



**BANK OF GREECE**  
EUROSYSTEM



**D ONE**  
WE MAKE SENSE.  
d-one.ai

---

# Documind x READ

**GenAI-assisted structural metadata generation  
for Bank of Greece's internal data hub**

---

*Costas Polychronopoulos (BoG)*  
*George Verouchis (D-ONE)*

*Rome, 30/09/2025*

# Περιεχόμενα - Agenda



**BANK OF GREECE**  
EUROSYSTEM



**D ONE**  
WE MAKE SENSE.  
d-one.ai

## **1** READ

**1.1** The need

**1.2** The ingredients

**1.3** The recipe

## **2** Documind

**2.1** The challenge

**2.2** The architecture

**2.3** Key features

# READ



**BANK OF GREECE**  
EUROSYSTEM



**D ONE**  
WE MAKE SENSE.  
d-one.ai

## Research & Economic Analysis Database

Bank of Greece's internal data hub



- Research & Economic Analysis Database
- Unified access to data for Research & Analysis purposes
- Demand driven by the Bank's Economists
  - Feature-wise and data-wise
- The offering includes:
  - Access to selected data published by various organisations (ranging from national to international)
  - Categorised across several dimensions (e.g., Providing Organisation, Subject Area, Publication etc.)
  - Automated data updates (e.g., on a scheduled basis)
  - Alerts for new/ revised data
  - Facility to easily retrieve the updated timeseries and feed further analysis downstream
- Not used for data dissemination/ reporting

- Unified access → SDMX information model
- Data & Metadata management platform → [.Stat Suite](#)
- Metadata editing/ curation → [FMR Workbench](#)
- 2 personas
  - Economist – Research → .Stat Data Explorer
  - Economist – Analysis → .Stat Excel Add-in
- Capacity building → [.Stat Academy](#), SDMX conferences and the community
- Multiple providers
  - SDMX APIs compatibility → [SDMX Test Compatibility Kit](#)
  - Non-SDMX: Human/ GenAI-assisted structural metadata generation (see Documind)
- Data Pipelines → Azure Pipelines (inspired by [DBnomics](#))



