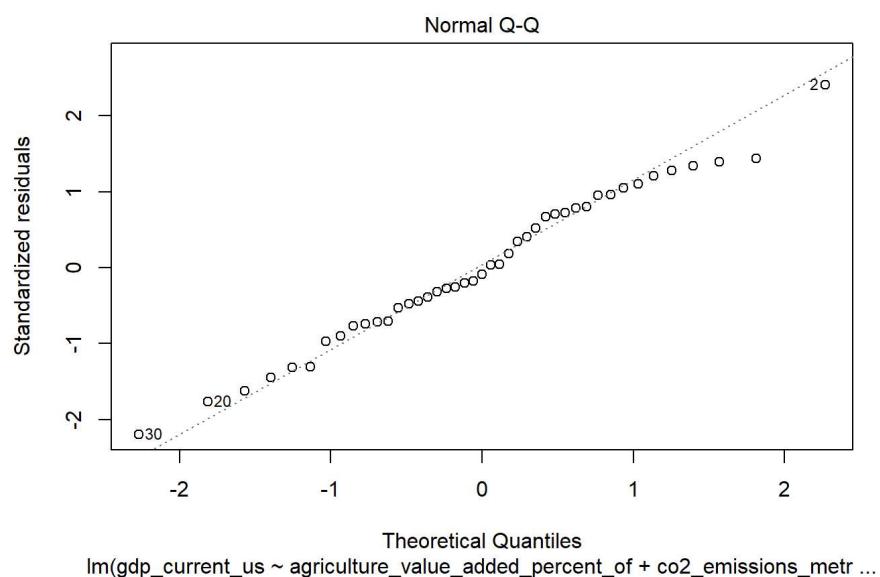
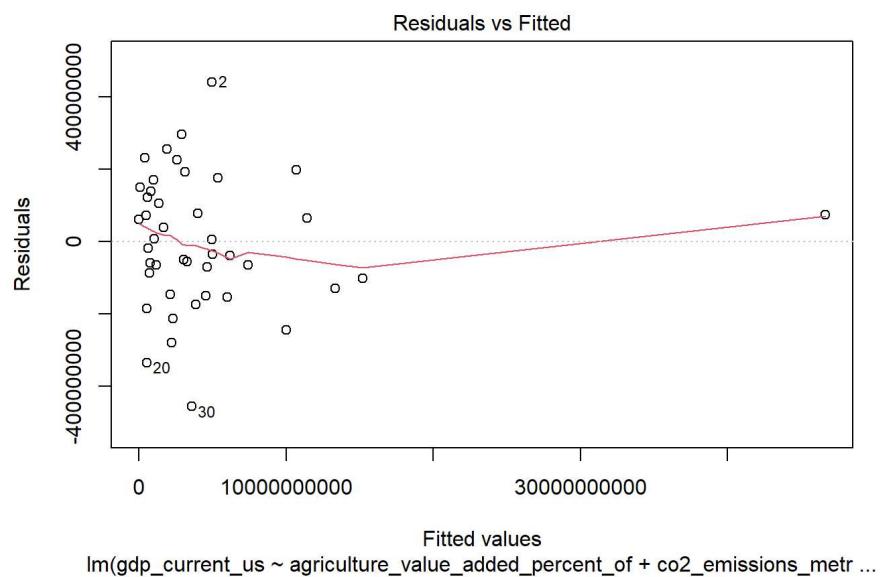
```
summary(model_3)
```

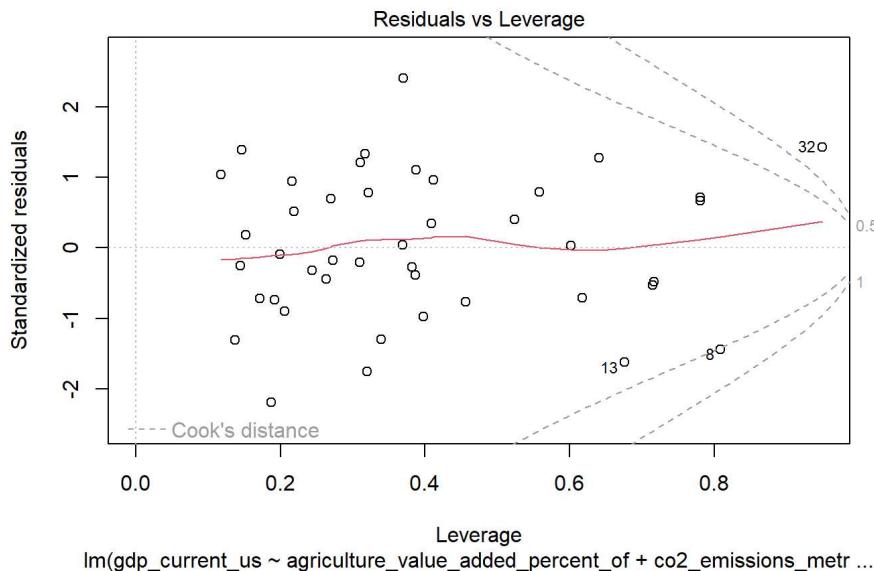
```

## 
## Call:
## lm(formula = gdp_current_us ~ agriculture_value_added_percent_of +
##     co2_emissions_metric_tons_per + fertility_rate_total_births_p +
##     foreign_direct_investment_net + gni_atlas_method_current_us +
##     gross_capital_formation_percent_of_g + immunization_measles_percent_of_chi +
##     imports_of_goods_and_services + inflation_gdp_deflator_annual +
##     internet_users_per_1_000_peopl + long_term_debt_dod_current_us +
##     merchandise_trade_percent_of_gdp + official_development_assistance +
##     population_total + services/etc_value_added_percent + surface_area_sq_km,
##     data = prosperity)
## 
## Residuals:
##      Min        1Q     Median        3Q       Max 
## -456139549 -115582265 -18264578 130300233 440621269 
## 
## Coefficients:
##                               Estimate     Std. Error t value
## (Intercept)             -14206074.18525 492943351.54085 -0.029
## agriculture_value_added_percent_of    3182233.17092 3729037.70508  0.853
## co2_emissions_metric_tons_per        238722283.64334 70335118.76871  3.394
## fertility_rate_total_births_p        56375250.79889 45871462.18207  1.229
## foreign_direct_investment_net       1.59664      0.30666  5.207
## gni_atlas_method_current_us         1.05588      0.02638 40.033
## gross_capital_formation_percent_of_g -9954166.62759 6899233.10582 -1.443
## immunization_measles_percent_of_chi -11782035.95006 3704066.34066 -3.181
## imports_of_goods_and_services       10054698.32510 3497406.20045  2.875
## inflation_gdp_deflator_annual      30916156.51439 6633981.99495  4.660
## internet_users_per_1_000_peopl     -6123354.22100 3276948.70003 -1.869
## long_term_debt_dod_current_us      0.13877      0.03658  3.793
## merchandise_trade_percent_of_gdp   -7343926.34531 1964855.90581 -3.738
## official_development_assistance    -0.41189      0.11792 -3.493
## population_total                  -14.15628      5.04369 -2.807
## services/etc_value_added_percent   6947560.39359 4751840.49566  1.462
## surface_area_sq_km                 -289.69024     94.21364 -3.075
##                               Pr(>|t|) 
## (Intercept)             0.977229
## agriculture_value_added_percent_of 0.401250
## co2_emissions_metric_tons_per      0.002218 **
## fertility_rate_total_births_p      0.230086
## foreign_direct_investment_net     0.0000195 ***
## gni_atlas_method_current_us       < 0.0000000000000002 ***
## gross_capital_formation_percent_of_g 0.161019
## immunization_measles_percent_of_chi 0.003778 **
## imports_of_goods_and_services      0.007956 **
## inflation_gdp_deflator_annual     0.0000824 ***
## internet_users_per_1_000_peopl    0.072984 .
## long_term_debt_dod_current_us     0.000800 ***
## merchandise_trade_percent_of_gdp  0.000923 ***
## official_development_assistance   0.001727 **
## population_total                  0.009359 **
## services/etc_value_added_percent   0.155703
## surface_area_sq_km                0.004904 **
## --- 
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 230200000 on 26 degrees of freedom
## Multiple R-squared:  0.9994, Adjusted R-squared:  0.9991 
## F-statistic: 2785 on 16 and 26 DF,  p-value: < 0.000000000000022

```

```
plot(model_3)
```





```
#check for multicollinearity
```

```
vifres_3 <- car::vif(model_3)
vifres_3
```

## agriculture_value_added_percent_of	co2_emissions_metric_tons_per
## 2.966750	5.097130
## fertility_rate_total_births_p	foreign_direct_investment_net
## 3.178185	8.035301
## gni_atlas_method_current_us	gross_capitalFormation_percent_of_g
## 22.899532	3.492920
## immunization_measles_percent_of_chi	imports_of_goods_and_services
## 3.076220	4.796982
## inflation_gdp_deflator_annual	internet_users_per_1_000_peopl
## 2.297341	6.565989
## long_term_debt_dod_current_us	merchandise_trade_percent_of_gdp
## 24.219566	4.291634
## official_development_assistance	population_total
## 2.196654	9.980162
## services/etc_value_added_percent	surface_area_sq_km
## 3.626126	2.466195

Reduced Model - Remove agriculture_value_added_percent_of (p-value > 0.05)

```
model_4 <- lm(gdp_current_us ~ co2_emissions_metric_tons_per + fertility_rate_total_births_p +
foreign_direct_investment_net + gni_atlas_method_current_us +
gross_capitalFormation_percent_of_g + immunization_measles_percent_of_chi +
imports_of_goods_and_services + inflation_gdp_deflator_annual +
internet_users_per_1_000_peopl + long_term_debt_dod_current_us +
merchandise_trade_percent_of_gdp + official_development_assistance +
population_total + services/etc_value_added_percent + surface_area_sq_km, data = prosperity)
```

```
model_4
```

```

## 
## Call:
## lm(formula = gdp_current_us ~ co2_emissions_metric_tons_per +
##     fertility_rate_total_births_p + foreign_direct_investment_net +
##     gni_atlas_method_current_us + gross_capital_formation_percent_of_g +
##     immunization_measles_percent_of_chi + imports_of_goods_and_services +
##     inflation_gdp_deflator_annual + internet_users_per_1_000_peopl +
##     long_term_debt_dod_current_us + merchandise_trade_percent_of_gdp +
##     official_development_assistance + population_total + services/etc_value_added_percent +
##     surface_area_sq_km, data = prosperity)
## 

## Coefficients:
##              (Intercept)          co2_emissions_metric_tons_per
##                      180440648. 9818                         213230036. 0887
##      fertility_rate_total_births_p          foreign_direct_investment_net
##                      59727184. 2421                           1. 5648
##      gni_atlas_method_current_us  gross_capital_formation_percent_of_g
##                          1. 0527                       -9572257. 9583
##  immunization_measles_percent_of_chi          imports_of_goods_and_services
##                     -11999517. 0070                         9352490. 9521
##  inflation_gdp_deflator_annual          internet_users_per_1_000_peopl
##                     32146902. 2625                        -5214430. 8441
##  long_term_debt_dod_current_us          merchandise_trade_percent_of_gdp
##                          0. 1397                         -7568805. 8789
##  official_development_assistance          population_total
##                          -0. 4211                           -13. 1527
##  services/etc_value_added_percent          surface_area_sq_km
##                      5317120. 7507                         -294. 3713
## 
```

```
summary(model_4)
```

```

## 
## Call:
## lm(formula = gdp_current_us ~ co2_emissions_metric_tons_per +
##     fertility_rate_total_births_p + foreign_direct_investment_net +
##     gni_atlas_method_current_us + gross_capital_formation_percent_of_g +
##     immunization_measles_percent_of_chi + imports_of_goods_and_services +
##     inflation_gdp_deflator_annual + internet_users_per_1_000_peopl +
##     long_term_debt_dod_current_us + merchandise_trade_percent_of_gdp +
##     official_development_assistance + population_total + services/etc_value_added_percent +
##     surface_area_sq_km, data = prosperity)
## 

## Residuals:
##      Min        1Q     Median        3Q       Max 
## -472016898 -95487373 -9932235 144303385 410774116 
## 

## Coefficients:
##                               Estimate Std. Error t value
## (Intercept)           180440648.98185 434792579.55067  0.415
## co2_emissions_metric_tons_per 213230036.08874 63354915.29325  3.366
## fertility_rate_total_births_p 59727184.24208 45472391.07656  1.313
## foreign_direct_investment_net 1.56481   0.30285  5.167
## gni_atlas_method_current_us  1.05271   0.02598 40.519
## gross_capital_formation_percent_of_g -9572257.95829 6849966.37308 -1.397
## immunization_measles_percent_of_chi -11999517.00703 3676644.29914 -3.264
## imports_of_goods_and_services    9352490.95211 3382075.53324  2.765
## inflation_gdp_deflator_annual  32146902.26250 6442644.04852  4.990
## internet_users_per_1_000_peopl -5214430.84411 3083387.44637 -1.691
## long_term_debt_dod_current_us   0.13966   0.03639  3.838
## merchandise_trade_percent_of_gdp -7568805.87886 1937280.39582 -3.907
## official_development_assistance -0.42110   0.11683 -3.604
## population_total              -13.15268   4.87992 -2.695
## services/etc_value_added_percent 5317120.75070 4328864.23424  1.228
## surface_area_sq_km             -294.37134   93.57927 -3.146
## 
## Pr(>|t|)

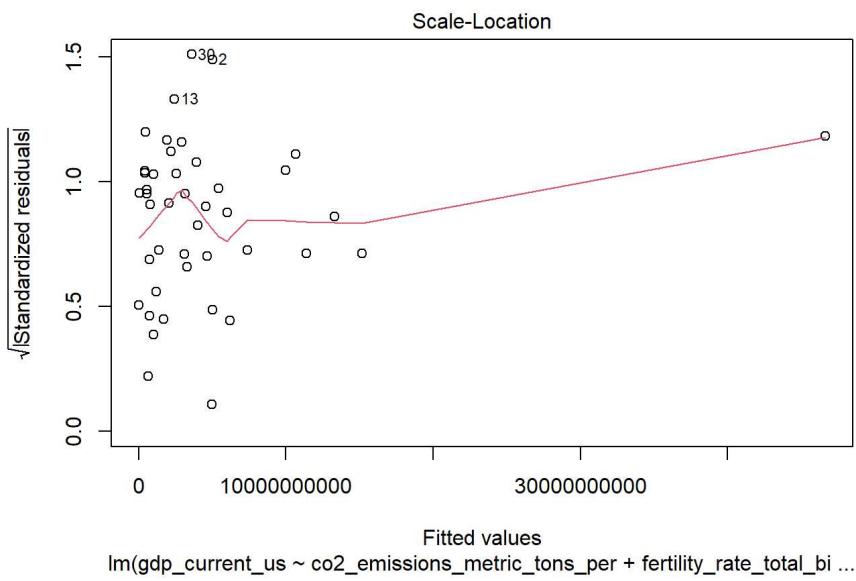
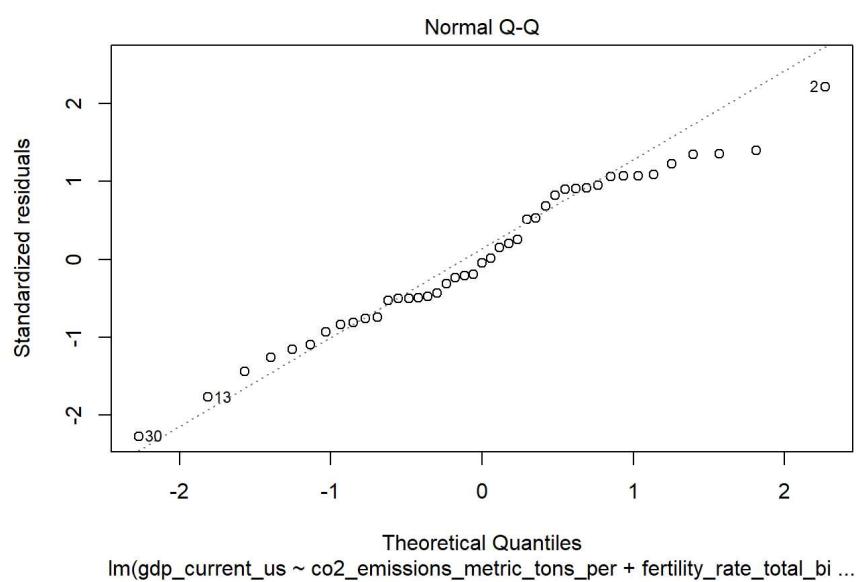
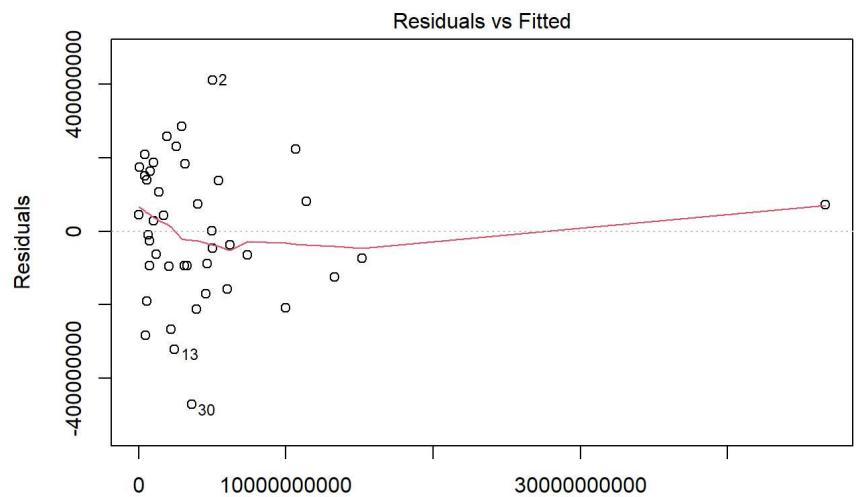
## (Intercept)          0.681418
## co2_emissions_metric_tons_per 0.002303 **
## fertility_rate_total_births_p 0.200073
## foreign_direct_investment_net 0.0000195 ***
## gni_atlas_method_current_us < 0.0000000000000002 ***
## gross_capital_formation_percent_of_g 0.173667
## immunization_measles_percent_of_chi 0.002982 **
## imports_of_goods_and_services 0.010129 *
## inflation_gdp_deflator_annual 0.0000313 ***
## internet_users_per_1_000_peopl 0.102324
## long_term_debt_dod_current_us 0.000678 ***
## merchandise_trade_percent_of_gdp 0.000566 ***
## official_development_assistance 0.001248 **
## population_total          0.011954 *
## services/etc_value_added_percent 0.229936
## surface_area_sq_km         0.004008 **

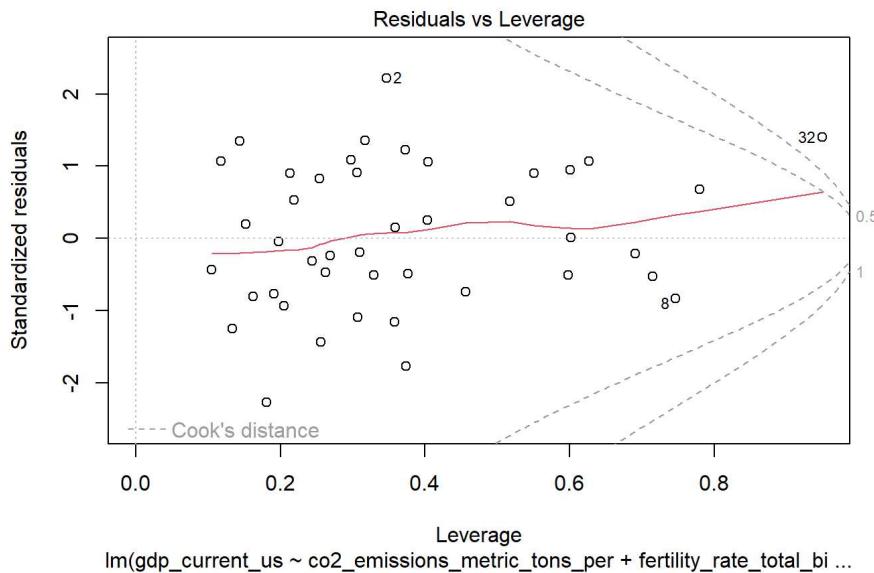
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

## 
## Residual standard error: 229000000 on 27 degrees of freedom
## Multiple R-squared:  0.9994, Adjusted R-squared:  0.9991
## F-statistic: 3001 on 15 and 27 DF,  p-value: < 0.0000000000000022

