Kohesio initial data summary and overview

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The purpose of the following document is to provide some insight into the environment of the data collected. We begin by outlining the different variables observed throughout the original data set en masse. We are then splitting the data based on the fund — the European Social Fund (ESF) and the European Regional Development fund (ERDF) — to comprehend the differences between the two cardinal funds present in our data. With our two data sets in hand we do some simple calculations on the numerical variables to find the average, min, max, etc. Finally, we will run a regression to see if we can find correlation between GDP/capita and funding/capita at district level.

An introduction to the data

Kohesio is a database that allows for access to information regarding EU contributions and funding from the EU Cohesion policy towards operation in hopes of "strengthening economic, social, and territorial cohesion," with the goal of correcting "imbalances between countries and regions (About Kohesio, n.d.)."

In total the data initially consists of 298,890 operation entries with 29 corresponding columns or variables. As mentioned before, the data is split up based on the funds: the ERDF data has 43,980 entries, while the ESF data has 254,840 entries. Many of the variables (columns) present in the Kohesio data come in pairs; where one would describe the code allocated to the variable and the other would indicate what the code means as a label. More importantly, at a first glance, there are far more unique variables and a wider variety of operations among the ERDF data entries in contrast to the ESF data entries.

Among the descriptions of the variables below is a simple summary of the numerical values present in the data for ESF and ERDF and a count of observations per programme. The three numerical variables are: "Cofinancing_Rate", "Total_Eligible_Expenditure", and "Project_EU_Budget".

What follows is an outline of all the columns in order and the sort of information present in each of the columns:

Operation_Unique_Identifier: A column with all the wiki links for each operation. The links have a unique identifier

Operation_Name_English: Coupled with **Operation_Name_Programme_langauge.** Both columns indicate the names of the operation. The latter is in German. There are 87156 unique operations among both ERDF and ESF

Country: It is the country of Germany

Postal_Code: Postal codes

Operation _Start_date: Coupled with **Operation _End_date.** These two columns indicate the DD/MM/YYYY when the operation started and ended.

Cofinancing_Rate: Indicated the percentage of the total operation funded by the EU.

Cofinancing_Rate Numerical Summary

Co financing rate (%) among both ESF and ERDF

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0.00	0.00	0.00	21.38	50.00	98.96

Co financing rate (%) ESF

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0.00	0.00	0.00	13.36	0.00	98.96

Co financing rate (%) ERDF

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0.00	50.00	80.00	67.85	80.00	90.00

Total_Eligible_Expenditure: A set of two columns each with the suffix **_amount** and **_Currency. _amount** indicated the total contribution for the operation from both the EU and Germany. While **_Currency** indicated the value is in euros

Total_Eligible_Expenditure Numerical Summary

Total eligible expenditure amount (EUR) among both ESF and ERDF

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
0	1999	3580	117566	14500	162500000	2148

Total eligible expenditure amount (EUR) ESF

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
0	1650	3000	45526	8800	53956200	2064

Total eligible expenditure amount (EUR) ERDF

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
1	7000	56376	532410	331164	162500000	84

Project_EU_Budget: The amount of money contributed or co financed by the EU.

Project_EU_Budget Numerical Summary

EU contributions among (EUR) both ESF and ERDF

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	0	0	48901	1032	130000000

EU contributions among (EUR) ESF

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	0	0	7267	0	19849539

EU contributions among (EUR) ERDF

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	4972	29986	290145	179275	130000000

Benificiary_Name: Currently a link to the wiki page, however I have written some code to extract the beneficiary names from the wiki.

Location_Indicator: Latitude and longitude coordinates for the location of the operation

Category_Of_intervention: Coupled with **Category_Labels**. These two variables describe forms of intervention fields in Germany. Between the ESF and ERDF there are 78 unique intervention categories of the 128 possible kinds of intervention. These categories are divided up among the following sections:
(001-004) Productive investment
(005-048) Infrastructure providing basic services & related investment
(048-055) Social, health & education infrastructure & related investment
(056-114) Promoting social inclusion combating poverty & discrimination
(115-118) Investing in education, training & vocational training for skills & lifelong learning
(119-120) Enhancing institutional capacity of public authorities & stakeholders & efficient public administration
(121-123) Technical assistance

** Although the ERDF data contains categories of intervention across most intervention sections, the same cannot be said regarding the ESF data.

