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## The EU economy's dependency on nature

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2025/4*

Hirschbuehl, D., Neuville, A., Petracco, M., Sanchez  
Arjona, I.

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# The EU economy’s dependency on nature\*

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## Abstract

While the importance of nature for economic production is undisputed, nature’s contribution is still underrepresented in economic modelling. Following previous studies, this work produces a “high-level” estimate of the dependencies of all EU economic sectors on ecosystem services by applying the ENCORE (Exploring Natural Capital Opportunities, Risks and Exposure) framework to an input-output model. Depending on the version of ENCORE used and on some other assumptions, between 19% and 36% of the EU economy’s gross value added (GVA) is found to be highly dependent on ecosystem services. International extensions of the analysis show that the economies of EU and China appear to be more dependent on nature than that of the United States. The analysis also reveals that the entire economy is vulnerable to nature degradation, as all sectors are interlinked through supply and customer connections, potentially leading to cascading effects along value chains.

**JEL Classification:** C67, Q5, Q57.

**Keywords:** Natural capital, nature degradation.

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# 1 Introduction

Ongoing nature degradation and biodiversity loss (see [IPBES, 2019](#)), and the possible adverse effects on societies, economies and their financial systems have increasingly caught the attention of policymakers, leading to ambitious commitments to nature protection and restoration, including significant financial investments. In Europe, these commitments are reflected in the European Green Deal, specifically the EU Biodiversity Strategy for 2030<sup>1</sup>, and at the international level, in the Kunming-Montreal Global Biodiversity Framework (see [CBD, 2022](#)). Concurrently, academia and policy institutions try to advance economic frameworks to integrate natural capital and ecosystem services to enhance the information available for policy and decision-making.

Although the connection between nature and economic activities is indisputable, the specific relationships between ecosystem services and the production process are not necessarily immediately apparent. Furthermore, in many cases, these relationships are location-specific and context-dependent, giving rise to substantial data and modelling challenges. To begin our analysis, we define ecosystems and their contribution to economic production. According to Article 2 of the Convention on Biological Diversity<sup>2</sup>, an ecosystem is defined as a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit. According to the United Nations (UN) System of Environmental-Economic Accounting - Ecosystem Accounting (SEEA EA) definition, ecosystem services are the contributions of ecosystems to the benefits that are used in economic and other human activity. They can be biotic and abiotic. These services can **mitigate or regulate** other natural phenomena, such as flood protection that softens the damage of a flood, or they can be **direct inputs** to production, such as biomass, timber or water. Similar to climate, a **double-materiality** perspective applies. Ecosystems can enter a firm's production function - a so-called **dependency** on ecosystems, and a firm's production can have negative externalities that can adversely **impact** ecosystems - so-called **pressures**.

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<sup>1</sup>see EU Biodiversity Strategy Actions Tracker, <https://dopa.jrc.ec.europa.eu/kcbd/actions-tracker/> accessed on December 2024.

<sup>2</sup>see Convention on Biological Diversity <https://www.cbd.int/convention> accessed on December 2024.

Approaches focusing on analysing the dependencies of economic sectors on ecosystem services can help identify the sectors potentially most exposed to nature degradation, both directly and indirectly, and assess the importance of these sectors for the economy. However, rather than focusing on flows of specific ecosystem services and the dependencies of individual sectors, we aggregate contributions from all ecosystems to all sectors of the economy. Applying a similar approach to that described in [WEF \(2020\)](#) and [Evison et al. \(2023\)](#), the paper uses ad-hoc structural analysis using an Input-output (IO) framework and a set of assumptions on modelling sectoral dependence on nature, with the latter being approximated with [ENCORE \(2024\)](#) (Exploring Natural Capital Opportunities, Risks and Exposure). Doing this makes it possible to run a high-level economic analysis to understand to what extent economies rely on nature. To this end, the study provides insights into the share of the EU’s gross value added (GVA) that may be directly and/or indirectly affected by nature degradation and the disruption of ecosystem services.<sup>3</sup> In particular, it looks at the share of GVA generated by economic activities for which failure to maintain the capacity of ecosystems to deliver services could entail significant costs, or even stop production. In this context, this paper aims to make two main contributions. First, it intends to provide a set of model-based figures describing the EU economy’s dependence on nature. Secondly, it aims to outline the assumptions and methodological choices necessary to replicate this type of analysis, and it conducts a sensitivity analysis around key data sources and assumptions. The underlying methodology may also open an avenue for more advanced economic analysis.

The remainder of the paper is structured as follows. Section 2 provides insight into the data, methods and assumptions used. Section 3 discusses the results and provides sensitivity analysis. Finally, section 4 concludes and highlights potential for further research.

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<sup>3</sup>GVA measures the total value of goods and services produced within a country, but, in contrast with GDP, it excludes taxes and includes subsidies, providing a more accurate representation of the actual production process.

## 2 Data and methodology

The starting point for our analysis is [ENCORE \(2024\)](#), a holistic framework that links ecosystem services and economic activities. By linking this data on ecosystem dependencies of economic sectors with EXIOBASE input-output tables (see [Stadler et al., 2018](#)), it is possible to calculate the share of gross value-added that is dependent on nature to different degrees. This section describes the data, methodology and additional modelling assumptions.

### 2.1 ENCORE: dependencies of economic sectors on ecosystem services

ENCORE is a holistic mapping that provides information on dependency linkages between individual economic sub-sectors and ecosystem services. The latest version of ENCORE of July 2024<sup>4</sup> follows the SEEA EA categorisation of ecosystem services (25 services) and the UN Industrial Classification of All Economic Activities (ISIC) sector classification (271 sub-sectors). Compared to the previous version of ENCORE, the change in the classification of economic sectors used in ENCORE 2024 has the advantage, for EU-level analyses, of being reported in International Standard Industrial Classification (ISIC) that is consistent with the NACE classification (Nomenclature statistique des Activités économiques dans la Communauté Européenne).

As regards the ecosystem services covered in ENCORE, each of the 25 SEEA EA services belongs to one of the broad categories of provisioning, regulating and maintenance, and cultural services (see Table 1 and [ENCORE \(2024\)](#) for a more detailed description of each service). The first two categories have an essential meaning from an economic production perspective. **Provisioning** services can be understood as a direct input to production, e.g. biomass or water supply. In contrast, **regulating and maintenance** services can be understood as components that protect economic capital against disruption or enhance Total Factor Productivity. Ecosystems that protect against disruption are, for instance, flood mitigation services that reduce damages caused by floods or soil and sediment retention services that decrease soil erosion, preventing nutrients from being washed from the top-soil

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<sup>4</sup>ENCORE can be freely downloaded after registration, <https://ENCOREnature.org/>.



TABLE 1 SEEA reference list of ecosystem services

Category	Ecosystem service
Provisioning Services	Biomass provisioning services Genetic material services Water supply Other provisioning services - Animal-based energy
Regulating and maintenance services	Global climate regulation services Rainfall pattern regulation services Local (micro and meso) climate regulation services Air filtration services Soil quality regulation services Soil and sediment retention services Soil waste remediation Water purification services Water flow regulation services Flood mitigation services Storm mitigation services Noise attenuation services Pollination services Biological control services Nursery population and habitat maintenance services Other R and M service - Dilution by atmosphere and ecosystems Other R and M service - Mediation of sensory impacts (other than noise)
Cultural services	Recreation-related services Visual amenity services Education, scientific and research services Spiritual, artistic and symbolic services

Source: [ENCORE \(2024\)](#), JRC elaboration.

layer and requiring farmers to lower the amount of fertilizer.

The dependencies of sectors on individual ecosystem services are provided as “materiality ratings”. Based on literature reviews complemented by expert assessment (including the use of quantitative indicators when available), the ratings range on a 5-level scale from “Very Low” to “Very High” dependency (in addition to “No link”, see Table 2).<sup>5</sup> “High” and “Very High” materiality ratings indicate a high potential exposure to nature-related shocks or deteriorating trends, which means that the disruption of an ecosystem service

<sup>5</sup>There is also the case of insufficient data ND (No Data) for which we also assume no link for computational reasons.

could cause production failure and severe financial loss. These six qualitative ratings are transformed into a 0-5 score scale to perform a quantitative evaluation. This is a common choice in the literature (see [Evison et al., 2023](#); [EC FISMA et al., 2024](#)), underlined by implicit assumptions about the relationship between the ratings.

