

Global Credibility Commitments

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Introduction:

In this project, we will replicate and diagnose the findings of Appel and Loyle from their study on post-conflict justice and foreign direct investment. In the article titled *The economic benefits of justice: post-conflict justice (PCJ) and foreign direct investment (FDI)* the authors seek to explain if post-conflict states that implement post-conflict justice are more likely to receive foreign direct investments than those states which refrain from implementing justice institutions.

I selected this article to examine more closely if the credibility commitments that certain states hold up are actually genuine, or if there is a factor that makes them more likely than another state to implement justice institutions.

Replication:

The authors argue that PCJs are in two categories: restorative and retributive. Restorative justice is the primary focus for this paper, as they serve as signals of stability. Since a PCJ is a costly signal both politically and financially, there is likely a high chance that the actors are acting in good faith. This Forms the basis of Appel and Loyle's Hypothesis Ho: FDI is likely to be greater in a post-conflict state where there is a PCJ compared with a post- conflict state that lacks a similar justice institution.

The population model, as stated by the authors, comes from the Post-Conflict Justice dataset, focusing on PCJ activity related to all extra systemic, internationalized internal and internal armed conflicts with at least 25 annual battle-related deaths as coded by the UCDP/PRIO Armed Conflict Database. Only internal armed conflicts, including internationalized conflicts, in developing nations from 1970 to 2001 are of focus. After combining same-state conflicts, the results is a dataset with 95 civil conflicts.

For this project's sample model, which will be the Final EQ, the authors tested effects of three control variables: Economic, Institutions, and Conflict. The independent variables are measured as PCJ (No to Yes), Economic size (25th to 75th percentile), Economic growth (25th to 75th percentile), KAOPEN Index (25th to 75th percentile), Exchange rate (25th to 75th percentile), Damage, Political constraints (25th to 75th percentile), Regime type (+/- 8).

In their study, the authors measured their control variables based on their relation to economic controls, political institutions, and conflict from their PCJ dataset published in 2012. /p>

The authors model on the Final EQ is replicated below:

##

Summary Statistics

=====

## Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)
## testnewid_lag	95	2,476,202.000	499,072.800	1,222,440	2,160,000	2,840,000
## ccode	95	480.537	226.163	41	368.5	630
## id	95	99.432	41.918	5	70.5	133.5
## damage	95	-3.070	27.677	-150	-7.1	4.8
## victory_lag	95	0.411	0.495	0	0	1
## peace_agreement_lag	95	0.179	0.385	0	0	0
## issue_territory_lag	95	0.263	0.443	0	0	1
## cw_duration_lag	95	5.074	7.113	1	1	5
## fv8	95	2,390.526	2,674.067	132.990	617.443	2,984.376
## fv10	95	84,651,306,071.000	194,852,386,376.000	273,049,789	5,098,770,094	47,787,621,7
## fv11	95	2.129	11.876	-16.227	-1.971	3.824
## fv27	95	0.237	0.269	0	0	0.4
## fv34	95	-0.463	1.258	-1.812	-1.131	-0.087
## v2diff	95	2.922	11.883	-12.414	-0.176	2.129
## v3Mdiff	95	759.146	2,910.949	-1,858.914	-0.572	408.250
## coldwar	95	0.284	0.453	0	0	1
## xratf	95	4.215	20.713	0	1.0	1.4
## labor	95	64.937	11.038	43.300	56.350	71.950
## physint	79	3.696	1.989	0.000	2.000	5.000
## worker	79	0.873	0.774	0.000	0.000	1.000
## polity2	95	-0.379	6.036	-10	-7	5
## v60mean	93	32.754	27.991	0.257	10.045	54.652
## v63mean	90	29.472	31.224	0.000	1.563	52.832
## v64mean	95	59.605	10.244	30.607	53.052	68.406
## truthvictim	95	0.189	0.394	0	0	0

```
## [1] "data.frame"
```

```
##
## =====
##               Dependent variable:
##               -----
##               v3Mdiff
## -----
## truthvictim      1,960.282***
##                  (702.992)
##
## fv8              -0.111
##                  (0.133)
##
## fv10             0.000***
##                  (0.000)
##
## fv11             37.400
##                  (23.239)
##
## fv34             198.823
##                  (201.590)
##
## fv27             2,557.954*
##                  (1,459.599)
```

```
##
## victory_lag          -33.969
##                     (650.725)
##
## cw_duration_lag      0.811
##                     (35.543)
##
## damage               28.379***
##                     (10.242)
##
## peace_agreement_lag  -1,215.137
##                     (793.826)
##
## coldwar              81.531
##                     (654.092)
##
## polity2             -90.169
##                     (56.309)
##
## xratf               -42.516***
##                     (13.888)
##
## labor               9.844
##                     (25.528)
##
## v64mean             3.475
##                     (32.993)
##
## Constant            -1,278.322
##                     (2,852.294)
##
## -----
## Observations          95
## R2                   0.514
## Adjusted R2          0.422
## Residual Std. Error  2,213.314 (df = 79)
## F Statistic          5.573*** (df = 15; 79)
## =====
## Note:                 *p<0.1; **p<0.05; ***p<0.01
```