Notably, of the 254,840 entries present as a part of the ESF fund; these are all the unique categories for the ESF: 7, 102, 103, 104, 105, 106, 109, 112, 114, 115, 116, 117, 118, 121, 122, 123. Among those, 102, 103, 104, 105, 106, 109, 112, 114, 115, 116, 117 are not represented in the ERDF.

The ERDF does not cover the following sections: *Investing in education, training & vocational training for skills & lifelong learning (115-118).*

The ESF does not cover the following sections: *Productive investment (001-004),* and *Social, health & education infrastructure & related investment (048-055).*

Neither the ERDF nor the ESF cover the following section: *Enhancing institutional capacity of public authorities & stakeholders & efficient public administration (119-120).*

Thematic_Objective_ID Coupled with **Thematic_Objective_Label.** This a list of 13 possible themes tackled by the operation. Between the ESF and ERDF 11 of the 13 available themes are contained in the data. The themes are as follows:

TO01 Research and innovation
TO02 Information and communication technology
TO03 Competitiveness of SMEs
TO04 Low-carbon economy
TO05 Climate change adaptation and risk prevention
TO06 Environment protection and resource efficiency
TO07 Network infrastructure in transport and energy
TO08 Sustainable and quality employment
TO09 Social inclusion
TO10 Educational and vocational training
TO11 Efficient public administration
TO12 Technical assistance
TO13 React EU

ERDF Thematic Count

Blank	TO01	TO02	TO03	TO04	TO05	TO06	TO07	TO09	TO10	TO12
2161	10893	36	22392	5489	557	968	65	788	293	338

ESF Thematic Count

Blank	TO07	TO08	TO09	TO10	TO12
8989	1	176858	14307	54126	559

** As mentioned above, there exists far more variety among the ERDF fund operations contrary to the ESF fund. This sentiment is observed in the thematic objectives category as well. Of the 5 themes covered by the ESF fund: “TO07”, “TO08”, “TO09”, “TO10”, “TO12”. Among those themes, only *TO08 Sustainable and quality employment* is not found among the themes covered by the ERDF.

Neither the ERDF or the ESF cover the following sections: *TO11Efficient public administration*, and *TO13 React EU*

Policy_Objective_ID Coupled with **Policy_Objective_Label.** This a list of 5 possible policy objectives for the operations. Between the ESF and ERDF 4 of the 5 available themes are contained in the data. The themes are as follows:
PO01 Smarter Europe
PO02 Greener, carbon-free Europe
PO03 Connected Europe
PO04 Social Europe
PO05 Europe closer to citizens

ERDF Policy Count

Blank	PO01	PO02	PO03	PO04
2499	33321	7014	65	1081

ESF Policy Count

Blank	PO03	PO04
9548	1	245291

The ESF does not cover the following sections: *PO01 Smarter Europe*, and *PO02 Greener, carbon-free Europe*. Neither the ERDF nor the ESF cover the following section: *PO05 Europe closer to citizens.*

Fund_Code Coupled with **Fund_Name.** We have selected the ESF and the ERDF. However, bellow is a list of all the possible available through Kohesio
Cohesion Fund (CF)
The European Neighbourhood Instrument (ENPI/ENI)
European Regional Development Fund (ERDF)
European Social Fund (ESF)
Instrument for Pre-accession Assistance (IPA/IPA II)
Youth Employment Initiative (YEI)

Of these funds, ENPI/ENI, ERDF, ESF, and IPA/IPA II were present in the latest_DE.csv data files.

Programme_Code Coupled with **Programme_Name.** These two variables each indicate the location of the operation in addition to the fund associated with the operation.

Among the programme's covered by the ESF we find that they are exclusively within the 16 German states and the federal government of Germany. However, the ERDF contains programmes across all the German states and operations between countries and regions around Germany. These cross-national operations are usually labeled with the prefix Interreg. Below is a list of observations per programme.

