Reply to “Proactive measures help shape the EU candidate list of substances of very high concern”

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Matters arising

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Jessica Coria [1] ✉, Erik Kristiansson [2] & Mikael Gustavsson [3]

REPLYING TO A.K. Mörk et al. *Nature Communications* https://doi.org/10.1038/s41467-025-60145-1 (2025)

In Coria et al. (2022)[1], we analyzed the relative importance of toxicological properties, economic motivations, and available scientific knowledge for the inclusion of a substance on the REACH Candidate List (CL). The results showed that the most important factor for listing is whether a substance is produced in, or imported into, the European Economic Area (EEA), with substances being less likely to be on the list if they are currently produced or imported into the EEA. In their Matters Arising, Mörk et al. (2025) raised concerns about our methodological approach and the data quality used in the analysis. Below, we address these issues and demonstrate the robustness of our results.

The Methodological Approach

We used a retrospective experimental design to examine the outcomes of the Authorization program of REACH more than ten years after its implementation. Retrospective studies are designed to identify associations between factors and are a standard statistical approach for scrutinizing legislation and other governmental processes. Such studies have, on multiple occasions, provided important insights into legislative processes[2–4], and many authorities, including the European Parliament, use retrospective designs to evaluate the outcome of policymaking[5,6]. In this context, it should be emphasized that the experimental strategies required to assess direct causality, such as controlled randomization, are typically not applicable when studying legal processes.

Mörk et al. (2025) claim that we do not distinguish between correlation and causation, leading to a conflation of these concepts. However, this is not the case, as evidenced, for example, in the second paragraph of the Discussion. Furthermore, they erroneously interpreted the discussion on the importance of different factors in Coria et al. (2022) as evidence that causality and correlation are incorrectly conflated. This is a misinterpretation since the term 'importance' is a common statistical concept describing how a factor influences a model and is not in any way related to an assessment of causality[7].

We would also like to emphasize that our approach is quantitative and designed to measure relative effects, where we compare all substances in REACH (not on the CL) to those on the CL. We also compare the CL to the Authorization List, as well as to two other lists, including the PRIO list that is maintained by the Swedish Chemicals Agency. This is not true for the data compiled by Mörk et al. (2025), which only includes substances from the CL. Due to the lack of a counterfactual, a direct comparison to the quantitative analysis in Coria et al. (2022) is not feasible.

Data Selection and Quality

The dataset compiled by Coria et al. (2022) encompasses data on toxicity, economic factors, and scientific publication records. It represents the most comprehensive resource available to date and is freely accessible. Mörk et al. (2025) claim that our conclusions "stem from a strong negative correlation between substances included in the CL and substances registered in REACH" and that our included factors are not "adequate proxies". These statements are, however, not supported by the data.

First, to examine the impact of the grouping of substances suggested by Mörk et al. (2025), we have rerun the comparison between REACH and the CL using the grouping provided by ECHA (21st February 2023, Supplementary Data 1). For this new comparison, we only included the substance with the largest Country Count per group, effectively making the influence of the grouping as large as possible. In addition, as suggested by Mörk et al. (2025), we obtained historical tonnage bands from 2008 to 2020 (Supplementary Data 2). We then substituted the tonnage band for each substance on the CL for the tonnage band at the year of inclusion on CL. Implementing these two changes had no significant effect on the results (Fig. 1). This can be explained by the fact that the updated tonnage data shows minimal variation compared to the previously used data (see also refs. 8,9) and that grouping does not explain the observed effects.