# READ

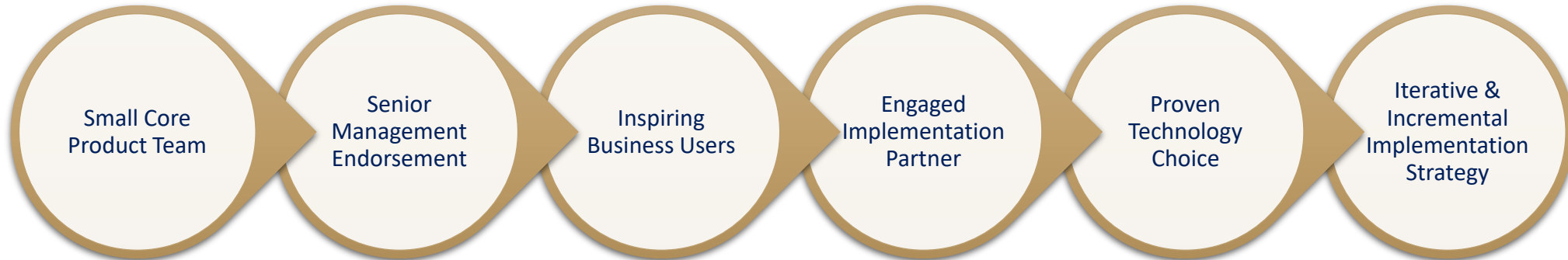
## The recipe



**BANK OF GREECE**  
EUROSYSTEM



**D ONE**  
WE MAKE SENSE.  
d-one.ai



# Documind



**BANK OF GREECE**  
EUROSYSTEM



**D ONE**  
WE MAKE SENSE.  
d-one.ai

## GenAI-assisted structural metadata generation

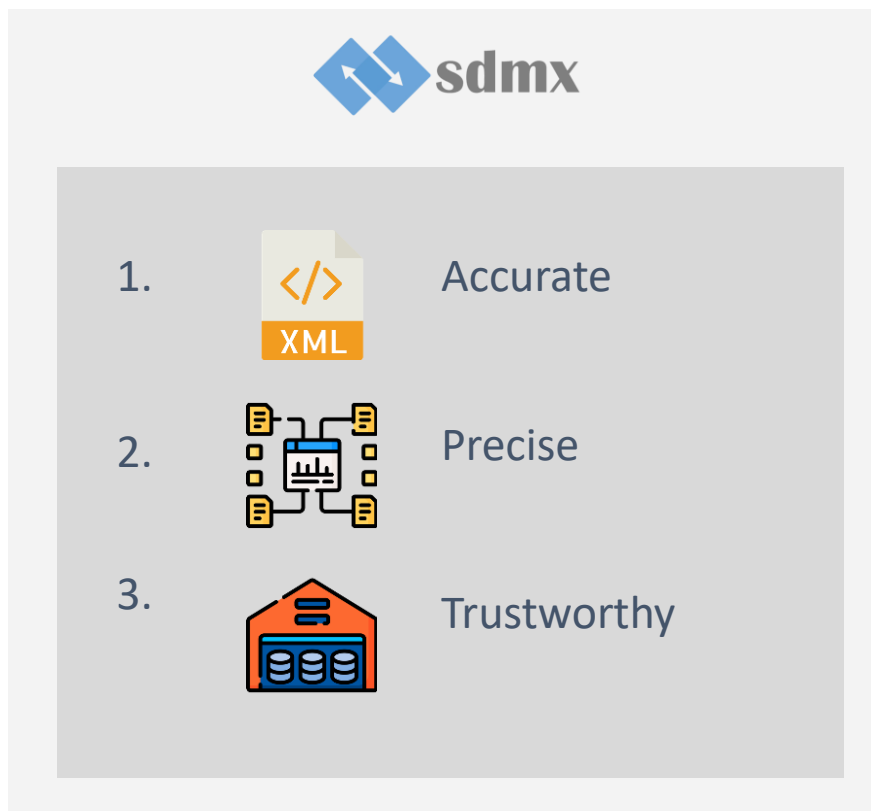
# The Challenge



BANK OF GREECE  
EUROSYSTEM



**D ONE**  
WE MAKE SENSE.  
d-one.ai



Publication each Q ~ 250 pages each



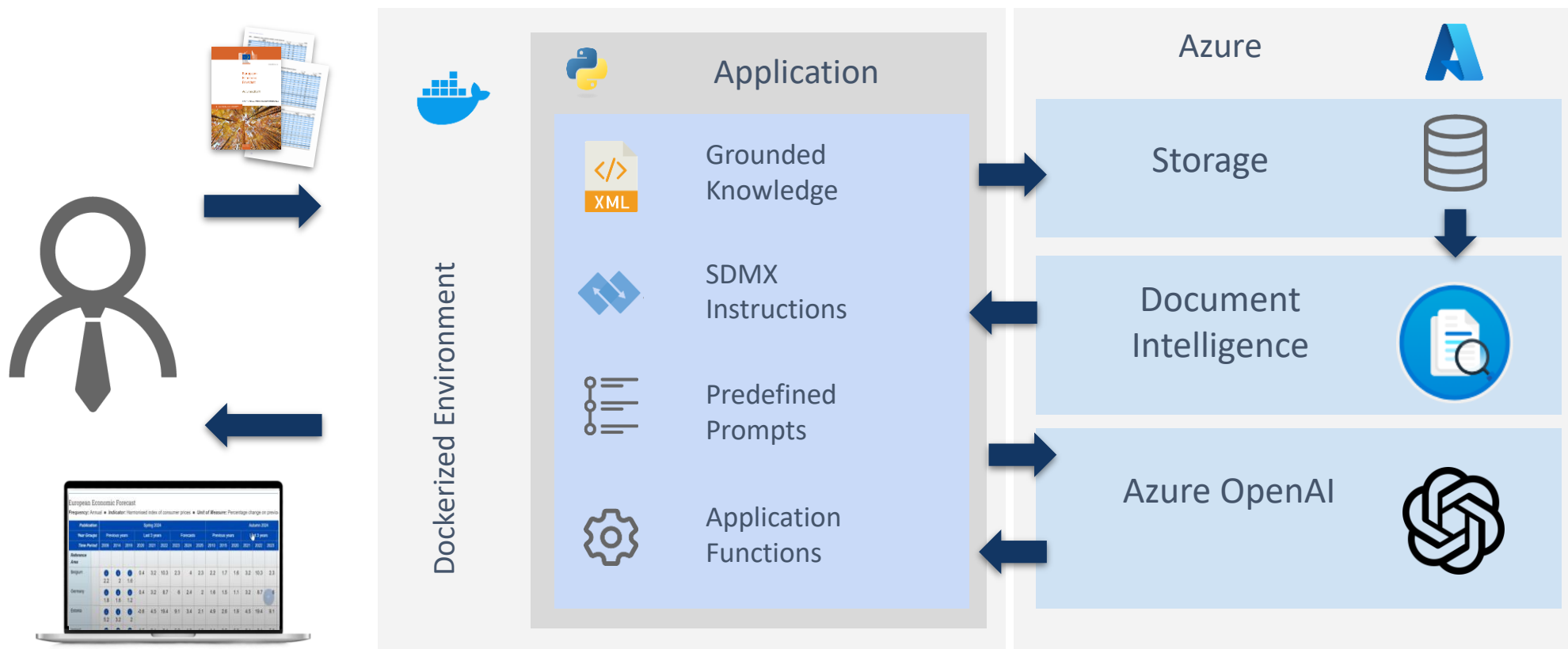
# Microservice Architecture



BANK OF GREECE  
EUROSYSTEM



D ONE  
WE MAKE SENSE.  
d-one.ai



# Our Solution: End-to-End Data Preparation



BANK OF GREECE  
EUROSYSTEM



D ONE  
WE MAKE SENSE.  
d-one.ai

Table 17a: Harmonised index of consumer prices (national index if not available), (percentage change on preceding year, 2005-2025)

	5-year averages			Spring 2024 Forecast						
	2005 - 09	2010 - 14	2015 - 19	2020	2021	2022	2023	2024	2025	
Belgium	2.2	2.0	1.6	0.4	3.2	10.3	2.3	4.0	2.3	
Germany	1.8	1.6	1.2	0.4	3.2	8.7	6.0	2.4	2.0	
Estonia	5.2	3.2	2.0	-0.6	4.5	19.4	9.1	3.4	2.1	
Ireland	1.8	0.5	0.3	-0.5	2.4	8.1	5.2	1.9	1.8	
Greece	3.1	1.3	0.3	-1.3	0.6	9.3	4.2	2.8	2.1	
Spain	2.7	1.8	0.7	-0.3	3.0	8.3	3.4	3.1	2.3	
