Fetching and Visualizing Official Statistics with R

Nicolas

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# Interfaces to Official Statistics

* Packages or set of classes and methods to read data and metadata documents through exchange frameworks
  + Use [R](https://www.r-project.org/) (or [Python](https://www.python.org/)) packages to read data from APIs, databases, and web pages
    - Individual packages:
      * [eurostat](https://cran.r-project.org/package=eurostat): Access data from Eurostat
      * [OECD](https://cran.r-project.org/package=OECD): Access data from the OECD API
  + General-purpose packages:
    - [rdbnomics](https://cran.r-project.org/package=rdbnomics): Unified access to many economic databases (e.g. ECB, **Eurostat**, IMF, World Bank)
* Interface standards:
  + [SDMX](https://sdmx.org/?page_id=5008): Statistical Data and Metadata Exchange format
  + [pxweb](https://cran.r-project.org/package=pxweb): Access to data sources using the PX-Web API (e.g. Statistics Sweden, Statistics Estonia)

### DBnomics

* [DBnomics](https://db.nomics.world/) is a database of databases
  + free platform to aggregate publicly-available economic data provided by national and international statistical institutions, but also by researchers and private companies
  + Unified interface to access data from many sources
  + Harmonized data formats and metadata
  + Data series are available upon release by the provider
  + Each revision is archived to build a real-time database

## How to fetch data (from DBnomics using R)

* DBnomics R client

install.packages("rdbnomics")  
library(rdbnomics)

### Packages used in this tutorial

* 📦 Fetching data (rdbnomics)
* 🧹 Data wrangling and transformation (tidyverse)
* 📊 Visualization (ggplot2, plotly)
* 📋 Tabular summaries (gt)
* 🧾 Building this presentation (quarto)

library(quarto) # for compiling Quarto presentations  
library(rdbnomics) # for accessing economic data via DBnomics  
library(tidyverse) # dplyr, ggplot2, readr, etc.  
library(plotly) # interactive visualizations  
library(gt) # pretty tables

### Example: Fetch Unemployment Data

* Assume we know exactly the series ID we want to fetch
  + Unemployment rate, ILO definition, total, Estonia, from Eurostat

unemp <- rdb(ids = "Eurostat/ei\_lmhr\_m/M.PC\_ACT.SA.LM-UN-T-TOT.EE") # fetch data

glimpse(unemp)

Rows: 296  
Columns: 22  
$ `@frequency` <chr> "monthly", "monthly", "monthly", "mo…  
$ dataset\_code <chr> "ei\_lmhr\_m", "ei\_lmhr\_m", "ei\_lmhr\_m…  
$ dataset\_name <chr> "Unemployment rate (%) - monthly dat…  
$ freq <chr> "M", "M", "M", "M", "M", "M", "M", "…  
$ geo <chr> "EE", "EE", "EE", "EE", "EE", "EE", …  
$ `Geopolitical entity (reporting)` <chr> "Estonia", "Estonia", "Estonia", "Es…  
$ indexed\_at <dttm> 2024-10-31 15:26:51, 2024-10-31 15:…  
$ indic <chr> "LM-UN-T-TOT", "LM-UN-T-TOT", "LM-UN…  
$ Indicator <chr> "Unemployment according to ILO defin…  
$ observations\_attributes <chr> "OBS\_FLAG,", "OBS\_FLAG,", "OBS\_FLAG,…  
$ original\_period <chr> "2000-02", "2000-03", "2000-04", "20…  
$ original\_value <chr> "14.9", "14.2", "14.5", "13.9", "14"…  
$ period <date> 2000-02-01, 2000-03-01, 2000-04-01,…  
$ provider\_code <chr> "Eurostat", "Eurostat", "Eurostat", …  
$ s\_adj <chr> "SA", "SA", "SA", "SA", "SA", "SA", …  
$ `Seasonal adjustment` <chr> "Seasonally adjusted data, not calen…  
$ series\_code <chr> "M.PC\_ACT.SA.LM-UN-T-TOT.EE", "M.PC\_…  
$ series\_name <chr> "Monthly – Percentage of population …  
$ `Time frequency` <chr> "Monthly", "Monthly", "Monthly", "Mo…  
$ unit <chr> "PC\_ACT", "PC\_ACT", "PC\_ACT", "PC\_AC…  
$ `Unit of measure` <chr> "Percentage of population in the lab…  
$ value <dbl> 14.9, 14.2, 14.5, 13.9, 14.0, 13.9, …

colnames(unemp)

