Information Classification: Internal Use



## SPRING RESEARCH UPDATE 21 March 2023





## **ON TODAY'S CALL**



**LUDOVIC THEBAULT, PHD** HEAD OF RESEARCH, EUROPEAN DATAWAREHOUSE

■ ludovic.thebault@eurodw.eu



**USMAN JAMIL** RESEARCH MANAGER, EUROPEAN DATAWAREHOUSE

usman.jamil@eurodw.eu



## AGENDA

PUBLICATIONS

DATA AVAILABILITY

**PERFORMANCE UPDATE** 

ALL-IN-ONE DATABASE / ADJUSTED DATABASE

AUTO CALCULATED FIELDS

LOAN AND BORROWER IDENTIFIERS

**UPDATE ON THE GAS PROJECT** 

Q & A

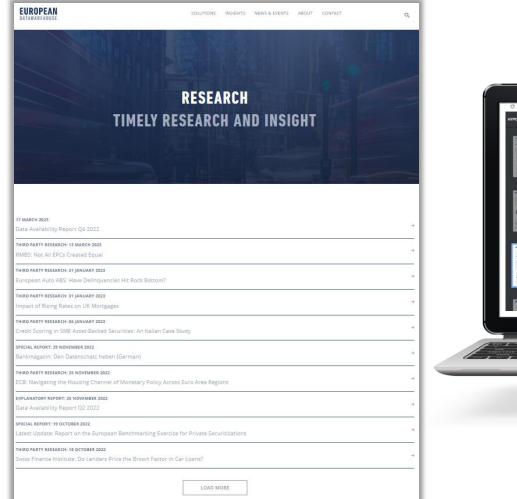


# **PUBLICATIONS** LUDOVIC THEBAULT, EUROPEAN DATAWAREHOUSE



## **RESEARCH SECTION**

#### EDW publications as well as third party research: https://eurodw.eu/knowledge/research/





## **BLOG**

### Concise and insightful articles: https://eurodw.eu/knowledge/magazine/

EUROPEAN	SOLUTIONS INSIGHTS NEWS & EVE	ITS ABOUT CONTACT Q	
TIME	BLOG Ly Research and in:	SIGHT	
			RMBS AMORTISATION RATES SHOW SIGNS OF RETURN TO PRE-COVID LEVELS
LATEST BLOGS			Threaghant the CPUID-19 pendemic, European Batz/Barnhouse has etilised fits varial least-level database to pervise insights link lease performance across series asset classes in Europe. In the TMME associations of exemption, a province ZDVF Q1 2021 analysis shown that designational new during the COVID-19 cmist. Despite this, Nonexes, their bata leave a class impacts on incontinuous parement of merges bases parts to the implementation of papenet biologies, which were added in many cuanties to actual a new of addeds.
ESG   27.62.3023 EBA Seeks Input From Credit Institutions on Green Loans and Mortgages	NFL ( 18.81.3023) Updated GAP Analysis on the EBA NPL Transaction Data Templates	COMMANY BULLETIN   12.12.2022 What it takes to have the 'Best Data Quality' of the Year (and Decade)	Ouarterly Amortisation Patterns of European Mortgages in Focus In this blog we focus on the proportion of laws (by sustainable gament) that amounted in each quarter. This there below represents only these laws that reported consustantly over the Laws the same methodology, we updated the results to QL 2021 as published in the annual Appainter Apport 2027 Use page; 11). How that a methodology is updated the results to QL 2021 as published in the annual Appainter Apport 2027 Use page; 11). How that a methodology is updated the results to QL 2021 as published in the annual Appainter Apport 2027 Use page; 11).
COMPANY BULLETIN   14.10.2522 European Commission Report on the Review of the Securitisation Regulation	COMPARY BULLETIN   26.09.2022 Loan-Level insight beyond the field of securitisation	COMPANY BULLETIN ( 27.97.2022 EDW Conducts GAP Analysis on the proposed EBA NPL Templates	Inst 4 definitioning leaves Casaling Relations for the 's do Casal 1076
DATA IN USE   22.97.3022 Stability implications of the EU securitisation market	COMMANY BULLETIN   28:06.3022 ECG and ESMA Data in Use – A Snapshot of Moratoria in SME Loans	COMPANY BULLETIX   22.06.2022 The new EBA NPL templates and taxonomy: another step towards European NPL transparency and standardisation	
COMPANY BULLETIN   25.85.2822 Everything you need to know about EDW's Data Quality Scoring	COMPANY BULLETIN   12.05.2022 "Reporting for reporting's sake: Bank of America Commentary highlights use case for EDW solutions	ESE   11.04.2022 European DataWarehouse submits suggestions for the revision of the Energy Performance for Buildings Directive	



### **WEBINARS**

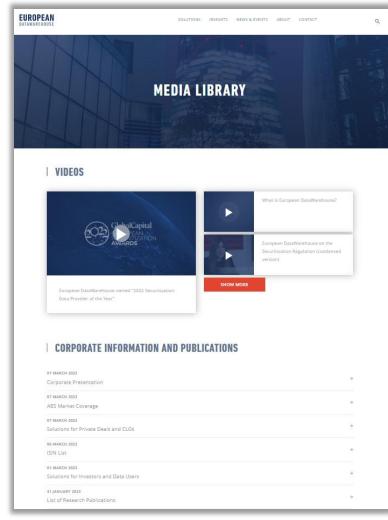
#### Slides and recordings of EDW webinars: https://eurodw.eu/news-events-and-multimedia/events/

EUROPEAN Datamarenouse	SOLUTIONS RESIGNTS NEWS & EVENTS ABOUT CONTACT Q
	EVENTS STAY IN THE LOOP
UPCOMING EVENTS	
21. Mar WYESINAR	Research Update webinar @ 16:00 CET
22.	EDW's 2023 Greek Securitisation Workshop – Athens
25.	EDW's 2023 Irish Securitisation Workshop – Dublin
D9.	EDW's 2023 Spring Italian Workshop – Rome
11. MAY MED	EDW's 2023 Spring Italian Workshop – Milan
LOAD MORE	
ARCHIVED EVENTS	
N4.	



## **LIST OF PUBLICATIONS**

#### Our own publications, plus third party research Media Library - European DataWarehouse (eurodw.eu)



YEAR	MONTH			PUBLICATION TYP -	KEYWORDS	- ACCESSIBILIT -	EDW/THIRD PART
2022	July	European Systemic Risk Board (ESRE): Monitoring Systemic Ris	ESRB	Central bank publicati	c Systemic risk, securitisation	Direct	Central bank
2022	June	Spring 2022 Research Webiner	EDW (Guest speaker from Universit		Loan performance, data availability, energy performance, adjust	te Direct	EDW
2022	June	Deutsche Bundesbenk discussion peper on the replenishment	Deutsche Bundesbank	Central bank publicati	c ABS SME, nevolving transactions	Direct	Central bank
2022	May	Moody's Investors Service: ESMA rules will raise data quality, b	Moody's	Data comment	ESMA reporting standards	Restricted	Rating agency
2022	April	Introducing the EDW adjusted Database	EDW	Webinar	Adjusted database	Direct	EDW
2022	February	New Year 2022 Research Webinar	EDW	Webinar	Loan performance, energy performance, adjusted database, CO	W Direct	EDW
2022	February	AFME Report ESG securitisation issuance increases 273% from		Data comment	ESG, sustainable finance, data availability	Direct	Others
2021	December	Winter 2021 Research Webinar	EDW (Guest speaker from Europea	n Webinar	Loan defaults, machine learning, RMBS prepayments, forecastin	ng Direct	EDW
2021	November	Hypostet 2021 - From the EMF-ECBC (European Montgage Fed		COVID Impact	COVID impact, moratoria, mortgages	Direct	Others
2021	October	Journal of Financial Econometrics: Forecasting Loan Default in	Journal of Financial Econometrics	Academic publication	mortage defaults, machine learning	Direct	Academic Publicatio
2021	September	Summer 2021 Research Webinar	EDW	Webinar	COVID, moratoria, credit risk and COVID	Direct	EDW
2022	May	Spring 2021 Research Webinar	EDW	Webinar	Data availability, COVID, Energy efficiency, payment holidays,	Direct	EDW
2021	May	Journal of Real Estate Finance & Economics: Buildings' Energy I	The Journal of Real Estate Finance a	Academic publication	mortgage defaults, energy efficiency	Direct	Academic Publicatio
2021	May	Data Availability Report 04 2020	EDW	Data comment	Deta availability	Direct	EDW
2021	March	Monitoring the Impact of COVID-19: 01 2021 RMBS Report	EDW	COVID Impact	COVID impact, moratoria, mortgages	Direct	EDW
2021	February	New Year 2021 Research Weblinar	EDW (Gest speaker from European	cWebinar	COVID, RMBS performance, Loan amortisation, Cover your asse	ts Direct	EDW
2021	February	Monitoring the Impact of COVID-19: 01 2021 RMBS Tracker	EDW	COVID Impact	COVID impact, moratoria, mortgages	Direct	EDW
2020	December	COVID-19 Webinar	EDW	Webinar	COVID, loan performance, payment holiday, reporting practices	Direct	EDW
2020	December	COVID-19: Who Has Benefited Most from COVID-ERA Auto Loa	EDW	COVID Impact	COVID Impact, auto loans, mortgages	Direct	EDW
2020	December	COVID-19: Survey of Payment Holiday Reporting Practices in El	EDW	COVID Impact	COVID impact, moratoria	Direct	EDW
2020	November	Moody's Analytics: COVID-19: 360" View of the Dutch Mongage	Moody's	COVID Impact	COVID Impact, Netherlands mortgages	Restricted	Rating agency
2020	November	Moody's Analytics: Continued Stress of the U.K. Mortgage Mari	Moody's	Credit research	COVID impact, mortgages	Restricted	Rating agency
2020	November	Monitoring the Impact of COVID-19: Q4 2020 AUTO Tracker	EDW	COVID Impact	COVID Impact, moratoria, auto loans	Direct	EDW
2020	September	Credit Performance Review	EDW	COVID IMPACT	COVID impact, implied payment holidays	Direct	EDW
2020	August	Monitoring the Impact of COVID-19: 03 2020 RMBS Tracker	EDW	COVID Impact	COVID Impact, moratoria, mortgages	Direct	EDW
2020	kely.	Maron Hibbeln and Werner Osterkamp: The Impact of Skin in s	Academic Publication	Academic publication	security design, asset-backed securities, retention, moral hazar	d, Direct	Academic Publication
2020	June	Thomas Panagan, Stealth Recapitalization and Bank Risk Takin	Academic Publication	Academic publication	TLTRO, Unconventional Monetary Policy, Credit Risk, Bank Capit	al Direct	Academic Publicatio
2020	lune	Monitoring the impact of Covid-19: 02 2020 report	EDW	COVID Impact	First time delinquencies, auto, consumer, leases, RMBS	Direct	EDW
2020	February	Data Timing and Timelines	EDW	Data comment	Reporting lag, data timeliness	Direct	EDW
2019	December	Gap analysis version 3.0 and 3.1	EDW	Data comment	ESMA data vs ECB data	Direct	EDW
2019	November	RPH Index Insight from European Datawarehouse	EDW	Data comment	IRPH Index Spain	Direct	EDW
2019	November	Italian SME Index	EDW	SME performance	kaly, SME, performance	Direct	EDW
2019	October	ECB: The Impact of Lending Standards on Default Rates of Res	ECB	Central bank publicati	c loan defaults, lending standards, residential real estate, loan-lei	ré Direct	Central bank
2019 2019	November November	IRPH Index Insight from European Datawarehouse Italian SVE Index	EDW EDW	Data comment SME performance	IRPH Index Spain kaly, SME, performance	Direct Direct	EDW EDW



# DATA AVAILABILITY REPORT (Q4 2022 UPDATE)

**LUDOVIC THEBAULT, EUROPEAN DATAWAREHOUSE** 

9



## LATEST DATA AVAILABILITY REPORT NOW ONLINE

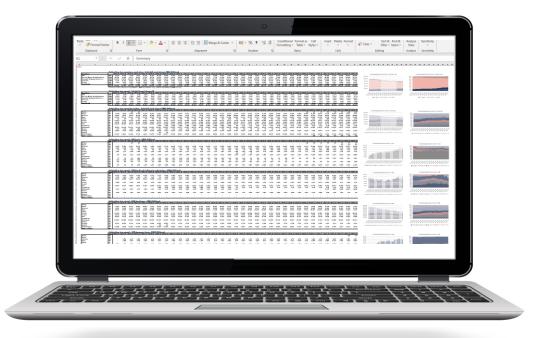
A list of available deals and key metrics: Data Availability Report Q4 2022 - European DataWarehouse (eurodw.eu)



The values for these loan amounts are adjusted for errors (dummy values, decimal points inconsistencies) observed in the oldest uploads. Currencies have been converted when loan amounts were reported in a currency other than the Euro.

Thanks to our comprehensive coverage of the entire European public securitisation market, EDW's data reflects the peculiarities of the various securitisation markets, jurisdictions, and data providers.

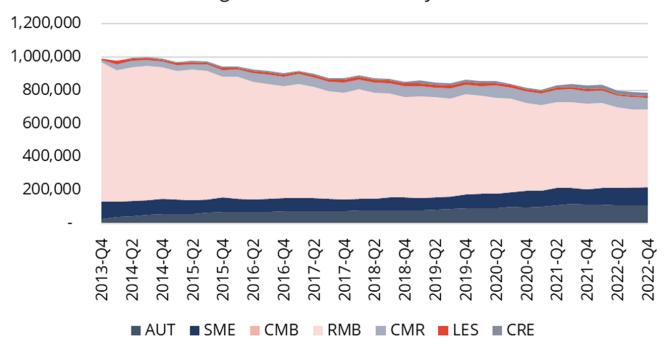
Please note that securitization does not matter equally in all countries and to all lenders. While mortgage securitizations are found in most countries, not all countries are equally represented. This is also the case with other asset classes. For instance, Germany accounts for 51% of all auto loan amounts, and Italy represents a substantial share of European consumer loans (50%) and lease (57%).





