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Importing Clothing Made from Recycled Textile Materials? A Study of Retailers' Sourcing Strategies in Five European Countries

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Abstract: This study examined retailers' sourcing strategies for clothing made from recycled textile materials in the five largest European clothing retail markets (i.e., the UK, Italy, France, Germany, and Spain), given the increasing availability of such products. The multivariate analysis of variance (MANOVA) was conducted based on the detailed country of origin and product assortment information of thousands of such clothing items for sale in these five EU countries from January 2021 to May 2023. The results show that EU retailers sourced clothing using recycled textile materials diversely from over 40 developing and developed countries across Asia, America, Europe, and Africa. The geographic location of supplying countries statistically affects the detailed assortment of recycled clothing that EU retailers import. However, apart from assortment diversity, no statistical evidence indicates that developing countries had advantages over developed ones regarding product sophistication, replenishment frequency, and pricing in the five EU markets. The study's findings offer new insights into the business aspects of recycled clothing and reveal promising global sourcing opportunities for such products. The results also imply a potentially significant shift in global apparel trade patterns as retailers embrace fashion circularity and expand sourcing clothing made from recycled textile materials.

Keywords: clothing made from recycled textile materials; textile recycling; EU retailers

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1. Introduction

As environmental awareness among consumers grows, retailers in Europe (EU) have expressed a heightened interest in selling clothing using recycled textile materials (referred to as "recycled clothing" in this study). For example, fast fashion giants like H&M and Zara and luxury brands such as Hugo Boss have started carrying recycled clothing, aiming to integrate circularity into their product designs and business models [1]. Moreover, the European Union outlined a vision to have apparel placed on the EU market containing substantial recycled textile materials by 2030, implying further growth of the recycled clothing market in the years ahead [2].

Textile recycling and recycled clothing have also been popular interdisciplinary research topics. For example, existing studies have investigated various textile recycling techniques or the unique design process of using recycled textile materials [3–5]. Other studies examined consumers' shopping behaviors for recycled clothing [6–8]. Additionally, some studies have investigated retailers' merchandising strategies for clothing made from recycled textile materials [9]. However, as a critical research gap, where clothing made with recycled textiles comes from and what its supply chain looks like remains mostly a "black box". Even fewer studies specifically looked at EU retailers' sourcing and supply chain strategies for recycled clothing despite the increasing availability and sales of such products in the retail market [10].

This study explores retailers' sourcing strategies for clothing made from recycled textile materials in five European countries, including the United Kingdom (UK), Italy, France, Germany, and Spain. These five countries represent the EU's largest clothing

retail markets, consistently accounting for over 60% of the region's total apparel sales [11]. Specifically, by leveraging unique product-level data collected from EDITED, a big data tool for the fashion industry, the study will examine where recycled clothing sold in these five EU countries came from and factors affecting the sourcing patterns [12].

The study's findings fill critical research gaps regarding EU retailers' sourcing strategies for clothing made from recycled textile materials and offer essential new knowledge about recycled clothing's supply chains. The results also provide valuable input for fashion companies interested in expanding recycled clothing sales in the competitive EU retail markets. Additionally, the findings could help policymakers develop appropriate policies supporting EU companies' efforts to source more recycled clothing and promote the development of a circular fashion business model.

2. Literature Review

2.1. Supply Chains for Making Clothing Using Recycled Textile Materials

Compared to making clothing from virgin fiber, the supply chains for making clothing using recycled textile materials could be more versatile due to the various methods of creating recycled textile fibers. For example, Table 1 shows that recycled textiles can be produced through mechanical recycling, i.e., shredding and carding used clothing to create new textile fibers [13]. Chemical recycling is another commonly adopted method that generally breaks down textile waste into its chemical components and reconstitutes them into new materials [14]. Additionally, certain recycled textiles, like recycled polyester, are often made from plastic bottles through a mechanical process [15].

Table 1. Methods of making recycled textile materials.