```

```
plot(model_4)
```





```
#check for multicollinearity
```

```
vifres_4 <- car::vif(model_4)
vifres_4
```

```
##          co2_emissions_metric_tons_per      fertility_rate_total_births_p
##                4.177682                  3.154882
##          foreign_direct_investment_net      gni_atlas_method_current_us
##                7.916382                 22.445905
## gross_capitalFormation_percent_of_g immunization_measles_percent_of_chi
##                3.478223                  3.061658
##          imports_of_goods_and_services      inflation_gdp_deflator_annual
##                4.531438                  2.188762
##      internet_users_per_l_000_peopl      long_term_debt_dod_current_us
##                5.872332                 24.199863
## merchandise_trade_percent_of_gdp      official_development_assistance
##                4.214438                  2.178238
##          population_total      services_etc_value_added_percent
##                9.437557                  3.039909
##          surface_area_sq_km
##                2.457835
```

Reduced Model - Remove services_etc_value_added_percent ($p\text{-value} > 0.05$)

```
model_5 <- lm(gdp_current_us ~ co2_emissions_metric_tons_per + fertility_rate_total_births_p +
foreign_direct_investment_net + gni_atlas_method_current_us +
gross_capitalFormation_percent_of_g + immunization_measles_percent_of_chi +
imports_of_goods_and_services + inflation_gdp_deflator_annual +
internet_users_per_l_000_peopl + long_term_debt_dod_current_us +
merchandise_trade_percent_of_gdp + official_development_assistance +
population_total + surface_area_sq_km, data = prosperity)
```

```
model_5
```

```

## 
## Call:
## lm(formula = gdp_current_us ~ co2_emissions_metric_tons_per +
##     fertility_rate_total_births_p + foreign_direct_investment_net +
##     gni_atlas_method_current_us + gross_capital_formation_percent_of_g +
##     immunization_measles_percent_of_chi + imports_of_goods_and_services +
##     inflation_gdp_deflator_annual + internet_users_per_1_000_peopl +
##     long_term_debt_dod_current_us + merchandise_trade_percent_of_gdp +
##     official_development_assistance + population_total + surface_area_sq_km,
##     data = prosperity)
## 

## Coefficients:
##              (Intercept)          co2_emissions_metric_tons_per
##                      241625049.6927                  203059980.1268
##      fertility_rate_total_births_p      foreign_direct_investment_net
##                      62027661.1775                  1.4413
##      gni_atlas_method_current_us  gross_capital_formation_percent_of_g
##                      1.0549                  -6308506.6865
##  immunization_measles_percent_of_chi imports_of_goods_and_services
##                     -10333394.7079                  10275446.7656
##  inflation_gdp_deflator_annual    internet_users_per_1_000_peopl
##                     31725338.7322                  -4237563.5223
##  long_term_debt_dod_current_us   merchandise_trade_percent_of_gdp
##                      0.1490                  -8547572.5768
##  official_development_assistance      population_total
##                      -0.4222                  -14.7891
##      surface_area_sq_km
##                      -285.9242
## 
```

```
summary(model1_5)
```

```

## 
## Call:
## lm(formula = gdp_current_us ~ co2_emissions_metric_tons_per +
##     fertility_rate_total_births_p + foreign_direct_investment_net +
##     gni_atlas_method_current_us + gross_capital_formation_percent_of_g +
##     immunization_measles_percent_of_chi + imports_of_goods_and_services +
##     inflation_gdp_deflator_annual + internet_users_per_1_000_peopl +
##     long_term_debt_dod_current_us + merchandise_trade_percent_of_gdp +
##     official_development_assistance + population_total + surface_area_sq_km,
##     data = prosperity)
## 

## Residuals:
##      Min       1Q   Median       3Q      Max 
## -417774642 -101919686 -16367610 129174762 414228280 
## 

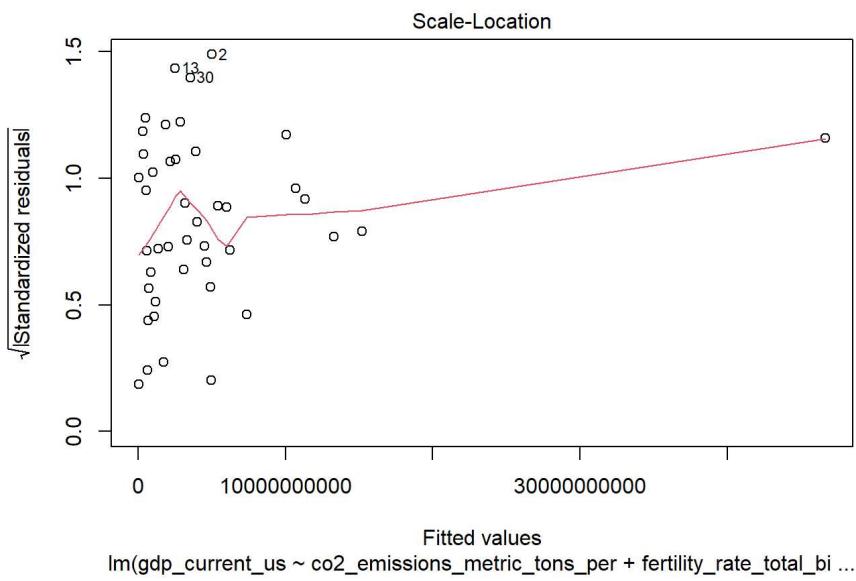
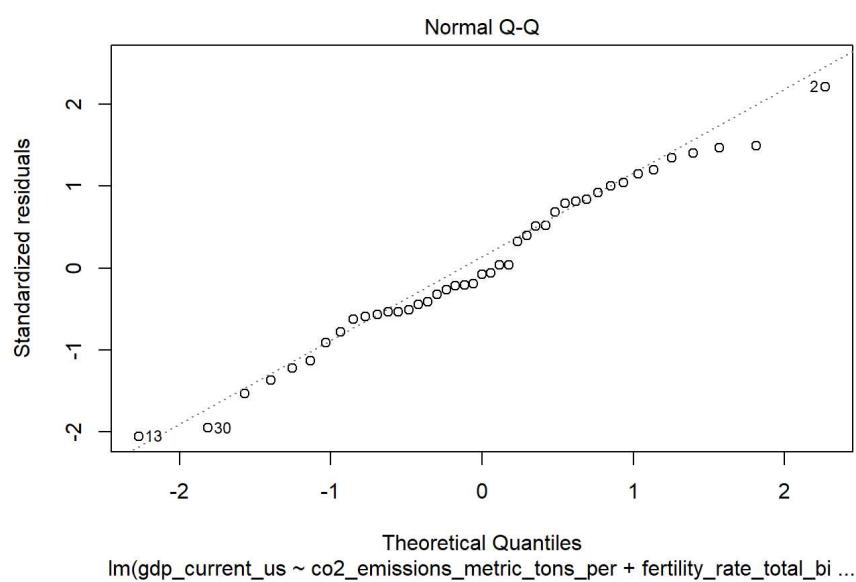
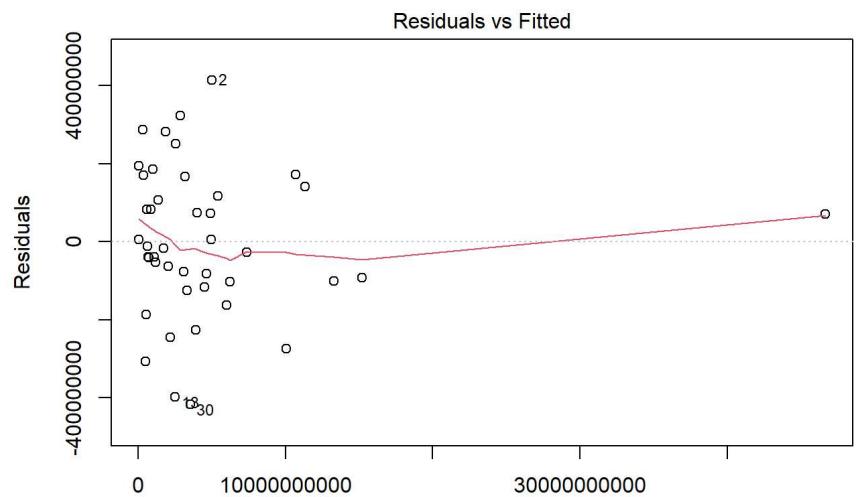
## Coefficients:
##                               Estimate Std. Error t value
## (Intercept)            241625049.69272 435835761.69416  0.554
## co2_emissions_metric_tons_per 203059980.12678 63379558.69411  3.204
## fertility_rate_total_births_p 62027661.17752 45844670.35786  1.353
## foreign_direct_investment_net 1.44133    0.28826  5.000
## gni_atlas_method_current_us 1.05494    0.02615 40.338
## gross_capital_formation_percent_of_g -6308506.68646 6370702.95041 -0.990
## immunization_measles_percent_of_chi -1033394.70788 3448175.62983 -2.997
## imports_of_goods_and_services 10275446.76559 3327367.01319  3.088
## inflation_gdp_deflator_annual 31725338.73222 6491675.09907  4.887
## internet_users_per_1_000_peopl -4237563.52234 3005995.36159 -1.410
## long_term_debt_dod_current_us 0.14896    0.03591  4.148
## merchandise_trade_percent_of_gdp -8547572.57678 1781778.62082 -4.797
## official_development_assistance -0.42216    0.11789 -3.581
## population_total          -14.78914    4.73698 -3.122
## surface_area_sq_km         -285.92423    94.17019 -3.036
## 
## Pr(>|t|) 
## (Intercept) 0.583710
## co2_emissions_metric_tons_per 0.003372 **
## fertility_rate_total_births_p 0.186881
## foreign_direct_investment_net 0.0000277 ***
## gni_atlas_method_current_us < 0.000000000000002 ***
## gross_capital_formation_percent_of_g 0.330539
## immunization_measles_percent_of_chi 0.005662 **
## imports_of_goods_and_services 0.004511 **
## inflation_gdp_deflator_annual 0.0000378 ***
## internet_users_per_1_000_peopl 0.169638
## long_term_debt_dod_current_us 0.000282 ***
## merchandise_trade_percent_of_gdp 0.0000483 ***
## official_development_assistance 0.001276 **
## population_total          0.004144 **
## surface_area_sq_km         0.005135 **

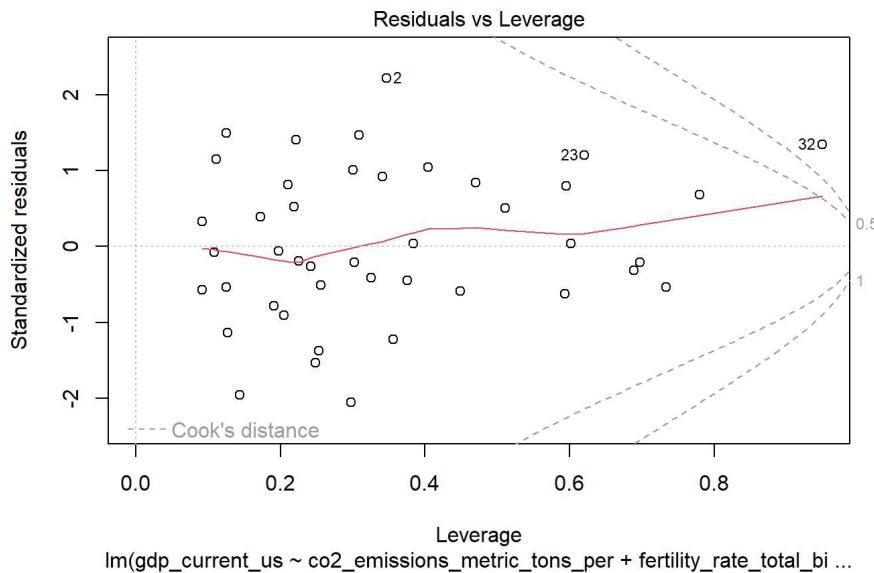
## --- 
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 

## Residual standard error: 23110000 on 28 degrees of freedom
## Multiple R-squared:  0.9994, Adjusted R-squared:  0.9991
## F-statistic: 3158 on 14 and 28 DF,  p-value: < 0.000000000000022

```

```
plot(model_5)
```





```
#check for multicollinearity
```

```
vifres_5 <- car::vif(model_5)
vifres_5
```

```
##          co2_emissions_metric_tons_per      fertility_rate_total_births_p
##                4.106329                  3.149530
##          foreign_direct_investment_net      gni_atlas_method_current_us
##                7.044149                 22.337194
## gross_capitalFormation_percent_of_g  immunization_measles_percent_of_chi
##                2.954852                  2.644921
##          imports_of_goods_and_services      inflation_gdp_deflator_annual
##                4.307758                  2.182551
##          internet_users_per_1_000_peopl    long_term_debt_dod_current_us
##                5.481652                 23.151705
## merchandise_trade_percent_of_gdp     official_development_assistance
##                3.501408                  2.178119
##          population_total      surface_area_sq_km
##                8.734100                  2.444561
```

Reduced Model - Remove gross_capitalFormation_percent_of_g (p-value > 0.05)

```
model_6 <- lm(gdp_current_us ~ co2_emissions_metric_tons_per + fertility_rate_total_births_p +
foreign_direct_investment_net + gni_atlas_method_current_us + immunization_measles_percent_of_chi +
imports_of_goods_and_services + inflation_gdp_deflator_annual +
internet_users_per_1_000_peopl + long_term_debt_dod_current_us +
merchandise_trade_percent_of_gdp + official_development_assistance +
population_total + surface_area_sq_km, data = prosperity)
```

```
model_6
```

```

## 
## Call:
## lm(formula = gdp_current_us ~ co2_emissions_metric_tons_per +
##     fertility_rate_total_births_p + foreign_direct_investment_net +
##     gni_atlas_method_current_us + immunization_measles_percent_of_chi +
##     imports_of_goods_and_services + inflation_gdp_deflator_annual +
##     internet_users_per_1_000_peopl + long_term_debt_dod_current_us +
##     merchandise_trade_percent_of_gdp + official_development_assistance +
##     population_total + surface_area_sq_km, data = prosperity)
## 
## Coefficients:
##                               (Intercept)          co2_emissions_metric_tons_per
##                               83966027.7895                  198497409.3084
##     fertility_rate_total_births_p      foreign_direct_investment_net
##                               73735444.9819                  1.2554
##     gni_atlas_method_current_us  immunization_measles_percent_of_chi
##                               1.0539                  -10072849.8891
##     imports_of_goods_and_services      inflation_gdp_deflator_annual
##                               8915925.3146                  31980169.0456
##     internet_users_per_1_000_peopl      long_term_debt_dod_current_us
##                               -3822665.6598                  0.1601
##     merchandise_trade_percent_of_gdp  official_development_assistance
##                               -8301028.8631                  -0.4595
##     population_total                  surface_area_sq_km
##                               -14.4367                  -300.9162