France	1.7	1.6	1.0	0.5	2.1	5.9	5.7	2.5	2.0	
Croatia	3.4	1.8	0.6	0.0	2.7	10.7	8.4	3.5	2.2	
Italy	2.1	1.9	0.7	-0.1	1.9	8.7	5.9	1.6	1.9	
Cyprus	2.2	1.9	-0.2	-1.1	2.3	8.1	3.9	2.4	2.1	
Latvia	8.4	1.2	1.7	0.1	3.2	17.2	9.1	1.6	2.0	
Lithuania	5.5	2.0	1.7	1.1	4.6	18.9	8.7	1.9	1.8	
Luxembourg	2.7	2.4	1.2	0.0	3.5	8.2	2.9	2.3	2.0	
Malta	2.5	1.9	1.3	0.8	0.7	6.1	5.6	2.8	2.3	
Netherlands	1.6	1.8	1.2	1.1	2.8	11.6	4.1	2.5	2.0	
Austria	1.9	2.3	1.5	1.4	2.8	8.6	7.7	3.6	2.8	
Portugal	1.9	1.6	0.8	-0.1	0.9	8.1	5.3	2.3	1.9	
Slovakia	2.8	2.0	1.2	2.0	2.8	12.1	11.0	3.1	3.6	
Slovenia	3.0	1.8	0.9	-0.3	2.0	9.3	7.2	2.8	2.4	
Finland	1.8	2.3	0.7	0.4	2.1	7.2	4.3	1.4	2.1	
Euro area	2.1	1.7	1.0	0.3	2.6	8.4	5.4	2.5	2.1	
Bulgaria	7.1	1.5	0.8	1.2	2.8	13.0	8.6	3.1	2.6	
Czechia	2.7	1.7	1.6	3.3	3.3	14.8	12.0	2.5	2.2	
Denmark	2.0	1.6	0.5	0.3	1.9	8.5	3.4	2.0	1.9	
Hungary	5.1	3.2	1.8	3.4	5.2	15.3	17.0	4.1	3.7	
Poland	2.8	2.2	0.8	3.7	5.2	13.2	10.9	4.3	4.2	
Romania	6.8	4.0	1.5	2.3	4.1	12.0	9.7	5.9	4.0	
Sweden	1.9	1.0	1.5	0.7	2.7	8.1	5.9	2.0	1.8	
EU	2.3	1.8	1.0	0.7	2.9	9.2	6.4	2.7	2.2	
United Kingdom	2.5	2.5	1.6	1.0	2.5	7.9	6.8	2.4	2.0	
Japan	0.0	0.4	0.5	0.0	-0.2	2.5	3.3	2.8	2.2	
United States	2.6	2.0	1.6	1.2	4.7	8.0	4.1	2.9	2.4	