Method	Processes
Mechanical recycling from textile waste	1. Collecting textile waste; 2. Sorting textile waste based on their fiber type, fabric composition, or color; 3. Shredding sorted textile waste into small pieces or fibers 4. Cleaning shredded fibers to remove any impurities or containments; 5. The cleaned fibers are then carded to separate and align the fibers; 6. Spinning the carded fibers into yarns and then weaving them into new fabrics; 7. The new fabrics may undergo finishing processes such as dyeing, printing, or coating;
Chemical recycling from textile waste	1. Collecting textile waste; 2. Depolymerizing textile wastes into their component polymers using methods such as acid hydrolysis; 3. Purifying the depolymerized polymers to remove any contaminants or impurities; 4. Repolymerizing the purified polymers into new long-chain molecules; 5. Spinning and weaving the new polymer chains into new textile fibers, yarns and fabrics; 6. The new fabrics may undergo finishing processes such as dyeing, printing, or coating;
Creating recycled textiles from plastic	1. Collecting plastic waste, such as PET bottles 2. Soring and cleaning collected plastic waste to remove any labels, caps, or other non-plastic materials; 3. Shredding the cleaned plastic waste into small flakes or granules; 4. Melting down the shredded plastic and extruding it into long strands or filaments; 5. Spinning and weaving the new strands or filaments into new textile fibers, yarns, and fabrics; 6. The new fabrics may undergo finishing processes such as dyeing, printing, or coating;

References: [14–17].

The distinctive process and characteristics of making clothing using recycled textile materials could impact its production location. Specifically, according to the factor proportion trade theory, countries should specialize in producing goods that intensively use their abundant production factors, such as labor and capital [18]. In general, developing countries abundant with cheap labor are typically involved in making labor-intensive products, whereas developed countries, rich in capital and technology, generally focus on making capital and technology-intensive goods [19,20].

Unlike making virgin textile fiber mainly using automated machines, producing recycled textile waste requires both significant labor and capital input. For example, studies found that collecting and sorting textile waste remains highly labor-intensive due to limited technology and the complexity of separating different fiber content [5,21]. However, companies usually rely on expensive and specialized machinery to mechanically or chemically transform sorted textile waste into recycled fibers and further process them into new yarns and fabrics [22]. Further, studies found that cutting and sewing recycled fabrics into clothing is not significantly different from making clothing using virgin fibers, and it remains a labor-intensive process [20,23].

Therefore, in theory, countries at different stages of economic development could become involved in the supply chain of making clothing using recycled textile materials [12]. Prior studies also indicate that countries around the world, from Asia, EU, and America to Africa covering both developed and developing economies, have engaged in making and exporting clothing using recycled textiles [23–26].

2.2. EU Retailers' Apparel Sourcing Strategies

As EU retailers typically treat clothing made from recycled textile materials as part of their product assortment, companies' sourcing criteria and strategies for regular clothing (Note: In this paper, "regular clothing" refers to apparel items that use virgin fiber only and do not contain recycled textile materials.) could also apply to clothing made from recycled textile materials [4,20]. In general, EU retailers' apparel sourcing strategies have several unique features.

First, EU retailers considered various factors when deciding where to source apparel products. As apparel retailing is a buyer-driven industry, EU retailers must strike a delicate balance to meet consumers' diversified demand regarding product assortment, quality standards, pricing, and delivery speed [27,28]. For example, European apparel retailers, especially those targeting the mass and value market segments, regard cost and product quality as essential vendor selection criteria. These factors directly impact apparel retailers' ability to survive in the highly competitive market with relatively low profit margins [29]. Meanwhile, studies such as [30,31] found that in response to market uncertainties, some European apparel retailers increasingly prefer suppliers that could offer sourcing flexibility and agility, i.e., allowing the adjustment of order quantities and product details within a short timeframe. Working with such vendors would provide apparel retailers with several potential benefits, from optimizing inventory levels and accurately responding to market demand to increasing profit margins [32].

Further, with consumers' growing awareness of the fashion industry's environmental impact and garment workers' well-being, EU retailers commonly consider environmental and social compliance risks in their sourcing decisions [33,34]. Most studies agree that effectively controlling compliance risks in sourcing helps fashion companies protect their brand images and avoid potential supply chain disruptions [35,36]. Likewise, in recent years, EU fashion companies have pulled out of specific sourcing destinations, such as Cambodia and Myanmar, primarily because of rising social responsibility concerns [37].

Second, EU retailers adopt a diverse sourcing base for their apparel products. For example, trade statistics show that apparel sold in the EU came from over 100 countries, covering both developed and developing economies globally [11,38]. Firm-level data also indicates that leading EU apparel retailers typically source from more than ten countries, and many continue to develop a more diverse sourcing base for whatever reasons [28,39].

