

// Data visualisation: Generating maps with ESPON mapkit and open data

Excercise

Analysing Foreign Direct Investments to European regions

Context

ESPON study: **The World in Europe: Global FDI Flows towards Europe**

Provides recommendations that could support regions and cities in their positioning and defining their policies towards receiving FDI, as well as integrating the attraction of foreign firms in regional development strategies by focusing on:

- FDI patterns & trends
- Factors for attracting FDI
- Relevance for regional growth, competitiveness and disparities
- Policy responses

Context

europa.eu/rapid/press-release_IP-19-1532_en.htm

European Commission - Press release

Foreign Investment Screening: new European framework to enter into force in April 2019

Brussels, 5 March 2019

The Council of the EU today approved a new framework to screen foreign direct investments coming into the European Union, thus concluding the legislative process on this proposal.

This means, the new framework will enter into force in April this year. Based on a Commission proposal presented by President Juncker in his 2017 State of the Union Address, the new framework will help safeguarding Europe's security, public order and strategic interests when it comes to foreign investments into our Union.

In reaction to the Council's decision President Jean-Claude **Juncker** said: *"Today's decision is a proof the EU is able to act quickly when strategic interests of our citizens and economy are at stake. With the new investment screening framework, we are now much better equipped to ensure that investments coming from countries outside the EU actually benefit our interests. I committed to work for a Europe that protects, in trade as in other areas; with this new legislation in place we are delivering on a crucial part of our promise."*

Context

← → × <https://www.independent.co.uk/topic/foreign-direct-investment>

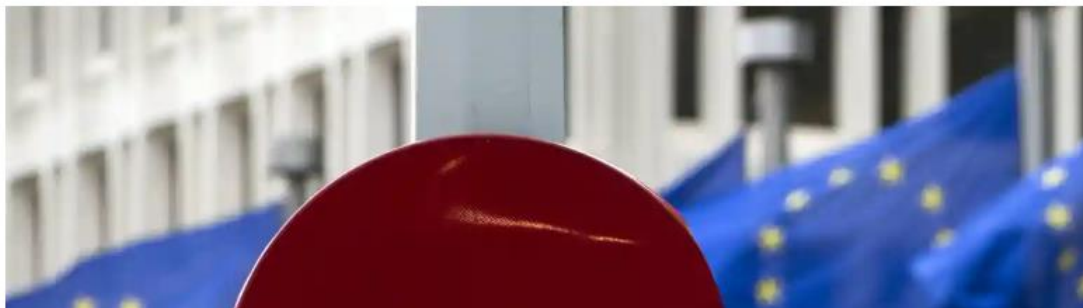


NEWS POLITICS VOICES FINAL SAY SPORT CULTURE VIDEO **INDY/LIFE** INDYBEST LONG READS INDY100 VOUCHE

www.theguardian.com/business/2018/may/21/brexit-blamed-for-dramatic-fall-in-uk-business-registrations

Brexit blamed for dramatic fall in UK business registrations

Collapse is mirrored by tumble in direct foreign investment into Britain of 90%



foreign direct investment

UK POLITICS



UK projects funded by foreign direct investment fall by nearly 10%

Data also shows that safeguarded jobs in the UK fell by 54 per cent in the last financial year

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18 06.01 BST

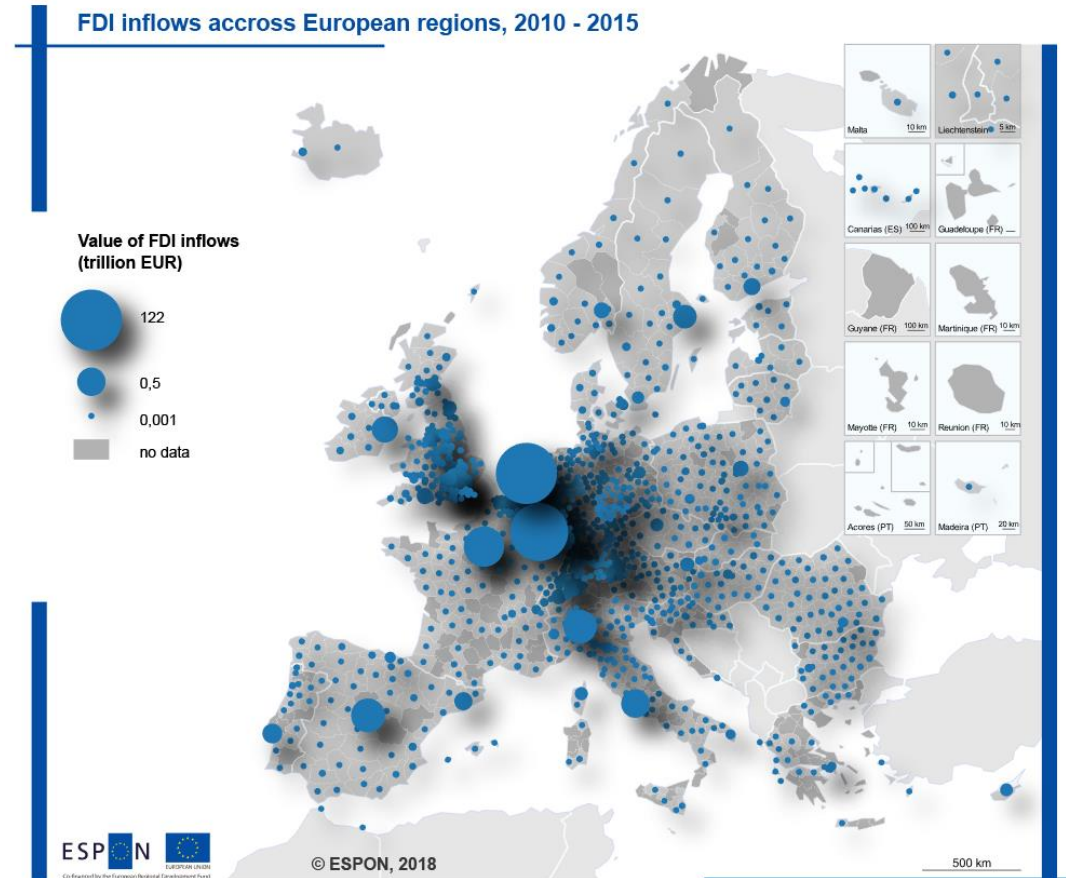


1,805

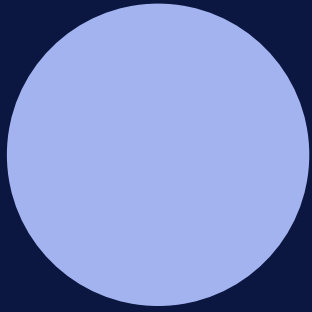
Scenario for exercise I

The study provides information of the FDI inflows to NUTS3 regions cumulatively for the periods for 2003 – 2009 and 2010 – 2015.

We are interested in understanding the the size of the average annual investments over the period 2010 – 2015 in per capita, in order to compare the attractiveness of investments among groups of regions with different population size.



Regional level: NUTS 3 (2013)
Source: WORLD IN EUROPE, 2018
Origin of data: ESPON Database, 2018
© UMS RIATE for administrative boundaries



Downloading the data from ESPON Database Portal

What do we need?

- FDI deal values.
- Population data for normalisation.

Normalisation is transforming a set of data so that they may be compared in a meaningful way.

Find FDI data by project, keyword or theme

The screenshot displays the ESPON database interface. At the top, the browser address bar shows 'projects.mcrit.com/esponDB/'. The navigation menu includes 'MAIN DATA', 'PROJECT ARCHIVES', 'RESOURCES', 'ABOUT', 'DATA UPLOAD', and 'LOGIN'. The ESPON logo and 'Co-financed by the European Regional Development Fund' are visible on the left.

The search interface includes several filters:

- Theme:** Territorial nomenclature
- Level (for NUTS):** Project (circled in orange), FDI - World in Europe
- To (Year):** Indicators, All
- Standard data:** Standard data

Buttons for 'Search indicators' and 'Clear current search' are present. A 'Data filters' section is also visible.

The search results are displayed in a table with columns: Name, Type, Data, and Period. The active search is 'Project: FDI - World in Europe, Indicators: All (28 results found)'. The table shows a list of indicators, with 'FDI deal value between 2010 and 2015' circled in orange.

An 'Explore data' modal window is open, showing options for 'Graph data' and 'Map data'. The 'Text delimited' export option (40.3 KB) is circled in orange. Other export options include 'Shape format' (5.6 MB), 'Worksheet', and 'Exchanging data'.

At the bottom right, there are links for 'Map / Links / Legal Notice'.

Find population data by keyword or theme

The screenshot displays the ESPON database interface. At the top, the browser address bar shows 'projects.mcrit.com/esponDB/'. The navigation menu includes 'MAIN DATA', 'PROJECT ARCHIVES', 'RESOURCES', 'ABOUT', 'DATA UPLOAD', and 'LOGIN'. The ESPON logo and 'Co-financed by the European Regional Development Fund' are visible on the left. A search bar is labeled 'Name' with a dropdown arrow. Below it, the 'Data filters' section shows a search for 'total population'. A list of population age groups is shown, with 'Total Population by NUTS3' circled in orange. A modal window titled 'Explore data' is open, showing 'Graph data' and 'Map data' options. At the bottom of the modal, the 'Text delimited (CSV) (167.7 KB)' option is circled in orange. The background shows a table of data with columns for year (1990-2016) and NUTS codes.

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Preparing the data for mapping

Text delimited or shape format?

- Shape format has geometries, administrative codes as well as statistical attributes.
- Text delimited file has administrative codes and statistical attributes.

Shape formats from ESPON database portal are ready for spatial analysis and mapping.

Text delimited data needs to be joined with shapes first.

Both types of data allows to associate records in one table with records in another table through a common field, known as a key. Most common key in spatial data analysis is code for administrative units. In the EU level statistics, this is regulated by the [NUTS regulation](#).

