

**Bank of Italy Workshop
"The use of consumer transaction data
and other Big Data in European Banks"**

**Beyond Cards: Big Data
at BBVA Research**

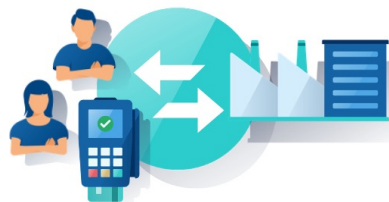
**Alvaro Ortiz, PhD
Head of Big Data Analysis
BBVA Research**

Rome, December 2022

Big Data at BBVA Research: What we do?



**Text as
Data For
Social Sciences**



**National Accounts
In “Real Time” &
“High Definition”**



**Big Data for
Economic Analysis
& “Smart” Policies**



**Big Data
For
Sustainability**

How do we work: The BBVA Research Model & Topics

Macroeconomics Economic Policy Banking & Finance Sustainability Urban Economics



National Accounts in a World of Naturally Occurring Data

UNIVERSITY OF CAMBRIDGE
UCL
BBVA Research

The Heterogeneous Impact of Inflation on Households

BBVA Research
BANCO DE ESPAÑA Eurosistema

A Crowding-In Monitor of NGEU Funds Procurement

BBVA Research

The Evolution of E-commerce in Spain

BBVA Research

New Lending Loans by NACE code

BBVA Research

Distributional Accounts of Co2 Emissions by Households

UNIVERSITY OF CAMBRIDGE
UCL
BBVA Research

Urban Lifestyles & Sustainability Impact

BBVA Research
mit media lab

Estimation of Co2 Emissions by Households

BBVA Research
uc3m

Estimation of Co2 Emissions by Corporates

BANCO DE ESPAÑA Eurosistema
BBVA Research

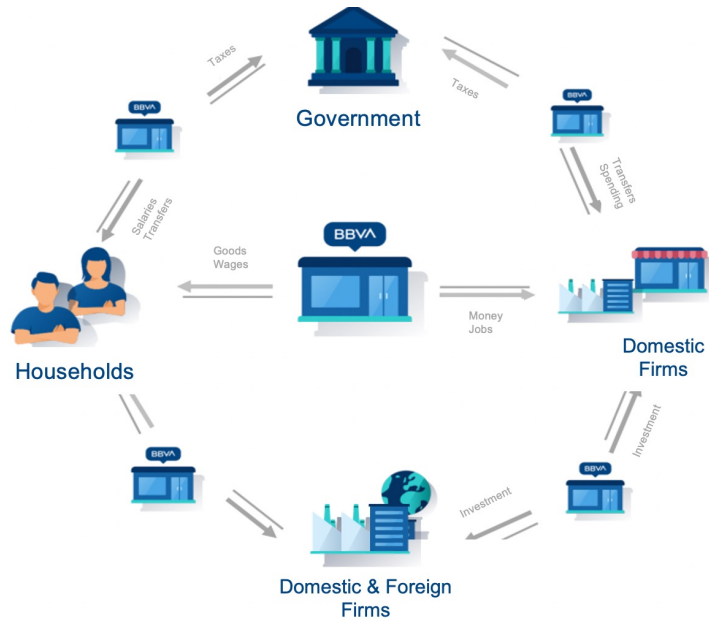
The Supply of Amenities in Cities

cemfi
UAB
CHICAGO BOOTH

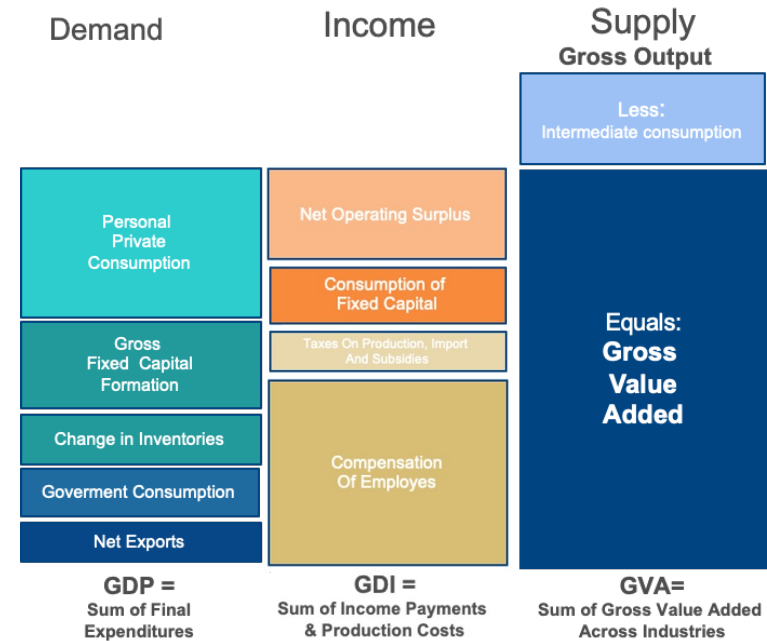
Big Data for Economics: National Accounts in Real Time and High Definition

Naturally Occurring National Account System from Financial Transactions

The Flow of Income & Financial Transactions



The National Accounts System

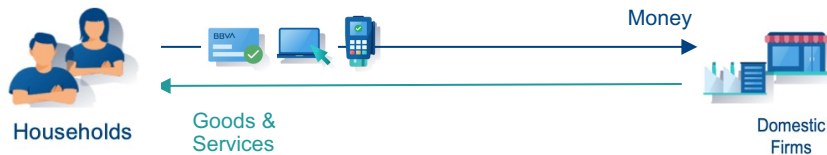


Like many others, we started out using Credit and Debit cards as a proxy for consumption...

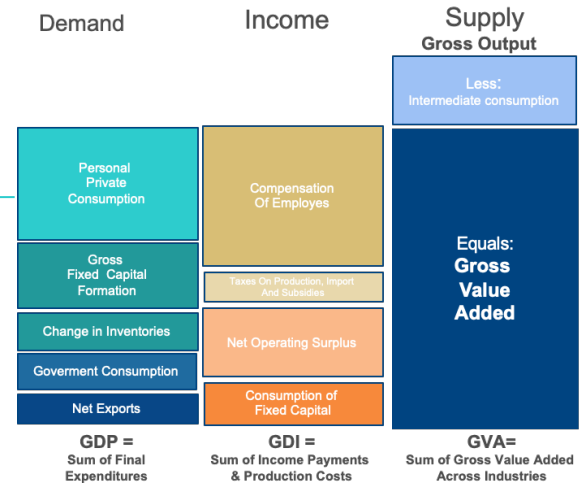
Individual to Firm Transactions

Credit/Debit Cards

Physical PoS and On-Line Payments



The National Accounts System



Tracking the COVID-19 crisis through the lens of 1.4 billion transactions

Vasco Carvalho, Juan R. Garcia, Stephen Hansen, Álvaro Ortiz, Tomasa Rodrigo, José V. Rodríguez Mora, Pep Ruiz
 27 April 2020
 Individual transaction-level data can be used to map the changes in consumer behaviour in response to the COVID-19 lockdown measures. This column reports data from BBVA to analyse the nature of the impact in Spain. The article includes data from a large number of novel expenditure and that anticipatory spending (shopping) has been placed, which non-expenditure have more or less unchanged. The authors find no evidence that differential exposure to the pandemic has affected regional expenditure patterns, but rather cities, areas with more prevalence of the pandemic have suffered a bigger economic collapse overall.



Summer Institute 2020

Economic Fluctuations and Growth, Summer

2020

ROYAL SOCIETY OPEN SCIENCE

Research articles

Tracking the COVID-19 crisis with high-resolution transaction data

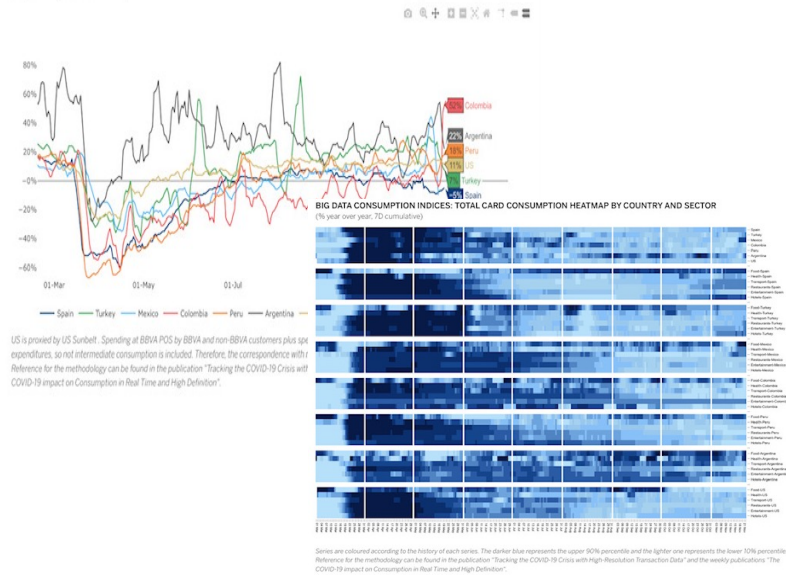
Vasco M. Carvalho, Juan R. Garcia, Stephen Hansen, Álvaro Ortiz, Tomasa Rodrigo, José V. Rodríguez Mora and Pep Ruiz

Published: 11 August 2021 <https://doi.org/10.1098/rsos.210218>

The Covid triggered “crisis & uncertainty” & a urgent response was needed. Cards Transactions proved to be very useful for real time & HD

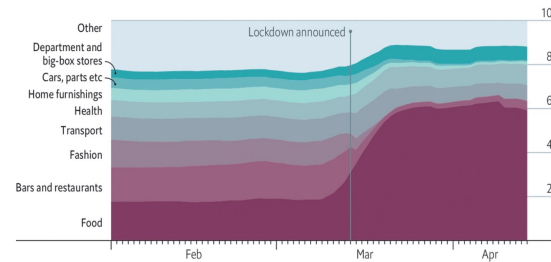
Real Time...