Two factors contribute to EU apparel retailers' sourcing diversification strategy. On the one hand, studies show that no single sourcing destination can perfectly meet all of the primary sourcing criteria an apparel retailer sets [36,40]. Instead, like their peers in the United States, EU apparel retailers commonly source from various countries that can collectively serve companies' sourcing needs, such as competitive sourcing costs and fast speed to market [41,42]. On the other hand, compared to "putting all eggs in one basket", sourcing diversification, primarily geographically, allows EU apparel retailers to

control various supply chain risks better, such as potential shipping delays and unexpected imposition of new trade barriers [43].

Third, near-sourcing is a notable strategy among EU apparel retailers. Table 2 shows that, in value, around half of EU countries' apparel imports consistently came from within the EU over the past decade, known as the EU intra-region trade [44,45]. The firm-level analysis of EU apparel retailers' detailed supplier base also indicates that near-sourcing from within the EU region was common, whether for fast fashion retailers like Zara and H&M or luxury brands such as Hugo Boss [1,41,46].

Table 2. Sources of EU apparel imports (by value).

Exporters	2010	2015	2019	2021	2022
Intra-EU	43.5%	43.6%	47.3%	50.9%	48.2%
China	24.8%	20.2%	15.6%	15.3%	15.8%
Bangladesh	5.0%	8.6%	9.3%	8.6%	10.7%
Turkey	6.6%	5.9%	5.5%	5.6%	5.7%
India	3.6%	3.3%	2.7%	2.2%	2.5%
Vietnam	1.1%	1.8%	2.0%	1.9%	2.3%
Others	15.5%	16.6%	17.6%	15.3%	14.8%

Data source: [45]. "Apparel" refers to the Standard International Trade Classification (SITC) code 84. "EU" covers the 27 European Union members (excluding the UK).

Several factors supported EU apparel retailers' near-sourcing pattern. One was the EU region's relatively complete textile and apparel supply chains. For example, several Western EU countries, such as Italy, Germany, and France, are known for their long history and skilled craftsmanship in making textiles and apparel products, especially those targeting the high-end market [45,47]. Meanwhile, Eastern EU countries like Romania and Poland have long been significant clothing exporters serving the EU market, and they typically use textile supplies from Western EU countries [48,49]. Second, near-sourcing enables EU apparel retailers to enjoy several advantages over sourcing from distant locations outside the region, such as shorter lead times, greater sourcing flexibility, and a more sustainable business model achieved through a reduced carbon footprint [50–52]. Additionally, near-sourcing allows EU apparel retailers to enjoy relatively lower tariffs and non-tariff barriers for their apparel imports due to the customs union and other regional trade arrangements among EU countries [44,53].

Furthermore, numerous studies indicate that EU apparel retailers often use near-sourcing from within the EU region for specific product and sourcing goals. For example, Refs. [52,54] found that EU fashion retailers typically sourced clothing items that require a smaller volume but faster turnaround locally from the EU. Meanwhile, studies argue that due to EU countries' higher wage levels, clothing "Made in the EU" is more likely to target the premium and luxury markets as a means to offset the higher production costs [28,41]. In contrast, it remains common for EU retailers to rely on Asia as their primary sourcing destination for cheaper clothing targeting the mass and value markets [55].

2.3. EU Retailers' Sourcing Strategies for Clothing Made from Recycled Textile Materials

In summary, trade theories and past studies suggest that EU retailers' sourcing strategies for clothing made from recycled textile materials could be affected by the supplying countries' geographic location and economic development level and demonstrate several unique patterns:

Hypothesis 1. *EU retailers would source clothing made from recycled textile materials from diverse sources.*

On the one hand, there seems to be no "perfect" sourcing destination for clothing made from recycled textiles due to its complex supply chain requiring both intensive labor and capital input [5,21]. Thus, it is likely that EU retailers may rely on a diverse souring

base that collectively meets their sourcing demand for such products. On the other hand, retailers mainly treat clothing made from recycled textile materials as part of their total product assortment and apply the same vendor selection criteria as regular clothing using virgin fibers [20]. Therefore, similar to the case of regular clothing, sourcing diversification would more easily allow EU retailers to achieve essential sourcing objectives, ranging from costs, speed to market, and flexibility to compliance risks when importing clothing made from recycled textiles [56,57].