While it is easier to prepare data (add/subtract/multiply/divide) cells/rows/columns in excel type spreadsheet application, than in QGIS, we will use text delimited data for our exercise.

Preparing the data

- Save the data in a work folder where we can easily access it.
- Make copies so you can always easily backtrack your steps or restart the analysis.
- Open and explore the **data** and the **metadata**.
- Identify relevant columns such as the **key** and **attributes**.
- Clean up the dataset, and keep only the **key** and the relevant attributes for easier navigation.

- FDI ind_401_a10-vfdi_data copy

G	H	K
tunit_code	tunit_name	y_2003-2015

- Population ind_314_pop_t_data

G	AJ
tunit_code	y_2015

- Use **VLOOKUP** or similar functions to join different tables using the **key** when working with spreadsheets.

Using VLOOKUP in Excel to combine tables

- Open the FDI table.
- Click on cell D2.
- Enter the formula
`=VLOOKUP(A2,'ind_314_pop_t_data copy.csv'!$A:$B,2,FALSE)`.
- Expand the formula.
- Save as new table “fdi inh”

value - The value to look for in the first column of a table.

table - The table from which to retrieve a value.

col_index - The column in the table from which to retrieve a value.

range_lookup - [optional] TRUE = approximate match (default). FALSE = exact match.

	A	B	C	D	E	F	G	H
1	tunit_code	tunit_name	y_2003-2015					
2	AL011	Dibër	0	135444.5				
3	AL012	Durrës	20001.3					
4	AL013	Kukës	0					
5	AL014	Lezhë	0					
6	AL015	Shkodër	0					
7	AL021	Elbasan	0					
8	AL022	Tiranë	229538					
9	AL031	Berat	0					
10	AL032	Fier	7219.15					
11	AL033	Gjirokastrë	0					
12	AL034	Korçë	0					
13	AL035	Vlorë	0					
14	AT111	Mittelburg	0					
15	AT112	Nordburgen	36580.17					
16	AT113	Sudburgen	0					

	A	B	C
1	tunit_code	y_2015	
2	AL	2913851	
3	AT	8576261	
4	BA	3455212	
5	BE	11237274	
6	BG	7202198	
7	CH	8237666	
8	CY	847008	
9	CZ	10538275	
10	DE	81197544	
11	DK	5659715	
12	EE	1314870	
13	EL	10858018	
14	ES	46449564	
15	FI	5471753	
16	FR	66488192	

Make the necessary calculations

- Open the FDI table
- Multiply FDI values by 1000 (values, population values and metadata).
- Calculate FDI per inhabitant in a year by dividing

TIP: pay attention to auto formatting of cells in Excel.

- When opening a data table in Excel, pay attention to the auto formatting of cells.
- Excel by default tends to convert information that it recognises as a date to date.
- Therefore, 1 German NUTS2 and 6 NUTS3 regions will be converted into date, which you need to manually correct again.
 - Insert the correct codes
 - Set the type for the cells as **Text**.

DEB3I	Rhein-Pfalz-Kreis
DEB3J	Mainz-Bingen
DEB3K	Südwestpfalz
DEC01	Regionalverband Saarbrücken
DEC02	Merzig-Wadern
DEC03	Neunkirchen
DEC04	Saarlouis
DEC05	Saarpfalz-Kreis
DEC06	St. Wendel
DED21	Dresden, Kreisfreie Stadt
DED2C	Bautzen
DED2D	Görlitz

DEB3I	Rhein-Pfalz-Kreis
DEB3J	Mainz-Bingen
DEB3K	Sudwestpfalz
Dec-01	Regionalverband Saarbrücken
Dec-02	Merzig-Wadern
Dec-03	Neunkirchen
Dec-04	Saarlouis
Dec-05	Saarpfalz-Kreis
Dec-06	St. Wendel
DED21	Dresden, Kreisfreie Stadt
DED2C	Bautzen
DED2D	Görlitz

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Explore QGIS and the MapKit

ESPON Public MapKit - why to use it?

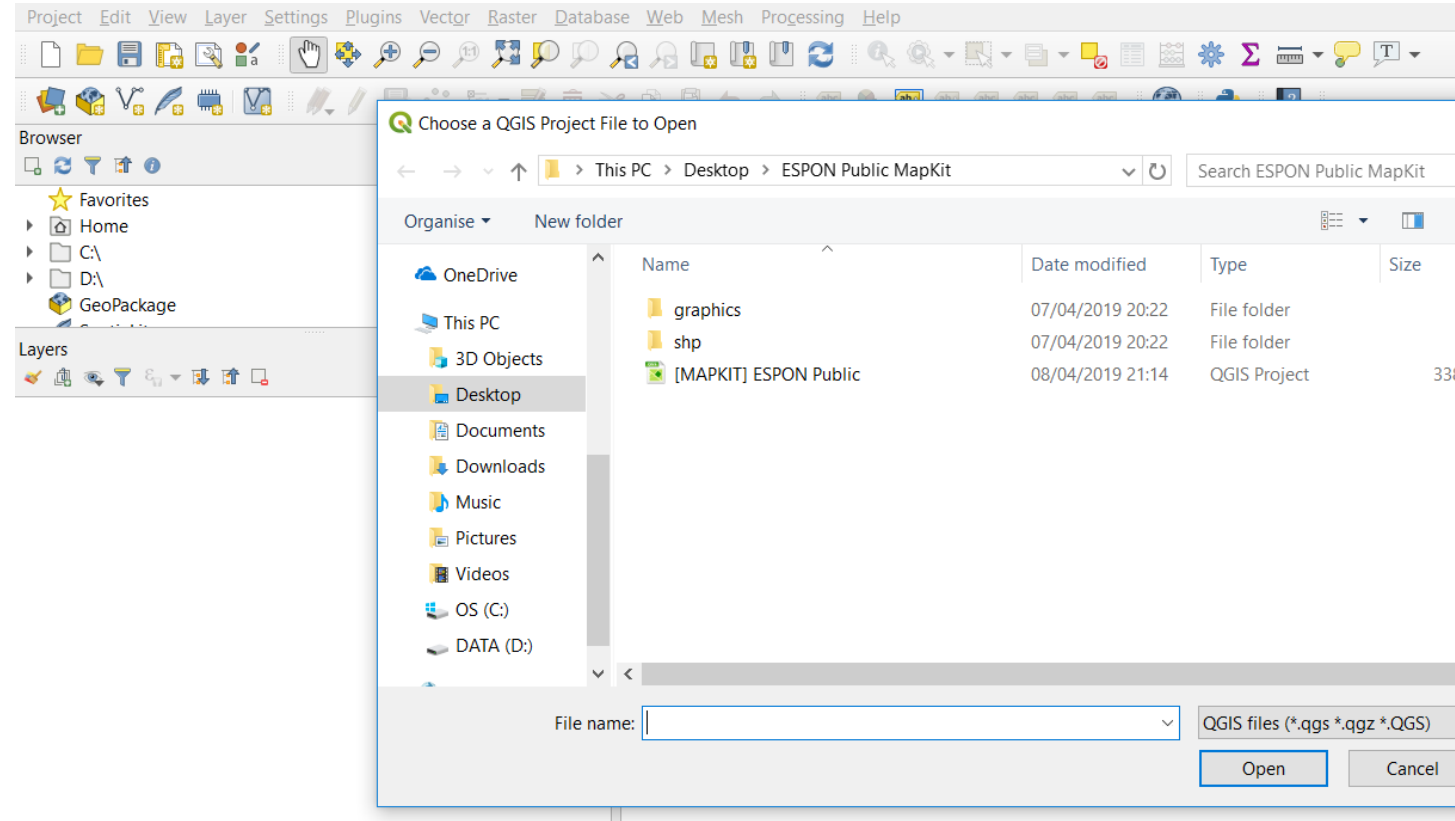
- Free & open source map template with predesigned layout.
- Quick and easy way to get into mapping without prior extensive knowledge about coordination systems, projections, etc.
- A large variety of spatial data with creative commons license.
- Easy to use with both new and old data.

QGIS- why to use it?

- QGIS is a user friendly Open Source Geographic Information System (GIS) licensed under the GNU General Public License. QGIS is an official project of the Open Source Geospatial Foundation (OSGeo). It runs on Linux, Unix, Mac OSX, Windows and Android and supports numerous vector, raster, and database formats and functionalities.
- <https://qgis.org/>