BIG DATA CONSUMPTION INDICES: TOTAL CARD CONSUMPTION BY COUNTRY
(% year over year, 7D cumulative)



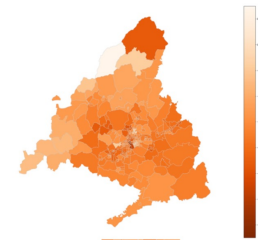
...High Definition

Locked down, loading up
Spain, selected retail sales, % of total*

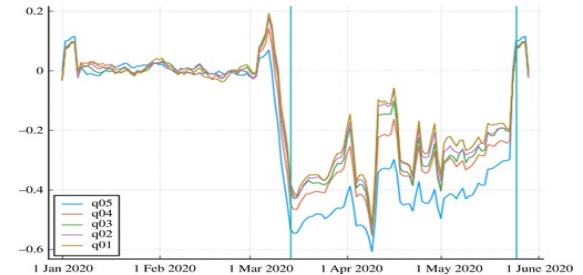


Source: “Tracking the COVID-19 Crisis with High-Resolution Transaction Data.” by Carvalho et al, Cambridge Working Papers in Economics (2020)

Figure 6 Heat map of difference in average year-on-year growth rate of expenditures before March 9th, and after March 13th



Consumption by Income Quintiles during Covid

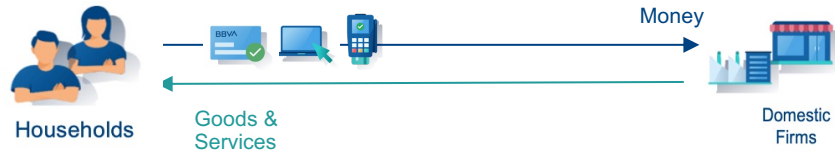


While Card Payment proved to be key is only a part of the story ...

Individual to Firm Transactions

Credit/Debit Cards

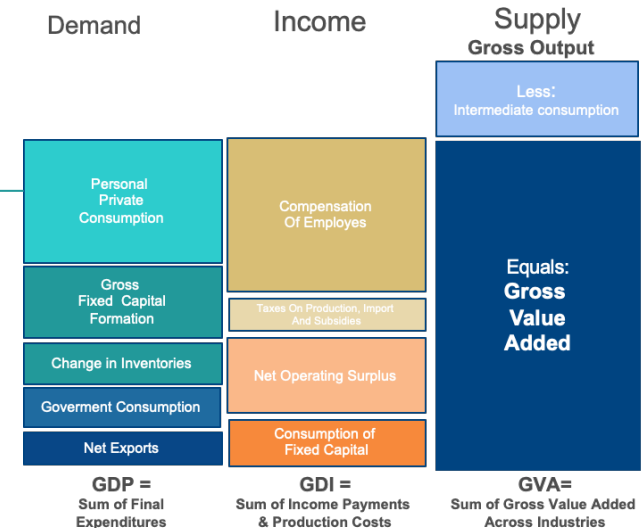
Physical PoS and On-Line Payments



38%

Total Consumption Payments

The National Accounts System



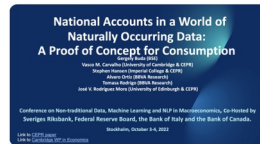
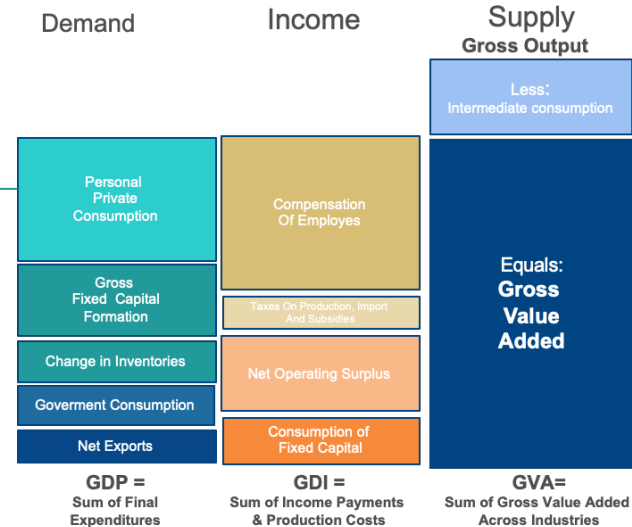
.. and we decided to complete consumption in a “consistent way with National Accounts” by completing the rest of the means of payment.

Individual to Firm Transactions
 Credit/Debit + Cash
 +Transfers + Direct Debit + Imputed Rents



→ **100%**
 Total Consumption Payments

The National Accounts System



Innovative Data in Household Finance: Opportunities and Challenges, Fall 2022

A Massive Consumption Survey from “Transparent & Robust” rules

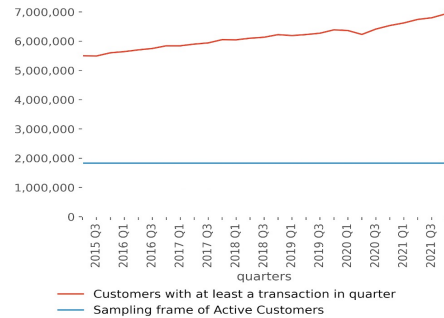
Bank Accounts
≠
Active Consumers

Expenditure
≠
Consumption

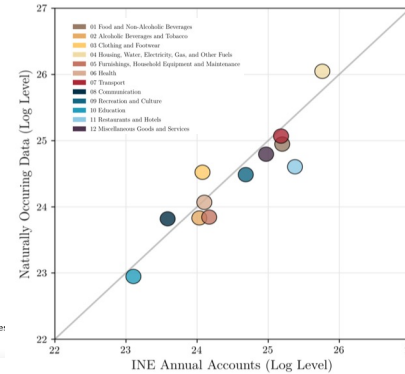
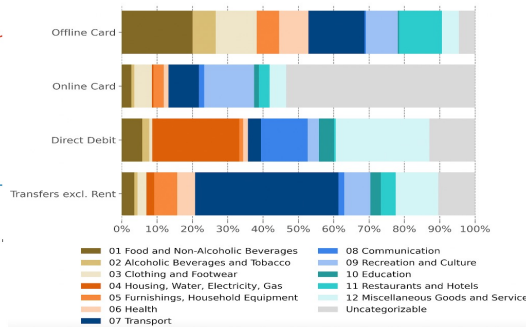
Transactions
≠
N. Acc (COICOP)

Bank Clients
≠
Population

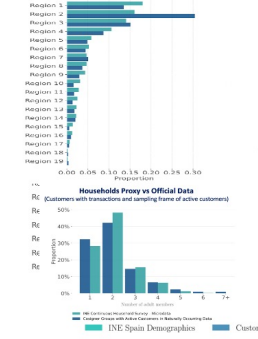
Customers with transactions and sampling frame of active customers



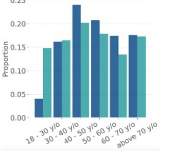
Share of Spending in COICOP by Payment Method



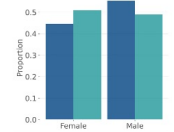
Regional distribution (Autonomous Communities)



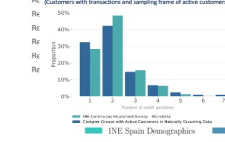
Age distribution



Gender distribution

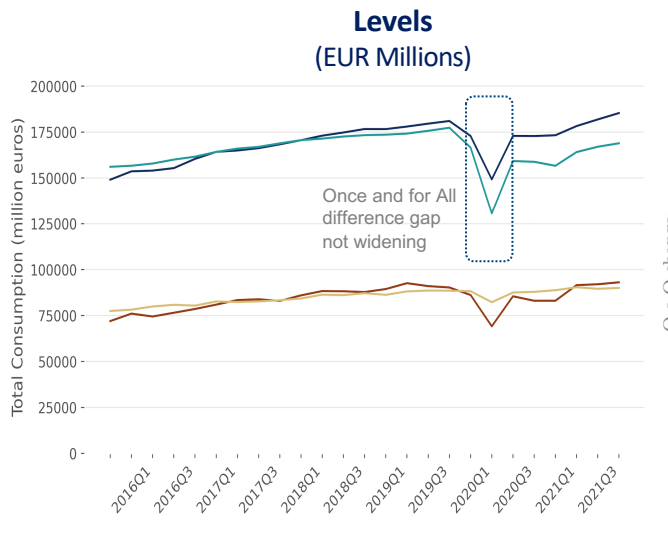


Households Proxy vs Official Data



Aggregation after Sticking to Robust Rules produce good results replicating National Accounts in Levels, Growth & Categories

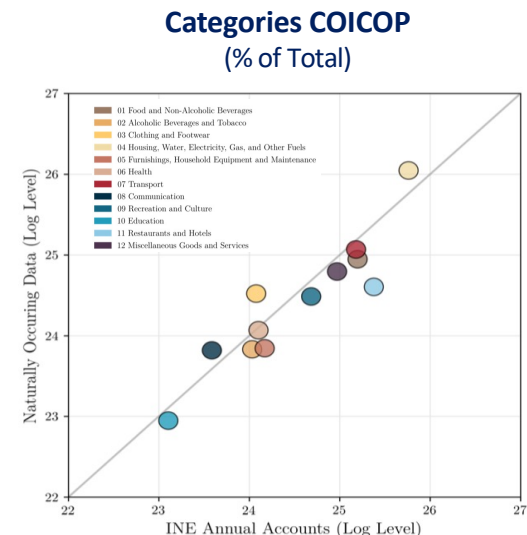
Total Consumption: Naturally Occurring vs Official



- Total Consumption in Naturally occurring data
- INE Household Final Consumption Expenditure
- Card and Cash Consumption in Naturally occurring data
- Consumption except Card and Cash in Naturally occurring data



- Total Consumption in Naturally occurring data
- INE Household Final Consumption Expenditure