```

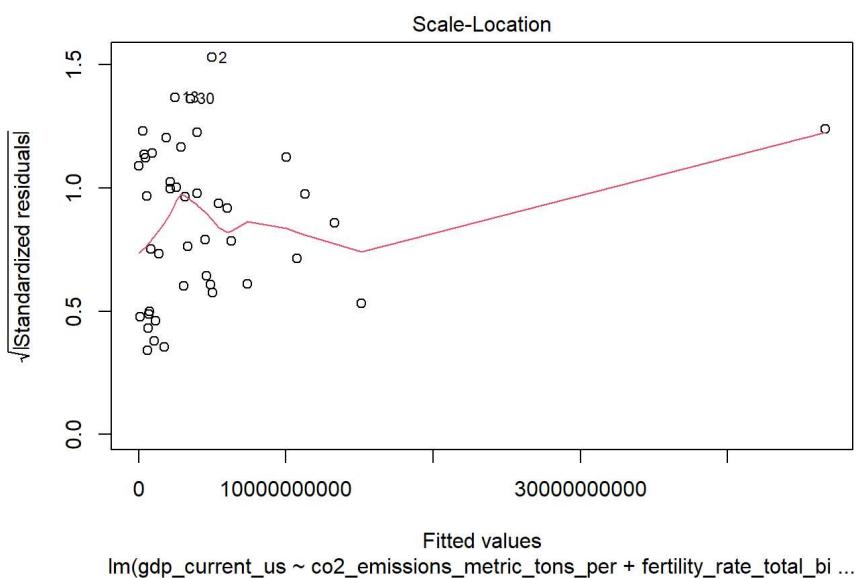
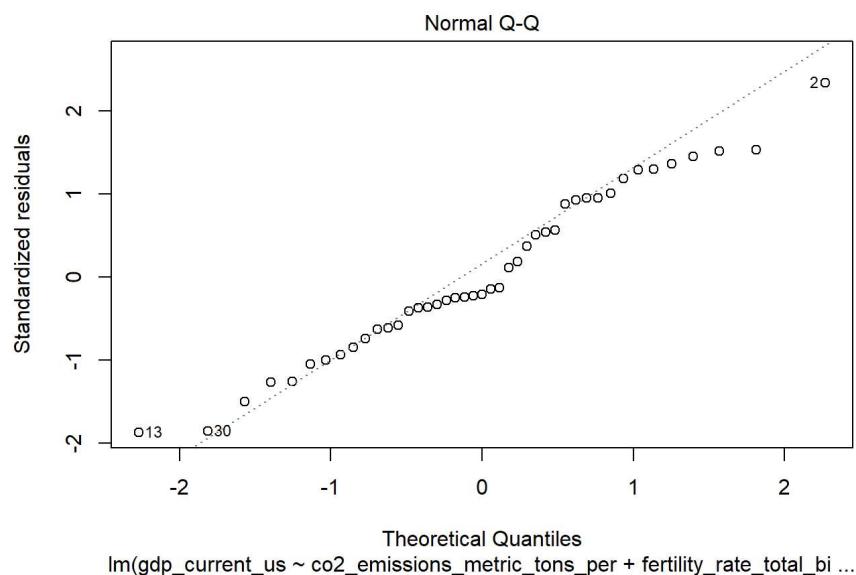
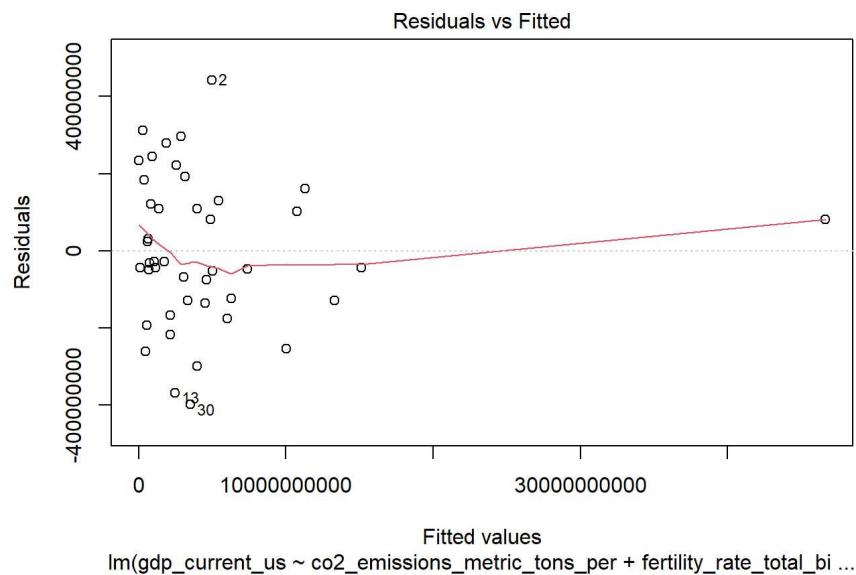
```
summary(model_6)
```

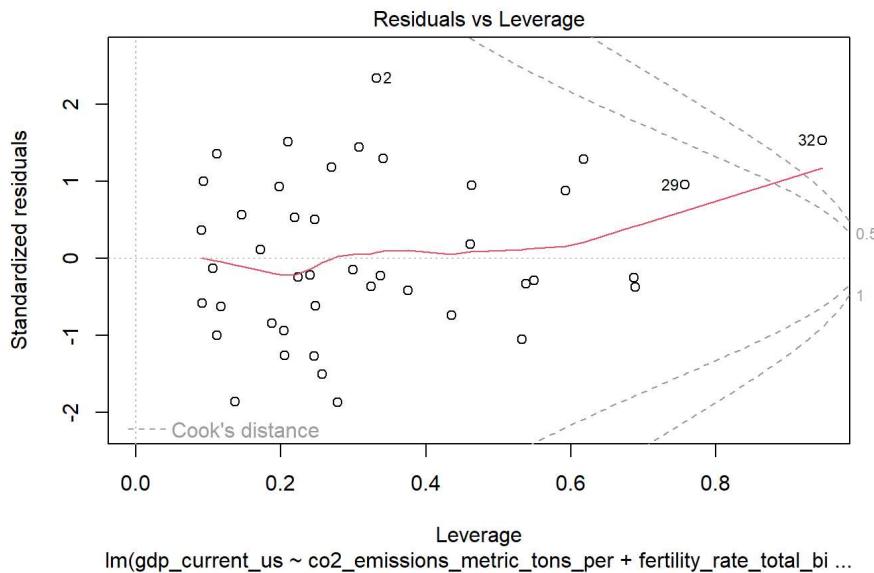
```

## 
## Call:
## lm(formula = gdp_current_us ~ co2_emissions_metric_tons_per +
##     fertility_rate_total_births_p + foreign_direct_investment_net +
##     gni_atlas_method_current_us + immunization_measles_percent_of_chi +
##     imports_of_goods_and_services + inflation_gdp_deflator_annual +
##     internet_users_per_1_000_peopl + long_term_debt_dod_current_us +
##     merchandise_trade_percent_of_gdp + official_development_assistance +
##     population_total + surface_area_sq_km, data = prosperity)
## 
## Residuals:
##      Min        1Q    Median        3Q       Max 
## -398343687 -128061555 -32137636  124835765  441786196 
## 
## Coefficients:
##             Estimate Std. Error t value
## (Intercept) 83966027.78951 405578127.69354  0.207
## co2_emissions_metric_tons_per 198497409.30841 63190677.38783  3.141
## fertility_rate_total_births_p 73735444.98193 44279012.23344  1.665
## foreign_direct_investment_net 1.25542   0.21867  5.741
## gni_atlas_method_current_us 1.05392   0.02612 40.344
## immunization_measles_percent_of_chi -10072849.88915 3436970.52735 -2.931
## imports_of_goods_and_services 8915925.31463 3029899.80029  2.943
## inflation_gdp_deflator_annual 31980169.04560 6484398.89827  4.932
## internet_users_per_1_000_peopl -3822665.65982 2975654.58636 -1.285
## long_term_debt_dod_current_us 0.16013   0.03408  4.698
## merchandise_trade_percent_of_gdp -8301028.86309 1763706.66797 -4.707
## official_development_assistance -0.45948   0.11166 -4.115
## population_total -14.43673   4.72201 -3.057
## surface_area_sq_km -300.91618   92.91407 -3.239
## 
## Pr(>|t|) 
## (Intercept) 0.837435
## co2_emissions_metric_tons_per 0.003854 ***
## fertility_rate_total_births_p 0.106632
## foreign_direct_investment_net 0.00000325 ***
## gni_atlas_method_current_us < 0.0000000000000002 ***
## immunization_measles_percent_of_chi 0.006532 **
## imports_of_goods_and_services 0.006342 **
## inflation_gdp_deflator_annual 0.00003066 ***
## internet_users_per_1_000_peopl 0.209083
## long_term_debt_dod_current_us 0.00005863 ***
## merchandise_trade_percent_of_gdp 0.00005730 ***
## official_development_assistance 0.000293 ***
## population_total 0.004764 **
## surface_area_sq_km 0.003006 **
## --- 
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 23100000 on 29 degrees of freedom
## Multiple R-squared: 0.9993, Adjusted R-squared: 0.9991
## F-statistic: 3403 on 13 and 29 DF, p-value: < 0.000000000000022

```

```
plot(model_6)
```





```
#check for multicollinearity
vifres_6 <- car::vif(model_6)
vifres_6
```

```
##      co2_emissions_metric_tons_per      fertility_rate_total_births_p
##            4.084627                  2.940052
##      foreign_direct_investment_net      gni_atlas_method_current_us
##            4.056152                  22.302526
##  immunization_measles_percent_of_chi      imports_of_goods_and_services
##            2.629521                  3.574354
##      inflation_gdp_deflator_annual      internet_users_per_1_000_peopl
##            2.179121                  5.375155
##      long_term_debt_dod_current_us      merchandise_trade_percent_of_gdp
##            20.867737                  3.433041
##      official_development_assistance      population_total
##            1.955533                  8.684800
##      surface_area_sq_km
##            2.381376
```

Reduced Model - Remove `internet_users_per_1_000_peopl` (p-value > 0.05)

```
model_7 <- lm(gdp_current_us ~ co2_emissions_metric_tons_per + fertility_rate_total_births_p +
foreign_direct_investment_net + gni_atlas_method_current_us + immunization_measles_percent_of_chi +
imports_of_goods_and_services + inflation_gdp_deflator_annual + long_term_debt_dod_current_us +
merchandise_trade_percent_of_gdp + official_development_assistance +
population_total + surface_area_sq_km, data = prosperity)

model_7
```

```

## 
## Call:
## lm(formula = gdp_current_us ~ co2_emissions_metric_tons_per +
##     fertility_rate_total_births_p + foreign_direct_investment_net +
##     gni_atlas_method_current_us + immunization_measles_percent_of_chi +
##     imports_of_goods_and_services + inflation_gdp_deflator_annual +
##     long_term_debt_dod_current_us + merchandise_trade_percent_of_gdp +
##     official_development_assistance + population_total + surface_area_sq_km,
##     data = prosperity)
## 
## Coefficients:
##              (Intercept)      co2_emissions_metric_tons_per
##                      -49870945.5987          138437561.7890
##     fertility_rate_total_births_p   foreign_direct_investment_net
##                         91594817.1391            1.2514
##     gni_atlas_method_current_us  immunization_measles_percent_of_chi
##                           1.0523           -9884054.3654
##     imports_of_goods_and_services   inflation_gdp_deflator_annual
##                         7569076.9935          31019414.0951
##     long_term_debt_dod_current_us   merchandise_trade_percent_of_gdp
##                           0.1666           -7578573.5721
##     official_development_assistance   population_total
##                           -0.4464            -15.2153
##     surface_area_sq_km
##                         -289.2709

```

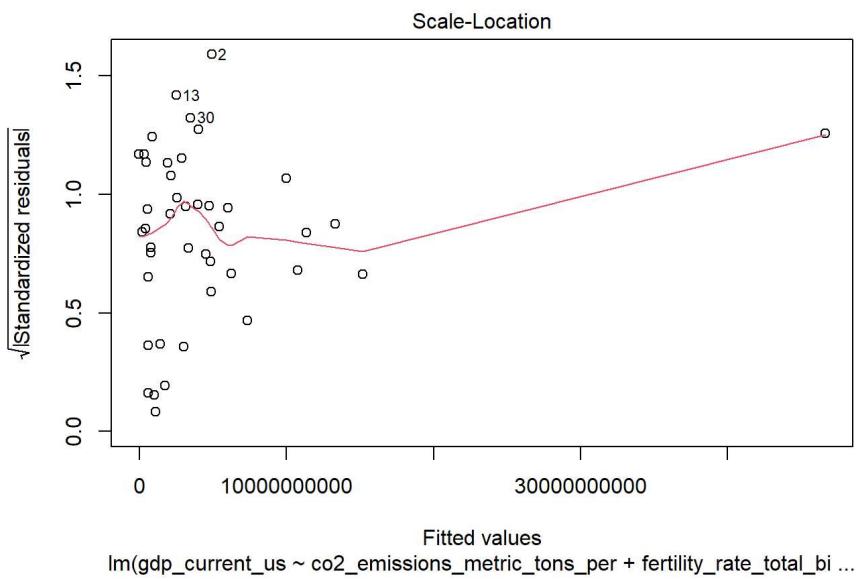
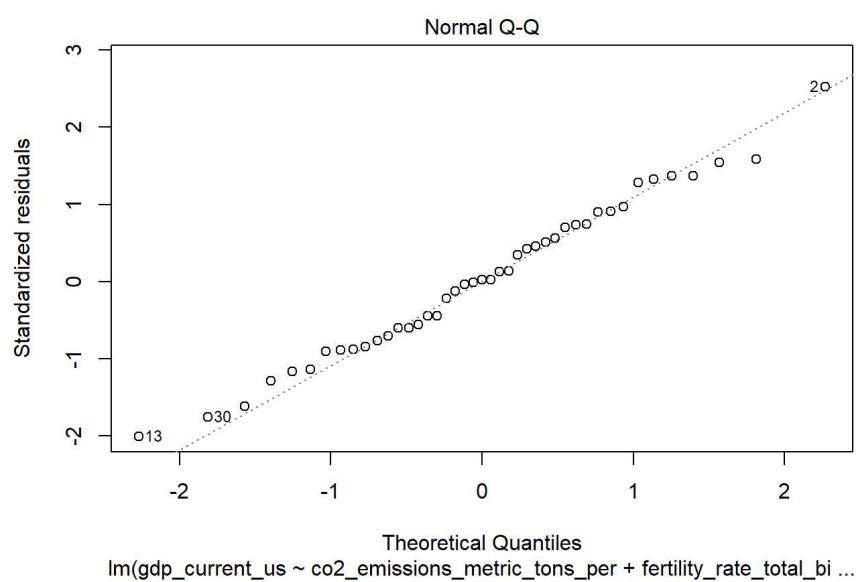
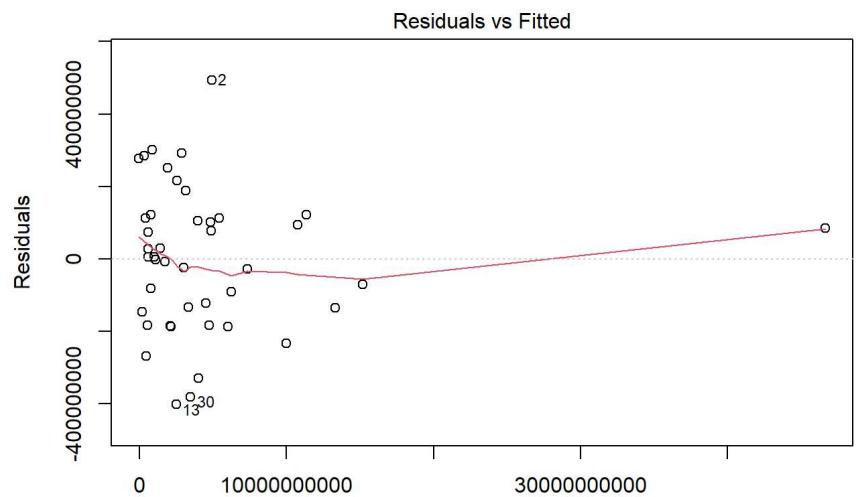
```
summary(model_7)
```