[1] "@frequency" "dataset\_code"   
 [3] "dataset\_name" "freq"   
 [5] "geo" "Geopolitical entity (reporting)"  
 [7] "indexed\_at" "indic"   
 [9] "Indicator" "observations\_attributes"   
[11] "original\_period" "original\_value"   
[13] "period" "provider\_code"   
[15] "s\_adj" "Seasonal adjustment"   
[17] "series\_code" "series\_name"   
[19] "Time frequency" "unit"   
[21] "Unit of measure" "value"

# Extract source and series ID from the metadata  
(source\_name <- unique(unemp$dataset\_code))

[1] "ei\_lmhr\_m"

(provider\_code <- unique(unemp$provider\_code))

[1] "Eurostat"

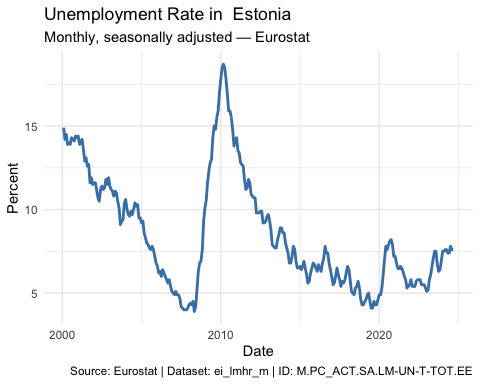
(country\_name <- unique(unemp$`Geopolitical entity (reporting)`) )

[1] "Estonia"

(series\_id <- unique(unemp$series\_code))

[1] "M.PC\_ACT.SA.LM-UN-T-TOT.EE"

# Plot the data  
p1 <- ggplot(unemp, aes(x = period, y = value)) +  
 geom\_line(color = "steelblue", linewidth = 1) +  
 labs(  
 title = paste("Unemployment Rate in ", country\_name),  
 subtitle = paste("Monthly, seasonally adjusted —", provider\_code),  
 x = "Date", y = "Percent",  
 caption = paste("Source:", provider\_code, "| Dataset:", source\_name, "| ID:", series\_id)  
 ) +  
 theme\_minimal()  
p1



### Interactive plot

ggplotly(p1)



### How do we find the series ID/mask/dimensions?

* Go to the [DBnomics website](https://db.nomics.world/)
  + Search directly for a series or pick a provider
  + Search for the [data](https://db.nomics.world/Eurostat/ei_lmhr_m?tab=list) you want (dataset\_code)
  + Click on the [series](https://db.nomics.world/Eurostat/ei_lmhr_m/M.PC_ACT.SA.LM-UN-T-TOT.EE) (series\_code)
  + Copy the series ID from the URL
* Show the available datasets of a provider:

head(rdb\_datasets(provider\_code = "Eurostat"))

$Eurostat  
 code  
 <char>  
 1: aact\_ali01  
 2: aact\_ali02  
 3: aact\_eaa01  
 4: aact\_eaa02  
 5: aact\_eaa03  
 ---   
8289: yth\_empl\_120  
8290: yth\_empl\_130  
8291: yth\_empl\_130  
8292: yth\_empl\_140  
8293: yth\_empl\_140  
 name  
 <char>  
 1: Agricultural labour input statistics: absolute figures (1 000 annual work units)  
 2: Agricultural labour input statistics: indices  
 3: Economic accounts for agriculture - values at current prices  
 4: Economic accounts for agriculture - values at n-1 prices  
 5: Economic accounts for agriculture - values at constant prices (2015 = 100)  
 ---   
8289: Youth long-term unemployment rate (12 months or longer) by sex and age  
8290: Youth long-term unemployment rate (12 months or longer) by sex, age and NUTS 2 regions  
8291: Youth long-term unemployment rate (12 months or longer) by sex, age and NUTS 2 region  
8292: Youth unemployment ratio by sex, age and NUTS 2 regions  
8293: Youth unemployment ratio by sex, age and NUTS 2 region

