



UNIVERSIDADE
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DE PERNAMBUCO

A relação entre investimentos em defesa e o crescimento econômico: análise da Rússia (2002 - 2021)

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Variáveis

Variável dependente

- ❑ Crescimento econômico (PIB per capita)

Variáveis independentes

- ❑ Gasto militar
- ❑ Indústria de armas
- ❑ Importação e exportação de armas
- ❑ Pessoal militar

Comparação dos modelos de regressão linear

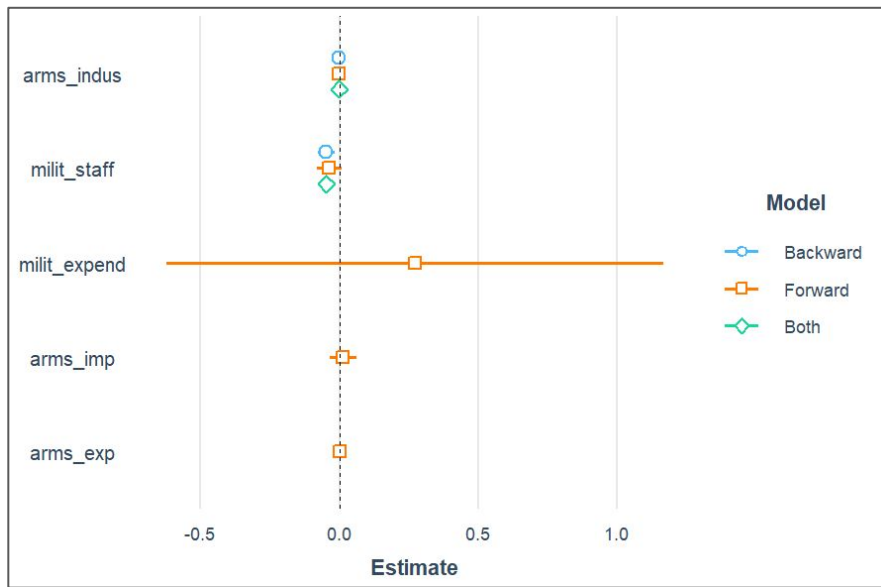
Defesa e Crescimento Economico			
=====			
Dependent variable:			

	(1)	pib_capita (2)	(3)
	regrOriginalBack	regrOriginalForw	regrOriginalBoth

milit_expend		0.272 (0.417)	
arms_indus	-0.0004*** (0.0001)	-0.0005** (0.0002)	-0.0004*** (0.0001)
arms_imp		0.013 (0.022)	
arms_exp		0.0004 (0.001)	
milit_staff	-0.047*** (0.015)	-0.037* (0.021)	-0.047*** (0.015)
Constant	62.156*** (15.184)	48.076* (24.666)	62.156*** (15.184)

Observations	20	20	20
R2	0.470	0.492	0.470
Adjusted R2	0.407	0.311	0.407
Residual Std. Error	4.554 (df = 17)	4.911 (df = 14)	4.554 (df = 17)
F Statistic	7.533*** (df = 2; 17)	2.715* (df = 5; 14)	7.533*** (df = 2; 17)
=====			
Note:		*p<0.1; **p<0.05; ***p<0.01	

Confiabilidade das variáveis



Both/Back

	2.5 %	97.5 %
(Intercept)	30.1203865613	94.1906774119
arms_indus	-0.0005992773	-0.0001610152
milit_staff	-0.0772433455	-0.0159692765

Forward

	2.5 %	97.5 %
(Intercept)	-4.8270007332	1.009785e+02
milit_expend	-0.6224526647	1.165825e+00
arms_indus	-0.0008794549	-6.700181e-05
arms_imp	-0.0354056784	6.054951e-02
arms_exp	-0.0017091406	2.490394e-03
milit_staff	-0.0809814011	7.845596e-03

