

Preferences and Willingness-to-Pay for BEVs and PHEVs Across Six European Markets

Stefan E. Mabit, Anders F. Jensen, Símun P. Pálsson, and
Jeppe Rich

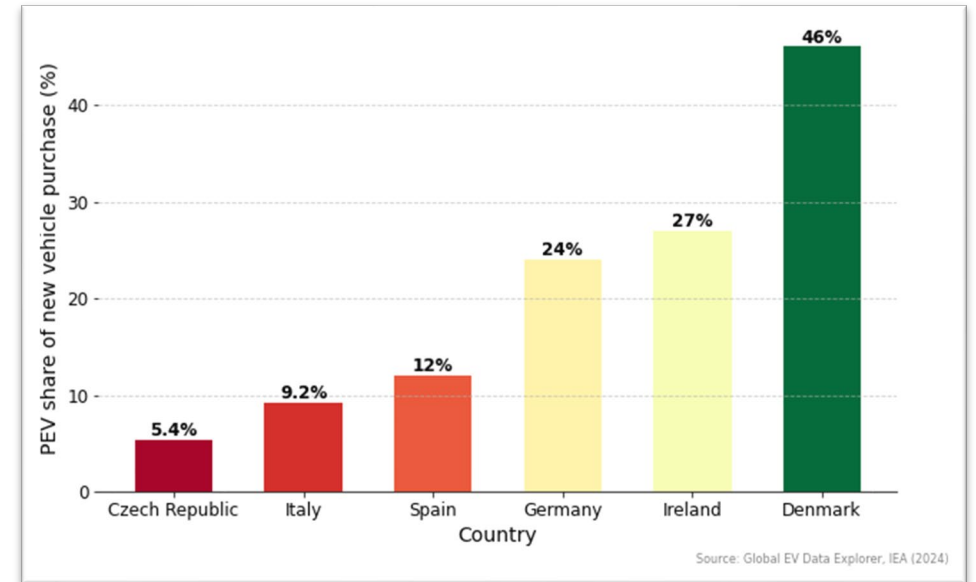


Agenda

- Motivation and research question
 - Methodology – survey and modelling approach
 - Data and Analysis
 - Discussion and conclusion
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- NB We use the term Plug-in Electric Vehicles (PEVs) to denote Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs)

Motivation

- Motorised transport currently moves towards electrification
 - PEV (BEV and PHEV) share in Europe increased from 3% in 2019 to 22% in 2024
- However, there are large differences across countries



Motivation II

- Trends within countries are very different
- PHEV trends
 - DK seems to have peaked
 - D might have peaked
 - CZ, EI, ES, IT are stable or have small decrease or increase
- BEV trends
 - DK sharp increase
 - DE and EI some increase + small decrease
 - CZ, ES and IT mild increasing trend

