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Special

Protein for Scraps: A Study of the European Union “Circular” Raw Materials Trade

Proteínas por chatarra: un estudo do comercio de materias primas “circulares” na Unión Europea

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Abstract

The shift from the current extractive linear production and consumption system to a circular economy (CE) has been heralded as a way to reduce the negative environmental and social impacts of human economic activity. The European Union (EU) has committed to leading the way to a worldwide CE, with the development of an international market of recyclable raw materials (RRM) as one of the main pillars of its strategy. However, there is extensive evidence regarding the unequal distribution of the economic benefits and environmental damages related to international trade. Therefore, the objective of a global fair transition to a CE may be undermined if the related markets continue to reproduce the prevailing patterns of ecologically unequal exchange. In order to test whether or not this is the case, this research studies the physical trade balance and the terms of trade on the recent RRM trade flows from, to and between the EU27 member states.

Keywords: Circular economy; Ecologically unequal exchange; Secondary raw materials; Recyclable waste; International trade.

Resumo

O cambio do actual sistema de lineal de extracción, produción e consumo cara unha economía circular (EC) foi anunciado como un xeito de reducir os impactos medio ambientais e sociais negativos da actividade económica humana. A Unión Europea (UE) comprometeuse a liderar a ruta cara unha EC global, co desenvolvemento dun mercado internacional de materias primas reciclables (MPR) como un dos principais pilares da súa estratexia. Porén, hai fortes evidencias da distribución desigual do beneficio e o dano medio ambiental causado polo comercio internacional. Por tanto, o obxectivo dunha transición xusta global cara unha EC pode ser socavada se os mercados implicados continúan cos patróns previos de intercambio ecoloxicamente desigual. Para comprobar se isto é o caso, este estudo analiza o saldo físico comercial e os termos de comercio para os fluxos de comercio de MPR recentes dende, cara e entre os países membro da UE27.

Palabras chave: Economía circular; Intercambio ecoloxicamente desigual; Materias primas secundarias; Residuos reciclables; Comercio internacional.

JEL: Q56; F18; Q57; F54.

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1. INTRODUCTION

The notion of an urgent need for a radical shift from the prevailing extractive system of production and consumption to a regenerative circular economy (CE) has been gaining growing attention in recent years. Yet, there is still no consensus on the general understanding of the concept, on the depth of the required socio-economic transformation, or on the most appropriate strategy for its implementation (Prieto-Sandoval et al, 2018; Llorente-González & Vence, 2019; Genovese & Pansera, 2021). Despite these many discrepancies, some level of agreement exists in that the basic tenets of CE could contribute to mitigating the most pressing environmental and social negative impacts of human economic activity. Thus, the overarching goal of transitioning towards a CE has been incorporated as a key component in the development strategies of an increasing number of countries and regions (SCOEISP, 2008; European Commission, 2020a; EPA, 2021).

In this context, CE has been heralded in the European Union as a way to promote both an environmentally sustainable and socially just transition, providing equal opportunities for all territories (European Commission, 2020b; Schroder, 2020). Among other strategic objectives, the European Commission has pledged to "lead the way to a CE at the global level", "addressing EU waste exports" and promoting the creation of a "well-functioning" EU market for secondary raw materials (European Commission, 2020a). These general goals involve the intention to promote policy initiatives such as the development of EU-wide end-of-waste criteria, product and component standardization, monitoring, restrictions on certain substances and exports of hazardous waste, building international agreements and partnerships, and incorporating CE in free-trade agreements. Moreover, the extension of the EU's secondary raw materials market has been incorporated among the indicators to measure the progress of the region in the transition towards a CE (European Commission, 2018).

The initiatives proposed by the European Commission are based on the 1990's orthodox notion that environmental sustainability should emerge as a by-product of international trade, through the channels of income growth and increased efficiency in resource use (Grossman & Krueger, 1991). However, since then, a dearth of empirical evidence has emerged pointing towards the opposite being the case: far from fostering sustainable development, the specialization patterns derived from international trade have resulted in an increasingly unequal distribution of both economic gains and ecological damage (Hornborg, 1998; Andersson & Lindroth, 2001; Dorninger & Hornborg, 2015; Frey et al., 2019).

Empirical evidence on the negative environmental consequences of the development of international trade has been conceptually theorized under the notion of ecologically unequal exchange (EUE). The theory of EUE posits that, while most of the global wealth, materials and energy flow to a handful of affluent core economies, it is the periphery, or "global South," that bears the brunt of the negative social and ecological impacts of international trade (Oulu, 2016; Hickel et al., 2022). Far from being an unintended side-effect of international trade, the unequal distribution of natural wealth and environmental burden is the ecological counterpart and pre-requisite of capital accumulation and economic development in the core countries (Hornborg, 1998; Andersson & Lindroth, 2001; Howell, 2007; Foster & Holleman, 2014; Oulu, 2016; Givens et al., 2019).

Empirical studies aiming to test the existence of EUE have focused on measuring the different ecological impacts of international trade of final goods and primary raw materials (Piñero et al., 2020). These impacts have been extensively accounted for in terms of embodied resources (ecological footprints) (Oulu, 2015; Fitzgerald & Auerbach, 2016; Dorninger et al., 2021), physical material flows (Pérez-Rincón, 2006; Infante-Amate & Krausmann, 2019; Piñero

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et al., 2020; Infante-Amate et al., 2022), greenhouse gas emissions and other pollutants (Moran et al., 2013; Yu et al., 2014; Prell & Feng, 2016; Oppon et al., 2018). In contrast, empirical research on EUE in waste trade flows is less frequent (Frey, 2012; Tong et al., 2022), while, so far, only two studies have focused on "circular" or recyclable waste from this perspective (Llorente-González, 2019; Bai & Givens, 2021). The present study seeks to address this knowledge gap by analyzing the EU's trade flows of recyclable raw materials (RRM).

As one of the key components of the European CE strategy, trade in recyclable wastes is being promoted simultaneously as an enabler for the sustainable management of residues and as a strategy to secure the EU provision of critical raw materials. While these objectives may well be complementary, the several physical, economic and political systemic limitations implied by a trans-boundary CE (Korhonen et al., 2018a), together with a long history of the appropriation of resources by the global North (Hickel et al., 2022) and, in particular, by the leading European economies (Cooper, 2011; Adas, 2015), call for more thorough scrutiny.

This paper is structured as follows: in Section 2 (Literature Review), the current discussion about the two major contesting conceptual approaches to CE is outlined, followed by an overview of the main tenets of the EUE theory, and of the most salient empirical strategies that study international trade from an EUE perspective. The empirical strategy is described in Section 3 (Materials and Methods). The main results of the analysis of the 2021 EU27 trade flows of RRM are presented in Section 4. Section 5 contains a discussion of the results under the light of EUE theory and the broader understanding of CE. The main conclusions and limitations are dealt with in Section 6, together with some proposed avenues for future research.

2. LITERATURE REVIEW

The overarching concept of CE generally envisages a transformative paradigm shift in the way societies approach resource management and economic systems. Rooted in pre-existing ideas, some of which used to be contained in the ample notions of green growth and sustainability, the CE seeks to redefine traditional linear models of production and consumption by aiming to decouple economic growth from resource depletion and environmental degradation (Reike et al, 2018; Vence, 2023).

As a comprehensive theoretical-practical approach that encompasses wide-ranging notions from different fields and disciplines (Blomsma & Brennan, 2017), the concept of CE is currently a bone of contention due to this profusion of understandings (Kirchherr et al., 2017; Korhonen et al., 2018b). Among these, two broad interpretations of CE stand out, which in turn give rise to clearly differentiated agendas for its practical implementation: a technocratic "eco-modernist" approach, on the one hand, and a holistic transformational stance, on the other (Calisto Friant, 2021; Genovese & Pansera, 2021).

2.1 Conceptualizations of CE: narrow vs broad approaches

The "eco-modernist" interpretation of CE is currently the mainstream approach. It is supported by influential international practitioners and organizations (Ellen MacArthur Foundation, 2013; World Economic Forum et al., 2014), and has been incorporated by policy-makers into the development strategies of the EU and China, among other territories (SCOEISP, 2008; European Commission, 2020a). In this approach, a CE is defined as that in which the available material resources and energy are intended to effectively be kept in use within the profit-driven productive process for as long as possible, relying on innovative technologies and business models to extend the useful life of goods, increase resource efficiency and close material loops (Geisendorf & Pietrulla, 2018).

From this view, economic growth and market competitiveness are assumed to be compatible with resource decoupling, and therefore continue to be unquestioned as the primary objectives to which ecological and social considerations should be adapted (Leipold, 2021). Therefore, businesses are expected to be the leading actors in the transformation and profitability is a pre-requisite for any implementation strategy, while promotion policies focus on the provision of market-based incentives, and public engagement is limited mainly to a matter of consumer choice.

In practice, this first narrow approach to CE leads to a prioritization of incremental innovations based on material recovery and resource savings per unit of output (relative decoupling) over other options that would imply an overall decrease in resource use (absolute decoupling), such as reduction of consumption, reuse or repair. Although the latter may be formally encouraged on paper (European Commission, 2020b), these activities are primarily expected to be supported in self-regulated market-based mechanisms related to technical innovations in industrial design and changes in consumer awareness. However, the limited capacity of this regulatory approach to generate incentives that are strong enough to alter the status quo results in these strategies to remain confined to marginal niches embedded in a linear extractive economy (Llorente-González & Vence, 2020).

The second alternative interpretation understands the transition towards a CE as part of a radical, holistic and systemic transformation of human economic activity, shifting from the production of ever-increasing flows of outputs and throughputs to the preservation of physical stocks and the adaptation to natural ecological cycles (Boulding, 1966; Korhonen et al, 2018b). Building a CE would therefore not only require a profound technical and organizational reconfiguration of the economic process but, above all, a radical social, cultural and political transformation (Hobson & Lynch, 2016; Pansera et al., 2021). This perspective also stresses that, due to the planet's ecological limits and the physical impossibility of a completely "circular" economy (Korhonen et al, 2018a), transition strategies should be based mostly on reducing the current dependence of human livelihood on the increasing production and consumption of disposable items.

In terms of practical applications, this broad approach to CE proposes the shift to "convivial" technologies (see Genovese & Pansera, 2021), which do not rely on further increases in material and energy use, and are supported by economic downscaling, cooperative production and consumption, collaborative access to technology and knowledge, and community driven democratic participation (Calisto Friant et al., 2020). Prioritized "circular" strategies are those designed to extend and preserve the use value of goods that are required for dignified, just and sufficient lives, such as the abovementioned reduce, reuse and repair activities, among others (Llorente-González & Vence, 2020; López Pérez et al., 2023). The notion of proximity in production, distribution and consumption puts the focus on the advantages of locally-based and short value chains over global value chains, in order to reduce emissions from transport, improve energy and resource efficiency, foster innovation and collaboration through productive symbiosis, increase ecological resilience and security, and promote local development (Gallaud & Laperche, 2016; Vence, 2023). Therefore, this broader perspective deeply calls into question the role of international trade in the context of a genuinely sustainable and equitable CE.

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2.2 The theory of EUE

The notion of ecologically unequal exchange (EUE) refers to the asymmetric global distribution of the economic benefits and environmental damages resulting from international trade (Oulu, 2016; Piñero et al., 2020).

Since the seminal paper of Bunker on the relationship between modes of extraction and underdevelopment in the Brazilian Amazon (Bunker, 1984), many studies have been devoted both to the theoretical discussion of EUE and to its empirical testing. Building on diverse concepts and methodologies, they all have in common a fundamental critique of the notion in neoclassical mainstream economics that international prices reflect an equitable exchange between countries. However, unlike the strictly economic theories of unequal exchange on which EUE theory is inspired (Prebisch, 1949; Emmanuel, 1972; Amin, 1976; Mandel, 1978; Wallerstein, 2004; Shaikh, 2009), the main focus of the analysis is not on the transfer of economic value embodied in traded goods, but on the physical effects of trade and its consequences for the development dynamics of different territories.