Before : Paper/PDF Unstructured

Applied filters 3 576 data points

Indicator: x Harmonised index of consumer prices x Frequency: Annual Time Period: x Last 3 time series value(s) x

Clear all filters x

European Economic Forecast

Frequency: Annual • Indicator: Harmonised index of consumer prices • Unit of Measure: Percentage change on previous year

Publication	Spring 2024									Autumn 2024					
	Previous years			Last 3 years			Forecasts			Previous years			Last 3 years		
Year Groups	2009	2014	2019	2020	2021	2022	2023	2024	2025	2010	2015	2020	2021	2022	2023
Time Period	2009	2014	2019	2020	2021	2022	2023	2024	2025	2010	2015	2020	2021	2022	2023
Reference Area															
Belgium	2.2	2	1.6	0.4	3.2	10.3	2.3	4	2.3	2.2	1.7	1.6	3.2	10.3	2.3
Germany	1.8	1.6	1.2	0.4	3.2	8.7	6	2.4	2	1.6	1.5	1.1	3.2	8.7	6
Estonia	5.2	3.2	2	-0.6	4.5	19.4	9.1	3.4	2.1	4.9	2.6	1.9	4.5	19.4	9.1

After: DWH Structured

# Key Feature: Human-in-the-Loop



BANK OF GREECE  
EUROSYSTEM



**D ONE**  
WE MAKE SENSE.  
d-one.ai

**Step 1: Upload PDF**

Upload File (PDF or Image)

Choose file

ECONOMIC\_FORECAST\_SPRING\_2025.pdf

Describe the table

I need the table 24

Upload & Analyze

Fast Generation

Upload successful! Proceed to table selection.

User selects verbally

**Step 2: Table Selection**

Select a table:

Table 24: Table 24: Unemployment rate 1 (number of unemployed as

Table 20: Table 20: Price deflator of imports of goods in national curr

Table 21: Table 21: Terms of

Table 22: Table 22: Total population (percentage change on precedin

Table 23: Table 23: Total

Table 24: Table 24: Unemployment rate 1 (number of unemployed as

Table 25: Table 25: Compensation

Table 26: Table 26: Real compensation of employees per head 1 (per

Table 27: Table 27: Labour

Table 28: Table 28: Unit labour costs, whole economy 1 (percentage c

Table 29: Table 29: Real unit

Luxembourg	4.7	5.7
Malta	6.6	6.0

System recommends

# Artefact Generation



BANK OF GREECE  
EUROSYSTEM



D ONE  
WE MAKE SENSE.  
d-one.ai

Step 1: Upload CSV

Upload CSV File

Choose Filefinal\_table.csv

Agency

EC

Name

COMP\_EMP

Advanced Grounded Knowledge

Select Data Vendor

ESTAT

Step 3: Verification

CONCEPT SCHEMEDSDDATAFLOWDATAFILECODELISTS

```
</m:Header>
<m:DataSet structureRef="COMP_EMP">
  <g:Series>
    <g:SeriesKey>
      <g:Value id="COUNTRY" value="BE"/>
    </g:SeriesKey>
    <g:Obs>
      <g:ObsDimension value="2025"/>
      <g:ObsValue value="2.7"/>
    </g:Obs>
  </g:Series>
  <g:Series>
    <g:SeriesKey>
      <g:Value id="COUNTRY" value="DE"/>
    </g:SeriesKey>
  </g:Series>

```

Step 2: Dashboard

Generate SDMX artifacts:

Generate Concept Scheme

Generate DSD

Generate Dataflow

Generate Datafile

Artifact Preview

```
<structure:Concepts>
  <structure:ConceptScheme id="COMP_EMP_CONCEPTS" agencyID="EC" version="1.0" isFinal="true">
    <common:Name xml:lang="en">Concept Scheme for COMP_EMP</common:Name>
    <structure:Concept id="COUNTRY">
      <common:Name xml:lang="en">Country</common:Name>
      <common:Description xml:lang="en">The country identifier.</common:Description>
    </structure:Concept>
    <structure:Concept id="TIME_PERIOD">
      <common:Name xml:lang="en">Time Period</common:Name>
      <common:Description xml:lang="en">The period of the observation (e.g., monthly, quar
    </structure:Concept>
    <structure:Concept id="OBS_VALUE">

```

Copy to ClipboardDownload XMLAccept Artifact

Refine Artifact with Feedback:

Enter your feedback...

Submit Feedback

# Thank you!



**BANK OF GREECE**  
EUROSYSTEM



**D ONE**  
WE MAKE SENSE.  
d-one.ai



## Contributors

Marina Georgiadou, Nassos Kourentas,  
Tassos Thomaidis, George Stavroulakis [BoG]

Thanos Gkinakos, Christos Gkatzis [D-ONE]



[cpolychronopoulos@bankofgreece.gr](mailto:cpolychronopoulos@bankofgreece.gr)

[george.verouchis@d-one.ai](mailto:george.verouchis@d-one.ai)



*Disclaimer: Any views expressed in this presentation are those of the presenters and not necessarily those of the Bank of Greece*

# Key Feature: Human-in-the-Loop

Step 3: Modify Table

**Options**

- ☐ SDMX Date Refactoring
- ☐ Null Refactoring
- ☐ Column Names Refactoring
- ☐ Integrity Checks
- ☐ Warnings Refactoring
- ☐ General Recommendations

Custom Instructions:

Add after country column the country ISO column

Apply Custom Changes

Current Version: 1

Go to version... Go

Belgium	7.9	8.2	6.5	6.3	5.6	5.5	5.7	6.1	5.8	5.6	5.7
Germany	7.7	4.9	3.5	3.7	3.2	3.1	3.4	3.6	3.3	3.3	3.3
Estonia	9.2	8.9	5.9	6.2	5.6	6.4	7.6	7.6	7.3	7.5	7.7
Ireland	8.8	13.3	6.4	6.2	4.5	4.3	4.3	4.3	4.4	4.4	4.4
Greece	9.7	24.5	20.2	14.7	12.5	11.1	10.1	9.3	8.7	10.4	9.8
Spain	13.2	23.8	16.3	14.9	13.0	12.2	11.4	10.4	9.9	11.5	11.0
France	8.5	10.0	9.0	7.9	7.3	7.3	7.4	7.9	7.8	7.4	7.5
Croatia	10.1	16.1	9.3	7.5	6.8	6.1	5.0	4.6	4.5	5.1	4.7
Italy	7.3	11.3	10.6	9.5	8.1	7.7	6.5	5.9	5.9	6.8	6.3