Hypothesis 2. *Near-sourcing would be a critical component of EU retailers' sourcing strategies for clothing made from recycled textile materials, especially those targeting the luxury or premium market.*

For several reasons, EU retailers would source clothing made from recycled textile materials locally from within the EU. One factor is the readily available local supply chain, supported by a relatively abundant supply of textile waste in the EU, one of the world's largest apparel consumer markets, and the capability of EU countries to produce recycled textile raw materials and finished garments [5,39]. Meanwhile, EU policy directives mandating increased offerings of apparel products made from recycled textile materials could incentivize investments to strengthen the region's local manufacturing capacity for such products [2,58]. Additionally, given the EU's reputation for producing luxury apparel items, it is reasonable to speculate that retailers may employ a similar strategy for clothing made from recycled textile materials to mitigate the relatively higher production costs in the EU [47,59].

Hypothesis 3. *A supplying country's economic advancement level could affect the product assortment of recycled clothing imported by EU retailers.*

The cutting and sewing process of making clothing from recycled textiles has no significant difference from using virgin fibers [20,23]. Thus, based on the factor proportion trade theory, a country's economic advancement level theoretically could affect the characteristics of the recycled clothing it produces [60]. For example, as garment manufacturing has mostly shifted to developing countries with abundant skilled labor forces, developing nations could enjoy an advantage in producing a wider range of recycled clothing categories than developed economies [61,62]. Meanwhile, EU retailers may source recycled clothing with a deeper assortment (e.g., more color or sizing choices) from developing countries, given developing countries' overall superior garment manufacturing capabilities and flexibility over developed economies [36,63].

However, it remains uncertain whether EU retailers would view developing countries as cost-effective sourcing destinations for clothing made from recycled materials. For example, EU retailers' limited sourcing volume for recycled clothing could potentially undermine the economies of scale advantages developed countries enjoy over developed ones in garment manufacturing [9]. Easier access to a more abundant supply of textile waste could also assist developed countries in reducing transportation costs in making clothing using recycled textile materials despite their significantly higher labor costs [64,65].

3. Methods

3.1. Data Source

Data for the study was obtained from EDITED, a prominent big data tool specializing in the fashion apparel industry [12]. Employing a blend of web crawling and manual curation techniques, EDITED systematically captures intricate details about product characteristics, label descriptions, and pricing information for hundreds of thousands of clothing items available in the EU retail market cataloged at the Stock-Keeping Unit (SKU) level [12]. Unlike trade statistics, which mainly provide aggregated industry-level data, EDITED's data offered unique insights into the country of origin information and detailed product-

level features of clothing made from recycled textile materials carried by EU retailers, allowing us to analyze companies' detailed sourcing strategies for such products.

Specifically, based on the most recent available data, EDITED randomly selected 5000 Stock Keeping Units (SKUs) of clothing items made from recycled textile materials for sale in the five EU markets (i.e., UK, Germany, Italy, France, and Spain) between January 2021 and May 2023. These samples explicitly mentioned on the product labels that they were "100% made from recycled textile materials". Random sampling helps ensure that the selected samples closely resemble the population and enables statistical inference for the results [66]. Also, the 2.5-year period covered by the samples was long enough to reveal EU retailers' relatively stable sourcing patterns [9].

In conducting the study, data regarding the product assortment, pricing, and country of origin for each clothing item were extracted from the raw data provided by EDITED. Specifically,

- *Assortment diversity*: the quantity of Stock Keeping Units (SKUs) offered for the clothing item. For example, an Assortment diversity value of 4 indicates that a clothing item is available in four different sizing or color options. A higher *Assortment diversity* value (i.e., having more sizing or color options) indicated that a clothing item's assortment was deeper and more diverse [67].
- *Product sophistication*: the technical complexity involved in producing the garment. Utilizing EDITED's classification, *Product sophistication* employs a 3-point rating scale: simple products are rated as 1 (e.g., T-shirts, swimwear, and hosiery); moderately sophisticated products as 2 (e.g., bottoms and tops other than T-shirts); highly sophisticated products as 3 (e.g., outerwear, dresses, and suits).
- *Replenishment*: the frequency with which a clothing item was restocked during the examined period.
- *Market segment*: the market segment of a clothing item as per EDITED's 4-scale classification. The scale rates the item's target market as follows: EU value market = 1, mass market = 2, premium market = 3, luxury market = 4.
- *Retail price*: the original listed price of a clothing item as per EDITED.
- *Development*: according to information from the product label, a value of 1 indicates that a developed country made the clothing, while a value of 0 indicates that the garment was made by a developing country. The country grouping was based on the United Nations classification [68].
- *Region*: the origin of where the clothing item was made, such as Asia, Europe, America, and Africa [68].