Standard error test

```
## Loading required package: carData
```

```
## Loading required package: zoo
```

```
##
```

```
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':
```

```
##
```

```
## as.Date, as.Date.numeric
```

```
##
## t test of coefficients:
##
##           Estimate Std. Error t value Pr(>|t|)
## (Intercept) -1.2783e+03 2.5776e+03 -0.4959 0.62132
## truthvictim  1.9603e+03 1.1661e+03  1.6811 0.09669 .
## fv8          -1.1097e-01 1.6590e-01 -0.6689 0.50551
## fv10         1.0954e-08 5.8364e-09  1.8769 0.06422 .
## fv11         3.7400e+01 2.3379e+01  1.5997 0.11366
## fv34         1.9882e+02 2.0662e+02  0.9623 0.33885
## fv27         2.5580e+03 2.0049e+03  1.2758 0.20575
## victory_lag  -3.3969e+01 5.0246e+02 -0.0676 0.94627
## cw_duration_lag 8.1107e-01 1.9690e+01  0.0412 0.96725
## damage       2.8379e+01 1.6567e+01  1.7130 0.09064 .
## peace_agreement_lag -1.2151e+03 8.9370e+02 -1.3597 0.17780
## coldwar      8.1531e+01 5.0486e+02  0.1615 0.87212
## polity2     -9.0169e+01 7.5164e+01 -1.1996 0.23387
## xratf       -4.2516e+01 2.7388e+01 -1.5524 0.12457
## labor       9.8437e+00 2.0940e+01  0.4701 0.63958
## v64mean     3.4751e+00 2.8210e+01  0.1232 0.90227
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

With the results fully and accurately replicated for the Final EQ, we can see that they in fact do match the observations shown in Table 1 of Appel and Loyle's article. The PCJ is shown to be a statistically significant variable even after controls were ensured, making them fail to reject their