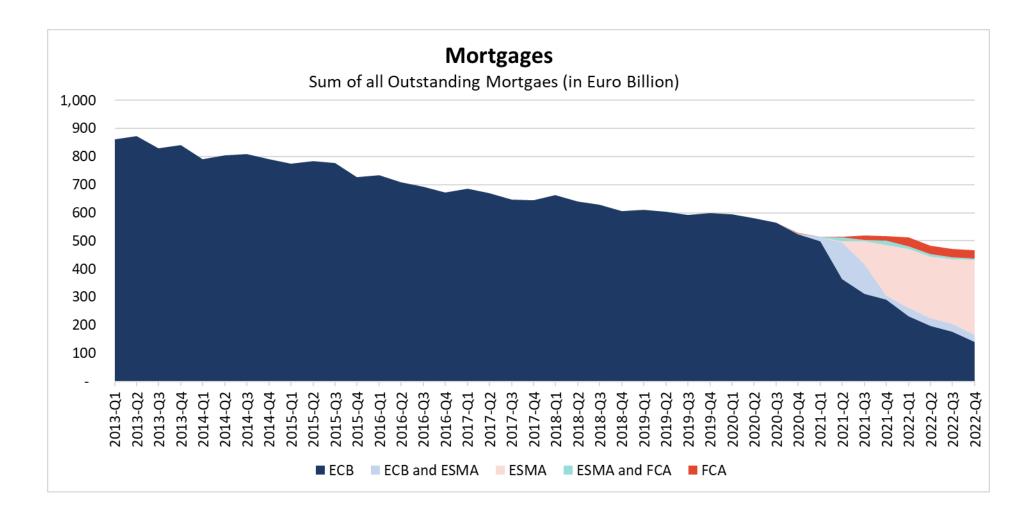
## ESMA VS ECB DATA AVAILABILITY (Q4 2022)

- Not all asset classes are equally representative or diversified
- Securitised loans are not necessarily representative
- Outstanding amount at 785 billion as of Q4 2022
  - Decease mostly due to reduction in the RMBS asset class
  - SME and Auto asset classes close to highest levels
  - Recent decrease in Leasing asset class

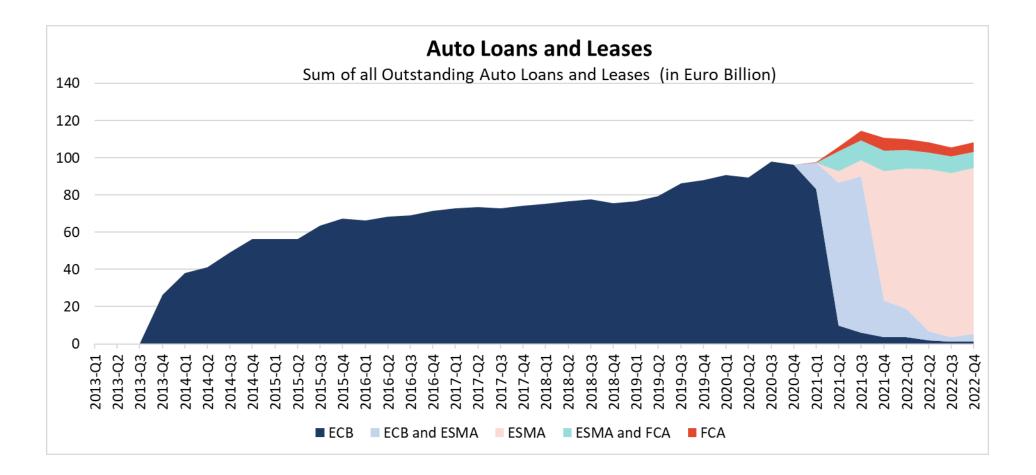


Outstanding EUR Loan Amount - by Asset Class

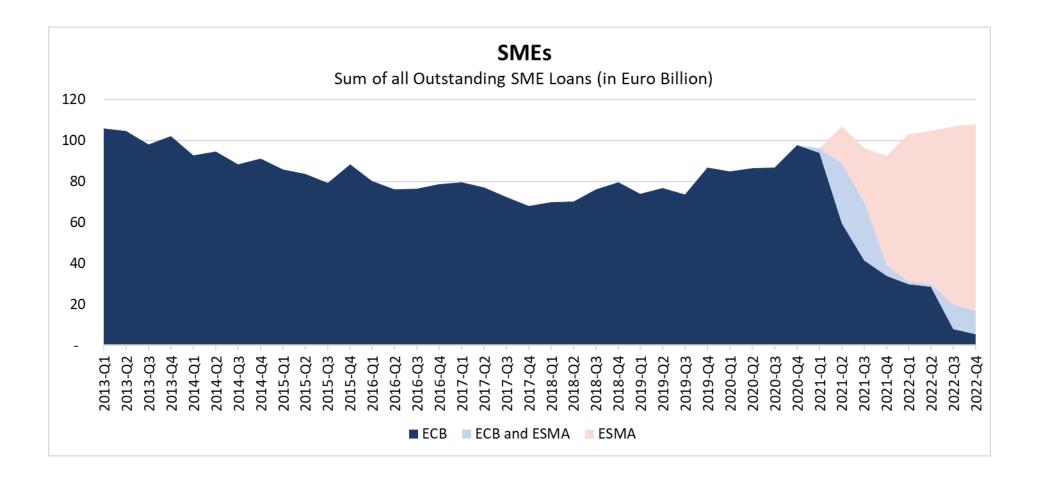
## ECB VS ESMA VS FCA DATA AVAILABILITY (1)



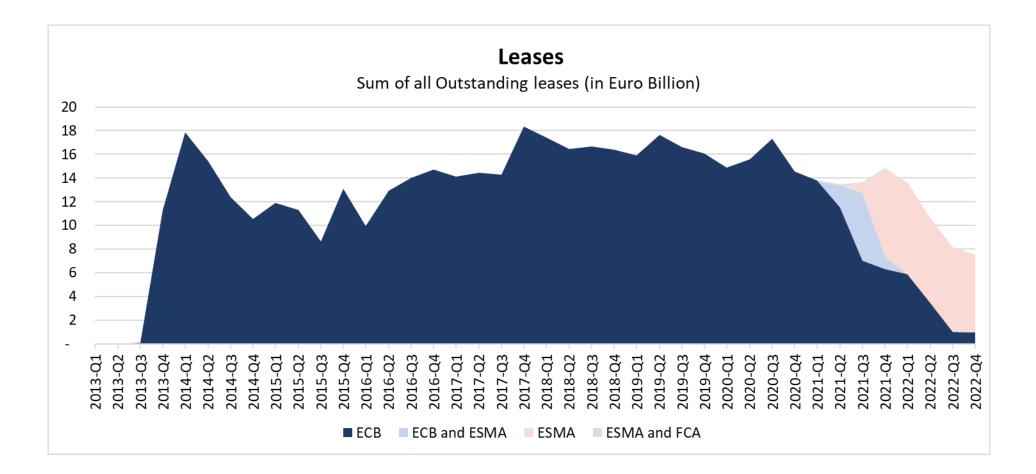
## ECB VS ESMA VS FCA DATA AVAILABILITY (2)



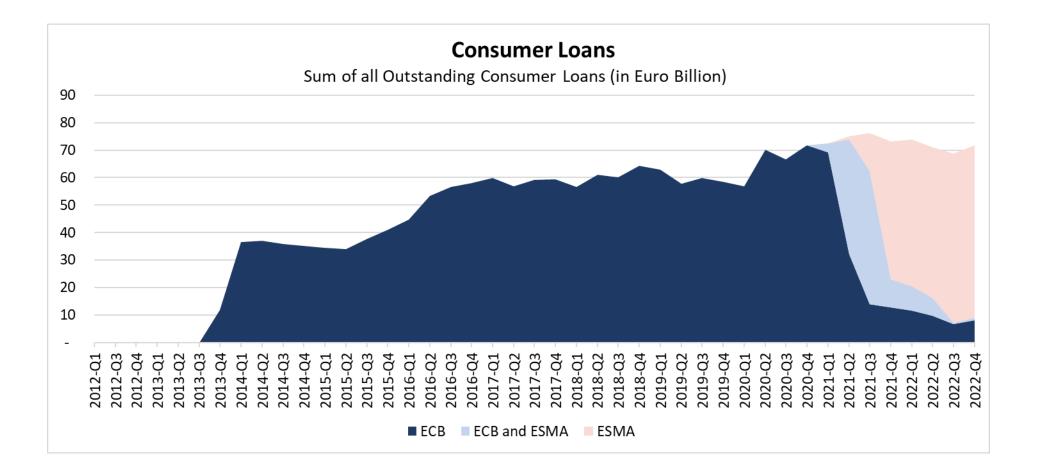
## ECB VS ESMA VS FCA DATA AVAILABILITY (3)



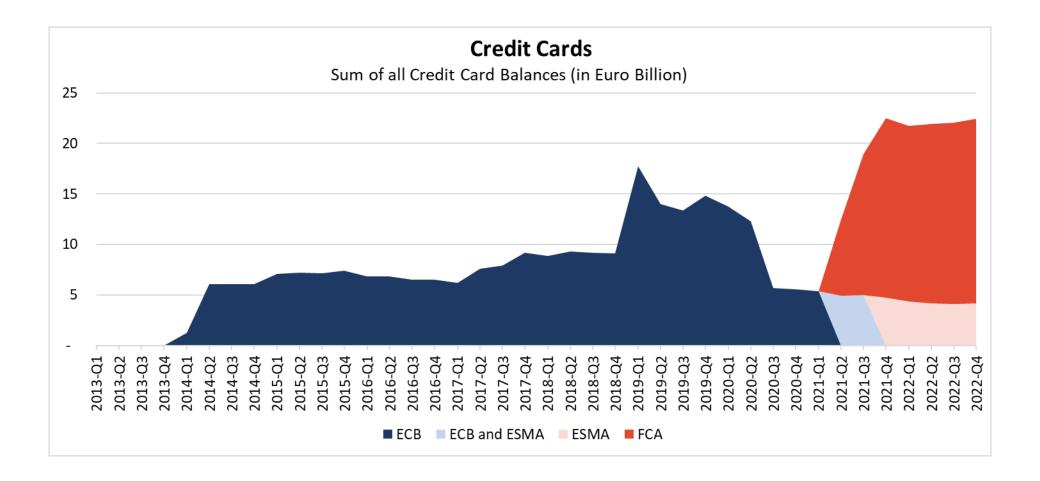
## ECB VS ESMA VS FCA DATA AVAILABILITY (4)



## ECB VS ESMA VS FCA DATA AVAILABILITY (5)



## ECB VS ESMA VS FCA DATA AVAILABILITY (6)



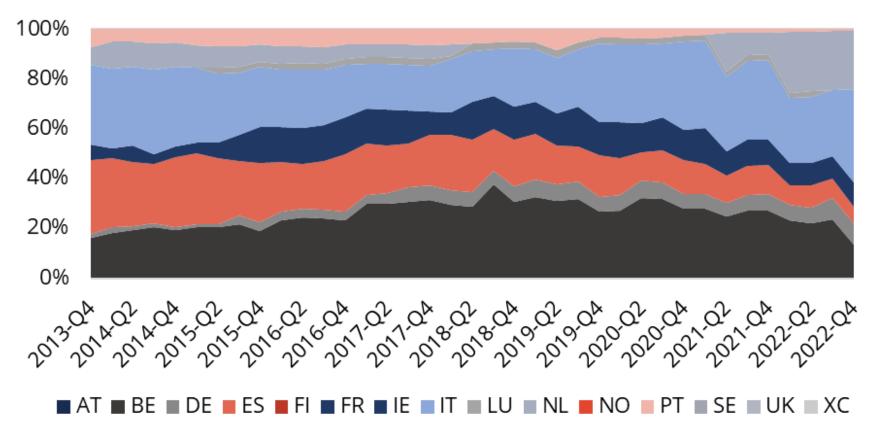


# LOAN PERFORMANCE UPDATE LUDOVIC THEBAULT, EUROPEAN DATAWAREHOUSE



## ABS SME DATA AVAILABILITY (Q4 2022)

### **Outstanding EUR Loan Amount - SME**

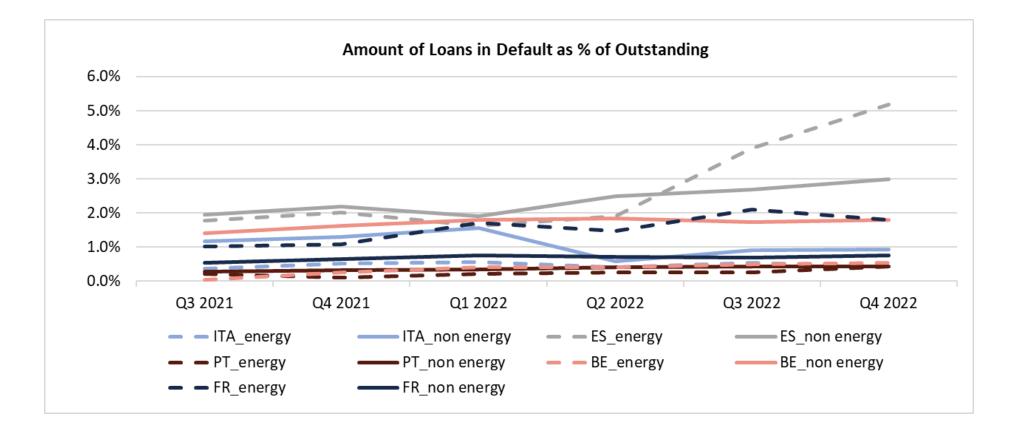




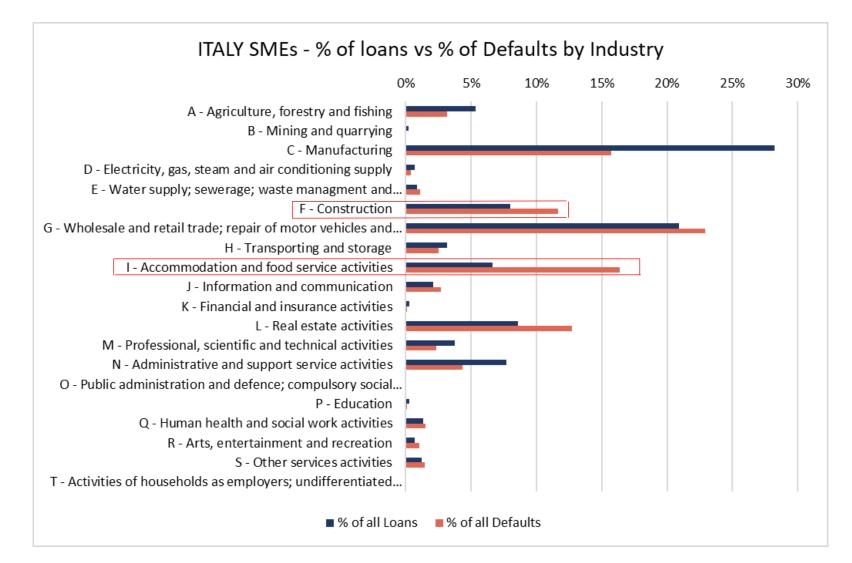
## **SME SNAPSHOT: EXPOSURE TO ENERGY-INTENSIVE INDUSTRIES**