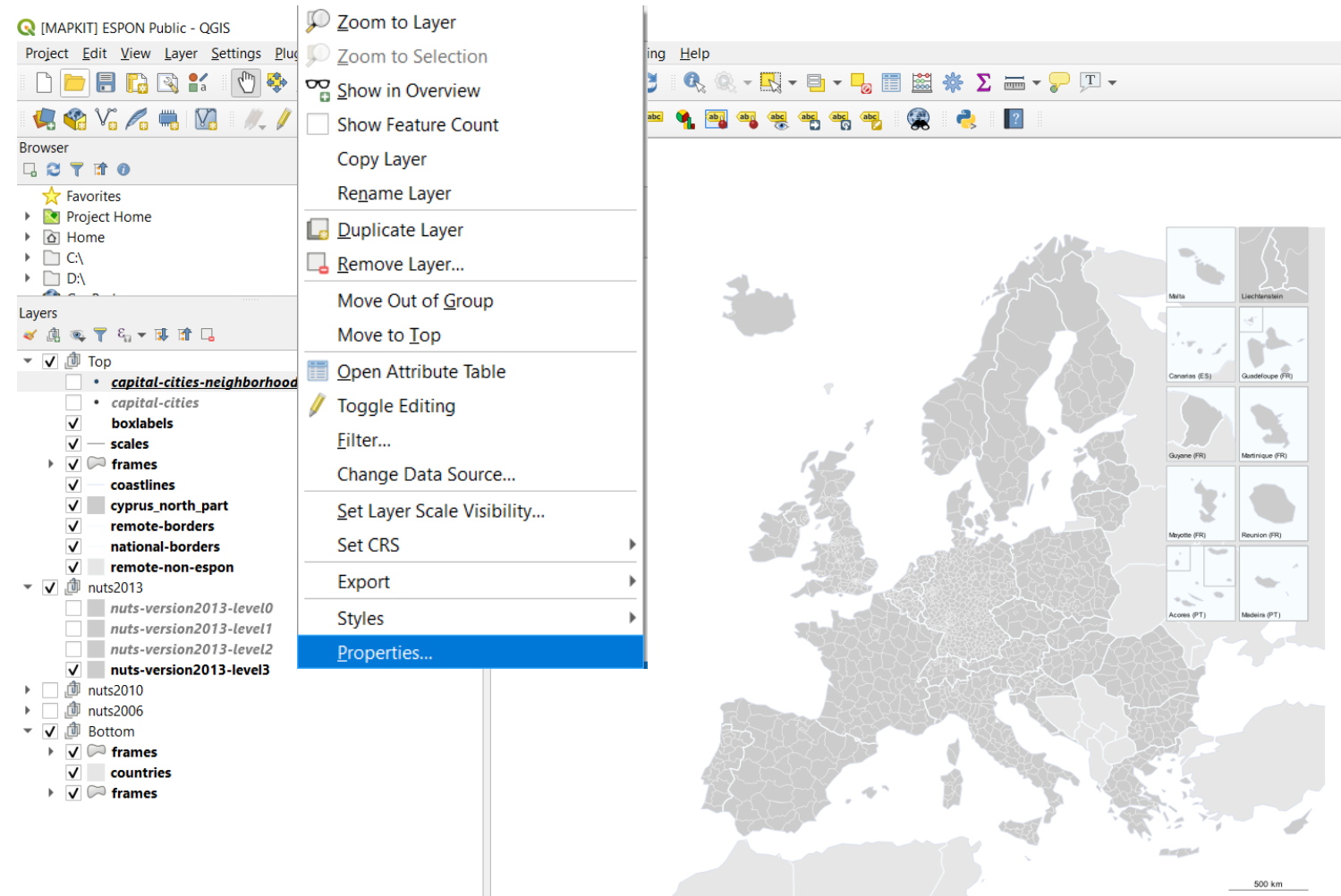
Download and open the ESPON Public MapKit

- Download the ESPON Public MapKit from the resource section of the **ESPON Database**.
- Open **QGIS Desktop**.
- Click on **Project - Open** – and locate the **ESPON Public MapKit QGIS** project file.
- Alternatively, locate the **ESPON Public MapKit** file and open it from the folder.



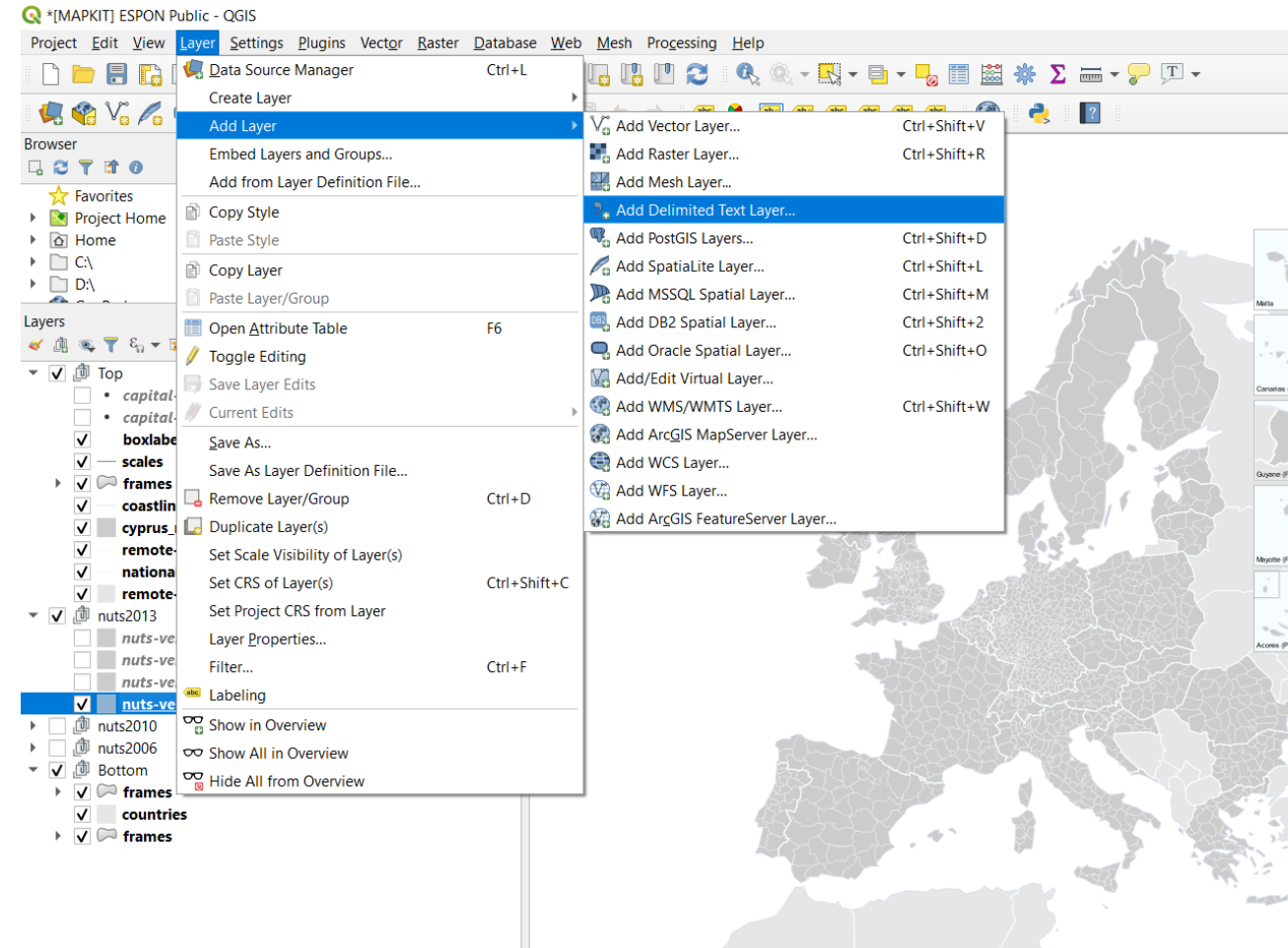
Explore the MapKit and QGIS: Data view

- Data view (default) for analysis
 - Layer tree for navigation (right click)
 - Open Attribute Table – view data
 - Duplicate layer
 - Properties
 - Source fields – type of data
 - Join – joining tables
 - Symbology – visualising data



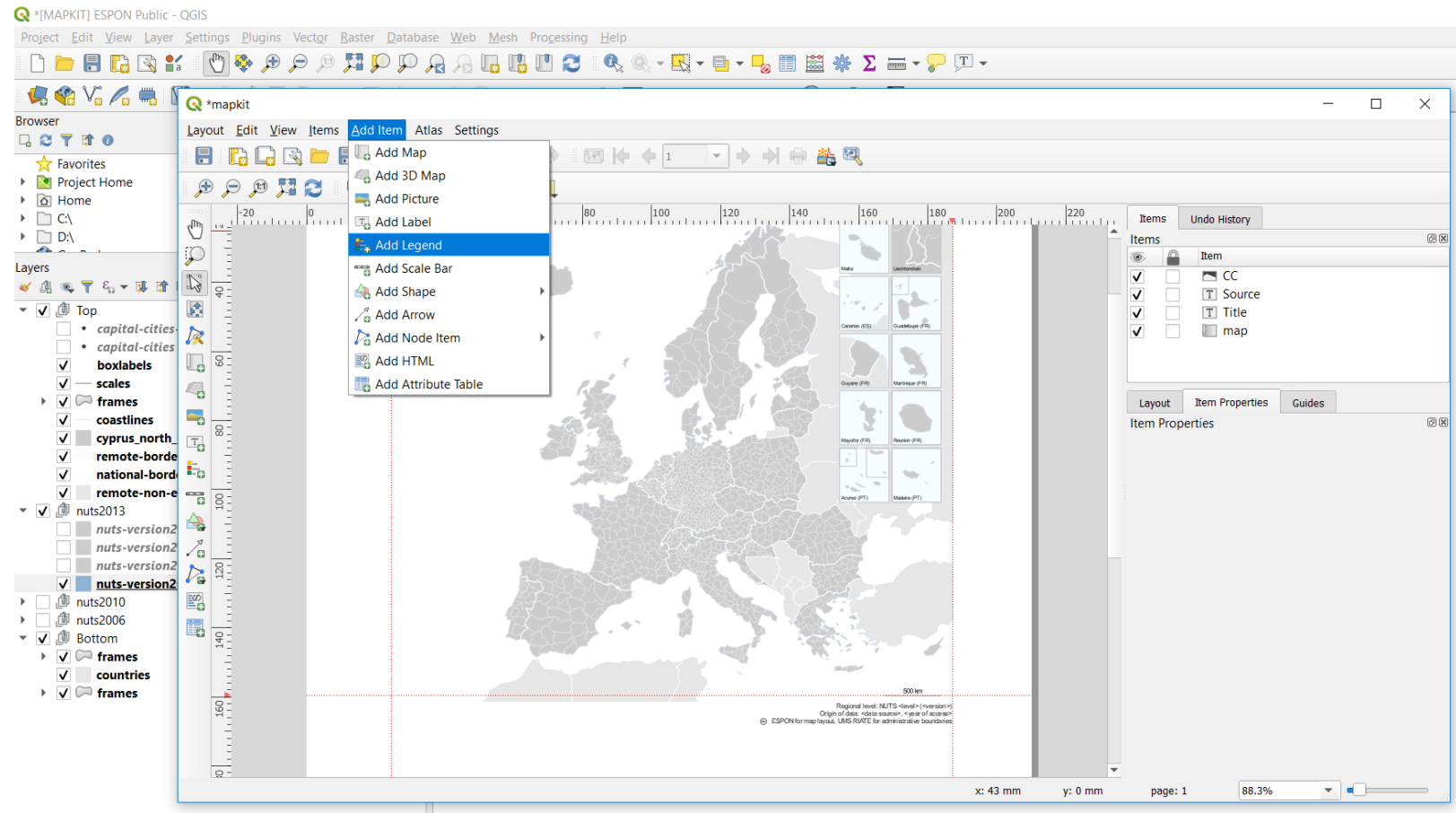
Explore the MapKit and QGIS: Data view

- Data view (default) for analysis
 - Top menu
 - Add layer – adding additional data
 - Add vector layer – add shapes
 - Add Delimited Text layer – add data tables
 - Processing
 - Toolbox – powerful GIS tools
 - Refactor tool – change attribute type