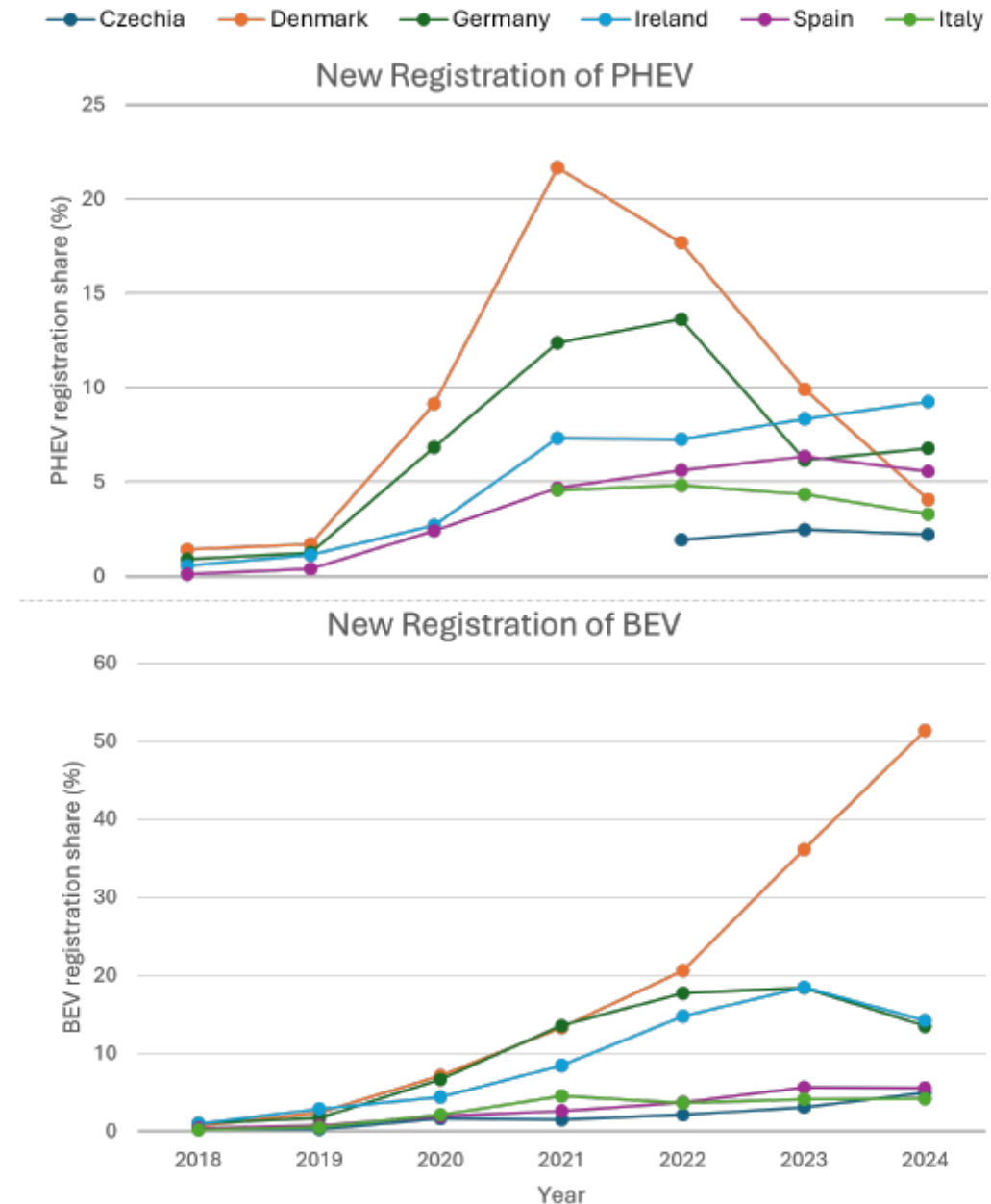


Figure 3: Observed PEV shares of ownership across regions

Research questions

- **How do preferences and WTP measures for PEVs vary across six countries in Europe?**
- **How can we explain variation in PEV demand across six countries in Europe?**
 - Differences in vehicle attribute preferences?
 - Differences in charging preferences?
 - Socio-economic effects?
 - Other country-specific effects?

Methodology – survey with SC experiments

- We rely on stated choice (SC) experiments, see Ben-Akiva et al. (2019). This instrument is included within a survey organised in four parts
 1. Introduction and intro questions
 2. SC experiments
 3. Background questions (age, household, income, ...)
 4. Attitudinal questions
- Each choice that respondents make is a choice between 6 different cars out of 15 potential cars defined by 3 fuel types times 5 car segments.
- We apply panel mixed logit models, see Train (2009) for details on mixed logit and Jensen et al. (2021) for a similar availability approach.