hypothesis. The significant variables at one level are fv8 (economic development, fv10 (Economic Size), and peace_agreement_lag (Peace Agreement). The author includes corrections to account for robustness by including two human rights variables: Physical Integrity Rights and Workers' Rights from the Cingranelli- Richards (CIRI) Human Rights Dataset (Cingranelli & Richards, 2010). We will test to see if these variables made an impact in a diagnostic test.

Diagnostic Tests and Corrections

In order to satisfy the Gauss-Markov Theorem, the model must be diagnosed to meet certain criteria. If the Gauss-Markov theorem is satisfied, we know we have the best fitted model. In order to test this, we run test to determine heteroskedacity, OLS estimates, multicollinearity and variance tests, and calculating Cooks' D threshold.

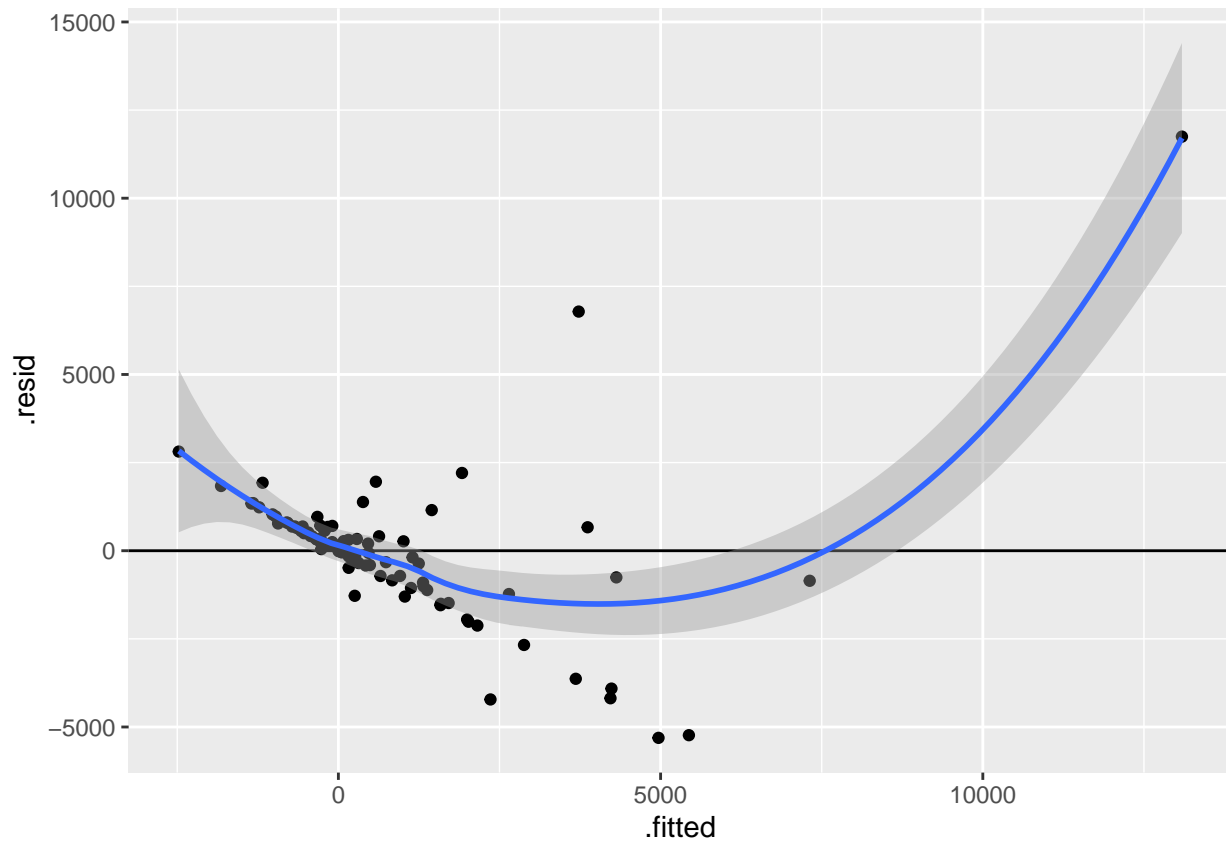
We can start off by plotting residuals against fitted values to determine independence and linearity.

Fitted vs Residual Plot

The contents of the loess curve indicate that the fitted and residual points follow the same line minus some outliers. We can at least confirm that there is no evidence of heteroskedsticity.

A RESET test will be able to tell us if there is any non-linearity for certain in residuals.

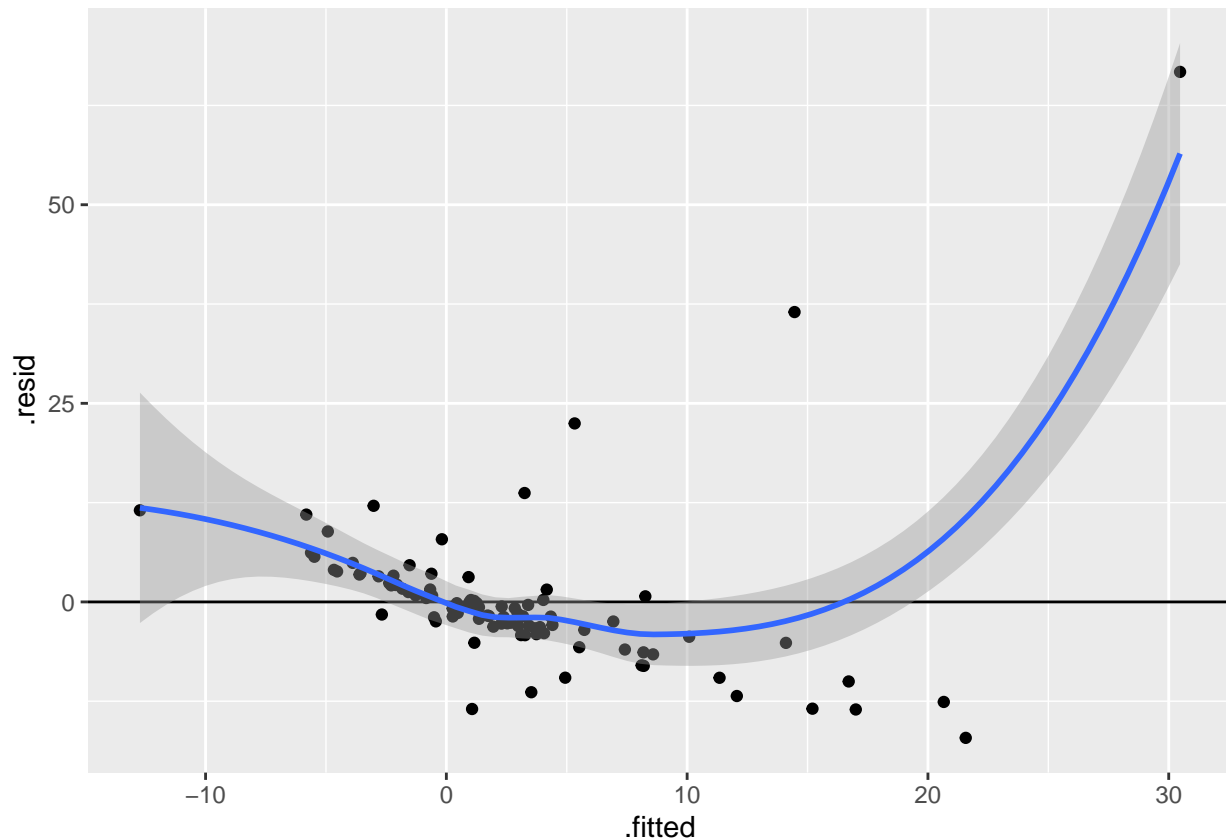
```
## 'geom_smooth()' using formula 'y ~ x'
```



Robust Model

When testing the robust model that takes the two control variables into account, the relationship between fitted and residual lines appears visually stronger.