The theory of EUE generally postulates that international trade leads to a continuous uneven net flow of materials, nutrients and energy to regions specialized in high monetary value-added activities (alternatively referred to as rich, core, industrialized or developed economies). At the same time, the peripheral economies of the Global South, typically exporters of raw materials, natural resource-intensive and low monetary value-added goods, are the most harmed by the social and ecological impacts which the underlying pattern of international specialization creates (Andersson & Lindroth, 2001; Bunker, 1984; Hornborg, 1998; Oulu, 2015; Peinado, 2015; Hornborg & Martínez-Alier, 2016; Jorgenson, 2016; Piñero et al., 2020).

The perpetuation of these commerce imbalances over time cannot be explained in terms of the mainstream neoclassical theory of trade, as market prices are inherently unable to reflect the environmental and social costs associated with the specialization on primary extractive activities (Martínez-Alier, 2002; Frey, 2012), such as pollution, the depletion of natural resources, precarious and unhealthy working conditions, and the weakening of community ties and social cohesion. From the perspective of EUE theory, continuous physical trade imbalances lead to pervasive dynamic effects on peripheral economies, because the materials, nutrients and energy that flow to core countries are no longer available as resources applicable to local development. Instead, they contribute to reinforcing the capital stock of core industrialized economies, perpetuating the pattern of economic dependency (Hornborg, 1998). As a result, the technical edge that industrialized countries have leads to their control over global natural resources.

This relationship of dependency is sustained even if peripheral countries eventually manage to shift from primary commodities to the production of industrial goods, as the control of the critical links of the global value chains in terms of technology, knowledge and added monetary value continue to be monopolized by capital from countries in the Global North (Hickel et al., 2022). Hence, one of the main mechanisms through which this dynamic is reinforced and perpetuated is that of capital flows in the form of FDI dividends to multinational firms based in core countries, together with the external debt burden. As a result, the chronic need for foreign currency to meet these obligations becomes a further driver for extractivism, indefinitely postponing local development objectives (Breard & Llorente-González, 2022; Martínez Alier & Roca Jusmet, 2013; Warlenius et al., 2015).

The social and ecological effects of these unequal power relations are invisible to mainstream neoclassical economic analysis, in which the variety of use values, social labor and ecological diversity is homogenized in terms of monetary exchange value, and which depicts the complex process of human socio-metabolism as simple market-system relations independent of the ecological limits of the planet (Foster & Holleman, 2014; Martínez Alier & Roca Jusmet, 2013; Naredo, 2015; Polanyi, 1977).

2.3 Empirical approaches to EUE and CE

In the last three decades, a growing number of studies have been devoted to the empirical testing of the mechanisms and effects highlighted in the EUE theory. A variety of methodological tools have been applied, depending mainly on the information available, and on a range of different theoretical approaches. Of these, the most common is that concerned with measuring the physical socio-metabolic flows that constitute the material basis of international trade (Oulu, 2015; Infante-Amate & Krausmann, 2019).

Accounting for physical trade flows was first hypothesized and measured in terms of energy (Fischer-Kowalski, 1998; Martínez-Alier, 2007), leading to notions aimed at unveiling the thermodynamic dimension of human labor, and raising further discussions about the ontology of economic value. Some examples are the concepts of “emergy”, which refers to *past* energy applied to and embedded through the production process in manufactured goods (Odum, 1988; Podolinsky [1881], 2004), and “exergy”, i.e., the available energy (or productive potential) of raw materials before they enter the industrial system (Hornborg, 1998).

The most widespread approach today focuses on net changes in material stocks in economies, based on material flow analysis (MFA) (Fischer-Kowalski, 1998; Schaffartzik et al., 2014). The MFA methodology follows the path of materials from their extraction (or their import), via processing, either in the form of intermediate use or temporary build-up of stocks, distribution and consumption, to either their recycling or (normally) their final exit from the economic cycle as waste and/or emissions (Haas et al., 2015). The material flow methodology is not only able to quantify the physical counterpart of human economic activity, but also intuitively reveal the asymmetric distribution of the material impacts of international trade.

For this purpose, empirical studies on EUE usually make use of different analytical tools, depending on the amount and type of data available and the methodological strategy used. For example, the Environmentally Extended Multi-Regional Input-Output (EMRIO) approach is frequently used to examine ecological burden displacement between economies, in terms of the emissions and natural resources embedded in global trade (Dorninger et al, 2021; Hickel et al, 2022). Its strength lies in allowing for a comprehensive evaluation of both direct and indirect environmental impacts, while also defining the entire global supply chain as the system boundary (Yu et al, 2014; Hubacek & Feng, 2016). As a complex model that integrates national input-output monetary tables and bilateral trade accounts with ecological physical estimations, it relies heavily on assumptions and simplifications, and on extensive and high-quality data, which is not always available for certain countries and/or material flows.

An alternative approach is to use physical trade indicators, such as the Physical trade balance (PTB) and Terms of trade (ToT) (Giljum, 2004; Pérez-Rincón, 2006; Infante-Amate and Krausmann, 2019; Piñero et al, 2020; Infante-Amate et al, 2022). PTB is defined as the difference between the direct imports and exports of a country, while ToT reflects the relative price of the mass of exported materials in relation to the imported amount, expressed as the ratio of the total monetary value in US$ per tonne of exports and that of imports (Infante-Amate & Krausmann, 2019). Although this methodology lacks the mentioned analytical nuances of the input-output based approach, its main advantage is that it relies on straightforward, transparent data regarding physical quantities of traded materials, making it less susceptible to data quality issues, simplifying the analysis process compared to more sophisticated models.

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Given the initial state of knowledge on this topic and the consequent limited availability of data, this study relies on this approach.

With specific regard to the CE, socio-metabolic studies such as that of Schaffartzik et al. (2014) and Haas et al. (2015) have set the basis for calculating the level of material "circularity" at the macroeconomic level, in terms of the proportion of recycled materials that are reintroduced into production over the total amount of materials processed (extracted and imported) in an economy. This methodological approach is behind the circular material use rate, a key metric in the CE Monitoring Framework (CEMF) of the European Union. Overall, MFA is increasingly being used as an intuitive tool to gain empirical insight into the extent to which discarded materials are recovered by an economy's productive system (Llorente-González & Vence, 2023).

However, the MFA also has limitations when applied to transnational material flows, as the results can be significantly biased depending on the selected system boundaries, and on the criteria applied to determine the extent of the ecological footprint of the economy under study. Certain accounting approaches may lead to higher levels of material circularity when in fact ecological impacts are being displaced overseas, e.g. by importing footprint-intensive goods, or by exporting recyclable waste (Llorente-González & Vence, 2023).

While some empirical research has dealt with waste trade flows (see Frey, 2012; Kellenberg, 2012), to the best of our knowledge, only two attempts have been made so far to analyze the international flow of secondary raw materials from a critical ecological perspective (Llorente-González, 2019; Bai & Givens, 2021). The present study seeks to address this knowledge gap.

3. MATERIALS AND METHODS

The main input of this study was the datasets from the public database that deals with international trade in goods of EU countries, compiled by Eurostat (Comext database). We used the 2021 annual database, containing information on the total amount of goods traded (in euros and kg) among the member states and between them and the rest of the world, with an 8-digit product disaggregation level (CN8 classifier)[1] .

This was chosen instead of other sources like the United Nations *Comtrade* database or the *Global Trade Atlas* (Higashida & Managi, 2014) because of its higher level of disaggregation at the product level. This allows to apply the classification of recyclable raw materials (RRM) developed by Eurostat as part of the assessment framework of the CE in the European Union (European Commission, 2018), and is therefore relevant for the purposes of this study. The database was extracted from the Eurostat bulk download facility[2] .

Eurostat's classification covered 208 types of recyclable waste[3] , including organic (animal and vegetable), minerals, glass, plastic, textiles, rubber, wood, paper and cardboard, ferrous metals, precious metals, copper, aluminum and nickel. The selected recyclable raw materials

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[1] Datasets available at https://ec.europa.eu/eurostat/comext/newxtweb/

[2] Available at https://ec.europa.eu/eurostat/data/bulkdownload. The 2021 database was downloaded on September 15th, 2022.

[3] A different classification of recyclable raw materials (referred to as "secondary raw materials") was applied by Eurostat when the European Circular Economy Monitoring Framework was first released in 2018. It consisted of 39 types of waste and scrap from plastic, paper and cardboard, precious metals, iron and steel, and copper, aluminum and nickel. The data derived from this classification portrayed the European Union largely as a net exporter of recyclable waste to the rest of the world (on this, see Llorente-González, 2019).

were sub-divided in the Eurostat classification into *by-products* (mainly originating from agriculture and forestry) and *waste and scraps* (most of the remaining waste) (see Eurostat, 2023).

Due to the scope of this study and the nature of the data sources, we mainly focused on the physical trade balance (PTB) and terms of trade (ToT) indicators, namely, mass amount of imports and exports, and average value measured in euros (€) per tonne. Since the database was built from an EU perspective, all trade flows originated in or were destined for the EU27 countries. In the case of trade between the EU27 member states, the flows reported by the importers and the exporters did not usually match. In the event of discrepancies, the values declared by importers were taken as valid, following the same criteria applied by Eurostat.

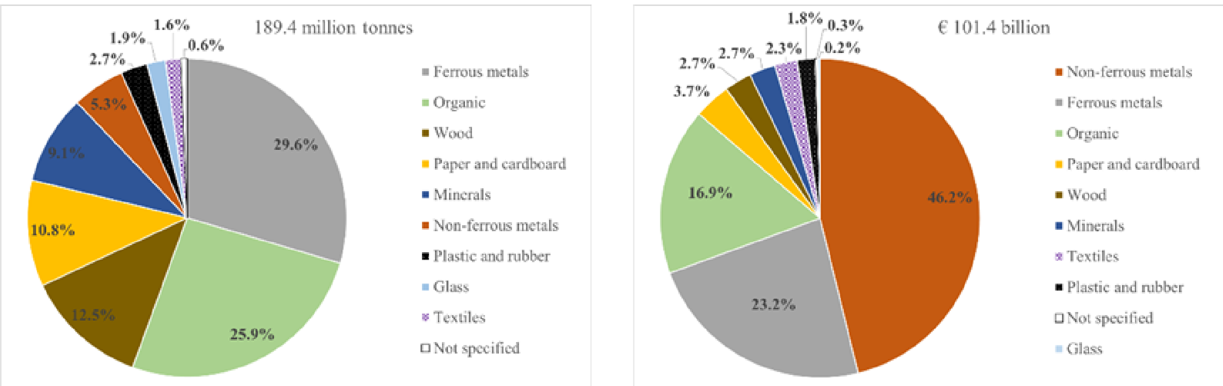
4. RESULTS

In 2021, EU27 trade in RRM as classified in the European CEMF reached 189.4 million tonnes, equivalent to 2.2% of the total mass of imported and exported goods and around 1% of the total materials processed by the economies of the region[4]. Of this overall mass, 101.8 million tonnes (54%) were traded among EU27 countries, while 40.1 million tonnes were exported to and 47.6 million tonnes were imported from the rest of the world.

More than two thirds of the total mass of recyclable raw materials traded by the EU27 corresponded to ferrous metals (30%), organic residues (26%) and wood (13%). Other relevant flows in mass were paper and cardboard (11%), minerals (9%) and non-ferrous metal (5%) waste (Figure 1).

In terms of monetary value, trade in RRM amounted to €101.4 billion, 0.7% of EU27 total monetary value traded and 0.3% of its GDP. This meant a flow of €50.9 billion between the EU27 countries and a net outflow of €6.3 billion to the rest of the world (€28.4 billion imported and €22.1 billion exported). Despite their relatively small share in the overall traded mass, non-ferrous metals had, by and large, the most relevant flows in monetary terms (46%), followed by ferrous metals (23%) and organic waste (17%).

Figure 1. EU27 overall trade in RRM in tonnes and euros. Share by type of material. 2021



Source: Own elaboration based on Comext database (Eurostat)

It must be highlighted that roughly 37% of the overall mass traded consisted of residues classified by Eurostat as *by-products*, while the remaining 120 million tonnes was made up of *waste and scraps* (Eurostat, 2023). The bulk of the traded by-products comprised mostly

[4] Source: Eurostat database (https://ec.europa.eu/eurostat/web/main/data/database).