* Show the dimensions of a dataset:

head(rdb\_dimensions(provider\_code = "Eurostat", dataset\_code = "ei\_lmhr\_m"))

$Eurostat  
$Eurostat$ei\_lmhr\_m  
$Eurostat$ei\_lmhr\_m$freq  
 freq Time frequency  
 <char> <char>  
1: M Monthly  
  
$Eurostat$ei\_lmhr\_m$geo  
 geo Geopolitical entity (reporting)  
 <char> <char>  
 1: AT Austria  
 2: BA Bosnia and Herzegovina  
 3: BE Belgium  
 4: BG Bulgaria  
 5: CH Switzerland  
 6: CY Cyprus  
 7: CZ Czechia  
 8: DE Germany  
 9: DK Denmark  
10: EA20 Euro area – 20 countries (from 2023)  
11: EE Estonia  
12: EL Greece  
13: ES Spain  
14: EU27\_2020 European Union - 27 countries (from 2020)  
15: FI Finland  
16: FR France  
17: HR Croatia  
18: HU Hungary  
19: IE Ireland  
20: IS Iceland  
21: IT Italy  
22: JP Japan  
23: LT Lithuania  
24: LU Luxembourg  
25: LV Latvia  
26: MT Malta  
27: NL Netherlands  
28: NO Norway  
29: PL Poland  
30: PT Portugal  
31: RO Romania  
32: SE Sweden  
33: SI Slovenia  
34: SK Slovakia  
35: TR Türkiye  
36: UK United Kingdom  
37: US United States  
 geo Geopolitical entity (reporting)  
  
$Eurostat$ei\_lmhr\_m$indic  
 indic  
 <char>  
1: LM-UN-F-GT25  
2: LM-UN-F-LE25  
3: LM-UN-F-TOT  
4: LM-UN-M-GT25  
5: LM-UN-M-LE25  
6: LM-UN-M-TOT  
7: LM-UN-T-GT25  
8: LM-UN-T-LE25  
9: LM-UN-T-TOT  
 Indicator  
 <char>  
1: Unemployment according to ILO definition - over 25 years - females  
2: Unemployment according to ILO definition - under 25 years - females  
3: Unemployment according to ILO definition - females  
4: Unemployment according to ILO definition - over 25 years - males  
5: Unemployment according to ILO definition - under 25 years - males  
6: Unemployment according to ILO definition - males  
7: Unemployment according to ILO definition - over 25 years - total  
8: Unemployment according to ILO definition - under 25 years - total  
9: Unemployment according to ILO definition - total  
  
$Eurostat$ei\_lmhr\_m$s\_adj  
 s\_adj  
 <char>  
1: NSA  
2: SA  
 Seasonal adjustment  
 <char>  
1: Unadjusted data (i.e. neither seasonally adjusted nor calendar adjusted data)  
2: Seasonally adjusted data, not calendar adjusted data  
  
$Eurostat$ei\_lmhr\_m$unit  
 unit Unit of measure  
 <char> <char>  
1: PC\_ACT Percentage of population in the labour force

* Query to filter/select series from a provider’s dataset

head(rdb\_series(  
 provider = "Eurostat",  
 dataset\_code = "ei\_lmhr\_m",  
 query = "United Kingdom"  
))