German States

Baden-Württemberg	- ESF: 7198	ERDF: 267
Bayern	- ESF: 4448	ERDF: 695
Berlin	- ESF: 1492	ERDF: 2702
Brandenburg	- ESF: 7978	ERDF: 2329
Bremen	- ESF: 850	ERDF: 381
Hamburg	- ESF: 86	ERDF: 73
Hessen	- ESF: 3296	ERDF: 563
Mecklenburg-Vorpommern	- ESF: 5387	ERDF: 3243
Niedersachsen	- ESF: 13753	ERDF: 1917
Nordrhein-Westfalen	- ESF: 56415	ERDF: 3176
Rheinland-Pfalz	- ESF: 1428	ERDF: 569
Saarland	- ESF: 659	ERDF: 327
Sachsen-Anhalt	- ESF: 7184	ERDF: 4985
Sachsen	- ESF: 26126	ERDF: 14116
Schleswig-Holstein	- ESF: 380	ERDF: 1346
Thüringen	- ESF: 11573	ERDF: 5730
Federal Germany	- ESF: 106587	ERDF: N/A

Interreg: ERDF fund

Urbact:	ERDF: 20
ESPON	ERDF: 23
Interreg Europe	ERDF: 91

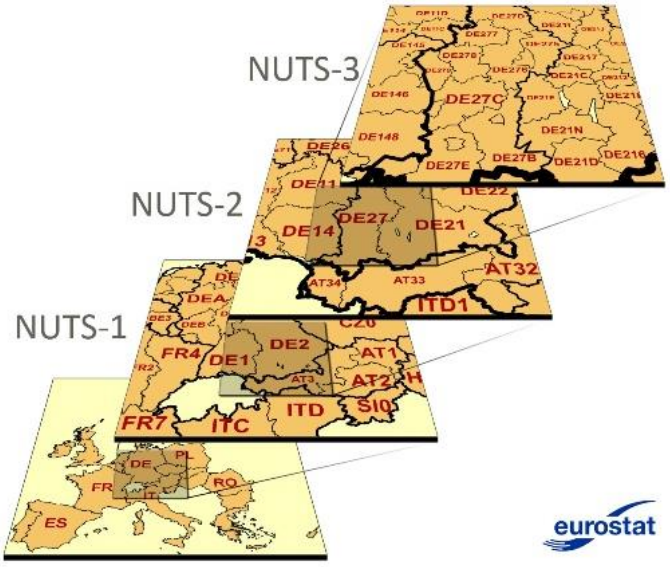
Interreg V-A: ERDF fund

Austria-Germany/Bayern	ERDF: 78
Belgium-Germany-The Netherlands (Euregio Maas-Rijn)	ERDF: 52
Belgium-The Netherlands	ERDF: 4
France-Belgium-Germany-Luxembourg (Grande Région)	ERDF: 63
France-Germany-Switzerland (Rhin supérieur)	ERDF: 122
Germany-Austria-Switzerland-Liechtenstein (Alpenrhein-Bodensee-Hochrhein)	ERDF: 94
Germany-Denmark	ERDF: 73
Germany-The Netherlands	ERDF: 171
Germany (Mecklenburg-Vorpommern-Brandenburg)-Poland	ERDF: 37
Germany/Bayern-Czech Republic	ERDF: 130
Germany/Brandenburg-Poland	ERDF: 43
Germany/Sachsen-Czech Republic	ERDF: 96
Poland-Denmark-Germany-Lithuania-Sweden (South Baltic)	ERDF: 59
Poland-Germany/Sachsen	ERDF: 45

Interreg V-B: ERDF fund

Alpine Space	ERDF: 60
Atlantic Area	ERDF: 1
Baltic Sea	ERDF: 43
Central Europe	ERDF: 102
Danube	ERDF: 11
North Sea	ERDF: 66
North West Europe	ERDF: 75
Northern Periphery and Arctic	ERDF: 2

NUTS3_Code Coupled with **Region.** These two variables give us fine geographic locations for each of the operations. "The NUTS classification (Nomenclature of territorial units for statistics) is a hierarchical system for dividing up the economic territory of the EU and the UK for the purpose of: The collection, development, and harmonization of European regional statistics. The Socio-economic analyses of the regions is:
NUTS 1: major socio-economic regions
NUTS 2: basic regions for the application of regional policies
NUTS 3: small regions for specific diagnoses (Background - NUTS - Nomenclature of Territorial Units for Statistics, n.d.)"



Programming_Period All the entries are 2014-2020

Operation_Summary_English Coupled with **Operation_Summary_Programme_Language.** They

	provide a summary of what the operation entails, with the later being a summary in the original language (German)
ManagingAuthority	A list of 57 unique ministry or organization responsible for the management of the operations.