	All SME	oans	Of which Loans to Energy Intensive SMEs			
Country	<b>EUR Billions</b>	nr. Of Loans	% of CBAL	% Nr. of Loans		
Italy	38.15	517,263	25.8%	11.1%		
Germany	8.29	51,200	22.8%	13.3%		
Portugal	0.8	201,109	17.6%	13.8%		
Spain	5.3	42,768	14.5%	6.3%		
France	8.4	10,962	9.2%	5.9%		
Netherlands	25.4	123,133	7.5%	6.2%		
Belgium	22.6	7,536	5.2%	4.3%		

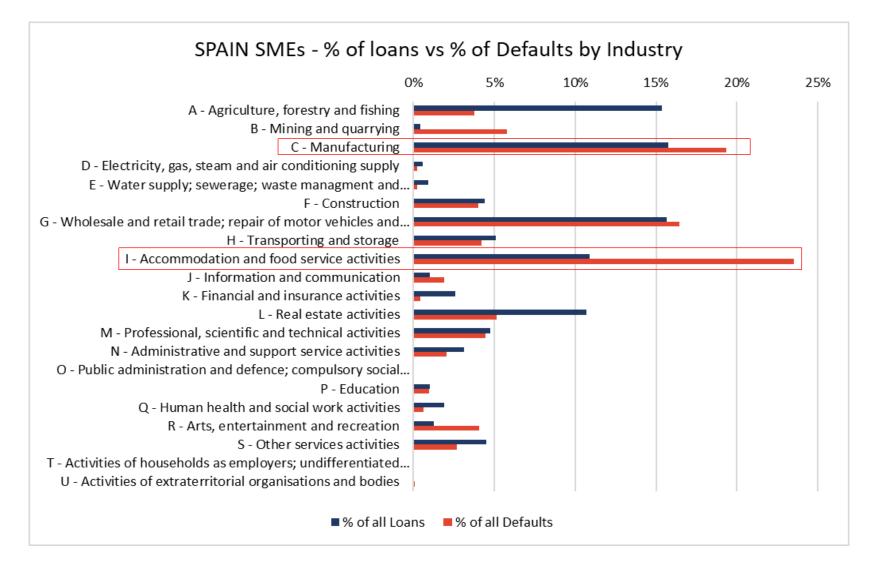
## SME SNAPSHOT: DEFAULT LOAN AMOUNT AS % OF OUTSTANDING



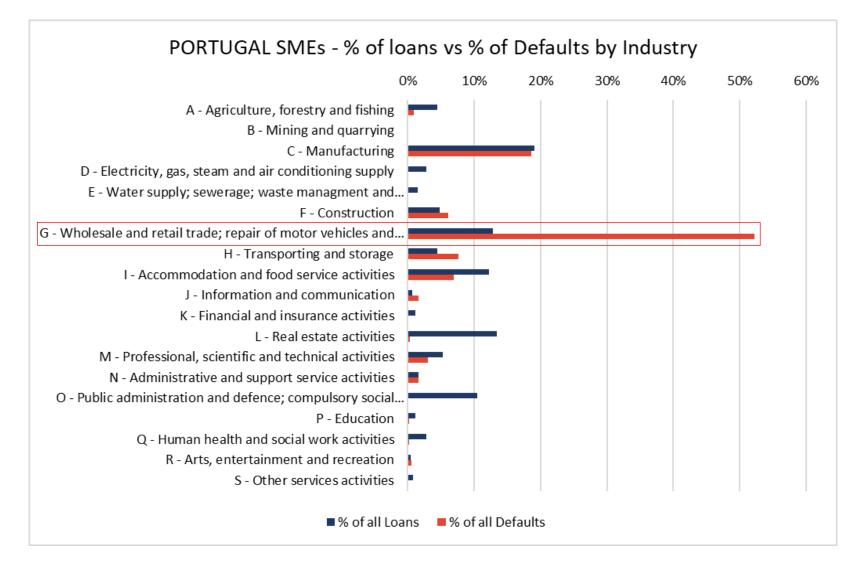




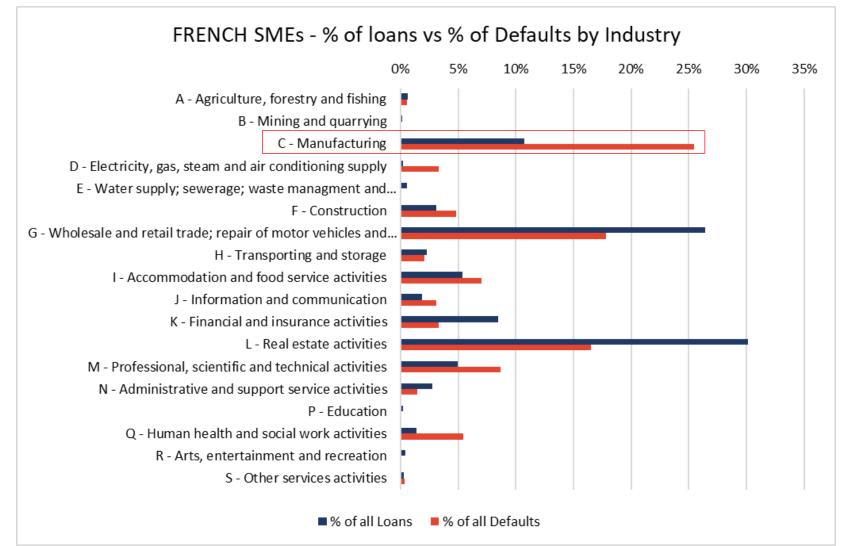




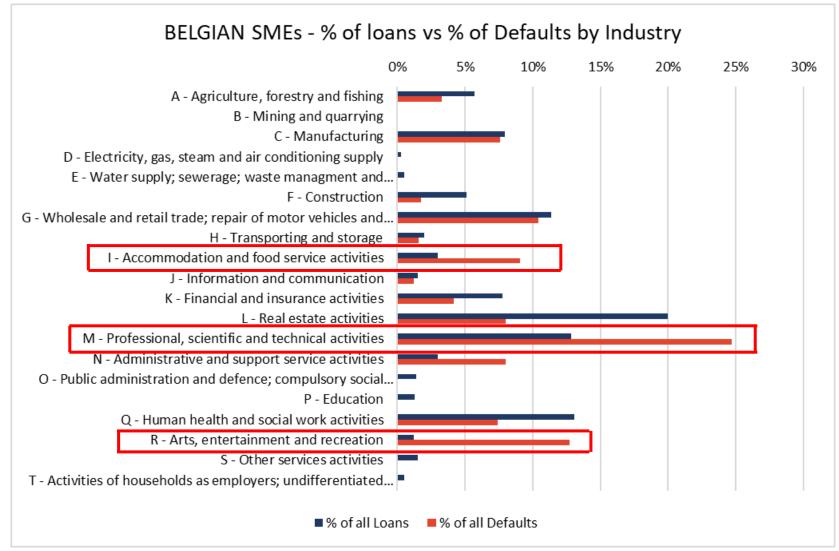




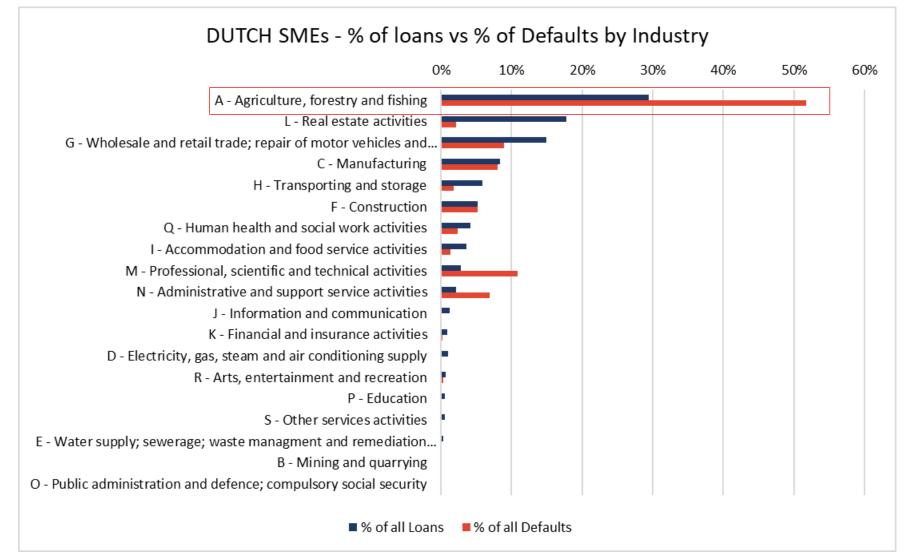










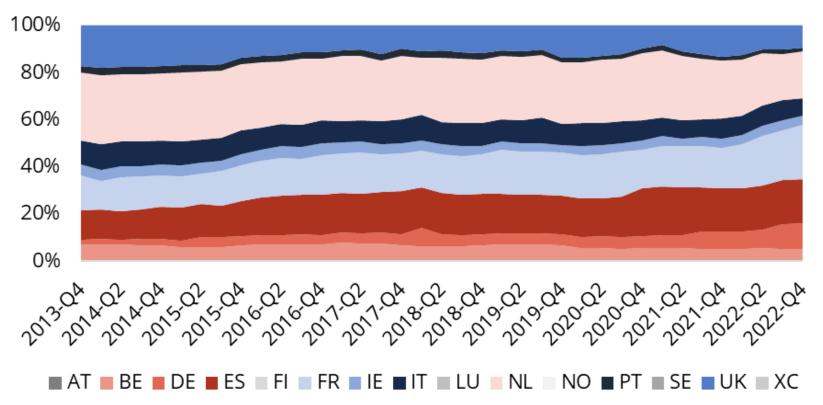




## ESMA VS ECB DATA AVAILABILITY (Q4 2022)

RMBS segment is one of the most representative and diversified

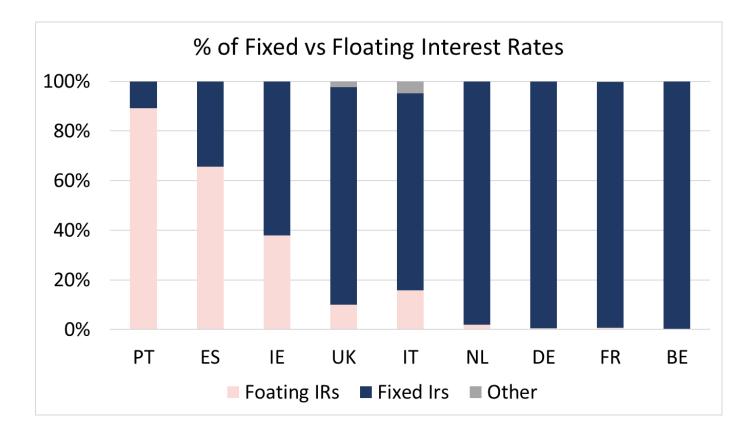
### Outstanding EUR Loan Amount - RMB





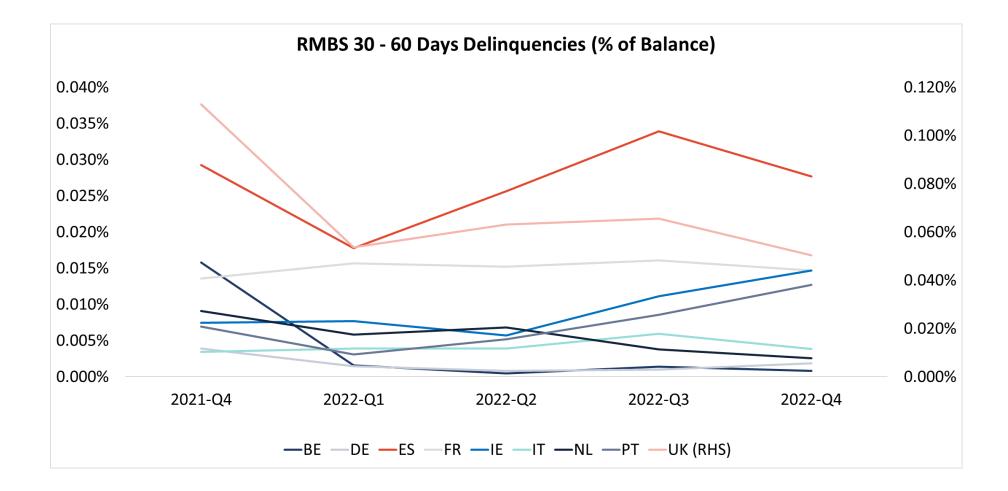
## ESMA VS ECB DATA AVAILABILITY (Q4 2022)

We would expect delinquencies to increase particularly in countries with floating interest rates





## **RMBS SNAPSHOT: EARLY DELINQUENCIES AS % OF OUTSTANDING**

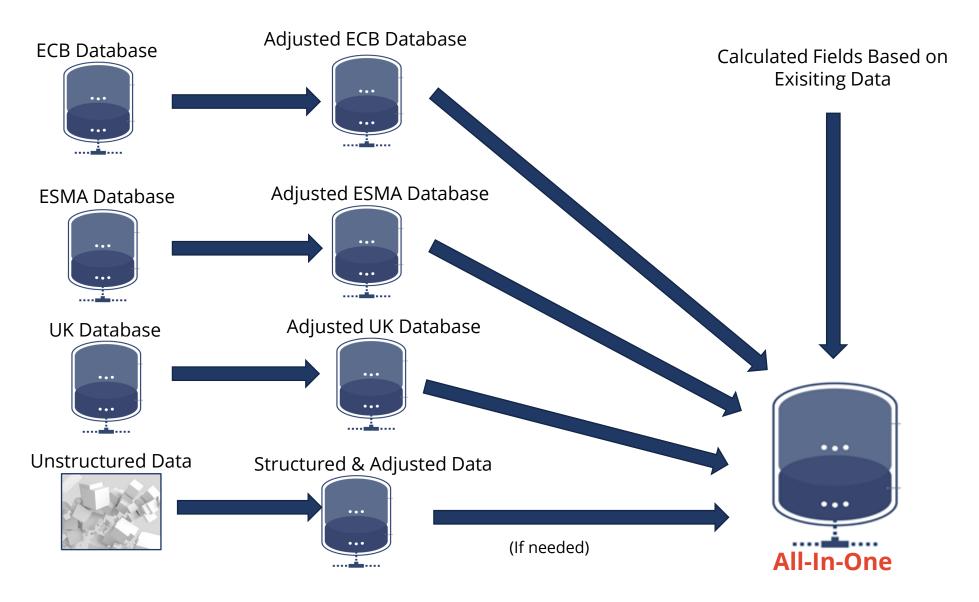




# ALL-IN-ONE DATABASE (PROJECT) LUDOVIC THEBAULT, EUROPEAN DATAWAREHOUSE



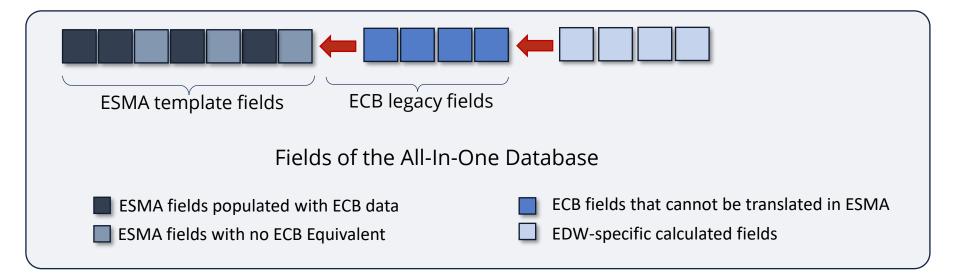
## **5 INGREDIENTS OF THE ALL-IN-ONE DATABASE**