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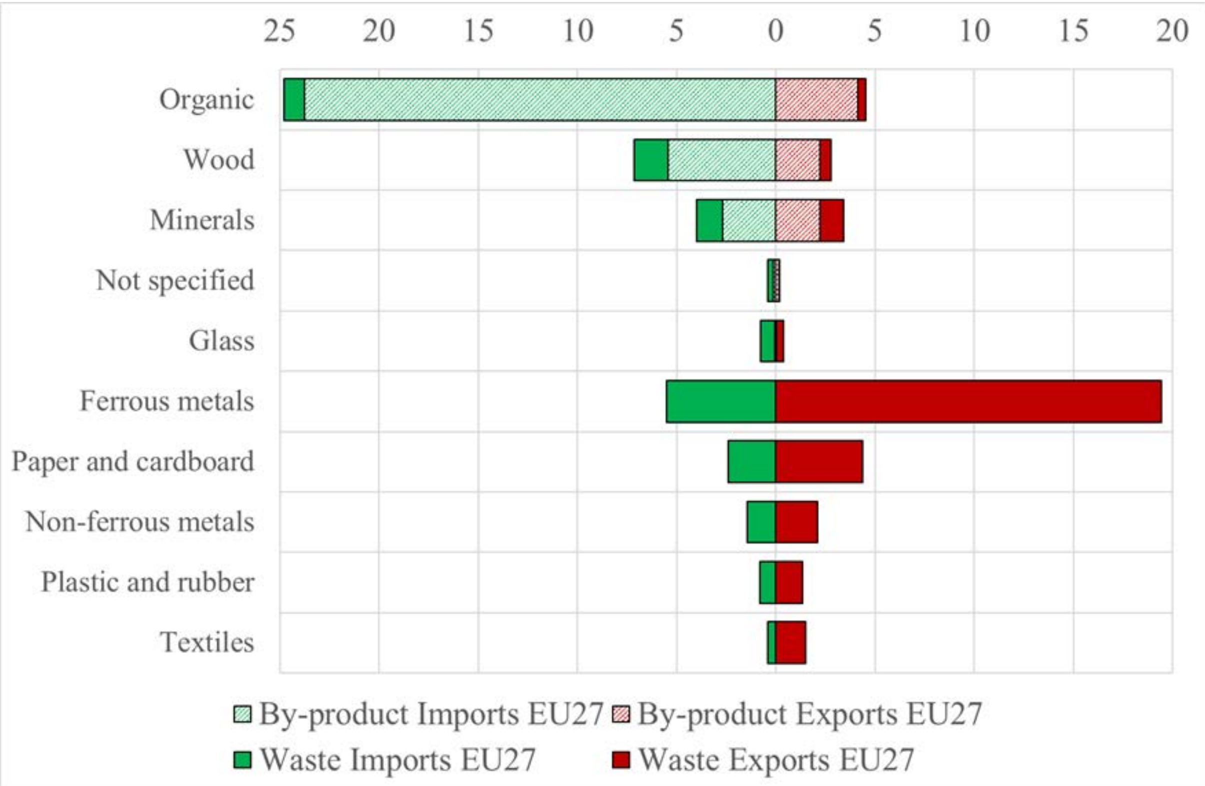
organic waste originating from the food and wood industries. They also included, to a lesser extent, some inorganic mineral residues from the manufacture of iron and steel. Traded recyclable waste and scraps included, to a great extent, end-of-life residue made of different types of metals, paper, cardboard and plastic.

4.1 EU27 trade with the rest of the world

The 2021 data showed significant differences between the types of materials that made up the EU27's in- and out-flows. While net imports from the rest of the world largely consisted of organic by-products, EU27 net exports mainly comprised ferrous metal waste and, to a lesser extent, paper, cardboard, plastic, rubber and textile waste (Figure 2). Half of the 32 million tonnes of EU27 imports of by-products came from South America (almost exclusively from Argentina and Brazil), over a quarter (27%) from non-EU27 European countries (notably Russia and Ukraine) and 9% from North America (mainly the United States). In contrast, 70% of the 16 million tons of imported potentially recyclable waste was shipped from non-EU27 European countries (predominantly the United Kingdom, Switzerland and Norway), while another 15% came from North America (mainly the United States).

The EU27 exported 31 million tonnes of potentially recyclable waste to the rest of the world. The main destination was Western Asia (mainly Turkey) (46%), followed far behind by the rest of Asia (23%), non-EU27 European countries (17%) and Africa (10%). The comparatively smaller mass of EU27 by-product exports (9 million tonnes) was destined mainly to the United Kingdom (47%) and other non-EU27 European countries (13%).

Figure 2. EU27 trading in RRM with the rest of the world by type of material (millions of tonnes). 2021



Source: Own elaboration based on Comext database (Eurostat)

Even though, on average, the monetary value in euros per tonne of EU27 recyclable raw material imports was only slightly higher to that of exports, significant differences were observed when the type of material (waste and by-products) and the location of the trading partner were considered. In the case of recyclable waste, the monetary value of EU27 imports from the rest of the world was almost double that of exports (Figure 3).

Moreover, the ratio between the value of EU27 imports and exports of recyclable waste was 3.6 for Western Asia, slightly higher, at 4.6 for the rest of Asia, and as high as 8.8 in the case of Africa. This ratio was only lower than 1 for trade between non-EU27 European countries (0.8). Regarding by-products, the monetary value of EU27 imports and exports was comparatively more balanced in all cases, with an overall import/export ratio of 1.2. However, it must be highlighted that the average price per tonne of the by-products imported by the EU27 was only a quarter of that of the imported recyclable waste.

These remarkable disparities in monetary value were largely due to differences in the material composition of the recyclable waste flows entering and leaving the EU27, mainly concerning the share of ferrous and non-ferrous metals and organic waste. Ferrous metal waste comprised various kinds of residues and scraps of relatively low value per tonne, containing primarily iron and steel. Non-ferrous metal waste mainly consisted of copper, aluminum and nickel (CAN) waste and scraps and, to a lesser extent, residues from precious metal (gold, silver and platinum) and other higher-value per tonne metals (e.g. zinc and lead). Trade flows of organic waste principally included by-products of vegetable origin from oil manufacturing and, to a much lesser extent, industrial waste of various forms from animals and vegetables.

In 2021, the average value of ferrous metal waste was approximately €380 per tonne for EU27 exports and €460 for imports. In the case of non-ferrous metals, the average monetary value per tonne of CAN waste was €2,475 (exports) and €3,615 (imports), while that of precious metals was as high as €64,000 and € 80,000, respectively. Exports of organic waste averaged €360 per tonne and for imports it was €415 (see Annex A, Table A3).

Once again, as regards the composition of trade flow, while 49% of the mass and 33% of the total value of the recyclable raw materials exported by the EU27 corresponded to ferrous metals, this type of waste accounted for only 9% of the mass and 12% of the value of the imports. Conversely, organic waste made up 52% of the mass and 32% of the value of imports, and just 11% and 9%, respectively, when it came to EU27 exports. When considering the most relevant trading partners, ferrous metal waste represented around 85% of EU27 exports of recyclable raw materials to Western Asia (almost exclusively Turkey), both in mass and in monetary value, while organic waste made up 90% of the mass and 95% of the monetary value of the imports from South America (mostly Argentina and Brail).

Regarding non-ferrous metals, although their share in mass was lower for EU27 imports (3%) than for exports (5%), the opposite was the case for monetary value (48% and 43%, respectively). This was owing to the slightly greater presence of precious metal waste among the mass of imports (0.3%, vs 0.2% for exports), which nevertheless meant an astounding difference in the share in terms of monetary value (34% vs 21%, respectively). The share of precious metal waste among EU27 imports was particularly high in the case of Africa (mostly South Africa), accounting for 2% of the mass and 60% of the total monetary value of recyclable raw materials traded with the region (see Annex A, Table A1 and Table A2).

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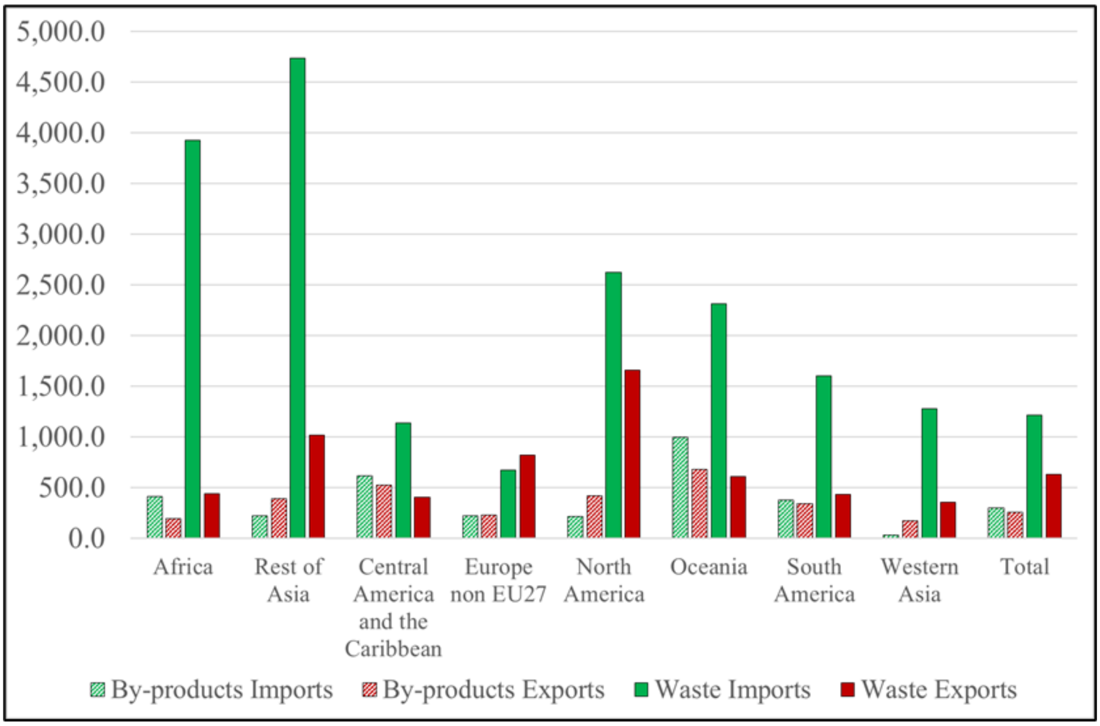
Figure 3. Average monetary value of EU27 trade in RRM with the rest of the world, by region and type of material 8 (euros per tonne). 2021



Source: Own elaboration based on Comext database (Eurostat)

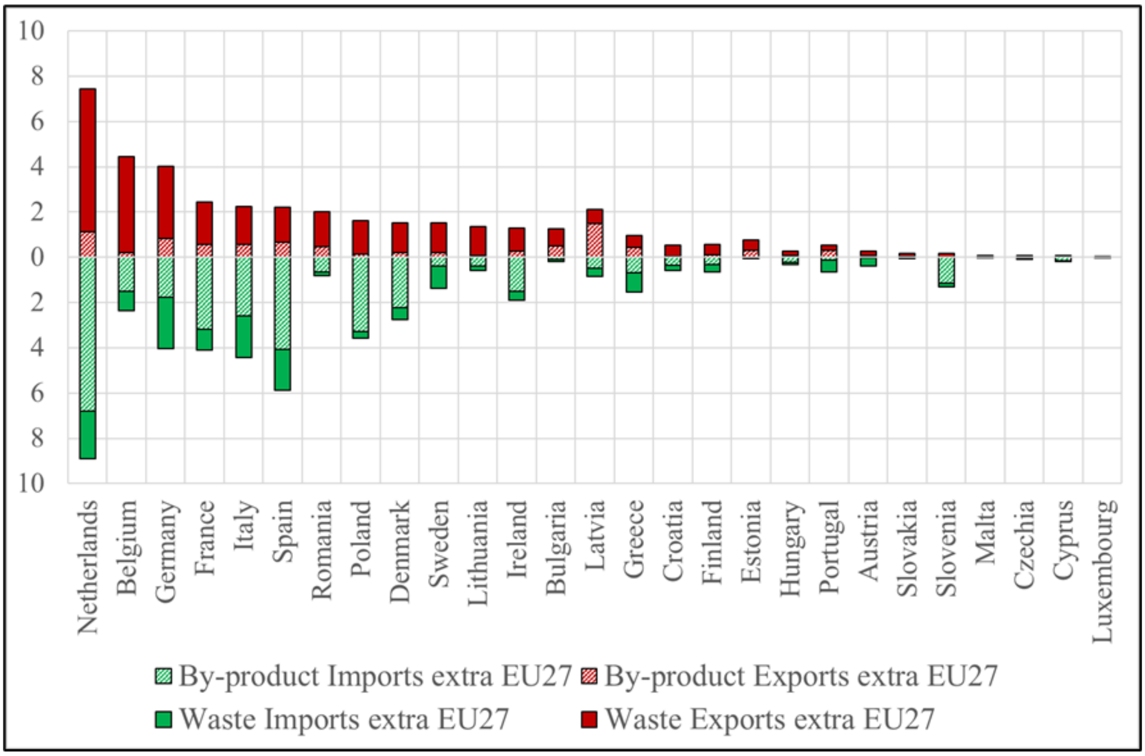
The main destinations for the total mass of recyclable raw materials imported by the EU27 were the Netherlands (19%), Spain (12%), Italy (9%), France (9%), Germany (8%) and Poland (8%) (see Annex B, Table B1). Regarding the most relevant inward flows, the Netherlands and Spain accounted for one third of the total imported mass of organic vegetable waste (17% and 15%, respectively) followed by Poland (12%), France (12%), Italy (9%), Ireland (7%), Germany (7%) and Denmark (6%). The Netherlands was also the highest importer of wood residues (27%), followed far behind by Denmark (11%), Latvia (9%), Belgium (9%) and Sweden (8%). Italy (22%) and Spain (21%) were the main destinations for the imported mass of ferrous metal waste, followed by Greece (12%), the Netherlands (12%) and Germany (11%).

