

European SMEs' Exposure to Ecosystems and Natural Hazards: A First Exploration

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1. Complex, horizontal and policy-relevant topic

- Policymakers are increasingly concerned about the role of nature-related financial risks (e.g. nature degradation and biodiversity loss) for financial stability.
- Similar to climate risks, a double-materiality perspective applies: Ecosystem “dependencies” create vulnerabilities for production, even a possible failure, while ecosystem “impacts” are negative externalities of production to ecosystems.
- Study is a first attempt to refine risk analysis on the dependency side by connecting sectoral ecosystem service risk exposures with geospatial information on ecosystem services.
 - ▷ Multidisciplinary expertise, on top of economic and financial modelling, on various kinds of natural hazards, soil, water, ecosystem services, and climate risks.
 - ▷ Analysis to guide policy necessitates a transparent approach to data and awareness of trade-offs to communicate model and data limitations.

Goals and contributions of this study:

- Propose a first step towards transparently constructing firm-level ecosystem dependency indicators that use publicly and freely accessible data while communicating data limitations.
- Provide a first glimpse of actual nature-related risk exposures of long-term debt of European SMEs given current ecosystem service conditions.
- Be a “data commentary” that aligns “technical” language from differing fields to have a baseline for communication among scientists (natural sciences, economics and finance).
- From a methodological perspective, it serves as a baseline for more advanced asset-pricing exercises, starting a broader discussion about the implications of pricing these risks, and it can also serve as a starting point for possible nature-climate scenario modelling.

2. Data and method

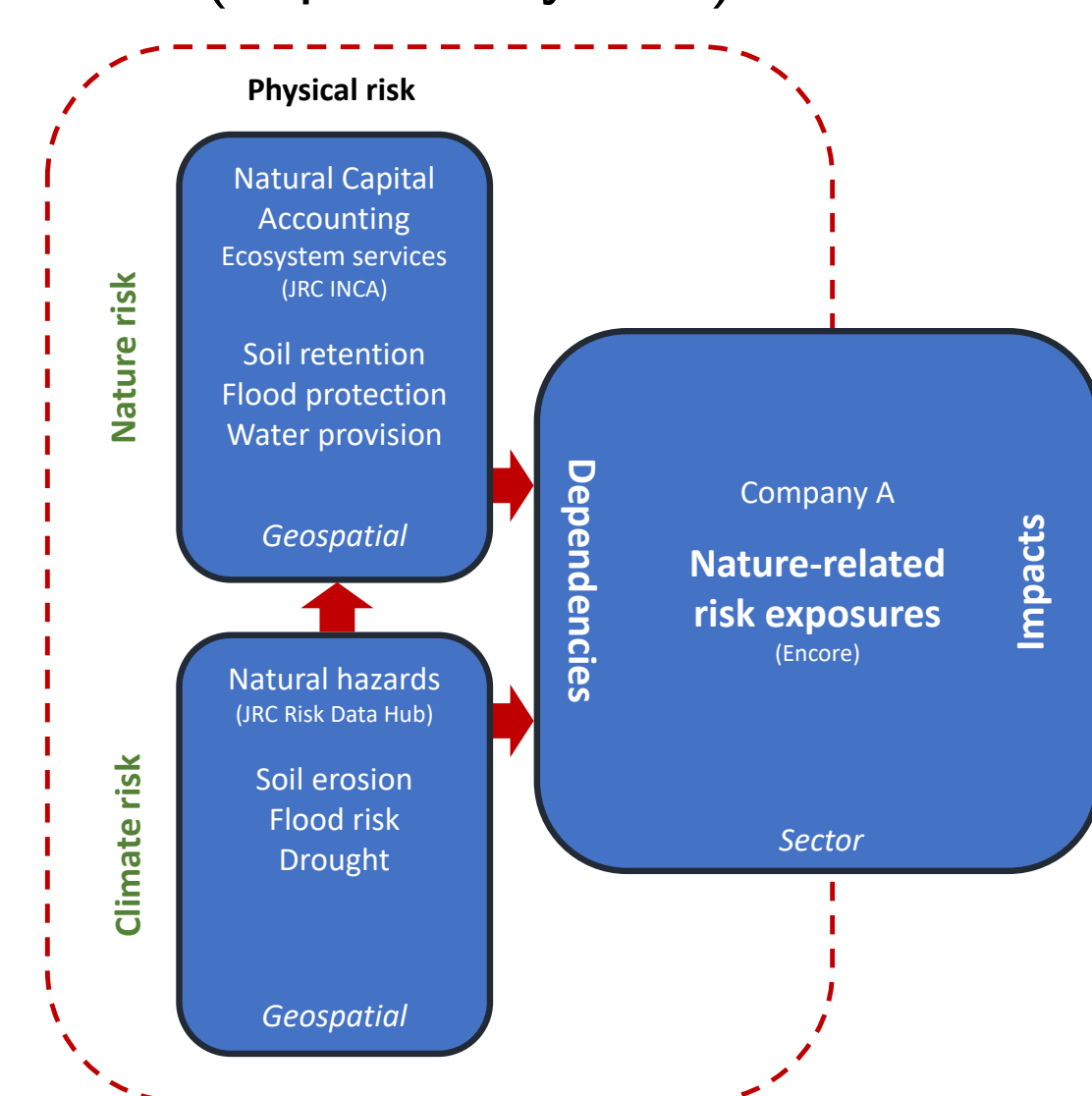
Chart (a):