Regression of funding per capita on GDP per Capita

Before diving into the regression, a list of all the regions that aren't included in the regression is provided. Since these are regions that are only engaged in interreg projects or did not receive any funding from the ERDF or the ESF.

ERDF - 394 observations
Baden-Württemberg
DE12B
Bavaria (mostly only interreg projects for the following)
DE21C | DE21I | DE258 |
Lower Saxony (there are only interreg projects for the following)
DE94D | DE94E
Rhineland-Palatinate (DEB39 only have interreg projects)
DEB39

ESF – 399 observations
Saxony
DED2D
Saxony-Anhalt (Sachsen-Anhalt)
DEE01

For the purposes of this exploration let's describe how the 3 levels of NUTS codes differ in Germany.

- NUTS1 are 3-digit regional codes that describe the state within Germany.
- NUTS2 are 4-digit regional codes for finer geographic regions. These tend to be administrative regions or Regierungsbezirk.
- NUTS3 are 5-digit regional codes that describe districts or cities, and rural or urban regions at a very fine level.

ERDF Regression outputs - 394 observations

ERDF Regression

```
lm(formula = funding_per_capita_germany_erdf ~ GDP_per_capita, data =
Germany_erdf)

Residuals:
       Min       | 1Q        | Median    | 3Q      | Max       |
       -319.8441 | -239.3710 | -148.5128 | 68.0599 | 3313.4610 |

Coefficients:  | Estimate | Std. Error   | t value  | Pr(>|t|)
(Intercept)    | 359.2348 | 48.9450      | 7.33956  | 1.2465e-12 ***
GDP_per_capita | -0.0017  | 0.0012       | -1.36698 | 0.17242

Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 401.0651 on 392 degrees of freedom
Multiple R-squared:  0.004744278      | Adjusted R-squared:  0.0022054
F-statistic: 1.868622 on 1 and 392 DF | p-value: 0.1724164
```

ERDF Regression (log)

```
lm(formula = log_funding_per_capita ~ log_GDP_per_capita, data =
Germany_erdf)

Residuals:
            Min     | 1Q      | Median | 3Q     | Max    |
            -7.5683 | -0.7890 | 0.1606 | 1.0551 | 3.4715 |

Coefficients:      | Estimate | Std. Error | t value  | Pr(>|t|)
(Intercept)        | 10.55961 | 2.4607430  | 4.29123  | 2.2414e-05 ***
log_GDP_per_capita | -0.54942 | 0.2361258  | -2.32680 | 0.020485 *

Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.615291 on 392 degrees of freedom
Multiple R-squared:  0.0136231        | Adjusted R-squared:  0.0111068
F-statistic: 5.414012 on 1 and 392 DF | p-value: 0.02048458
```

ERDF Correlation coefficient

Non log: -0.08174761423 | log: -0.1479303288

ERDF Regression (log) with state as a factor

```
lm(formula = log_funding_per_capita ~ log_GDP_per_capita +
factor(NUTS1_states), data = Germany_erdf)

Residuals:
            Min      | 1Q       | Median | 3Q      | Max     |
            -7.3464 | -0.5460 | 0.0884 | 0.8130 | 2.9396 |

Coefficients:           | Estimate | Std. Error | t value  | Pr(>|t|)
(Intercept)             | -3.69893 | 2.3243054  | -1.59142 | 0.1123543
log_GDP_per_capita      | 0.690676 | 0.2180605  | 3.16736  | 0.0016637 **
factor(NUTS1_states)DE2 | 0.385893 | 0.2469588  | 1.56258  | 0.1189904
factor(NUTS1_states)DE3 | 2.415846 | 1.3529783  | 1.78558  | 0.0749716 .
factor(NUTS1_states)DE4 | 2.571144 | 0.3859827  | 6.66129  | 9.6320e-11 ***
factor(NUTS1_states)DE5 | 2.436087 | 0.9674214  | 2.51812  | 0.0122116 *
factor(NUTS1_states)DE6 | 0.988395 | 1.3557766  | 0.72903  | 0.4664389
factor(NUTS1_states)DE7 | 0.773919 | 0.3331550  | 2.32300  | 0.0207107 *
factor(NUTS1_states)DE8 | 3.608816 | 0.5246948  | 6.87793  | 2.5351e-11 ***
factor(NUTS1_states)DE9 | 1.953027 | 0.2943233  | 6.63565  | 1.1257e-10 ***
factor(NUTS1_states)DEA | 1.150825 | 0.2780904  | 4.13831  | 4.3186e-05 ***
factor(NUTS1_states)DEB | 1.341949 | 0.3105775  | 4.32082  | 1.9910e-05 ***
factor(NUTS1_states)DEC | 1.479860 | 0.5860591  | 2.52510  | 0.0119757 *
factor(NUTS1_states)DED | 2.671620 | 0.4326826  | 6.17455  | 1.7175e-09 ***
factor(NUTS1_states)DEE | 3.069541 | 0.4240580  | 7.23849  | 2.5647e-12 ***
factor(NUTS1_states)DEF | 2.783389 | 0.4066016  | 6.84549  | 3.1022e-11 ***
factor(NUTS1_states)DEG | 3.004828 | 0.3586376  | 8.37845  | 1.0731e-15 ***

Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.337391 on 377 degrees of freedom
Multiple R-squared:  0.3496999         | Adjusted R-squared:  0.322101
F-statistic: 12.67077 on 16 and 377 DF | p-value: < 2.2204e-16
```