The exported mass of recyclable raw materials among the EU27 was also led by the Netherlands (19%), followed this time by Belgium (11%), Germany (10%) and France (6%). Considering the main outward flows, collectively, the Netherlands and Belgium accounted for 40% of the total exported mass of ferrous metal waste (24% and 16%, respectively). Other significant exporters of this type of waste were Romania (7%), Germany (7%), Lithuania (6%), Denmark (6%), France (5%) and Poland (5%). The Netherlands was also the top exporter of organic vegetable waste (19%), followed by Bulgaria (13%), Germany (12%) and Romania (12%). The exported mass of paper and cardboard was headed by Italy (18%), the Netherlands (18%) and Spain (13%). Two thirds of mineral waste exports were concentrated in Germany (20%), Spain (19%), Italy (13%) and the Netherlands (12%), while a staggering 54% of the exports of wood residues (1.4 million tonnes) corresponded to Latvia alone.

Measuring the flows in monetary terms, Germany took the lead for both imports to and exports from the rest of the world. More precisely, a quarter of the total monetary value of recyclable raw material imports corresponded to Germany, which was followed by Belgium (15%), Italy (12%), the Netherlands (10%) and Spain (9%). Changes in the overall share were, to a great extent, because of the flows of valuable non-ferrous metals. In particular, Germany, Belgium and Italy received more than 90% of the €9.5 billion share of the EU27 precious metal waste imports from the rest of the world (45%, 30% and 17%, respectively). Germany and Belgium were also the main importers of CAN.

A similar situation was observed in the case of EU27 recyclable raw material exports. Germany held 20% of the total monetary value exported, followed by the Netherlands (15%), Belgium (12%), Spain (6%), Italy (6%) and France (6%). Again, Germany alone were responsible for 46% of the total exported value of precious metal waste, and 25% for CAN residues. At the same time, more than 40% of the total value of EU27 ferrous metal waste exports corresponded to the Netherlands (25%) and Belgium (16%).

Figure 4. EU27 trading in RRM with the rest of the world by member state (millions of tonnes). 2021

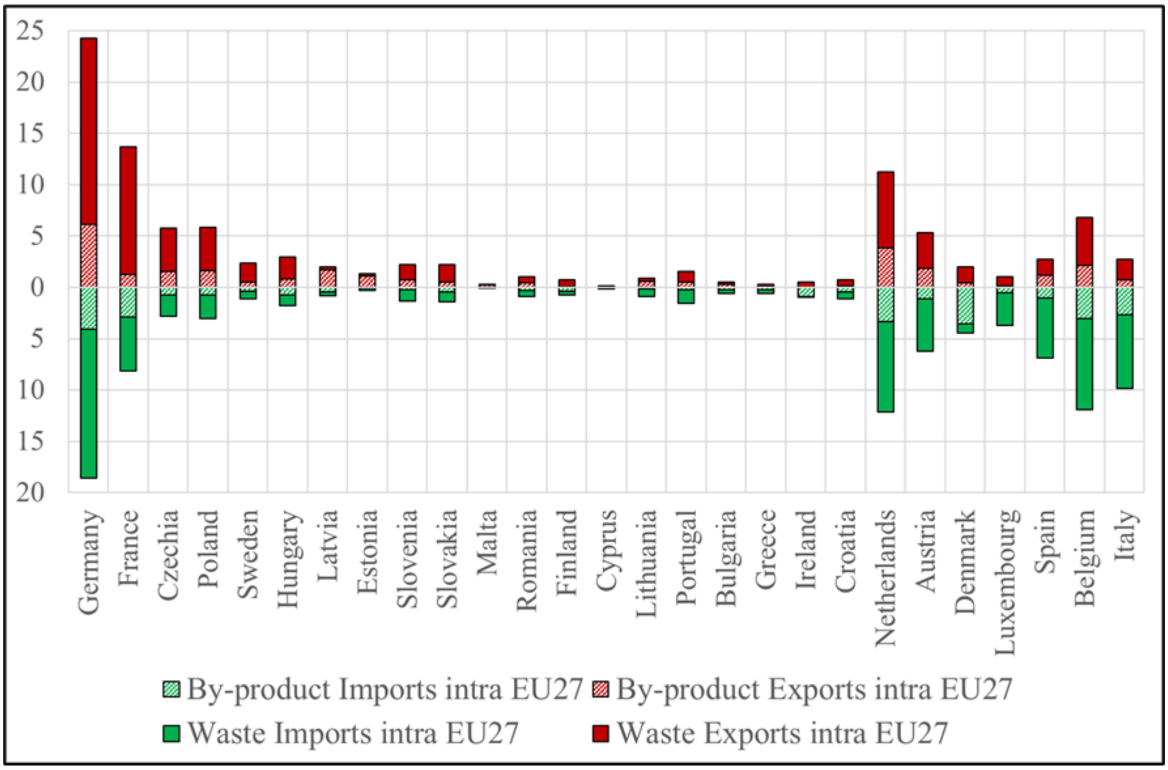


Source: Own elaboration based on Comext database (Eurostat)

4.2 Intra-EU27 trade

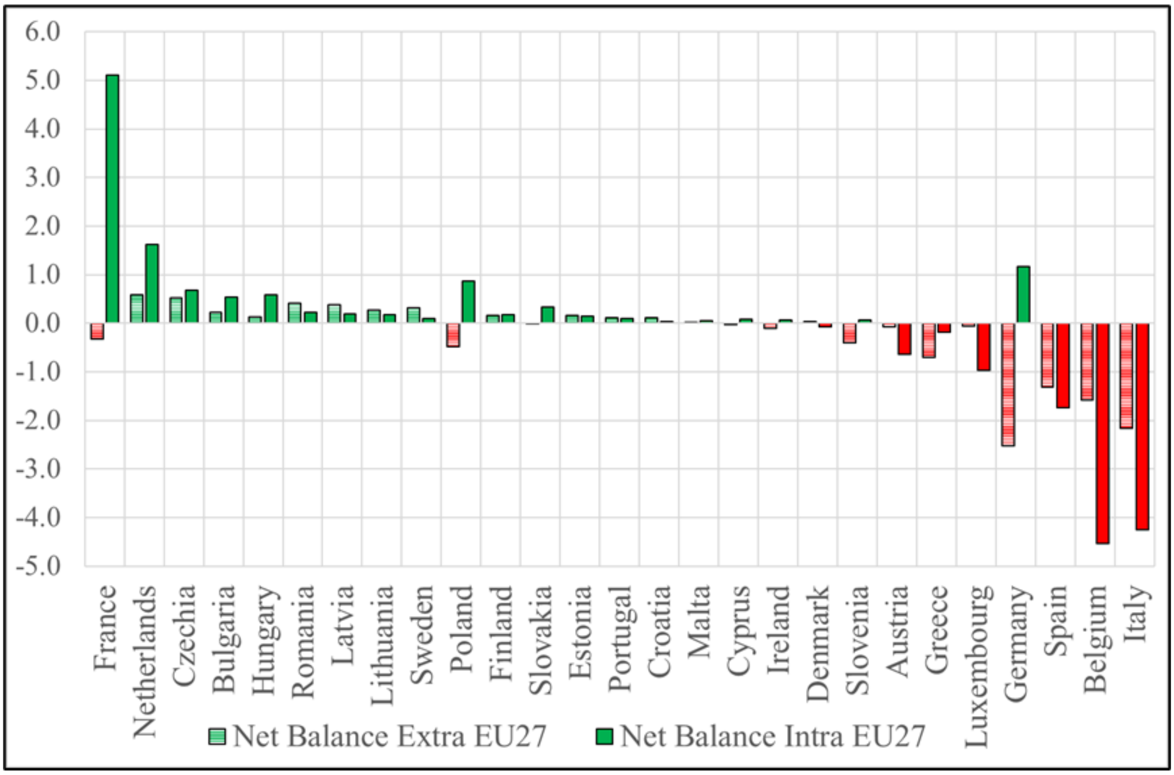
Regarding the physical trade balance (PTB) of recyclable raw materials for the EU27 (101.8 million tonnes), the member states could be divided between net exporters (those with a negative physical balance) and net importers (positive balance). Among the countries that made up the first group, Germany held 24% of the total mass of exports and 18% of the imports; it was followed by France (13% and 8%, respectively), Czechia (6% and 3%) and Poland (6% and 3%) (Figure 5). For the second group, the most noteworthy cases were Italy (10% of the total mass of imports and 3% of the exports), Belgium (12% and 7%), Spain (7% and 3%), Luxembourg (4% and 1%) and Denmark (4% and 2%). The Netherlands (12% and 11%) and Austria (6% and 5%) were also net importers, although in both cases their RRM inflows and outflows were more balanced.

Figure 5. Intra-EU27 trade in RRM by member state sorted by PTB (millions of tonnes). 2021



Source: Own elaboration based on Comext database (Eurostat)

Figure 6. EU27 trade in RRM by member state sorted by PTB (billions of euros). 2021



Source: Own elaboration based on Comext database (Eurostat)

In contrast to the polarized scenario of PTB, trade in RRM resulted in a positive monetary net balance for most of the EU27 economies (Figure 6). This was especially the case for France (€5.1 billion), the Netherlands (€1.6 billion), Germany (€1.2 billion), Poland (€0.9 billion) and Czechia (€0.7 billion). Large negative monetary balances were concentrated among a small group of countries, including Belgium (-€4.5 billion), Italy (-€4.3 billion), Spain (-€1.6 billion) and Luxembourg (-€1 billion).

Not surprisingly, nearly a third of the total mass of RRM traded between the EU27 countries corresponded to ferrous metal waste and scrap (31 million tonnes), half of which was exported by two countries alone, Germany (28%) and France (22%). The main importers of this type of material were Italy (17%), Belgium (16%), Germany (14%), the Netherlands (11%), Spain (10%) and Luxembourg (7%). Germany received relevant inflows of ferrous metal waste from most of the EU27 countries (especially from the Netherlands, Czechia and Poland), and channeled its outflows mainly towards the Netherlands, Italy and Belgium. France mostly exported ferrous metal waste to Belgium, Spain and Luxembourg. It should be noted that, whereas Italy, Spain and Luxembourg were, overall, net importers of ferrous metal scraps, in the case of the Netherlands and Belgium, the net physical inflows of this type of waste within the EU27 were balanced with the significant outflows from the two Benelux countries to the rest of the world.

While non-ferrous metal waste accounted for only 6.4% of the total mass of RRM traded within the EU27, due to its higher price per tonne, its share represented 46% of the total monetary value traded. Germany was the main importer with almost 30% of the total value traded of CAN, and 40% for precious metals. Italy and Belgium were also among the major importers of CAN (13% and 11%, respectively) and of precious metals (10% and 29%). Other relevant importers of CAN were Poland (8%) and Austria (7%), while Spain and Czechia also accounted for a significant share of the total value of precious metal imports (8% and 6%, respectively). The biggest exporters of CAN waste were Germany (25%), France (14%), the Netherlands (13%), Poland (6%) and Spain (5%), while the top exporters of precious metal scraps were Germany (24%), France (19%), Belgium (12%), Poland (7%) and the Netherlands (6%).