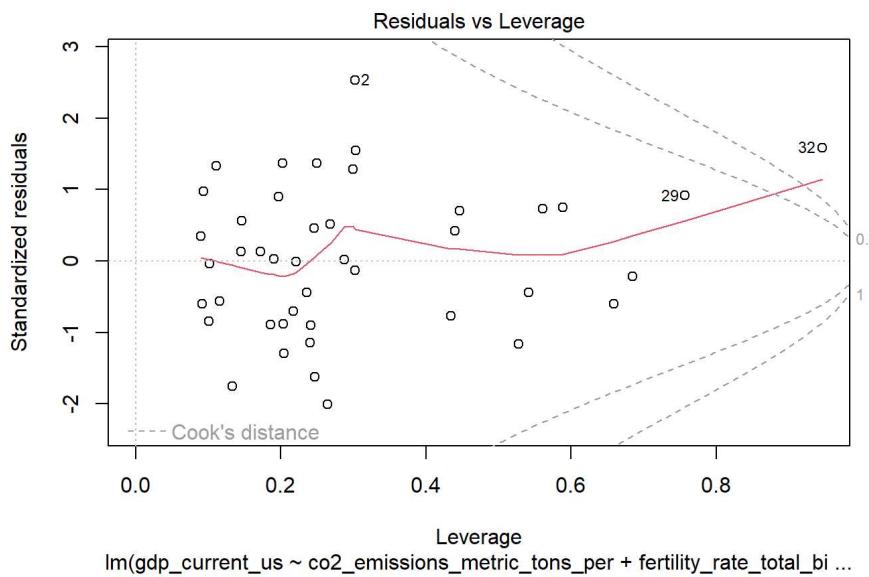
```

## 
## Call:
## lm(formula = gdp_current_us ~ co2_emissions_metric_tons_per +
##     fertility_rate_total_births_p + foreign_direct_investment_net +
##     gni_atlas_method_current_us + immunization_measles_percent_of_chi +
##     imports_of_goods_and_services + inflation_gdp_deflator_annual +
##     long_term_debt_dod_current_us + merchandise_trade_percent_of_gdp +
##     official_development_assistance + population_total + surface_area_sq_km,
##     data = prosperity)
## 
## Residuals:
##      Min        1Q    Median        3Q       Max 
## -402353079 -140162084   4629983  112578456  493328618 
## 
## Coefficients:
##                               Estimate     Std. Error t value
## (Intercept)          -49870945.59867 396194695.34690 -0.126
## co2_emissions_metric_tons_per 138437561.78899 42970773.67324  3.222
## fertility_rate_total_births_p  91594817.13910 42493203.20637  2.156
## foreign_direct_investment_net  1.25142   0.22100  5.662
## gni_atlas_method_current_us    1.05231   0.02637 39.899
## immunization_measles_percent_of_chi -9884054.36542 3470845.50698 -2.848
## imports_of_goods_and_services   7569076.99354 2873375.48922  2.634
## inflation_gdp_deflator_annual  31019414.09511 6510565.35148  4.764
## long_term_debt_dod_current_us   0.16656   0.03408  4.888
## merchandise_trade_percent_of_gdp -7578573.57214 1689665.25395 -4.485
## official_development_assistance -0.44636   0.11239 -3.971
## population_total             -15.21534   4.73344 -3.214
## surface_area_sq_km            -289.27088  93.46770 -3.095
## 
##              Pr(>|t|)    
## (Intercept)          0.900671
## co2_emissions_metric_tons_per 0.003063 ***
## fertility_rate_total_births_p 0.039268 *  
## foreign_direct_investment_net 0.00000359 *** 
## gni_atlas_method_current_us < 0.0000000000000002 ***
## immunization_measles_percent_of_chi 0.007874 **
## imports_of_goods_and_services 0.013210 *  
## inflation_gdp_deflator_annual 0.00004527 ***
## long_term_debt_dod_current_us 0.00003197 ***
## merchandise_trade_percent_of_gdp 0.00009921 ***
## official_development_assistance 0.000413 ***
## population_total           0.003120 ** 
## surface_area_sq_km          0.004239 ** 
## --- 
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 233500000 on 30 degrees of freedom
## Multiple R-squared:  0.9993, Adjusted R-squared:  0.999
## F-statistic: 3608 on 12 and 30 DF,  p-value: < 0.0000000000000022

```

```
plot(model_7)
```





```
#check for multicollinearity
vifres_7 <- car::vif(model_7)
vifres_7
```

##	co2_emissions_metric_tons_per	fertility_rate_total_births_p
	1.848753	2.650235
##	foreign_direct_investment_net	gni_atlas_method_current_us
	4.055329	22.251356
##	immunization_measles_percent_of_chi	imports_of_goods_and_services
	2.624713	3.146386
##	inflation_gdp_deflator_annual	long_term_debt_dod_current_us
	2.150134	20.417552
##	merchandise_trade_percent_of_gdp	official_development_assistance
	3.083997	1.939167
##	population_total	surface_area_sq_km
	8.541718	2.358709

Reduced Model - Remove gni_atlas_method_current_us (VIF > 10)

```
model_8 <- lm(gdp_current_us ~ co2_emissions_metric_tons_per + fertility_rate_total_births_p +
foreign_direct_investment_net + immunization_measles_percent_of_chi +
imports_of_goods_and_services + inflation_gdp_deflator_annual + long_term_debt_dod_current_us +
merchandise_trade_percent_of_gdp + official_development_assistance +
population_total + surface_area_sq_km, data = prosperity)

model_8
```

```

## 
## Call:
## lm(formula = gdp_current_us ~ co2_emissions_metric_tons_per +
##     fertility_rate_total_births_p + foreign_direct_investment_net +
##     immunization_measles_percent_of_chi + imports_of_goods_and_services +
##     inflation_gdp_deflator_annual + long_term_debt_dod_current_us +
##     merchandise_trade_percent_of_gdp + official_development_assistance +
##     population_total + surface_area_sq_km, data = prosperity)
## 

## Coefficients:
##                               (Intercept)      co2_emissions_metric_tons_per
##                               1844205850. 085                  -137105650. 235
##     fertility_rate_total_births_p      foreign_direct_investment_net
##                               -492445464. 054                      3. 118
##     immunization_measles_percent_of_chi      imports_of_goods_and_services
##                               39699416. 749                  -37097068. 768
##     inflation_gdp_deflator_annual      long_term_debt_dod_current_us
##                               -72293574. 696                      1. 220
##     merchandise_trade_percent_of_gdp      official_development_assistance
##                               9405967. 899                      -1. 736
##     population_total      surface_area_sq_km
##                               65. 781                  -1106. 828

```

```
summary(model_8)
```

```

## 
## Call:
## lm(formula = gdp_current_us ~ co2_emissions_metric_tons_per +
##     fertility_rate_total_births_p + foreign_direct_investment_net +
##     immunization_measles_percent_of_chi + imports_of_goods_and_services +
##     inflation_gdp_deflator_annual + long_term_debt_dod_current_us +
##     merchandise_trade_percent_of_gdp + official_development_assistance +
##     population_total + surface_area_sq_km, data = prosperity)
## 

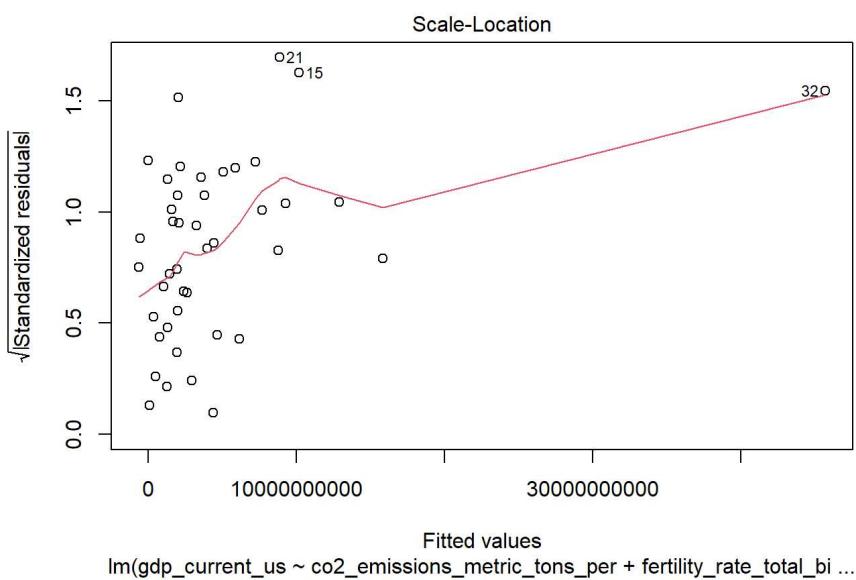
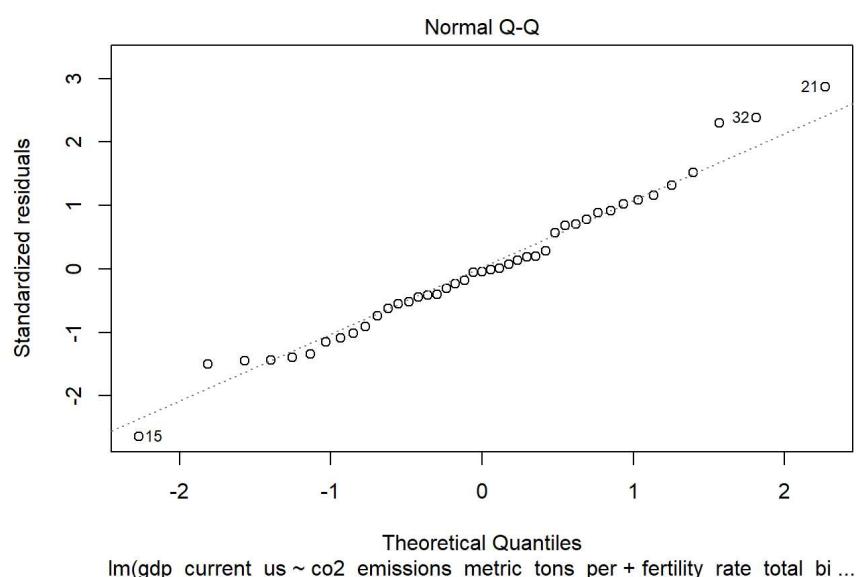
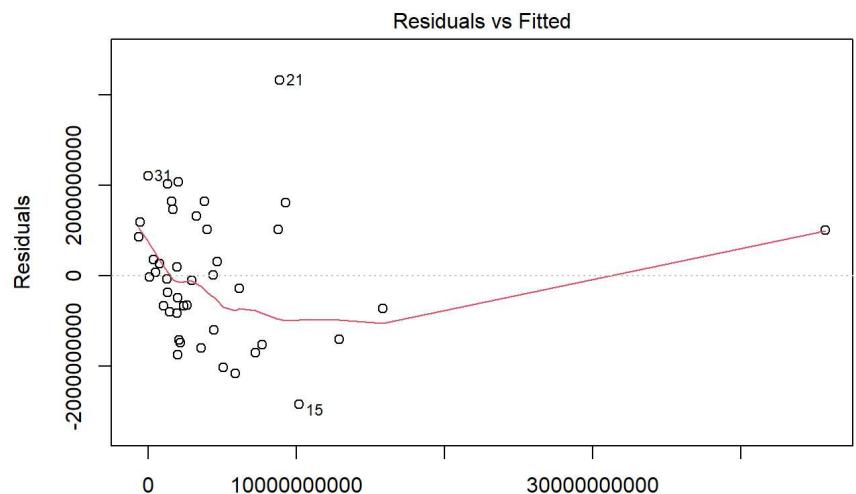
## Residuals:
##      Min       1Q   Median       3Q      Max 
## -2844295758 -1013285501  -65841313  1021011525  4324464823
## 

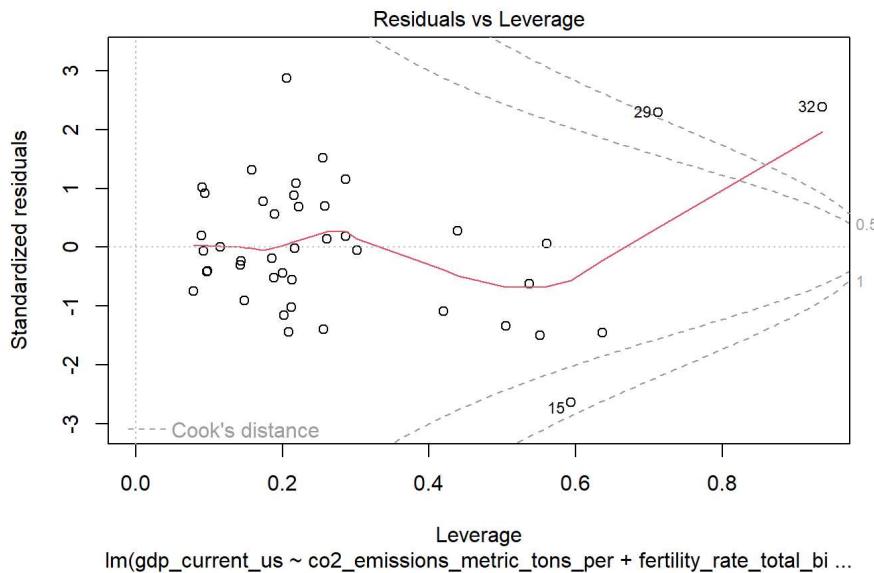
## Coefficients:
##                               Estimate Std. Error t value
## (Intercept)           1844205850.0853 2845113579.2213  0.648
## co2_emissions_metric_tons_per -137105650.2346 306776268.8897 -0.447
## fertility_rate_total_births_p -492445464.0539 288549638.7912 -1.707
## foreign_direct_investment_net  3.1182    1.5623  1.996
## immunization_measles_percent_of_chi 39699416.7485 23440931.3688  1.694
## imports_of_goods_and_services -37097068.7684 19141413.2268 -1.938
## inflation_gdp_deflator_annual -72293574.6960 43207481.3140 -1.673
## long_term_debt_dod_current_us   1.2196    0.1559  7.822
## merchandise_trade_percent_of_gdp 9405967.8994 11827470.9295  0.795
## official_development_assistance -1.7363    0.7786 -2.230
## population_total                65.7809   30.9293  2.127
## surface_area_sq_km              -1106.8281  659.6250 -1.678
## 
## Pr(>|t|)

## (Intercept)          0.5216
## co2_emissions_metric_tons_per 0.6580
## fertility_rate_total_births_p 0.0979 .
## foreign_direct_investment_net 0.0548 .
## immunization_measles_percent_of_chi 0.1004
## imports_of_goods_and_services 0.0618 .
## inflation_gdp_deflator_annual 0.1044
## long_term_debt_dod_current_us 0.00000000792 ***
## merchandise_trade_percent_of_gdp 0.4325
## official_development_assistance 0.0331 *
## population_total          0.0415 *
## surface_area_sq_km         0.1034
## --- 
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 1689000000 on 31 degrees of freedom
## Multiple R-squared:  0.9626, Adjusted R-squared:  0.9493
## F-statistic: 72.47 on 11 and 31 DF,  p-value: < 0.0000000000000022

```

```
plot(model_8)
```





```
#check for multicollinearity
```

```
vifres_8 <- car::vif(model_8)
vifres_8
```

```
##          co2_emissions_metric_tons_per      fertility_rate_total_births_p
##                1.801001                  2.335739
##          foreign_direct_investment_net immunization_measles_percent_of_chi
##                3.873557                  2.288225
##          imports_of_goods_and_services      inflation_gdp_deflator_annual
##                2.668782                  1.810022
##          long_term_debt_dod_current_us    merchandise_trade_percent_of_gdp
##                8.169308                  2.888246
##          official_development_assistance      population_total
##                1.778698                  6.970610
##          surface_area_sq_km
##                2.245346
```

Reduced Model - Remove gni_atlas_method_current_us (VIF > 5)

```
model_9 <- lm(gdp_current_us ~ co2_emissions_metric_tons_per + fertility_rate_total_births_p +
foreign_direct_investment_net + immunization_measles_percent_of_chi +
imports_of_goods_and_services + inflation_gdp_deflator_annual + merchandise_trade_percent_of_gdp + official_development_assistance +
population_total + surface_area_sq_km, data = prosperity)

model_9
```

```
##  
## Call:  
## lm(formula = gdp_current_us ~ co2_emissions_metric_tons_per +  
##      fertility_rate_total_births_p + foreign_direct_investment_net +  
##      immunization_measles_percent_of_chi + imports_of_goods_and_services +  
##      inflation_gdp_deflator_annual + merchandise_trade_percent_of_gdp +  
##      official_development_assistance + population_total + surface_area_sq_km,  
##      data = prosperity)  
##  
## Coefficients:  
## (Intercept) co2_emissions_metric_tons_per  
## 12562377940.075 -190951882.435  
## fertility_rate_total_births_p foreign_direct_investment_net  
## -1270547166.435 8.579  
## immunization_measles_percent_of_chi imports_of_goods_and_services  
## -32449226.268 -47245291.943  
## inflation_gdp_deflator_annual merchandise_trade_percent_of_gdp  
## 53607180.289 -6121824.246  
## official_development_assistance population_total  
## -1.008 234.705  
## surface_area_sq_km  
## -2461.209
```

