

THE RELATIONSHIP BETWEEN SUSTAINABLE SUPPLY CHAIN AND BUSINESS PERFORMANCE: A META-ANALYSIS STUDY

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ABSTRACT

Introduction: This study conducted a comprehensive meta-analysis to investigate the relationship between Sustainable Supply Chain Management (SSCM) and business performance. With increasing global environmental concerns, businesses are increasingly required to integrate sustainable practices into their supply chains. This study aims to address the inconsistencies of previous studies on SSCM and business performance.

Methods: This study uses the Random Effect Size meta-analysis method through the Jamovi application to analyze empirical data from accredited journals. This study also identifies the publication bias of Meta-analysis.

Results: The findings show that SSCM has a positive correlation with financial, environmental, and social performance. Overall, SSCM is associated with business performance. The study also identified moderator variables such as year of publication, country classification by income, country, industry type, and company size. The relationship is stronger in Developed countries, electronics, shipping, and MSME sectors.

Conclusion and suggestion: SSCM has shown to have a significant positive correlation to financial, environmental, and social performance, with moderate social correlation. Future research needs to expand the sample, especially the social dimension, as published or unpublished studies may have different results.

INTRODUCTION

The frightening pace of climate change and its related effects have made environmental awareness and sustainable development popular themes in recent years (Adam et al., 2023). This is due to the increasing consumption of goods and services, which has led to the consequent depletion of natural resources and environmental degradation, resulting in climate change that impacts all parts of the world (Hernandez Marquina et al.,

2022). Amid increasing global geopolitical, regulatory, and climate change challenges, companies face increasing pressure on global SSCM practices (Hall & Lund, 2025). In the context of limited environmental resources and a growing world population, sustainable supply chain governance has become an increasingly pressing issue. This increased attention arises because manufacturing and distribution processes not only deplete limited natural assets but also exacerbate waste levels and environmental contamination.

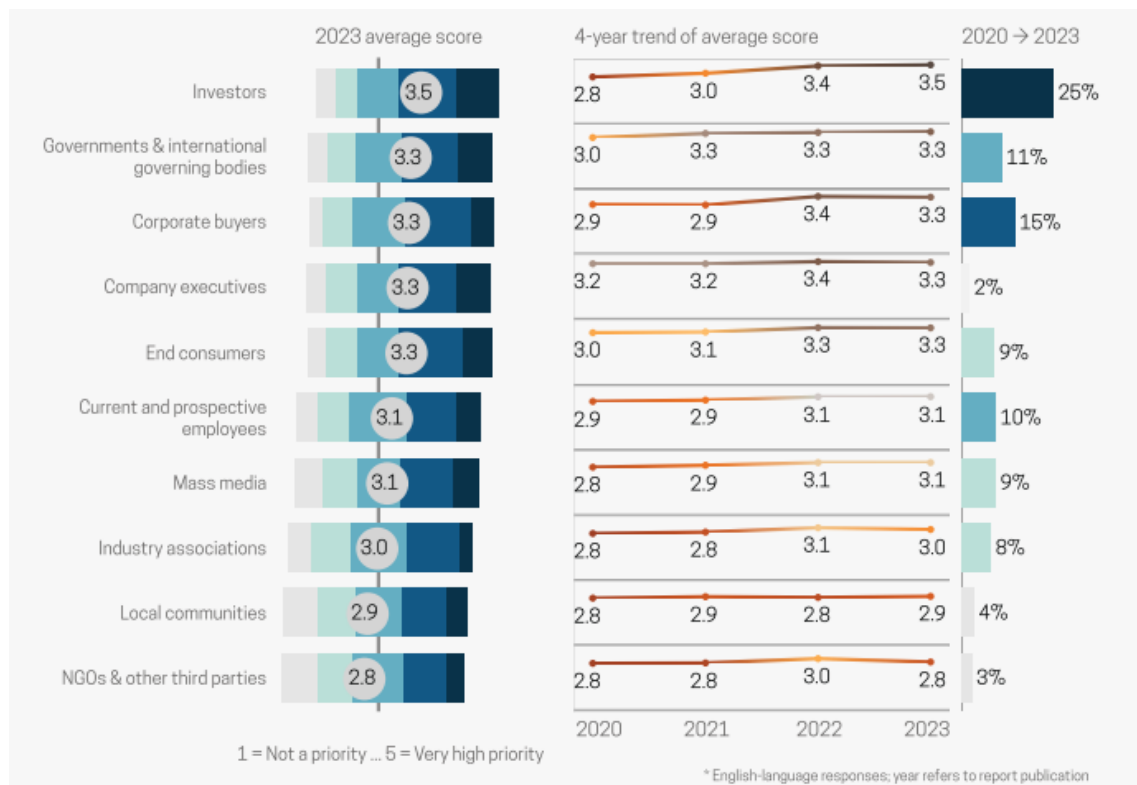


Figure 1: Level of pressure from top 2023 sources year over year

Source: MIT Sustainable Supply Chain Lab (2024)