Explore the MapKit and QGIS: Layout view

- Layout view for publishing
- Top menu
 - Project – Layout – mapkit

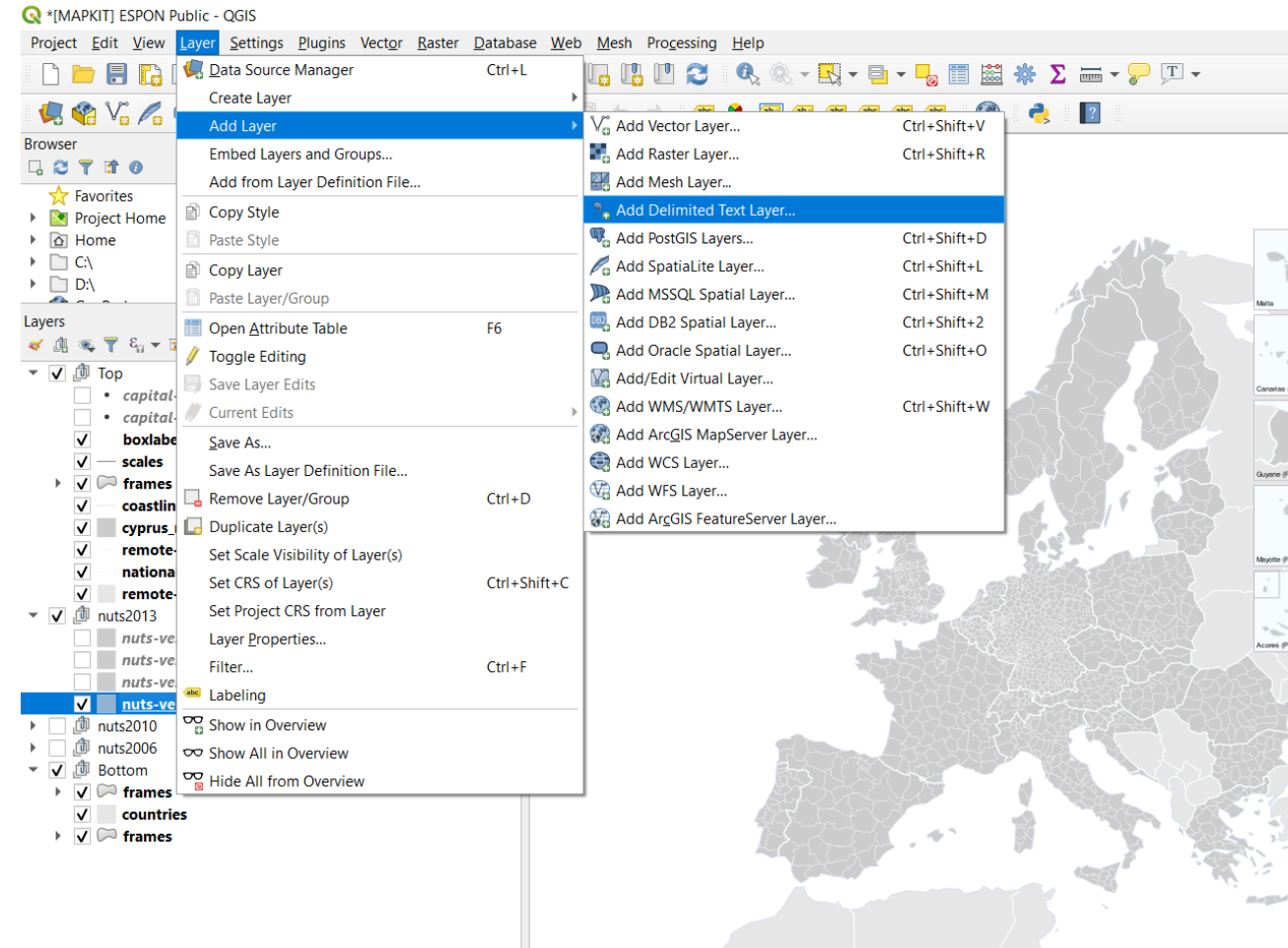


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Joining data in QGIS

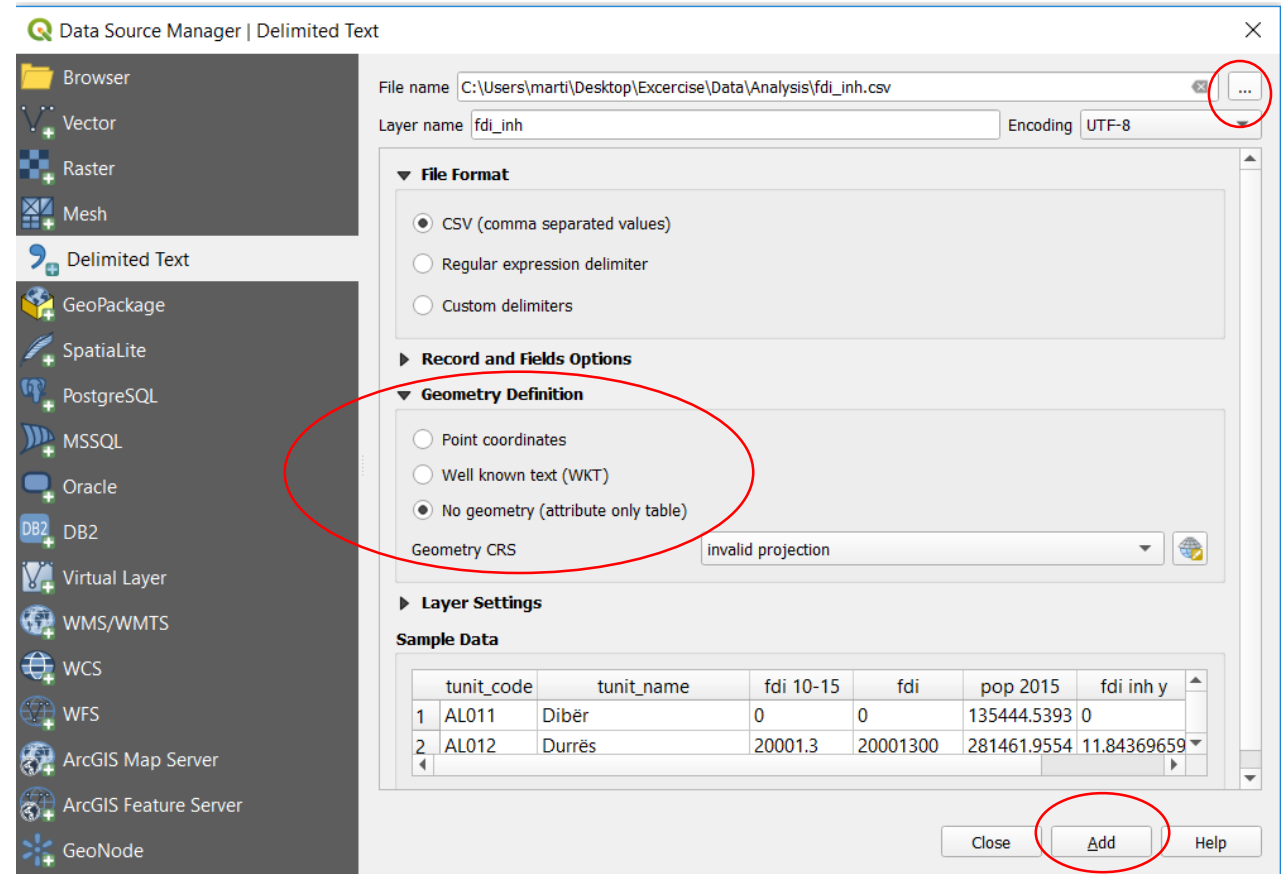
Add layer

- Data view (default) for analysis
 - Top menu
 - Add layer – adding additional data
 - Add Delimited Text layer – add data tables



Add Layer (Delimited Text)

- Browse the file **fdi inh.csv** and import under **File name - ...**
- **Find**
- Tick the box **No Geometry** under the **Geometry Definition**
- Click **Add**.
- Layer is now visible in **Layer tree**.