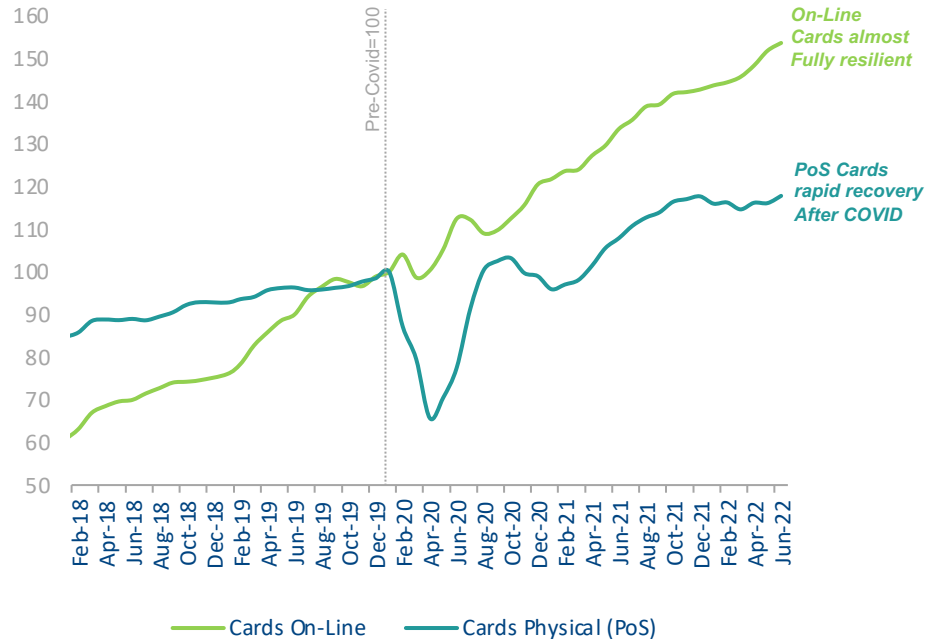


Beyond Cards: The Benefits to Consider the rest of the Payments

Cards (PoS & OnLine) proved to be very useful to track activity...

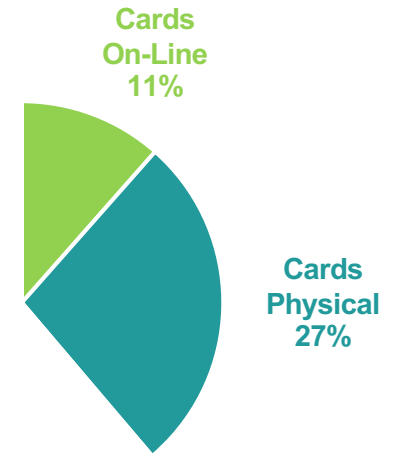
Spain: Evolution of Payments for Consumption

(SAdj. Cum 3M January 2020=100)



Spain: Distribution of Payments for Consumption

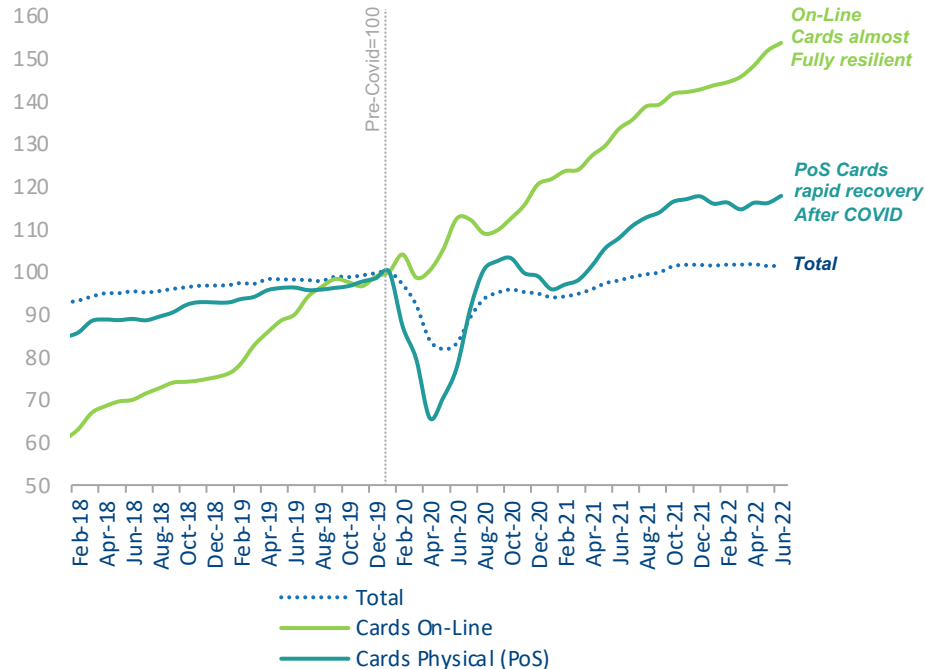
(Cumulative June 2020-2021, % of Total)



... But the real view is partial (38%) & biased (upwards) after COVID...

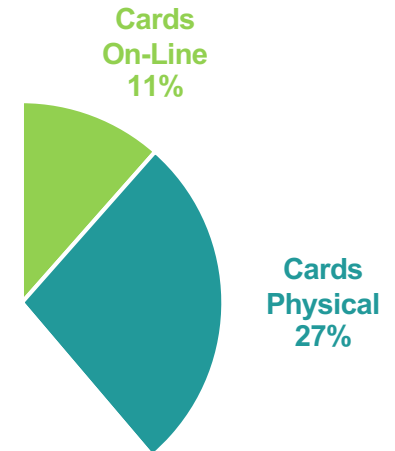
Spain: Evolution of Payments for Consumption

(SAdj. Cum 3M January 2020=100)



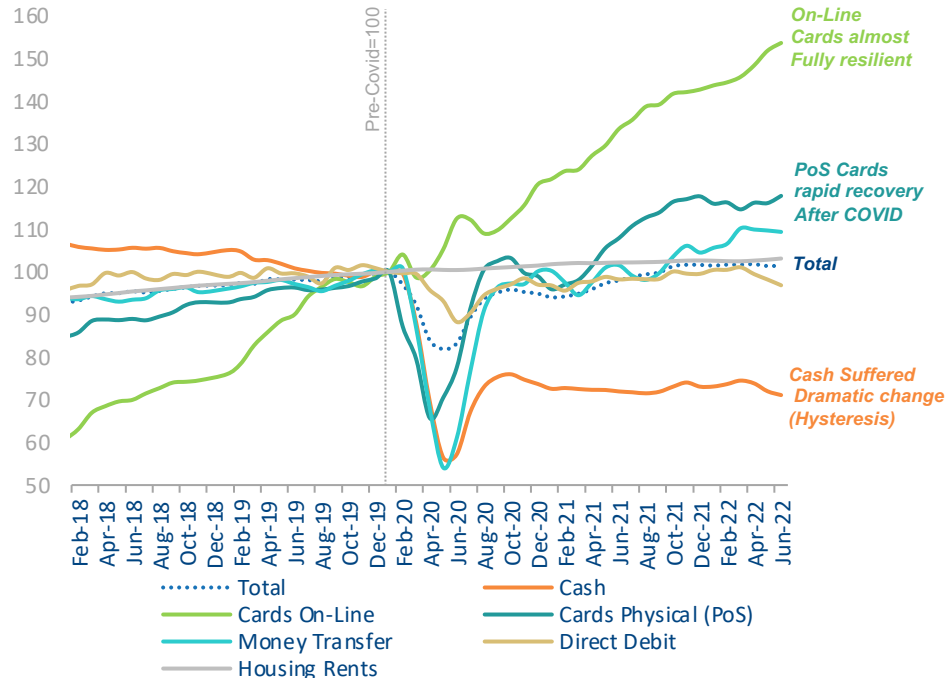
Spain: Distribution of Payments for Consumption

(Cumulative June 2020-2021, % of Total)

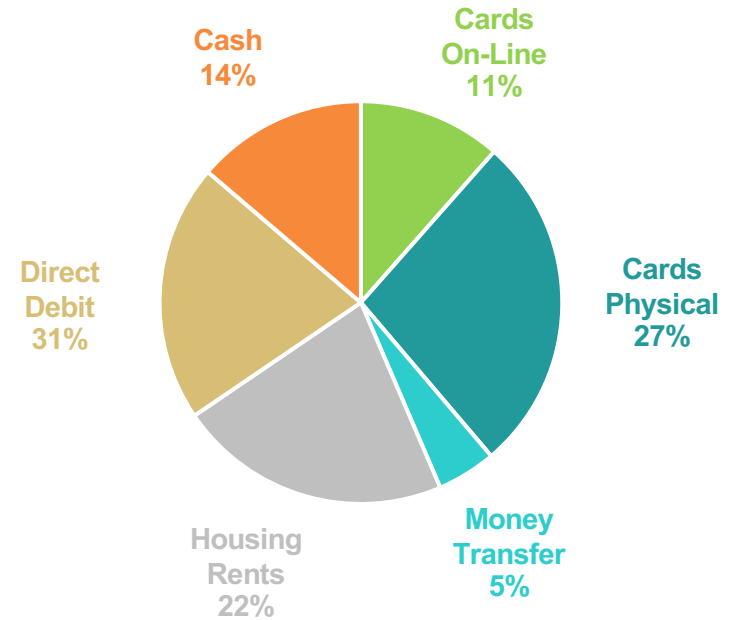


.. Cards can be misleading, leading to an optimistic view and important biases for the lower income consumption distribution

Spain: Evolution of Payments for Consumption
(SAj. Cum 3M January 2020=100)