ESF Regression outputs– 399 observations

ESF Regression

```
lm(formula = funding_per_capita_germany_esf ~ GDP_per_capita, data =
Germany_esf)

Residuals:
            Min      | 1Q      | Median | 3Q     | Max      |
            -164.36 | -86.22 | -54.60 | 10.81 | 1281.78 |

Coefficients:  | Estimate  | Std. Error | t value | Pr(>|t|)
(Intercept)    | 8.731e+01 | 2.113e+01  | 4.132   | 4.39e-05 ***
GDP_per_capita | 5.222e-04 | 5.399e-04  | 0.967   | 0.334

Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 174 on 397 degrees of freedom
Multiple R-squared:  0.002351       | Adjusted R-squared:  -0.0001618
F-statistic: 0.9356 on 1 and 397 DF | p-value: 0.334
```

ESF Regression (log)

```
lm(formula = log_funding_per_capita ~ log_GDP_per_capita, data =
Germany_esf)

Residuals:
            Min      | 1Q      | Median | 3Q     | Max    |
            -7.6450 | -0.7418 | 0.1985 | 1.0364 | 3.7002 |

Coefficients:      | Estimate | Std. Error | t value | Pr(>|t|)
(Intercept)        | -9.7224  | 2.7652     | -3.516  | 0.000489 ***
log_GDP_per_capita | 1.2814   | 0.2654     | 4.828   | 1.97e-06 ***

Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.822 on 397 degrees of freedom
Multiple R-squared:  0.05547       | Adjusted R-squared:  0.05309
F-statistic: 23.31 on 1 and 397 DF | p-value: 1.968e-06
```

ESF Correlation coefficient

Non log: 0.04848931 | log: 0.2355125

ESF Regression (log) with state as a factor

```
lm(formula = log_funding_per_capita ~ log_GDP_per_capita +
factor(NUTS1_states), data = Germany_esf)

Residuals:
            Min      | 1Q       | Median | 3Q      | Max     |
            -5.8640 | -0.5253 | 0.0296 | 0.5452 | 8.4265 |

Coefficients:            | Estimate | Std. Error | t value | Pr(>|t|)     |
(Intercept)              | -12.0261 | 2.1671     | -5.549  | 5.37e-08 *** |
log_GDP_per_capita       | 1.5135   | 0.2035     | 7.439   | 6.77e-13 *** |
factor(NUTS1_states)DE2 | -0.5264  | 0.2297     | -2.292  | 0.02243 *    |
factor(NUTS1_states)DE3 | 1.2562   | 1.2739     | 0.986   | 0.32474      |
factor(NUTS1_states)DE4 | 1.8546   | 0.3618     | 5.126   | 4.72e-07 *** |
factor(NUTS1_states)DE5 | 0.7033   | 0.9107     | 0.772   | 0.44042      |
factor(NUTS1_states)DE6 | -0.6890  | 1.2767     | -0.540  | 0.58974      |
factor(NUTS1_states)DE7 | -0.8030  | 0.3123     | -2.571  | 0.01051 *    |
factor(NUTS1_states)DE8 | 2.5027   | 0.4929     | 5.078   | 5.98e-07 *** |
factor(NUTS1_states)DE9 | 0.7468   | 0.2726     | 2.739   | 0.00645 **   |
factor(NUTS1_states)DEA | 0.6029   | 0.2600     | 2.319   | 0.02092 *    |
factor(NUTS1_states)DEB | -1.3680  | 0.2883     | -4.744  | 2.96e-06 *** |
factor(NUTS1_states)DEC | -0.4116  | 0.5510     | -0.747  | 0.45555      |
factor(NUTS1_states)DED | -4.7430  | 0.4181     | -11.345 | < 2e-16 ***  |
factor(NUTS1_states)DEE | -2.3382  | 0.4089     | -5.718  | 2.18e-08 *** |
factor(NUTS1_states)DEF | -0.3355  | 0.3815     | -0.879  | 0.37972      |
factor(NUTS1_states)DEG | 2.1411   | 0.3359     | 6.374   | 5.30e-10 *** |

Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.26 on 382 degrees of freedom
Multiple R-squared:  0.5656         | Adjusted R-squared:  0.5474
F-statistic: 31.08 on 16 and 382 DF | p-value: < 2.2e-16
```