TABLE 2 Materiality ratings for ecosystem services

Materiality Rating	Score	Impact on the production process
Very High (VH)	5	The ecosystem service is critical and irreplaceable in the production process.
High (H)	4	Production process is extremely vulnerable to the disruption of the ecosystem service.
Medium (M)	3	Production process can take place without the ecosystem service due to availability of substitutes.
Low (L)	2	Most of the time, the production process can take place even with full disruption of the ecosystem service.
Very Low (VL)	1	Production process can take place even with full disruption of the ecosystem service.
No link	0	Production process is independent of the ecosystem service.

Source: [ENCORE \(2022\)](#), JRC elaboration.

## 2.2 EXIOBASE: harmonized interregional input-output tables

These materiality ratings reflect the direct nature dependencies of sectors based on their own operations, but not those that occur through value chains, both within countries and across international value chains. To have a complete picture of how the contributions from ecosystem services diffuse via inputs to other sectors, ENCORE needs to be combined with information on the structure of the economy provided by a set of Input-Output (IO) tables. IO tables provide a detailed description of the sale and purchase relationships between different production sectors, and between producers and consumers within an economy or a set of economies linked by trade relationships. In this analysis, we employ EXIOBASE multi-regional IO dataset (Version 3.7) for 2022 at basic prices reports 163 sectors for 49 countries (including all EU-27 countries) (see [Stadler et al. \(2018\)](#)).<sup>6</sup> The EXIOBASE research dataset is updated yearly with a two-year lag by the academic community. The

<sup>6</sup>see <https://www.EXIOBASE.eu/>. Updated tables can be obtained: <https://zenodo.org/records/5589597>, accessed on December 2024.

choice of using EXIOBASE is motivated by its completeness in terms of countries, its granularity in terms of sectors and its widespread use in macroeconomic environmental analysis literature (e.g. see [Wood et al., 2014](#); [Bleischwitz et al., 2018](#); [Sun et al., 2022](#); [Zhong et al., 2024](#)).

## **2.3 Data aggregation choices**

In line with existing literature, the framework makes three major aggregation choices, which may impact the results. These choices are presented in detail in the following subsections.

### **2.3.1 ENCORE-EXIOBASE sector mapping**

Figure 1 displays materiality ratings for ecosystem dependencies for different EXIOBASE sectors as provided by ENCORE 2024. Many primary sectors are highly reliant (e.g. materiality rating of 5) on ecosystem services, while mining and manufacturing are only highly dependent on a few ecosystem services. When applying ENCORE to other sector classifications, some choices need to be made. For instance, some sectors in EXIOBASE are a mix of different ISIC sectors (e.g. hotels and restaurants). Further, discrepancies between previous versions of ENCORE and the latest one may emerge because some sectors (e.g. agriculture) were more differentiated, such as small- and large-scale farming (e.g. crops, livestock) and forestry, usually assuming that small-scale counterparts have higher materiality scores. Moreover, materiality ratings may have been revised. The EXIOBASE sectoral classification does not completely coincide with the ISIC and other classifications used by ENCORE, and requires the introduction of a mapping via a crosswalk table. Table A.8 provides the unique mapping of ecosystem services with economic sectors as proposed by [ENCORE \(2024\)](#) used in this analysis.



first component using a normalisation factor, which is necessary due to changes (mostly increases) in the materiality ratings and the increasing number of ecosystem services across versions of ENCORE. The three components are given an equal weighting to create an overall dependency score (see Equation 1). Table A.9 displays the dependency scores for all sectors for ENCORE (2024) and ENCORE (2022), and Figure A.1 provides information on the distribution within the scores.

$$\text{Overall dependency score}_i = \frac{1}{3} \text{Score}_1 \frac{5}{25} + \frac{1}{3} \text{Score}_2 + \frac{1}{3} \text{Score}_3 \quad (1)$$

where

$\text{Score}_1$  = Number of different sectoral ecosystem dependencies

$\text{Score}_2$  = Mean materiality rating of all ecosystem service dependencies

$\text{Score}_3$  = Maximum strength of any individual dependency

Taking into account the increases in materiality ratings compared to ENCORE 2022, the following thresholds have been defined for ENCORE 2024 materiality ratings: consolidated dependency scores below 2.25 are considered “Low Dependency”, scores between 2.25 and 3.25 “Medium Dependency” and scores above 3.25 “High Dependency”. A sensitivity analysis was carried out on different thresholds.<sup>7</sup> Table 3 and 4 explain this procedure using a minimum example with 25 ecosystem services and one sector.

TABLE 3 Materiality ratings for dependencies on ecosystem services

Ecosystem Service	1	2	3	4	5	...	15	...	25
Sector 1	4	3	2	5	1	1	1	0	0

Source: JRC elaboration.

<sup>7</sup>For ENCORE 2022, we chose 5/21 ecosystem services as the normalisation factor and retain the thresholds of the original study (2 and 3).

TABLE 4 Calculation of scores

Score 1	15 (0 not counted)
Score 2	$(4+3+2+5+1+10)/25 = 1$
Score 3	5
Overall dependency sector 1	$1/3 \times 15 \times 5/25 + 1/3 \times 1 + 1/3 \times 5 = 3$

Source: JRC elaboration.

### 2.3.3 Aggregating sectors by industry groups

We reduce the dimensionality of the calculated results by grouping the 136 EXIOBASE sectors into 23 industry groups (see Table 5), similar to what is done in [Evison et al. \(2023\)](#). This is done for purely illustrative reasons when *ex post* processing the results.

TABLE 5 Assumption on industry groups

Industry group	EXIOBASE sectors (nr.)
Forestry	18
Agriculture	1:17
Fishery and aquaculture	19
Food beverages and tobacco	35:46
Heat utilities	111
Construction	113:114
Electricity	96:109
Water utilities	112,152
Supply chain and transport	120:124,126
Chemical and materials industry	47:54,59,60,64:85
Aviation travel and tourism	125,119
Real estate	131
Mining and metals	20,24:31,34
Retail consumer goods and lifestyle	116:118
Oil and gas	21:23,57
Automotive	91,115
Healthcare delivery	138
Electronics	87:90
Information technology	133
Insurance and asset management	129
Banking and capital markets	126,128
Digital communications	127
Public services and others	55,56,58,86,93,94,95,132,134:137,139:151,153:163

Source: JRC elaboration, adapted from [Evison et al. \(2023\)](#), using industry groups from the World Economic Forum (WEF) Strategic Intelligence.

## 2.4 Structure of input-output tables

Figure 2 presents a simplified example of an input-output table. In this table, outputs flow from sectors/countries listed in rows to sectors/countries and final demand components listed in columns. Key elements are: (1) the intermediate **input-output table** matrix **Z**, which contains information on the supply and demand of intermediate inputs. Each row represents the **intermediate output** of a specific region/sector, exported to all other regions/sectors (columns). Conversely, each column shows the **intermediate inputs** required by a certain region/sector, imported from the respective regions/sectors indicated in the rows; (2) the final demand table matrix **Y**, which contains information on goods and services used for final consumption by all sectors of the economy. In EXIOBASE, there are seven final demand components stored in the final demand matrix **Y**: (1) private consumption, (2) consumption by non-profit organisations, (3) public consumption, (4) gross fixed capital formation/investment, (5) changes in inventories, (6) changes in valuables and (7) total exports.

FIGURE 2 simplified example of a multi-regional input-output table

		Country 1						Country 2						Final demand								Total output (TO)
		Country 1			Country 2			Country 1				Country 2										
		Sector 1	...	Sector N	Sector 1	...	Sector N	Private consumption	Public consumption	Total Investment	Exports	Private consumption	Public consumption	Total Investment	Exports							
Country 1	Sector 1																					
	...																					
	Sector N																					
Country 2	Sector 1																					
	...																					
	Sector N																					
Value added																						
Total input (TI)																		TI= TO				

Source: JRC elaboration.