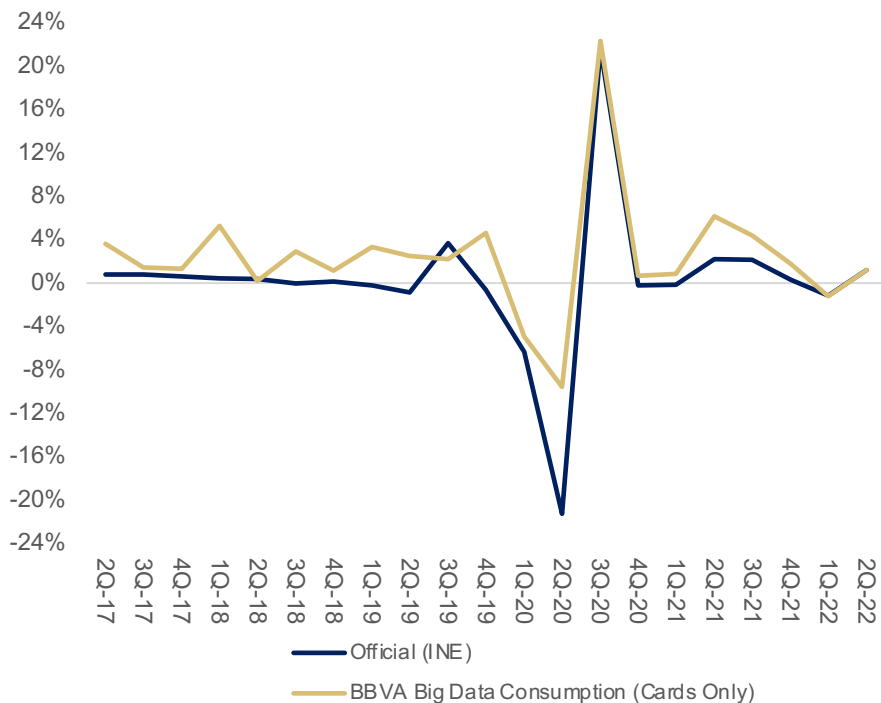
Spain: Distribution of Payments for Consumption
(Cumulative June 2020-2021, % of Total)



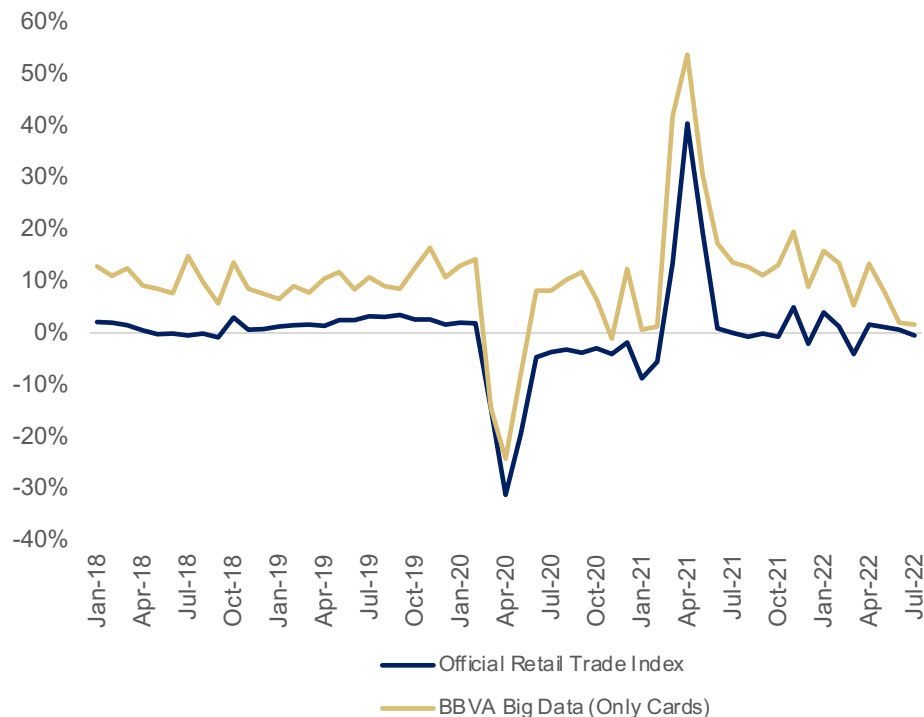
Source: BBVA Research & Buda et Al (2022).

How Naturally Occurring fits Official Statistics: The case of Cards

Spain: Real Household Consumption vs BBVA BigData
(Sadj %QoQ Growth Rate CPI deflated)

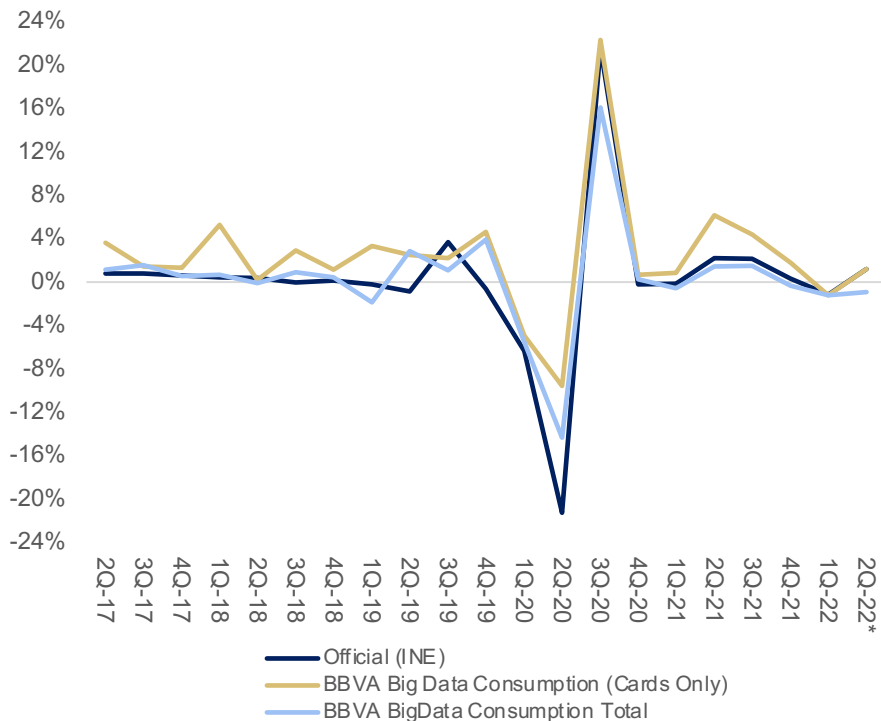


Spain: Retail Sales Index vs BBVA Big Data
(Sadj %mom Growth Rate. Big Data CPI deflated)

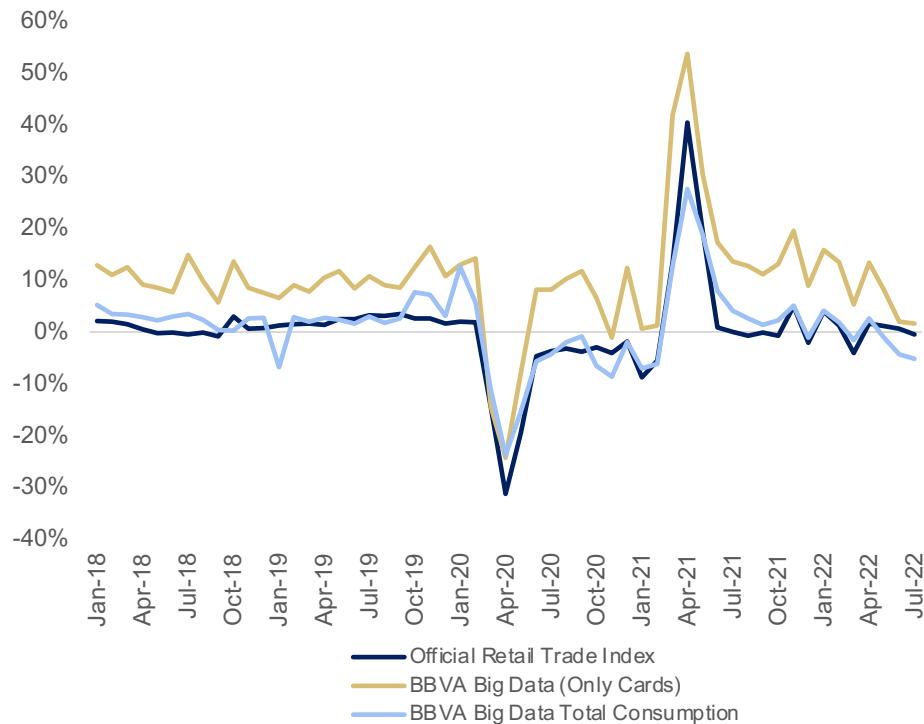


How Naturally Occurring fits Official Statistics: Total Consumption

Spain: Real Household Consumption vs BBVA BigData (Sadj %QoQ Growth Rate CPI deflated)



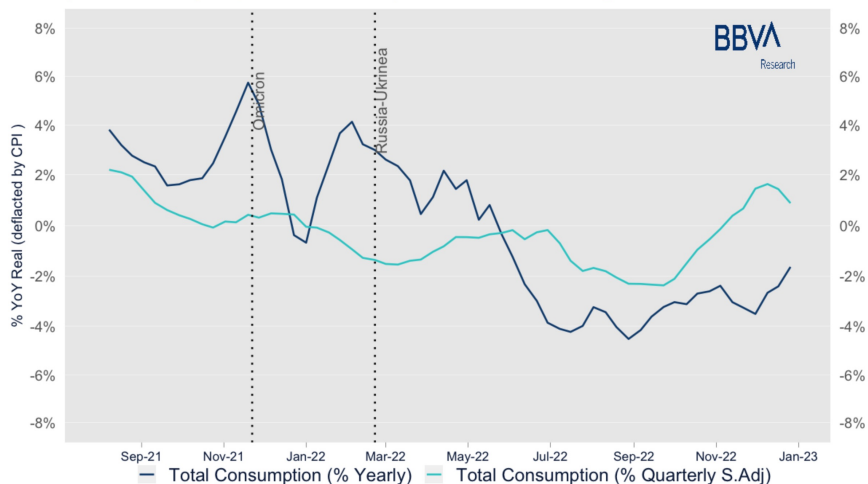
Spain: Retail Sales Index vs BBVA Big Data (Sadj %mom Growth Rate. Big Data CPI deflated)



We can obtain reliable indicators for Total Consumption & Categories

Spain: BigData Total Consumption (BBVA Research)