## FIELDS OF THE ALL-IN-ONE DATABASE (WORK IN PROGRESS)

- The all in one database would include
  - a) All the ESMA fields
  - b) The ECB fields with no ESMA field equivalent
  - c) Some calculated fields

### Fields of the All-In-One Database (same logic for all asset classes)

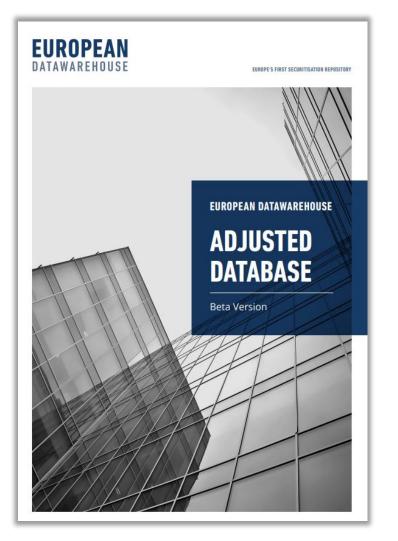




# ADJUSTED DATABASE (ECB DATA ONLY) LUDOVIC THEBAULT, EUROPEAN DATAWAREHOUSE

## **ADJUSTED DATABASE REPORT**

Available online: https://eurodw.eu/research\_articles/edw-adjusted-database-beta-report/



	î	FROM [re	s].[aut loan add	DRAFT 202202 ED	0_3. manufacturer, model engine_size] 9 O 'NNEL' AND MODEL O 'NN	ILL' AND GEO	1 0 100111	
AA41 (nvarchar(12), NULL) AA42 (numeric(14,8), NULL)								
A443 (numeric(14,2), NULL) A444 (nvmchar(100), NULL)								
E AA45 (nvarchar(100, NULL)			gill Meldungen					
AA46 (nvarchar(100, NULL)		GTR_ED		GEO_2	GEO_3	manufacturer	nodel	
AA47 (nvarchar(12), NULL)		2014-Q3	Sacheen-Anhalt	Sachsen-Anhalt	Stendal	CITROEN	C5	
E AA48 (marchar(12), NULL)	2	2015-02	Nordhein-Westfalen	Kain	Rheinisch-Bergischer Kreis	CITROEN	BERLINGO	
AA49 (nvarchar(15), NULL)	3	2014-03	Sachsen-Anhalt	Sacheen-Anhait	Burgenlandkreis	CITROEN	3	
AA50 (numeric(14,2), NULL)		2014-03	Thuringen	Thuringen	Gera, Kreisfreie Stadt	CITROEN	C4	
AA51 (numeric(14,2), NULL)	5	2014-03	Sachsen-Anhalt	Sachsen-Anhalt Oberbavern	Stendal	CITROEN	C)	
AA52 (numeric(14,2), NULL)		2015-Q2 2014-Q3	Bayem	Edg-Regio NUTS 2	Atoting Edge-Regio NUTS 3	CITROEN	G (1	
AAS3 (nvarchar(12), NULL)	/	2014-03	Extra-Regio NUTS 1 Nordhein-Westleien	Deta-Hego NUTS 2 Dumeldor	Extra-Regio NUTS 3 Rhein-Keis Neum	CITROEN	64	
AA54 (nvanchar(12), NULL)	°.	2014-03	Nordhein-Westfalen	Munster	Boken	CITROEN	0	
AA35 (miechae(12), NULL)	10		Rheinland-Pfalz	Rheinhessen-Pfalz	Mainz-Bingen	CITROEN	C1	
AA56 (nvarchar(12), NULL)	11		Nedersachsen	Luneburg	Stade	CITROEN	8	
AA57 (revencher(12), NULL) AA58 (revencher(12), NULL)	12		Nordhein-Westfalen		Euskitchen	CITROEN	3	
AAS9 (marchar(12), NULL)	13		Bayern	Schaaben	Augsburg, Landows	CITROEN	BERLINGO	
E A460 (numeric(14,8), NULL)			Rheinland Platz	Rheinhessen-Pfalz	Mainz-Brigen	CITROEN	0	
Add1 (numeric(14,8), NULL)	15		Nedersachsen	Braunechweig	Braunschweig, Kreistreie Stadt	CITROEN	C1	
E A465 (numeric(11,2), NULL)	16		Nederaschaen	Hannover	Region Hannover	CITROEN	C5	
AA66 (numeric(8.2), NULL)	17		Reven	Obebayem	Landsberg an Lech	CITROEN	C1	
E AA67 (nvercher(12), NULL)	18		Sachaen	Deaders	Dweden, Kreisfreie Stadt	CITROEN	XSARA	
A468 (numeric(14,2), NULL)	19		Bronn	Mitefranken	Erlangen, Kreistreie Stadt	CITROEN	C4	
AA69 (numeric(14,2), NULL)	20		Nordhein-Westfalen	Dussektor	Mulheim an der Ruhr. Kreisfreie Stadt	CITROEN	62	
E AA70 (numeric(14,2), NULL)	21		Nordhein-Westfalen	Amphena	Speat	CITROEN	9	
AA71 (numeric(14,2), NULL)	22		Baden-Wuttenberg		Hohenishekowa	CITROEN	C3	
AA72 (nvarchar(12), NULL)	23		Sachsen-Anhalt	Sachsen-Anhalt	Burgenlandkreis	CITROEN	C4	
AA73 (numeric(14,2), NULL)	24		Thuringen	Thuringen	Efurt, Neisfreie Stadt	CITROEN	8	
AA74 (nvarchar(12), NULL)	25		Nedersachsen	Luneburg	Sade	CITROEN	C4	
GE0_1 (nvarchar(80), NULL)	25		Nordhein-Westfalen	Dusseldorf	Rhein-Kreis Neuss	CITROEN	C4	
								,
					STREET, STREET		A see from from from the	State of Lot of
and the time to be	$\cdot \cdot \cdot \cdot \cdot \cdot$	· 1	·· • •	1	- <b>I</b>	1 1 1	1 · 1 · 1	- 7 - 1
source for the former of the f	1111					× .		-
··· I ··· I					<u>1</u> <u>1</u> .	- 1	* I ~ I ~ .	I want I wanted

## LIST OF CALCULATED FIELDS AS OF MARCH 2023 IN ECB ADJUSTED DATABASE

	Auto	Consumer	Credit Cards	Leasings	RMBS	SME
DATA_ORIGIN	yes	yes	yes	yes	yes	yes
EDCODE	yes	yes	yes	yes	yes	yes
PCD	yes	yes	yes	yes	yes	yes
GEO_1	yes	yes	yes	yes	yes	yes
GEO_2	yes	yes	yes	yes	yes	yes
GEO_3	yes	yes	yes	yes	yes	yes
QTR_ED	yes	yes	yes	yes	yes	yes
COUNTRY_ED	yes	yes	yes	yes	yes	yes
Manufacturer	yes	No	No	No	No	No
Model	yes	No	No	No	No	No
Fuel_Type	yes	No	No	No	No	No
Year_Model	yes	No	No	No	No	No
Engine_size	yes	No	No	No	No	No



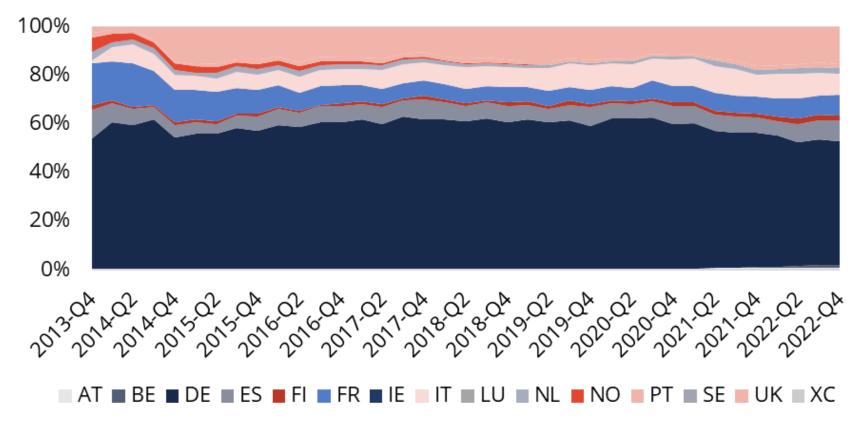
# AUTO MANUFACTURERS/ENGINE SIZE LUDOVIC THEBAULT, EUROPEAN DATAWAREHOUSE



### AUTO ABS DATA AVAILABILITY (Q4 2022)

50% of the Auto asset class is concentrated in Germany

#### Outstanding EUR Loan Amount - Auto

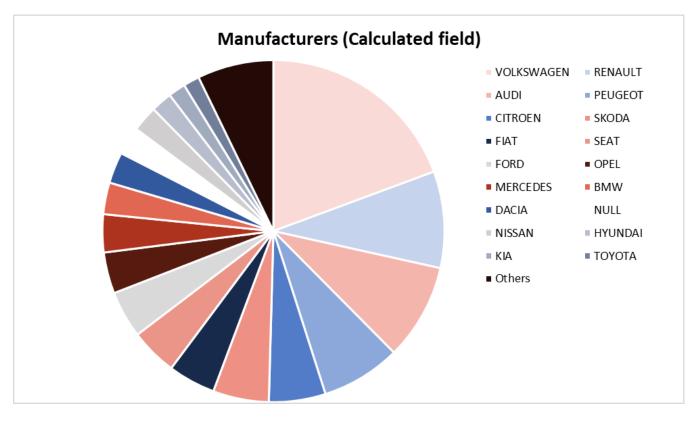




#### MANUFACTURER

#### Calculating "Manufacturer" from AA44 (manufacturer) and AA45 (car model)

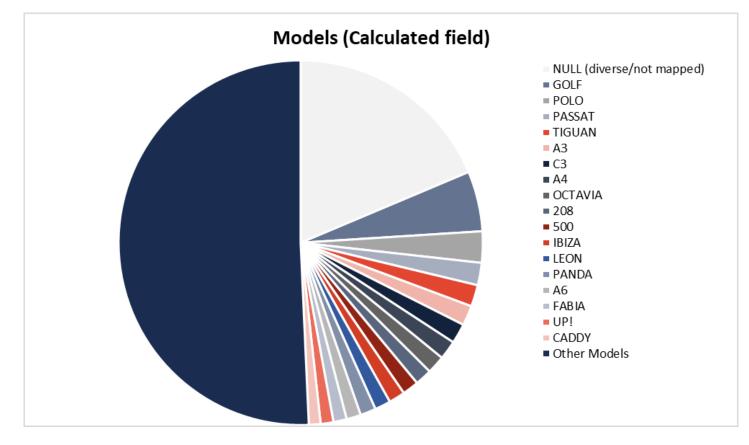
- "Select distinct" on field AA44 = > 110,000 results
- 97% of all observations have a calculated Manufacturer (else NULL)
- We mapped 149 brands from Abarth (sports brand of Fiat) to Zündapp (motorcycles/e-bikes)



### MODEL

#### Calculating "Model" from AA44 (manufacturer) and AA45 (car model)

- A clean model name is available for more than 80% of all auto loans
- We have mapped 455 models so far

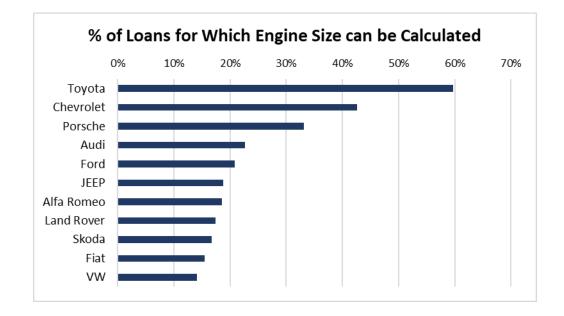




## **ENGINE SIZE**

#### Calculating "Engine Size" from ECB fields AA46 (engine size) and AA45 (car model)

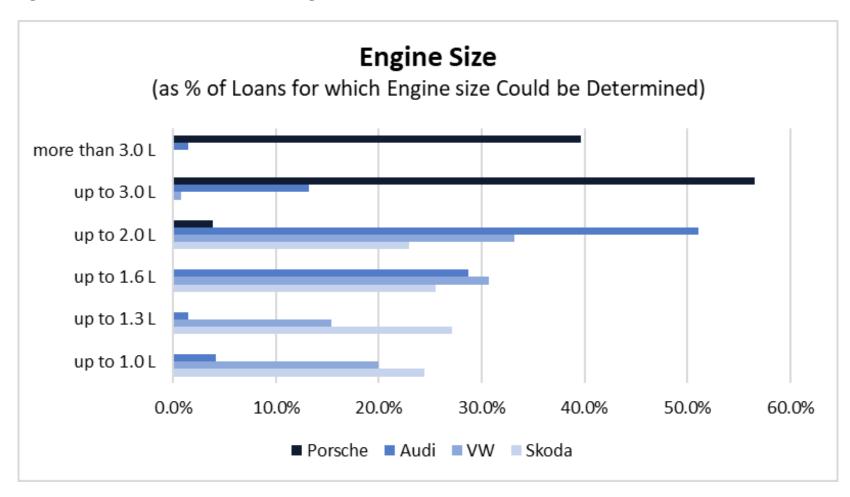
- AA46 Engine size is an optional field, which is not consistently populated
  - Usually not populated, and when populated, not populated consistently with a directly usable content
  - Typical entries for a 2 liter engines include: 1984000; 1984; 2; 1.984; 2,0 L; 2.0 or a model name including engine size (e.g GOLF 2.0 TSI)
- AA45 (car model) can also contain engine related clues as part of the name of the vehicle
  - AYGO Cool 1,0 5-Türer 5-Gang; MITO TURISMO 1.4 16V; SPORT 4.4 SDV8
- In some cases (Mercedes, BMW, Lexus, Volvo...), exact model + car vintage can be combined to map engine size; for some other brands, a HP output is provided instead





#### **ENGINE SIZE (2)** Example for Volkswagen AG

• Engine size as % of cases where engine size could be calculated





# LOAN IDENTIFIERS LUDOVIC THEBAULT, EUROPEAN DATAWAREHOUSE



### **LOAN IDENTIFIERS MATTER**

- Loan/borrower/property identifiers make it possible to track loans overtime for a given deal (EDCODE)
  - Stable loan and borrower IDs are essential to calculate cumulative defaults/recoveries/prepayments
  - Loan/borrower ID changes can distort the result
  - And yet, loans can be dropped from submissions once they become inactive
- Flagging loan ID changes is a necessary first step...
  - What % of loans have modified IDs and when? What loans have ID changes? Do such changes affect only delinquent/restructured loans?
  - Is there a way to repair the time series? Is there a logic to the ID changes? Can a substitute ID can be used?