Explicação do modelo “Both”

```
Call:
lm(formula = pib_capta ~ arms_indus + milit_staff, data = regrOriginal)

Residuals:
    Min       1Q   Median       3Q      Max
-6.6828 -3.1313 -0.7717  3.7264  7.3816

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  62.1555320  15.1838605   4.094  0.000757 ***
arms_indus   -0.0003801   0.0001039  -3.660  0.001939 **
milit_staff  -0.0466063   0.0145212  -3.210  0.005141 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

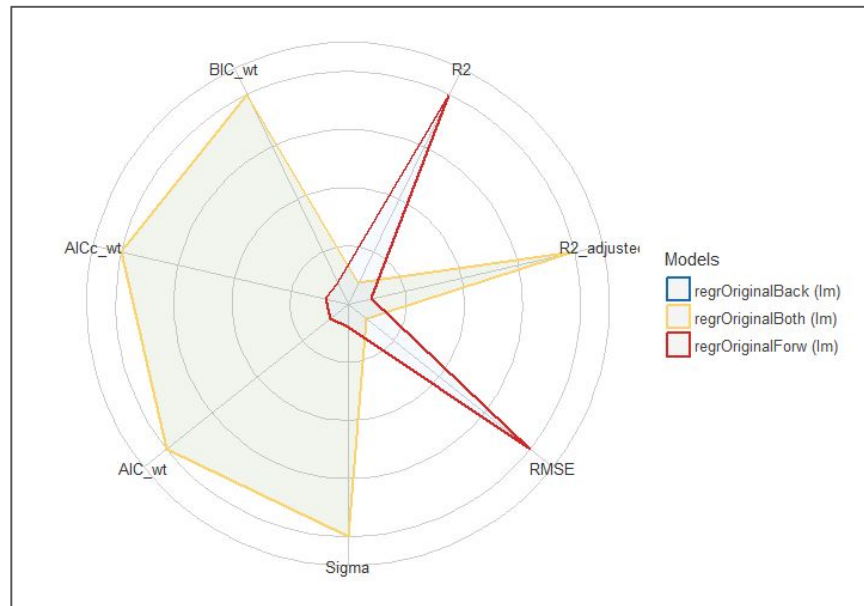
Residual standard error: 4.554 on 17 degrees of freedom
Multiple R-squared:  0.4698,    Adjusted R-squared:  0.4075
F-statistic: 7.533 on 2 and 17 DF,  p-value: 0.004545
```

Beta

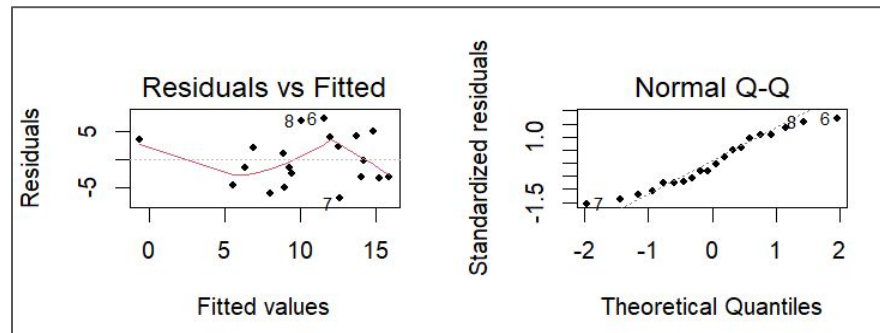
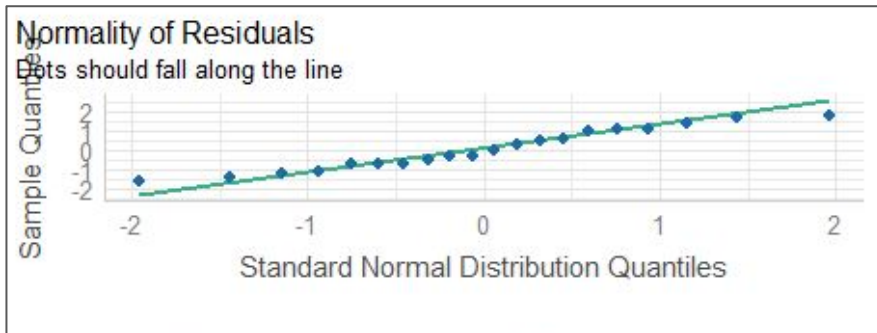
-0.8024388