```
## 'geom_smooth()' using formula 'y ~ x'
```



OLS Estimates

After a RESET test, evidence shows that the F-statistic is 144.24 and p is 2.2e-16, or -10.02. Given this, we fail to reject the null hypothesis as there is no difference in how the model changes/

```
## Analysis of Variance Table
##
## Model 1: v3Mdiff ~ truthvictim + fv8 + fv10 + fv11 + fv34 + fv27 + victory_lag +
##      cw_duration_lag + damage + peace_agreement_lag + coldwar +
##      polity2 + xratf + labor + v64mean
## Model 2: v3Mdiff ~ truthvictim + fv8 + fv10 + fv11 + fv34 + fv27 + victory_lag +
##      cw_duration_lag + damage + peace_agreement_lag + coldwar +
##      polity2 + xratf + labor + v64mean + I(.fitted^2)
##   Res.Df    RSS Df Sum of Sq    F    Pr(>F)
## 1      79 387001995
## 2      78 135826265  1 251175730 144.24 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Multicollinearity Test

By running a test of multicollinearity we can see if the variables have a high variance inflation factor, which they do not appear to.

```
##      truthvictim      fv8      fv10      fv11
##      1.471819      2.423514      2.201891      1.461635
```

##	fv34	fv27	victory_lag	cw_duration_lag
##	1.234101	2.947597	1.987182	1.226627
##	damage	peace_agreement_lag	coldwar	polity2
##	1.541806	1.795498	1.687875	2.216426
##	xratf	labor	v64mean	
##	1.587739	1.523470	2.191917	