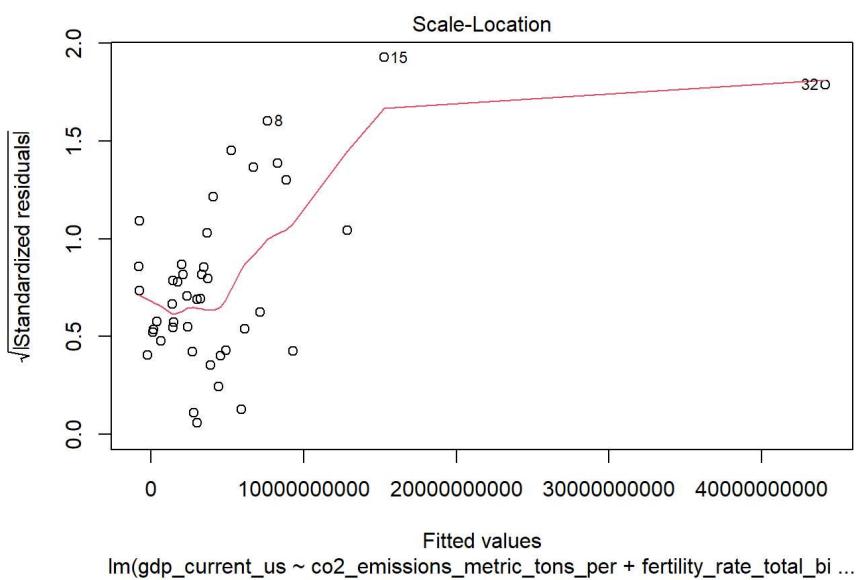
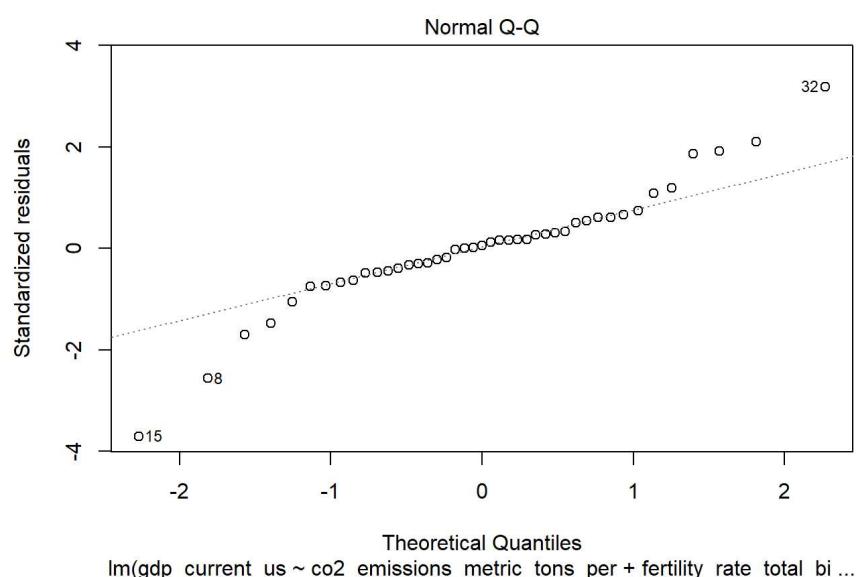
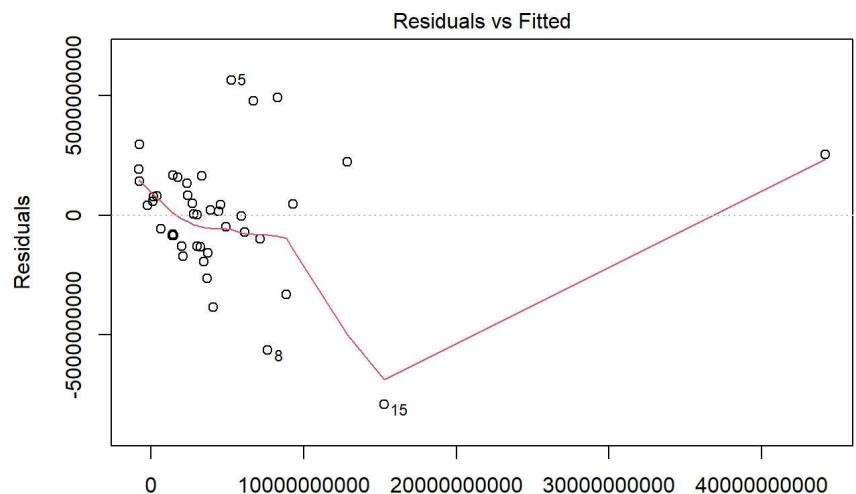
```
summary(model_9)
```

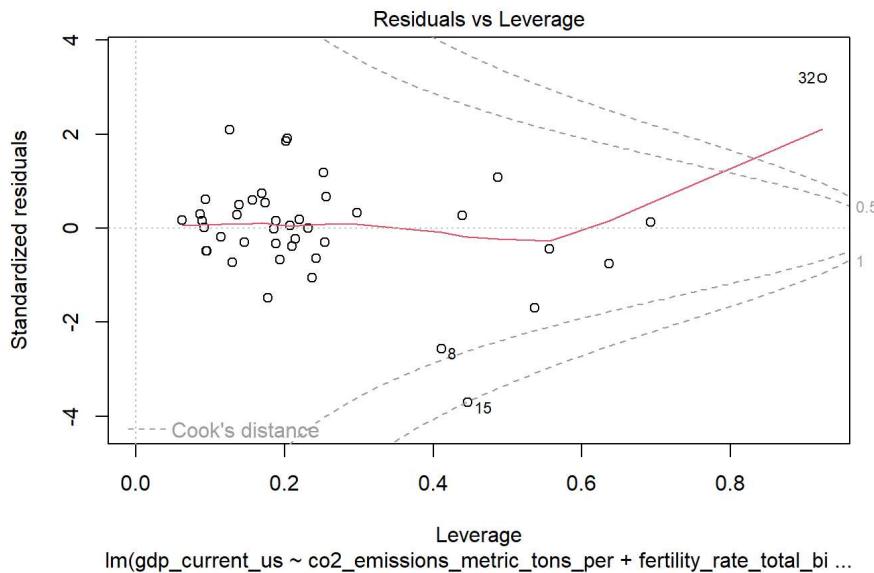
```

## 
## Call:
## lm(formula = gdp_current_us ~ co2_emissions_metric_tons_per +
##     fertility_rate_total_births_p + foreign_direct_investment_net +
##     immunization_measles_percent_of_chi + imports_of_goods_and_services +
##     inflation_gdp_deflator_annual + merchandise_trade_percent_of_gdp +
##     official_development_assistance + population_total + surface_area_sq_km,
##     data = prosperity)
## 
## Residuals:
##      Min       1Q   Median       3Q      Max 
## -7913940043 -1146673938  153281966  1370378876  5634938628 
## 
## Coefficients:
##                               Estimate Std. Error t value
## (Intercept)             12562377940.075 4232237706.219  2.968
## co2_emissions_metric_tons_per -190951882.435  520573401.741 -0.367
## fertility_rate_total_births_p -1270547166.435 459746891.073 -2.764
## foreign_direct_investment_net    8.579      2.372  3.616
## immunization_measles_percent_of_chi -32449226.268 36577991.373 -0.887
## imports_of_goods_and_services -47245291.943 32414834.211 -1.458
## inflation_gdp_deflator_annual  53607180.289 68059968.092  0.788
## merchandise_trade_percent_of_gdp -6121824.246 19790519.012 -0.309
## official_development_assistance     -1.008      1.312 -0.769
## population_total                  234.705     37.584  6.245
## surface_area_sq_km                -2461.209    1080.353 -2.278
## 
## Pr(>|t|)
## (Intercept) 0.00563 **
## co2_emissions_metric_tons_per 0.71617
## fertility_rate_total_births_p 0.00940 **
## foreign_direct_investment_net 0.00101 **
## immunization_measles_percent_of_chi 0.38163
## imports_of_goods_and_services 0.15472
## inflation_gdp_deflator_annual 0.43670
## merchandise_trade_percent_of_gdp 0.75907
## official_development_assistance 0.44777
## population_total 0.000000535 ***
## surface_area_sq_km 0.02954 *
## --- 
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 2867000000 on 32 degrees of freedom
## Multiple R-squared:  0.8887, Adjusted R-squared:  0.8539
## F-statistic: 25.55 on 10 and 32 DF,  p-value: 0.00000000001731

```

```
plot(model_9)
```





```
#check for multicollinearity
```

```
vifres_9 <- car::vif(model_9)
vifres_9
```

```
##          co2_emissions_metric_tons_per      fertility_rate_total_births_p
##                1.800094                  2.058172
##          foreign_direct_investment_net immunization_measles_percent_of_chi
##                3.100121                  1.933969
##          imports_of_goods_and_services      inflation_gdp_deflator_annual
##                2.656523                  1.558871
##          merchandise_trade_percent_of_gdp official_development_assistance
##                2.806891                  1.753294
##          population_total           surface_area_sq_km
##                3.572609                  2.090649
```

Reduced Model - Remove merchandise_trade_percent_of_gdp (p-value > 0.05)

```
model_10 <- lm(gdp_current_us ~ co2_emissions_metric_tons_per + fertility_rate_total_births_p +
  foreign_direct_investment_net + immunization_measles_percent_of_chi +
  imports_of_goods_and_services + inflation_gdp_deflator_annual + official_development_assistance +
  population_total + surface_area_sq_km, data = prosperity)
```

```
model_10
```

```

## 
## Call:
## lm(formula = gdp_current_us ~ co2_emissions_metric_tons_per +
##     fertility_rate_total_births_p + foreign_direct_investment_net +
##     immunization_measles_percent_of_chi + imports_of_goods_and_services +
##     inflation_gdp_deflator_annual + official_development_assistance +
##     population_total + surface_area_sq_km, data = prosperity)
## 
## Coefficients:
##              (Intercept)      co2_emissions_metric_tons_per
##                      12290040295.551                  -211029911.418
##     fertility_rate_total_births_p      foreign_direct_investment_net
##                         -1279154602.415                           8.288
##     immunization_measles_percent_of_chi      imports_of_goods_and_services
##                         -29069674.083                  -53346457.224
##     inflation_gdp_deflator_annual      official_development_assistance
##                         45153325.534                           -1.019
##     population_total      surface_area_sq_km
##                         239.389                  -2402.952

```

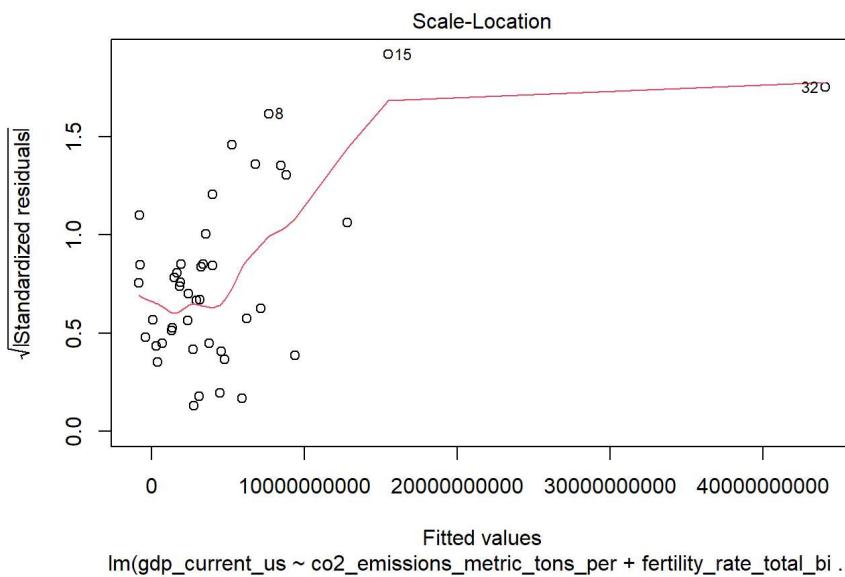
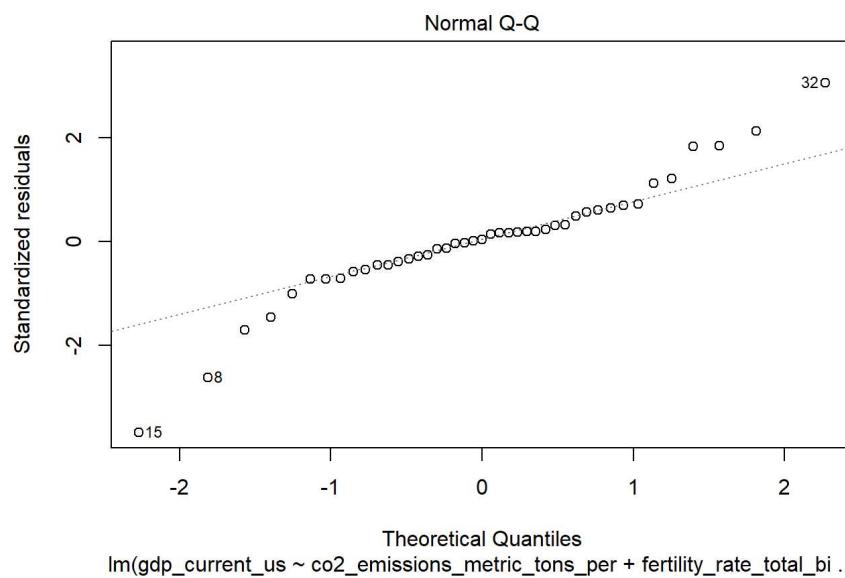
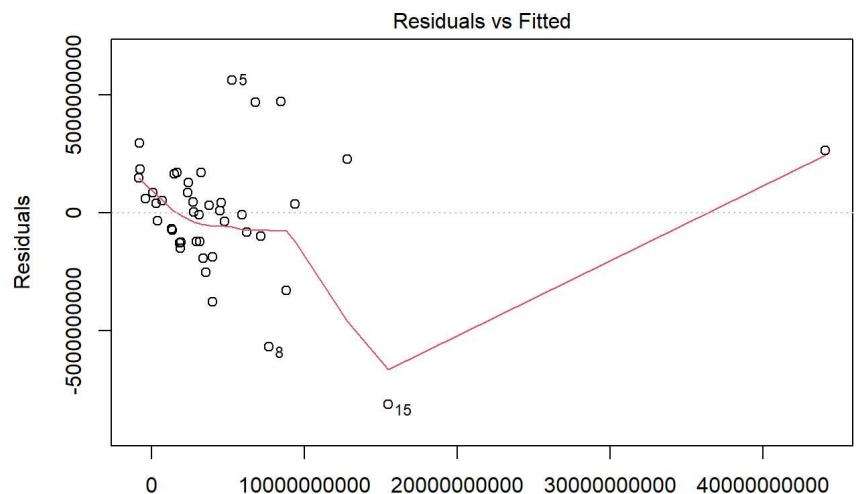
```
summary(model_10)
```

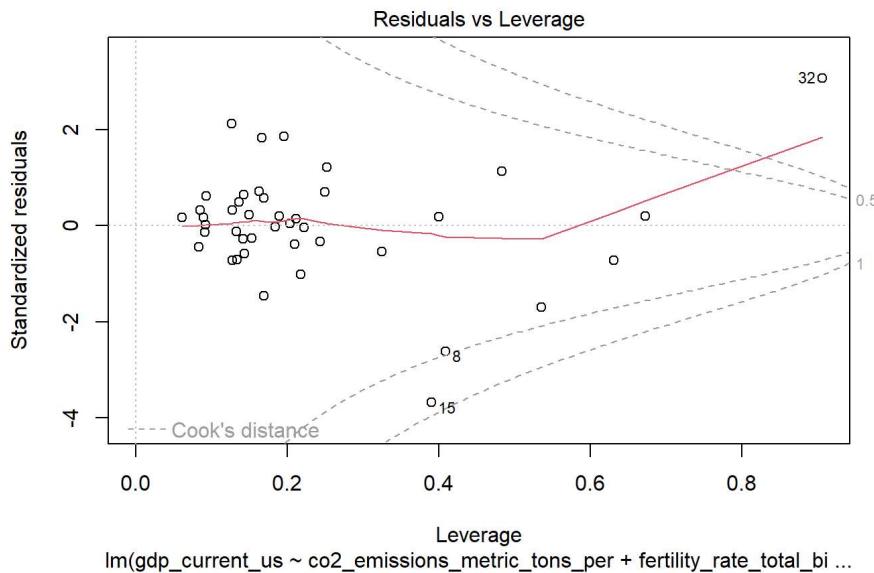
```

## 
## Call:
## lm(formula = gdp_current_us ~ co2_emissions_metric_tons_per +
##     fertility_rate_total_births_p + foreign_direct_investment_net +
##     immunization_measles_percent_of_chi + imports_of_goods_and_services +
##     inflation_gdp_deflator_annual + official_development_assistance +
##     population_total + surface_area_sq_km, data = prosperity)
## 
## Residuals:
##    Min      1Q   Median      3Q      Max 
## -8123203835 -1209592662   97308503  1381465846  5623120438 
## 
## Coefficients:
##              Estimate Std. Error t value
## (Intercept) 12290040295.551 4082537481.461  3.010
## co2_emissions_metric_tons_per -211029911.418 509384765.236 -0.414
## fertility_rate_total_births_p -1279154602.415 452572585.243 -2.826
## foreign_direct_investment_net          8.288        2.147  3.860
## immunization_measles_percent_of_chi -29069674.083 34426626.816 -0.844
## imports_of_goods_and_services -53346457.224 25368544.960 -2.103
## inflation_gdp_deflator_annual       45153325.534 61471864.365  0.735
## official_development_assistance      -1.019        1.294 -0.787
## population_total                   239.389       33.924  7.057
## surface_area_sq_km                 -2402.952      1049.133 -2.290
## 
## Pr(>|t|) 
## (Intercept) 0.00497 ***
## co2_emissions_metric_tons_per 0.68135
## fertility_rate_total_births_p 0.00793 **
## foreign_direct_investment_net 0.00050 ***
## immunization_measles_percent_of_chi 0.40453
## imports_of_goods_and_services 0.04319 *
## inflation_gdp_deflator_annual 0.46781
## official_development_assistance 0.43664
## population_total 0.0000000447 ***
## surface_area_sq_km 0.02852 * 
## 
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 2828000000 on 33 degrees of freedom
## Multiple R-squared:  0.8883, Adjusted R-squared:  0.8579
## F-statistic: 29.17 on 9 and 33 DF,  p-value: 0.0000000000003225