Aside from the direction of the trade flows, some interesting features could be observed regarding the average value per tonne of the non-ferrous metals traded in and out of each member state. In particular, while the amount of CAN waste imported by some countries such as Germany, Belgium, Austria and Poland clearly exceeded that of their exports, the opposite situation was true for others, such as Spain, Italy and Czechia.

5. DISCUSSION

According to the data analyzed, trade flows of RRM entering and exiting the EU27 were relatively balanced for mass and overall monetary value. Yet, there were significant differences in the material composition of the inflows and the outflows, especially in terms of their final use or destination and the consequent value per tonne. This has potential implications from an economic and an ecological perspective, which diverge from the official narrative presented by the European Commission regarding international trade in relation to the CE.

When analyzing EU27 trade flows of recyclable waste[5] , the European Commission applies Eurostat's methodological distinction between *by-products* and *waste and scraps*. The former are referred to as "secondary raw materials" (SRM), while the latter are those residues regarded

[5] See: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20220510-1

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as "recyclable raw materials" (RRM). As explained in the Materials and Methods section, the waste streams that Eurostat includes as by-products (or SRM) mainly originate from agriculture and forests, while the rest fall under the definition of recyclable waste and scraps.

As a result, when presenting the official statistics on RRM trade as part of the "improved circular economy monitoring framework", the European Commission's narrative conveys that: a) the overall rise experienced by EU27 international commerce in RRM since 2004 has been a step forward in the EU27 transition towards a CE (see also Llorente-González, 2019); b) EU27 is a net exporter of recyclable waste and scraps and a net importer of *by-products*; and c) intra-EU27 trade flows, and material disparities between extra-EU27 in- and out- flows are not worth considering.

The results presented in the previous section showed that, on the one hand, the EU27 was, on the whole a net importer of high-price-per-tonne recyclable raw materials (HPRRM). At the same time, it exported low-price-per-tonne recyclable raw materials (LPRRM) to the rest of the world, mainly scraps of iron and steel followed by other "cheap" residues (such as those of paper and carboard, plastic and rubber, and textiles). While a portion of the HPRRM originated in rich core economies, such as the USA, most came from countries with an average income far below that of the EU27. The opposite could be said about the main destinations of the EU27's LPRRM exports. Even within the same specific material flows, such as CAN or precious metal scraps, the average monetary value of imports was considerably higher than that of exports.

Although, at first glance, these findings may appear to diverge from the main hypothesis of this study, we believe this is not the case. Since this study dealt with (potentially recyclable) waste, not with regular commodities or goods, the analysis requires some further considerations. The EUE theory generally depicts the ecological imbalance of international trade as follows: core economies import large amounts of low-market-price primary raw materials containing ecologically undervalued resources from periphery countries, in exchange for high-market-price industrial goods, which are manufactured with capital that is created and reproduced via sustained imports of undervalued resources. The "unevenness" does not rest on the higher or lower prices paid *per se*, but on the fact that richer countries are paying poorer countries for their resources below their ecological value (which should at least roughly reflect the environmental damage they cause as well as the permanent loss of nutrients and local resources). If core economies were to pay that actual value, both trade and core industries would cease to be profitable, thus stopping the process of capital accumulation that triggered the unequal trade flows in the first place.

Regarding RRM, the results show that the EU is currently exporting large amounts of cheap (in terms of their market price) low-value wastes (in terms that it is not possible or profitable to utilize them within UE27) to lower income countries, in exchange for a much smaller amount of relatively expensive wastes that are indeed of value for the local EU27 industries. We argue that these trade flows are unequal from the perspective of EUE theory, while the European Commission's CE narrative claims that they are "circular" or "sustainable". On the contrary, from a genuine CE stance, EU27 countries should find ways to reutilize locally their recyclable wastes regardless of their current market value and related profitability, instead of shipping them hundreds (and sometimes thousands) of kilometres to other countries that have to devote their (presumably) fewer resources to process and introduce them into currently less profitable value chains (see Llorente-González & Vence, 2020).

This uneven pattern is also replicated, although to a lesser extent, within the EU27 between northern and southern countries. In this case, Spain and Italy are the main final destinations of a significant proportion of the less valuable EU27 recyclable waste, while the Netherlands and Belgium are in general net importers of HPRRM. Some exceptions of this are Germany and Austria, both of which are net importers of RRM streams of both high and low value per tonne.

Future studies should focus on the role of the EU27 countries as RRM “recycling hubs” or “trade hubs,” as, currently, the European Commission’s definition of the “circular use” of materials does not provide a distinction.

On the other hand, data shows that EU27 imports of RRM consist mainly of by-products of vegetable origin. Of these, two-thirds correspond just to soybean "cakes". Soybean cake, also referred to as soy meal or expeller, becomes residue when oil is manufactured from the extrusion of soybeans. It is estimated that approximately 90% of global soybean production is destined for the manufacture of soybean oil and soymeal (Hirakuri & Lazzarotto, 2014), which are mainly used as a source of protein for animal feed (INDEC, 2022). Soybean cakes should thus be understood as a key primary link in the meat production chain.

Soybean oil and meal are obtained from the processed soya beans in a ratio of 20 to 80, respectively (Hirakuri & Lazzarotto, 2014). Both in physical and monetary terms, it is not the oil but the meal that accounts for the largest share of processed soybean production and exports in Argentina and Brazil, the two main countries of origin of European imports (Burgos et al., 2014; Freitas Lemos et al., 2017; Storti, 2019). This raises doubts as to whether it is conceptually correct to consider soybean meal as a by-product or SRM, especially when it is clear that the crop is intended primarily for soymeal production.

Besides this, there appears to be a fundamental difference between soybean meal production and other so-called “circular” models of organic waste recovery, such as those proposed for the re-valorization of residues from wineries (Molina-Alcaide et al., 2008; Devesa-Rey et al., 2011; Spigno et al., 2017) and olive mills (Dermeche et al., 2013; Gullón et al., 2020), and of fruit waste (Fidelis et al., 2019; Santagata et al., 2021; Scarano et al., 2022), among others. In all these cases it is very clear which is the main economic activity, and which is the problematic waste that is revalorised via its use as a substitute for a primary material or source of energy. However, this does not seem to be the case with soybean meal.

Hence, as mentioned above, the main destination of soybean meal is the manufacture of animal feed. Due to its high protein content, soybean is mostly used as a complement to other traditional sources of nutrients and energy such as grains and forage crops (Cabellos et al., 2022). In the case of the European Union, soybean meal is mostly used for poultry, pig and cattle feed, as the region is among the world's leading producers of beef and poultry meat (Hocquette et al., 2018), and is the world's second largest producer and leading exporter of pork meat (Augère-Granier, 2020).

In particular, about half of the meat produced in the EU comes from pigs (Figure 7). Among European pork producers, Germany and Spain stand out, together accounting for more than 40% of total production, followed far behind by France, Poland, the Netherlands, Denmark and Italy. Naturally, all these countries are among the main importers of RRM of organic origin. In the case of Spain, its position as the main importer of inputs for the manufacture of animal feed, together with the high weight of pork exports in total production, gives the country a production profile that has been described as a “pork *maquila*” (Casalduero & Ramírez-Melgarejo, 2021; Cabellos et al., 2022).

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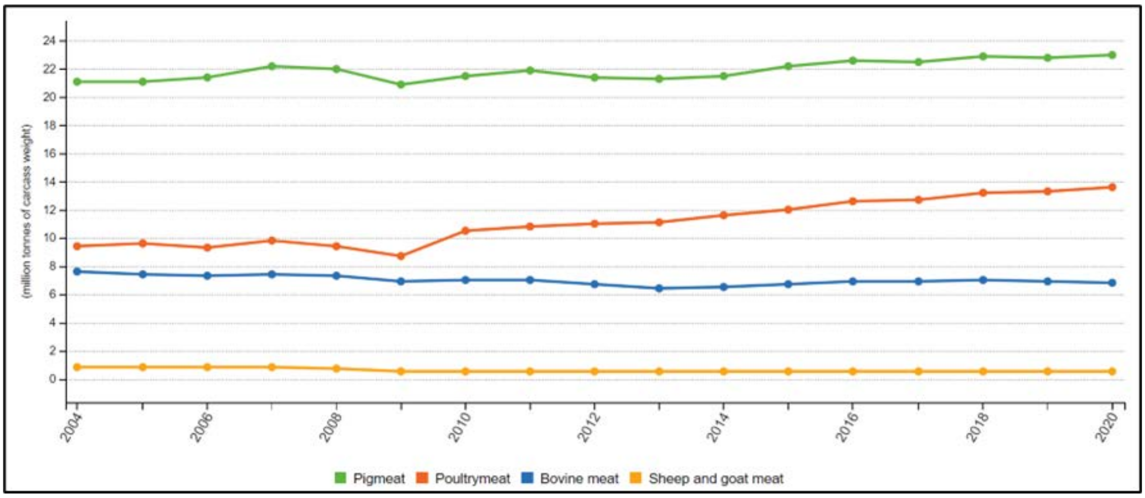
Figure 7. Meat production, EU, 2004-2020



Source: Eurostat[6]

Several studies have warned of the environmental, human and animal health risks associated with the industrial meat production chain, whose carbon footprint, along with that of dairy products, is estimated to be one the highest in the food industry (Hoekstra, 2010; Gerber et al., 2013; Eberle & Fels, 2016). Among others, these environmental issues include adverse impacts in terms of greenhouse gas emissions (Lesschen et al., 2011; MacLeod et al., 2013), aquifer eutrophication (MacLeod et al., 2013; Martínez et al., 2019) and soil acidification (Zira et al, 2023), all of which mostly occur in meat-exporting economies (such as Spain), in addition to the threats posed by monoculture to the fragile balance of local ecosystems in soybean-producing countries (Nijdam et al., 2012).

Finally, even if we concede that soymeal is a by-product of soybean oil production, it is questionable whether its trans-oceanic export is in line with the principles of the CE. Firstly, exports of different types of industrial soybean (and other oilseed) derivatives represent, from an ecological point of view, a net transfer of water, nutrients and energy from producing countries to consumers (Hickel et al., 2022; Infante-Amate et al., 2022). Once they cross borders, these resources are no longer available for local use and need to be regenerated. The effects that the technological package required for the intensive production of industrial monocultures such as soybeans has on the ecosystem of origin should also be taken into consideration, in terms of pollution, health damage to the local population, soil deterioration and loss of nutrients and biodiversity, among others (Martínez Alier & Roca Jusmet, 2013; Pengue, 2005). Secondly, the CO2 emissions involved in the shipping of RRM should be taken into account in any serious assessment of their contribution to "circularity" (Vence & López-Bermúdez, 2023).

To summarize, the results of the study challenge the European Commission's narrative on RRM and CE in two ways. First of all, the role of trade in RRM appears to be less related to retaining recyclable materials within the EU27, but rather to dispose of those scraps of lower market value that are not processed locally. Secondly, trade in organic (so-called) by-products, which constitute the greater part of EU27 RRM in-flows, does not reflect a circular use of resources but instead supports a linear global value chain responsible for a considerable ecological footprint both within and outside the EU27.

[6] Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Agricultural_production_-_livestock_and_meat

6. CONCLUSIONS

This study examined the recent EU27 international trade flows of recyclable raw materials (RRM) from the conceptual perspective of the theory of ecologically unequal exchange (EUE). Physical trade balance (PTB) and terms of trade (ToT) analysis was applied to the eight-digit EU27 trade data on RRM, available from Eurostat's Comext database. This methodological approach was selected for two reasons: firstly, it was considered to be the most appropriate one according to the features of the available source of information; secondly, it provides simple but compelling results, something that is deemed to be valuable in a field that is as yet little explored.