Cook/Weisberg Error Variance

In order to satisfy the Gauss-Markov theorem by maintaining constant error significance accross all observations, we can test error variance using two tests.

```
## Non-constant Variance Score Test
## Variance formula: ~ fitted.values
## Chisquare = 373.7873, Df = 1, p = < 2.22e-16
```

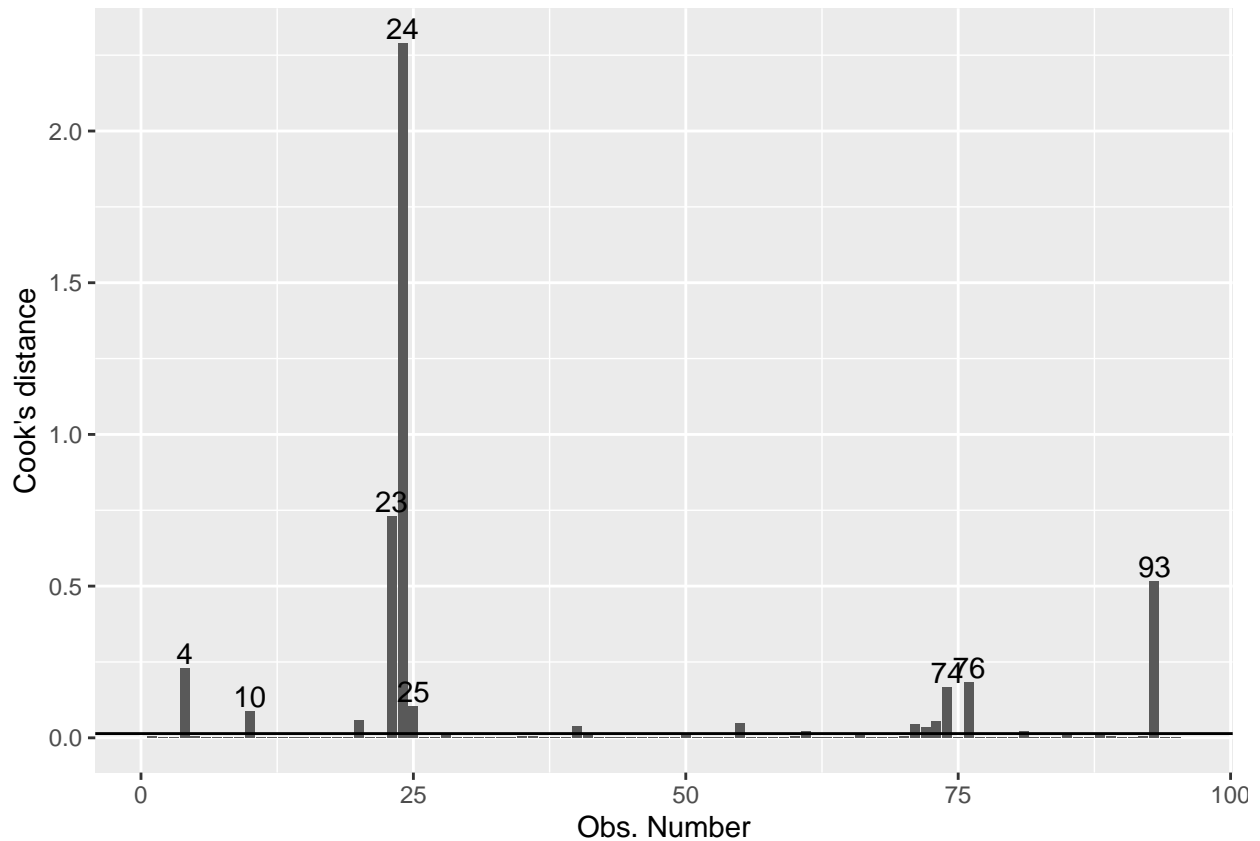
Breush/Pagan Error Variance

Both Cook/Wiesberg and Breush/Bagan's tests show a low p-value, indicative of violation of the White robust error standard.

```
##
## studentized Breusch-Pagan test
##
## data:  model1
## BP = 57.496, df = 15, p-value = 6.761e-07
```

Diagnosing Influential Observations

We can diagnose influential observations to see if the coefficient estimates change, using Cook's distance plot.