# LOAN AND BORROWER ID REPORTING REQUIREMENTS

**ECB templates** make a loan ID change is possible if...

AR3 definition: "Unique identifier (ID) for each loan. The loan ID should If the original loan ID cannot be maintained in this field enter the original ID followed by the new ID, comma delimited not change through the life of the transaction. (e.g. further advances / second liens are shown as separate entries). Refer to Taxonomy for multiple loan definitions."

#### **ESMA templates** explicitly require static IDs for loans and borrowers

• Thus the definition for RREL 2 (Loan ID, RMBS 'Original Underlying Exposure Identifier')

'Unique underlying exposure identifier. The identifier must be different from any external identification number, to ensure anonymity of the obligor. The reporting entity must not amend this unique identifier.'

	Α	UT	C	ИR	С	RE	L	ES	R	MB	S	ME
	Loan	Borrower										
Static	AUTL2	AUTL4	CMRL2	CMRL4	CCDL2	CCDL4	LESL2	LESL4	RREL2	RREL4	CRPL2	CRPL4
Non Static	AUTL3	AUTL5	CMRL3	CMRL5	CCDL3	CCDL5	LESL3	LESL5	RREL3	RREL5	CRPL3	CRPL5



# FLAGGING LOAN / BORROWER ID CHANGES

#### A measure of loan ID stability

- Check if all the loan IDs reported at T+1 were already reported at T 0.
  - If yes, the score is 100%, meaning: 100% of the loans at T + 1 already had a reported loan ID at T 0.
  - If the score is 0%, it means that none of the loan IDs reported at T + 1 were already reported at T 0.
  - 99% means that 99% of the loans reported at T + 1 had a loan ID reported at T 0...
  - A 0% score is possible if all the loan IDs were changed even while respecting the ECB taxonomy
  - A 99 % score looks "almost perfect", but what if the 1% of loan ID s that changed were the loans in arrears?
  - For a replenishing/revolving deal, the ratio would not be 100% during the revolving period
  - ID change tracking table
    - The ID change tracking table can help to see where the loan IDs are stable...
    - Can be done for all IDs in both ECB and ESMA reporting



# FLAGGING LOAN / BORROWER ID CHANGES (ECB TEMPLATE)

AR3	FirstEntry	AverageFar 2013-Q1	2013-Q2	2013-Q3	2013-Q4	2014-Q1	2014-Q2	2014-Q3	2015-Q1	2015-Q2	2015-Q3
RMBSDE000556100120088	2014-Q1	97.09%				START	96.98%	98.51%	97.88%	96.85%	98.26%
RMBSES000045100120098	2013-Q1	80.00% START	100.00%	100.00%	0.00%	100.00%	100.00%				
RMBSES000045100220096	2013-Q1	95.45% START	100.00%	100.00%	0.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
RMBSES000045100320078	2013-Q1	97.14% START	100.00%	100.00%	0.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
RMBSES000045100420084	2013-Q1	94.34% START	1.82%	100.00%	0.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
RMBSES000045100520057	2013-Q1	96.88% START	100.00%	100.00%	100.00%	0.00%	100.00%	100.00%	100.00%	100.00%	100.00%
RMBSES000045100620063	2013-Q1	97.06% START	100.00%	100.00%	0.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
RMBSES000045100720046	2013-Q1	94.46% START	100.00%	100.00%	5.78%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
RMBSES000045100820085	2013-Q1	90.91% START	0.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
RMBSES000045100920091	2013-Q1	83.33% START	0.00%	100.00%	100.00%	100.00%	100.00%	100.00%	0.00%	100.00%	100.00%
RMBSES000045101020099	2013-Q1	95.24% START	100.00%	100.00%	100.00%	0.00%	100.00%	100.00%	100.00%	100.00%	100.00%
RMBSES000045101120071	2013-Q1	95.24% START	100.00%	100.00%	0.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
RMBSES000045101220079	2013-Q1	84.38% START	100.00%	90.68%	0.00%	100.00%	100.00%	100.00%	100.00%		
RMBSES000045101320077	2013-Q1	97.14% START	100.00%	100.00%	0.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
RMBSES000045101420083	2013-Q1	75.00% START	100.00%	100.00%	0.00%	100.00%					
RMBSES000045101520072	2013-Q1	95.24% START	100.00%	100.00%	0.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
RMBSES000045101620088	2013-Q1	51.70% START	6.80%	100.00%	0.00%	100.00%					
RMBSES000060100120048	2013-Q1	100.00% START	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
RMBSES000060100220061	2013-Q1	100.00% START	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
RMBSES000060100420026	2013-Q1	100.00% START	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
RMBSES000060100520072	2013-Q1	100.00% START	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
RMBSES000060100620088	2013-Q1	100.00% START	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
RMBSES000060100720029	2013-Q1	100.00% START	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	
RMBSES000060100820035	2013-Q1	100.00% START	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
RMBSES000060100920058	2013-Q1	100.00% START	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
RMRSES000060101020098	2013-01	100 00% START	100 00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%



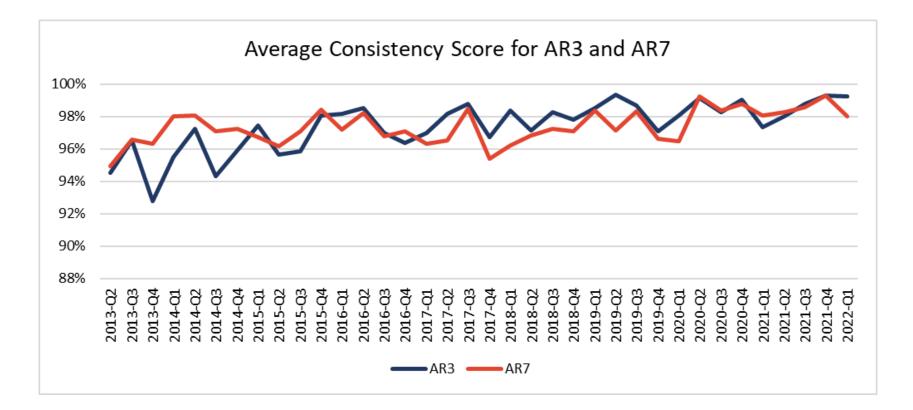
# FLAGGING LOAN / BORROWER ID CHANGES (ECB TEMPLATE)

13 F	irstEntr Avera	- 2013-	g 2013-g 2013-	2013-6	2014-6 20	J14-6 201	4-6 2015	-Q 2015-F	2015-0	2015-@ 2	016-6 2	016-6 201	6-6 2016	-6 2017-6	2017-0 2	017-@ 2017	Q 2018-G	2018-6 2	018-6 2018	-6 2019-6	g 2019-g :	2019-6 20	)19-d 2020	-E 2020-E	2020-62	2020-6 20/	21-6 2021-6	2021-0 20	021-6 2
BSBE000087100420090 2		02 START		100.00%	100.00% 100	0.00% 100/	00% 100.0	0% 100.00%	100.00%	100.00% 1	00.00% 10	00.00% 100.	00% 100.00	02 100.002	100.00% 10	0.00% 100.00	2 100.002	100.00% 10	0.00% 100.0	0% 100.00%	: 100.00%	100.00% 10	0.00% 100.00	2					
BSBE000087100520121 2	013-Q1 98.5	92 START	96.27% 90.75	94.22%	35.82% 32	2.36% 36	.57% 95.8	9% 99.77%	99.80%	33.83%	99.88% 10	00.00% 100.	00% 100.00	02 100.002	100.00% 10	0.00% 100.00	2 100.002	100.00% 10	0.00% 100.0	0% 100.00%	: 100.00%	100.00% 10	0.00% 100.00	2					
IBSBE000108100120082 2	013-Q1 100.0	0% START	33.34% 100.00	39,99%	100.00% 100	0.00% 100/	00% 100.0/	02 100.002	100.00%	100.00% 1	00.00% 10	00.00% 100.	00% 100.00	0% 100.00%	100.00% 10	0.00% 100.00	02 100.002	100.00% 10	0.00% 100.0	0% 100.00%	100.00%	100.00% 10	0.00% 100.00	2 100.00%	100.00% 1/	00.00% 100	.00%		
BSBE000108100220106 2	015-Q4 91.	75%								START	35.50%	90.96% 96.	43% 95.78	67.97%	97.09% \$	8.48%													
IBSBE000108100320112 2	015-Q4 93.0	12%								START 🔡	94.42%	95.17% 93.	06% 94.15	5 <mark>% -</mark> 95.97%	79,90%	8.47%													
IBSBE000161100120115 2		57% START			100.00% 100						71.21% 10		.21%																
			100.00% 100.00	100.00%	100.00% 100	0.00% 100.0	<mark>.00%</mark>	9% 100.00%	100.00%	100.00%	80.06% 10	00.00% <mark>80.</mark>	06% 100.00																
	017-Q1 88.8													START		0.00% 0.00	100.00%	100.00% 10	0.00% 100.0	0% 33.37%	100.00%	100.00% 10	0.00% 100.00	2 100.002	100.00% 10	00.00% 100	.00% 100.00%	100.00% 10	0.00%
			100.00% 100.00					_																					
		IOX START					. <mark>62%</mark> 100.00																						
			100.00% 100.00	100.00%	97.46% 100	1.00% 100.6	00% 100.06													_									
	015-Q2 95.0							START	31.84%	95.26%	96.16%	<u>94.76% 94.</u>	70% 32.06	5 <mark>2 94.80</mark> 2	97.74%	6.21% 35.50													
IBSDE000055100520173 2																STAR			96.52% 96.6	8% 95.76%	\$ 95.73%	96,13% 9	6.78% 96.34	2 97.192	95.82%	95.95% 94.	.02% 35.86%	97.18% 9	/7.62%
IBSDE000097100120083 2			START 36.65							36.25%	34.88%	36.65% 36.	93% 95.72	28 94.50%	35.51%	0.28% 91.33	9% 36.55%	97.31%						_					
IBSDE000190100120086 2 IBSDE000556100120088 2			100.00% 100.00	100.00%	91.36% 100 START 96					02.201	07.00E																		
BSES000045100120038 2		192 102 START	100.00% 100.00	0.000	START 36 100.00% 100		014 01.00	5% 36.85%	30.26%	31,164	31.324	63.53 <u>4</u> 38	.41% 31.12	24 35.364	35.24%	1.66% 36.0	14 30.524	36,33% 3	30.56% 30.1	24 30.204	\$ 36.62%	30.00% 3	0.30% 30.3	% 35.54%	30.00% 3	30.40% 30.	194 99.904	33,06% 3	3.66%
IBSES000045100120036 2			100.00% 100.00		100.002 100		0.02 100.0	02 100 005	100.007	100.007.1	00.002 1	00.007 100	002 100 00	100.002	100.002 10	0.002 100.00	100.005	100.007.10	0.007 100.0	02									
BSES000045100320078 2			100.00% 100.00		100.00% 100															02 100 005	100.002	100.002 10	0.002 100.00	100.002	100.002 1	00.002 100	002 100 002	100.002 10	0.002.10
BSES000045100320018 2		42 START			100.00% 100																								
BSES000045100420054 2		82 START																	0.00% 100.0									100.004 10	
BSES000045100620063 2				0.002																							00% 100.00%	100.002 10	10.002
BSES000045100720046 2			100.00% 100.00	5,78%	100.00% 100																								
BSES000045100820085 2		12 START		100.00%	100.00% 100											-													-+
	013-Q1 83.3				100.00% 100							00.00%																	-+
		42 START	100.00% 100.00										00% 100.00	0% 100.00%	100.00% 10	0.00% 100.00	100.00%	100.00% 10	0.00%										
			100.00% 100.00		100.00% 100																								
BSES000045101220079 2	013-Q1 84.3	82 START	100.00% 30.68		100.00% 100																								
BSES000045101320077 2	013-Q1 97.	42 START	100.00% 100.00	0.00%	100.00% 100	0.00% 100/	00% 100.0/	02 100.002	100.00%	100.00% 1	00.00% 10	00.00% 100.	00% 100.00	02 100.002	100.00% 10	0.00% 100.00	100.00%	100.00% 10	0.00% 100.0	0% 100.00%	100.00%	100.00% 10	0.00% 100.00	2 100.00%	100.00% 1/	00.00% 100	00% 100.00%	100.00% 10	0.00% 1
BSES000045101420083 2	013-Q1 75.0	0% START	100.00% 100.00	0.00%	100.00%																								_
BSES000045101520072 2	013-Q1 95.2	42 START	100.00% 100.00	0.00%	100.00% 100	0.00% 100/	00% 100.0/	0% 100.00%	100.00%	100.00% 1	00.00% 10	00.00% 100.	00% 100.00	0% 100.00%	100.00% 10	0.00% 100.00	0% 100.00%	100.00% 10	0.00%										
BSES000045101620088 2	013-Q1 51.1	0% START	6.80% 100.00		100.00%																								
BSES000060100120048 2				100.00%	100.00% 100	0.00% 100/	00% 100.0/	0% 100.00%	100.00%	100.00% 1	00.00% 10	00.00% 100.	00% 100.00	0% 100.00%	100.00% 10	0.00% 100.00	02 100.002	100.00% 10	0.00% 100.0	0% 100.00%	: 100.00%	100.00% 10	0.00% 100.00	2					
BSES000060100220061 2			100.00% 100.00	100.00%	100.00% 100	0.00% 100.0	.00% 100.00	0% 100.00%	: 100.00% 1	100.00% 1	00.00% 10	00.00% 100.	00% 100.00	0% 100.00%	100.00% 10	0.00% 100.00	02 100.002	100.00% 10	0.00% 100.0	0% 100.00%	: 100.00%	100.00% 10	0.00% 100.00	2 100.00%	100.00% 10	00.00% 100	.00% 100.00%	100.00% 10	0.00% 10
IBSES000060100420026 2			100.00% 100.00	100.00%				0% 100.00%																					
BSES000060100520072 2			100.00% 100.00																								.00% 100.00%		
BSES000060100620088 2			100.00% 100.00		100.00% 100					100.00% 1	00.00% 10	00.00% 100.	00% 100.00	0% 100.00%	100.00% 10	0.00% 100.00	02	100.00% 10	0.00% 100.0	0% 100.00%	: 100.00%	100.00% 10	0.00% 100.00	A 100.00%	100.00% 10	00.00% 100.	.00% 100.00%	100.00% 10	0.00% 10
BSES000060100720029 2			100.00% 100.00	100.00%	100.00% 100																								
BSES000060100820035 2			100.00% 100.00	100.00%												0.00% 100.00				0% 100.00%	: 100.00%			_					
BSES000060100920058 2		02 START		100.00×	100.00% 100														0.00% 100.0				0.00% 100.00	2 100.002	100.00% 10	00.002 100.	002 100.002	100.00%	
BSES000060101020098 2				100.00%	100.00% 100 100.00% 100																						00% 100.00%		
BSES000060101120036 2 BSES000060101320050 2		IOX START		100.00%	100.00% 100																						.00% 100.00%		
			100.00% 100.00																								002 100.002		
			100.00% 100.00		100.00% 100																								
			100.00% 100.00		100.00% 100																								
			100.00% 100.00		100.00% 100																								
SSES000060101320081 2			100.00% 100.00		100.00% 100																								
SES000060102420073 2		02 START			100.00% 100																							10.000	
SES000060102520112 2		0% START			100.00% 100																							100.002 10	0.002
BSES000060102620094 2		02 START			100.00% 100																								
SES000060102720043 2				100.00%												0.00% 100.00													
BSES000060102820066 2			100.00% 100.00	100.00%																02 100,002	100.00%	100.00% 10	0.002 100.00	12 100.002	100.00% #	00.002 100	.00% 100.00%	100.00% 10	0.00% 1
SES000060103020088 2			100.00% 100.00	100.002	100.002.100																								
SES000060103120052 2			100.00% 100.00	100.00%	100.00% 100	0.00% 100/	002 100.0	02 100.002	100.002	100.002 1	00.002 10	00.00% 100.	00% 100.00	2 100.002	100.002 10	0.002 100.00	2 100.002	100.00% 10	0.00% 100.0	02 100.002	100.00%	100.00% 10	0.002 100.00	2 100.002	100.002 1	00.002 100	002 100.002	100.00% 10	0.002 1
SES000060103220134 2			STAR	100.00%	100.00% 100																					00.00% 100	00% 100.00%	100.00% 10	0.00% 1
SES000060103320132 2			STAR		100.00% 100	0.00% 100.	00% 100.0	0% 100.00%	100.002	100.00% 1	00.00% 10	00.00% 100.	00% 100.00	0% 100.00%	100.00% 10	0.00% 100.00	100.002	100.00% 10	0.00% 100.0	0% 100.00%	100.002	100.00% 10	0.00% 100.00	2 100.002	100.00% 1/	00.00% 100	00% 100.00%	100.00% 10	0.00%
SES000060103420130 2			STAR		100.00% 100																								
SES000060104120135 2				START																							00% 100.00%		
SES000060104820148 2		10%																									00% 100.00%		
SES000060104920146 2																											00% 100.00%		
SES000060105120142 2																											00% 100.00%		
SES000060105220157 2	015-Q2 100.0	10%						START.	100.00%	100.00% 1	00.00% 10	00.00% 100.	00% 100.00	0% 100.00%	100.00% 10	0.00% 100.00	100.00%	100.00% 10	0.00% 100.0	0% 100.00%	100.00%	100.00% 10	0.00% 100.00	2 100.002	100.00% 1	00.00% 100	00% 100.00%	100.00% 10	0.00%
SES000060105520168 2	016-Q2 100.0	10%																									00% 100.00%		
BSES000060105720164 2		10%																									00% 100.00%		
BSES000060105820071 2																											00% 100.00%		
00500000000000000000000000000000000000	000.01 100.0	0.0					-	-																a. 100.000	100.000.0			100.001.10	0.000