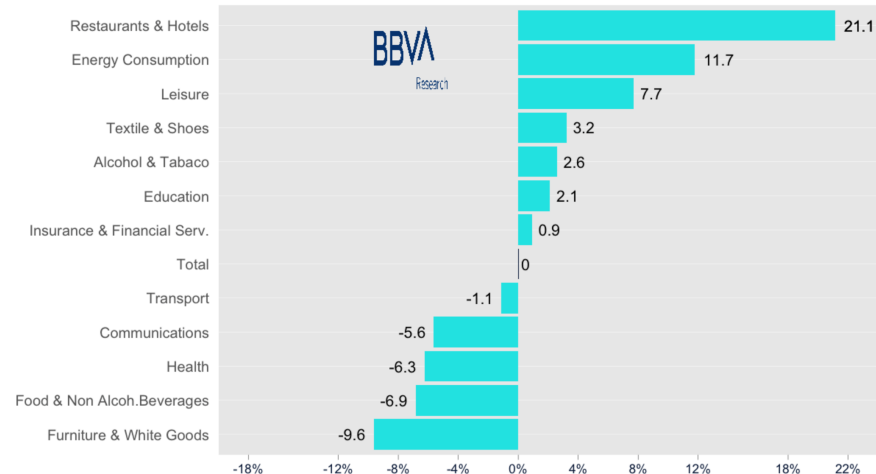
(Real deflated by CPI, Cum 28D % Yearly & Cum 90D % QoQ Sadj)



Source: BBVA Research

Consumption by Categories COICOP (BBVA Research)

(Real deflated by IPC Coicops, Cum 28D YoY)



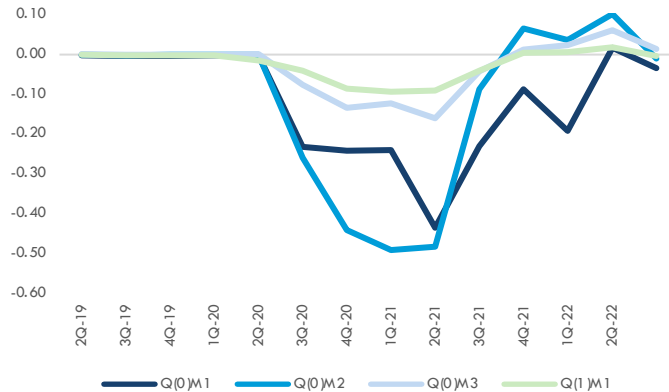
Source: BBVA Research

...Or introduced in Nowcasting Models (i.e Dynamic Factor Models)

$$X_t = \lambda(L)f_t + e_t$$

$$f_t = \Psi(L)f_{t-1} + \eta_t$$

Spain: Improvement of AIREF Nowcasting Model by introducing Big Data (Reduction in the average 4 quarter RMSE error)



Relevance of Big Data as a Nowcasting Variable in AIREF Model (2018-22) (Deterioration in RMSE of the Model when Dropping any of the variables)

	Social Security Registered employment	BBVA Consumption Data	PMI services	Large Company Sales deflated	Large Company Salaries Deflated	Industrial Production	Real Imports of goods	Electricity Consumption
Nowcasting Q(0)M1	-30,09%	-4,05%	-8,89%	0,22%	0,39%	1,77%	0,53%	5,31%
Nowcasting Q(0)M2	-87,88%	-10,10%	9,87%	-7,33%	-6,55%	-19,22%	-0,60%	7,15%
Nowcasting Q(0)M3	-28,39%	-2,06%	3,78%	1,94%	2,40%	8,56%	1,52%	4,85%
Back-Cast Q(1)M1	-48,91%	-1,53%	-5,09%	-0,82%	0,64%	8,67%	4,36%	-0,55%
Average	-44,23%	-4,25%	-1,32%	-0,98%	-0,39%	0,72%	1,26%	4,48%

Source: BBVA Research (forthcoming)

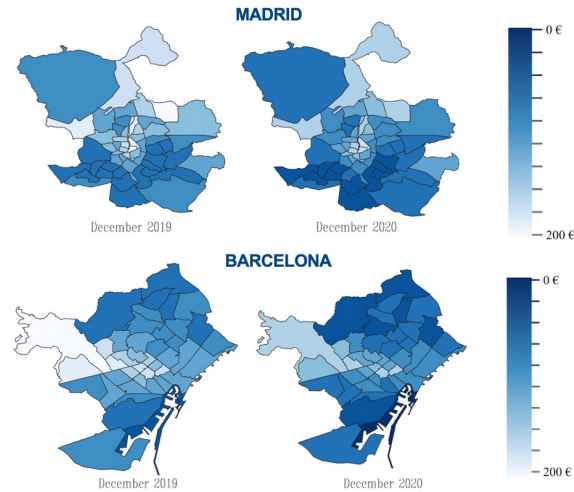
Zooming Out: National, Regional, Provincial, Urban and Zip Code...

Urban Big Data Consumption: Barcelona & Madrid in Real Time & High Definition for Smart Policies

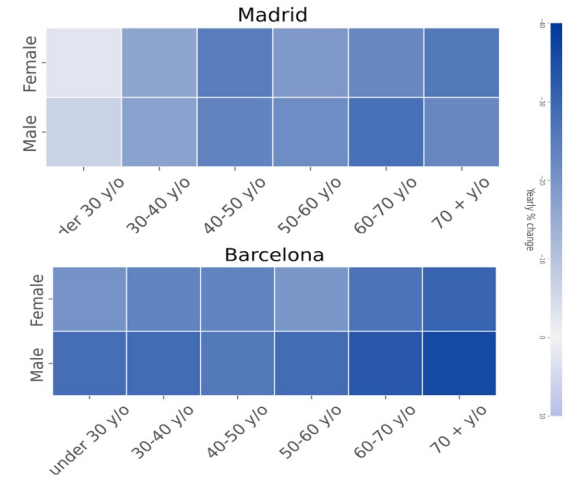
Urban Big Data Consumption: Barcelona & Madrid
(Moving Average 28D. YoY Nominal)



Consumption in Restaurants & Hotels in 2020
(Avg Consumption per person December 2020 & December 2019, %)



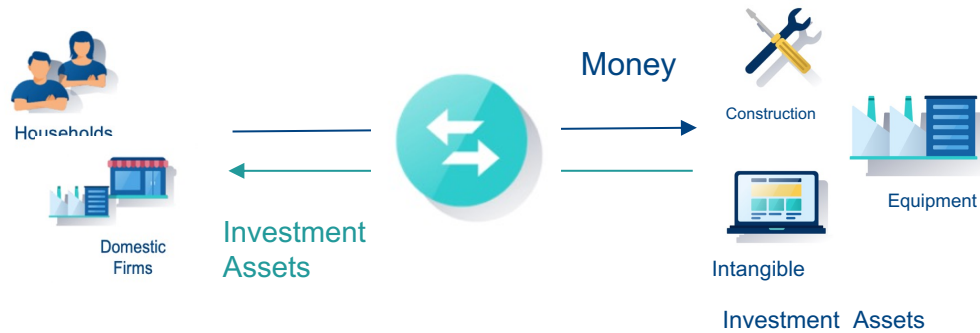
Change in Consumption Restaurants & Hotels in 2020
(December 2020 vs December 2019, % YoY)



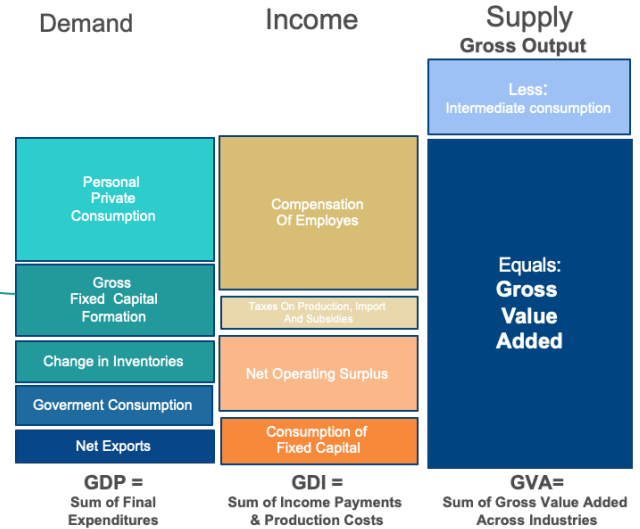
Source: Buda et al (2022) BBVA Research

Firm-to-Firm Transactions should be considered to replicate Investment

Financial Transactions & Private Investment



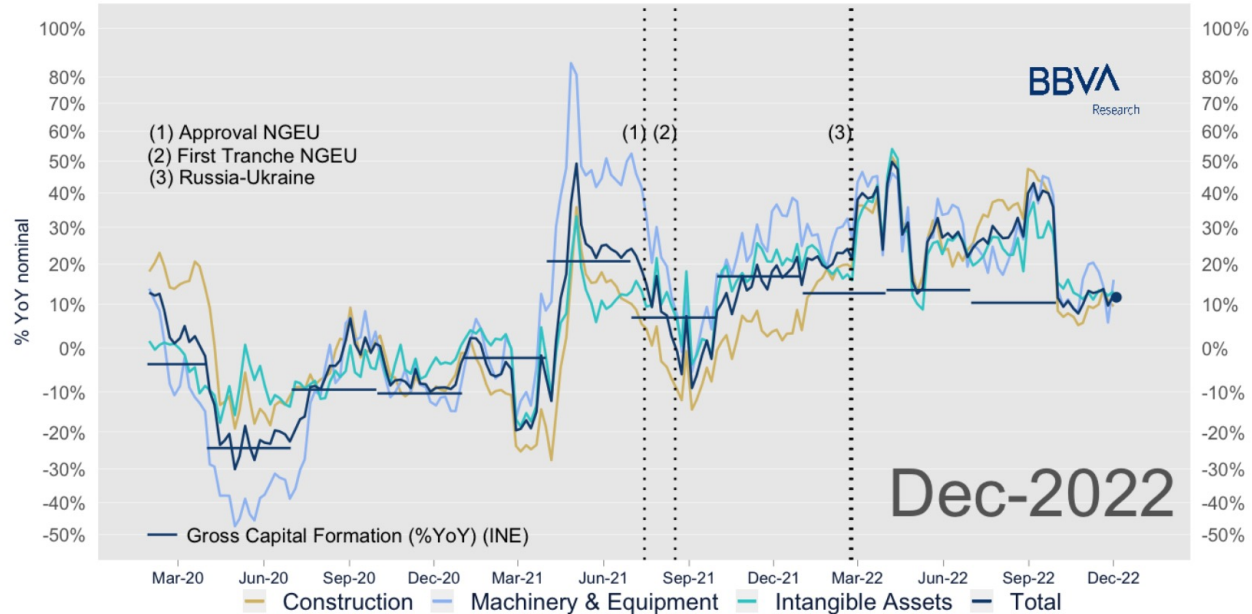
The National Accounts System



... and we can obtain good proxies for Investment & asset categories

Spain: Big Data Investment Index (BBVA Research)