- Nature-related risk assessment toolkit related to the production side.
 - ▷ (Sectoral-)risk exposures by Encore (2022) are converted to 4-digit NACE.
 - ▷ Each firm in ORBIS is assigned a risk exposure for each ecosystem service dependency based on Encore, given its main business segment.
 - ▷ Each firm is exposed to local ecosystem service conditions and natural hazards based on its NUTS3 location.

Chart (b):

- Encore risk exposures are expressed as materiality ratings from Very Low (VL) to Very High (VH) (sectoral exposure).
- Firms that face a High (H) or Very High (VH) exposure to an ecosystem service dependency may face production failure in case of an interruption of an ecosystem service.
- We refine these shares with geospatial information on ecosystem stress and natural hazard risks (refined exposure).

(a) Nature-risk assessment toolkit (dependency side)



(b) Moving from sectoral exposure to a more accurate exposure

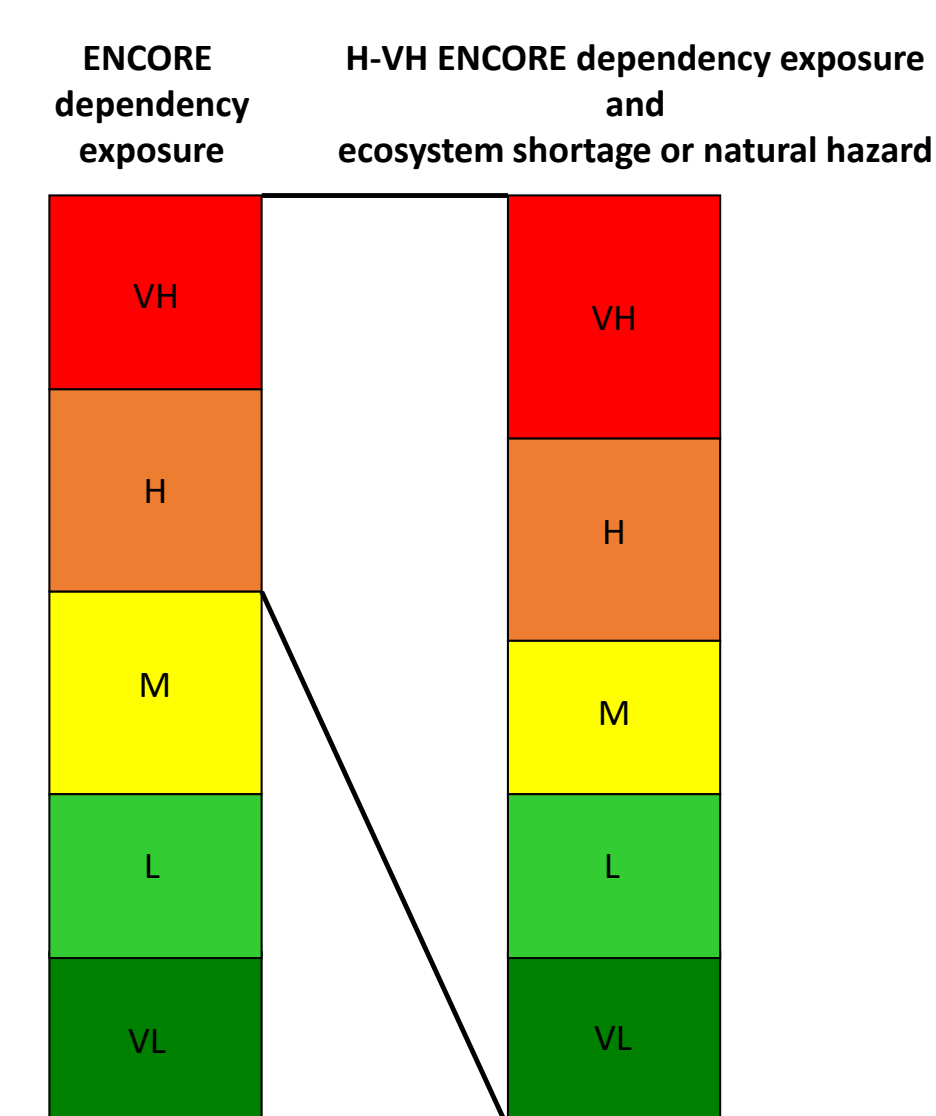
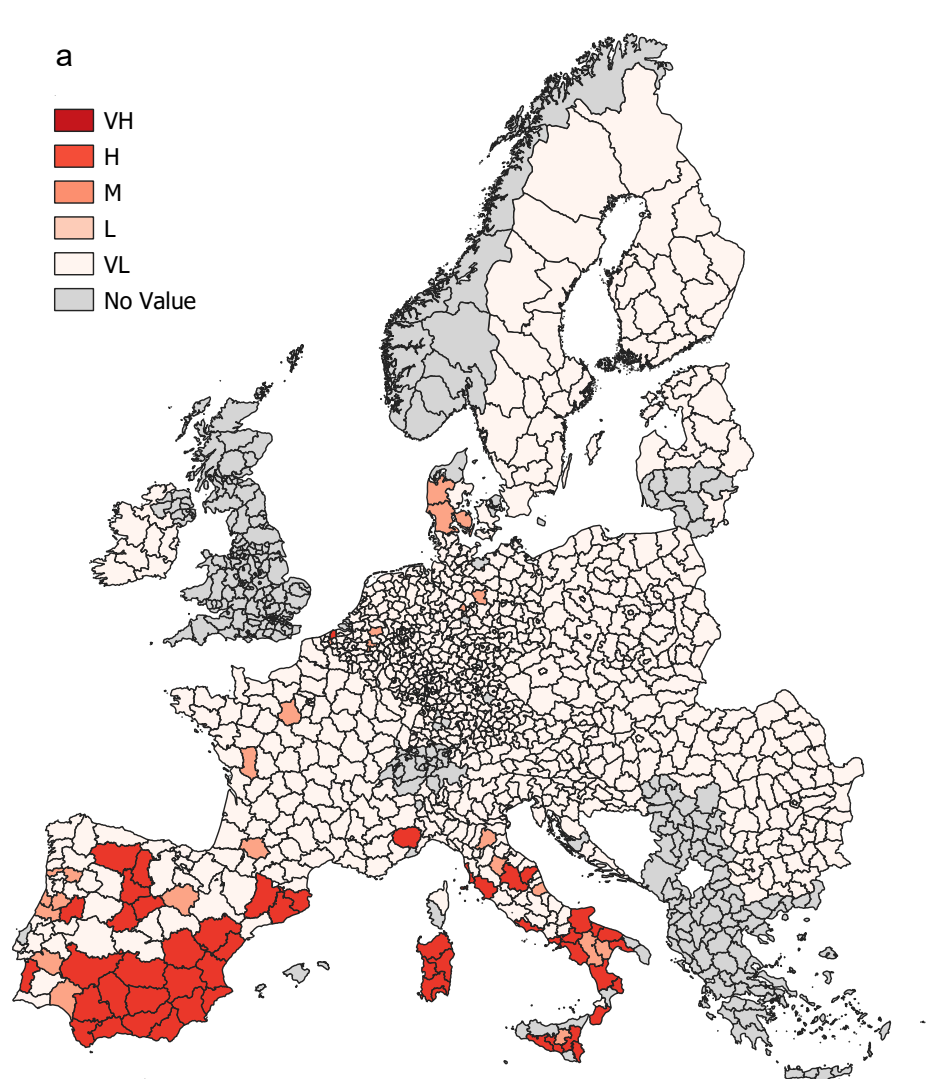