Companies are increasingly focusing on sustainability, with a recent survey showing a strong need for a holistic and ROI-backed roadmap to achieve sustainability performance goals in the supply chain (EY, 2022). Based on the findings of Erol & Velioğlu (2019), the practice of SSCM in Turkey is still at a rather hesitant stage because SSCM implementation is costly. (Mansour et al., 2025) The findings indicate that Europe records the highest SSCM index at 85%, followed by North America at 70%, while Latin America and Africa display considerably lower indices. Mathivathanan & Haq (2017) argue that geographical factors largely explain this adoption pattern, reflecting variations in the scale of industrial development across regions. Their study revealed that industries in

developed regions tend to adopt SSCM practices more readily than those in developing or less developed areas. The report of [MIT Sustainable Supply Chain Lab \(2024\)](#) reveals that investors are the fastest-growing source of pressure, with average response scores increasing by 25%, followed by governments and international regulatory bodies, corporate buyers, corporate executives, and end consumers.

Several scholars have reported a positive association between SSCM and business performance. Research results by [Fernando et al. \(2022\)](#) found that one dimension of the triple bottom line—social supply chain practices—positively influences corporate social performance. [Kirchoff & Falasca \(2022\)](#) demonstrated that implementing an environmental differentiation strategy, supported by integrative SSCM exchange relationships among supply chain members, can enhance firm performance. Similarly, [Pakdeechoho & Sukhotu \(2018\)](#) observed that SSCM improves economic and social performance, though it does not necessarily lead to superior environmental performance; moreover, incentives provided within the supply chain strengthen SSCM's effect on social performance.

While others argue that there is a negative relationship between some aspects of the triple bottom line, [Shou et al. \(2019\)](#) suggest that this study found no significant impact of SSCM practices on economic performance. This suggests that while SSCM brings environmental and social benefits, it may not result in direct economic gains in the short term, due to the large investments required. [Khokhar et al. \(2022\)](#) also suggest that during the COVID-19 pandemic, SSCM had a negative role in business performance ([Junaid et al., 2022](#)). The impact of green process innovation on business performance is found to be significantly negative, suggesting that rapid modifications to manufacturing processes and operational procedures can adversely affect the company in multiple ways, ultimately diminishing profitability. In addition, studies from different countries indicate that firms in developed countries tend to have higher adoption rates of SSCM and gain more consistent performance benefits, whereas in developing countries, the results are more variable and highly influenced by contextual factors ([Esfahbodi et al., 2016](#); [Hong et al., 2018](#); [Jum'a, 2023](#)). This inconsistency is a concern for business managers in SSCM implementation.

This study aims to address these inconsistencies by conducting a meta-analysis of various empirical studies on the relationship between SSCM and business performance. Using a quantitative effect size approach, this study not only confirms the positive trend of SSCM but also identifies available moderating variables. This meta-analysis research uses the effect size of published studies from 2014 to 2024 to analyze the current impact of the relationship between SSCM and business performance; hence, it is different from previous studies such as [Ardian et al. \(2020\)](#), [Geng et al. \(2017\)](#), and [Govindan et al. \(2020\)](#).

LITERATURE REVIEW

Overall Relationship of SSCM and Business Performance

Sustainable Supply Chain Management (SSCM) and the Triple Bottom Line (TBL) Framework are two interrelated concepts that have been at the center of both academic research and business practice. A supply chain refers to a network of organizations, individuals, activities, information flows, and resources that collectively facilitate the delivery of a product or service from the supplier to the final customer (Stroumpoulis et al., 2024). Ahi & Searcy (2013) point out that GSCM definitions are generally narrower compared to SSCM definitions and have an overwhelming emphasis on environmental issues. While several definitions of SSCM substantially overlap with those of GSCM, SSCM can be viewed as an extension of GSCM. It encompasses the integration of environmental, economic, and social considerations to meet present needs without jeopardizing the ability of future generations to meet their own needs (Mageto, 2021).