(Nominal, % YoY, cumulative 28D - Fecha:22-12)

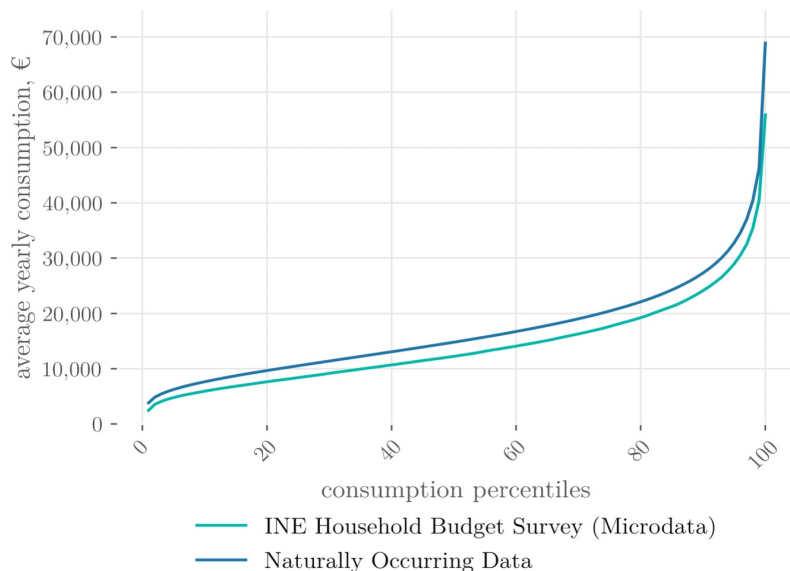


Source: BBVA Research

National Accounts in a World of Naturally Occurring Data: Distributional Accounts & Analysis

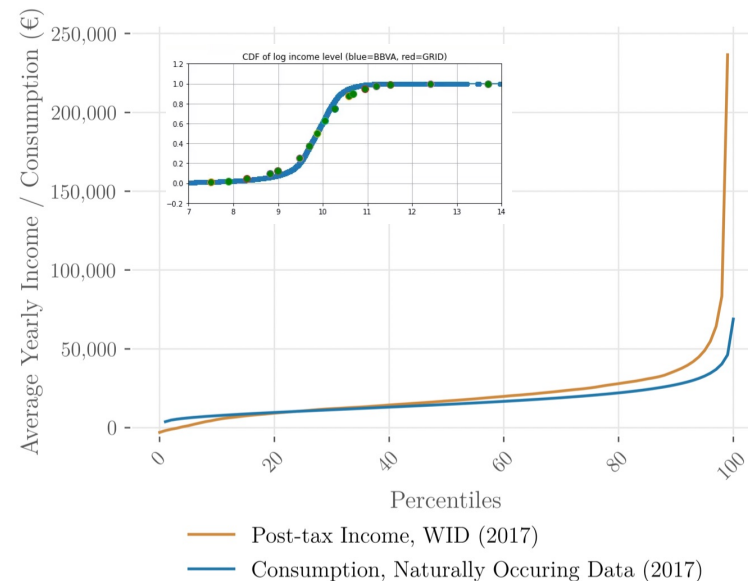
Consumption Distributional Accounts: Right Tail Inequality

Distribution of Consumption BBVA vs. Spanish Household Budget Survey
(yearly consumption per adult distribution 2017)



Source: Buda et Al (2022).

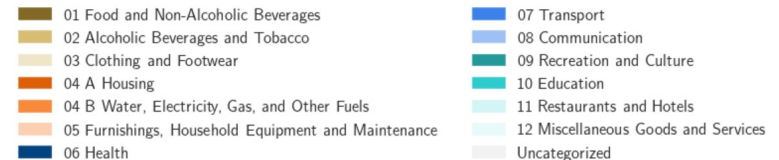
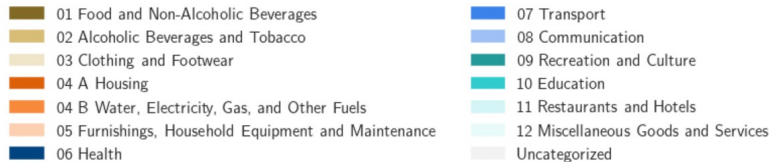
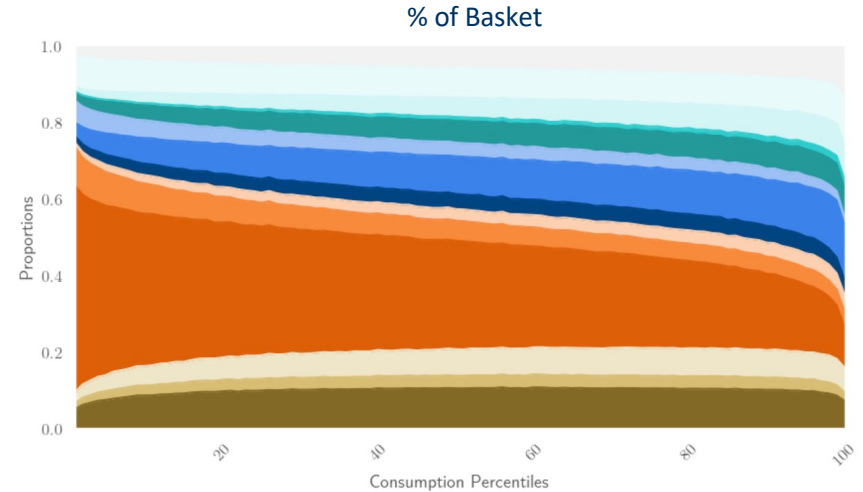
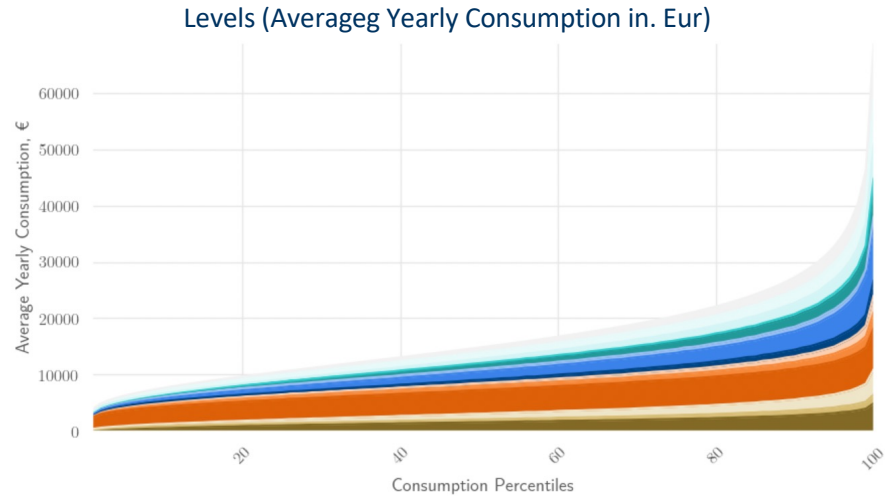
Consumption Distribution per Spanish adult in 2017 BBVA vs. WID 2017 post-tax income distribution.



Source: Buda et Al (2022).

Consumption Distributional Accounts: Mainly due to Services

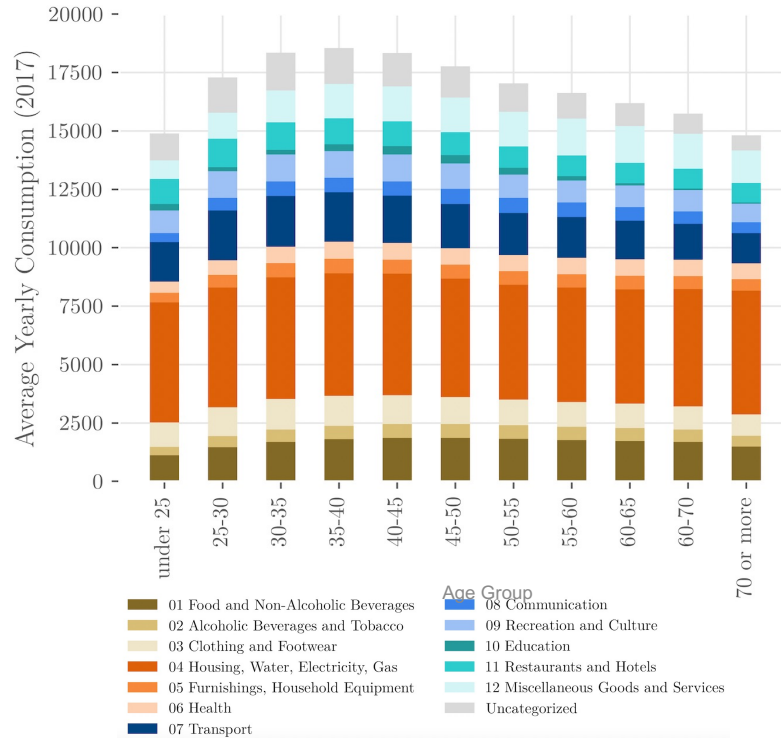
Spain: Consumption distribution disaggregated by COICOP consumption categories pre Covid (2017)