If the timing of the annual tonnage data collection introduced measurement errors that influenced our results, removing this variable should eliminate any significant effects. However, even when tonnage information is completely excluded from the model, the effects and

[1]Environmental Social Science and Geography Unit, Department of Environmental Sciences, Aarhus University, Roskilde, Denmark. [2]Department of Mathematical Sciences, Chalmers University of Technology/University of Gothenburg, Gothenburg, Sweden. [3]Department of Biological and Environmental Sciences, University of Gothenburg, Gothenburg, Sweden. ✉e-mail: Jessica.Coria@envs.au.dk

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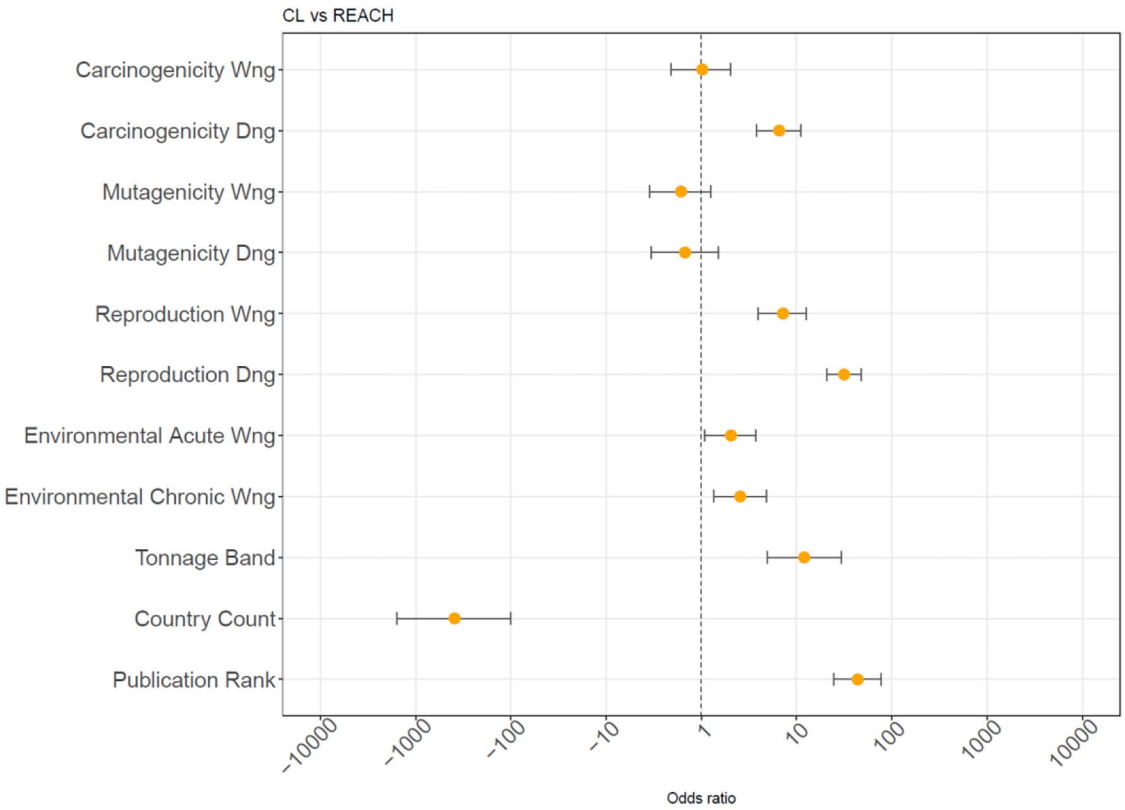

Fig. 1 | Marginal contribution of explanatory variables to the odds of inclusion on Candidate List. The figure presents the point estimates of the odds ratio and the corresponding 95% confidence interval for all parameters included in the logit model, where we explore in further detail which specific toxicological properties affect the listing on the Candidate List. The parameters were estimated after the grouping of substances and after the tonnage band parameter was shifted to the value at the year of inclusion on the Candidate List. The chemicals listed in the Candidate List are compared to all substances registered under the European chemical regulation REACH (Registration, Evaluation, Authorization, and Restriction of Chemicals) ($n = 15{,}146$).

significance of the remaining factors persist. Predictably, the proportion of explained variability decreases. Furthermore, if measurement errors in the 'Country Count' variable were responsible for our results, we would not observe consistent effects when using alternative variables correlated with 'Country Count.' Substituting 'Country Count' with the highly correlated 'Total Number of Active and Inactive Registrants' yields the same conclusions. This further supports using 'Country Count' as an appropriate proxy for our analysis.