$Eurostat  
$Eurostat$ei\_lmhr\_m  
 series\_code  
 <char>  
 1: M.PC\_ACT.NSA.LM-UN-F-GT25.UK  
 2: M.PC\_ACT.NSA.LM-UN-F-LE25.UK  
 3: M.PC\_ACT.NSA.LM-UN-F-TOT.UK  
 4: M.PC\_ACT.NSA.LM-UN-M-GT25.UK  
 5: M.PC\_ACT.NSA.LM-UN-M-LE25.UK  
 6: M.PC\_ACT.NSA.LM-UN-M-TOT.UK  
 7: M.PC\_ACT.NSA.LM-UN-T-GT25.UK  
 8: M.PC\_ACT.NSA.LM-UN-T-LE25.UK  
 9: M.PC\_ACT.NSA.LM-UN-T-TOT.UK  
10: M.PC\_ACT.SA.LM-UN-F-GT25.UK  
11: M.PC\_ACT.SA.LM-UN-F-LE25.UK  
12: M.PC\_ACT.SA.LM-UN-F-TOT.UK  
13: M.PC\_ACT.SA.LM-UN-M-GT25.UK  
14: M.PC\_ACT.SA.LM-UN-M-LE25.UK  
15: M.PC\_ACT.SA.LM-UN-M-TOT.UK  
16: M.PC\_ACT.SA.LM-UN-T-GT25.UK  
17: M.PC\_ACT.SA.LM-UN-T-LE25.UK  
18: M.PC\_ACT.SA.LM-UN-T-TOT.UK  
 series\_name  
 <char>  
 1: Monthly – Percentage of population in the labour force – Unadjusted data (i.e. neither seasonally adjusted nor calendar adjusted data) – Unemployment according to ILO definition - over 25 years - females – United Kingdom  
 2: Monthly – Percentage of population in the labour force – Unadjusted data (i.e. neither seasonally adjusted nor calendar adjusted data) – Unemployment according to ILO definition - under 25 years - females – United Kingdom  
 3: Monthly – Percentage of population in the labour force – Unadjusted data (i.e. neither seasonally adjusted nor calendar adjusted data) – Unemployment according to ILO definition - females – United Kingdom  
 4: Monthly – Percentage of population in the labour force – Unadjusted data (i.e. neither seasonally adjusted nor calendar adjusted data) – Unemployment according to ILO definition - over 25 years - males – United Kingdom  
 5: Monthly – Percentage of population in the labour force – Unadjusted data (i.e. neither seasonally adjusted nor calendar adjusted data) – Unemployment according to ILO definition - under 25 years - males – United Kingdom  
 6: Monthly – Percentage of population in the labour force – Unadjusted data (i.e. neither seasonally adjusted nor calendar adjusted data) – Unemployment according to ILO definition - males – United Kingdom  
 7: Monthly – Percentage of population in the labour force – Unadjusted data (i.e. neither seasonally adjusted nor calendar adjusted data) – Unemployment according to ILO definition - over 25 years - total – United Kingdom  
 8: Monthly – Percentage of population in the labour force – Unadjusted data (i.e. neither seasonally adjusted nor calendar adjusted data) – Unemployment according to ILO definition - under 25 years - total – United Kingdom  
 9: Monthly – Percentage of population in the labour force – Unadjusted data (i.e. neither seasonally adjusted nor calendar adjusted data) – Unemployment according to ILO definition - total – United Kingdom  
10: Monthly – Percentage of population in the labour force – Seasonally adjusted data, not calendar adjusted data – Unemployment according to ILO definition - over 25 years - females – United Kingdom  
11: Monthly – Percentage of population in the labour force – Seasonally adjusted data, not calendar adjusted data – Unemployment according to ILO definition - under 25 years - females – United Kingdom  
12: Monthly – Percentage of population in the labour force – Seasonally adjusted data, not calendar adjusted data – Unemployment according to ILO definition - females – United Kingdom  
13: Monthly – Percentage of population in the labour force – Seasonally adjusted data, not calendar adjusted data – Unemployment according to ILO definition - over 25 years - males – United Kingdom  
14: Monthly – Percentage of population in the labour force – Seasonally adjusted data, not calendar adjusted data – Unemployment according to ILO definition - under 25 years - males – United Kingdom  
15: Monthly – Percentage of population in the labour force – Seasonally adjusted data, not calendar adjusted data – Unemployment according to ILO definition - males – United Kingdom  
16: Monthly – Percentage of population in the labour force – Seasonally adjusted data, not calendar adjusted data – Unemployment according to ILO definition - over 25 years - total – United Kingdom  
17: Monthly – Percentage of population in the labour force – Seasonally adjusted data, not calendar adjusted data – Unemployment according to ILO definition - under 25 years - total – United Kingdom  
18: Monthly – Percentage of population in the labour force – Seasonally adjusted data, not calendar adjusted data – Unemployment according to ILO definition - total – United Kingdom