-0.7036604

Comparação de performance



Pressuposto 1: Normalidade dos resíduos

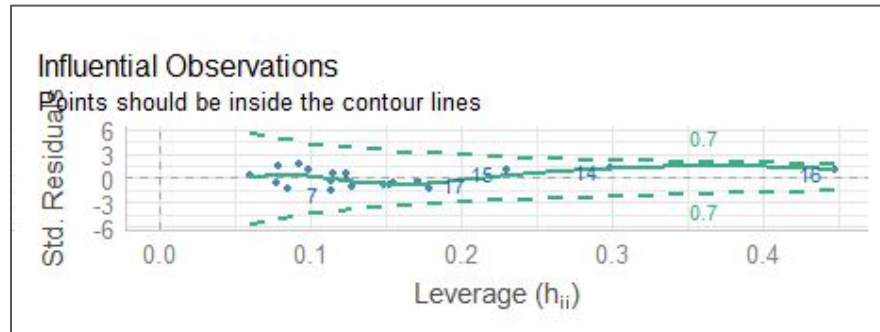


Teste shapiro

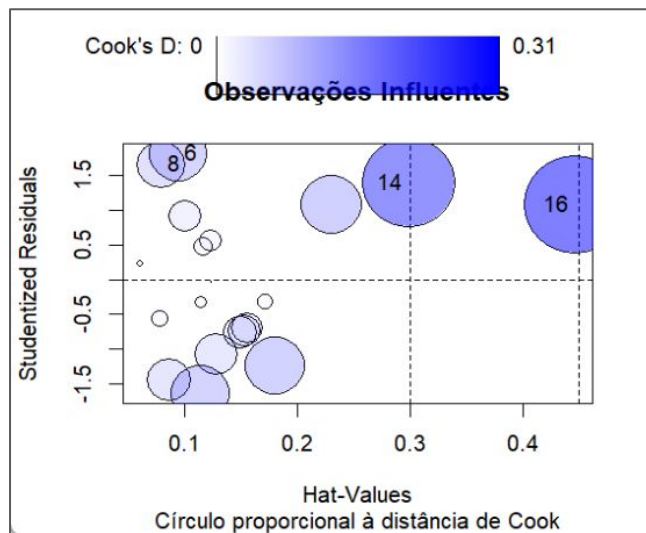
$w = 0.95551$, $p\text{-value} = 0.4585$

Teste de outliers

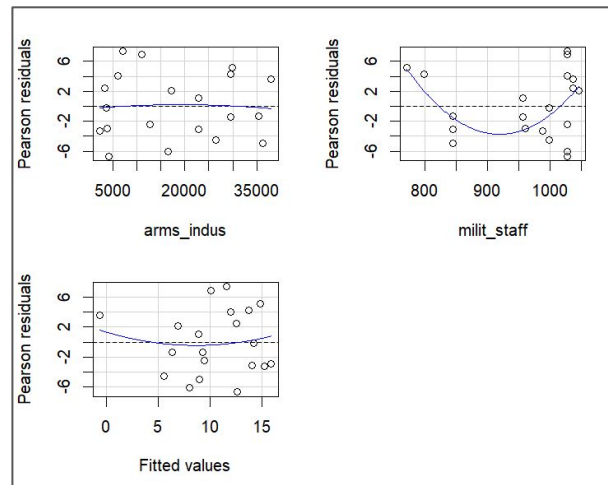
OK: No outliers detected.
- Based on the following method and threshold: cook (0.821).
- For variable: (whole model)