The main conclusion that emerged from the analysis was that, undelying an apparent underlying physical and monetary equilibrium, RRM flows between the EU27 and the rest of the world entail both economic and ecological imbalances, which are in line with those predicted by the theory of ecologically unequal exchange (EUE) (Foster & Holleman, 2014; Hornborg & Martínez-Alier, 2016; Oulu, 2016; Frey et al, 2019). Firstly, EU27 trade in organic vegetable RRM implies an uncompensated inflow of low-price-per-tonne high-value proteins, which are composed mainly of soymeal destined to be used as inputs for the European meat industry. These unbalanced nutrient flows add to those already embedded in the primary raw materials trade (Bunker, 1984; Giljum, 2004; Oulu, 2015; Hickel et al, 2022; Infante Amate et al, 2022), resulting in a double resource imbalance to the detriment of agricultural exporters. From a systemic perspective, soymeal exporters do not only bear the negative ecological impacts of primary monoculture, but also give up the so-called *by-products* instead of using them locally to partially compensate for the loss of natural resources and nutrients. Conversely, soymeal imports are incorporated into linear economic processes (the meat industry) with large ecological impacts that mostly affect the EU27 meat-producing countries (Casalduero & Ramírez-Melgarejo, 2021; Cabellos et al., 2022).

The fact that organic recyclable waste is shipped across the ocean only further emphasizes the inconsistency of considering it as a *by-product* or a "circular" raw material from the EU point of view. Therefore, doubts have been raised on whether calling soybean meal a "by-product" is merely a discursive device to make it seem like it is sustainable while forming yet another ecologically unequal trade pattern.

Regarding the inorganic RRM flows, what emerges from the analysis is that the EU is first and foremost a major net exporter of (potentially) recyclable low-price per tonne wastes, which cannot be processed and/or utilized locally. These residues are mostly shipped to lower income countries, while their final destination and use is unknown. This same logic is reproduced, albeit to a lesser extent, among EU27 countries. It can be argued that, at least for the time being, the EU27's trade in so-called "circular" materials is still a euphemism for exporting undesired cheap scraps in exchange for valuable proteins and critical materials, which are ultimately incorporated into conventional linear value chains.

As for the limitations of this body of research, a more detailed study of the global value chains of which the RRM are part (both as end-waste and secondary inputs) is highly recommended. Other dimensions of environmental impacts beyond those related to material flows should also be taken into account. It would also be of interest to delve deeper into the different roles of the EU27 countries and their main RRM trading partners, considering those which are mainly producers of RRM, those which act as trading "hubs" and those that have managed to develop local capacities to incorporate former waste as a genuine replacement of "primary" raw materials.

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Appendix

Annex A. Trade in recyclable raw materials with the rest of the world by trading partner region and material

Table A1. EU27 trade in recyclable raw materials with the rest of the world by trading partner region and material (thousands of tonnes and percentages). 2021

	Africa		Asia (Central and Eastern)		Central America and the Caribbean		Europe non EU27		North America		Oceania		South America		Western Asia		Total	
	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export
Total (Thousand tonnes)	969.5	3,641.6	3,494.5	8,486.5	89.2	92.7	19,435.3	10,532.5	5,052.0	1,199.6	99.4	32.0	16,535.5	335.8	1,756.7	15,637.2	47,570.1	40,080.9
	100%	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*
Glass	*0.4%*	*0.7%*	*0.2%*	*0.1%*	*0.0%*	*0.0%*	*3.6%*	*3.0%*	*0.1%*	*0.1%*	*0.0%*	*0.0%*	*0.0%*	*5.1%*	*1.5%*	*0.2%*	*1.6%*	*1.0%*
Minerals	*8.2%*	*9.1%*	*27.8%*	*0.5%*	*1.1%*	*35.1%*	*7.3%*	*18.1%*	*5.7%*	*28.0%*	*15.1%*	*44.7%*	*0.6%*	*43.6%*	*60.5%*	*3.9%*	*8.4%*	*8.5%*
Ferrous metals	*8.4%*	*59.2%*	*0.8%*	*19.7%*	*22.4%*	*0.0%*	*19.9%*	*16.3%*	*15.2%*	*50.5%*	*1.6%*	*0.6%*	*1.7%*	*3.8%*	*24.3%*	*84.2%*	*11.5%*	*48.5%*
Copper, aluminum and nickel	*9.2%*	*0.0%*	*1.0%*	*16.0%*	*14.0%*	*0.2%*	*3.2%*	*2.5%*	*3.7%*	*2.8%*	*38.1%*	*0.5%*	*0.2%*	*0.5%*	*5.4%*	*0.9%*	*2.3%*	*4.5%*
Other non ferrous metals	*0.5%*	*0.0%*	*0.5%*	*1.0%*	*1.0%*	*0.0%*	*0.8%*	*1.0%*	*0.3%*	*3.0%*	*4.5%*	*2.4%*	*0.0%*	*0.6%*	*0.4%*	*0.0%*	*0.4%*	*0.6%*
Precious metals	*1.9%*	*0.0%*	*0.4%*	*0.7%*	*0.3%*	*0.0%*	*0.1%*	*0.1%*	*0.5%*	*0.5%*	*3.9%*	*0.0%*	*0.1%*	*0.0%*	*0.6%*	*0.0%*	*0.3%*	*0.2%*
Not Specified	*1.4%*	*0.6%*	*0.0%*	*0.6%*	*0.1%*	*0.7%*	*1.3%*	*0.2%*	*0.8%*	*0.6%*	*0.0%*	*4.3%*	*0.0%*	*5.1%*	*0.2%*	*0.2%*	*0.8%*	*0.4%*
Organic (animal)	*7.8%*	*0.2%*	*0.5%*	*0.4%*	*2.8%*	*0.5%*	*1.4%*	*1.4%*	*0.2%*	*1.8%*	*1.9%*	*0.1%*	*0.3%*	*0.4%*	*0.0%*	*0.1%*	*0.9%*	*0.6%*
Organic (vegetable)	*49.6%*	*7.6%*	*65.7%*	*14.4%*	*4.9%*	*11.8%*	*24.2%*	*19.1%*	*19.9%*	*5.9%*	*21.9%*	*6.4%*	*95.7%*	*29.2%*	*0.5%*	*4.1%*	*51.2%*	*10.8%*
Paper and cardboard	*3.2%*	*1.4%*	*0.0%*	*35.4%*	*6.4%*	*2.3%*	*10.3%*	*7.9%*	*6.8%*	*0.1%*	*0.3%*	*20.2%*	*0.0%*	*1.7%*	*0.8%*	*2.9%*	*5.1%*	*10.9%*
Plastic	*2.0%*	*0.2%*	*0.6%*	*5.2%*	*5.6%*	*0.1%*	*3.2%*	*2.2%*	*0.8%*	*3.6%*	*9.9%*	*17.8%*	*0.0%*	*0.7%*	*1.1%*	*2.6%*	*1.6%*	*2.8%*

	Africa		Asia (Central and Eastern)		Central America and the Caribbean		Europe non EU27		North America		Oceania		South America		Western Asia		Total	
	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export
Rubber	*0.0%*	*2.8%*	*0.1%*	*0.1%*	*0.0%*	*27.7%*	*0.2%*	*0.3%*	*0.1%*	*0.7%*	*2.4%*	*0.3%*	*0.0%*	*2.4%*	*0.0%*	*0.1%*	*0.1%*	*0.5%*
Textiles (natural)	*1.4%*	*0.3%*	*1.4%*	*0.4%*	*17.3%*	*0.3%*	*0.1%*	*0.2%*	*0.2%*	*1.3%*	*0.3%*	*0.2%*	*0.0%*	*0.4%*	*2.0%*	*0.1%*	*0.3%*	*0.2%*
Textiles (synthetic)	*2.4%*	*17.8%*	*0.9%*	*5.3%*	*22.2%*	*21.3%*	*0.8%*	*1.6%*	*0.4%*	*0.6%*	*0.2%*	*0.9%*	*0.0%*	*6.0%*	*1.1%*	*0.7%*	*0.6%*	*3.6%*
Wood	*3.7%*	*0.0%*	*0.0%*	*0.2%*	*1.8%*	*0.0%*	*23.6%*	*26.1%*	*45.3%*	*0.4%*	*0.0%*	*1.6%*	*1.3%*	*0.5%*	*1.4%*	*0.1%*	*15.0%*	*7.0%*

Source: Own elaboration based on Comext database (Eurostat)

Table A2. EU27 trade in recyclable raw materials with the rest of the world by trading partner region and material (millions of euros and percentages). 2021

	Africa		Asia (Central and Eastern)		Central America and the Caribbean		Europe non EU27		North America		Oceania		South America		Western Asia		Total	
	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export
Total (Million €)	1,879.7	1,470.2	2,464.0	7,847.8	98.6	39.4	9,169.0	5,543.5	6,585.1	1,674.7	199.3	19.8	6,722.7	127.3	1,291.5	5,352.9	28,430.5	22,131.2
	100%	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*
Glass	*0.0%*	*0.2%*	*0.2%*	*0.0%*	*0.0%*	*0.0%*	*0.4%*	*0.4%*	*0.1%*	*0.3%*	*0.0%*	*0.1%*	*0.0%*	*3.0%*	*0.1%*	*0.1%*	*0.2%*	*0.2%*
Minerals	*1.3%*	*0.7%*	*3.4%*	*3.3%*	*1.3%*	*3.3%*	*2.5%*	*2.0%*	*4.1%*	*1.6%*	*6.6%*	*23.8%*	*0.3%*	*1.2%*	*4.7%*	*0.4%*	*2.5%*	*2.0%*
Ferrous metals	*3.1%*	*52.3%*	*1.7%*	*13.8%*	*12.6%*	*0.1%*	*18.2%*	*10.8%*	*5.1%*	*15.1%*	*1.0%*	*0.8%*	*1.9%*	*9.6%*	*20.8%*	*85.9%*	*8.9%*	*33.3%*
Copper, aluminum and nickel	*19.1%*	*0.2%*	*6.6%*	*42.8%*	*55.8%*	*0.9%*	*20.4%*	*14.0%*	*14.4%*	*4.4%*	*38.8%*	*4.1%*	*2.4%*	*2.6%*	*27.8%*	*4.7%*	*14.1%*	*20.2%*
Other non ferrous metals	*0.5%*	*0.2%*	*4.1%*	*2.7%*	*1.3%*	*0.2%*	*2.6%*	*3.2%*	*1.1%*	*10.0%*	*2.6%*	*10.1%*	*0.2%*	*2.3%*	*1.7%*	*0.2%*	*1.7%*	*2.6%*
Precious metals	*59.6%*	*1.5%*	*45.6%*	*19.5%*	*3.6%*	*0.0%*	*26.6%*	*36.7%*	*61.3%*	*58.4%*	*35.4%*	*15.3%*	*4.1%*	*0.0%*	*38.0%*	*0.1%*	*33.6%*	*20.7%*
Not Specified	*0.1%*	*0.5%*	*0.0%*	*0.2%*	*0.1%*	*1.1%*	*0.8%*	*0.1%*	*0.3%*	*0.2%*	*0.0%*	*3.7%*	*0.0%*	*3.9%*	*0.0%*	*0.1%*	*0.3%*	*0.2%*
Organic (animal)	*4.9%*	*0.5%*	*0.8%*	*0.6%*	*3.2%*	*1.7%*	*1.5%*	*3.8%*	*0.2%*	*1.7%*	*2.4%*	*1.3%*	*1.1%*	*1.4%*	*0.1%*	*0.2%*	*1.2%*	*1.4%*
Organic (vegetable)	*8.3%*	*6.7%*	*30.2%*	*5.7%*	*2.2%*	*13.7%*	*15.0%*	*13.0%*	*5.1%*	*4.1%*	*9.7%*	*8.4%*	*89.3%*	*45.8%*	*0.2%*	*3.4%*	*30.4%*	*7.2%*
Paper and cardboard	*0.3%*	*0.7%*	*0.0%*	*7.6%*	*1.6%*	*1.8%*	*3.8%*	*2.9%*	*1.5%*	*0.0%*	*0.0%*	*6.0%*	*0.0%*	*0.8%*	*0.3%*	*1.6%*	*1.6%*	*3.9%*
Plastic	*0.5%*	*0.2%*	*0.9%*	*1.7%*	*3.1%*	*0.2%*	*1.7%*	*1.3%*	*0.4%*	*1.7%*	*2.3%*	*12.8%*	*0.0%*	*0.7%*	*0.9%*	*1.7%*	*0.8%*	*1.5%*
Rubber	*0.0%*	*2.3%*	*0.3%*	*0.0%*	*0.0%*	*27.7%*	*0.3%*	*0.6%*	*0.1%*	*0.4%*	*0.5%*	*1.4%*	*0.0%*	*2.3%*	*0.2%*	*0.1%*	*0.2%*	*0.4%*