Calculate average score for a given period...

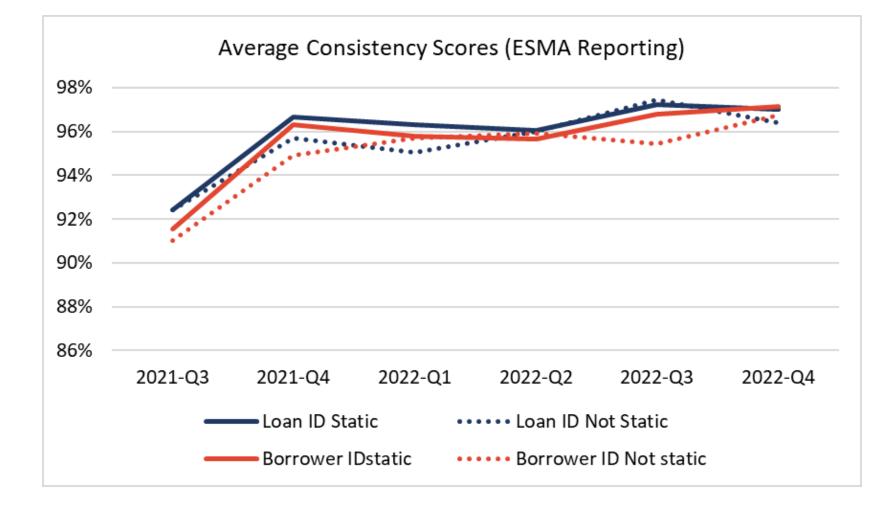
# FLAGGING LOAN / BORROWER ID CHANGES (ECB TEMPLATE)

- Example for RMBS
  - The average scores have somewhat improved overtime
  - The scores for AR3 and AR7 are in a similar range





# FLAGGING LOAN / BORROWER ID CHANGES (ESMA DATA)





#### WHAT CAN WE DO? (1) FOCUS ON THE TIME SERIES WHERE LOAN IDS ARE REPORTED CONSISTENTLY

	terac * 20	1013- G 2013- G 2013- G 2013- G 2013- G 2014- G 2014- G 2014- G 2015- G 2015- G 2015- G 2016- G 2016- G 2016- G 2017- G 2017- G 2017- G 2018- G 2018- G 2018- G 2018- G 2019- G 2019- G 2019- G 2019- G 2020- € 2020- € 2020- € 2020- € 2020- € 2020- € 2020- € 2020- € 2021- G 2021-
		TART 93.39% 100.00%
MBSBE000087100520121 2013-Q1		TART 96.21% 90.75% 94.22% 95.82% 92.96% 96.57% 95.89% 99.87% 99.89% 99.88% 100.00% 100.00% 100.00% 100.00% 100.00% 100.00% 100.00% 100.00% 100.00% 100.00% 100.00% 100.00%
		TART 33.34% 100.00% 33.33% 100.00%
MBSBE000108100220106 2015-Q4	91.75%	START 95.50% 90.96% 96.40% 95.70% 67.97% 97.09% 98.48%
	93.02%	START 34.422 35.17X 33.06X 34.15X 35.37X 73.30X 36.47X
MBSBE000161100120115 2013-Q1	95.57% ST	
MBSBE000161100220121 2013-Q1		TART 100.00% 100.00% 100.00% 100.00% 100.00% 100.00% 100.00% 100.00% 100.00% 80.06% 100.00%
	88.89%	START 0.00% 10
MBSBE000170100120030 2013-Q1		TART 100.00% 100.00% 100.00% 100.00%
MBSDE000055100120081 2013-Q1		TART 100.00% 100.00% 100.00% 32.70% 100.00% 35.62% 100.00%
MBSDE000055100220089 2013-Q1	99.64% ST	TART 100.00% 100.00% 100.00% 37.46% 100.00% 100.00%
MBSDE000055100320152 2015-Q2	95.09%	START 91842 35.26% 96.16% 94.76% 94.76% 92.06% 94.80% 97.74% 95.21% 95.50% 97.00%
MBSDE000055100520173 2017-Q4	91.03%	START 6.841 95.832 96.522 96.682 95.752 96.732 96.732 96.732 96.732 96.732 96.732 96.732 95.742 95.742 95.742 95.852 95.952 94.022 95.852 97.182 97.622
MBSDE000037100120083 2013-Q2	36.06%	START 96.65% 96.65% 95.67% 95.94% 94.94% 96.00% 95.92% 96.25% 94.86% 96.65% 96.93% 95.72% 94.50% 97.39% 96.55% 97.31%
MBSDE000190100120086 2013-Q1	99.04% ST	TART 100.00% 100.00% 100.00% 100.00% 100.00% 100.00% 100.00%
MBSDE000556100120088 2014-Q1	97.09%	START 36,38% 38,51% 37,86% 36,85% 38,26% 37,78% 37,32% 63,53% 38,41% 37,12% 35,36% 36,24% 37,65% 36,37% 38,52% 38,35% 38,62% 38,68% 38,36% 38,64% 38,80% 38,48% 38,30% 39,66%
MBSES000045100120098 2013-Q1	80.00% ST	TART 100.002 100.002 100.002 100.002
MBSES000045100220096 2013-Q1	95.45% ST	TARE 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002
MBSES000045100320078 2013-Q1	97.14% ST	TART 100.002 1
		TART 1522 100.001 100.002 100.
		TARE 100.002 1
MBSES000045100620063 2013-Q1		TART 100.001 100.002 1
		TART 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002
MBSES000045100820085 2013-Q1	90.91% ST	
MBSES000045100920091 2013-Q1	83.33% ST	
MBSES000045101020033 2013-Q1	95.24% ST	
MBSES000045101120071 2013-Q1		TART 100.001 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002
		TART 100.002 30.682 0.002 100.002 100.002 100.002
MBSES000045101320077 2013-Q1		TART 100.002 1
MBSES000045101420083 2013-Q1		14ET 100.03 100.003
MBSES000045101520072 2013-Q1		TARE 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002
MBSES000045101620088 2013-Q1		
		1/211 100.002
		TARE 100.002 1
		TART 100.002 1
	100.00% ST	
	100.00% ST	
	100.00% ST	
		TARE 100.002 1
		TARE 100.001 100.002 1
		1/2/#T 100.00\$
	100.00% ST	
	100.00% ST	
	100.00% ST	
	100.00% ST	
	100.00% ST	
	100.00% ST	
		TARE 100.008 10000000000
	100.00%	START 100.002 100.003 100.003 100.003 100.003 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.002 100.003 100000 10000000000
	100.00%	START 100.002 100.003 100000 100.003 10000000000
	100.00%	START 100.00%
	100.00%	STARE 100.00%
	100.00%	START 100.002 100
	100.00%	START 100.002 100
	100.00%	STAFT 100.00% 100
	100.00%	START 100.00%
MBSES000060105220157 2015-Q2		
MBSES000060105220157 2015-Q2	100.00*	START 100.00%
MBSES000060105220157 2015-02 MBSES000060105520168 2016-02		START         100.002



#### WHAT CAN WE DO? (2) REPAIR LOAN IDS WHEN THERE IS AN INCONSISTENCY

- In this period, a systematic change has affected all the loans from a specific data provider
  - Find out the logic...
  - "Repair past loan IDs"

AR3	FirstEntry	AverageFe 2013	-Q1 2013-Q2	2013-Q3	2013-Q4	2014-Q1	2014-Q2	2014-Q3	2015-Q1	20
RMBSDE000556100120088	2014-Q1	97.09%		-		START	96.98%	98.51%	97.88%	
RMBSES000045100120098	2013-Q1	80.00% STAF	T 100.009	6 100.00	6 0.00%	100.00%	100.00%			
RMBSES000045100220096	2013-Q1	95.45% STAR	T 100.009	6 100.00	6 0.00%	100.00%	100.00%	100.00%	100.00%	1
RMBSES000045100320078	2013-Q1	97.14% STAR	T 100.009	6 100.00	6 0.00%	100.00%	100.00%	100.00%	100.00%	1
RMBSES000045100420084	2013-Q1	94.34% STAR	IT 1.829	100.00	0.00%	100.00%	100.00%	100.00%	100.00%	1
RMBSES000045100520057	2013-Q1	96.88% STAR	T 100.009	6 100.00	6 100.00%	0.00%	100.00%	100.00%	100.00%	1
RMBSES000045100620063	2013-Q1	97.06% STAR	T 100.009	6 100.00	6 0.00%	100.00%	100.00%	100.00%	100.00%	6 1
RMBSES000045100720046	2013-Q1	94.46% STAR	T 100.009	6 100.00	5.78%	100.00%	100.00%	100.00%	100.00%	1
RMBSES000045100820085	2013-Q1	90.91% STAF	T 0.00%	100.00	6 100.00%	100.00%	100.00%	100.00%	100.00%	, 1
RMBSES000045100920091	2013-Q1	83.33% STAR	T 0.009	100.00	6 100.00%	100.00%	100.00%	100.00%	0.00%	1
RMBSES000045101020099	2013-Q1	95.24% STAF	T 100.009	6 100.00	6 100.00%	0.00%	100.00%	100.00%	100.00%	1
RMBSES000045101120071	2013-Q1	95.24% STAR	T 100.009	6 100.00	6 0.00%	100.00%	100.00%	100.00%	100.00%	1
RMBSES000045101220079	2013-Q1	84.38% STAR	T 100.009	90.68	6 0.00%	100.00%	100.00%	100.00%	100.00%	
RMBSES000045101320077	2013-Q1	97.14% STAR	T 100.009	6 100.00	6 0.00%	100.00%	100.00%	100.00%	100.00%	1
RMBSES000045101420083	2013-Q1	75.00% STAR	T 100.009	6 100.00	0.00%	100.00%				
RMBSES000045101520072	2013-Q1	95.24% STAR	T 100.009	6 100.00	6 0.00%	100.00%	100.00%	100.00%	100.00%	1
RMBSES000045101620088	2013-Q1	51.70% STAR	T 6.80%	100.00	6 0.00%	100.00%				
RMBSES000060100120048	2013-Q1	100.00% STAR	T 100.009	6 100.00	100.00%	100.00%	100.00%	100.00%	100.00%	. 1
RMBSES000060100220061	2013-Q1	100.00% STAR	r 100.009	6 100.00%	6 100.00%	100.00%	100.00%	100.00%	100.00%	1
RMBSES000060100420026	2013-Q1	100.00% STAR	T 100.009	6 100.00%	6 100.00%	100.00%	100.00%	100.00%	100.00%	1