## Fetch two (or more) series at once

* Example: Balance of Payments (BOP) for France and Germany from the [IMF](https://db.nomics.world/IMF/BOP?tab=list) for Current Account, Total, Net, Euros, Millions, Annual

### Option A

# by ID  
bop <- rdb(ids = c("IMF/BOP/A.FR.BCA\_BP6\_EUR", "IMF/BOP/A.DE.BCA\_BP6\_EUR"))  
bop %>% count(`Reference Area`)

Reference Area n  
 <char> <int>  
1: France 15  
2: Germany 26

### Option B:

# by Mask  
bop <- rdb(provider = "IMF",  
 dataset\_code = "BOP",  
 mask = "A.FR+DE.BCA\_BP6\_EUR")  
bop %>% count(`Reference Area`)

Reference Area n  
 <char> <int>  
1: France 15  
2: Germany 26

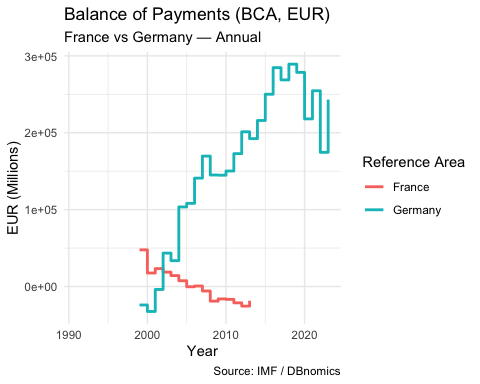
### Option C:

⚠️You must specify all dimensions!

# by Dimension  
dim <- list(  
 REF\_AREA = c("DE", "FR"),  
 INDICATOR = c("BCA\_BP6\_EUR"),  
 FREQ = "A"  
)  
bop <- rdb(provider = "IMF", dataset\_code = "BOP", dimensions = dim)  
bop %>% count(`Reference Area`)

Reference Area n  
 <char> <int>  
1: France 15  
2: Germany 26

# Line plot with color by country  
p2 <- ggplot(bop, aes(x = period, y = value, color = `Reference Area`)) +  
 geom\_step(linewidth = 1) +  
 labs(  
 title = "Balance of Payments (BCA, EUR)",  
 subtitle = "France vs Germany — Annual",  
 x = "Year",  
 y = "EUR (Millions)",  
 caption = "Source: IMF / DBnomics"  
 ) +  
 theme\_minimal()  
p2



## Fetch two series from different datasets of different providers

unemp2 <- rdb(ids = c("AMECO/ZUTN/EA19.1.0.0.0.ZUTN", "Eurostat/une\_rt\_q/Q.SA.Y15-24.PC\_ACT.T.EA19"))

# See which providers and datasets are included  
dim(unemp2)

[1] 122 27

unique(unemp2$provider\_code)

[1] "AMECO" "Eurostat"

unique(unemp2$dataset\_code)

[1] "ZUTN" "une\_rt\_q"

unique(unemp2$series\_code)

[1] "EA19.1.0.0.0.ZUTN" "Q.SA.Y15-24.PC\_ACT.T.EA19"

unique(unemp2$`@frequency`)