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	Africa		Asia (Central and Eastern)		Central America and the Caribbean		Europe non EU27		North America		Oceania		South America		Western Asia		Total	
	Import	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**
Textiles (natural)	*0.4%*	*0.5%*	*3.1%*	*0.3%*	*6.4%*	*1.0%*	*0.1%*	*0.3%*	*0.1%*	*1.3%*	*0.7%*	*1.3%*	*0.1%*	*0.6%*	*3.4%*	*0.1%*	*0.6%*	*0.4%*
Textiles (synthetic)	*0.8%*	*33.5%*	*2.9%*	*1.5%*	*9.0%*	*48.3%*	*1.5%*	*4.2%*	*0.5%*	*0.5%*	*0.2%*	*8.9%*	*0.0%*	*22.8%*	*1.5%*	*1.3%*	*1.0%*	*4.4%*
Wood	*0.8%*	*0.0%*	*0.0%*	*0.1%*	*0.0%*	*0.0%*	*4.7%*	*6.7%*	*5.7%*	*0.3%*	*0.0%*	*2.0%*	*0.5%*	*2.9%*	*0.3%*	*0.1%*	*3.0%*	*1.8%*

Source: Own elaboration based on Comext database (Eurostat)

Table A3. EU27 trade in recyclable raw materials with the rest of the world by trading partner region and material. Avg. value in euros per tonne. 2021

	Africa		Asia (Central and Eastern)		Central America and the Caribbean		Europe non EU27		North America		Oceania		South America		Western Asia		Total	
	Import	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**
Total (euros per tonne)	1,938.8	403.7	705.1	924.7	1,105.8	425.2	471.8	526.3	1,303.5	1,396.0	2,004.7	618.5	406.6	379.1	735.2	342.3	597.7	552.2
Glass	134.7	88.1	1,067.5	262.6	0.0		46.1	76.0	469.5	2,851.2	159,000.0	11,552.2	124.6	228.0	54.5	116.8	58.6	102.1
Minerals	313.7	29.9	87.5	6,627.3	1,338.8	39.7	162.0	56.9	940.9	78.7	871.8	329.6	180.5	10.2	56.8	32.2	176.3	127.0
Ferrous metals	718.7	356.9	1,434.9	648.8	619.5	853.0	430.6	350.4	440.1	416.6	1,234.4	809.8	455.4	953.6	628.5	349.4	459.3	378.9
Copper, aluminum and nickel	4,038.9	2,431.1	4,499.9	2,471.7	4,402.8	1,713.4	3,024.5	2,953.0	5,129.1	2,248.1	2,037.8	5,476.9	5,391.0	1,850.8	3,754.8	1,701.9	3,616.9	2,474.4
Other non ferrous metals	1,935.1	6,021.9	6,422.0	2,377.5	1,393.8	5,211.7	1,654.4	1,639.1	4,276.1	4,609.7	1,157.4	2,630.7	6,355.3	1,461.3	2,883.7	1,482.2	2,356.7	2,360.1
Precious metals	62,053.1	2,282,862.5	89,077.2	27,122.9	12,660.1		87,862.5	226,947.6	151,295.9	164,632.7	18,314.5	980,965.1	13,734.6	77,166.7	47,050.0	164,460.7	79,818.3	63,946.1
Not Specified	179.0	318.2	570.6	359.8	572.9	743.1	267.9	230.9	544.2	490.8	6,509.6	528.7	9,471.2	291.5	84.1	192.6	253.1	301.4
Organic (animal)	1,209.8	1,285.0	1,083.3	1,316.1	1,249.7	1,425.6	514.2	1,423.7	1,277.3	1,360.9	2,424.3	11,719.2	1,379.3	1,223.7	1,799.7	1,157.1	796.5	1,384.9
Organic (vegetable)	324.7	354.9	323.7	364.3	492.9	495.2	291.8	360.1	333.2	959.5	886.5	813.5	379.3	594.0	329.9	290.3	354.8	366.4
Paper and cardboard	168.4	215.2	604.9	198.1	268.5	348.1	174.0	194.8	283.7	443.6	24.2	184.6	251.8	182.1	221.7	182.6	190.4	196.1
Plastic	485.2	413.1	1,095.4	310.1	608.4	1,034.3	241.8	302.3	668.6	673.3	457.7	442.3	486.7	427.6	600.7	225.1	309.5	293.7
Rubber	2,935.0	327.7	1,689.9	389.1		425.3	708.2	890.2	2,153.1	680.3	419.4	2,668.6	1,834.3	370.2	3,877.4	443.1	943.4	469.5

	Africa		Asia (Central and Eastern)		Central America and the Caribbean		Europe non EU27		North America		Oceania		South America		Western Asia		Total	
	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export
Textiles (natural)	640.4	632.5	1,614.8	783.1	405.9	1,385.7	704.6	880.0	767.3	1,341.8	4,839.1	4,057.1	2,358.7	636.8	1,261.3	498.8	1,167.4	848.6
Textiles (synthetic)	652.9	759.1	2,155.5	257.1	449.4	964.3	941.6	1,401.2	1,395.3	1,252.5	2,089.7	5,816.3	2,432.5	1,435.9	1,023.2	629.4	1,072.1	680.8
Wood	437.9	794.4	627.8	736.1	0.7	627.0	93.9	134.0	163.2	989.9	3,107.4	797.7	167.0	2,225.4	147.6	316.4	120.3	141.0

Source: Own elaboration based on Comext database (Eurostat)

Annex B. Trade in recyclable raw materials with the rest of the world by member state and material

Table B1. EU27 trade in recyclable raw materials with the rest of the world by member state and material (thousands of tonnes). 2021

	Glass		Minerals		Ferrous metals		Copper, aluminum and nickel		Other non ferrous metals		Precious metals		Not Specified		Organic (animal)		Organic (vegetable)		Paper and cardboard		Plastic		Rubber		Textiles (natural)		Textiles (synthetic)		Wood		Total	
	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export
Austria	30.2	0.0	47.0	0.1	72.9	136.3	39.5	9.4	7.0	3.2	0.1	0.0	0.4	4.7	0.0	0.0	6.0	70.3	57.5	1.3	29.7	10.5	3.1	1.7	0.0	0.1	23.2	1.7	69.9	40.3	386.4	279.8
Belgium	84.3	76.6	507.3	80.9	242.6	3,141.5	143.0	213.1	36.6	44.3	53.6	2.1	74.8	0.7	0.9	0.7	443.7	193.1	61.5	186.6	37.2	218.6	4.8	52.1	22.2	21.6	28.8	214.4	628.1	7.2	2,369.5	4,453.3
Bulgaria	11.9	0.0	12.5	1.2	31.2	569.8	22.3	25.8	0.3	0.3	0.2	0.0	3.5	0.0	0.1	0.0	16.7	549.1	3.9	69.2	7.1	5.1	0.2	2.3	0.0	1.4	7.8	26.6	82.8	4.6	200.6	1,255.5
Croatia	33.7	0.0	407.7	1.9	66.8	410.1	0.6	5.1	3.6	0.0	0.0	0.0	0.0	0.0	0.1	0.1	11.8	13.2	45.5	40.9	3.4	8.8	0.1	0.0	0.1	0.5	0.0	1.7	11.0	43.9	584.5	526.3
Cyprus	0.0	0.0	0.3	0.0	0.2	5.7	0.0	13.1	0.0	0.9	0.0	0.0	1.2	0.0	0.0	0.0	139.0	0.1	0.0	46.7	38.2	0.3	0.0	0.0	0.0	0.0	0.0	2.6	0.8	0.0	179.8	69.4
Czechia	12.8	0.1	1.7	0.0	0.4	36.3	2.6	12.0	4.3	0.4	0.8	3.3	0.3	3.8	0.6	0.2	20.6	5.7	0.1	8.6	3.8	1.4	0.0	0.0	1.0	0.3	1.7	11.5	23.2	0.6	74.1	84.2
Denmark	7.7	3.8	58.1	55.7	116.5	1,183.2	16.1	46.0	4.3	2.5	0.2	0.0	64.0	0.6	191.4	151.4	1,460.2	54.3	32.1	35.1	18.8	2.0	0.0	1.3	0.5	0.1	0.1	1.8	775.4	0.3	2,745.4	1,538.1
Estonia	0.0	9.7	0.2	10.5	24.4	411.3	0.5	3.2	2.3	1.4	0.9	1.3	0.0	0.0	0.4	0.9	17.9	0.7	0.1	6.1	0.1	0.7	0.0	0.0	0.0	1.8	0.7	4.4	7.7	319.1	55.2	771.2
Finland	4.0	10.8	25.6	59.7	1.8	366.2	1.0	42.6	1.5	3.3	0.0	0.0	5.4	8.3	4.4	0.3	186.0	52.2	6.3	8.5	0.2	3.7	0.1	0.3	0.0	0.0	0.3	6.6	422.2	5.4	658.9	567.9
France	35.0	36.9	209.8	296.2	141.3	1,014.2	42.6	147.7	8.1	14.4	0.8	0.5	10.5	7.4	19.4	7.8	2,927.1	335.1	258.9	362.1	14.5	17.3	4.8	12.0	17.4	12.1	5.7	129.1	414.1	65.1	4,110.0	2,457.9
Germany	153.5	28.1	173.9	680.7	572.9	1,278.8	294.5	425.2	37.9	38.8	30.0	15.6	12.7	99.1	61.8	11.7	1,629.0	520.7	651.5	179.4	99.4	284.5	16.2	50.9	31.0	13.0	40.2	213.2	220.1	190.6	4,024.8	4,030.4
Greece	4.7	0.0	72.4	373.0	669.4	118.8	103.9	33.6	2.0	0.7	0.0	0.0	23.7	0.0	40.8	0.0	573.8	84.7	10.1	330.2	11.7	12.2	0.2	0.9	0.6	0.6	7.8	11.7	12.5	3.1	1,533.6	969.6
Hungary	2.2	1.0	226.5	0.0	0.1	71.7	6.7	12.6	0.0	0.5	0.0	0.3	4.1	0.0	0.2	0.1	17.0	87.5	32.3	52.8	2.9	11.5	0.0	0.5	0.5	3.1	10.3	44.9	13.9	0.2	316.7	286.7
Ireland	0.9	106.5	92.2	88.5	0.7	329.0	1.3	41.6	12.6	14.3	0.0	0.2	0.2	0.0	29.0	19.0	1,707.5	222.5	0.1	360.1	21.8	40.9	0.3	1.8	0.2	0.3	1.3	8.4	39.5	66.8	1,907.7	1,299.8
Italy	31.6	1.5	123.6	452.9	1,223.5	405.6	136.2	147.9	6.7	15.1	4.5	1.6	36.2	11.4	15.2	1.1	2,178.5	155.4	166.2	793.2	35.1	43.6	2.0	15.2	18.8	20.1	27.3	181.3	416.5	1.8	4,421.9	2,247.8
Latvia	0.0	0.0	12.1	0.2	38.9	548.7	0.2	10.4	0.4	0.7	0.0	0.0	0.0	0.0	0.0	1.6	91.9	55.4	2.0	27.6	20.6	3.9	0.1	2.1	0.4	0.1	2.5	8.1	663.3	1,439.1	832.5	2,097.9
Lithuania	0.1	21.0	50.8	0.0	93.9	1,200.7	1.4	7.5	0.3	0.4	2.5	2.3	0.7	0.0	0.2	1.3	156.6	66.2	2.1	7.8	10.9	9.9	0.4	2.2	1.7	3.2	12.7	41.3	235.3	1.1	569.7	1,364.9