Pressuposto 1: Normalidade dos resíduos



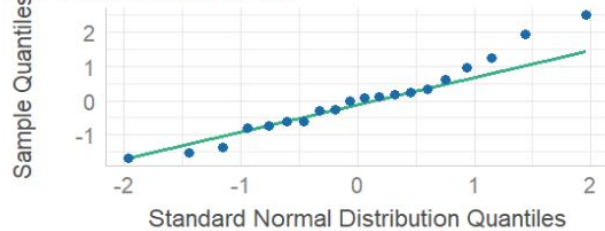
Resíduos



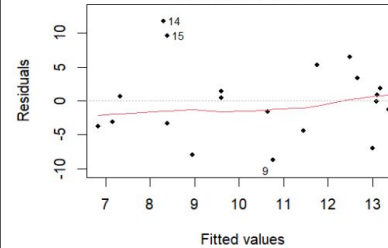
Pressuposto 1: Normalidade dos resíduos

Normality of Residuals

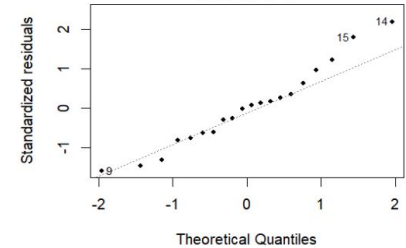
Dots should fall along the line



Residuals vs Fitted



Normal Q-Q



Teste shapiro

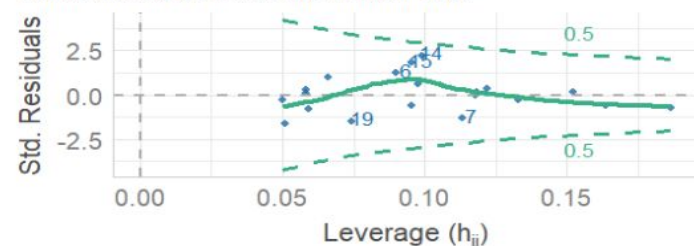
$w = 0.97097$, $p\text{-value} = 0.7752$

Teste de outliers

OK: No outliers detected.
- Based on the following method and threshold: cook (0.721)

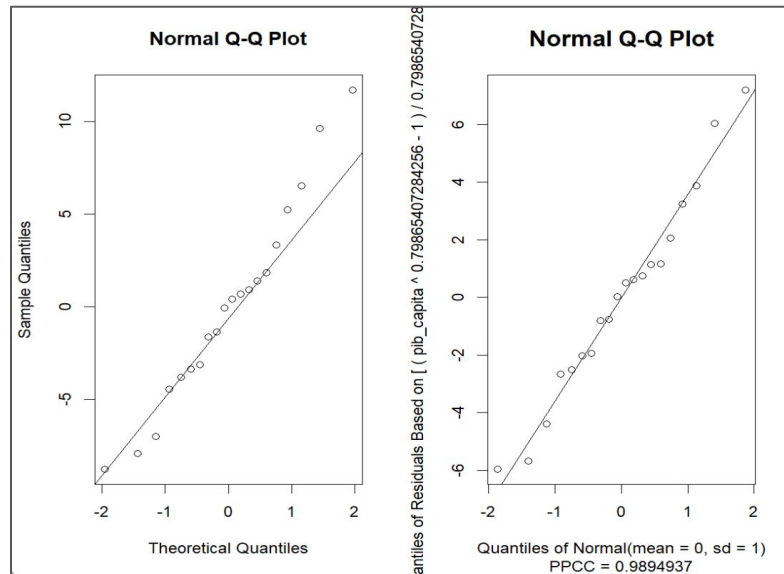
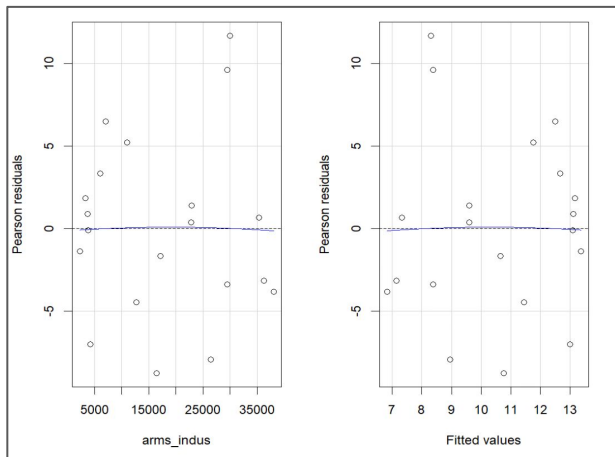
Influential Observations