3.2. Data Analysis

The multivariate analysis of variance (MANOVA) technique was adopted for the data analysis, which aligned with the research objectives and the nature of the collected data. MANOVA is a commonly used statistical method for comparing the mean values of observation vectors and assessing the degree of difference between groups.

Compared to other methods, such as Analysis of Variance (ANOVA), MANOVA offers the advantage of handling multiple dependent variables within the model without inflating Type I errors [66].

Corresponding to the study's hypotheses, MANOVA could evaluate whether retailers in the five EU countries set differentiated product assortments for clothing made from recycled textile materials based on a supplying country's geographic location and economic development level. Specifically, four dependent variables measuring the product assortment were included in the MANOVA analysis, i.e., *Assortment diversity*, *Product sophistication*, *Replenishment*, *Market segment*, and *Retail price*. Meanwhile, *Development* and *Region* were used as the two independent variables in the model.

4. Results and Discussions

4.1. Descriptive Analysis

In total, the analysis encompassed 4159 clothing items made from recycled textile materials, each of which provided information regarding its country of origin. These are summarized in Tables 3–5:

Table 3. Sources of apparel made from recycled textile materials (N = 4159).

Suppliers	*Region*	*Development*	Observations	Percent
China	Asia	Developing	1330	31.0%
Italy	Europe	Developed	591	13.8%
Portugal	Europe	Developed	327	7.6%
India	Asia	Developing	216	5.0%
Vietnam	Asia	Developing	206	4.8%
Bulgaria	Europe	Developing	198	4.6%
Japan	Asia	Developed	162	3.8%
Canada	America	Developed	142	3.3%
Romania	Europe	Developed	131	3.1%
UK	Europe	Developed	127	3.0%
Mexico	America	Developing	113	2.6%
Colombia	America	Developing	63	1.5%
Spain	Europe	Developed	58	1.4%
USA	America	Developed	54	1.3%
Europe	Europe	Developed	54	1.3%
France	Europe	Developed	45	1.0%
Turkey	Europe	Developing	43	1.0%
Hungary	Europe	Developed	38	0.9%
Indoensia	Asia	Developing	32	0.7%
Morocco	Africa	Developing	31	0.7%
Thailand	Asia	Developing	28	0.7%
Nicaragua	America	Developing	28	0.7%
Sri Lanka	Asia	Developing	24	0.6%
Tunisia	Africa	Developing	17	0.4%
Greece	Europe	Developed	16	0.4%
El Salvador	America	Developing	15	0.3%
Cambodia	Asia	Developing	13	0.3%
Poland	Europe	Developing	9	0.2%
Lithuania	Europe	Developed	7	0.2%
Indonesia	Asia	Developing	7	0.2%
Germany	Europe	Developed	6	0.1%
Bangladesh	Asia	Developing	5	0.1%
Albania	Europe	Developing	4	0.1%
Czech Republic	Europe	Developed	4	0.1%
Denmark	Europe	Developed	4	0.1%
Myanmar	Asia	Developing	3	0.1%
Nepal	Asia	Developing	2	<0.1%
Kenya	Africa	Developing	2	<0.1%
Madagascar	Africa	Developing	2	<0.1%
Taiwan	Asia	Developed	2	<0.1%

Table 4. Descriptive analysis by region.

Variables	Asia (N = 2030)	America (N = 415)	Europe (N = 1662)	Africa (N = 52)
Assortment diversity	5.46	5.63	4.95	5.77
Product sophistication	2.78	2.22	2.49	1.91
Replenishment	0.16	0.30	0.12	0.16
Market segment	2.85	3.16	3.28	3.40
Retail price	$379.59	$401.41	$657.91	$195.51

Table 5. Descriptive analysis by economic development.