#### WHAT CAN WE DO? (3) CALCULATE A "SYNTHETIC" LOAN IDENTIFIER TO TRACK LOANS OVERTIME

- Define a loan by its key characteristics rather than by its loan ID
- It is possible to concatenate several key static fields that define a loan to trace if overtime
  - If borrower ID has not change, include borrower ID, original amount, origination date, maturity etc...
  - Works best for small sample
  - Even static fields can actually be subject to change...
  - Try several combinations
  - Limit this technique to the "switch" period, back populate with the corrected loan ID
- In some cases, only a few IDs change
  - Check if these loans are precisely the ones that are in arrears/default/restructured



# **GREEN AUTO SECURITISATION USMAN JAMIL, EUROPEAN DATAWAREHOUSE**

# **GREEN AUTO SECURITISATION (GAS) PROJECT**

Under the Climate Protection and Finance (KlimFi) funding initiative by the German Ministry for Education

- SAFE\* and EDW have been awarded a grant for the 3-year project ending in September 2025
- SAFE will perform research on ways to incentivize purchases of low-emission vehicles through bank lending
- EDW will support SAFE with data by:
  - Adjusting/Standardising Loan Level Data
  - Requesting and collecting additional information on car characteristics from Auto ABS issuers like:
    - CO2 Emissions
    - Car Weight
    - Fuel Type
    - Engine Size
  - Gathering relevant data from other sources like EEA

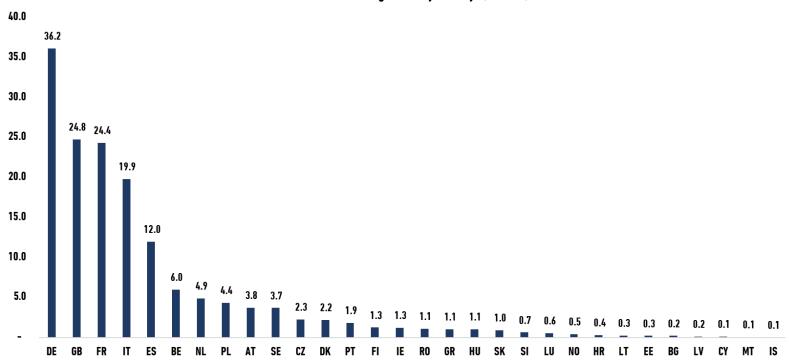






#### The EEA Database collects data on CO2 emissions of all new registered vehicles

- Also includes car manufacturer, model, weight, fuel type, engine size
- 156M cars for the years 2010-2021
- Covers 30 countries



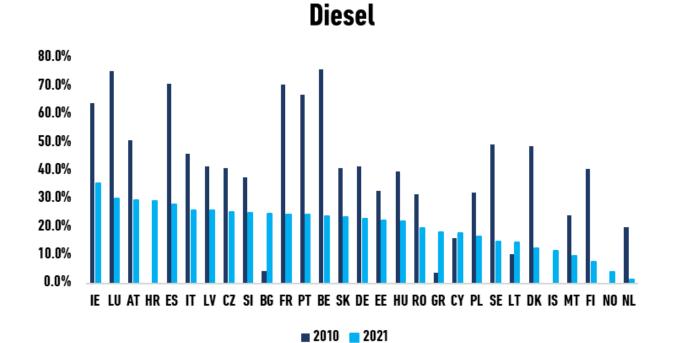
Number of New cars registered by country\* (Millions)

\* GB does not include registrations in 2021



Diesel cars as a percentage of all cars registered in 2010 vs 2021 by country

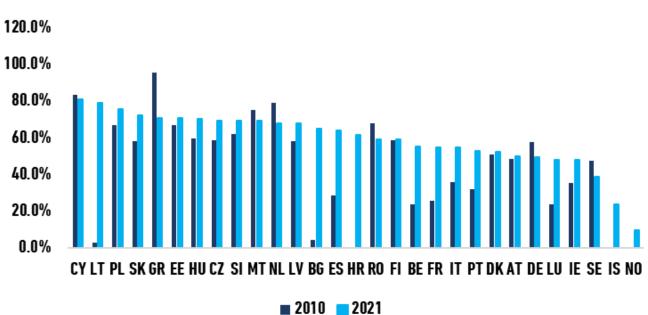
- Highest % of diesel cars Ireland
- Lowest % of diesel cars Netherlands





Petrol cars as a percentage of all cars registered in 2010 vs 2021 by country

- Highest % of petrol cars Cyprus
- Lowest % of petrol cars Norway

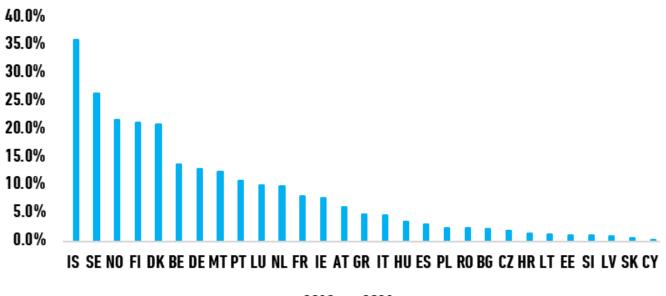


### Petrol



Hybrid cars as a percentage of all cars registered in 2010 vs 2021 by country

- Highest % of hybrid cars Iceland
- Lowest % of hybrid cars Cyprus



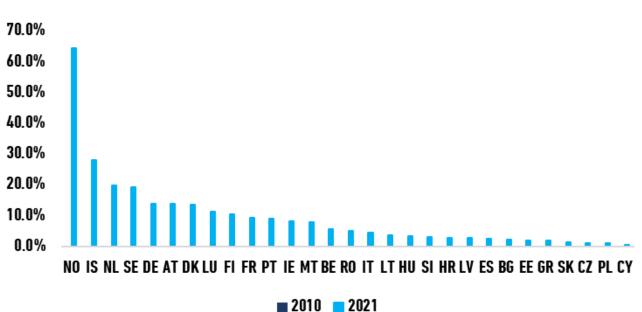
#### Hybrid

2010 2021



Electric cars as a percentage of all cars registered in 2010 vs 2021 by country

- Highest % of electric cars Norway
- Lowest % of electric cars Cyprus

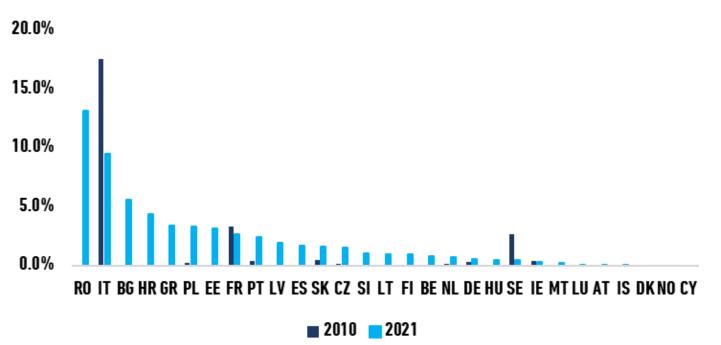


#### Electric



#### Natural gas cars as a percentage of all cars registered in 2010 vs 2021 by country

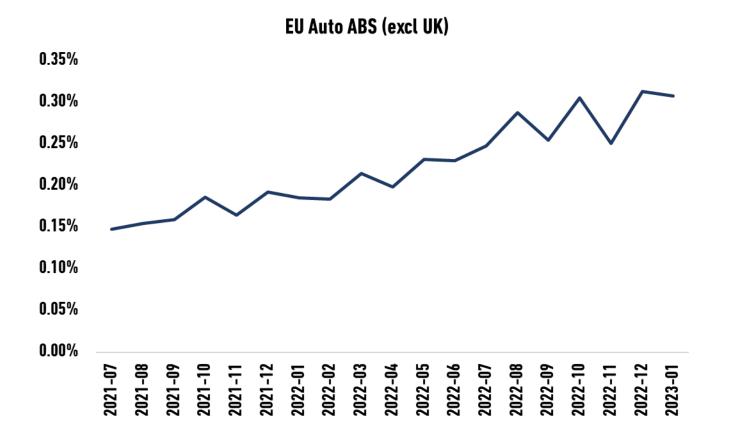
- Highest % of natural gas cars Romania
- Lowest % of natural gas cars Cyprus



## **Natural Gas**



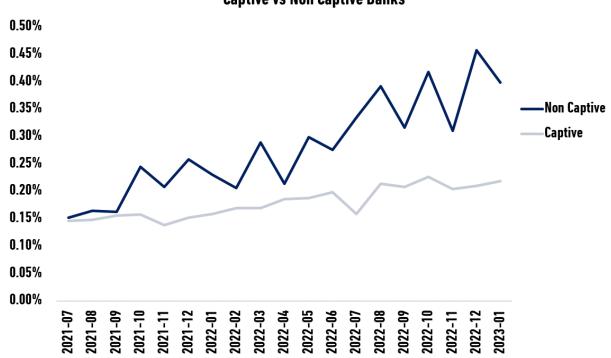
Delinquencies are creeping up slightly but the numbers are still quite low





Is there any difference in the delinquencies for ABS deals from <u>Captive vs Non Captive</u> banks?

Captive Banks have lower levels of delinquencies compared to Non Captives

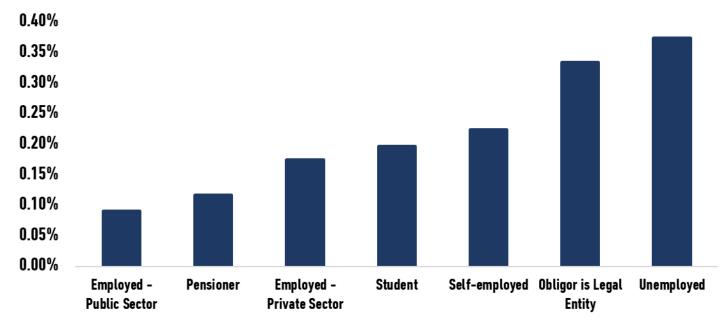


**Captive vs Non Captive Banks** 



What are the differences in delinquencies for borrowers from different types of employment?

- Lowest delinquencies Public Sector Employees and Pensioners
- Highest delinquencies Unemployed and Small Businesses



#### **Employment Type**



### ESTIMATED CAR WEIGHTS FOR EACH MODEL USING THE EEA DATABASE

Average weight of each model was estimated using the data for 156 million cars and matched with the EDWs Loan level data

#### <u>Up to 1000 kg</u>

CITROEN C1 PEUGEOT 108 TOYOTA IQ VW UP KIA PICANTO NISSAN PIXO SKODA CITIGO

#### 2000 kg or more

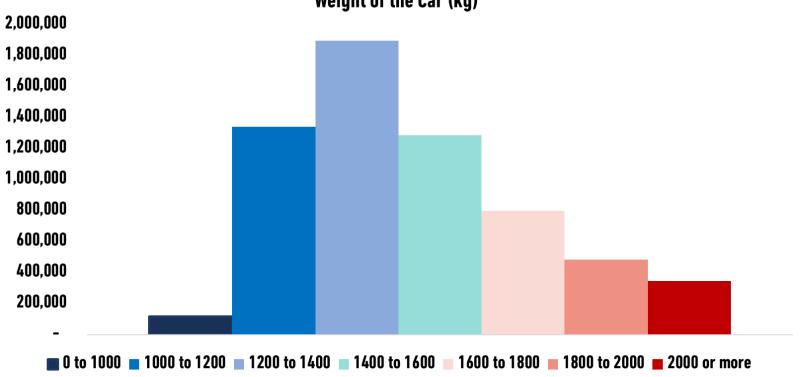
AUDI Q7 BMW X7 TESLA MODEL X MERCEDES EQS VW PHAETON PORSCHE CAYENNE VOLVO XC90



# **AUTOS – NUMBER OF CARS BY THEIR WEIGHT**

What is the distribution of weights across all new registered cars\*?

Most cars weigh between 1000 to 1600 kilograms 



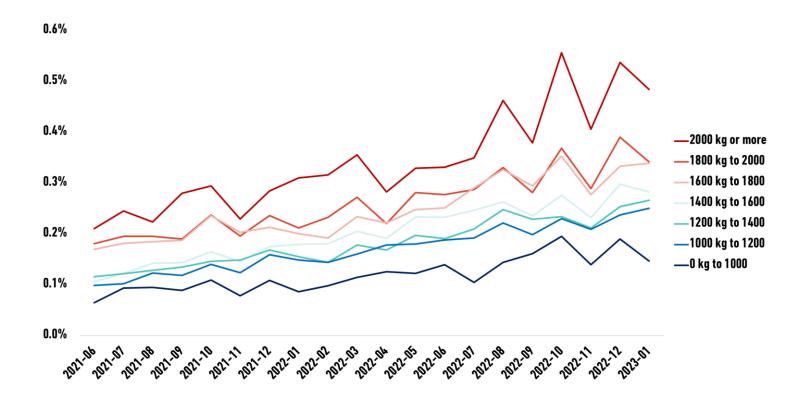
#### Weight of the Car (kg)

\* Only the countries for which EDW has loan level data are used here



Is there any difference in delinquencies if cars are grouped by weight?