View attributes

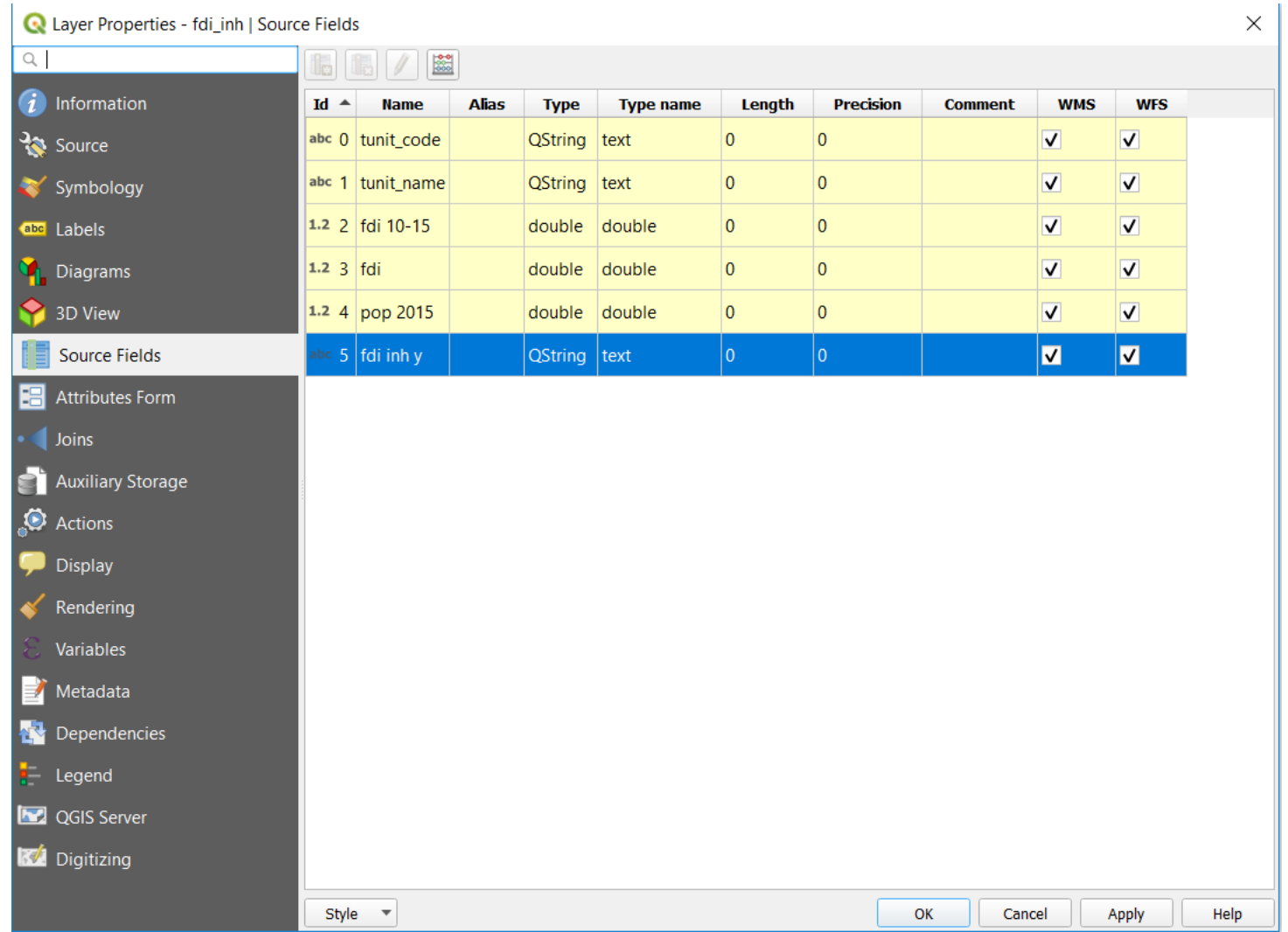
- Right click on the layer **fdi inh**
- Click on **Open Attribute Table**
- Browse column **tunit_code** (key for joining)
- Browse column **fdi inh y** (this we map)
 - Data type looks like **String!** Should be **Double!**

QGIS interface showing the 'fdi inh' layer selected in the Layers panel. The 'Open Attribute Table' context menu is open over the layer. The attribute table is displayed, showing columns: tunit_code, tunit_name, fdi 10-15, fdi, pop 2015, and fdi inh y. The 'tunit_code' and 'fdi inh y' columns are highlighted with yellow boxes.

	tunit_code	tunit_name	fdi 10-15	fdi	pop 2015	fdi inh y
1	PL114	Lodzki	398044.75	398044750	3832 8	173.0834038
2	NO072	Toms	173526.87	173526870	1634 9	176.9104594
3	NO073	Finnmark	0	0	756 7	0
4	PL117	Siedmiowiecki	603340.31	603340310	3651 3	275.4125937
5	PL127		21268866	21268866000	17312 7	2047.547808
6	PL115	Potrkowski	131030.02	131030020	5892 8	37.0638835
7	PL116	Sieradzki	105498.87	105498870	4480 7	39.24747828
8	PL12A	Warszawski zac...	1960080.12	1960080120	7943 2	411.2482974
9	PL12B	Ciechanowski	0	0	3421 2	0
10	PL128	Fadomski	27640.88	27640880	6140 4	7.502660048
11	PL129	Warszawski wsc...	71196.59	71196590	8017 1	14.79949056
12	RS121	West Backa	604388	604388000	235681.05	6 427.4053027
13	RS122	South Banat	384524.75	384524750	366029.90	7 175.0880402
14	RO424	Timis	1012557.68	1012557680	6955 9	242.6104887
15	RS111	Beograd	5507642	5507642000	208495.83	2 4402.679471

Prepare for join – right data type

- Correct the data type if necessary
- Check data types – Layer tree – Right click - Properties - Source fields
- Data for mapping should not text



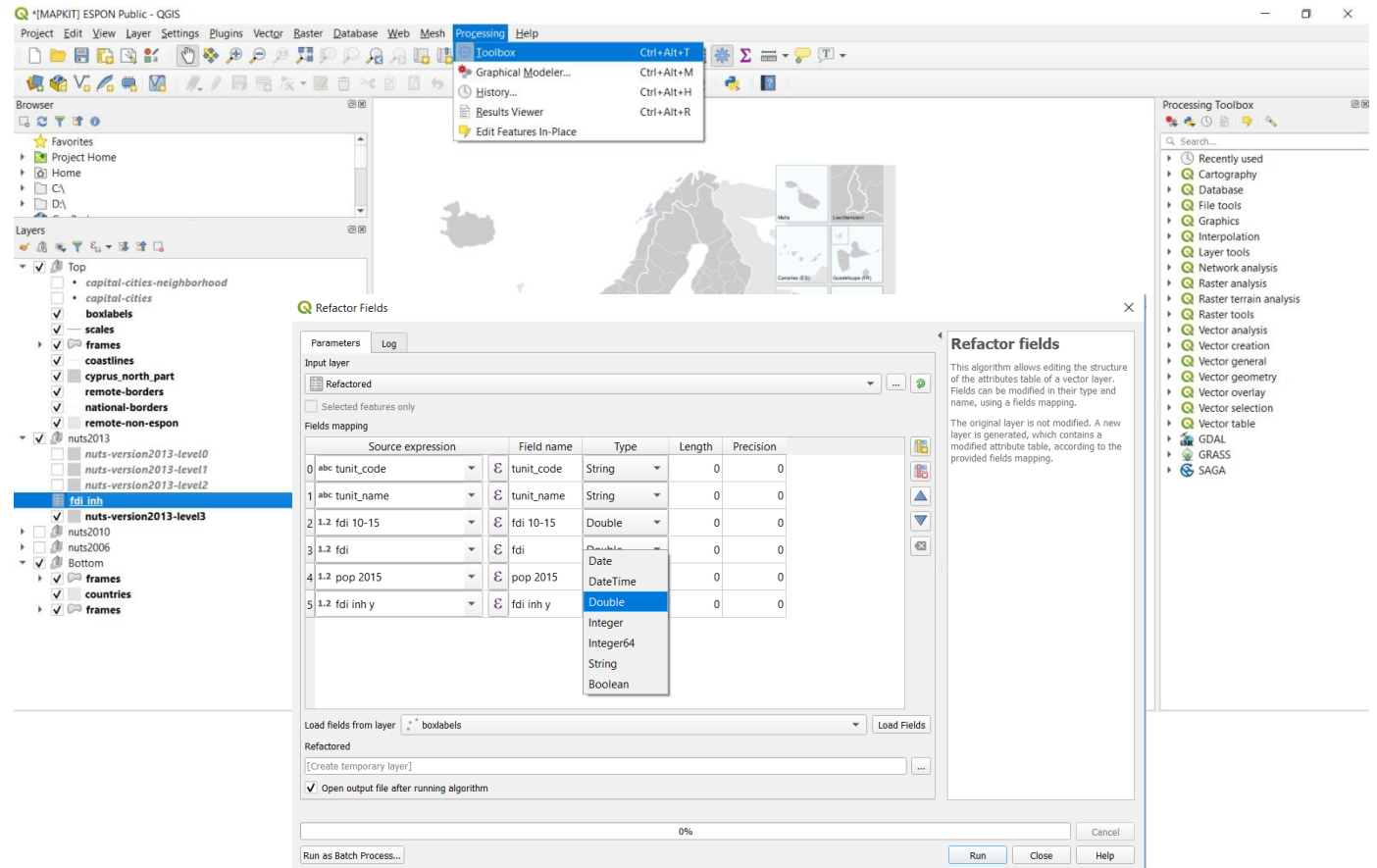
The screenshot shows the 'Layer Properties - fdi_inh | Source Fields' dialog box in QGIS. The 'Source Fields' tab is selected in the left sidebar. The main area displays a table of source fields with the following data:

Id	Name	Alias	Type	Type name	Length	Precision	Comment	WMS	WFS
abc 0	tunit_code		QString	text	0	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
abc 1	tunit_name		QString	text	0	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
1.2 2	fdi 10-15		double	double	0	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
1.2 3	fdi		double	double	0	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
1.2 4	pop 2015		double	double	0	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
abc 5	fdi inh y		QString	text	0	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

The 'fdi inh y' field is highlighted in blue. The dialog also features a sidebar with various property tabs like Information, Source, Symbology, Labels, Diagrams, 3D View, Attributes Form, Joins, Auxiliary Storage, Actions, Display, Rendering, Variables, Metadata, Dependencies, Legend, QGIS Server, and Digitizing. At the bottom, there are buttons for 'Style', 'OK', 'Cancel', 'Apply', and 'Help'.