Observations above Cook's D threshold

The plot indicates there are eight observations above the threshold of .0645. We now test the model without these to see if the results change.

```
## # A tibble: 8 x 6
##   id ccode .fitted .std.resid .hat .cooksd
##   <dbl> <dbl>   <dbl>      <dbl> <dbl> <dbl>
## 1     4    70   4968.      -2.88 0.306 0.229
## 2    10    93  -2476.       1.59 0.358 0.0878
## 3    23   365   2647.      -1.43 0.850 0.731
## 4    24   365  13089.       7.01 0.427 2.29
## 5    25   372   4238.      -2.08 0.276 0.103
## 6    74   651   3729.       3.40 0.187 0.165
## 7    76   670    582.       1.40 0.600 0.184
## 8    93   850   2360.      -2.76 0.521 0.517
```

Re-Estimating the Model

The outputs show similar values, meaning the residuals have stayed the same despite removing the values above Cook's D threshold.

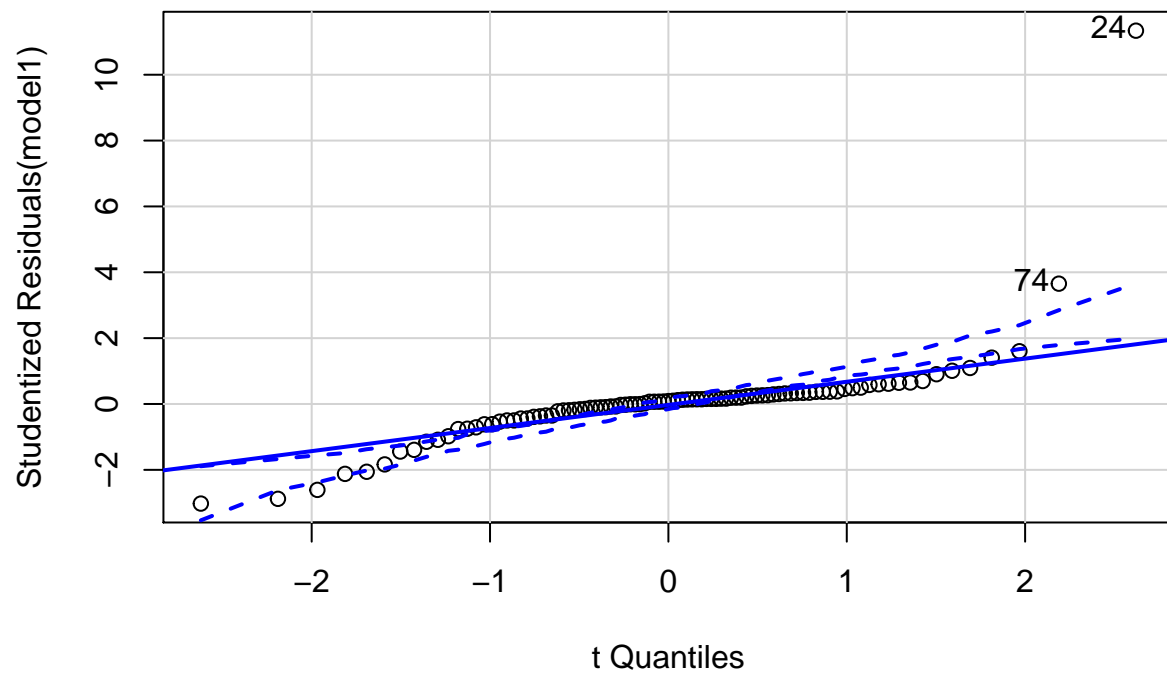
```
##
## Call:
## lm(formula = v3Mdiff ~ truthvictim + fv8 + fv10 + fv11 + fv34 +
##     fv27 + victory_lag + cw_duration_lag + damage + peace_agreement_lag +
```