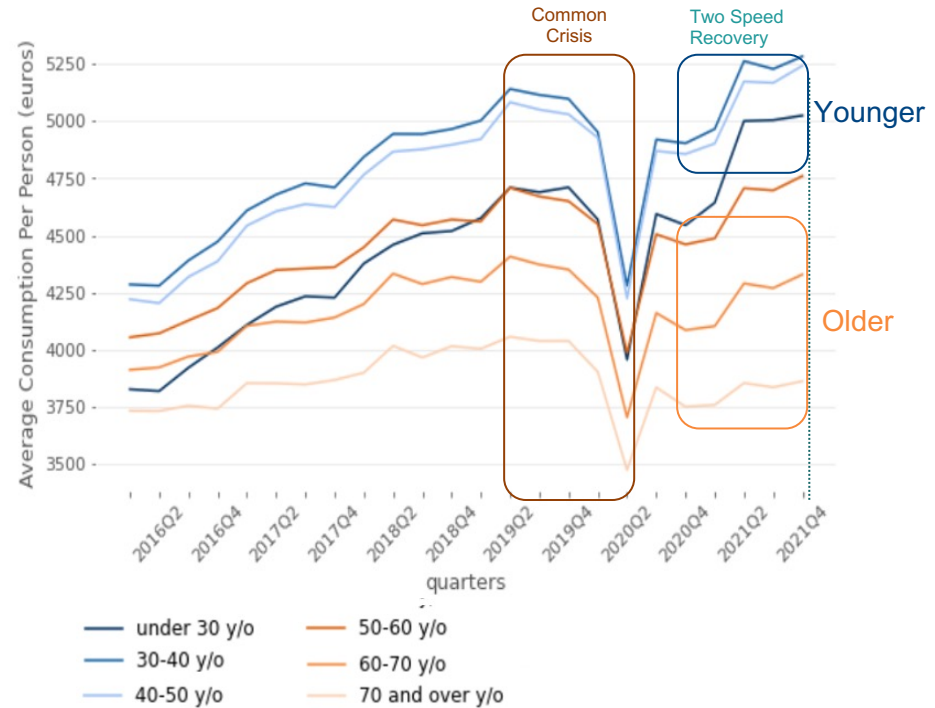
Source: Buda et Al (2022).

Consumption Distributional Accounts: Age Matters

Spain: Proportion of Consumption per Age (2017)



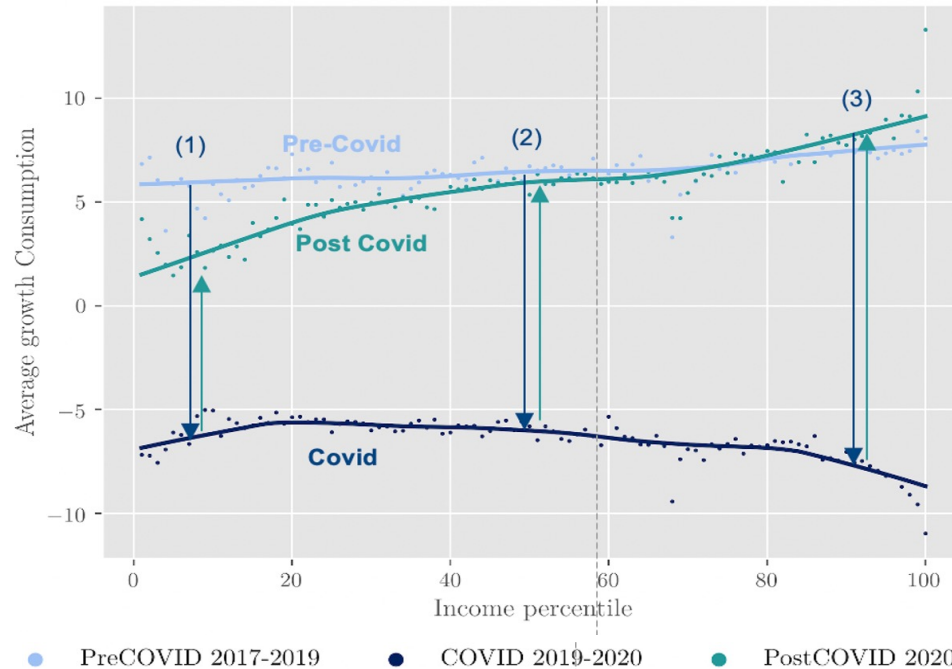
Spain: Levels of Consumption by Age Groups 2016-21



Source: Buda et al (2022). National Accounts in a World of Naturally Occurring Data: A Proof of Concept for Consumption. Forthcoming

Consumption Distributional Accounts: Uneven Distribution of Recovery

Spain: Consumption growth by Income Percentile



...Consumption growth rates were Evenly distributed before Covid

...A sharp adjustment in Consumption Growth for “High Income” and the lower ones ...

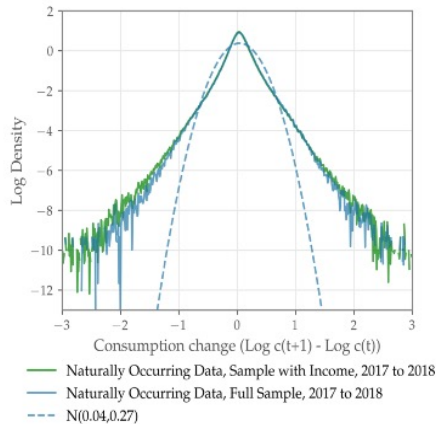
...Just a partial recovery for All but specially the lower income people

Source: BBVA Research & Buda et Al (2022)

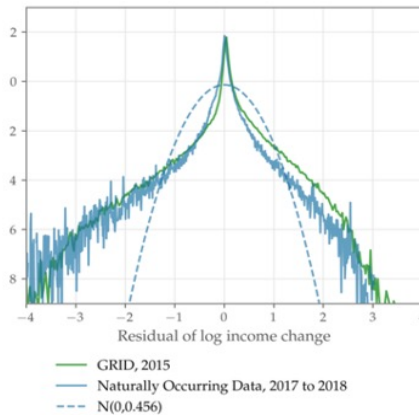
Consumption Dynamics Analysis: Fat Tails & Mean Reversion

Log Density of Consumption & Income Growth

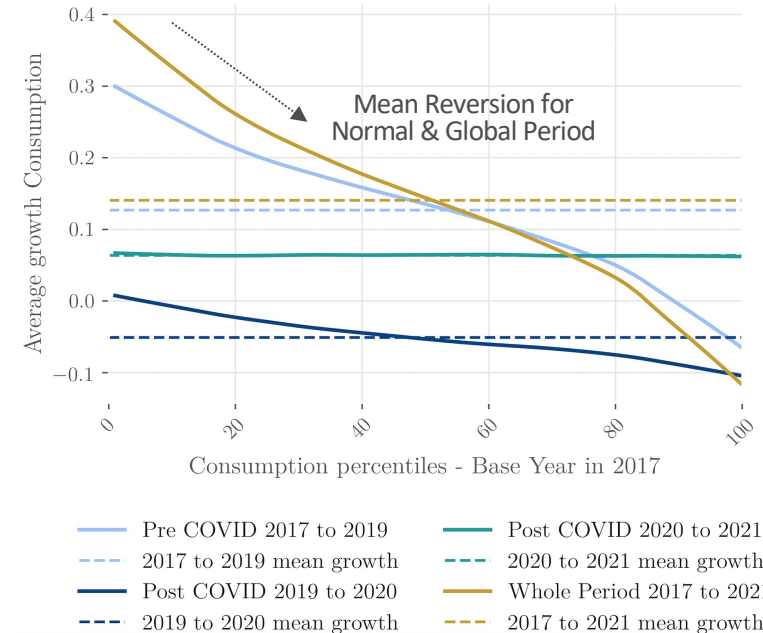
Consumption growth



Income growth



Consumption Growth rates conditional on initial consumption percentile (Growth Between Years for Consumption percentiles of 2017)

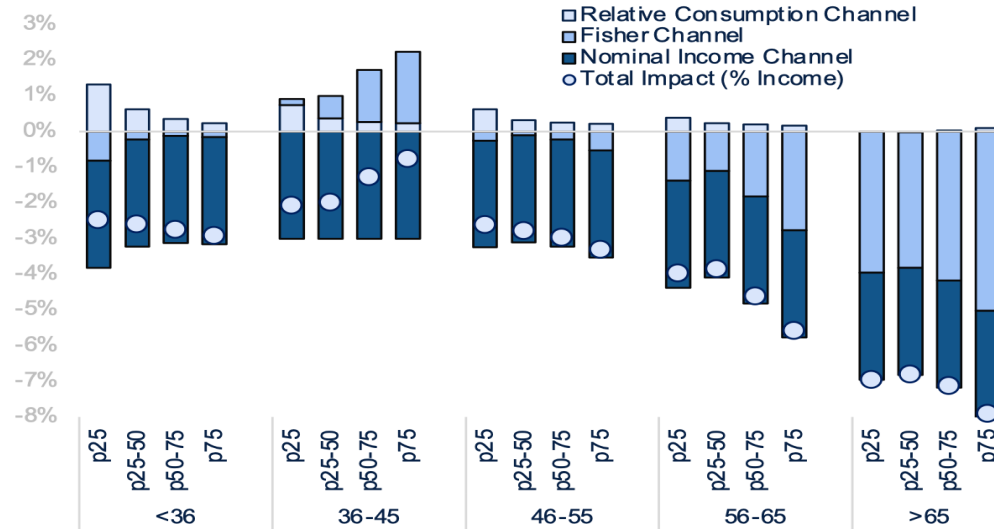


Big Data for “Smart Policies” and Sustainability

Monetary Policy: Inflation Bite is not All Alike

Effect of “Inflation Shock” on Household by Income & Age

(Unexpected Shock. Median Total Effects by Age & Percentiles of Income in % of Income)



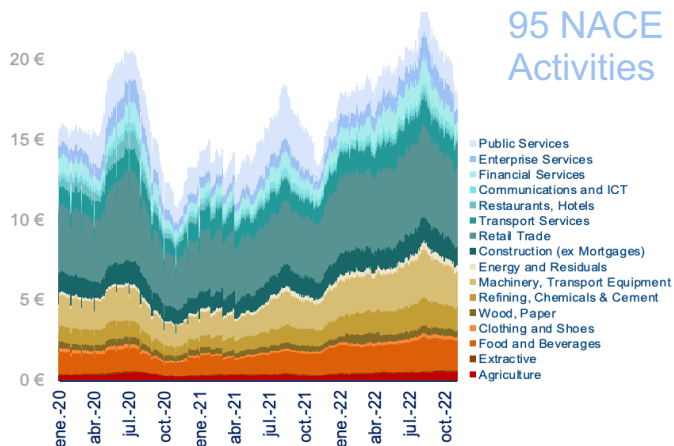
Source: Forthcoming by Cardoso et al (BBVA Research and Bank of Spain)