Variables	Developing Countries (N = 2519)	Developed Countries (N = 1640)
Assortment diversity	5.81	4.45
Product sophistication	2.70	2.47
Replenishment	0.18	0.10
Market segment	2.98	3.28
Retail price	$387.28	$642.90

First, consistent with Hypothesis 1, retailers from the five EU countries imported clothing using recycled textile materials from diverse sources. Specifically, Table 3 illustrates that the clothing items in the sample originated from nearly 40 countries, encompassing both developed and developing economies in Asia, America, the EU, and Africa. The results echo the findings of previous studies, suggesting that making clothing using recycled textile materials has already become a global phenomenon, offering many sourcing options worldwide for EU retailers [20].

However, unlike the trade pattern for regular clothing made from virgin fibers, for which labor-abundant developing countries dominate the exports, a much higher percentage (i.e., 40%) of clothing made from recycled textile materials came from developed economies in the samples [12,38]. The result could be attributed to the unique supply chain composition and labor and capital requirements of producing clothing using recycled textile materials, making it more likely for advanced economies to make such products [23].

Second, consistent with Hypothesis 2, the results indicated that near-sourcing from within the EU played a critical role in EU retailers' sourcing strategy for clothing made from recycled textile materials. For example, Table 3 shows that more than fifteen EU countries produced and exported clothing using recycled textile materials in the samples, including many prominent traditional apparel exporters in the region like Italy, Hungary, Portugal, and Romania [38].

Moreover, Table 4 indicates that clothing made from recycled textile materials produced by EU countries differed from those from other regions. For example, on average, EU-made products had the highest value in the variable *Market segment*, suggesting they were more likely to target luxury and premium consumers. Likewise, EU-made products also reported a much higher average retail price (variable *Retail price*) than those sourced from other regions like Asia. EU apparel manufacturers' relatively higher production costs and long-time strengths in making luxury items could be important factors behind the phenomenon [47].

However, Table 4 suggests that clothing made from recycled textile materials locally sourced from the EU, on average, offered fewer color or sizing choices than those from other regions (variable *Assortment diversity*). Likewise, there is no clear evidence that EU-made recycled clothing received more frequent replenishment than those products imported from Asia, America, and Africa (variable *Replenishment*). Thus, EU retailers' selection of sourcing destinations for clothing made from recycled materials and each region's strengths and weaknesses in making such products appear more sophisticated than what was suggested theoretically [28,39].

Third, consistent with Hypothesis 3, Table 5 revealed nuanced differences in product characteristics of clothing made from recycled textile materials sourced from developing and developed economies. For example, on average, products made by developing countries offered broader assortment choices (variable *Assortment diversity*) and focused on relatively more sophisticated categories (variable *Product sophistication*). In comparison, on average, products sourced from developed economies included more luxury and premium items (variable *Market segment*) and were priced higher than those from developing countries (variable *Retail price*), possibly due to the different costing structures [20,69]. However, statistical analysis needs to be conducted further to confirm the apparent differences in

product characteristics between developed and developing countries for clothing made from recycled textile materials.

4.2. Statistical Analysis

The Box's test for equality of covariance revealed that at the 99% confidence level (p-value < 0.01), the collected samples in the study did not fully satisfy the assumption of equal covariance, a typical challenge when dealing with a large dataset [70]. Therefore, Pillai's trace test was conducted for the MANOVA analysis to ensure robust statistical results [71].

First, as Table 6 shows, MANOVA's main effect was statistically significant at the 99% confidence level for the variables of *Development* and *Region* (p-value < 0.01), as determined by Pillai's trace test. These findings align with the hypotheses of the study, suggesting that the economic development level and geographical location of an exporting country influence the assortment of clothing products made from recycled textile materials that are sourced by EU retailers.

Table 6. Results of the MANOVA main effect test.

Statistics/Variables	*Development*	*Region*
Pillai's trace	3.78 (0.00) **	19.39 (0.00) **
Wilks' lambda	3.78 (0.00) **	19.61 (0.00) **
Hotelling–Lawly trace	3.78 (0.00) **	19.78 (0.00) **
Roy's greatest root	3.78 (0.00) **	19.39 (0.00) **

Note: Number in the bracket is p-value; ** $p < 0.01$.