ERDF Regression outputs - 1,653 observations

(region-theme funding)/(region funding) ~ regions GDP/capita

```
lm(formula = share1 ~ GDP_per_capita, data = Germany_theme_shares_erdf)

Residuals:
                  Min     | 1Q      | Median  | 3Q     | Max    |
                  -0.3361 | -0.1937 | -0.1053 | 0.1063 | 0.7786 |

Coefficients:  | Estimate  | Std. Error | t value | Pr(>|t|)
(Intercept)    | 1.893e-01 | 1.639e-02  | 11.549  | < 2e-16 ***
GDP_per_capita | 1.426e-06 | 4.370e-07  | 3.263   | 0.00113 **

Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.2639 on 1651 degrees of freedom
Multiple R-squared:  0.006407       | Adjusted R-squared:  0.005805
F-statistic: 10.65 on 1 and 1651 DF | p-value: 0.001126
```

(region-theme funding)/(theme funding) ~ regions GDP/capita * factor(theme)

```
lm(formula = share2 ~ GDP_per_capita * factor(Thematic_Objective_ID), data =
Germany_theme_shares_erdf)

Residuals:
                  Min     | 1Q      | Median  | 3Q     | Max    |
                  -0.0926 | -0.0033 | -0.0023 | 0.0004 | 0.2388 |

Coefficients:                     | Estimate   | Std. Error | t value | Pr(>|t|)
(Intercept)                       | 3.378e-03  | 2.958e-03  | 1.142   | 0.25364
GDP_per_capita                    | 2.874e-08  | 7.210e-08  | 0.399   | 0.69024
factor(Theme)TO01                 | -1.152e-03 | 3.800e-03  | -0.303  | 0.76179
factor(Theme)TO02                 | 7.029e-03  | 2.044e-02  | 0.344   | 0.73099
factor(Theme)TO03                 | 1.172e-03  | 3.921e-03  | 0.299   | 0.76497
factor(Theme)TO04                 | -6.631e-04 | 3.868e-03  | -0.171  | 0.86391
factor(Theme)TO05                 | 5.942e-03  | 5.958e-03  | 0.997   | 0.31879
factor(Theme)TO06                 | 1.719e-03  | 4.037e-03  | 0.426   | 0.67031
factor(Theme)TO07                 | -7.038e-02 | 1.427e-02  | -4.934  | 8.90e-07 ***
factor(Theme)TO09                 | 1.579e-03  | 6.218e-03  | 0.254   | 0.79960
factor(Theme)TO10                 | 2.173e-02  | 6.740e-03  | 3.224   | 0.00129 **
factor(Theme)TO12                 | 1.395e-01  | 1.243e-02  | 11.228  | < 2e-16 ***
GDP_per_capita:factor(Theme)TO01  | 7.438e-10  | 9.517e-08  | 0.008   | 0.99377
GDP_per_capita:factor(Theme)TO02  | 1.723e-06  | 6.683e-07  | 2.578   | 0.01003 *
GDP_per_capita:factor(Theme)TO03  | -6.595e-08 | 1.002e-07  | -0.658  | 0.51038
GDP_per_capita:factor(Theme)TO04  | -1.913e-08 | 9.798e-08  | -0.195  | 0.84524
GDP_per_capita:factor(Theme)TO05  | 2.905e-08  | 1.721e-07  | 0.169   | 0.86598
GDP_per_capita:factor(Theme)TO06  | -2.363e-08 | 1.042e-07  | -0.227  | 0.82067
GDP_per_capita:factor(Theme)TO07  | 3.466e-06  | 4.476e-07  | 7.745   | 1.67e-14 ***
GDP_per_capita:factor(Theme)TO09  | 1.587e-07  | 1.790e-07  | 0.887   | 0.37522
GDP_per_capita:factor(Theme)TO10  | -2.798e-07 | 1.778e-07  | -1.574  | 0.11571
GDP_per_capita:factor(Theme)TO12  | -1.735e-06 | 2.612e-07  | -6.642  | 4.21e-11 ***

Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
Residual standard error: 0.01724 on 1631 degrees of freedom
Multiple R-squared:  0.2809          | Adjusted R-squared:  0.2717
F-statistic: 30.35 on 21 and 1631 DF | p-value: < 2.2e-16
```