Prepare for join – change type

- Top Menu - Processing
- Check data types – Layer tree – Right click - Properties - Toolbox
- Search for [Refactor tool](#) – change attribute type to **Double**.
- Click **Run**.
- New layer is added "Refactored"
- This layer will be used for **Join**.



Prepare for join – Check NUTS version

- Open the data download zip for the data you downloaded and intend to display.
- Open **metadata PDF**.
- Check for **NUTS version (2006/2010/2013/2016)** and **level**.
- Identify which shape file corresponds to that NUTS **version** and **level** in the **Layer Tree**.

The image shows a file explorer window with a table of files and an Adobe Acrobat Reader window displaying a PDF document. The file explorer window has a 'Layers' panel on the left and a file list on the right. The file list includes:

Name	Date modified	Type	Size
id-a10-vfdi	09/04/2019 02:36	WinRAR ZIP archive	41 KB
ind_401_a10-vfdi_data	21/03/2019 19:30	Microsoft Office E...	325 KB
ind_401_a10-vfdi_metadata_espon	21/03/2019 19:30	Adobe Acrobat D...	27 KB
README	21/03/2019 19:30	Text Document	2 KB

The Adobe Acrobat Reader window shows the PDF document 'ind_401_a10-vfdi_metadata_espon.pdf'. The document content includes:

Nomenclature name:
NUTS

Nomenclature version:
[2013]

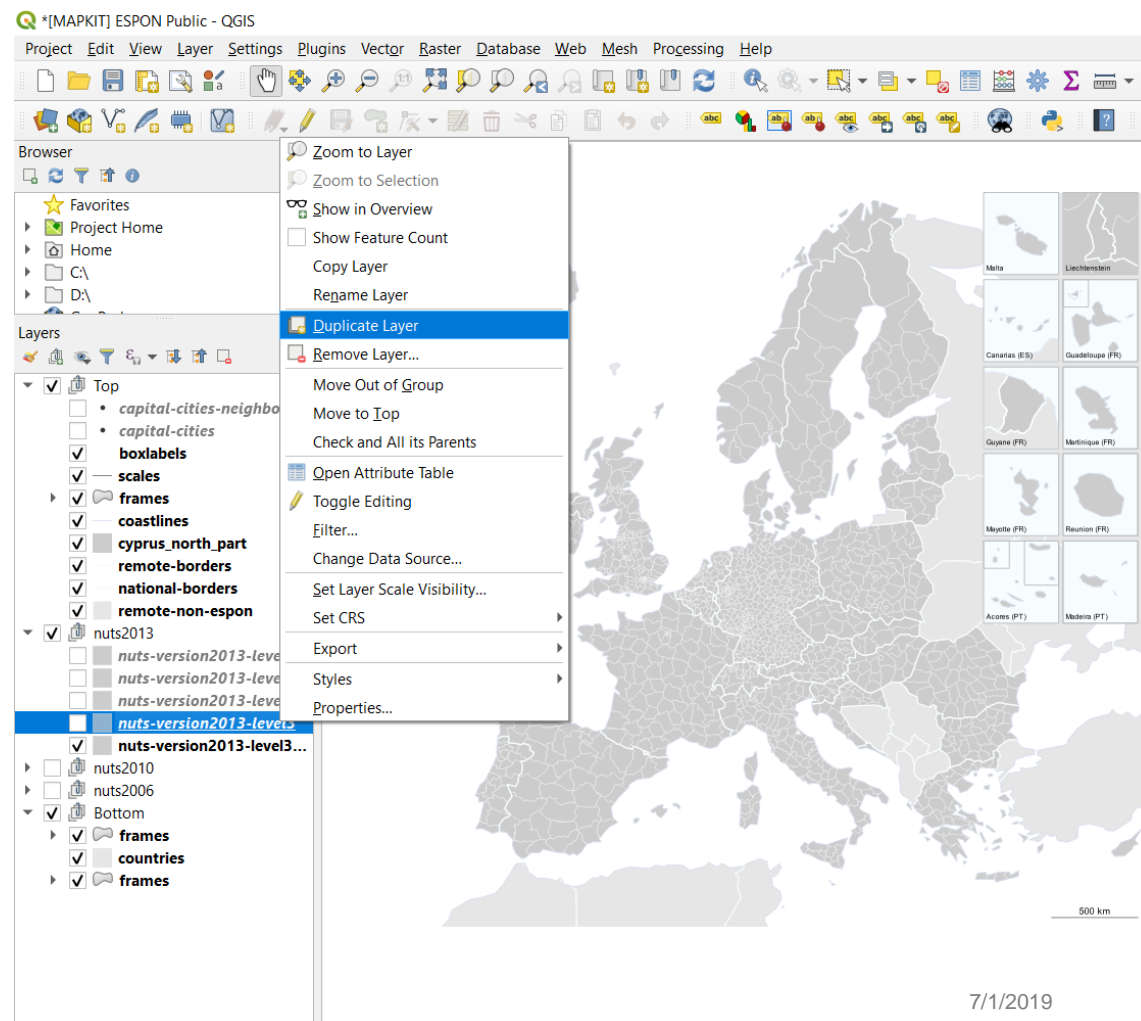
Nomenclature level:
[3]

The 'Layers' panel in the file explorer shows a tree structure with the following items:

- Top
 - capital-cities-neighborhood
 - capital-cities
 - boxlabels
 - scales
 - frames
 - coastlines
 - cyprus_north_part
 - remote-borders
 - national-borders
 - remote-non-espon
- nuts2013
 - nuts-version2013-level0
 - nuts-version2013-level1
 - nuts-version2013-level2
 - Refactored
 - fdi_inh
 - nuts-version2013-level3
- nuts2010
- nuts2006
- Bottom
 - frames
 - countries
 - frames

Tip: Duplicate layers you plan to modify

- It is always good to make a copy of a layer you plan to modify. This way you can easily go restore the default starting point before the analysis.
 - Find the layer you want to modify
 - Right click on it
 - Select "duplicate layer"



View attribute tables

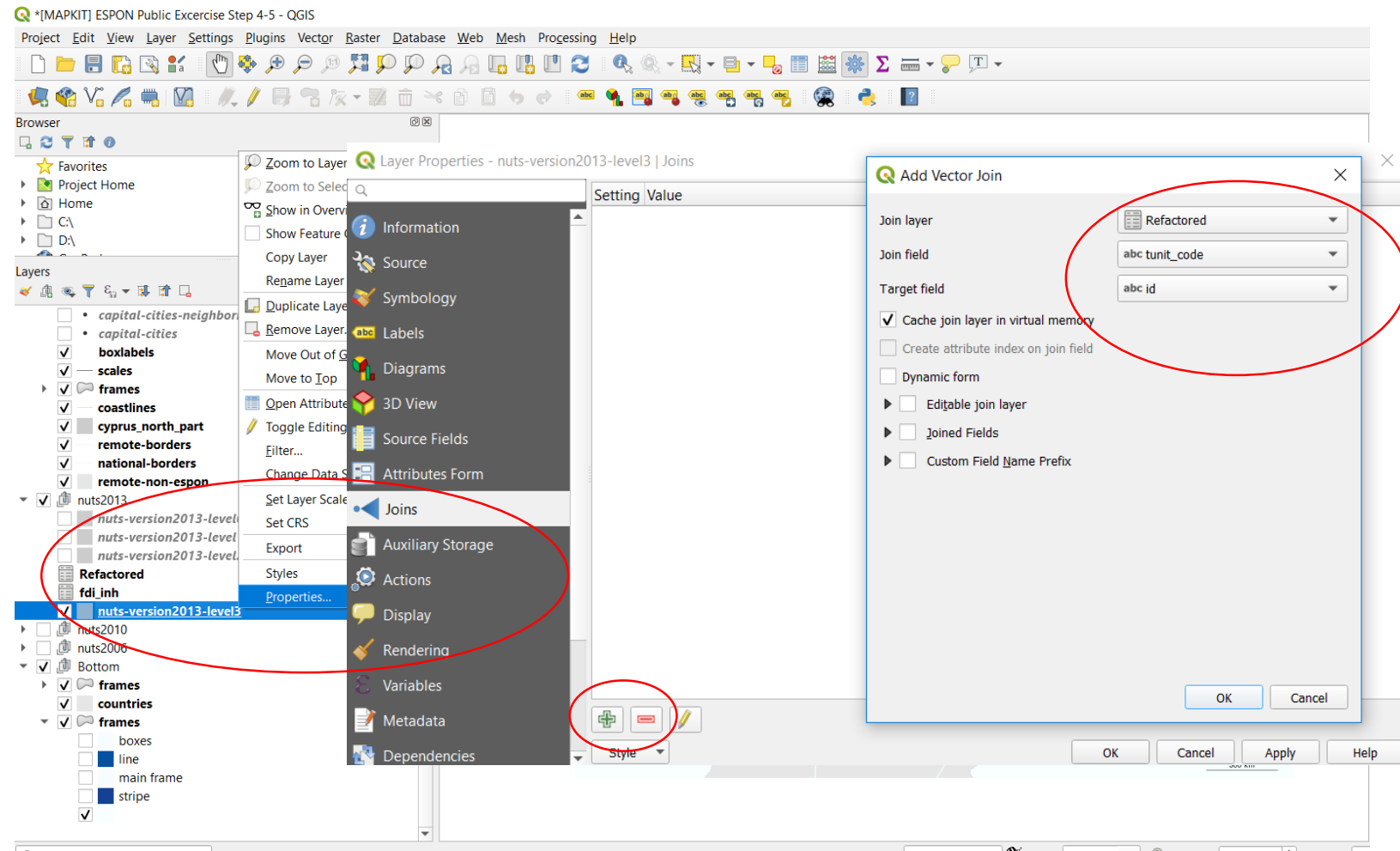
- Check also attribute layer for the shape file prior to join.