The sum of intermediate uses and final demand for each row constitutes the total output of each sector/country, represented in vector **X**. The sum of elements **X** at the country or world level gives GDP. Total output is equal to total input by construction. Subtracting intermediate inputs (sum of **Z** elements across columns) from total output (**X** vector) results in gross value added, reported in vector/matrix **V**. Value added can be obtained by subtracting taxes. As highlighted by [Aslam et al. \(2017\)](#), the **V** matrix from the IO table

should not be confused with Domestic Value Added (DVA). Depending on the input-output table, the V matrix provides accounting measures of value added, including up to six components, for instance, (1) compensation of employees; (2) taxes on production; (3) subsidies on production; (4) net operating surplus; (5) net mixed income, and (6) consumption of fixed capital.

## 2.5 Input-output model: calculating direct and supply chain value added

To obtain the sectoral direct and supply-chain value added, this study follows, this study follows [Koopman et al. \(2014\)](#) and [Aslam et al. \(2017\)](#) to obtain the sectoral direct and supply-chain value added. The calculation requires the matrix of input-output coefficients ( $\mathbf{A}$ ), the matrix of value-added shares/coefficients ( $\hat{\mathbf{V}}$ ) and the final demand vector  $\mathbf{y}$ .

Following the literature, this subsection briefly discusses the basic relationship between gross output (gross output  $\mathbf{x}$ ), intermediate goods (input-output coefficients matrix  $\mathbf{A}$ ) and final demand (vector of goods used for final demand  $\mathbf{y}$ ) given by:

$$\mathbf{x} = \mathbf{A}\mathbf{x} + \mathbf{y} \quad (2)$$

with  $\mathbf{A}\mathbf{x}$  being the matrix of goods for intermediate use and  $\mathbf{y}$  being the vector of final demand. Rearranging yields:

$$\mathbf{x} = \underbrace{(\mathbf{I} - \mathbf{A})^{-1}}_{\mathbf{B}} \mathbf{y} \quad (3)$$

with  $\mathbf{B}$  being termed the Leontief inverse. The matrix of value added shares can be obtained by summing across the rows of the  $\mathbf{A}$  matrix, putting the obtained values on the diagonal and subtracting it from an identity matrix of size industries  $\times$  countries. We follow the notation of [Aslam et al. \(2017\)](#) with  $i=1 \dots N$  (163) industries and  $c=1 \dots C$  (49) countries,



where all industries are listed for each country in turn:

$$\hat{\mathbf{V}} = \begin{bmatrix} \hat{\nu}_{11} & 0 & \cdots & 0 & \cdots & 0 \\ 0 & \hat{\nu}_{21} & \cdots & 0 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots & \vdots & \vdots \\ 0 & 0 & \cdots & \hat{\nu}_{icic} & \cdots & 0 \\ \vdots & \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & 0 & \cdots & \hat{\nu}_{NCNC} \end{bmatrix} \quad (4)$$

Koopman et al. (2014) and Aslam et al. (2017) point out that the matrix  $\hat{\mathbf{V}}\mathbf{B}$  reflects the underlying production structure and contains all needed information on value-added production by source. Hence, we multiply with  $\mathbf{B}$  and  $\text{diag}(\mathbf{y})$  to obtain the matrix  $\mathbf{T}_\nu$

$$\mathbf{T}_\nu = \begin{bmatrix} \hat{\nu}_1 & 0 & \cdots & 0 \\ 0 & \hat{\nu}_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \hat{\nu}_{NCNC} \end{bmatrix} \begin{bmatrix} B_{11} & B_{12} & \cdots & B_{1NC} \\ B_{21} & B_{22} & \cdots & B_{2NC} \\ \vdots & \vdots & \ddots & \vdots \\ B_{NC1} & B_{NC2} & \cdots & B_{NCNC} \end{bmatrix} \begin{bmatrix} \hat{y}_1 & 0 & \cdots & 0 \\ 0 & \hat{y}_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \hat{y}_{NCNC} \end{bmatrix} \quad (5)$$

The size of each of the matrices is  $\text{NC} \times \text{NC}$ . The matrix  $\mathbf{T}_\nu$  contains elements  $T_{\nu icjg}$  where the first two indices describe the value added from sector  $i$  in country  $c$  to sector  $j$  in country  $g$ :

$$T_{\nu icjg} = \begin{bmatrix} T_{\nu 1111} & T_{\nu 1121} & \cdots & T_{\nu 11jg} & \cdots & T_{\nu 11NC} \\ T_{\nu 2111} & T_{\nu 2121} & \cdots & T_{\nu 21jg} & \cdots & T_{\nu 21NC} \\ \vdots & \vdots & \ddots & \vdots & \vdots & \vdots \\ T_{\nu ic11} & T_{\nu ic21} & \cdots & T_{\nu icjg} & \cdots & T_{\nu icNC} \\ \vdots & \vdots & \vdots & \vdots & \ddots & \vdots \\ T_{\nu NC11} & T_{\nu NC21} & \cdots & T_{\nu NCjg} & \cdots & T_{\nu NCNC} \end{bmatrix} \quad (6)$$

The diagonal elements of this matrix represent the direct value added for each country/sector pair without considering supply chain contributions by other sector/country pairs. The upstream value added is obtained by summing along the columns (and sub-

tracting the diagonal elements). Finally, the downstream value-added can be obtained by summing along the rows (and subtracting the diagonal component). Having obtained three value-added components for each sector in each country allows us to evaluate each contribution with the overall score and combine sectors into industry groups.

## 2.6 The EU aggregation

To evaluate the EU, we have to aggregate 27 countries. Let's assume an interregional IO table with three countries and three sectors as illustrated in matrix 7. Countries 1 and 3 are part of the EU. To obtain the direct effect for the first, second and third sectors, we need to aggregate all relevant elements highlighted in green. To obtain the upstream effect for sector 1 for the EU, we aggregate all elements in red taking into account the extra and intra-EU supply chain. To obtain the downstream effect for sector 1 for the EU, we aggregate all elements in blue, considering extra and intra-EU customer sectors.

$$T_{\nu_{icjg}} = \begin{bmatrix} T_{\nu_{1111}} & T_{\nu_{1121}} & T_{\nu_{1131}} & T_{\nu_{1112}} & T_{\nu_{1122}} & T_{\nu_{1132}} & T_{\nu_{1113}} & T_{\nu_{1123}} & T_{\nu_{1133}} \\ T_{\nu_{2111}} & T_{\nu_{2211}} & T_{\nu_{2311}} & T_{\nu_{2112}} & T_{\nu_{2122}} & T_{\nu_{2232}} & T_{\nu_{2113}} & T_{\nu_{2123}} & T_{\nu_{2133}} \\ T_{\nu_{3111}} & T_{\nu_{3121}} & T_{\nu_{3131}} & T_{\nu_{3112}} & T_{\nu_{3122}} & T_{\nu_{3132}} & T_{\nu_{3113}} & T_{\nu_{3123}} & T_{\nu_{3133}} \\ T_{\nu_{1211}} & T_{\nu_{1221}} & T_{\nu_{1231}} & T_{\nu_{1212}} & T_{\nu_{1222}} & T_{\nu_{1232}} & T_{\nu_{1213}} & T_{\nu_{1223}} & T_{\nu_{1233}} \\ T_{\nu_{2211}} & T_{\nu_{2221}} & T_{\nu_{2231}} & T_{\nu_{2212}} & T_{\nu_{2222}} & T_{\nu_{2232}} & T_{\nu_{2213}} & T_{\nu_{2223}} & T_{\nu_{2233}} \\ T_{\nu_{3211}} & T_{\nu_{3221}} & T_{\nu_{3231}} & T_{\nu_{3212}} & T_{\nu_{3222}} & T_{\nu_{3232}} & T_{\nu_{3213}} & T_{\nu_{3223}} & T_{\nu_{3233}} \\ T_{\nu_{1311}} & T_{\nu_{1321}} & T_{\nu_{1331}} & T_{\nu_{1312}} & T_{\nu_{1322}} & T_{\nu_{1332}} & T_{\nu_{1313}} & T_{\nu_{1323}} & T_{\nu_{1333}} \\ T_{\nu_{2311}} & T_{\nu_{2321}} & T_{\nu_{2331}} & T_{\nu_{2312}} & T_{\nu_{2322}} & T_{\nu_{2332}} & T_{\nu_{2313}} & T_{\nu_{2323}} & T_{\nu_{2333}} \\ T_{\nu_{3311}} & T_{\nu_{3321}} & T_{\nu_{3331}} & T_{\nu_{3312}} & T_{\nu_{3322}} & T_{\nu_{3332}} & T_{\nu_{3313}} & T_{\nu_{3323}} & T_{\nu_{3333}} \end{bmatrix} \quad (7)$$