Grounded in the Natural Resources Based View (NRBV) Theory (Golicic & Smith, 2013), the study explored how green practices influence firms' economic and environmental performance, asserting that engagement with the natural environment can be a competitive advantage. Similarly, Mao et al. (2016), using the NRBV framework, found that carbon emission reductions through process improvements boost environmental performance but can negatively impact financial results. The NRBV framework underscores that distinctive environmental capabilities such as natural resource management and sustainable innovation constitute a competitive advantage that is difficult for rivals to replicate (Arda et al., 2021; He et al., 2019).

Empirical studies such as Çankaya & Sezen (2019); El-Garaihy et al. (2022); Hong et al. (2018); Huang et al. (2024); Jum'a et al. (2024); Susitha & Nanayakkara (2023); and Yosef et al. (2023) show that NRBV-based SSCM practices strengthen firms' economic, social, and environmental performance. Internal capabilities strengthen the relationship between environmental and social performance and economic performance (Wang & Dai, 2018). Recent research shows that although environmental and economic aspects have been widely studied, the social dimension often receives less attention, and the interaction between the three is still an important area for further exploration (Miemczyk & Luzzini, 2019; Montabon et al., 2020; Tundys & Wiśniewski, 2023; Yun et al., 2019). Research in Ethiopia, Ghana, China, Indonesia, and other countries shows that SSCM has a significant positive impact on competitive advantage, environmental performance, social performance, and financial performance (Asante-Darko et al., 2025; Asante-Darko & Osei, 2023; Baah & Jin, 2019; Fu et al., 2022; Shebeshe & Sharma, 2024).

Often, the implementation of SSCM faces barriers and challenges. As stated by [Chen \(2021\)](#), challenges in SSCM implementation are a lack of government support and strong regulations, and low market demand for sustainable products. Limited resources, such as funds, expertise, and data, hinder the implementation of sustainability practices, especially in the construction and manufacturing sectors ([Cataldo et al., 2022](#); [Yosef et al., 2023](#)). And the dominance of the economic dimension in decision-making means that social and environmental aspects are often neglected ([Laosirihongthong et al., 2020](#)). This is what adds to the implementation of SSCM in various countries.

Furthermore, research by Wang & Dai (2018) on Chinese firms found that SSCM practices do not have a significant impact on the economic and financial performance of small and medium-sized enterprises (SMEs). [Das \(2018\)](#) conducted a study in India revealing that certain SSCM practices, particularly environmental management practices, exhibit no significant association with either operational performance or competitiveness. In addition, during the COVID-19 pandemic, the implementation of SSCM and selection of sustainable suppliers actually had a negative impact on firm performance due to supply chain disruptions and lockdowns ([Hou et al., 2022](#); [Khokhar et al., 2022](#)). [Jum'a \(2023\)](#) suggests that only sustainable distribution practices have a significant impact on TBL performance; other practices are not significant. Therefore, the research synthesizes empirical studies on SSCM and business performance to overcome these inconsistencies. This study proposes the following hypotheses:

- H1: Does SSCM have a positive relationship with financial performance?*
- H2: Does SSCM have a positive relationship with social performance?*
- H3: Does SSCM have a positive relationship with environmental performance?*
- H4: Does SSCM have a positive relationship with business performance?*

Moderator Analysis

This study first outlines the theoretical rationale for selecting moderator variables, then examines their influence on the relationship between SSCM and business performance by categorizing the studies into mutually exclusive subgroups based on the underlying moderators. In the sample of this research, firm size, industry type, country, country classification, and publication year—commonly used as control variables—were designated as moderators. This approach aligns with [Lipsey & Wilson's \(2001\)](#) recommendation that moderator variables in meta-analysis should be consistently reported in primary studies.

[Lai & Wong \(2012\)](#) indicated that firm size has no significant influence on the adoption of GSCM practices. In contrast, [Wu \(2013\)](#) identified a positive relationship between firm size and both green purchasing and ecological design within Taiwanese

apparel manufacturing firms. Accordingly, this study highlights the pressing need to account for firm size as a moderating factor in analyses of SSCM practice adoption.