Survey - stated choice experiments



		Petrol car	Petrol car	Plug-in Hybrid car	Plug-in Hybrid car	Electric car	Electric car
Car class		Small	Medium	Small	Medium	Small	Medium
Costs							
Purchase price	①	209,000 DKK	447,000 DKK	349,000 DKK	268,000 DKK	349,000 DKK	268,000 DKK
Operation cost (Expenses per 10,000 km)	①	1.02 DKK/km (10,211 DKK)	1.25 DKK/km (12,528 DKK)	0.94 DKK/km (9,432 DKK)	0.68 DKK/km (6,800 DKK)	0.49 DKK/km (4,912 DKK)	0.61 DKK/km (6,120 DKK)
Yearly cost (tax/fees, insurance, car inspection)	①	6,759 DKK	7,444 DKK	6,759 DKK	7,444 DKK	7,729 DKK	8,514 DKK
Charging							
Range gained per 10 min fast charging	①					36 km	108 km
Vehicle-to-grid (V2G) capabilities	①					It is possible to use the car's battery to power your home	
Car Characteristics							
Boot size	①	325 litre (Medium)	392 litre (Medium)	325 litre (Medium)	504 litre (Extra large)	418 litre (Large)	336 litre (Medium)
Driving range	①	700 km	700 km	Electric: 18 km Petrol: 900 km	Electric: 35 km Petrol: 700 km	466 km	489 km
Acceleration (0-100 km/h)	①	14.3 sec.	14.3 sec.	5.4 sec.	6.9 sec.	10.2 sec.	11.2 sec.
CO ₂ emissions (emissions per 10,000 km)	①	87 g/km (870 kg)	121 g/km (1,210 kg)	81 g/km (810 kg)	57 g/km (570 kg)	36 g/km (360 kg)	41 g/km (410 kg)
Which car would you prefer in this situation?		☐	☐	☐	☒	☐	☐

Sample

- Online panels in 6 European countries
- Respondent fulfils the following criteria:
 - At least 1 car in household
 - At least 18 years of age
 - Spent at least 5.4 minutes on the full survey
- Data were collected in May-June 2024 where we obtained observations from 6,414 respondents.

Full sample

country	Sample	Female	House
Czech Republic	1077	0.51	0.45
Denmark	1087	0.50	0.67
Germany	996	0.48	0.58
Ireland	990	0.51	0.79
Italy	1020	0.53	0.65
Spain	1244	0.48	0.68
Total	6414	0.50	0.64

Subsample used in SP2

country	Sample	Female	House
Czech Republic	247	0.49	0.44
Denmark	273	0.50	0.66
Germany	243	0.49	0.53
Ireland	243	0.49	0.85
Italy	247	0.50	0.67
Spain	251	0.47	0.69
Total	1504	0.49	0.64

Data and descriptive statistics

- In the final sample, the population is skewed compared to the country populations above 18 years.
- We adjust for this by controlling for socio-economic variables in the modelling.

	Czechia	Denmark	Germany	Ireland	Italy	Spain
Sample size	1077	1087	996	990	1020	1244
Gender						
Female	0.51 (0.51)	0.50 (0.51)	0.48 (0.51)	0.51 (0.51)	0.53 (0.52)	0.48 (0.51)
Age						
Between 18 and 31	0.15 (0.16)	0.22 (0.21)	0.13 (0.17)	0.16 (0.20)	0.12 (0.15)	0.19 (0.17)
Between 31 and 45	0.32 (0.27)	0.20 (0.23)	0.21 (0.23)	0.36 (0.29)	0.26 (0.21)	0.31 (0.25)
Between 46 and 65	0.36 (0.33)	0.37 (0.32)	0.41 (0.34)	0.36 (0.32)	0.43 (0.36)	0.41 (0.36)
More than 65	0.17 (0.24)	0.21 (0.24)	0.26 (0.25)	0.12 (0.19)	0.19 (0.27)	0.09 (0.23)
Number of cars						
1	0.65	0.65	0.67	0.60	0.58	0.58
2	0.29	0.31	0.28	0.34	0.36	0.36
3+	0.06	0.04	0.05	0.06	0.06	0.06
Household monthly net income						
< 800 €	0.07	0.01	0.02	0.01	0.03	0.02
800 - 1.999 €	0.39	0.04	0.18	0.11	0.28	0.24
2.000 - 2.999 €	0.27	0.12	0.23	0.15	0.27	0.30
3.000 - 3.999 €	0.11	0.13	0.23	0.15	0.16	0.20
4.000 - 4.999 €	0.04	0.10	0.13	0.13	0.08	0.10
5.000 - 5.999 €	0.01	0.11	0.08	0.08	0.03	0.04
6.000 - 6.999 €	0.01	0.08	0.03	0.05	0.01	0.01
7.000 - 7.999 €	0.01	0.06	0.02	0.06	0.02	0.01
8.000 - 8.999 €	0.01	0.04	0.01	0.06	0.01	0.01
9.000 - 9.999 €	0.00	0.03	0.02	0.08	0.00	0.01
>= 10.000 €	0.01	0.06	0.02	0.08	0.03	0.04
Don't know / want to tell	0.07	0.22	0.04	0.04	0.07	0.03