This information allows for calculating the direct nature dependency of each sector as well as its indirect dependencies through its upstream value chain (suppliers) and downstream value chain (customers). This example also highlights that the value chain combines intra- and extra-EU components. To calculate the direct dependency, the consolidated dependency score of each sector is applied to the value-added generated by its own operations. Each sector's upstream dependency is calculated as a weighted average of the direct nature

dependencies of the sectors in its supply chain. Each sector’s downstream dependency is calculated as a weighted average of the direct nature dependencies of the sectors that are its primary customers.

Finally, when aggregating supply chain dependencies, two alternative options have been applied: either excluding or including the contributions of a sector to itself, i.e. the goods or services produced by a sector as intermediate inputs in its own final production (e.g. motors and frames produced by the automotive sector for use in car assembly). This ensures comparability of the results with the original studies that apply the latter option. Grouping the shares of value-added contributions of sectors to each other according to the dependency score of each sector, the approach finally allows obtaining the share of GVA that is generated under “High”, “Medium” and “Low” dependency within each industry group and each upstream or downstream chain, as shown in the next section.

### 3 Results

This section presents the results for nature dependencies of the EU economy, both direct and through value chains, and sensitivity analysis when varying overall dependency thresholds. Moreover, the analysis was replicated to compare the EU with other economies (US, China, and the world economy).

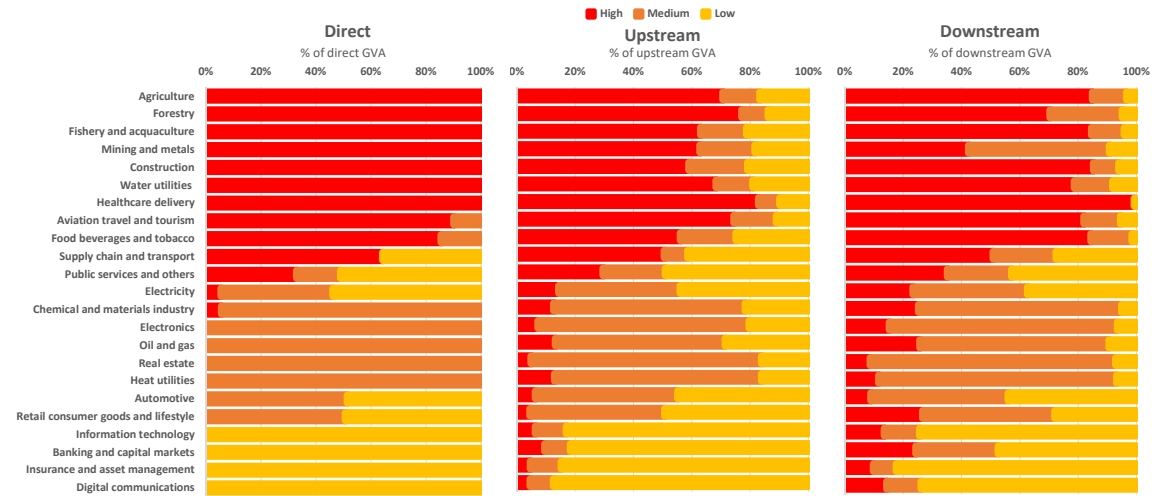
#### 3.1 European Union

For the EU economy, Figure 4 shows the dependency of the various industry groups on nature in terms of GVA shares, considering the direct upstream (suppliers) and downstream (customers) nature dependencies, mirroring the analysis of [Evison et al. \(2023\)](#). The primary industry groups “agriculture”, “forestry”, “fisheries and aquaculture”, as well as “construction”, “mining and metals”, “water utilities”, “healthcare”, “aviation travel and tourism”, “food, beverages and tobacco”, and, to a lesser extent “supply chains and transport”, all have a high direct dependency on nature, based on the above-mentioned consolidated dependency score. Although the level of dependency varies between sectors, in total 19 out of 23 sectors display high or medium direct dependencies on nature for a

substantial part (40% or more) of their GVA. It should be noted that, especially for service sectors exhibiting very low levels of direct and upstream dependencies, indirect dependency via the exposure of customers can be non-negligible.

A distinctive characteristic of the [Evison et al. \(2023\)](#) analysis is the inclusion of a sector’s self-contributions in visualising upstream and downstream supply chain diagrams. This approach results in the direct dependency pattern being prominently reflected across the other panels due to its substantial influence.

FIGURE 3 EU economy’s dependency on nature (incl. the contributions of a sector to itself)

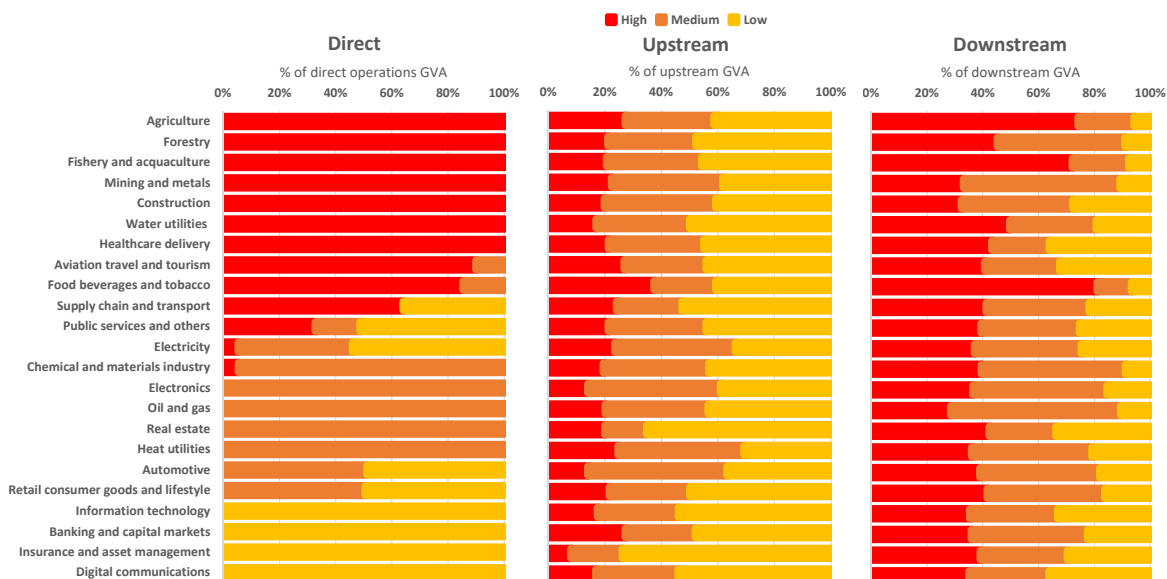


Source: ENCORE 2024, EXIOBASE 2022, JRC elaboration.

Figure 4 presents the results of an alternative calculation that does not include the contributions of a sector to itself in upstream and downstream value-chain considerations. Notably, highly nature-dependent upstream supply-chain contributions are entering every sector, highlighting the significance of nature’s contributions to the economy. Concerning downstream relations, the chart shows a relatively high nature dependency of the primary sectors, which is likely because other nature-dependent sectors request these sectors’ output.