The literature review indicates that most prior studies have drawn samples from a wide range of industries and firms with differing business orientations. A significant portion of the reviewed research collected data across various sectors (Afum et al., 2021; Miemczyk & Luzzini, 2019; Paulraj et al., 2017). However, some studies take their sample from one specific industry (Emamisaleh et al., 2018; Lu et al., 2018; Rodríguez-González et al., 2022). It is posited that incorporating multiple industries produces greater variability in the data compared to focusing on a single industry. Accordingly, this study aims to investigate whether industry type serves as a moderating variable in the relationship between SSCM practices and firm performance (Delbufalo, 2012).

This study incorporates publication year as a moderating variable to explore the evolution of the relationship between SSCM and business performance. Through this inclusion, the study seeks to shed light on the ongoing debate over whether SSCM enhances, diminishes, or maintains performance over time (Hollos et al., 2012). Nonetheless, no studies were found in this research database that examined the development of SSCM through a longitudinal data approach. Therefore, this study utilizes the publication year of each study as a proxy indicator to analyze the evolution of the relationship between SSCM and firm performance.

RESEARCH METHOD

This study examines the effect of SSCM on business performance using the Jamovi application and a meta-analysis approach. This method enables the identification, assessment, and synthesis of prior research findings to offer a thorough comprehension of the two concepts' relationship. Quantitative data from several empirical research were analyzed using meta-analysis. By combining the results of several separate investigations, this approach makes it possible to draw conclusions that are stronger than those drawn from a single study (Schmidt and Hunter, 2004). Additionally, meta-analysis supports evidence-based practice and resolves contradictory research findings (Gurevitch et al., 2018).

Sample selection and data collection

In literature selection, there are several steps to take. First, several criteria were used to ensure the quality and relevance of the sources studied. Literature sources consist of articles published in accredited journal databases such as Scopus. Second, the publication time span used is the last 10 years (2014-2024) to capture the latest

developments in the application of SSCM to business performance. Third, the keywords used in the search include Sustainable supply chain, Green supply chain, Business Performance, Firm Performance, financial performance, social performance, and environmental performance. Fourth, only articles that explicitly addressed the relationship between SSCM and firm performance were included, while studies that only focused on one aspect without linking it to other aspects were excluded. Fifth, data from the selected articles were extracted and organized into tables in Microsoft Excel. This study found 109 samples of the SSCM relationship to financial performance, 54 samples of the SSCM relationship to social performance, and 108 samples of the SSCM to environmental performance. All data were taken from 55 empirical studies from various relevant countries to be sampled for Meta-analysis. This study analyzed 12,178 companies that have implemented SSCM.

Meta-analysis Procedure

To strengthen the research results, a Meta-analysis was conducted on quantitative studies that present empirical data related to the impact of sustainable supply chains on business performance. The data collected includes the impact of sustainable supply chains on the performance of business, financial, environmental, and sustainability. The quantitative data of the study were coded to facilitate statistical combination and comparison based on effect size ([Retnawati et al., 2018](#)). In addition, heterogeneity analysis was conducted using Q-test or I^2 statistics to identify moderating factors that may affect the relationships found in this study ([Govindan et al., 2020](#)).

The meta-analysis procedure performed is that the data set is analyzed to determine the overall effect size and its variability. In this study, the average effect size was estimated using a random effects model to account for heterogeneity between studies ([Hunter & Schmidt, 2004](#)). The results of the effect size analysis will be used to analyze the relationship between SSCM and business performance. Furthermore, a heterogeneity test was conducted to determine the level of heterogeneity in the study. The I^2 test has been used to assess heterogeneity in the sample, denoted as $I^2 = ((Q \text{ df})/Q)*100\%$ ([Higgins et al., 2003](#)). If the I^2 statistic exceeds 75%, it indicates that the population connection has authentic variance. In such cases, subgroup analysis should be performed. Then, publication bias and heterogeneity are evaluated to assess their potential impact on the meta-analysis results. Fail-Safe N was used to detect bias and examine sample variability. Next, the selection of either a fixed or random effects model was determined based on the level of heterogeneity, with a random effects model applied when there was significant variability across studies.