```

```
plot(model_10)
```





```
#check for multicollinearity
```

```
vifres_10 <- car::vif(model_10)
vifres_10
```

```
##      co2_emissions_metric_tons_per      fertility_rate_total_births_p
##            1.772109                  2.050632
##      foreign_direct_investment_net immunization_measles_percent_of_chi
##            2.611645                  1.761433
##      imports_of_goods_and_services      inflation_gdp_deflator_annual
##            1.672955                  1.307516
##      official_development_assistance      population_total
##            1.752199                  2.992699
##      surface_area_sq_km
##            2.027115
```

Reduced Model - Remove co2_emissions_metric_tons_per (p-value > 0.05)

```
model_11 <- lm(gdp_current_us ~ fertility_rate_total_births_p +
  foreign_direct_investment_net + immunization_measles_percent_of_chi +
  imports_of_goods_and_services + inflation_gdp_deflator_annual + official_development_assistance +
  population_total + surface_area_sq_km, data = prosperity)
```

```
model_11
```

```

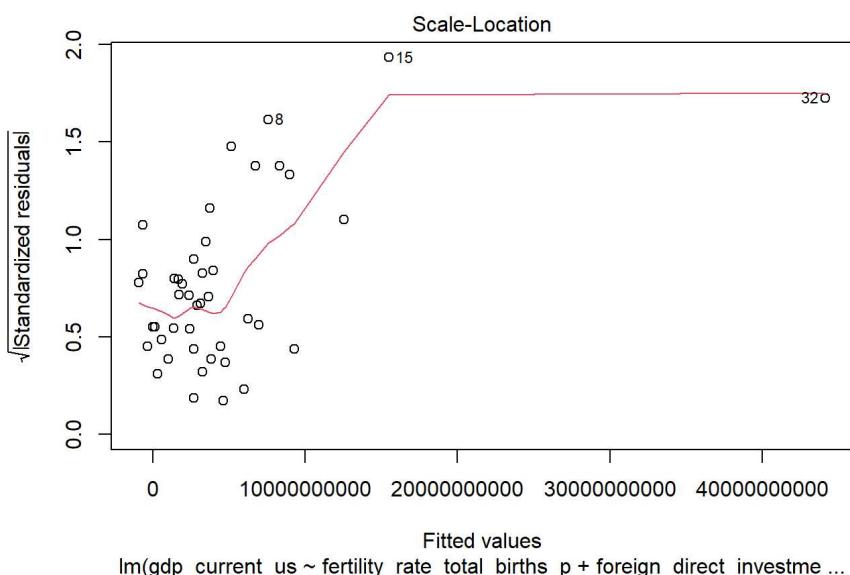
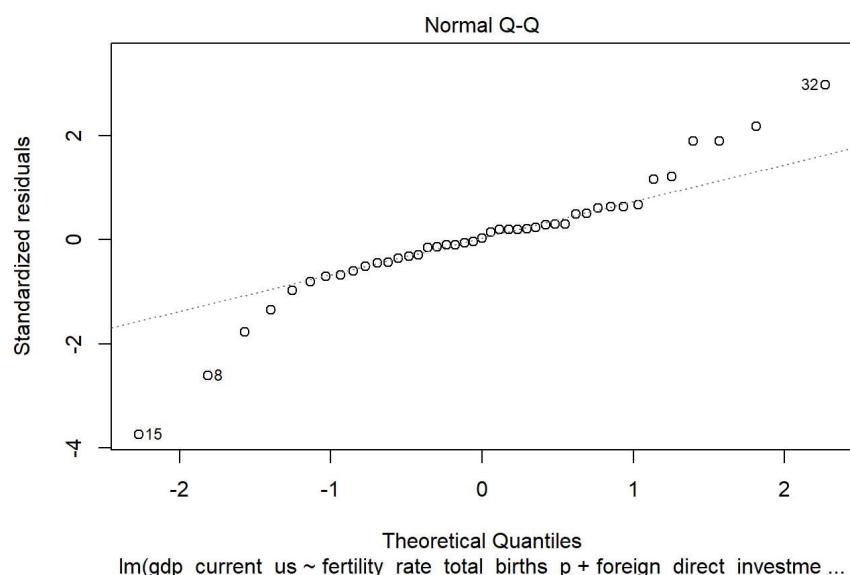
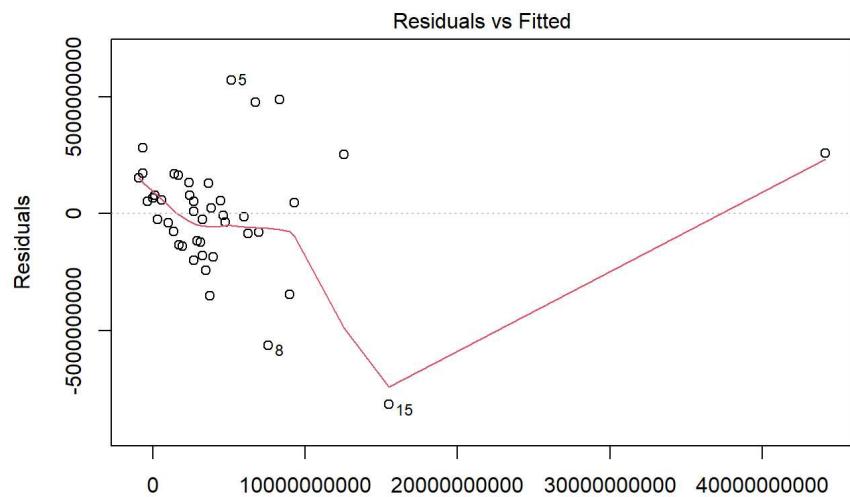
## 
## Call:
## lm(formula = gdp_current_us ~ fertility_rate_total_births_p +
##     foreign_direct_investment_net + immunization_measles_percent_of_chi +
##     imports_of_goods_and_services + inflation_gdp_deflator_annual +
##     official_development_assistance + population_total + surface_area_sq_km,
##     data = prosperity)
## 
## Coefficients:
##              (Intercept)      fertility_rate_total_births_p
##                      11805651714.4594          -1186268419.6628
##     foreign_direct_investment_net  immunization_measles_percent_of_chi
##                               8.2914                  -30843683.4846
##     imports_of_goods_and_services    inflation_gdp_deflator_annual
##                           -53862049.7124                  47310798.3904
##     official_development_assistance      population_total
##                               -0.9484                   240.0053
##     surface_area_sq_km
##                         -2443.8705
## 
```

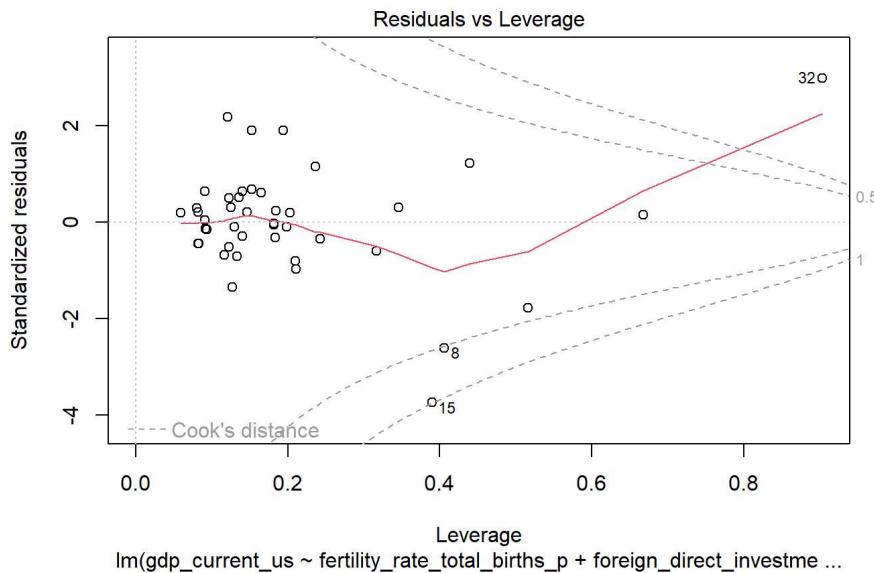
```
summary(model_11)
```

```

## 
## Call:
## lm(formula = gdp_current_us ~ fertility_rate_total_births_p +
##     foreign_direct_investment_net + immunization_measles_percent_of_chi +
##     imports_of_goods_and_services + inflation_gdp_deflator_annual +
##     official_development_assistance + population_total + surface_area_sq_km,
##     data = prosperity)
## 
## Residuals:
##       Min        1Q        Median         3Q        Max 
## -8158716588 -1188218205   91908241  1311709946  5705220254 
## 
## 
## Coefficients:
##              Estimate Std. Error t value
## (Intercept) 11805651714.4594 3863582855.4407  3.056
## fertility_rate_total_births_p -1186268419.6628 388312745.3928 -3.055
## foreign_direct_investment_net 8.2914          2.1210  3.909
## immunization_measles_percent_of_chi -30843683.4846 33740585.7553 -0.914
## imports_of_goods_and_services -53862049.7124 25027430.8969 -2.152
## inflation_gdp_deflator_annual 47310798.3904 60500123.2330  0.782
## official_development_assistance -0.9484          1.2667 -0.749
## population_total 240.0053          33.4756  7.170
## surface_area_sq_km -2443.8705          1031.6715 -2.369
## 
## Pr(>|t|) 
## (Intercept) 0.00435 **
## fertility_rate_total_births_p 0.00436 **
## foreign_direct_investment_net 0.00042 ***
## immunization_measles_percent_of_chi 0.36708
## imports_of_goods_and_services 0.03858 *
## inflation_gdp_deflator_annual 0.43963
## official_development_assistance 0.45919
## population_total 0.0000000273 ***
## surface_area_sq_km 0.02367 * 
## 
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 2793000000 on 34 degrees of freedom
## Multiple R-squared: 0.8878, Adjusted R-squared: 0.8614
## F-statistic: 33.62 on 8 and 34 DF, p-value: 0.0000000000005793
## 
```

```
plot(model_11)
```





```
#check for multicollinearity
```

```
vifres_11 <- car::vif(model_11)
vifres_11
```

```
##      fertility_rate_total_births_p      foreign_direct_investment_net
##                1.547343                  2.611607
## immunization_measles_percent_of_chi      imports_of_goods_and_services
##                1.734181                  1.668929
##      inflation_gdp_deflator_annual      official_development_assistance
##                1.298132                  1.722088
##      population_total      surface_area_sq_km
##                2.986937                  2.009149
```

Reduced Model - Remove official_development_assistance (p-value > 0.05)

```
model_12 <- lm(gdp_current_us ~ fertility_rate_total_births_p +
  foreign_direct_investment_net + immunization_measles_percent_of_chi +
  imports_of_goods_and_services + inflation_gdp_deflator_annual + population_total + surface_area_sq_km, data = prosperity)

model_12
```

```
##
## Call:
## lm(formula = gdp_current_us ~ fertility_rate_total_births_p +
##   foreign_direct_investment_net + immunization_measles_percent_of_chi +
##   imports_of_goods_and_services + inflation_gdp_deflator_annual +
##   population_total + surface_area_sq_km, data = prosperity)
##
## Coefficients:
## (Intercept)      fertility_rate_total_births_p
##           12406726691.289                 -1246552439.628
##   foreign_direct_investment_net  immunization_measles_percent_of_chi
##                   8.734                  -38180594.052
##   imports_of_goods_and_services      inflation_gdp_deflator_annual
##             -52542289.783                  45775099.594
##   population_total      surface_area_sq_km
##            229.110                  -2662.963
```

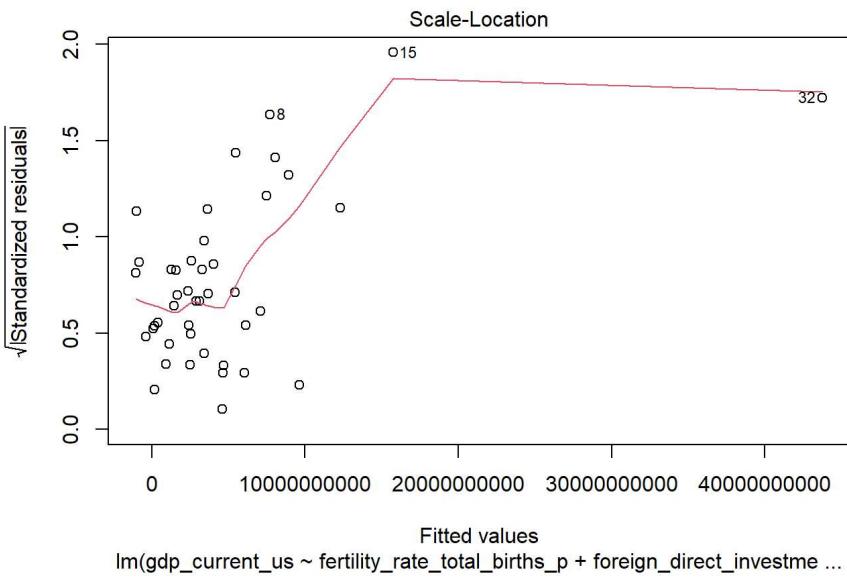
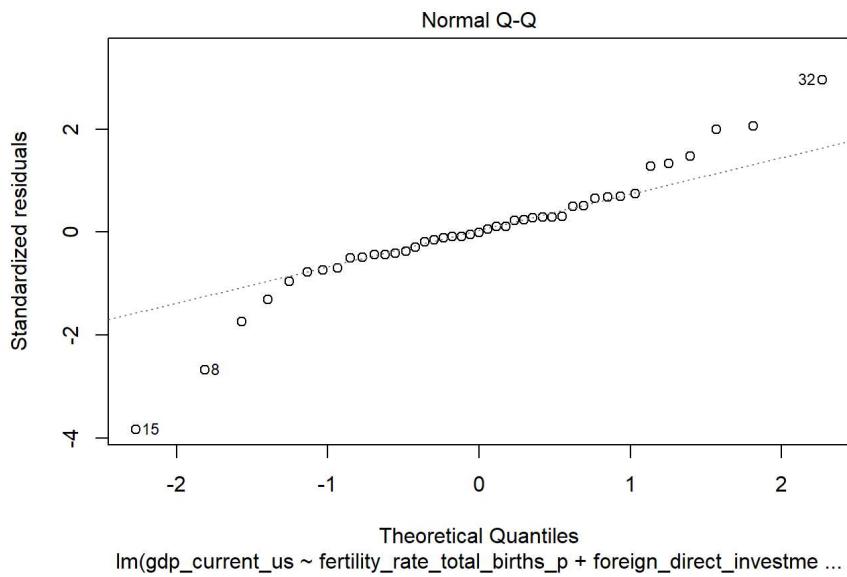
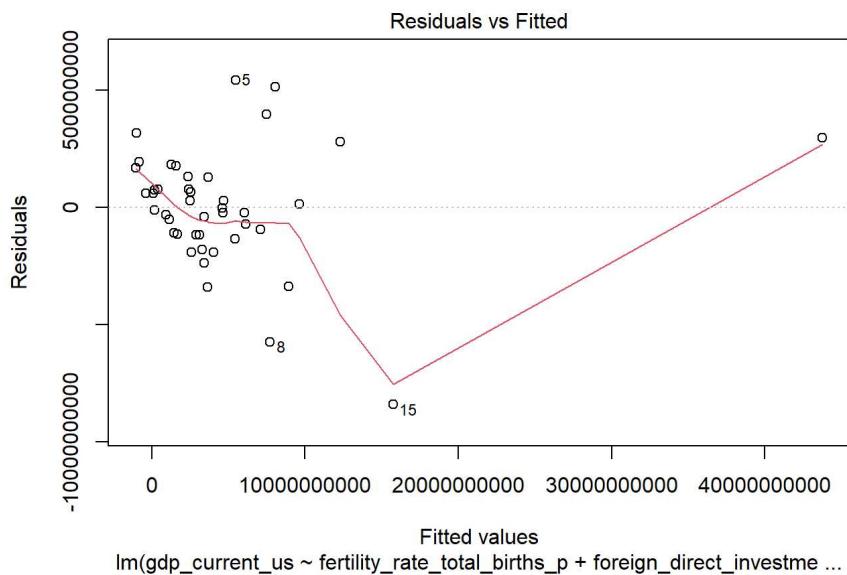
```
summary(model_12)
```