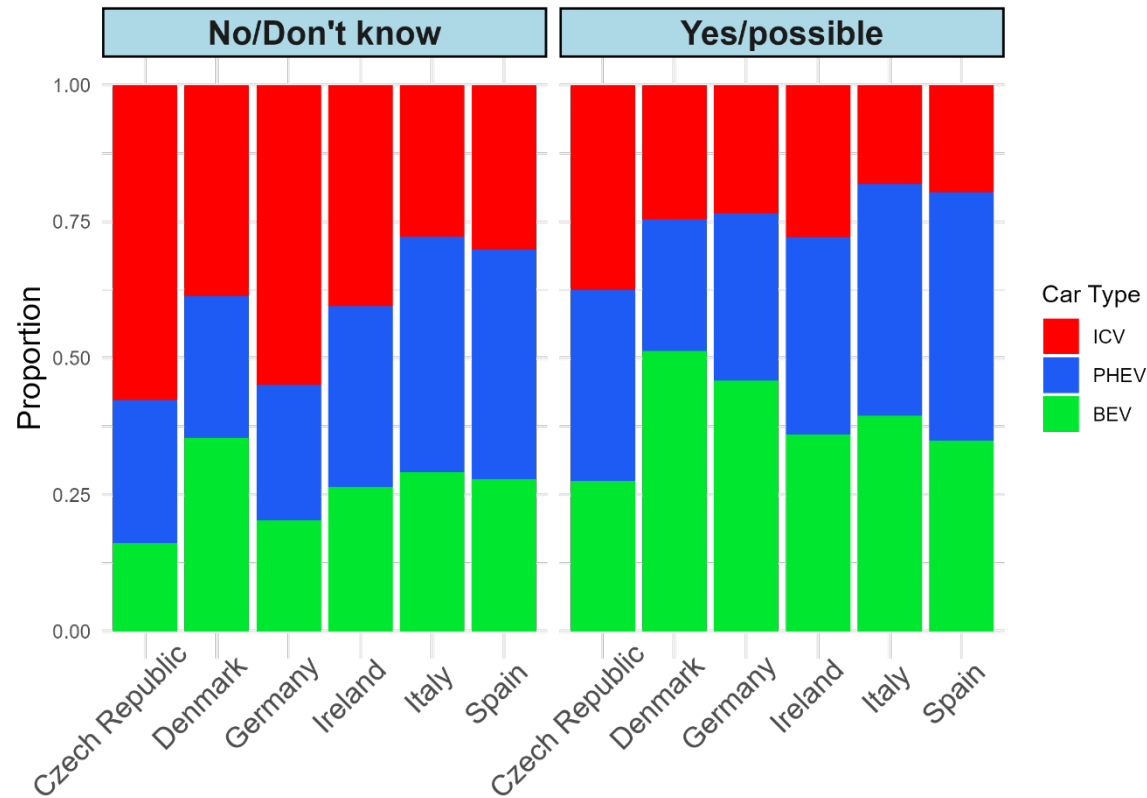
Data and descriptive statistics on observed choices