Points should be inside the contour lines



Pressuposto 1: Normalidade dos resíduos

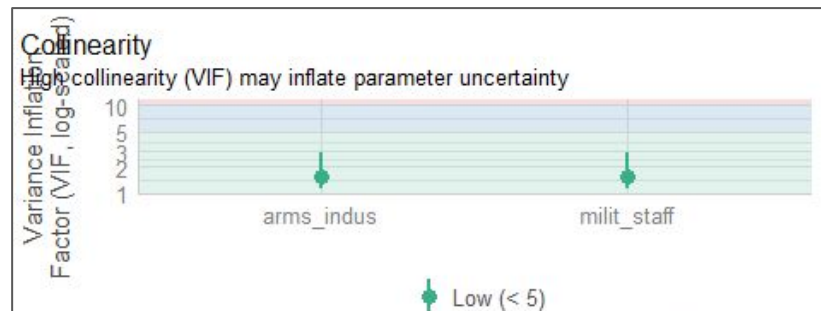
Resíduos



Pressuposto 2: Ausência de multicolinearidade

Teste unitário

Term	VIF	VIF 95% CI	Increased SE	Tolerance	Tolerance 95% CI
arms_indus	1.54	[1.15, 2.91]	1.24	0.65	[0.34, 0.87]
milit_staff	1.54	[1.15, 2.91]	1.24	0.65	[0.34, 0.87]



Após ajustes anteriores, por ficar com uma única variável: sem multicolinearidade

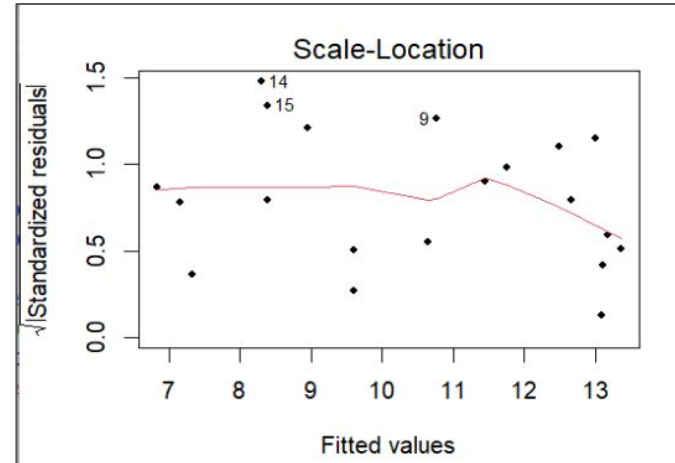
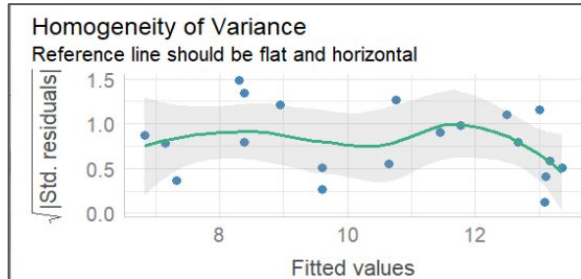
Pressuposto 3: Homocedasticidade

Teste unitário

OK: Error variance appears to be homoscedastic ($p = 0.330$)

Teste Breusch-Pagan

BP = 1.1239, $df = 1$, $p\text{-value} = 0.2891$



Pressuposto 4: Ausência de autocorrelação dos resíduos

Teste Breusch-Pagan

lag	Autocorrelation	D-W	Statistic	p-value
1	0.150421	1.660953	0.326	

Alternative hypothesis: $\rho \neq 0$

Conclusão

```
Call:
lm(formula = pib_capita ~ arms_indus, data = regrOriginal)

Residuals:
    Min       1Q   Median       3Q      Max
-8.7630 -3.4971  0.1535  2.2090 11.6966

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) 13.7704922   2.2311851   6.172 7.94e-06 ***
arms_indus  -0.0001826   0.0001030  -1.772  0.0933 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 5.609 on 18 degrees of freedom
Multiple R-squared:  0.1486,    Adjusted R-squared:  0.1013
F-statistic: 3.141 on 1 and 18 DF,    p-value: 0.09328
```

Conclusão

De acordo com ampla literatura sobre a relação investimentos em defesa e o crescimento econômico, foi comprovado com o caso da Rússia que não existe uma associação.

Obrigada!