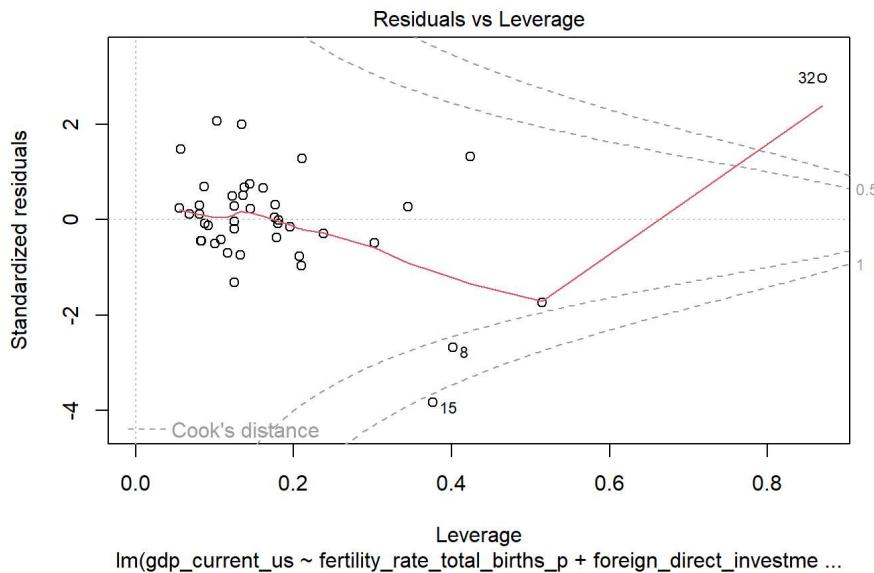
```

## 
## Call:
## lm(formula = gdp_current_us ~ fertility_rate_total_births_p +
##     foreign_direct_investment_net + immunization_measles_percent_of_chi +
##     imports_of_goods_and_services + inflation_gdp_deflator_annual +
##     population_total + surface_area_sq_km, data = prosperity)
## 
## Residuals:
##      Min       1Q   Median       3Q      Max 
## -8402428833 -1151395142  -28229840  1312557898  5420725389 
## 
## Coefficients:
##             Estimate Std. Error t value
## (Intercept) 12406726691.289 3755447715.360  3.304
## fertility_rate_total_births_p -1246552439.628 377480450.571 -3.302
## foreign_direct_investment_net  8.734    2.024  4.315
## immunization_measles_percent_of_chi -38180594.052 32082779.051 -1.190
## imports_of_goods_and_services -52542289.783 24808045.756 -2.118
## inflation_gdp_deflator_annual  45775099.594 60684535.660  0.762
## population_total        229.110    29.957  7.648
## surface_area_sq_km       -2662.963   983.068 -2.709
## 
## Pr(>|t|) 
## (Intercept) 0.002208 ***
## fertility_rate_total_births_p 0.002216 **
## foreign_direct_investment_net 0.000124 ***
## immunization_measles_percent_of_chi 0.242031
## imports_of_goods_and_services 0.041354 *
## inflation_gdp_deflator_annual 0.451256
## population_total 0.00000000568 ***
## surface_area_sq_km 0.010379 * 
## --- 
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 2775000000 on 35 degrees of freedom
## Multiple R-squared:  0.8859, Adjusted R-squared:  0.8631
## F-statistic: 38.83 on 7 and 35 DF,  p-value: 0.0000000000001165

```

```
plot(model_12)
```





```
#check for multicollinearity
```

```
vifres_12 <- car::vif(model_12)
vifres_12
```

```
##      fertility_rate_total_births_p      foreign_direct_investment_net
##                1.480812                  2.408300
## immunization_measles_percent_of_chi      imports_of_goods_and_services
##                1.587891                  1.660650
##      inflation_gdp_deflator_annual      population_total
##                1.296639                  2.422507
##      surface_area_sq_km
##                1.847497
```

Reduced Model - Remove inflation_gdp_deflator_annual (p-value > 0.05)

```
model_13 <- lm(gdp_current_us ~ fertility_rate_total_births_p +
  foreign_direct_investment_net + immunization_measles_percent_of_chi +
  imports_of_goods_and_services + population_total + surface_area_sq_km, data = prosperity)

model_13
```

```
##
## Call:
## lm(formula = gdp_current_us ~ fertility_rate_total_births_p +
##   foreign_direct_investment_net + immunization_measles_percent_of_chi +
##   imports_of_goods_and_services + population_total + surface_area_sq_km,
##   data = prosperity)
##
## Coefficients:
## (Intercept)      fertility_rate_total_births_p
##           11899951926.205                 -1210937873.663
##   foreign_direct_investment_net  immunization_measles_percent_of_chi
##                   8.423                  -32988617.652
##   imports_of_goods_and_services      population_total
##           -47748425.425                  230.340
##   surface_area_sq_km
##             -2357.267
```

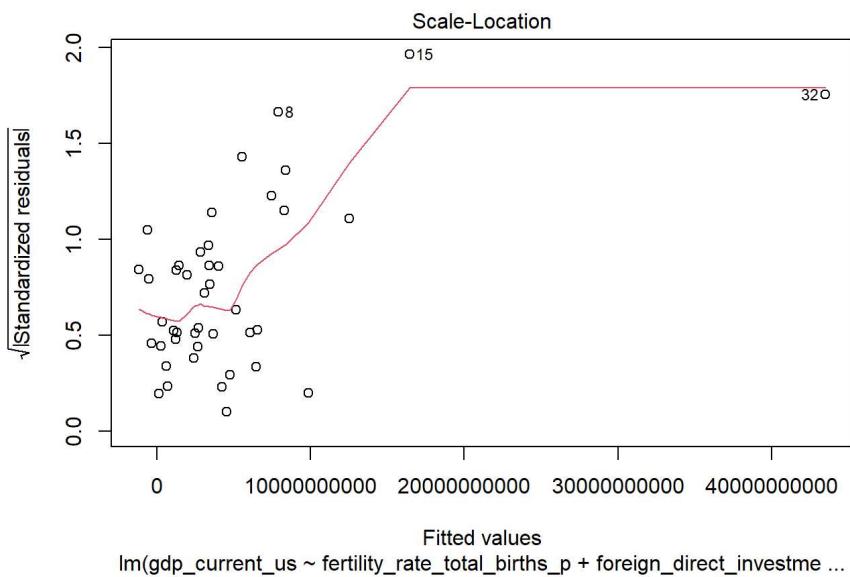
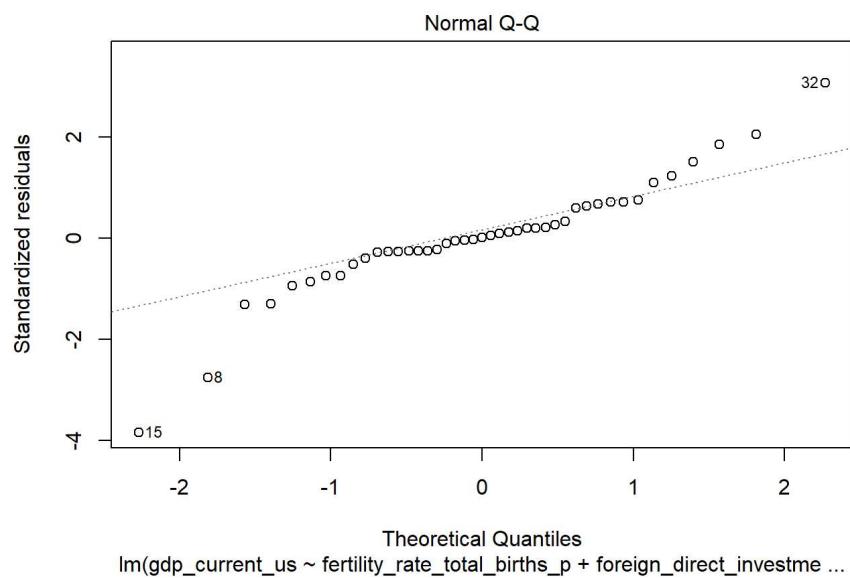
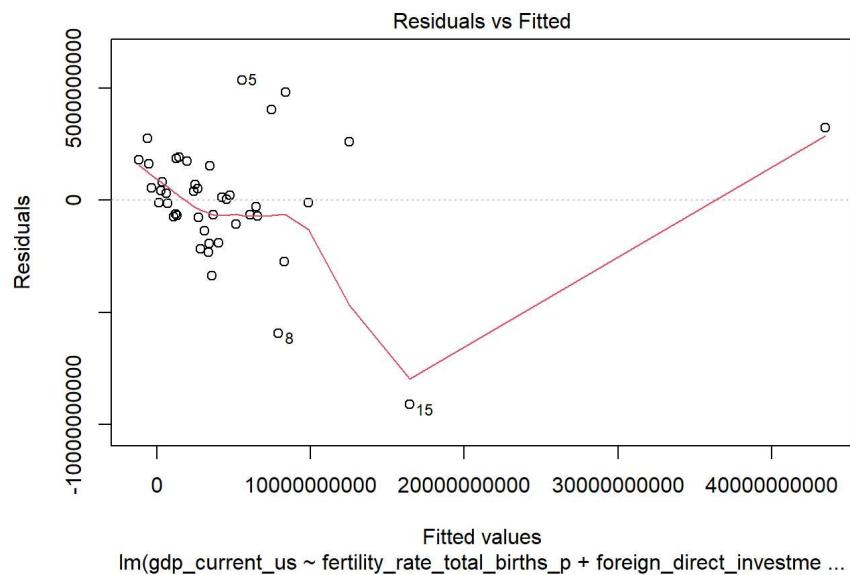
```
summary(model_13)
```

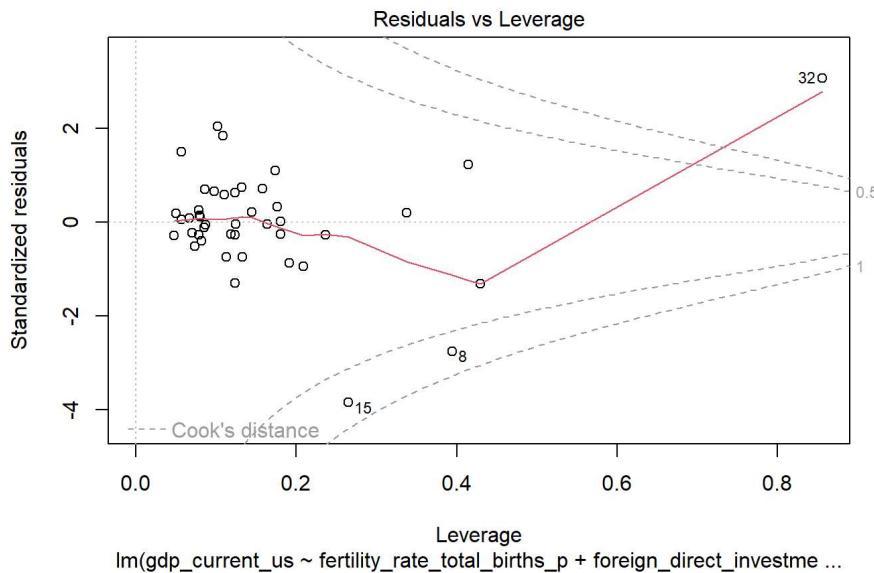
```

## 
## Call:
## lm(formula = gdp_current_us ~ fertility_rate_total_births_p +
##     foreign_direct_investment_net + immunization_measles_percent_of_chi +
##     imports_of_goods_and_services + population_total + surface_area_sq_km,
##     data = prosperity)
## 
## Residuals:
##      Min       1Q   Median       3Q      Max 
## -9109109864 -752929556  26229724 1580101601 5346567428 
## 
## Coefficients:
##             Estimate Std. Error t value
## (Intercept) 11899951926.205 3674463476.858 3.239
## fertility_rate_total_births_p -1210937873.663 372385309.844 -3.252
## foreign_direct_investment_net 8.423    1.971  4.274
## immunization_measles_percent_of_chi -32988617.652 31167368.466 -1.058
## imports_of_goods_and_services -47748425.425 23856501.384 -2.001
## population_total        230.340    29.739  7.745
## surface_area_sq_km       -2357.267    892.203 -2.642
## 
## Pr(>|t|) 
## (Intercept) 0.002584 ***
## fertility_rate_total_births_p 0.002492 **
## foreign_direct_investment_net 0.000134 ***
## immunization_measles_percent_of_chi 0.296908
## imports_of_goods_and_services 0.052921 .
## population_total 0.00000000354 ***
## surface_area_sq_km 0.012118 *
## 
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 2759000000 on 36 degrees of freedom
## Multiple R-squared:  0.884, Adjusted R-squared:  0.8647
## F-statistic: 45.74 on 6 and 36 DF,  p-value: 0.0000000000002168

```

```
plot(model_13)
```





```
#check for multicollinearity
```

```
vifres_13 <- car::vif(model_13)
vifres_13
```

```
##      fertility_rate_total_births_p      foreign_direct_investment_net
##                 1.458101                  2.309865
## immunization_measles_percent_of_chi      imports_of_goods_and_services
##                 1.516243                  1.553810
##      population_total      surface_area_sq_km
##                 2.415479                  1.539700
```

Reduced Model - Remove immunization_measles_percent_of_chi (p-value > 0.05)

```
model_14 <- lm(gdp_current_us ~ fertility_rate_total_births_p +
  foreign_direct_investment_net + imports_of_goods_and_services + population_total + surface_area_sq_km, data = prosperity)

model_14
```

```
##
## Call:
## lm(formula = gdp_current_us ~ fertility_rate_total_births_p +
##   foreign_direct_investment_net + imports_of_goods_and_services +
##   population_total + surface_area_sq_km, data = prosperity)
##
## Coefficients:
## (Intercept)  fertility_rate_total_births_p
##         9113124361.9          -1084507606.8
## foreign_direct_investment_net  imports_of_goods_and_services
##                   8.9          -52786646.5
## population_total      surface_area_sq_km
##             229.7           -2262.8
```

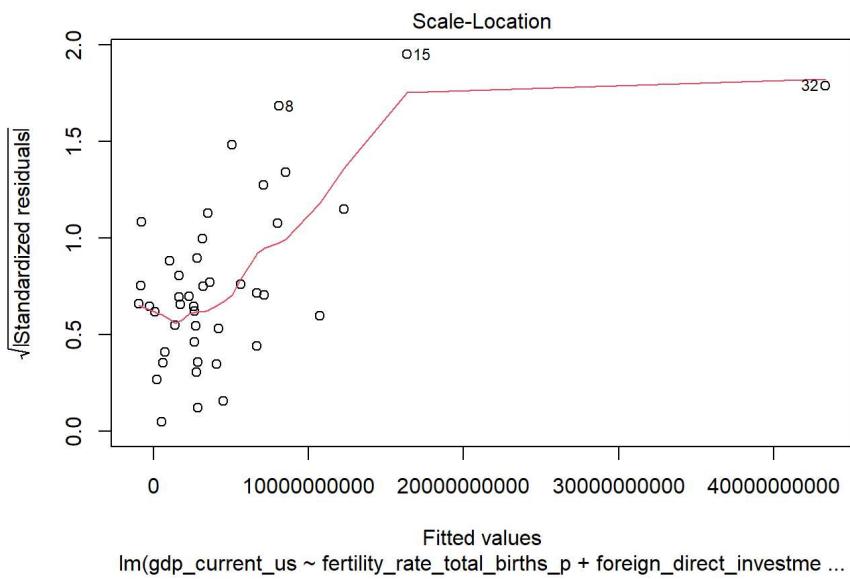
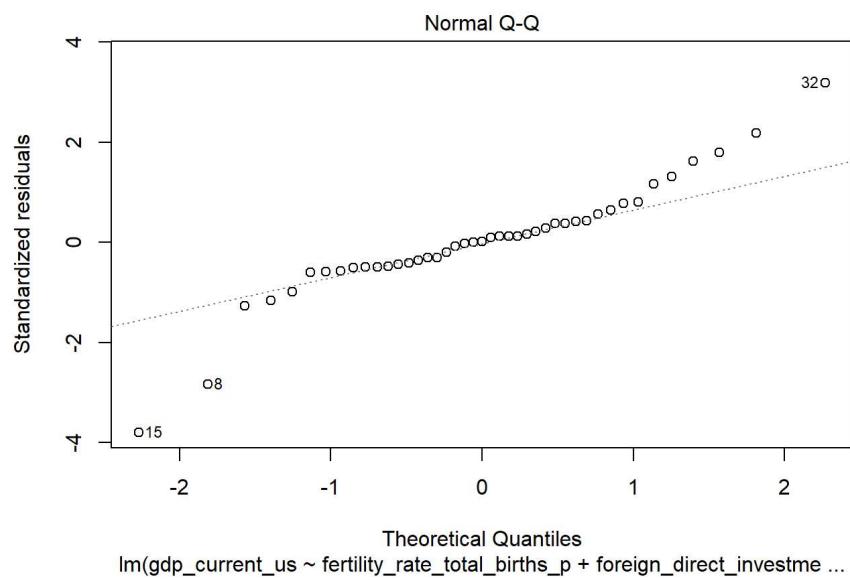
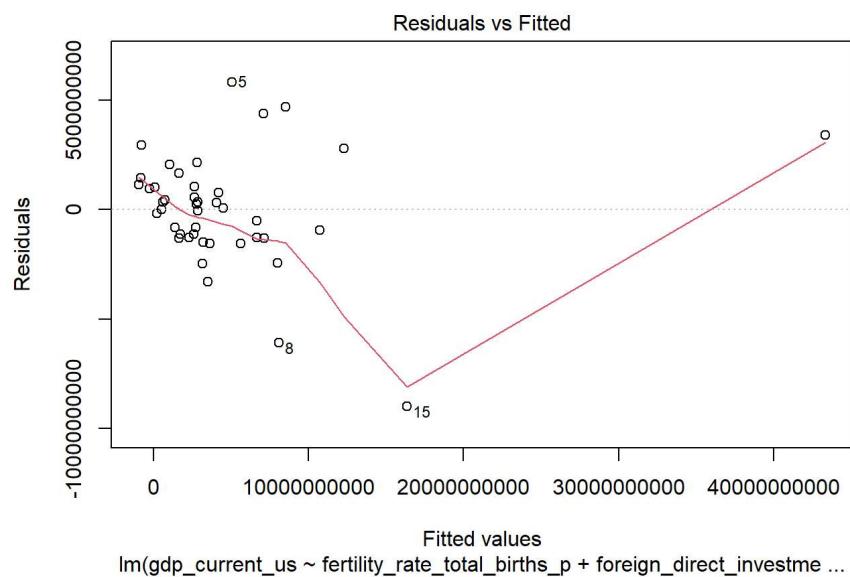
```
summary(model_14)
```