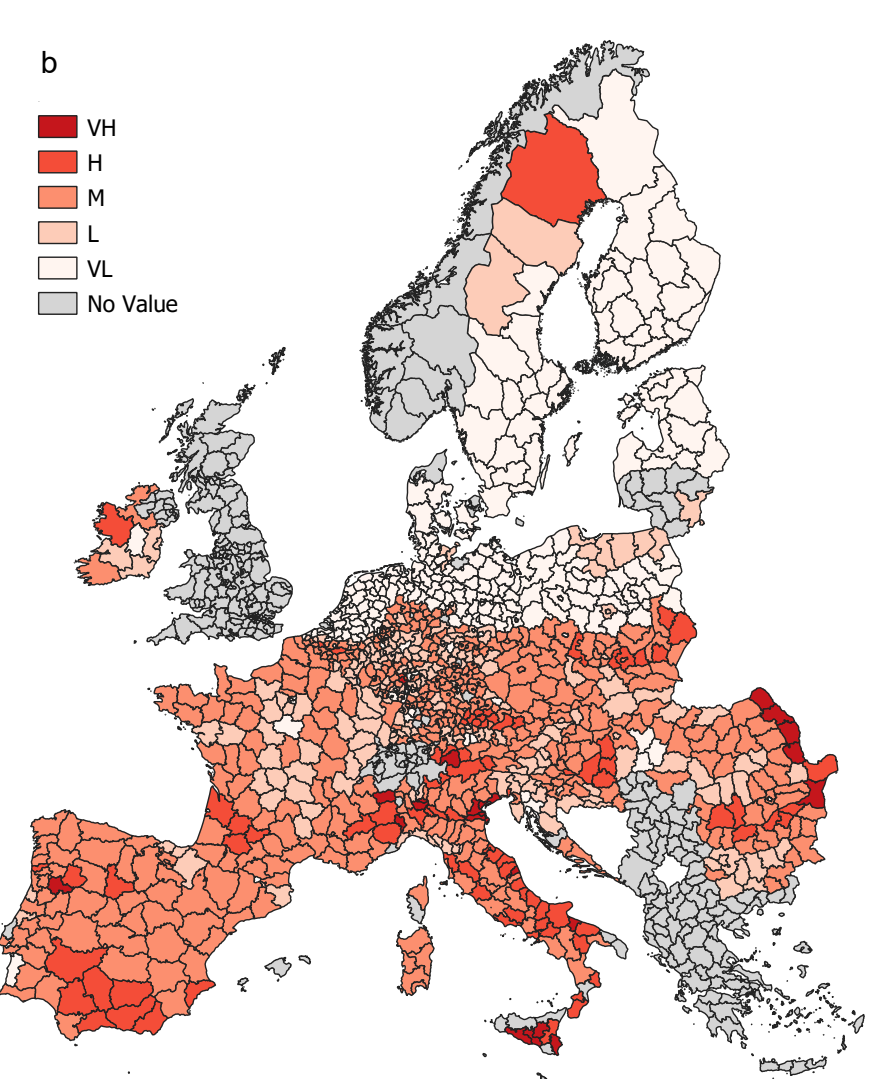
Chart (c) and (d):

- Examples of geospatial data at NUTS3 level: ecosystem service provisioning shortage, seasonal water exploitation index+ and soil retention.