Concluding remarks

We want to emphasize our concern that the CL, a crucial component of the Authorization Program designed to control the use of hazardous substances in Europe, appears to now function as a list of potential regrettable substitutes with uncertain prospects of entering the European market. Beyond its role in disclosure, a major purpose of the CL is to initiate the prioritization process, leading to the enforcement of obligatory restrictions on substance use in Europe[10,11]. Meanwhile, it is widely acknowledged that numerous substances currently used within Europe pose risks, both to human health and to the environment[12]. The presence of many hazardous substances among those registered under REACH but not included on the Candidate List is also corroborated by our analysis. While we appreciate and encourage the use of proactive measures, we wonder why the focus of REACH, a pivotal instrument for regulating chemical risk, seemed to have shifted from a reactive stance to one that operates proactively rather than addressing already existing risks.

Data availability

Previously published data and code discussed here are available online from the Zenodo data repository; Data for "Economic Interests Cloud Hazard Reductions in the European Regulation of Substances of Very High Concern"; https://doi.org/10.5281/zenodo.7051114.

References

1. Coria, J., Kristiansson, E. & Gustavsson, M. Economic interests cloud hazard reductions in the European regulation of substances of very high concern. *Nat. Commun.* **13**, 6686 (2022).
2. Martin, R. et al. The impact of the European Union Emissions Trading Scheme on regulated firms: what is the evidence after ten years? Review of environmental economics and policy (2016).
3. Gray, J. S. Divorce-law changes, household bargaining, and married women's labor supply. *Am. Economic Rev.* **88**, 628–642 (1998).
4. Cremers, K. et al. Patent litigation in Europe. *Eur. J. Law Econ.* **44**, 1–44 (2017).
5. OECD. Retrospective Evaluation of Chemical Regulations. Environmental Working Paper No. 188 (2017).
6. Rufas Quintana, J. L. & Anglmayer, I. Retrospective policy evaluation at the European Parliament. *Eur. JL Reform* **21**, 200 (2019).
7. Molnar, C. Interpretable Machine Learning: A Guide for Making Black Box Models Explainable (2nd ed.) (2022).
8. The Danish Environmental Protection Agency. Effect of some legal interventions under REACH 138 and CLP. Exemplified with notification volumes in the Nordic Product Registers. Environmental Project 139 No 2087. (The Danish Environmental Protection Agency, June, 2019).
9. ECHA (European Chemicals Agency). Changes of market volumes of chemicals subject to authorisation 149 in 2010-21. Available at: Change of tonnage of Annex XIV substance 2010-2021_en (europa.eu) (2022).

10. Hansen, B. G. & Blainey, M. REACH: A step change in the management of chemicals. *Rev. Eur. Community Int. Environ. Law* **15**, 270–280 (2006).
11. Bergkamp, L. & Herbatschek, N. Regulating chemical substances under REACH: the choice between authorization and restriction and the case of dipolar aprotic solvents. *Rev. Eur., Comp. Int. Environ. Law* **23**, 221–245 (2014).
12. EEA (European Environmental Agency). Environmental indicator report no. 19/2018, in support to the monitoring of the Seventh Environment Action Programme (2018).

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Author contributions

J.C., E.K., and M.G. contributed to the conceptualization of the manuscript, the analysis and interpretation of the data, and the writing of the text. M.G. made the figure. J.C., E.K., and M.G. proofread the text and approved it. Funding acquisition: J.C. and E.K.

Competing interests

The authors declare no competing interests.

Additional information

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Correspondence and requests for materials should be addressed to Jessica Coria.

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