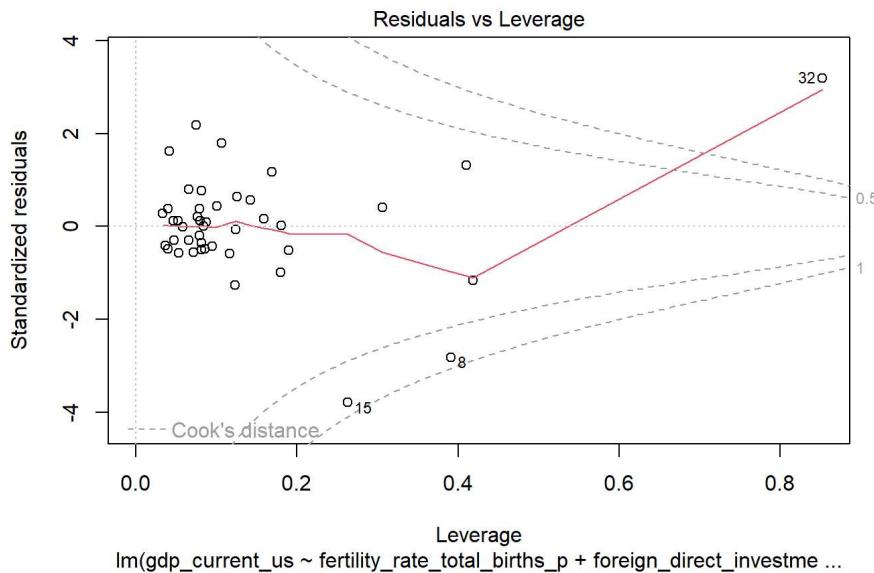
```

## 
## Call:
## lm(formula = gdp_current_us ~ fertility_rate_total_births_p +
##     foreign_direct_investment_net + imports_of_goods_and_services +
##     population_total + surface_area_sq_km, data = prosperity)
## 
## Residuals:
##    Min      1Q   Median      3Q     Max 
## -9004163011 -1273442218   61608334  1093257259  5823430830 
## 
## Coefficients:
##             Estimate Std. Error t value
## (Intercept) 9113124361.933 2567196908.353 3.550
## fertility_rate_total_births_p -1084507606.777 353280167.794 -3.070
## foreign_direct_investment_net 8.900 1.921 4.632
## imports_of_goods_and_services -52786646.533 23414759.014 -2.254
## population_total 229.714 29.781 7.713
## surface_area_sq_km -2262.840 889.174 -2.545
## 
##            Pr(>|t|)    
## (Intercept) 0.00107 ***
## fertility_rate_total_births_p 0.00400 ***
## foreign_direct_investment_net 0.00004364326 ***
## imports_of_goods_and_services 0.03018 *  
## population_total 0.00000000325 ***
## surface_area_sq_km 0.01523 *  
## 
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 2764000000 on 37 degrees of freedom
## Multiple R-squared:  0.8804, Adjusted R-squared:  0.8643
## F-statistic: 54.48 on 5 and 37 DF,  p-value: 0.00000000000004765

```

```
plot(model_14)
```





```
#check for multicollinearity
```

```
vifres_14 <- car::vif(model_14)
vifres_14
```

```
## fertility_rate_total_births_p foreign_direct_investment_net
##                 1.308072          2.188675
## imports_of_goods_and_services population_total
##                 1.491950          2.414523
## surface_area_sq_km
##                 1.524305
```

Reduced Model - take a log transformation

```
model_15 <- lm(log10(gdp_current_us) ~ fertility_rate_total_births_p +
  foreign_direct_investment_net + imports_of_goods_and_services + log10(population_total) + surface_area_sq_km, data = prosperity)
```

```
model_15
```

```
##
## Call:
## lm(formula = log10(gdp_current_us) ~ fertility_rate_total_births_p +
##   foreign_direct_investment_net + imports_of_goods_and_services +
##   log10(population_total) + surface_area_sq_km, data = prosperity)
##
## Coefficients:
## (Intercept)  fertility_rate_total_births_p
##             6.0935506813835             -0.2020131725527
## foreign_direct_investment_net  imports_of_goods_and_services
##             0.0000000003229            -0.0053509397768
## log10(population_total)      surface_area_sq_km
##             0.6734328603963            -0.0000000278680
```

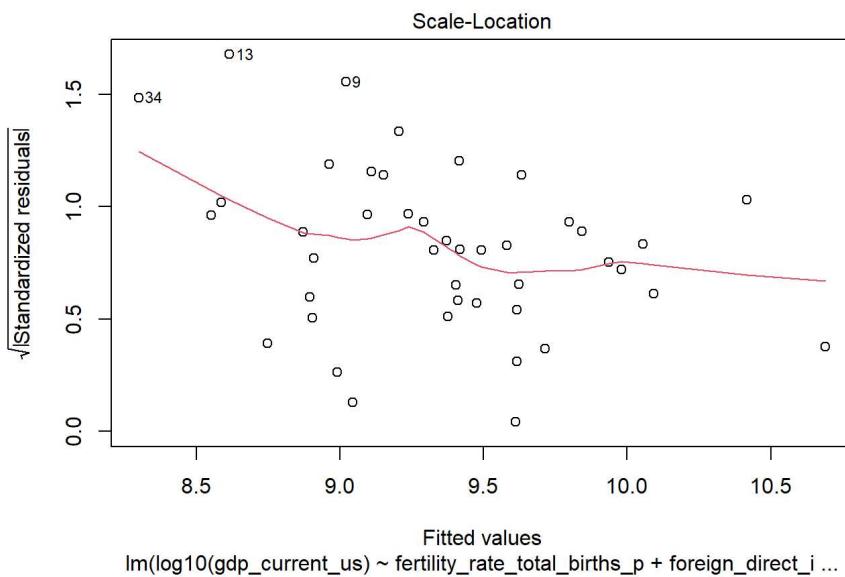
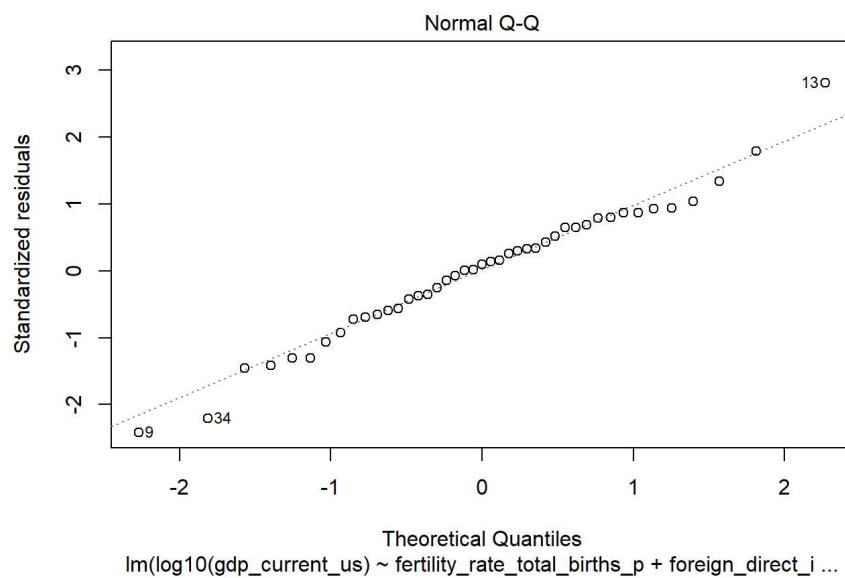
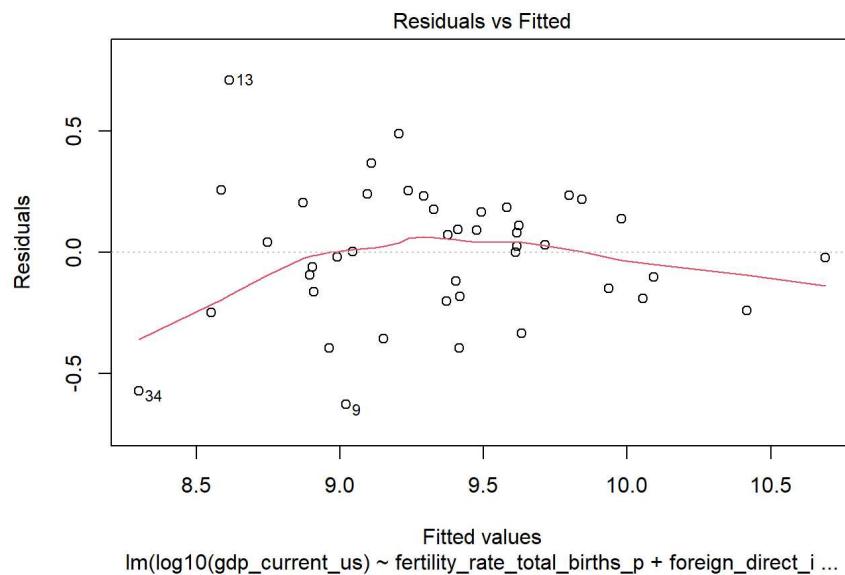
```
summary(model_15)
```

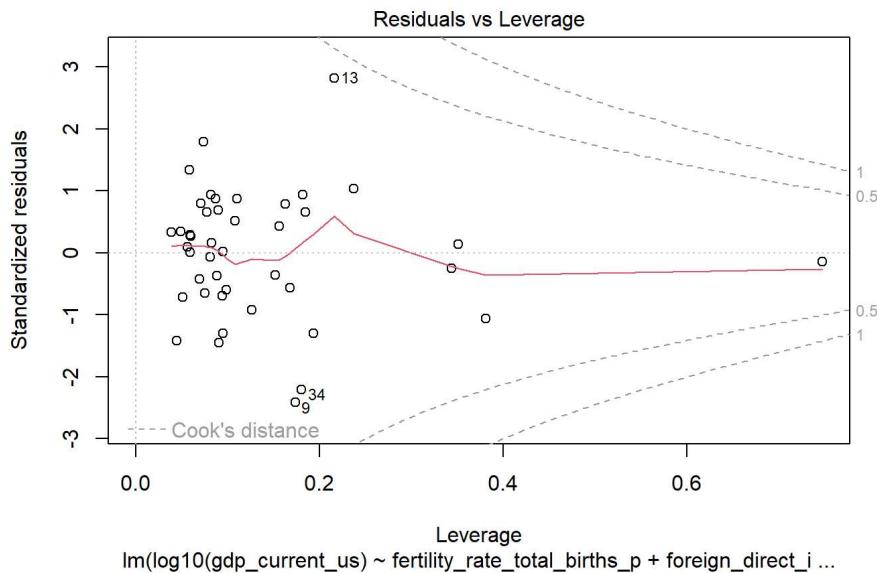
```

## 
## Call:
## lm(formula = log10(gdp_current_us) ~ fertility_rate_total_births_p +
##     foreign_direct_investment_net + imports_of_goods_and_services +
##     log10(population_total) + surface_area_sq_km, data = prosperity)
## 
## Residuals:
##      Min       1Q   Median       3Q      Max 
## -0.62712 -0.17046  0.02686  0.18234  0.71078 
## 
## Coefficients:
##                               Estimate Std. Error t value
## (Intercept)             6.0935506813835  0.6338737890795  9.613
## fertility_rate_total_births_p -0.2020131725527  0.0388925785512 -5.194
## foreign_direct_investment_net  0.0000000003229  0.0000000001546  2.089
## imports_of_goods_and_services -0.0053509397768  0.0025474985227 -2.100
## log10(population_total)      0.6734328603963  0.0951950232190  7.074
## surface_area_sq_km          -0.0000000278680  0.0000000953759 -0.292
##                               Pr(>|t|)    
## (Intercept)             0.000000000133 *** 
## fertility_rate_total_births_p 0.0000077317649 *** 
## foreign_direct_investment_net 0.0436 *  
## imports_of_goods_and_services 0.0426 *  
## log10(population_total)      0.0000000225777 *** 
## surface_area_sq_km          0.7718    
## --- 
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## 
## Residual standard error: 0.2852 on 37 degrees of freedom
## Multiple R-squared:  0.7774, Adjusted R-squared:  0.7473 
## F-statistic: 25.84 on 5 and 37 DF,  p-value: 0.0000000003933

```

```
plot(model_15)
```





```
#check for multicollinearity
```

```
vifres_15 <- car::vif(model_15)
vifres_15
```

```
## fertility_rate_total_births_p foreign_direct_investment_net
##                 1.488194          1.329687
## imports_of_goods_and_services log10(population_total)
##                      1.657814          2.269393
## surface_area_sq_km
##                      1.646300
```

predictions

```
data_predict <- add_predictions(prosperity, var = "winnings_pred", model_15)

residual <- data_predict %>%
  mutate(compare = if_else(winnings_pred < log10(gdp_current_us), 'underestimated', 'overestimated'), error = log10(gdp_current_us) - winnings_pred,
         abs_error = abs(log10(gdp_current_us) - winnings_pred), log_gdp = log10(gdp_current_us)) %>%
  dplyr::select(log_gdp, winnings_pred, compare, error, abs_error)
```

```
residual
```

log_gdp	winnings_pred	compare	error	abs_error
<dbl>	<dbl>	<chr>	<dbl>	<dbl>
9.448298	9.376002	underestimated	0.0722959847	0.0722959847
9.734265	9.621915	underestimated	0.1123500525	0.1123500525
9.505604	9.326851	underestimated	0.1787532585	0.1787532585
8.798026	9.152275	overestimated	-0.3542494464	0.3542494464
10.036621	9.799214	underestimated	0.2374070130	0.2374070130
8.789728	8.747615	underestimated	0.0421128778	0.0421128778
9.019503	9.414672	overestimated	-0.3951691472	0.3951691472
9.297161	9.631262	overestimated	-0.3341010926	0.3341010926
8.392236	9.019360	overestimated	-0.6271241962	0.6271241962
9.744069	9.712924	underestimated	0.0311452428	0.0311452428

1-10 of 43 rows

Previous 1 2 3 4 5 Next

```
residual %>%
  slice_min(order_by = abs_error, n = 10) %>%
  dplyr::select(log_gdp, winnings_pred, compare, abs_error)
```

log_gdp <dbl>	winnings_pred <dbl>	compare <chr>	abs_error <dbl>
9.611905	9.611397	underestimated	0.0005079957
9.047816	9.043384	underestimated	0.0044319042
8.971261	8.990417	overestimated	0.0191551933
10.669417	10.689841	overestimated	0.0204236223
9.643169	9.616311	underestimated	0.0268587728
9.744069	9.712924	underestimated	0.0311452428
8.789728	8.747615	underestimated	0.0421128778
8.844598	8.903528	overestimated	0.0589306957
9.448298	9.376002	underestimated	0.0722959847
9.697446	9.616511	underestimated	0.0809352495

1-10 of 10 rows

```
residual %>%
  slice_min(order_by = error, n = 10) %>%
  dplyr::select(log_gdp, winnings_pred, compare, error)
```

log_gdp <dbl>	winnings_pred <dbl>	compare <chr>	error <dbl>
8.392236	9.019360	overestimated	-0.6271242
7.728779	8.298721	overestimated	-0.5699422
9.019503	9.414672	overestimated	-0.3951691
8.567887	8.962541	overestimated	-0.3946541
8.798026	9.152275	overestimated	-0.3542494
9.297161	9.631262	overestimated	-0.3341011
8.304163	8.550422	overestimated	-0.2462586
10.179224	10.418022	overestimated	-0.2387976
9.169122	9.369873	overestimated	-0.2007518
9.865430	10.054504	overestimated	-0.1890733

1-10 of 10 rows

```
residual %>%
  slice_max(order_by = error, n = 10) %>%
  dplyr::select(log_gdp, winnings_pred, compare, error)
```

log_gdp <dbl>	winnings_pred <dbl>	compare <chr>	error <dbl>
9.325860	8.615084	underestimated	0.7107763
9.696428	9.205992	underestimated	0.4904363
9.479613	9.109738	underestimated	0.3698750
8.843964	8.585558	underestimated	0.2584059
9.494419	9.237848	underestimated	0.2565711
9.336556	9.096366	underestimated	0.2401894
10.036621	9.799214	underestimated	0.2374070

log_gdp	winnings_pred	compare	error
<dbl>	<dbl>	<chr>	<dbl>
9.524113	9.290953	underestimated	0.2331595
10.060021	9.841654	underestimated	0.2183669
9.076109	8.870727	underestimated	0.2053812

1-10 of 10 rows