For the EU economy as a whole, the study finds that 44% of the GVA from all sectors’ direct operations (i.e. excluding suppliers) has a high dependency on nature and 27% has a medium dependency (see Table 6). If considering only upstream supply chains (i.e., ignoring the contributions of a sector to itself), 22% of the GVA generated by suppliers is highly

FIGURE 4 EU economy's dependency on nature (excl. the contributions of a sector to itself)



Source: ENCORE 2024, EXIOBASE 2022, JRC elaboration.

dependent on nature and 33% has a medium dependency. The overall estimate, considering both direct operations and their supply chains, indicates that two thirds of the EU's GVA has a significant dependency on nature: a 36% share of GVA has a high dependency and 29% a medium dependency.

TABLE 6 EU economy's dependency on nature

EU	Direct	Upstream	Downstream	Direct + Upstream
High	0.44	0.22	0.41	0.36
Medium	0.27	0.33	0.38	0.29
Low	0.30	0.45	0.21	0.35

Source: ENCORE 2024, EXIOBASE 2022, JRC elaboration.

### 3.2 Sensitivity analysis

A sensitivity analysis has been conducted to assess the impacts on the results of the differences between ENCORE versions and the level of the dependency scores thresholds, which introduce strong assumptions. Table 7 shows how the nature dependency figures would

shift when adjusting the thresholds for the two latest versions of ENCORE, as sectors considered as having "high" and "medium" dependency would change. The 2024 version of ENCORE generally indicates an increased "high dependency" share of GVA compared to the 2022 version - for instance, 35% instead of 21% globally, if considering a threshold of 3. However, adjusting the upper threshold from 3 to 3.5 would significantly reduce the share of the global economy considered highly dependent on nature (from 35% to 20%), using the latest ENCORE version. Nonetheless, recognizing that between 19% and 36% of the EU GVA is highly susceptible to the health of natural ecosystems offers a crucial insight into the degree of urgency with which ecosystem services should be considered in Europe.

Additionally, the results for US, China and the world economy show significant differences between countries in the dependencies of various sectors, particularly in supply chains. However, using ENCORE 2024, the overall dependency on nature is found to be of the same order of magnitude for China as for the EU, but lower for the US, indicating that large parts of the US economy's GVA are generated in sectors that are not considered highly dependent on nature.

TABLE 7 High dependency share (direct and upstream)

	High threshold	Europe	United States	China	World
ENCORE 2024	3.00	0.38	0.24	0.36	0.35
	3.15	0.37	0.23	0.36	0.34
	<b>3.25</b>	0.36	0.22	0.35	0.33
	3.35	0.30	0.18	0.32	0.28
	3.50	0.22	0.12	0.23	0.20
	High threshold	Europe	United States	China	World
ENCORE 2022	2.75	0.25	0.26	0.30	0.29
	2.90	0.19	0.18	0.26	0.23
	<b>3.00</b>	0.19	0.17	0.24	0.21
	3.10	0.18	0.17	0.22	0.21
	3.25	0.06	0.03	0.13	0.09

Source: ENCORE 2022, ENCORE 2024, EXIOBASE 2022, JRC elaboration.

The analysis aimed to trace the importance of nature for different sectors and the entire economy. The results confirm the widespread nature dependencies across most sectors of the EU economy, both directly and through supply chains, in line with the findings of the

original study (see [Evison et al., 2023](#)). The estimated exposures of the world economy and the EU economy are somewhat higher than in the original studies, possibly due to the increase in the number of ecosystem services considered and the higher materiality ratings introduced in ENCORE 2024.

It should be remembered that there are high uncertainties in assessing exposure to nature-related risks, notably because of the complexity of both ecosystems and transmission channels to the economy. The ENCORE layer, the aggregation processes for economic sectors and their dependencies on individual ecosystem services, the aggregation of ecosystem services, and the level of the thresholds require strong assumptions that impact the results.

## 4 Conclusions

Even though the integrated assessment of economic, social and environmental impacts of projects or policies is becoming standard practice (see e.g. the European Commission’s better regulation guidelines), incorporating ecosystem and biodiversity considerations into macroeconomic and financial risk analyses raises significant challenges. This study offers insights into assessing the dependency of the EU economy on ecosystem services. The findings indicate that, depending on the version of ENCORE used (thus on the classification frameworks as well as data updates), between 19% and 36% of the EU’s GVA is highly dependent on ecosystem services and is generated by sectors that are at particular risk of being adversely affected by nature degradation. Overall, based on the recent data from ENCORE 2024, two thirds (65%) of the EU’s GVA is estimated to have a high or medium dependency on nature when including both direct and indirect links. The nature dependency figures for the EU are somewhat higher than those obtained for the US (between 17% and 22% of GVA highly dependent on ecosystem services), and are broadly similar to those obtained for China (between 24% and 35%).

As illustrated by the sensitivity analysis, these results should be interpreted as orders of magnitude rather than precise estimates. More importantly, the analysis shows that the entire economy is to some extent susceptible to nature degradation, since all sectors

are interconnected through their supply and value chains, although the different sectors' dependencies on nature vary. The methodology used in this study could be a foundation for more in-depth nature-economy modelling, notably to integrate information on the state of ecosystems and geospatial data on ecosystem services, since the unmet demand of ecosystem services can vary substantially with geographical location. This could be done by using, for instance, data from the INCA (Integrated System of Natural Capital Accounts) Platform (see [La Notte et al., 2022](#)). Geographical location could be easily introduced by considering smaller economic regions, e.g. at NUTS (Nomenclature of territorial units for statistics) 2 level, and making use of actual ecosystem service measurements, e.g. as described in [Fatica et al. \(2024\)](#). Of course, this higher granularity would have to be complemented with NUTS 2 input-output tables. More advanced analysis could then investigate how stress on local ecosystems may affect the delivery of their services, creating potential vulnerabilities on the production side of the EU economy.



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## A Mapping tables and overall dependency score