(a) Water Exploitation Index+ seasonal

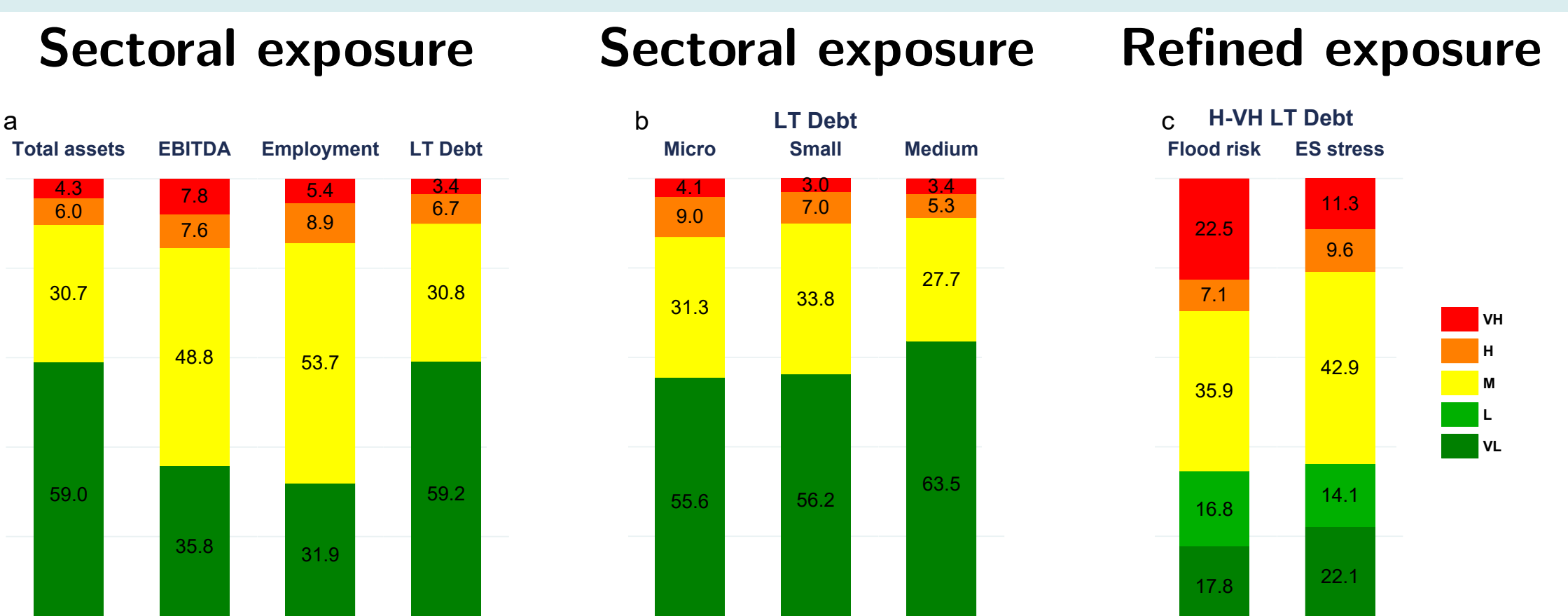


(b) ES shortage: soil retention



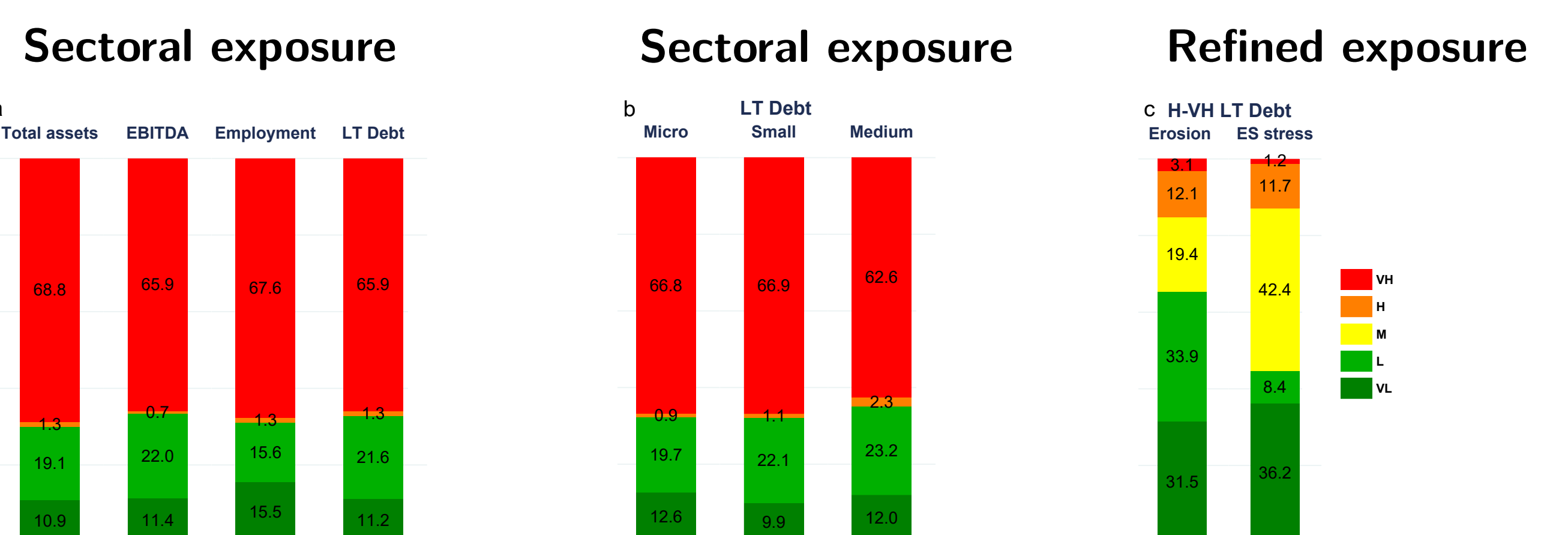
5. Results

Floods



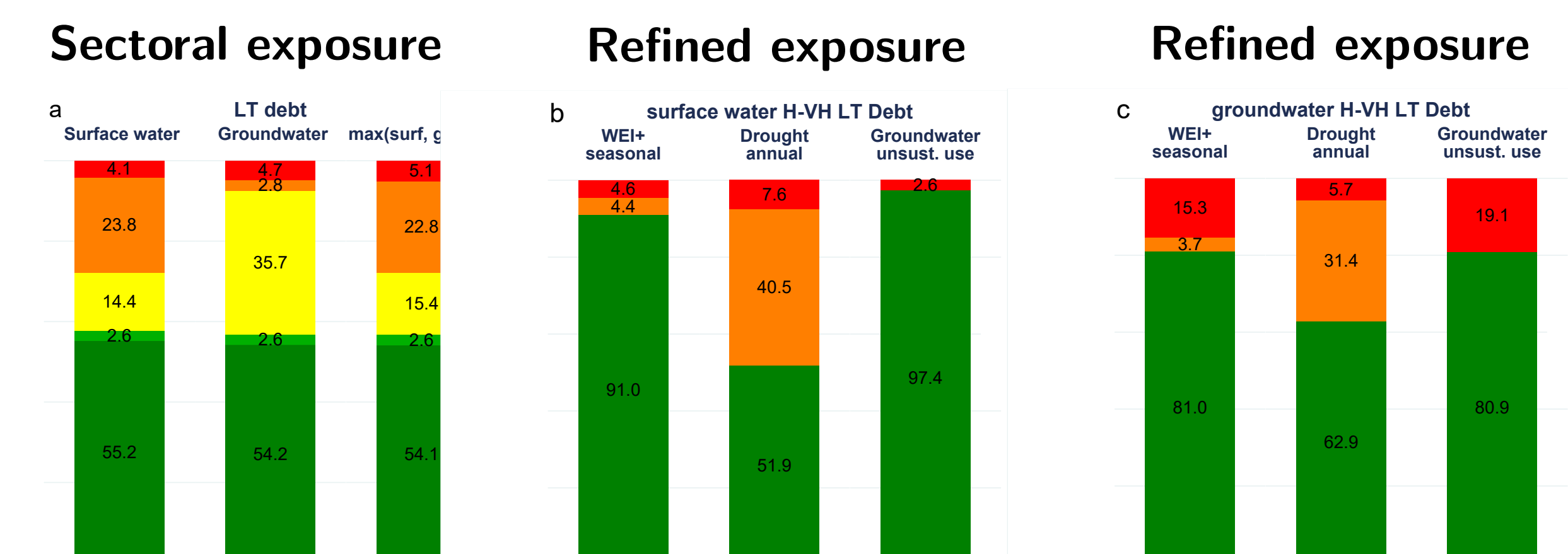
- Everything else equal, a degradation of flood protection ecosystems (upstream forest, downstream wetlands) goes along with increased flood risk.
- We only had one period of ecosystem measurements and calculated an ecosystem service provisioning shortage metric. This indicates a higher demand for this service than is supplied - this can be due to too high anthropogenic demand or a poor quality of ecosystems. It is also a measure of increasing flood risk.
- Bar chart (a) shows that 10 to 15% of companies' financials have a High to Very High exposure to flood protection ecosystem service. Chart (b) shows that for long-term debt, this is more or less equally distributed across firm size. Chart (c) column one shows that 29.6% of High to Very High-exposed long-term debt (3.4%+6.7%) are