[1] "annual" "quarterly"

unique(unemp2$`Seasonal adjustment`)

[1] NA   
[2] "Seasonally adjusted data, not calendar adjusted data"

# Summarize coverage and data availability  
unemp2\_summary <- unemp2 %>%  
 group\_by(series\_code) %>%  
 summarize(  
 provider = first(provider\_code),  
 dataset = first(dataset\_code),  
 start\_all = min(period, na.rm = TRUE),  
 end\_all = max(period, na.rm = TRUE),  
 start\_data = min(period[!is.na(value)]),  
 end\_data = max(period[!is.na(value)]),  
 n\_obs = sum(!is.na(value)),  
 .groups = "drop"  
 )

unemp2\_summary\_table <- unemp2\_summary |>   
gt() %>%  
 tab\_header(  
 title = "Time Coverage and Non-Missing Observations",  
 subtitle = "For Each Series from AMECO and Eurostat"  
 ) %>%  
 cols\_label(  
 series\_code = "Series ID",  
 provider = "Provider",  
 dataset = "Dataset",  
 start\_all = "Start (all)",  
 end\_all = "End (all)",  
 start\_data = "Start (non-NA)",  
 end\_data = "End (non-NA)",  
 n\_obs = "# Obs"  
 ) %>%  
 fmt\_date(  
 columns = c(start\_all, end\_all, start\_data, end\_data),  
 date\_style = "iso"  
 ) %>%  
 tab\_options(  
 table.width = pct(100),  
 column\_labels.font.weight = "bold"  
 )

unemp2\_summary\_table

Table 1: Time Coverage and Non-Missing Observations

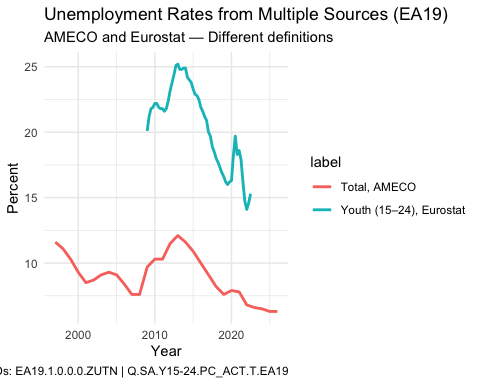
For Each Series from AMECO and Eurostat

| Series ID | Provider | Dataset | Start (all) | End (all) | Start (non-NA) | End (non-NA) | # Obs |
| --- | --- | --- | --- | --- | --- | --- | --- |
| EA19.1.0.0.0.ZUTN | AMECO | ZUTN | 1960-01-01 | 2026-01-01 | 1997-01-01 | 2026-01-01 | 30 |
| Q.SA.Y15-24.PC\_ACT.T.EA19 | Eurostat | une\_rt\_q | 2009-01-01 | 2022-07-01 | 2009-01-01 | 2022-07-01 | 55 |

# Metadata vectors  
providers <- unique(unemp2$provider\_code)  
datasets <- unique(unemp2$dataset\_code)  
series\_ids <- unique(unemp2$series\_code)

# Create a label that combines dataset + series ID  
unemp2\_clean <- unemp2 %>%  
 drop\_na(value) %>%  
 mutate(label = case\_when(  
 series\_code == "EA19.1.0.0.0.ZUTN" ~ "Total, AMECO",  
 series\_code == "Q.SA.Y15-24.PC\_ACT.T.EA19" ~ "Youth (15–24), Eurostat",  
 TRUE ~ series\_code  
 ))

p3 <- ggplot(unemp2\_clean, aes(x = period, y = value, color = label)) +  
 geom\_line(linewidth = 1) +  
 labs(  
 title = "Unemployment Rates from Multiple Sources (EA19)",  
 subtitle = "AMECO and Eurostat — Different definitions",  
 x = "Year", y = "Percent",  
 caption = paste("Series IDs:", paste(unique(unemp2\_clean$series\_code), collapse = " | "))  
 ) +  
 theme\_minimal()  
p3