TABLE A.8 ENCORE 2024 - EXIOBASE Mapping

EXIOBASE sector	Sector name	ISIC sector
i01.a	Cultivation of paddy rice	A.1.11.112
i01.b	Cultivation of wheat	A.1.11.111
i01.c	Cultivation of cereal grains nec	A.1.11.111
i01.d	Cultivation of vegetables, fruit, nuts	A.1.11.113
i01.e	Cultivation of oil seeds	A.1.11.111
i01.f	Cultivation of sugar cane, sugar beet	A.1.11.114
i01.g	Cultivation of plant-based fibers	A.1.11.116
i01.h	Cultivation of crops nec	A.1.11.115
i01.i	Cattle farming	A.1.14.141
i01.j	Pigs farming	A.1.14.145
i01.k	Poultry farming	A.1.14.146
i01.l	Meat animals nec	A.1.14.149
i01.m	Animal products nec	A.1.14.149
i01.n	Raw milk	A.1.14.141
i01.o	Wool, silk-worm cocoons	A.1.16.162
i01.w.1	Manure treatment (conventional), storage and land application	A.1.16.162
i01.w.2	Manure treatment (biogas), storage and land application	A.1.16.162
i02	Forestry, logging and related service activities (02)	A.2.22
i05	Fishing, operating of fish hatcheries and fish farms; service activities incidental to fishing (05)	A.3.31
i10	Mining of coal and lignite; extraction of peat (10)	B.5.51
i11.a	Extraction of crude petroleum and services related to crude oil extraction, excluding surveying	B.6.61
i11.b	Extraction of natural gas and services related to natural gas extraction, excluding surveying	B.6.62
i11.c	Extraction, liquefaction, and regasification of other petroleum and gaseous materials	B.9.91
i12	Mining of uranium and thorium ores (12)	B.7.72
i13.1	Mining of iron ores	B.7.71
i13.20.11	Mining of copper ores and concentrates	B.7.72
i13.20.12	Mining of nickel ores and concentrates	B.7.72
i13.20.13	Mining of aluminium ores and concentrates	B.7.72
i13.20.14	Mining of precious metal ores and concentrates	B.7.72
i13.20.15	Mining of lead, zinc and tin ores and concentrates	B.7.72
i13.20.16	Mining of other non-ferrous metal ores and concentrates	B.7.72
i14.1	Quarrying of stone	B.8.81
i14.2	Quarrying of sand and clay	B.8.81
i14.3	Mining of chemical and fertilizer minerals, production of salt, other mining and quarrying n.e.c.	B.8.89
i15.a	Processing of meat cattle	C.10.101.1010
i15.b	Processing of meat pigs	C.10.101.1010
i15.c	Processing of meat poultry	C.10.101.1010
i15.d	Production of meat products nec	C.10.101.1010
i15.e	Processing vegetable oils and fats	C.10.104.1040
i15.f	Processing of dairy products	C.10.105
i15.g	Processed rice	C.10.106
i15.h	Sugar refining	C.10.107
i15.i	Processing of Food products nec	C.10.107
i15.j	Manufacture of beverages	C.11.110.1104
i15.k	Manufacture of fish products	C.10.102.1020
i16	Manufacture of tobacco products (16)	C.12.120
i17	Manufacture of textiles (17)	C.13.139
i18	Manufacture of wearing apparel; dressing and dyeing of fur (18)	C.14.141
i19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19)	C.15.151
i20	Manufacture of wood and of products of wood and cork, except furniture;	C.16.161
i20.w	Re-processing of secondary wood material into new wood material	C.16.161
i21.1	Pulp	C.17.170
i21.w.1	Re-processing of secondary paper into new pulp	C.17.170
i21.2	Paper	C.17.170
i22	Publishing, printing and reproduction of recorded media (22)	C.18.181
i23.1	Manufacture of coke oven products	C.19.191
i23.2	Petroleum Refinery	C.19.192
i23.3	Processing of nuclear fuel	C.24.242
i24.a	Plastics, basic	C.20.201.2013
i24.a.w	Re-processing of secondary plastic into new plastic	C.20.201.2013
i24.b	N-fertiliser	C.20.201.2012
i24.c	P- and other fertiliser	C.20.201.2012
i24.d	Chemicals nec	C.20.201.2011
i25	Manufacture of rubber and plastic products (25)	C.22.221
i26.a	Manufacture of glass and glass products	C.23.231
i26.a.w	Re-processing of secondary glass into new glass	C.23.231
i26.b	Manufacture of ceramic goods	C.23.239
i26.c	Manufacture of bricks, tiles and construction products, in baked clay	C.23.239
i26.d	Manufacture of cement, lime and plaster	C.23.239
i26.d.w	Re-processing of ash into clinker	C.23.239
i26.e	Manufacture of other non-metallic mineral products n.e.c.	C.23.239
i27.a	Manufacture of basic iron and steel and of ferro-alloys and first products thereof	C.24.241
i27.a.w	Re-processing of secondary steel into new steel	C.24.241
i27.41	Precious metals production	C.24.242
i27.41.w	Re-processing of secondary precious metals into new precious metals	C.24.242
i27.42	Aluminium production	C.24.242
i27.42.w	Re-processing of secondary aluminium into new aluminium	C.24.242
i27.43	Lead, zinc and tin production	C.24.242
i27.43.w	Re-processing of secondary lead into new lead, zinc and tin	C.24.242

EXIOBASE sector	Sector name	ISIC sector
i27.44	Copper production	C_24_242
i27.44.w	Re-processing of secondary copper into new copper	C_24_242
i27.45	Other non-ferrous metal production	C_24_242
i27.45.w	Re-processing of secondary other non-ferrous metals into new other non-ferrous metals	C_24_242
i27.5	Casting of metals	C_24_243
i28	Manufacture of fabricated metal products, except machinery and equipment (28)	C_25_251
i29	Manufacture of machinery and equipment n.e.c. (29)	C_25_259
i30	Manufacture of office machinery and computers (30)	C_26_262
i31	Manufacture of electrical machinery and apparatus n.e.c. (31)	C_26_261
i32	Manufacture of radio, television and communication equipment and apparatus (32)	C_26_261
i33	Manufacture of medical, precision and optical instruments, watches and clocks (33)	C_26_265
i34	Manufacture of motor vehicles, trailers and semi-trailers (34)	C_29_291
i35	Manufacture of other transport equipment (35)	C_30_301
i36	Manufacture of furniture; manufacturing n.e.c. (36)	C_31_310
i37	Recycling of waste and scrap	E_38_383
i37.w.1	Recycling of bottles by direct reuse	E_38_383
i40.11.a	Production of electricity by coal	D_35_351_own_3511
i40.11.b	Production of electricity by gas	D_35_351_own_3511
i40.11.c	Production of electricity by nuclear	D_35_351_own_3512
i40.11.d	Production of electricity by hydro	D_35_351_own_3513
i40.11.e	Production of electricity by wind	D_35_351_own_3516
i40.11.f	Production of electricity by petroleum and other oil derivatives	D_35_351_own_3511
i40.11.g	Production of electricity by biomass and waste	D_35_351_own_3517
i40.11.h	Production of electricity by solar photovoltaic	D_35_351_own_3515
i40.11.i	Production of electricity by solar thermal	D_35_351_own_3515
i40.11.j	Production of electricity by tide, wave, ocean	D_35_351_own_3518
i40.11.k	Production of electricity by Geothermal	D_35_351_own_3514
i40.11.l	Production of electricity nec	D_35_351_own_3511
i40.12	Transmission of electricity	D_35_351_3510
i40.13	Distribution and trade of electricity	D_35_351_3510
i40.2	Manufacture of gas; distribution of gaseous fuels through mains	D_35_352
i40.3	Steam and hot water supply	D_35_353
i41	Collection, purification and distribution of water (41)	E_36_360
i45	Construction (45)	F_41_410
i45.w	Re-processing of secondary construction material into aggregates	F_41_410
i50.a	Sale, maintenance, repair of motor vehicles, motor vehicles parts, motorcycles, motor cycles parts	G_45_451
i50.b	Retail sale of automotive fuel	G_47_473
i51	Wholesale trade and commission trade, except of motor vehicles and motorcycles (51)	G_46_466
i52	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods (52)	G_47_471
i55	Hotels and restaurants (55)	L_55_551
i60.1	Transport via railways	H_49_491
i60.2	Other land transport	H_49_492
i60.3	Transport via pipelines	H_49_493
i61.1	Sea and coastal water transport	H_50_501
i61.2	Inland water transport	H_50_502
i62	Air transport (62)	H_51_511
i63	Supporting and auxiliary transport activities; activities of travel agencies (63)	H_52_521
i64	Post and telecommunications (64)	H_53_531
i65	Financial intermediation, except insurance and pension funding (65)	H_53_532
i66	Insurance and pension funding, except compulsory social security (66)	K_65_651
i67	Activities auxiliary to financial intermediation (67)	K_66_661
i70	Real estate activities (70)	L_68_681
i71	Renting of machinery and equipment without operator and of personal and household goods (71)	N_77_771
i72	Computer and related activities (72)	S_95_951
i73	Research and development (73)	M_72_721
i74	Other business activities (74)	M_69_691
i75	Public administration and defence; compulsory social security (75)	O_84_841
i80	Education (80)	P_85_851
i85	Health and social work (85)	Q_86_861
i90.1.a	Incineration of waste: Food	E_38_381
i90.1.b	Incineration of waste: Paper	E_38_381
i90.1.c	Incineration of waste: Plastic	E_38_381
i90.1.d	Incineration of waste: Metals and Inert materials	E_38_381
i90.1.e	Incineration of waste: Textiles	E_38_381
i90.1.f	Incineration of waste: Wood	E_38_381
i90.1.g	Incineration of waste: Oil/Hazardous waste	E_38_381
i90.2.a	Biogasification of food waste, incl. land application	E_38_382
i90.2.b	Biogasification of paper, incl. land application	E_38_382
i90.2.c	Biogasification of sewage sludge, incl. land application	E_38_382
i90.3.a	Composting of food waste, incl. land application	E_39_390
i90.3.b	Composting of paper and wood, incl. land application	E_39_390
i90.4.a	Waste water treatment, food	E_37_370
i90.4.b	Waste water treatment, other	E_37_370
i90.5.a	Landfill of waste: Food	E_38_381
i90.5.b	Landfill of waste: Paper	E_38_381
i90.5.c	Landfill of waste: Plastic	E_38_381
i90.5.d	Landfill of waste: Inert/metal/hazardous	E_38_381
i90.5.e	Landfill of waste: Textiles	E_38_381
i90.5.f	Landfill of waste: Wood	E_38_381
i91	Activities of membership organisation n.e.c. (91)	S_94_941
i92	Recreational, cultural and sporting activities (92)	R_90_900
i93	Other service activities (93)	R_93_931
i95	Private households with employed persons (95)	T_97_970
i99	Extra-territorial organizations and bodies	U_99_990

Source: JRC elaboration.