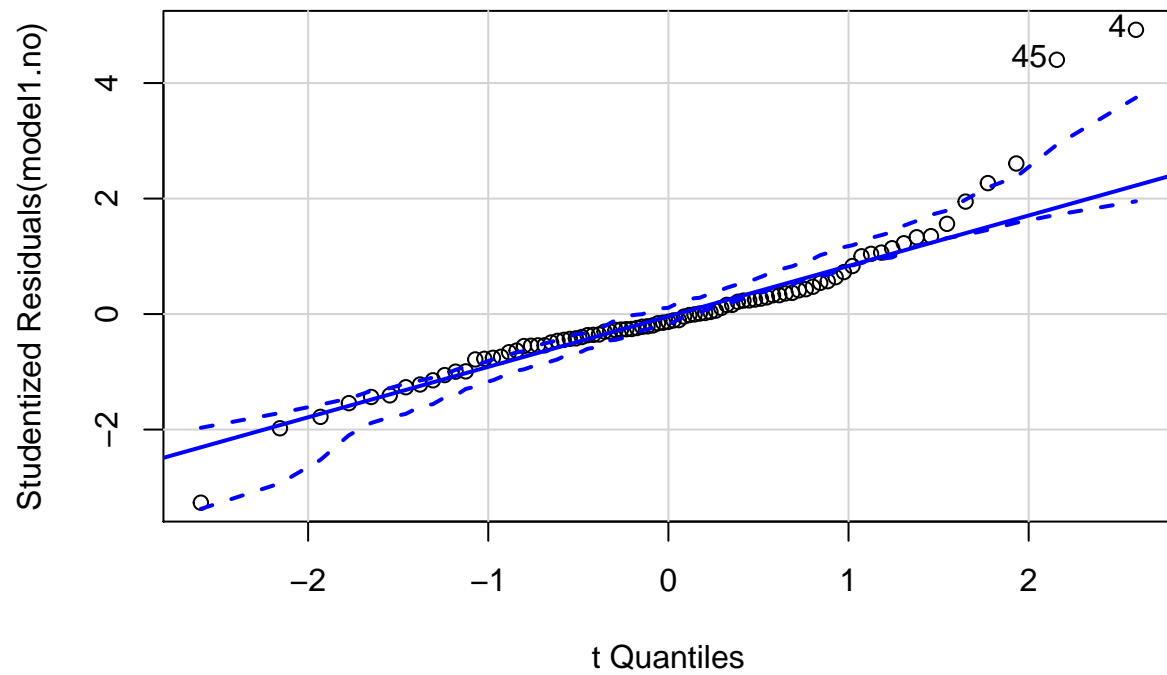
```
##      coldwar + polity2 + xratf + labor + v64mean, data = appel.v2[appel.v2$.cooks <
##      0.0645, ]
##
## Residuals:
##      Min        1Q    Median        3Q        Max
## -2146.0   -396.7   -104.9    277.9   2820.6
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -2.011e+03  1.129e+03  -1.781  0.079232 .
## truthvictim    1.174e+03  3.006e+02   3.905  0.000212 ***
## fv8           -2.072e-02  8.025e-02  -0.258  0.797054
## fv10           4.408e-09  1.066e-09   4.136  9.57e-05 ***
## fv11          -8.708e-01  9.395e+00  -0.093  0.926413
## fv34           2.807e+02  8.310e+01   3.377  0.001190 **
## fv27          -5.655e+02  5.988e+02  -0.944  0.348182
## victory_lag    -2.190e+02  2.563e+02  -0.854  0.395746
## cw_duration_lag -6.037e+00  1.313e+01  -0.460  0.647162
## damage         2.690e+00  4.971e+00   0.541  0.590143
## peace_agreement_lag -6.975e+02  3.221e+02  -2.166  0.033686 *
## coldwar        2.910e+01  2.545e+02   0.114  0.909280
## polity2        1.996e+01  2.276e+01   0.877  0.383320
## xratf          7.526e+00  6.235e+01   0.121  0.904267
## labor          1.569e+01  9.681e+00   1.620  0.109631
## v64mean        2.622e+01  1.405e+01   1.867  0.066075 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 807 on 71 degrees of freedom
## Multiple R-squared:  0.5285, Adjusted R-squared:  0.4289
## F-statistic: 5.305 on 15 and 71 DF, p-value: 5.836e-07
```