in areas that are very susceptible to high flood risk. Column two shows that 20.09% of H-VH-exposed long-term debt is also suffering an ecosystem shortage.

Soil



- Soil erosion by precipitation washes nutrients from the top-soil layer and requires farmers to use fertilizer to compensate. Soil retention ecosystems weaken soil erosion.
- Chart (a) shows that 67.2% (65.9%+1.3%) of all agricultural companies are highly exposed to soil retention ecosystems. Chart (b) displays that this share is very stable across the different company sizes. Chart (c) column 1 shows that 15.2% (3.1+12.1%) of 67.2% of H-VH-exposed long-term debt is suffering severe soil erosion requiring large amounts of fertilizer. Column 2 shows that 12.9% of H-VH exposed long-debt is in areas where there is an ecosystem provisioning shortage.

Water



- Water is an abiotic ecosystem service. Many areas in Europe suffer at least a seasonal shortage in surface water, which often goes along with a non-sustainable extraction of groundwater in the region.
- Water is an essential direct input to many (industrial) production processes, and a shortage may lead production to halt.
- Encore provides a surface and groundwater dependency ranking. Chart (a) shows that only a small share of European SMEs' long-term debt is classified to be highly reliant on groundwater 7.5% (4.7%+2.8%), while 27.9% (4.1%+23.8%) of long-term debt appears to depend essential on surface water. (b) shows that among the long-term debt is H to VH reliant on surface water, is exposed to droughts 48.1% (40.5%+7.6%). Chart (c) shows that 19.1% of the 7.5% (4.7%+2.8%) H-VH groundwater-exposed long-term debt is in areas with unsustainable groundwater extraction.

6. Further work

- Building a transition risk complement and conducting asset pricing exercises.
- Refine current and explore other indicators as uncertainties in some indicators may be too large.
- Integrating other ecosystem services: timber and crop provision, soil quality, water purification.