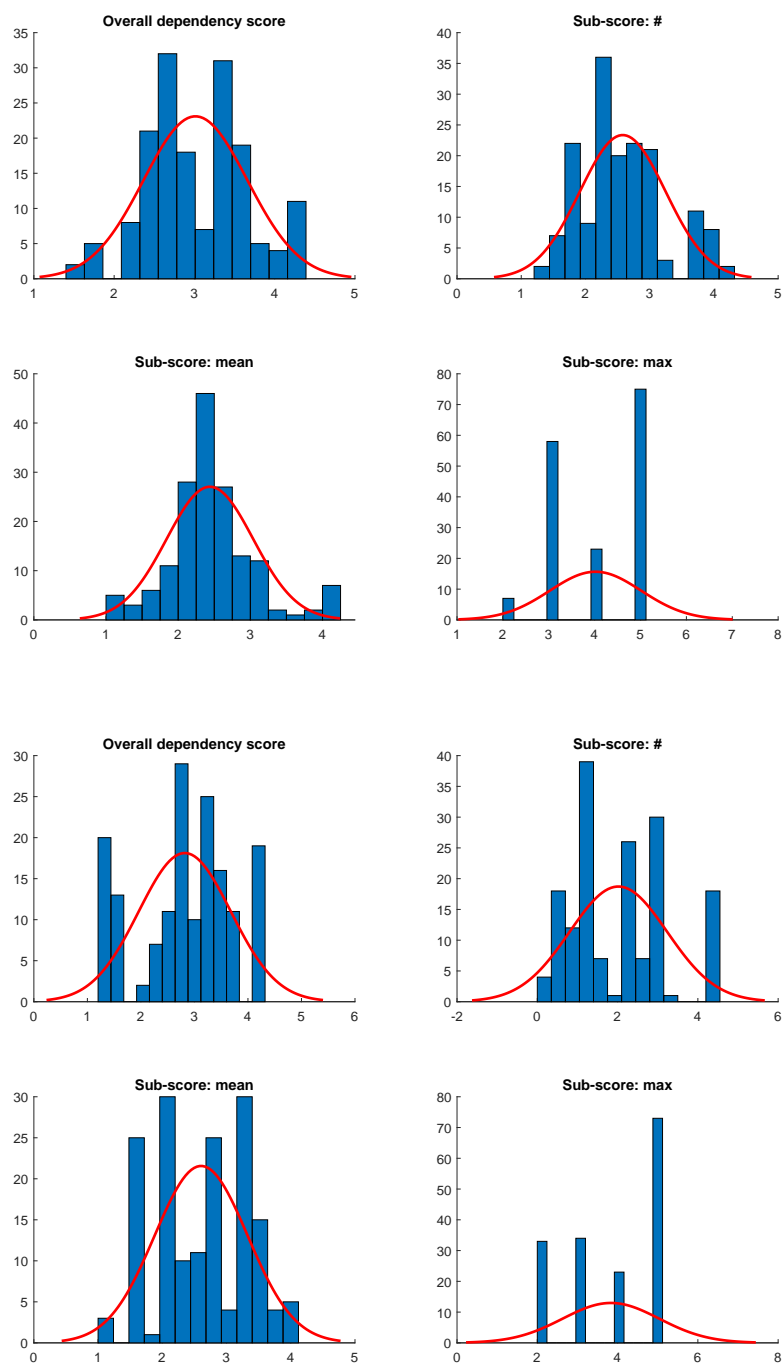
TABLE A.9 Overall dependency score

EXIOBASE sector	Sector name	ENCORE 2024	ENCORE 2022
i01.a	Cultivation of paddy rice	4.25	4.21
i01.b	Cultivation of wheat	4.28	4.21
i01.c	Cultivation of cereal grains nec	4.28	4.21
i01.d	Cultivation of vegetables, fruit, nuts	4.32	4.21
i01.e	Cultivation of oil seeds	4.28	4.21
i01.f	Cultivation of sugar cane, sugar beet	4.18	4.21
i01.g	Cultivation of plant-based fibers	4.27	4.21
i01.h	Cultivation of crops nec	4.30	4.21
i01.i	Cattle farming	4.19	4.10
i01.j	Pigs farming	4.05	4.10
i01.k	Poultry farming	4.00	4.10
i01.l	Meat animals nec	4.05	4.10
i01.m	Animal products nec	4.05	4.10
i01.n	Raw milk	4.19	4.10
i01.o	Wool, silk-worm cocoons	3.77	4.10
i01.w.1	Manure treatment (conventional), storage and land application	3.77	4.10
i01.w.2	Manure treatment (biogas), storage and land application	3.77	4.10
i02	Forestry, logging and related service activities (02)	3.58	4.09
i05	Fishing, operating of fish hatcheries and fish farms; service activities incidental to fishing (05)	4.32	4.10
i10	Mining of coal and lignite; extraction of peat (10)	3.67	3.00
i11.a	Extraction of crude petroleum and services related to crude oil extraction, excluding surveying	2.97	1.60
i11.b	Extraction of natural gas and services related to natural gas extraction, excluding surveying	2.94	1.60
i11.c	Extraction, liquefaction, and regasification of other petroleum and gaseous materials	2.98	1.60
i12	Mining of uranium and thorium ores (12)	3.64	3.00
i13.1	Mining of iron ores	3.64	2.86
i13.20.11	Mining of copper ores and concentrates	3.64	2.86
i13.20.12	Mining of nickel ores and concentrates	3.64	2.86
i13.20.13	Mining of aluminium ores and concentrates	3.64	2.86
i13.20.14	Mining of precious metal ores and concentrates	3.64	2.86
i13.20.15	Mining of lead, zinc and tin ores and concentrates	3.64	2.86
i13.20.16	Mining of other non-ferrous metal ores and concentrates	3.64	2.86
i14.1	Quarrying of stone	3.69	2.86
i14.2	Quarrying of sand and clay	3.69	3.00
i14.3	Mining of chemical and fertilizer minerals, production of salt, other mining and quarrying n.e.c.	3.67	3.00
i15.a	Processing of meat cattle	3.28	3.39
i15.b	Processing of meat pigs	3.28	3.39
i15.c	Processing of meat poultry	3.28	3.39
i15.d	Production of meat products nec	3.28	3.39
i15.e	Processing vegetable oils and fats	3.35	3.39
i15.f	Processing of dairy products	3.35	3.39
i15.g	Processed rice	3.27	3.39
i15.h	Sugar refining	3.33	3.39
i15.i	Processing of Food products nec	3.33	3.39
i15.j	Manufacture of beverages	3.05	3.39
i15.k	Manufacture of fish products	3.27	3.36
i16	Manufacture of tobacco products (16)	2.88	3.40
i17	Manufacture of textiles (17)	2.60	3.39
i18	Manufacture of wearing apparel; dressing and dyeing of fur (18)	2.62	3.39
i19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19)	2.58	2.32
i20	Manufacture of wood and of products of wood and cork, except furniture;	2.56	3.20
i20.w	Re-processing of secondary wood material into new wood material	2.56	3.20
i21.1	Pulp	2.58	3.20
i21.w.1	Re-processing of secondary paper into new pulp	2.58	3.20
i21.2	Paper	2.58	1.49
i22	Publishing, printing and reproduction of recorded media (22)	2.66	3.20
i23.1	Manufacture of coke oven products	2.43	2.33
i23.2	Petroleum Refinery	2.88	2.22
i23.3	Processing of nuclear fuel	2.58	3.20
i24.a	Plastics, basic	2.67	1.65
i24.a.w	Re-processing of secondary plastic into new plastic	2.67	1.65
i24.b	N-fertiliser	3.08	2.57
i24.c	P- and other fertiliser	3.08	2.57
i24.d	Chemicals nec	2.62	2.93
i25	Manufacture of rubber and plastic products (25)	2.43	3.06
i26.a	Manufacture of glass and glass products	3.41	2.24
i26.a.w	Re-processing of secondary glass into new glass	3.41	2.24
i26.b	Manufacture of ceramic goods	3.44	3.13
i26.c	Manufacture of bricks, tiles and construction products, in baked clay	3.44	3.13
i26.d	Manufacture of cement, lime and plaster	3.44	3.13
i26.d.w	Re-processing of ash into clinker	3.44	3.13
i26.e	Manufacture of other non-metallic mineral products n.e.c.	3.44	2.65
i27.a	Manufacture of basic iron and steel and of ferroy-alloys and first products thereof	2.97	2.65
i27.a.w	Re-processing of secondary steel into new steel	2.97	2.20
i27.41	Precious metals production	2.58	2.63
i27.41.w	Re-processing of secondary precious metals into new precious metals	2.58	2.63
i27.42	Aluminium production	2.58	2.33
i27.42.w	Re-processing of secondary aluminium into new aluminium	2.58	2.65
i27.43	Lead, zinc and tin production	2.58	2.65
i27.43.w	Re-processing of secondary lead into new lead, zinc and tin	2.58	2.65
i27.44	Copper production	2.58	2.65