Second, a between-subjects test was conducted to investigate which of the five dependent variables that measure EU retailers' product assortment contributed to the statistically significant MANOVA main effect (Table 7). Regarding a country's economic advancement level (variable *Development*), only the variable *Assortment diversity* was suggested to be statistically significant between developing and developed countries. In other words, no statistical evidence shows that developing countries have advantages over developed countries for clothing made from recycled textile materials in the EU market regarding product sophistication, replenishment frequency, and pricing. Meanwhile, the results suggest that, statistically, EU retailers sourced clothing made from recycled textile materials with region-specific distinct features, such as assortment diversity, product sophistication, market segments, and pricing.

Table 7. Results of between-subjects test F-value.

Variables	*Development*	*Region*
Assortment diversity	12.55 (0.00) **	62.95 (0.00) **
Product sophistication	0.04 (0.08)	7.24 (0.00) **
Replenishment	2.99 (0.99)	10.24 (0.00) **
Market segment	0.00 (0.99)	5.45 (0.00) **
Retail price	3.25 (0.07)	20.68 (0.00) **

Note: Number in the bracket is p-value; ** $p < 0.01$.

Third, a post hoc test was conducted to explore further whether EU retailers establish distinct product assortments for products imported from each world region [66]. Table 8 shows indicate several notable patterns.

Table 8. Results of post hoc comparisons (Tukey's HSD test).

Comparison	*Assortment Diversity*	*Product Sophistication*	*Replenishment*	*Market Segment*	*Retail Price*
Asia vs. America	−0.16 (0.45)	0.56 (0.00) **	−0.13 (0.00) **	−0.30 (0.00) **	−21.83 (0.91)
Asia vs. Europe	0.52 (0.00) **	0.29 (0.00) **	0.04 (0.07)	−0.42 (0.00) **	−278.32 (0.00) **
Asia vs. Africa	−0.30 (0.75)	0.88 (0.00) **	−0.28 (0.00) **	−0.54 (0.00) **	184.07 (0.21)
America vs. Europe	0.68 (0.00) **	−0.27 (0.00) **	0.17 (0.00) **	−0.12 (0.05) *	−256.49 (0.00) **
America vs. Africa	−0.14 (0.97)	0.31 (0.19)	−0.15 (0.24)	−0.24 (0.28)	205.32 (0.16)
Europe vs. Africa	−0.82 (0.038) *	0.58 (0.00) **	−0.32 (0.00) **	−0.12 (0.79)	462.39 (0.00) **

Note: Number in the bracket is *p*-value; * $p < 0.05$, ** $p < 0.01$.

1. Regarding *Assortment diversity*, the results suggested no statistically significant difference between clothing items made in Asia, America, and Africa at the 99% confidence level (*p*-value > 0.05). However, EU-made clothing items had the least assortment diversity (i.e., sizing and color options) statistically (*p*-value < 0.01). These results could be affected by the specific types of products EU retailers imported from each region.
2. In terms of *Product sophistication*, the results indicate that EU retailers' imports from Asia encompassed more sophisticated product categories, such as outerwear, compared to other world regions, with statistical significance at the 99% confidence level (*p*-value < 0.01). Conversely, EU retailers' imports from the Americas and Africa comprised simpler product categories, such as T-shirts or socks, statistically more than other world regions (*p*-value < 0.01). Moreover, clothing made from recycled textile materials locally sourced from the EU, on average, featured less sophisticated categories than those from Asia but were more sophisticated than imports from the Americas and Africa, with statistical significance at the 99% confidence level (*p*-value < 0.01).
3. The findings concerning *Market segment* and *Retail price* revealed that EU retailers sourcing from Asia and America tended to prioritize relatively lower-priced items targeting the mass and value market segments (*p*-value < 0.01). In contrast, clothing items manufactured in the EU and Africa tended to include a more significant proportion of higher-priced items targeting the luxury and premium market segments, with statistical significance at the 99% confidence level (*p*-value < 0.01).

5. Conclusions and Futures Research Agenda

5.1. Conclusions and Implications

This study examined retailers' sourcing strategies for clothing made from recycled textile materials in the five largest European countries (i.e., the UK, Italy, France, Germany, and Spain). The study unveils several critical findings based on an analysis of the country of origin information and product details of thousands of such clothing items for sale in these five EU countries from January 2021 to May 2023.