The screenshot displays the QGIS interface. On the left, the 'Layers' panel shows a list of layers. The 'nuts-version2013-level3 copy' layer is selected, and a context menu is open over it. The 'Open Attribute Table' option is highlighted. On the right, a window titled 'nuts-version2013-level3 copy :: Features Total: 1390, Filtered: 1390, Selected: 0' shows a preview of the attribute table. The table has two columns: 'id' and 'name'. The 'id' column contains alphanumeric codes, and the 'name' column contains city names. An orange box highlights the 'id' column header and the first few rows of data.

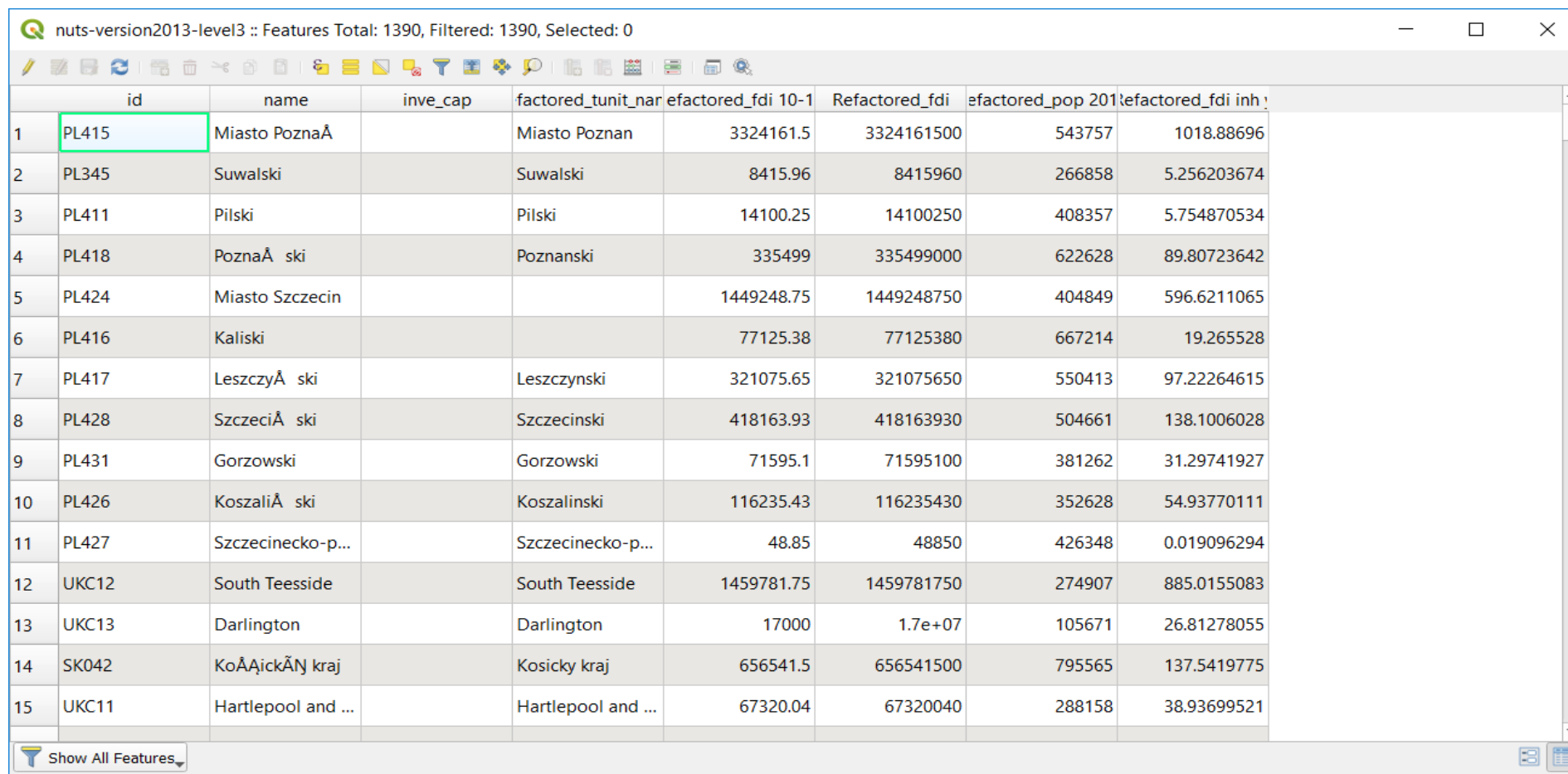
	id	name
235	ITG26	oro
236	ITG25	String (...)
237	ITG15	Caltanissetta
238	ITG14	Agrigento
239	ITG17	Catania
240	ITG16	Enna
241	ITG11	Trapani
242	ITF65	Poggio di Cala...
243	ITG13	Messina
244	ITG12	Palermo
245	ITI45	Posinone
246	ITI44	Latina
247	LT001	Aytaus apskritis

Join Data

- Right Click on **Properties** on the **NUTS-version2013-level 3** layer in the **Layer Tree**.
- Click on **Join**.
- Click on **Plus Symbol**.
- Select the data table **Refactored**.
- Select the join **key** - **NUTS3 code** - for both datasets.
- Click on **Ok**.



View attribute table to confirm the join



nuts-version2013-level3 :: Features Total: 1390, Filtered: 1390, Selected: 0

	id	name	inve_cap	factored_tunit_nar	efactored_fdi 10-1	Refactored_fdi	efactored_pop 201	tefactored_fdi inh
1	PL415	Miasto Poznań		Miasto Poznan	3324161.5	3324161500	543757	1018.88696
2	PL345	Suwalski		Suwalski	8415.96	8415960	266858	5.256203674
3	PL411	Pilski		Pilski	14100.25	14100250	408357	5.754870534
4	PL418	Poznań ski		Poznanski	335499	335499000	622628	89.80723642
5	PL424	Miasto Szczecin			1449248.75	1449248750	404849	596.6211065
6	PL416	Kaliski			77125.38	77125380	667214	19.265528
7	PL417	Leszczyński		Leszczynski	321075.65	321075650	550413	97.22264615
8	PL428	Szczeciński		Szczecinski	418163.93	418163930	504661	138.1006028
9	PL431	Gorzowski		Gorzowski	71595.1	71595100	381262	31.29741927
10	PL426	Koszaliński		Koszalinski	116235.43	116235430	352628	54.93770111
11	PL427	Szczecinecko-p...		Szczecinecko-p...	48.85	48850	426348	0.019096294
12	UKC12	South Teesside		South Teesside	1459781.75	1459781750	274907	885.0155083
13	UKC13	Darlington		Darlington	17000	1.7e+07	105671	26.81278055
14	SK042	Košický kraj		Kosicky kraj	656541.5	656541500	795565	137.5419775
15	UKC11	Hartlepool and ...		Hartlepool and ...	67320.04	67320040	288158	38.93699521

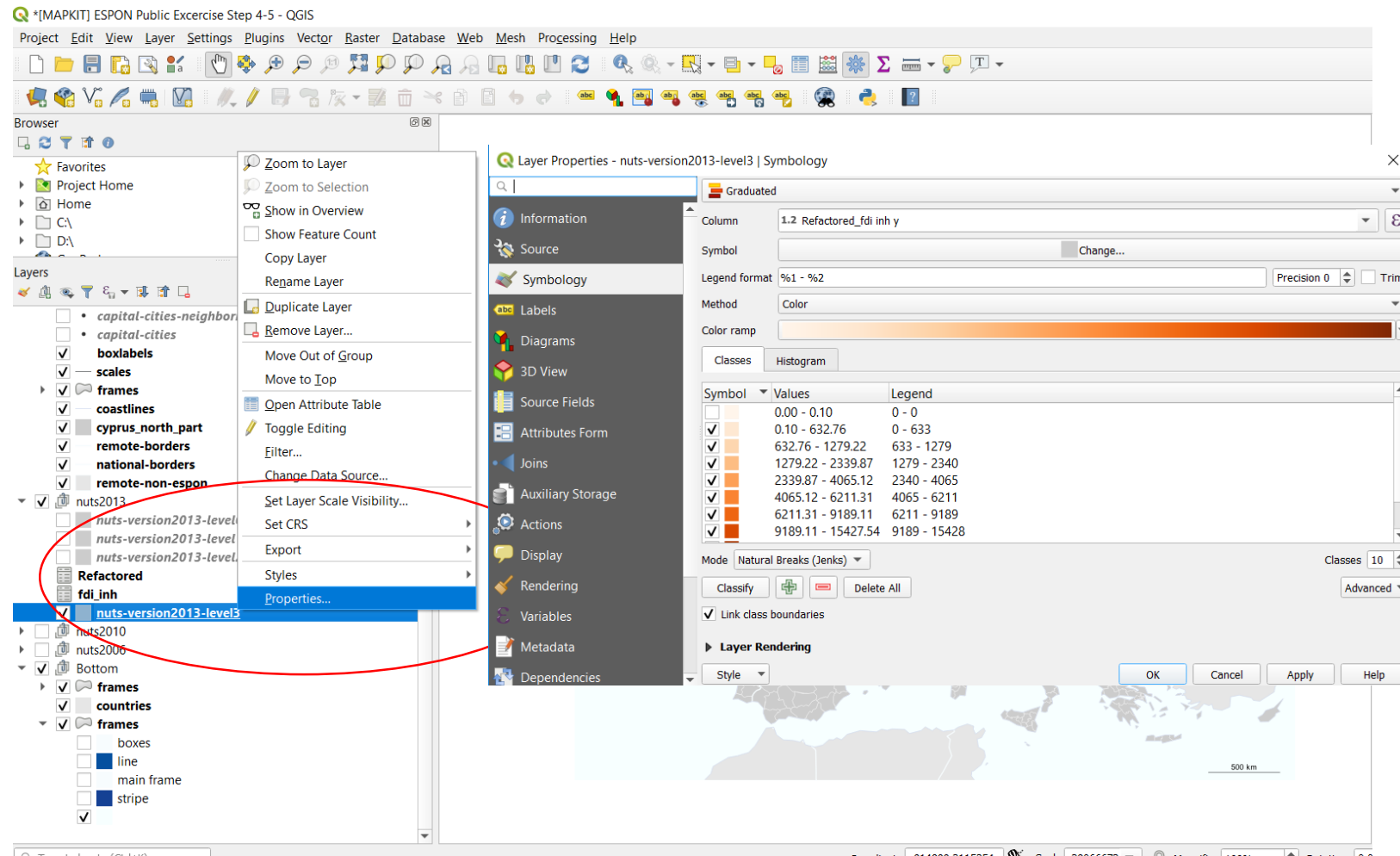
Show All Features

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Displaying the data

Display the data

- Right Click on **Properties** on the **NUTS-version2013-level 3** layer in the **Layer Tree**.
- Click on **Symbology**.
- Click on **Graduated**.
- Select the data column **fdy inh y**.
- Select the **Natural Breaks** - for **Classification**.
- Pick **10 Classes**.
- Select **0** for the first class value and **untick the box**.
- Click **Ok**.