EXIOBASE sector	Sector name	ENCORE 2024	ENCORE 2022
i27.44.w	Re-processing of secondary copper into new copper	2.58	2.65
i27.45	Other non-ferrous metal production	2.58	2.65
i27.45.w	Re-processing of secondary other non-ferrous metals into new other non-ferrous metals	2.58	2.65
i27.5	Casting of metals	2.56	2.65
i28	Manufacture of fabricated metal products, except machinery and equipment (28)	2.49	2.57
i29	Manufacture of machinery and equipment n.e.c. (29)	2.55	2.57
i30	Manufacture of office machinery and computers (30)	2.58	1.41
i31	Manufacture of electrical machinery and apparatus n.e.c. (31)	2.60	2.13
i32	Manufacture of radio, television and communication equipment and apparatus (32)	2.60	2.13
i33	Manufacture of medical, precision and optical instruments, watches and clocks (33)	2.60	2.57
i34	Manufacture of motor vehicles, trailers and semi-trailers (34)	2.60	2.57
i35	Manufacture of other transport equipment (35)	2.37	2.57
i36	Manufacture of furniture; manufacturing n.e.c. (36)	2.62	2.57
i37	Recycling of waste and scrap	2.79	3.78
i37.w.1	Recycling of bottles by direct reuse	2.79	3.78
i40.11.a	Production of electricity by coal	2.95	2.67
i40.11.b	Production of electricity by gas	2.95	2.67
i40.11.c	Production of electricity by nuclear	2.91	3.20
i40.11.d	Production of electricity by hydro	3.45	3.49
i40.11.e	Production of electricity by wind	3.24	3.39
i40.11.f	Production of electricity by petroleum and other oil derivatives	2.95	2.67
i40.11.g	Production of electricity by biomass and waste	2.80	3.26
i40.11.h	Production of electricity by solar photovoltaic	3.20	2.93
i40.11.i	Production of electricity by solar thermal	3.20	2.93
i40.11.j	Production of electricity by tide, wave, ocean	2.83	2.93
i40.11.k	Production of electricity by Geothermal	2.76	3.16
i40.11.l	Production of electricity nec	2.95	2.67
i40.12	Transmission of electricity	2.23	3.24
i40.13	Distribution and trade of electricity	2.23	3.24
i40.2	Manufacture of gas; distribution of gaseous fuels through mains	2.33	2.68
i40.3	Steam and hot water supply	2.82	2.67
i41	Collection, purification and distribution of water (41)	3.53	3.78
i45	Construction (45)	3.47	3.15
i45.w	Re-processing of secondary construction material into aggregates	3.47	3.13
i50.a	Sale, maintenance, repair of motor vehicles, motor vehicles parts, motorcycles, motor cycles parts	2.16	1.33
i50.b	Retail sale of automotive fuel	2.37	1.33
i51	Wholesale trade and commission trade, except of motor vehicles and motorcycles (51)	2.23	1.33
i52	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods (52)	2.33	1.33
i55	Hotels and restaurants (55)	3.77	2.89
i60.1	Transport via railways	3.30	2.75
i60.2	Other land transport	3.30	2.68
i60.3	Transport via pipelines	2.71	2.68
i61.1	Sea and coastal water transport	3.53	3.26
i61.2	Inland water transport	3.58	3.26
i62	Air transport (62)	3.23	2.80
i63	Supporting and auxiliary transport activities; activities of travel agencies (63)	2.13	2.68
i64	Post and telecommunications (64)	2.12	3.16
i65	Financial intermediation, except insurance and pension funding (65)	2.12	1.41
i66	Insurance and pension funding, except compulsory social security (66)	1.51	1.41
i67	Activities auxiliary to financial intermediation (67)	1.51	1.41
i70	Real estate activities (70)	2.98	2.60
i71	Renting of machinery and equipment without operator and of personal and household goods (71)	3.13	1.33
i72	Computer and related activities (72)	2.23	1.33
i73	Research and development (73)	3.50	1.33
i74	Other business activities (74)	1.73	1.33
i75	Public administration and defence; compulsory social security (75)	1.71	1.33
i80	Education (80)	3.55	1.33
i85	Health and social work (85)	3.60	1.33
i90.1.a	Incineration of waste: Food	2.38	1.60
i90.1.b	Incineration of waste: Paper	2.38	1.60
i90.1.c	Incineration of waste: Plastic	2.38	1.60
i90.1.d	Incineration of waste: Metals and Inert materials	2.38	1.60
i90.1.e	Incineration of waste: Textiles	2.38	1.60
i90.1.f	Incineration of waste: Wood	2.38	1.60
i90.1.g	Incineration of waste: Oil/Hazardous waste	2.38	1.60
i90.2.a	Biogasification of food waste, incl. land application	3.29	3.26
i90.2.b	Biogasification of paper, incl. land application	3.29	3.26
i90.2.c	Biogasification of sewage sludge, incl. land application	3.29	3.26
i90.3.a	Composting of food waste, incl. land application	3.28	3.26
i90.3.b	Composting of paper and wood, incl. land application	3.28	3.26
i90.4.a	Waste water treatment, food	3.41	3.78
i90.4.b	Waste water treatment, other	3.41	3.78
i90.5.a	Landfill of waste: Food	2.38	3.78
i90.5.b	Landfill of waste: Paper	2.38	3.78
i90.5.c	Landfill of waste: Plastic	2.38	3.78
i90.5.d	Landfill of waste: Inert/metal/hazardous	2.38	3.78
i90.5.e	Landfill of waste: Textiles	2.38	3.78
i90.5.f	Landfill of waste: Wood	2.38	3.78
i91	Activities of membership organisation n.e.c. (91)	1.64	1.33
i92	Recreational, cultural and sporting activities (92)	3.28	1.33
i93	Other service activities (93)	3.77	1.33
i95	Private households with employed persons (95)	1.66	1.33
i99	Extra-territorial organizations and bodies	1.64	1.33

Source: JRC elaboration.

FIGURE A.1 Distribution overall dependency score, ENCORE 2024 (top) and 2022 (bottom)



Source: JRC elaboration.

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