## Fetch large amounts of data

* Sometimes you need to fetch many if not all dimensions of the data
* You can wildcard dimension and post-filter
* Example: MFI Interest Rate Statistics from the ECB
  + Start with a [single series](https://db.nomics.world/ECB/MIR/M.EE.B.A2C.A.R.A.2250.EUR.N) (Estonia, mortgage rates)

mir\_mortgage\_ee <- rdb("ECB", "MIR", "M.EE.B.A2C.A.R.A.2250.EUR.N")  
unique(mir\_mortgage\_ee$series\_name)

[1] "Monthly – Estonia – Deposit-taking corporations except the central bank (S.122) – Lending for house purchase excluding revolving loans and overdrafts, convenience and extended credit card debt – Total – Annualised agreed rate (AAR) / Narrowly defined effective rate (NDER) – Total – Households and non-profit institutions serving households (S.14 and S.15) – Euro – New business"

### Wildcarding dimensions

* To fetch **multiple values** for a dimension (e.g. countries), just **remove** the value from that position
  + Example: remove "EE" to fetch all countries (REF\_AREA)

⚠️ This can take a while

# mir\_mortgage\_ee <- rdb("ECB", "MIR", "M.EE.B.A2C.A.R.A.2250.EUR.N")  
mir <- rdb("ECB", "MIR", "M..B..A.R.A..EUR.N")  
unique(mir$REF\_AREA)

[1] "AT" "BE" "CY" "DE" "EE" "ES" "FI" "FR" "GR" "HR" "IE" "IT" "LT" "LU" "LV"  
[16] "MT" "NL" "PT" "SI" "SK" "U2"

unique(mir$BS\_ITEM)

[1] "A2A" "A2AC" "A2B" "A2BC" "A2C" "A2CC" "A2D" "A2Z" "A2Z1" "A2Z3"  
[11] "L21" "L22" "L23" "L24"

unique(mir$`BS counterpart sector`)

[1] "Non-Financial corporations (S.11)"   
[2] "Households and non-profit institutions serving households (S.14 and S.15)"   
[3] "Households of which sole proprietors and unincorporated partnerships (SP/UP)"  
[4] "Non-Financial corporations and Households (S.11 and S.14 and S.15)"

### Filter and plot

* Filter Estonia, Latvia and Lithuania
* Keep only selected **BS items** (loan categories)

# Filter by BS\_ITEM and countries  
mir\_filtered <- mir %>%  
 filter(  
 REF\_AREA %in% c("EE", "LV", "LT"),  
 BS\_ITEM %in% c("A2I", "A2C", "A2B", "A2J", "A2A")  
 )

### Plot interest rates by country & type

country\_list <- paste(sort(unique(mir\_filtered$REF\_AREA)), collapse = ", ")  
item\_list <- paste(unique(mir\_filtered$BS\_ITEM), collapse = ", ")  
  
caption\_text <- paste(  
 "Source: ECB / DBnomics — Dataset code: MIR",  
 paste0("\nFiltered: REF\_AREA in ", country\_list, "; BS\_ITEM in ", item\_list)  
)  
  
mir\_filtered <- mir\_filtered %>%  
 mutate(facet\_label = paste0(`BS counterpart sector`, ".\n\n", `Balance sheet item`))  
  
p4 <- ggplot(mir\_filtered, aes(x = period, y = value, color = REF\_AREA)) +  
 geom\_line(linewidth = 0.8) +  
 facet\_wrap(~ facet\_label, labeller = label\_wrap\_gen(width = 30), ncol = 3) +  
 labs(  
 title = "Interest Rates for Households and Firms",  
 subtitle = "Faceted by Loan Type and Borrower Sector",  
 x = "Date", y = "Percent",  
 caption = caption\_text  
 ) +  
 theme\_minimal() +  
 theme(legend.position = "bottom")  
p4