- The table below presents choice frequency and shares across regions in Denmark

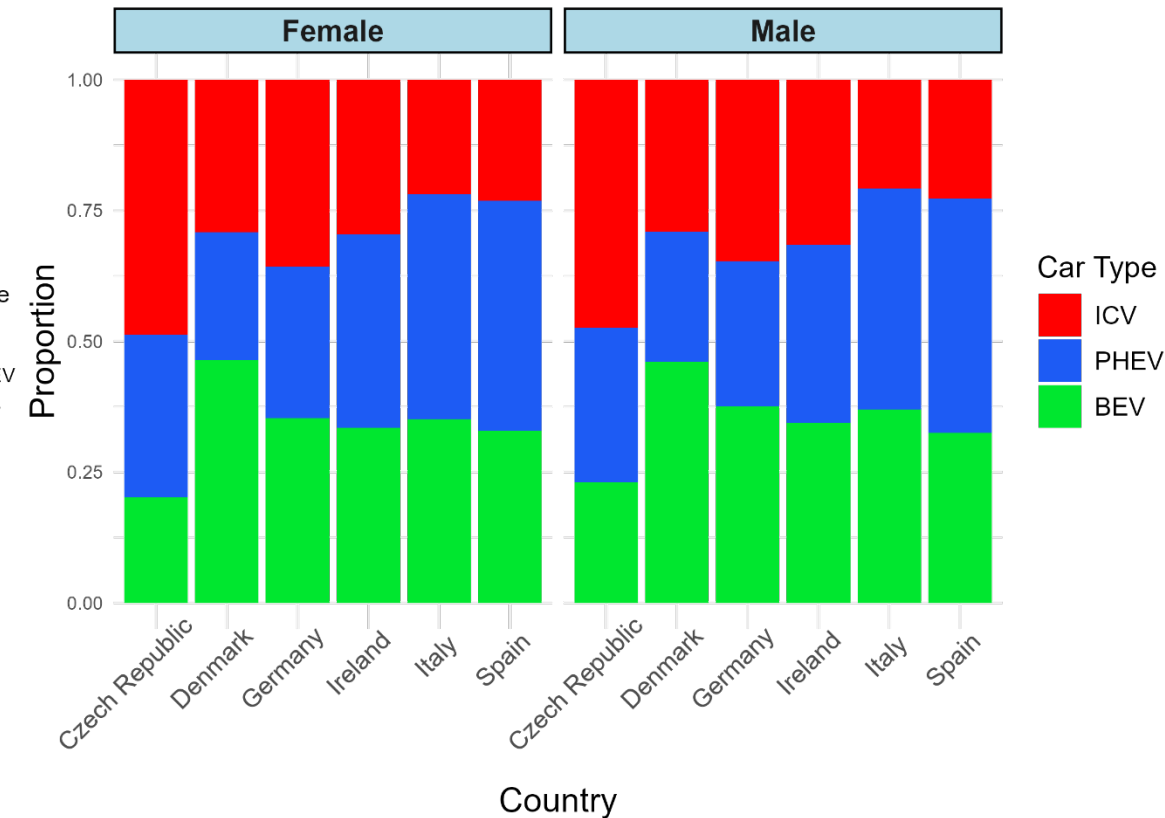
Region	BEV – share	ICV – share	PHEV - share	Total
Czechia	856 (0.20)	2170 (0.50)	1282 (0.30)	4308
Denmark	2007 (0.46)	1292 (0.30)	1049 (0.24)	4348
Germany	1323 (0.33)	1537 (0.39)	1124 (0.28)	3984
Ireland	1329 (0.34)	1204 (0.30)	1427 (0.36)	3960
Italy	1435 (0.35)	892 (0.22)	1753 (0.43)	4080
Spain	1625 (0.33)	1125 (0.23)	2226 (0.45)	4976
Total	8575 (0.33)	8220 (0.32)	8861 (0.35)	25656

How did the sample choose between car types?

Home charging possible?

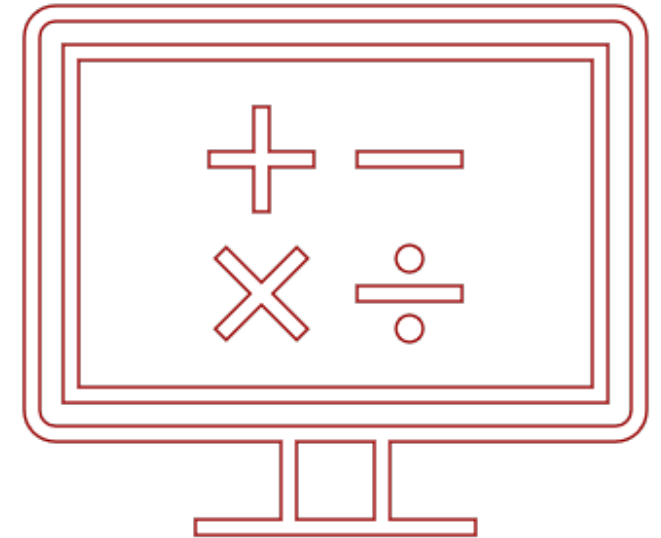


Gender



Mixed Logit model

- We estimate models that captures the effect of all attributes on the car decisions.
- In addition, interaction effects between alternatives and main respondent characteristics for
 - Country
 - Gender
 - Age group
 - Education
 - Charging access
- In addition, interaction
 - Income with cost attributes
 - Other car attributes and non-income characteristics