Normality Diagnostics

Once plotted, the plot without the values shows that the amount of high residuals in high quantiles decreased, bringing the distribution in a smaller range. The Asymptotes are violated in the graphs, indicative that the model without the outliers is a better OLS estimate.



```
## [1] 24 74
```



```
## [1] 4 45
```

Normality Test

A normality test supplements the findings that the first model does not have normality, but the second one seems to have a strong p-value of .001.

```
##
## Shapiro-Wilk normality test
##
## data: residuals(model1)
## W = 0.76971, p-value = 6.789e-11
```

```
##
## Shapiro-Wilk normality test
##
## data: residuals(model1.no)
## W = 0.93161, p-value = 0.0001882
```

Results

Before reaching a conclusion, we can compare our standard model, model of robustness, model and without outliers. We can see that the original model bears great weight on the significance of exchange rate functions and economic size, while the model without outliers bears great weight on the KAOPEN index, Peace agreements, and truthvictim, which all 3 models show a level of significance.

```
##
## =====
##              (1)              (2)              (3)
## -----
## truthvictim      1,960.282*** 1,960.282* 1,173.994***
##                  (702.992)  (1,166.055)  (300.602)
## fv8              -0.111      -0.111      -0.021
##                  (0.133)      (0.166)      (0.080)
## fv10             0.000***      0.000*      0.000***
##                  (0.000)      (0.000)      (0.000)
## fv11             37.400       37.400      -0.871
##                  (23.239)      (23.379)      (9.395)
## fv34             198.823      198.823     280.682***
##                  (201.590)      (206.618)      (83.104)
## fv27             2,557.954*    2,557.954    -565.505
##                  (1,459.599)    (2,004.911)    (598.816)
## victory_lag      -33.969      -33.969     -218.955
##                  (650.725)      (502.462)      (256.261)
## cw_duration_lag   0.811        0.811       -6.037
##                  (35.543)      (19.690)      (13.134)
## damage           28.379***      28.379*      2.690
##                  (10.242)      (16.567)      (4.971)
## peace_agreement_lag -1,215.137 -1,215.137 -697.520**
##                  (793.826)      (893.700)      (322.060)
## coldwar          81.531       81.531      29.101
##                  (654.092)      (504.863)      (254.480)
## polity2         -90.169      -90.169      19.962
##                  (56.309)      (75.164)      (22.756)
## xratf           -42.516***      -42.516      7.526
##                  (13.888)      (27.388)      (62.350)
## labor            9.844        9.844      15.685
##                  (25.528)      (20.940)      (9.681)
## v64mean           3.475        3.475      26.221*
##                  (32.993)      (28.210)      (14.047)
```

```

## Constant          -1,278.322  -1,278.322  -2,011.332*
##                   (2,852.294)  (2,577.603) (1,129.491)
## -----
## Observations           95                      87
## R2                     0.514                  0.528
## Adjusted R2            0.422                  0.429
## =====
## Note:                  *p<0.1; **p<0.05; ***p<0.01

```

Conclusion

When setting out to accomplish this project, I was hoping that I would find results close to the original findings. That would indicate to me that both the article and my work were done right. I believe I achieved that task, as the data from my replication closely matches that of the work of Appel and Loyle. I found that despite being unable to reject the hypothesis, there are several variables that can improperly give the illusion of a statistical relationship. Especially when modifying the outliers, which resulted in a much more accurate OLS estimate. I did expect the Gauss-Markov theorem to be met, but I understand the reasons as to why it could not happen, as the variance was inconsistent. While I only solved the final model, and not all four, I found my conclusions were similar to the authors, who overall agreed that there is a benefit for countries seeking FDI if they allow PCJ. It is evident by the residuals that economy, size, and significance of the country certainly play underlying roles in this.

References Appel, B. J., & Loyle, C. E. (2012). The economic benefits of justice: Post-conflict justice and foreign direct investment. *Journal of Peace Research*, 49(5), 685-699.