• The heavier the car, the higher the delinquencies

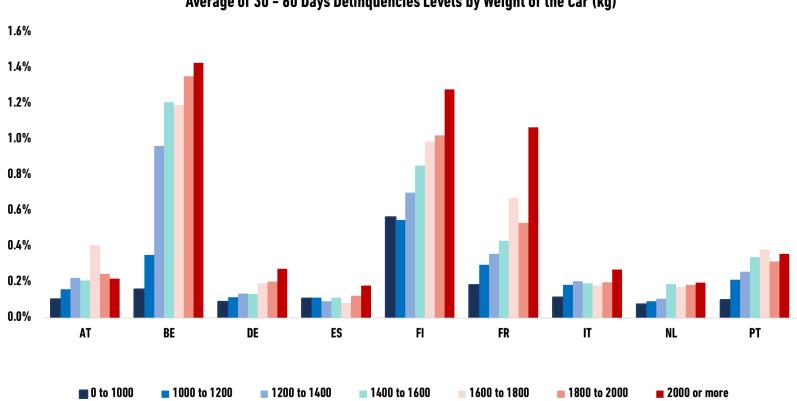




### **AUTOS - 30 TO 60 DAYS DELINQUENCY BUCKET**

#### Does this relationship hold for each country?

**Yes.** For each country, the heaviest cars have the highest delinquency levels 



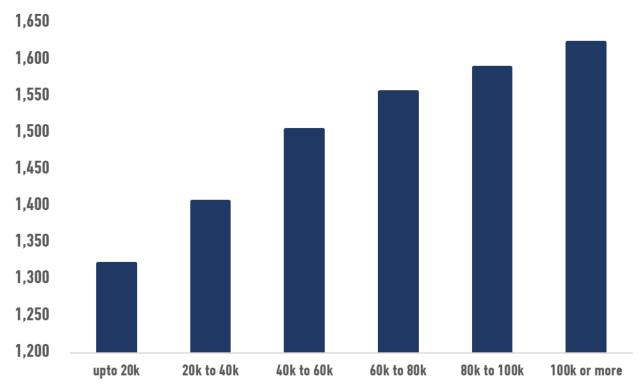
Average of 30 - 60 Days Delinquencies Levels by Weight of the Car (kg)



### **AUTOS – CAR WEIGHT AND BORROWER INCOME**

Is there any relationship between car weight and the income of the borrower?

• The higher the Income, the heavier the car



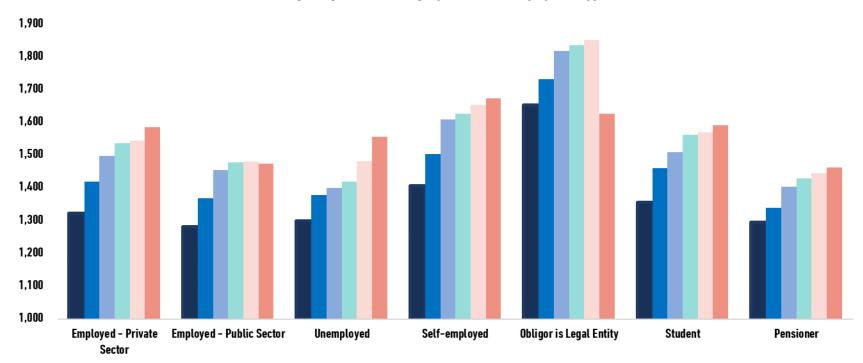
#### Average weight (kg) of the car by Income



### **AUTO – CAR WEIGHT AND BORROWER INCOME**

Does the relationship hold for different employment types?

• Yes. The higher the income, the heavier the car



Average weight of the car (kg) by Income and Employment Type

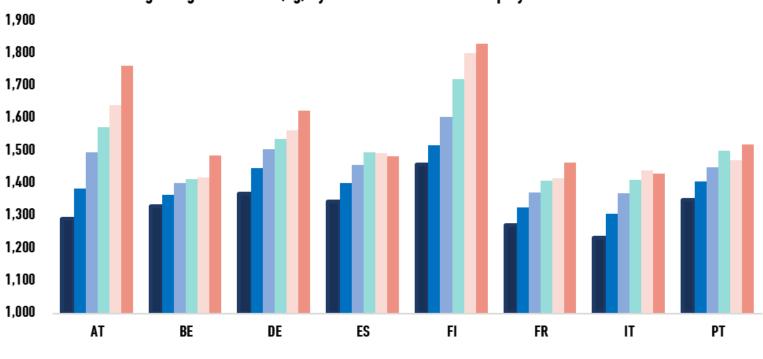
upto 20k 🗧 20k to 40k 📲 40k to 60k 📲 60k to 80k 📲 80k to 100k 📲 100k or more



#### AUTO - CAR WEIGHT BY COUNTRY

#### Does the relationship hold across different countries?

• **Yes.** The higher the income, the heavier the car



#### Average weight of the car (kg) by Income for Borrowers employed in Private Sector

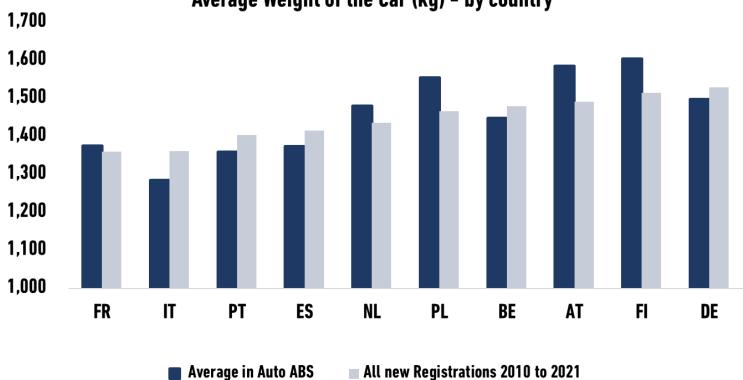
🛛 upto 20k 🛛 🗖 20k to 40k 🔄 40k to 60k 📄 60k to 80k 👘 80k to 100k 📁 100k or more



### **AUTO – CAR WEIGHT BY COUNTRY**

#### Which country has the heaviest cars?

- Heaviest Germany and Finland
- Lightest France and Italy



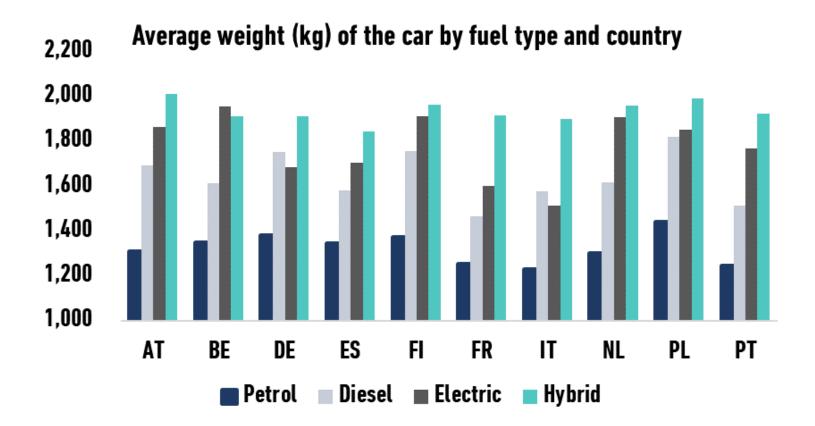
#### Average Weight of the Car (kg) - by country

All new Registrations 2010 to 2021



# AUTO - CAR WEIGHT BY FUEL TYPE (2021 REGISTRATIONS ONLY)

All new registrations in 2021 - Petrol cars are the lightest while hybrids are the heaviest





### **LINKEDIN POLL**

#### What car engine type has the highest CO2 emissions?

- Petrol
- Diesel
- Hybrid
- Electric

What car engine type emit	ts the most CO2?
You can see how people vote. Learn	more
Petrol	48%
Diesel	24%
Hybrid	24%
Electric	4%
25 votes • Poll closed	

#### WHAT CAR ENGINE TYPE HAS THE HIGHEST CO2 EMISSIONS? What does Chat GPT say?

110
US

\$

What car engine type has the highest CO2 emissions?



In general, gasoline engines tend to have higher CO2 emissions compared to diesel engines  $\square$   $\square$  or hybrid/electric engines. However, the specific CO2 emissions of a car engine depend on various factors such as engine size, fuel efficiency, and driving conditions.

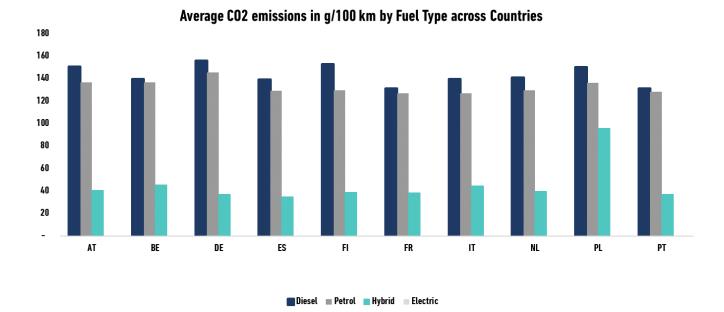
For example, high-performance gasoline engines with larger displacement tend to have higher CO2 emissions compared to smaller, more efficient engines. Similarly, if a gasoline engine is not properly maintained or driven in a way that maximizes fuel efficiency, its CO2 emissions can be higher than a well-maintained diesel engine or hybrid/electric engine.

It's also worth noting that emissions regulations vary by country and region, and newer engines tend to have lower emissions than older engines due to advances in technology and emissions control systems.



#### WHAT CAR ENGINE TYPE HAS THE HIGHEST CO2 EMISSIONS? What does the data tell us?

 We looked at New cars registered in 2021 across countries by fuel type and measured the average CO2 emissions in grams/100 km using the WLTP standard

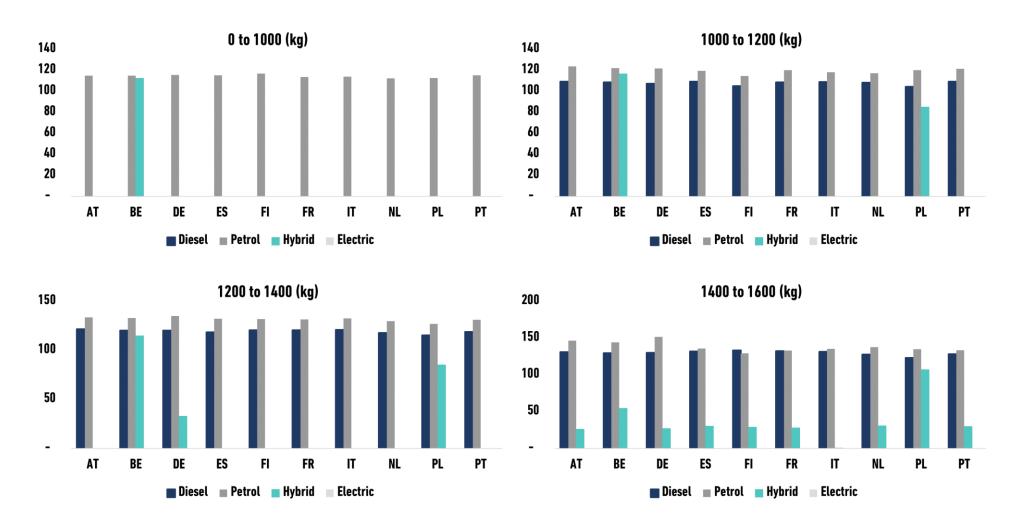


• Average CO2 emissions of Diesel cars is higher than Petrol Cars!!



#### WHAT CAR ENGINE TYPE HAS THE HIGHEST CO2 EMISSIONS?

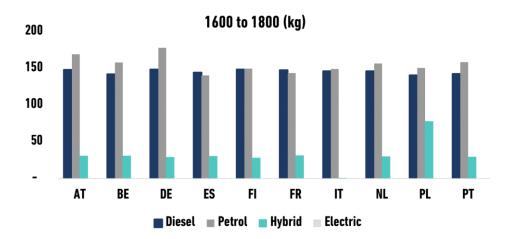
What if you consider the weight of the car?

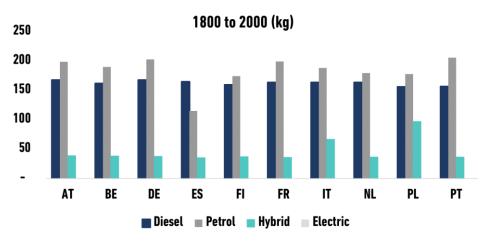


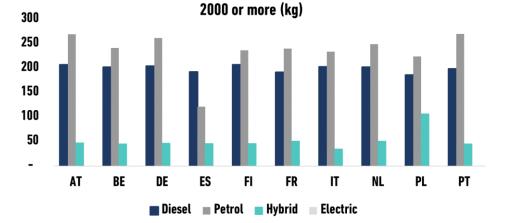


#### WHAT CAR ENGINE TYPE HAS THE HIGHEST CO2 EMISSIONS?

What if you consider the weight of the car?







• Within the same weight category, Diesel cars emit less CO2!!!





**MARCH 2023** 

### **UPCOMING EVENTS**

#### Visit the https://eurodw.eu/news-events-and-multimedia/events/ page to register for upcoming events

22. MAR 2023	EDW's 2023 Greek Securitisation Workshop – Athens
25. APR 2023	EDW's 2023 Irish Securitisation Workshop – Dublin
09. MAY 2023	EDW's 2023 Spring Italian Workshop – Rome
11. MAY 2023	EDW's 2023 Spring Italian Workshop – Milan
16. May 2023	EDW's 2023 UK Securitisation Workshop – London



# THANK YOU//CONTACT US

#### **EUROPEAN DATAWAREHOUSE GMBH**

Walther-von-Cronberg-Platz 2

- 60594 Frankfurt am Main
- www.eurodw.eu
- enquiries@eurodw.eu
- **\** +49 (0) 69 50986 9017

This presentation (the "Presentation") has been prepared by European DataWarehouse GmbH (the "Company") and is being made available for information purposes only. The Presentation is strictly confidential and any disclosure, use, copying and circulation of this Presentation is prohibited without the consent from the Company. Information in this Presentation, including forecast financial information, should not be considered as advice or a recommendation to investors or potential investors in relation to holding, purchasing or selling securities or other financial products or instruments and does not take into account your particular investment objectives, financial situation or needs. No representation, warranty or undertaking, express or implied, is made as to the accuracy, completeness or appropriateness of the information and opinions contained in this Presentation. Under no circumstances shall the Company have any liability for any loss or damage that may arise from the use of this Presentation or the information or opinions contained herein. Certain of the information contained herein May include forward-looking statements relating to the business, financial performance and results of the Company and/or the industry in which it operates. Forward-looking statements concern future circumstances and results and other statements that are not historical facts, sometimes identified by the words "believes", expects", "predicts", "intends", "projects", "plans", "estimates", "aims", "foresees", "anticipates", "targets", "May ", "will", "should" and similar expression. The forward-looking looking statements, contained in this Presentation, including assumptions, opinions and views of the Company or cited from third party sources are solely opinions and forecasts which are uncertain and subject to risks.