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	Glass		Minerals		Ferrous metals		Copper, aluminum and nickel		Other non ferrous metals		Precious metals		Not Specified		Organic (animal)		Organic (vegetable)		Paper and cardboard		Plastic		Rubber		Textiles (natural)		Textiles (synthetic)		Wood		Total	
	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export
Luxembourg	0.0	0.0	0.5	0.0	18.3	0.0	5.1	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.9	0.3
Malta	0.0	2.0	0.1	0.1	0.4	48.2	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.7	0.0	2.2	0.0	0.7	0.0	0.0	0.0	1.5	1.1	0.0	1.7	76.0
Netherlands	54.1	22.5	1,032.3	404.4	631.4	4,686.9	55.1	210.8	9.3	20.4	15.1	37.2	42.9	7.0	9.6	6.0	4,183.2	832.1	778.8	764.0	125.0	269.3	4.3	31.6	8.5	1.2	30.8	129.1	1,919.1	30.5	8,899.5	7,452.9
Poland	0.3	0.0	87.9	59.6	27.7	901.1	27.9	40.7	6.7	5.8	0.5	2.8	2.9	0.1	0.1	8.2	2,997.3	155.2	33.3	193.2	53.4	42.0	3.4	5.2	0.3	0.4	18.8	198.4	317.8	7.0	3,578.3	1,619.5
Portugal	211.1	0.0	16.3	0.7	216.7	21.9	1.6	35.2	8.1	0.9	0.0	0.3	0.5	14.8	0.1	0.1	156.9	65.1	0.1	113.6	15.8	4.2	0.5	0.3	4.7	1.0	2.3	26.7	19.4	236.0	654.2	520.7
Romania	0.2	25.4	81.9	2.0	35.5	1,395.5	3.6	17.3	1.9	1.8	0.0	0.0	1.6	0.0	0.0	0.1	539.9	494.4	3.7	62.5	8.2	10.3	1.3	0.7	0.2	0.6	2.4	6.8	121.3	2.2	801.6	2,019.8
Slovakia	0.0	0.0	14.0	90.4	0.4	0.4	8.2	2.9	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	8.1	0.0	64.3	0.8	3.9	0.0	0.2	0.1	0.6	2.0	14.3	24.6	0.6	55.2	185.7
Slovenia	0.0	0.0	116.7	1.4	71.4	55.8	20.2	17.2	3.9	1.6	0.0	0.0	0.1	0.1	0.0	0.9	947.9	20.6	14.6	2.7	2.6	53.6	0.0	1.7	0.0	0.0	1.3	4.1	133.2	0.7	1,312.0	160.5
Spain	68.4	2.9	597.1	663.2	1,143.0	309.7	98.7	221.8	22.6	6.7	0.4	2.9	21.9	1.2	49.9	9.7	3,661.5	179.4	88.9	580.2	66.3	67.9	3.6	13.5	30.3	11.8	27.4	128.4	4.5	14.7	5,884.5	2,214.1
Sweden	6.3	43.8	9.2	87.4	40.0	795.1	73.3	65.3	19.3	64.2	9.6	1.1	75.5	0.6	13.8	0.4	291.2	104.7	158.3	44.9	111.5	8.3	1.2	1.5	1.6	0.1	13.9	6.5	562.2	307.2	1,387.0	1,531.0

Source: Own elaboration based on Comext database (Eurostat)

Table B2. EU27 trade in recyclable raw materials with the rest of the world by member state and material (millions of euros). 2021

	Glass		Minerals		Ferrous metals		Copper, aluminum and nickel		Other non ferrous metals		Precious metals		Not Specified		Organic (animal)		Organic (vegetable)		Paper and cardboard		Plastic		Rubber		Textiles (natural)		Textiles (synthetic)		Wood		Total	
	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export
Austria	1.3	0.1	80.4	0.0	27.3	55.1	141.9	19.2	27.5	7.9	11.2	127.7	0.8	0.7	0.3	0.0	3.5	36.0	12.1	0.2	8.5	2.3	0.4	0.9	0.0	0.0	14.8	1.0	1.6	5.8	331.7	256.9
Belgium	2.1	6.8	97.4	14.7	123.1	1,162.8	672.3	395.5	81.3	117.4	2,833.3	533.9	4.0	0.8	0.7	0.7	157.9	70.8	10.6	30.5	18.7	55.3	7.4	16.7	24.1	21.9	26.2	130.8	82.4	1.8	4,141.6	2,560.5
Bulgaria	0.7	0.0	7.0	1.1	11.5	195.6	153.1	67.9	0.5	0.5	0.2	1.3	1.4	0.0	0.1	0.0	5.7	133.5	0.7	14.0	3.2	1.6	0.1	0.7	0.0	0.5	6.8	17.1	12.5	0.8	203.5	434.7
Croatia	2.0	0.0	7.9	0.0	23.1	142.7	0.7	7.7	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	5.6	5.1	7.7	7.3	1.3	1.3	0.1	0.0	0.0	0.2	0.0	0.4	1.6	5.5	53.2	170.3
Cyprus	0.0	0.0	0.0	0.0	0.0	3.5	0.0	19.8	0.0	0.7	0.0	0.0	0.6	0.0	0.1	0.0	52.3	0.1	0.0	6.1	2.3	0.1	0.0	0.0	0.0	0.0	0.2	0.8	0.1	0.0	55.8	31.2
Czechia	0.9	0.2	0.1	0.0	0.2	18.2	7.6	59.7	8.8	2.2	146.6	624.0	0.3	0.6	0.2	0.1	15.8	3.0	0.0	1.8	2.6	0.4	0.0	0.0	0.4	0.7	2.9	6.2	3.0	0.1	189.3	717.4
Denmark	0.6	0.2	4.8	1.5	30.1	465.9	39.3	92.2	12.2	5.0	7.4	3.4	10.9	0.6	81.3	219.4	482.0	30.1	4.9	7.4	2.5	0.6	0.0	0.7	0.1	0.5	0.7	1.4	120.6	0.2	797.4	829.2
Estonia	0.0	0.4	1.3	0.4	40.8	148.3	3.1	6.8	8.0	2.2	3.8	18.2	0.0	0.0	0.2	1.2	4.4	0.1	0.0	1.4	0.0	0.2	0.0	0.0	0.1	0.2	1.0	2.0	0.4	46.4	63.1	227.9
Finland	0.1	0.7	13.0	12.5	0.3	141.0	1.0	71.3	20.2	4.6	2.0	31.6	1.7	2.6	1.2	0.4	61.0	18.3	1.4	1.1	0.1	0.3	0.1	0.1	0.1	0.0	0.4	4.1	22.0	0.7	124.5	289.4
France	4.4	5.6	28.7	23.3	57.2	347.9	136.9	316.2	20.8	34.6	10.1	177.1	4.6	5.6	17.7	13.8	1,119.3	146.0	46.1	70.0	6.5	5.3	10.6	4.7	15.6	13.0	13.1	63.6	66.6	7.5	1,558.2	1,234.1
Germany	8.9	9.7	148.3	33.4	295.7	545.0	1,031.6	1,102.4	109.0	185.8	4,341.1	1,901.2	4.1	25.9	82.1	17.4	617.6	227.0	129.3	30.0	30.0	82.8	7.7	25.1	40.7	16.4	42.9	149.2	18.0	28.0	6,907.0	4,379.3
Greece	0.3	0.0	2.1	21.0	241.2	54.3	388.0	62.7	3.2	1.2	0.0	0.0	5.1	0.1	48.3	0.0	225.4	30.4	1.8	61.6	4.0	2.2	0.0	0.2	0.1	0.2	23.3	10.6	1.7	0.5	944.5	245.1
Hungary	0.1	0.1	6.2	0.0	0.0	23.4	13.1	49.9	0.8	4.7	0.1	17.7	1.7	0.0	0.3	0.2	5.3	35.5	6.0	10.3	1.1	2.0	0.0	0.1	0.8	0.8	11.3	30.3	1.9	0.1	49.0	175.0
Ireland	0.1	6.0	5.6	8.2	1.1	113.7	1.4	80.6	22.6	18.9	0.1	33.4	0.4	0.0	17.6	20.1	473.8	64.9	0.2	76.0	16.2	14.0	0.3	0.7	0.5	0.8	2.9	7.9	6.6	6.3	549.4	451.3

	Glass		Minerals		Ferrous metals		Copper, aluminum and nickel		Other non ferrous metals		Precious metals		Not Specified		Organic (animal)		Organic (vegetable)		Paper and cardboard		Plastic		Rubber		Textiles (natural)		Textiles (synthetic)		Wood		Total	
	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export
Italy	2.2	0.2	26.5	12.0	501.7	183.5	374.7	441.3	15.1	35.1	1,581.3	284.4	14.6	3.8	17.5	1.3	763.1	70.5	47.4	168.5	22.7	19.9	1.2	6.1	45.0	12.0	39.2	110.0	63.1	1.6	3,515.2	1,350.2
Latvia	0.2	0.0	1.6	0.3	27.5	191.8	0.6	28.1	1.0	1.3	0.4	18.1	0.0	0.0	0.0	1.9	19.7	17.8	0.4	5.4	11.6	0.7	0.0	0.5	0.2	0.1	3.6	13.1	39.7	206.9	106.7	486.1
Lithuania	0.0	0.9	3.4	0.0	56.8	439.0	4.3	21.3	1.0	0.6	154.5	33.2	0.2	0.0	0.5	1.5	48.5	21.6	0.5	1.4	3.6	2.2	0.2	0.5	0.9	2.2	17.8	56.0	22.0	0.3	314.3	580.9
Luxembourg	0.0	0.0	0.4	0.0	7.2	0.0	12.2	0.0	0.0	2.0	47.3	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	67.8	4.9
Malta	0.0	0.1	0.0	0.0	0.0	16.4	0.0	2.6	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	3.6	0.0	0.6	0.0	0.0	0.0	0.0	0.2	0.8	0.2	0.0	0.6	24.2
Netherlands	4.1	4.3	114.9	23.8	400.0	1,826.7	211.8	579.0	47.2	40.9	70.7	148.4	9.3	3.8	15.0	10.3	1,345.5	315.4	137.4	140.8	42.9	96.7	11.2	17.6	13.2	0.7	28.7	121.0	300.4	9.9	2,752.2	3,339.4
Poland	0.1	0.0	29.4	2.1	24.3	327.1	144.6	127.5	14.2	13.4	39.5	261.0	1.0	0.1	0.1	5.5	1,176.8	64.7	5.5	38.7	1.6	11.4	1.7	2.3	0.6	0.2	18.9	143.4	26.2	1.0	1,484.6	998.4
Portugal	10.2	0.0	0.5	0.8	76.8	11.5	4.9	139.8	9.9	1.6	0.5	26.6	0.4	1.4	0.6	0.1	44.6	26.0	0.1	18.8	6.7	1.0	0.3	0.1	3.4	0.5	2.5	12.1	9.9	43.9	171.6	284.1
Romania	0.0	1.9	4.3	0.4	14.3	481.0	9.0	44.5	3.6	2.7	0.0	0.0	0.9	0.0	0.1	0.0	220.2	140.3	0.6	12.1	1.9	2.8	0.6	0.3	0.2	0.4	1.9	3.9	14.2	0.5	271.8	690.9
Slovakia	0.0	0.0	5.2	0.7	0.1	0.5	40.4	13.4	1.1	0.0	0.0	0.2	0.0	0.0	0.0	0.0	2.2	3.9	0.0	15.4	0.4	1.3	0.0	0.0	0.2	0.2	1.4	11.0	3.0	0.1	54.1	46.8
Slovenia	0.0	0.0	38.8	0.1	30.6	21.8	54.4	36.8	4.2	1.9	2.1	0.0	0.1	0.0	0.0	1.8	340.5	11.5	3.8	0.5	1.5	10.5	0.0	0.4	0.1	0.0	1.5	11.8	21.9	0.1	499.4	97.4
Spain	5.3	0.9	67.1	271.7	490.4	149.4	363.9	551.1	30.0	13.5	269.8	74.6	7.7	1.8	60.5	10.6	1,328.1	83.3	18.1	124.0	25.1	16.6	1.4	13.8	15.1	7.7	15.5	56.9	2.3	3.4	2,700.2	1,379.2
Sweden	0.4	1.9	6.7	5.0	36.7	300.5	190.0	140.0	27.2	74.2	38.9	256.5	27.2	0.3	4.3	0.2	124.9	29.1	23.8	8.4	13.4	1.8	0.8	1.5	2.1	0.5	11.1	4.8	16.7	22.0	524.2	846.7

Source: Own elaboration based on Comext database (Eurostat)