Analysis – overview systematic heterogeneity

- The results show
 - Cost effects are stable across models and price sensitivity has an elasticity of approx. -0.33 or -0.41 with respect to income
 - Women care less for BEV range, while access to home charger and DK respondents care more
 - Access to home charger is important. In Germany even more for both BEV and PHEV, while only for PHEV in Czechia.
 - Many interactions with car segments, e.g. home charging is associated with larger cars, while women and younger respondent prefer smaller cars
 - BEVs and PHEVs are preferred by younger, more educated respondent, also more in ES, IT and DK compared to EI, which again are more positive than DE and CZ
 - Finally, there is a positive correlation between the random effects for BEV and PHEV

Analysis – WTP measures

- The WTP for a specific attributes is found as the trade-off between the marginal utility of the attribute, x_k , and the marginal utility of money, i.e. we get the value of one unit improvement.
- Here the mean values are presented with 95% confidence intervals found by bootstrapping.

Attribute	Unit	Model 7
Operation cost	1000 €/ (€/km)	62.7 (45.0;76.4)
Yearly cost	€/ (€/year)	13.1 (11.0;15.2)
CO2	€/ (g/km)	17.2 (6.0;26.9)
Acceleration	€/ (s/100m)	172.2 (36.7;269.8)
Range – ICV	€/km	4.5 (1.4;7.5)
Range - BEV	€/km	21.3 (16.6;26.5)
V2X	1000 €	2.7 (1.0;4.8)

Comparison of preferences for BEV vs. ICV

- Base individual on the left:
 - Female
 - Age > 31
 - Base edu
 - No home char
- Cars:
 - Medium size
 - BEV range 500
 - ICV range 700

Country	Female	Fem, Edu3	Male, Edu3	Male,Edu3,HomeChar
CZ	-3.87	-2.68	-2.38	-1.22
DE	-3.87	-2.68	-2.38	0.98
DK	-0.68	0.51	0.82	1.98
EI	-2.57	-1.38	-1.08	0.09
ES	-1.58	-0.39	-0.09	1.08
IT	-1.20	-0.01	0.30	1.46

Discussion

- The analysis highlights some policy implications
 - Denmark appears to most positive inline with market shares. So while a possible effect of cost incentives and charging infrastructure, attitudes are also positive.
 - Spain and Italy appear similarly positive as DK, however actual uptake is much lower. Hence, in these countries, there must be other reasons at play, e.g. policies, infrastructure, availability of car types
 - Ireland appears less positive than these countries in preferences but in-between in actual uptake, so here some factors must be at play, e.g. more favourable vehicle prices and charging infrastructure compared to IT and ES, while less than DK
 - For all countries there is a large gap between those with/without access to home charging
 - This gap is even more pronounced for Germany where those without home charging are tied for most negative with CZ. While when it comes to those with home charging they are similar positive as ES.
 - Czechia appears most negative among all six countries in line with actual uptake.

Conclusion

- **We have analysed how preferences and WTP measures for PEVs vary across six countries in Europe?**
- We identify several sources of heterogeneity in PEV preference both within countries and across countries.
- The most surprising results are
 - Spain and Italy are among the most positive despite limited current demand showing good potential when infrastructure or PEV supply is improved or for policies supporting PEV uptake
 - Czechia is most negative showing that policies that address both pricing, infrastructure as well as perceptions and attitudes might be relevant.
 - In Germany we find a much larger divide between those with and without home charging, which can halt the electrification if measures are not found to address the reluctance of those without home charging access.

The end



Any questions?

Literature

- Many studies have focused on attributes and socio-economic effects, e.g. Bansal et al. (2021), Jensen et al. (2021), or see Hardman et al. (2025) for a recent overview.
- Some studies look at charging attributes, e.g. Jensen et al. (2013), Ito et al. (2013).
- A few studies have look at cross-country comparisons, e.g. Helveston et al. (2015) for US and China, Sovacool et al. (2018) for the Nordic region both at the disaggregate level, or Chandra (2022) for many countries at the aggregate level.

Literature

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