Macro-Prudential Policy: Credit Supporting Scheme

Spain: New Loans from Sectoral Corporates

(in Eur Bn. Cumulative 90 days New Lending Operations by NACE Code)

95 NACE
Activities

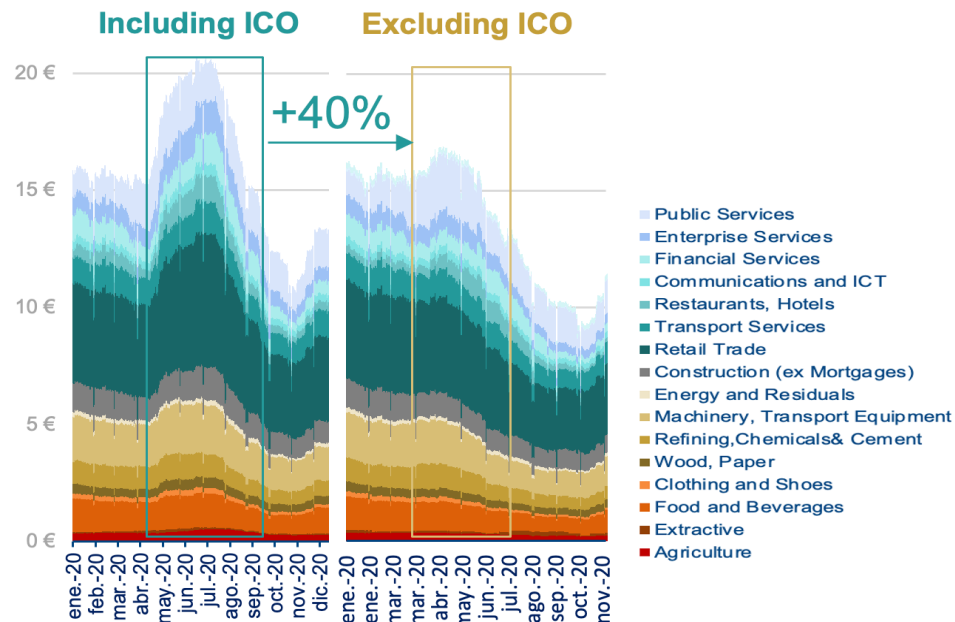


New Lending
Loans by NACE code

BBVA
Research

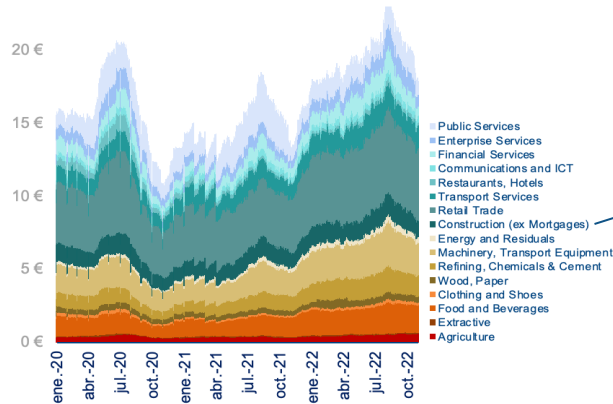
Spain: New Loans & Credit Supporting Scheme ICO

(in Eur Bn. Cumulative 90 days New Lending Operations by NACE Code)

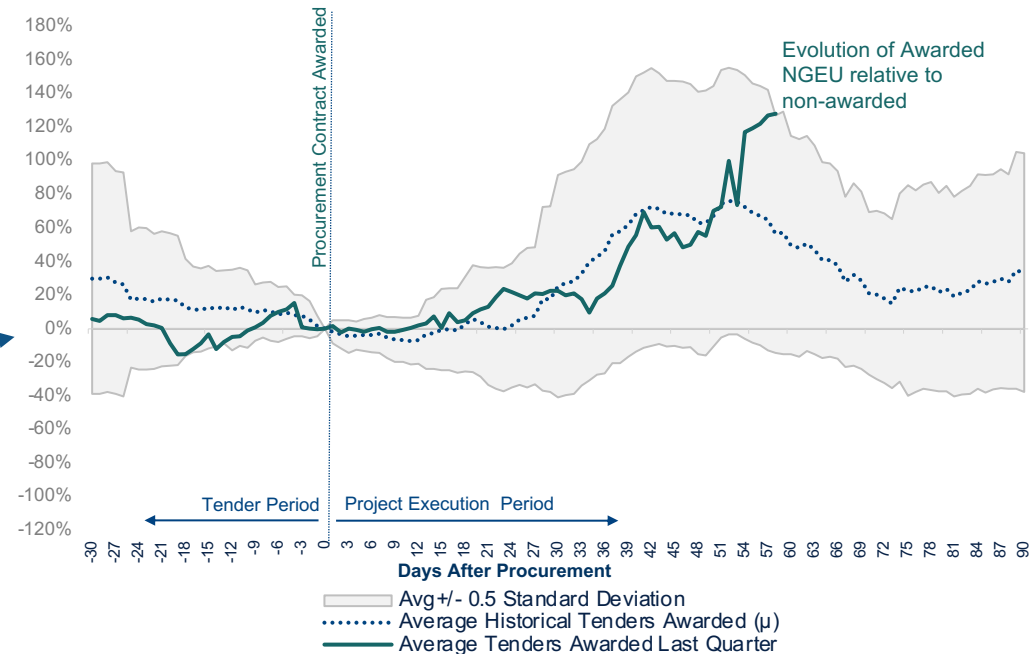


Fiscal Policy: A “Crowding-In” Monitor of NGEU Funds from

Spain: New Loans by NACE Sector
(90d cumulative, Eur Bn)



Impact of NGEU Funds on New Loans: Construction Sector
(Loans Awarded vs Non-Awarded ratio evolution. Procurement Award Day= 0)



Source: Forthcoming by BBVA Research & Spanish Ministry of Economics

Sustainability: Distributional Co2 Emissions & Sustainable Life-Styles

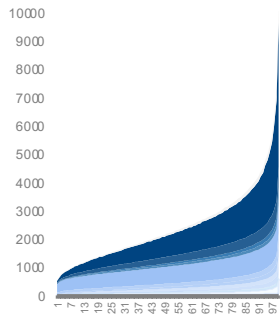
Distributional Accounts of Co2 Emissions by Households



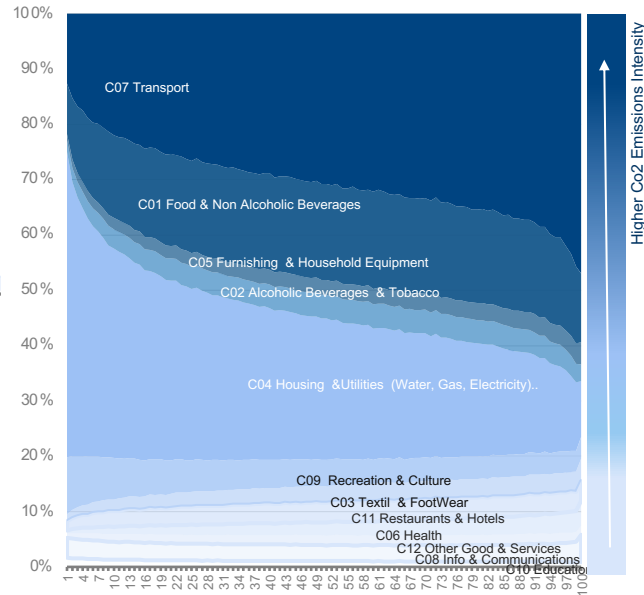
Urban Life-Styles and Sustainability



Households Co2 Emissions
(000 Tonnes)

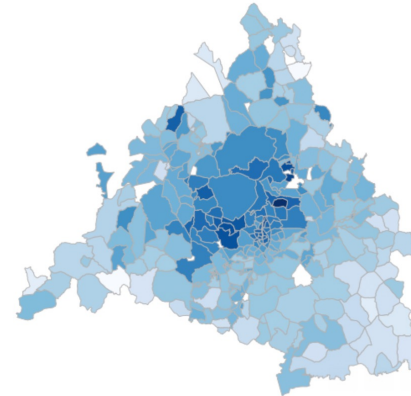


Households Co2 Emissions by Consumption Category
(% of total Emissions)

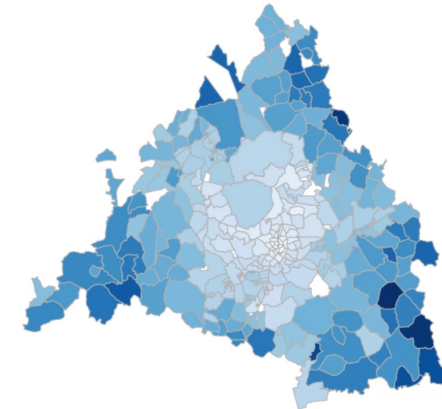


Madrid Lifestyles: Inner vs Outer Lifestyles Madrid Region
(Average Lifestyle intensity by zip-code)

Go Bars & Restaurants



Car Trips



Source: BBVA Research (forthcoming)

Source: BBVA Research & MIT Media Lab (forthcoming)

Conclusions & What's Next

Conclusions

- We have provided the **first proof of concept that naturally occurring transaction data, can be harnessed to produce high quality consumption survey.**
 - Aggregation of the data after implementing some **Consistency and Transparent rules result in good proxies of National Accounts levels and growth**
 - **Financial transaction data constitute a powerful economic tool to track the economy in real time and in high definition** across characteristics such as age, gender, consumption, income ...and the potential to zoom out geography to high granularity.
 - The combination of **this information constitutes the basis for better diagnoses and furthermore for the design of smart policies.**
 - We are **already working to complete the full map of national Accounts** (Demand, Income & Supply and their links through Input-Output table of Transactions)
-

**Bank of Italy Workshop
"The use of consumer transaction data
and other Big Data in European Banks"**

**Beyond Cards: Big Data
at BBVA Research**

**Alvaro Ortiz, PhD
Head of Big Data Analysis
BBVA Research**

Rome, December 2022