ESF Regression outputs - 1,365 observations

(region-theme funding)/(region funding) ~ regions GDP/capita

```
lm(formula = share1 ~ GDP_per_capita, data = Germany_theme_shares_esf)

Residuals:
                  Min     | 1Q      | Median  | 3Q     | Max    |
                  -0.3121 | -0.2223 | -0.0632 | 0.1647 | 0.7189 |

Coefficients:  | Estimate   | Std. Error | t value | Pr(>|t|)
(Intercept)    | 3.325e-01  | 1.700e-02  | 19.553  | <2e-16 ***
GDP_per_capita | -1.095e-06 | 4.235e-07  | -2.586  | 0.0098 **

Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.2559 on 1363 degrees of freedom
Multiple R-squared:  0.004884       | Adjusted R-squared:  0.004154
F-statistic: 6.689 on 1 and 1363 DF | p-value: 0.009803
```

(region-theme funding)/(theme funding) ~ regions GDP/capita * factor(theme)

```
lm(formula = share2 ~ GDP_per_capita * factor(Thematic_Objective_ID), data =
Germany_theme_shares_esf)

Residuals:
Min     | 1Q      | Median  | 3Q      | Max      |
-0.0219 | -0.0026 | -0.0016 | -0.0002 | 0.293076 |

Coefficients:                     | Estimate   | Std. Error | t value | Pr(>|t|)
(Intercept)                       | 7.093e-03  | 2.626e-03  | 2.701   | 0.00699 **
GDP_per_capita                    | -3.928e-08 | 6.262e-08  | -0.627  | 0.53055
factor(Theme)TO08                 | -6.911e-03 | 3.144e-03  | -2.198  | 0.02811 *
factor(Theme)TO09                 | -4.522e-03 | 3.221e-03  | -1.404  | 0.16063
factor(Theme)TO10                 | -7.723e-03 | 3.164e-03  | -2.441  | 0.01476 *
factor(Theme)TO12                 | 1.292e-03  | 6.107e-03  | 0.211   | 0.83254
GDP_per_capita:factor(Theme)TO08 | 1.047e-07  | 7.660e-08  | 1.367   | 0.17187
GDP_per_capita:factor(Theme)TO09 | 4.752e-08  | 7.798e-08  | 0.609   | 0.54240
GDP_per_capita:factor(Theme)TO10 | 1.300e-07  | 7.683e-08  | 1.693   | 0.09077 .
GDP_per_capita:factor(Theme)TO12 | 2.204e-07  | 1.408e-07  | 1.565   | 0.11785

Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.0142 on 1355 degrees of freedom
Multiple R-squared:  0.04532        | Adjusted R-squared:  0.03898
F-statistic: 7.147 on 9 and 1355 DF | p-value: 3.527e-10
```

References:

About Kohesio. (n.d.). Kohesio.ec.europa.eu; European Commission. Retrieved June 9, 2023, from https://kohesio.ec.europa.eu/en/about

Background - NUTS - Nomenclature of territorial units for statistics. (n.d.). Ec.europa.eu; eurostat. https://ec.europa.eu/eurostat/web/nuts/background