User suggest edits

Step 3: Modify Table

**Options**

- ☐ SDMX Date Refactoring
- ☐ Null Refactoring
- ☐ Column Names Refactoring
- ☐ Integrity Checks
- ☐ Warnings Refactoring
- ☐ General Recommendations

Custom Instructions:

Add after country column the country ISO column

Apply Custom Changes

Current Version: 2

Go to version... Go

Belgium	BE	7.9	8.2	6.5	6.3	5.6	5.5	5.7	6.1	5.8	5.6
Germany	DE	7.7	4.9	3.5	3.7	3.2	3.1	3.4	3.6	3.3	3.3
Estonia	EE	9.2	8.9	5.9	6.2	5.6	6.4	7.6	7.6	7.3	7.5
Ireland	IE	8.8	13.3	6.4	6.2	4.5	4.3	4.3	4.3	4.4	4.4
Greece	GR	9.7	24.5	20.2	14.7	12.5	11.1	10.1	9.3	8.7	10.4
Spain	ES	13.2	23.8	16.3	14.9	13.0	12.2	11.4	10.4	9.9	11.5
France	FR	8.5	10.0	9.0	7.9	7.3	7.3	7.4	7.9	7.8	7.4
Croatia	HR	10.1	16.1	9.3	7.5	6.8	6.1	5.0	4.6	4.5	5.1
Italy	IT	7.3	11.3	10.6	9.5	8.1	7.7	6.5	5.9	5.9	6.8

System applies and keeps track of versioning

# Key Feature: Human-in-the-Loop

Step 3: Modify Table

Options

- ☐ SDMX Date Refactoring
- ☐ Null Refactoring
- ☐ Column Names Refactoring
- ☐ Integrity Checks
- ☐ Warnings Refactoring
- ☐ General Recommendations

Custom Instructions:

Generate a table showing the average annual growth in employee compensation per head for each country over the period 2021–2026, based on the values provided. Classify the trend as 'High', 'Moderate', or 'Low' growth.

Apply Custom Changes

Current Version: 1

Go to version... Go

	Country	2006-2010 Averages	2011-2015	2016-2020	2021	2022	2023	2024	2025	2026	2024.1	2025.1	2026.1
0	Belgium	7.9	8.2	6.5	6.3	5.6	5.5	5.7	6.1	5.8	5.6	5.7	5.6
1	Germany	7.7	4.9	3.5	3.7	3.2	3.1	3.4	3.6	3.3	3.3	3.3	3.4
2	Estonia	9.2	8.9	5.9	6.2	5.6	6.4	7.6	7.6	7.3	7.5	7.7	7.2
3	Ireland	8.8	13.3	6.4	6.2	4.5	4.3	4.3	4.4	4.4	4.4	4.4	4.5
4	Greece	9.7	24.5	20.2	14.7	12.5	11.1	10.1	9.3	8.7	10.4	9.8	9.2
5	Spain	13.2	23.8	16.3	14.9	13.0	12.2	11.4	10.4	9.9	11.5	11.0	10.7
6	France	8.5	10.0	9.0	7.9	7.3	7.3	7.4	7.9	7.8	7.4	7.5	7.6
7	Croatia	10.1	16.1	9.3	7.5	6.8	6.1	5.0	4.6	4.5	5.1	4.7	4.6

Set this version as benchmark

User suggest edits

Step 3: Modify Table

Options

- ☐ SDMX Date Refactoring
- ☐ Null Refactoring
- ☐ Column Names Refactoring
- ☐ Integrity Checks
- ☐ Warnings Refactoring
- ☐ General Recommendations

Custom Instructions:

Generate a table showing the average annual growth in employee compensation per head for each country over the period 2021–2026, based on the values provided. Classify the trend as 'High', 'Moderate', or 'Low' growth.

Apply Custom Changes

Current Version: 2

Go to version... Go

	Country	Average Annual Growth (2021-2026)	Trend
0	Belgium	5.83	Low
1	Germany	3.38	Low
2	Estonia	6.85	Moderate
3	Ireland	4.33	Low
4	Greece	10.95	High
5	Spain	11.30	High
6	France	7.45	Moderate
7	Croatia	5.22	Low

Set this version as benchmark

System applies and keeps track of versioning