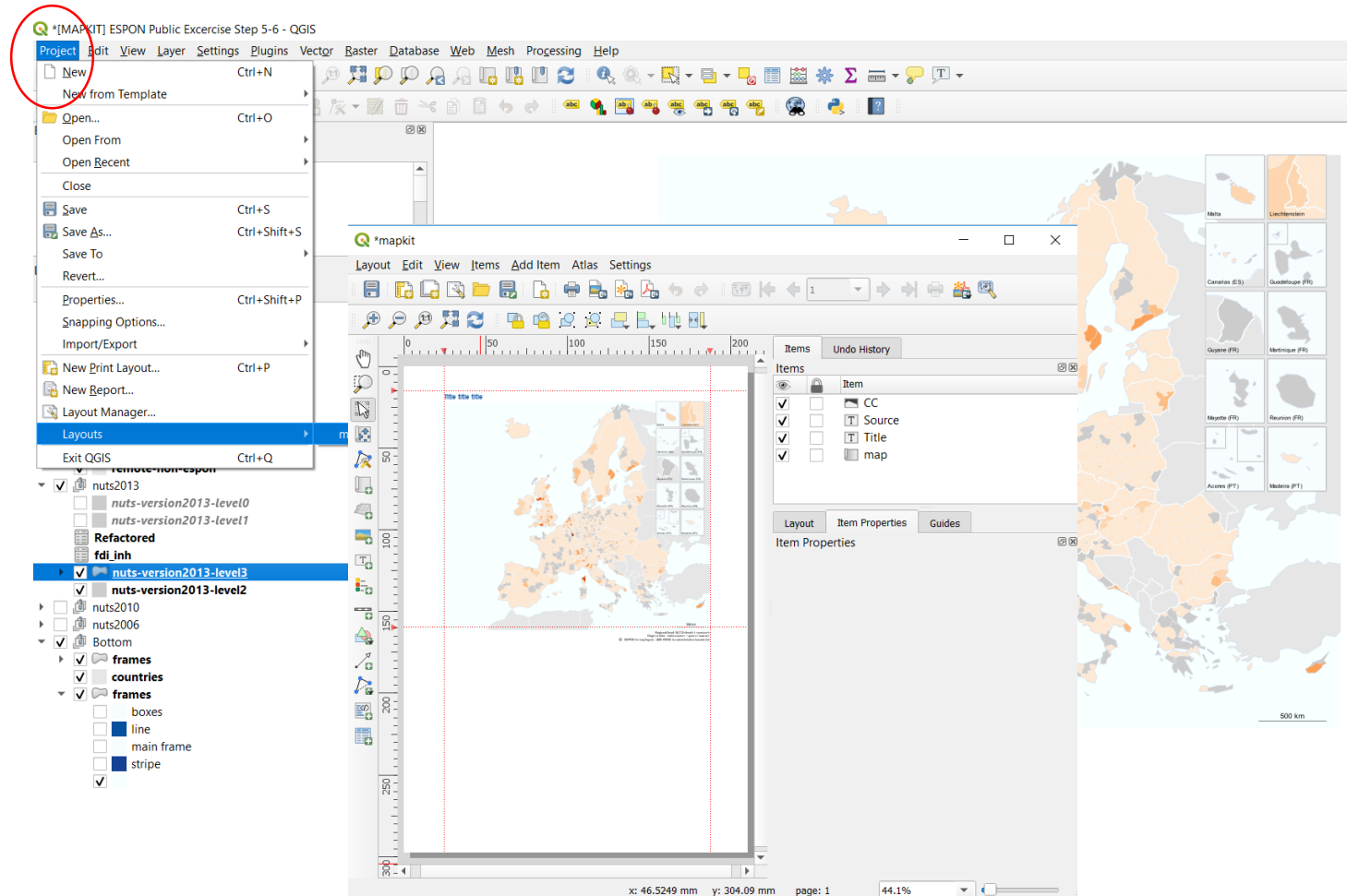


6

Finalising layout for publishing

Display the map in layout view

- Layout view for publishing
 - Top menu
 - Project – Layout – mapkit



Create and customise legend, title & meta info

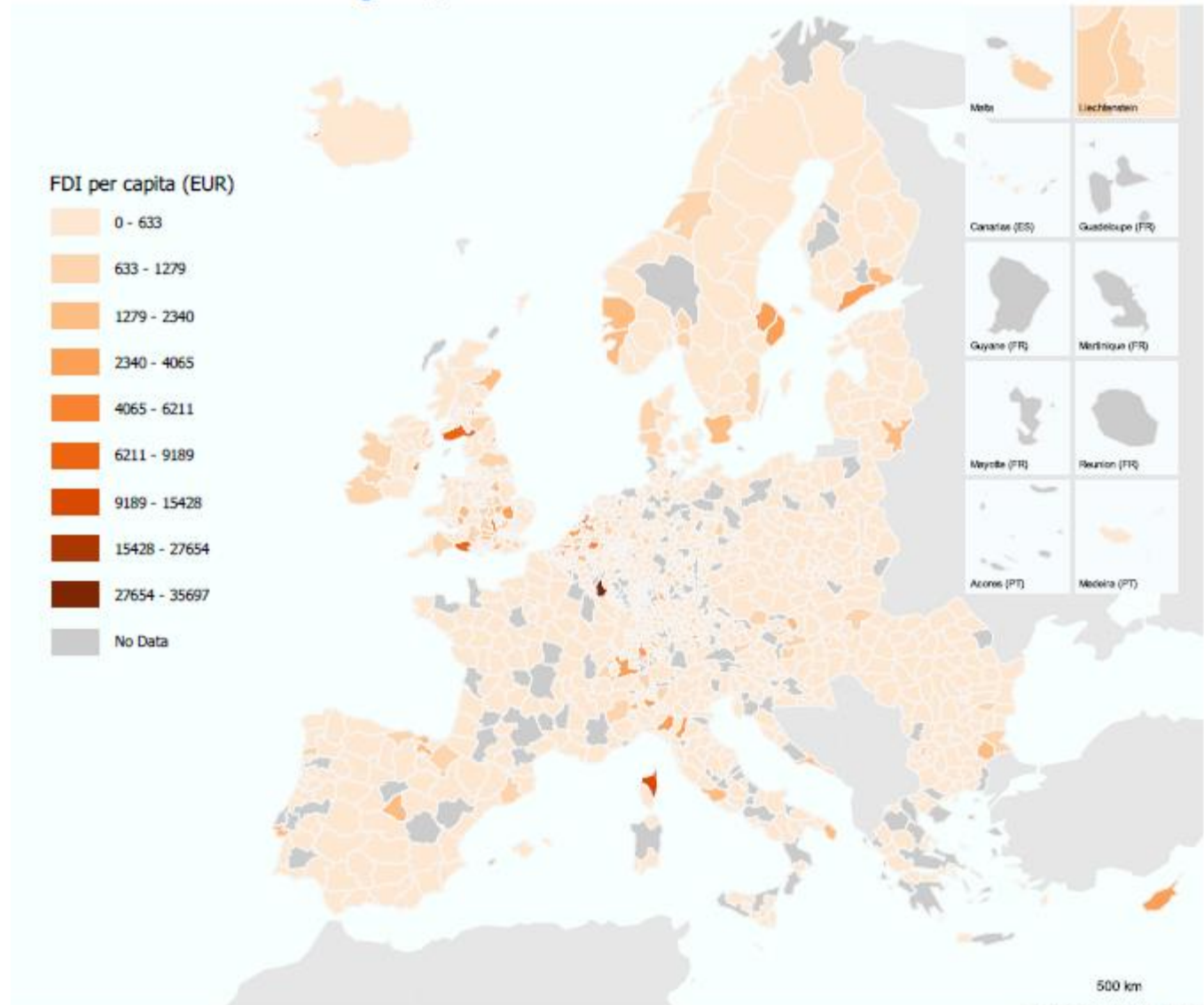
The screenshot shows the QGIS mapkit interface. The 'Add Item' menu is open, with 'Add Legend' selected. The main map area displays a choropleth map of Europe with a legend overlay. The legend shows value ranges and corresponding colors. On the right, the 'Items' and 'Item Properties' panels are visible, showing the legend item configuration.

Legend Items

Color	Value Range
Lightest Orange	0 - 633
Light Orange	633 - 1279
Orange	1279 - 2340
Dark Orange	2340 - 4065
Red-Orange	4065 - 6211
Red	6211 - 9189
Dark Red	9189 - 15428
Very Dark Red	15428 - 27654
Darkest Red	27654 - 35697

Export as PDF

Annual FDI inflows to regions, 2010-2015





Co-financed by the European Regional Development Fund

Inspire Policy Making with Territorial Evidence

// Thank you

Martin Gauk, ESPON EGTC, martin.gauk@espon.eu

This presentation will be made available at: www.espon.eu