First, the results show that EU retailers sourced clothing using recycled textile materials from diverse sources, including over 40 developing and developed countries worldwide. Second, other than assortment diversity, no statistical evidence shows that developing countries had advantages over developed ones regarding product sophistication, replenishment frequency, and pricing for clothing made from recycled textile materials in the five EU markets. Third, a supplying country's geographic location statistically affects the type of recycled clothing EU retailers import. In general, EU retailers sourced relatively more sophisticated clothing items (e.g., dresses and outerwear) targeting the mass and value market from Asia. In comparison, EU retailers typically sourced relatively simple clothing categories (e.g., T-shirts and socks) targeting the mass and value market from the Americas (North, South, and Central). Additionally, EU retailers sourced sophisticated clothing categories primarily for the luxury or premium market locally from Europe and those relatively simple clothing categories targeting the premium market from Africa.

The study's findings filled critical research gaps and enhanced our understanding of EU retailers' sourcing strategies for clothing made from recycled textile materials. The findings also offered new insights into the business aspects of recycled clothing, particularly regarding its intricate supply chains and leading suppliers. The study's results have several additional important implications.

First, while existing studies often suggest "local for local" textile recycling, the study's findings revealed promising *global sourcing* opportunities for clothing using recycled textile materials [72,73]. Particularly, leveraging a diverse sourcing base would allow EU retailers to take advantage of each supplying country's unique production strength regarding product categories and assortment features and more efficiently balance various sourcing factors ranging from costs and flexibility to speed to market. Meanwhile, the study's findings indicate that many countries worldwide have begun producing and exporting clothing using recycled textile materials. As textile recycling technologies advance and manufacturing capabilities expand globally, EU retailers could have more sourcing options for such products [4].

Second, the study's findings suggest that, unlike the patterns of making regular garments using virgin fiber, low-wage developing countries demonstrated no noticeable competitive edges over developed economies regarding producing and exporting clothing using recycled textile materials. Instead, according to the study's results, developed economies, including many high-wage Western EU countries, emerged as top suppliers and leading sourcing destinations for recycled clothing [12]. Developed countries' abundant capital and technological resources provided essential support for producing clothing using recycled textile materials [5,21]. Thus, expanding clothing production using recycled textile materials presents an exciting economic opportunity with a promising future in developed countries, where many have plans to revitalize the domestic manufacturing sector and establish a sustainable circular economy [2,10].

Third, building on the previous point, the sustained commitment of fashion brands and retailers to carry more clothing made from recycled textile materials in their product assortment could hold significant implications for the future landscape of global apparel trade and sourcing patterns. For example, whereas apparel products are predominantly exported from developing to developed countries today, more trade flows could occur between developed economies in the future, attributed to their increasing production capacity and growing demand for clothing using recycled textile materials. Similarly, major apparel exporters in Asia, such as China and Bangladesh, might assume a less dominant role as a sourcing base for recycled clothing due to their lack of sufficient infrastructure for efficiently sorting used clothing and generating high-quality recycled textile materials [74].

5.2. Limitations and Future Research Agendas

While the findings are intriguing, future studies have the potential to address the limitations of this study and explore additional dimensions.

First, while this study examined the origin of finished garments made from recycled textile materials, with new data availability, future research can delve deeper into the supply chain of such products, exploring the locations of tier 2 (i.e., fabric mills) or even tier 3 suppliers (i.e., fiber mills). The results would enhance our understanding of the critical stages of making clothing using recycled textile materials, the key players involved in each production stage, and the implications for trading and sourcing.

Second, due to data limitations, this study was not able to investigate the financial implications of carrying clothing made from recycled textile materials for EU retailers. Future research could collect data through surveys or in-depth interviews with retailers to better understand the financial opportunities and challenges of sourcing clothing made from recycled textile materials, such as the production and shipping costs and the impacts on retailers' profit margins. The results could offer new insights into the business aspects of making and selling recycled clothing and provide a helpful guide for companies interested in entering this growing market.

Additionally, future studies can explore policymakers' roles in promoting EU retailers' sourcing of clothing made from recycled textiles or other sustainable materials. Several EU regulations and policies have been adopted to develop a circular textile industry, such as the EU Strategy for Sustainable and Circular Textiles and the Extended Producer Responsibility (EPR) schemes [2,10]. Considering EU retailers' intriguing sourcing patterns for clothing made from recycled textile materials, future research could further evaluate the effectiveness of these policies in incentivizing companies' production and sourcing of recycled clothing while building a circular fashion business model.

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