Table 1. Summary of SSCM Study Data on Business Performance

No	Authors	Country	Industry	Industry Size	Number of Samples
1	(Aalirezaei et al., 2018)	Iran	Automotive	Large	217
2	(Abdul-rashid et al., 2017)	Malaysia	Manufacture	Large	443
3	(Afum et al., 2021)	Ghana	N/A	SMEs	248
4	(Agan et al., 2014)	Turkey	Manufacture	Large	314
5	(Zaid et al., 2018)	Palestine	Many Industry	Large	121
6	(Ali et al., 2017)	UK	Food	SMEs	84
7	(Amjad et al., 2017)	N/A	N/A	Large	360
8	(Ananda et al., 2018)	Indonesia	Manufacture	Large	198
9	(Abdallah & Al-ghwayeen, 2020)	Jordan	Many Industries	Large	215
10	(Ahmad et al., 2022)	N/A	Many Industry	Large	384
11	(Islam et al., 2025)	Bangladesh	Pharmaceutical	Large	206
12	(Bag, 2014)	Indian	N/A	Mixed	103
13	(Baliga et al., 2019)	Indian	Manufacture	Large	211
14	(Chan et al., 2016)	China	Many Industries	Large	250
15	(Mafini & Muposhi, 2017)	South Africa	N/A	SMEs	312
16	(Chiu & Hsieh, 2016)	Taiwan	Restaurant	Large	130
17	(Choi & Hwang, 2016)	South Korea	Manufacture	Large	230
18	(Das, 2018)	Indian	Manufacture	Large	255
19	(Zhu et al., 2022)	Pakistan	Automotive	Large	320
20	(Dubey et al., 2015)	N/A	Many Industry	Mixed	167
21	(Dubey et al., 2014)	Indian	N/A	Large	174
22	(Emamisaleh et al., 2018)	Iran	Food	Large	120
23	(Esfahbodi et al., 2016) 1	China	Manufacture	Large	72
24	(Esfahbodi et al., 2016) 2	Iran	Manufacture	Large	56

Table 1. Summary of SSCM Study Data on Business Performance

No	Authors	Country	Industry	Industry Size	Number of Samples
25	(Esfahbodi et al., 2017)	UK	Manufacture	Large	146
26	(Fernando et al., 2019)	Malaysia	Maritime	Large	144
27	(Green et al., 2015)	UK	Manufacture	Large	225
28	(Habib et al., 2021)	Bangladesh	Textile	Large	266
29	(Hong et al., 2018)	China	Manufacture	Large	209
30	(Isnaini et al., 2020)	Indonesia	Restaurant	Large	210
31	(Jawaad & Zafar, 2019)	Pakistan	Textile	Large	272
32	(Joshi & Sharma, 2022)	Indian	Consumer Goods	SMEs	153
33	(Grekova et al., 2015)	Netherlands	Food	Mixed	139
34	(Laari et al., 2015)	Finland	Manufacture	Large	119
35	(Li et al., 2016)	China	Technology	Large	256
36	(Lirn et al., 2014)	Taiwan	Shipping	Large	80
37	(Lu et al., 2018)	China	Manufacture	Large	154
38	(Luthra et al., 2014)	Indian	Automotive	Large	123
39	(Luzzini et al., 2015)	Many Countries	N/A	Large	383
40	(Feng et al., 2018)	China	Automotive	Large	126
41	(Miemczyk & Luzzini, 2019)	Many Countries	N/A	Large	350
42	(Syed et al., 2019)	Pakistan	N/A	Large	296
43	(Naseer et al., 2023)	Pakistan	Manufacture	Large	265
44	(Ni et al., 2019)	China	Manufacture	Large	250
45	(Oliveira et al., 2014)	Brazil	Bioenergy	SMEs	80
46	(Pakdeechoho & Sukhotu, 2018)	Thailand	Food	Large	215
47	(Paulraj et al., 2017)	Germany	N/A	Large	259
48	(Petljak et al., 2018)	Croatia	Retail	Large	190
49	(Rodriguez-Gonzalez et al., 2021)	Mexico	Automotive	Large	460
50	(Rodríguez-González et al., 2022)	Mexico	Automotive	Large	460

Table 1. Summary of SSCM Study Data on Business Performance

No	Authors	Country	Industry	Industry Size	Number of Samples
51	(Schmidt & Foerstl, 2017)	Many Countries	N/A	Large	284
52	(Çankaya & Sezen, 2018)	Turkey	Many Indutry	Large	281
53	(Vanalle et al., 2017)	Brazil	Automotive	Large	41
54	(Wang & Dai, 2018)	China	Manufacture	Large	172
55	(Huang et al., 2017)	Taiwan	Electronics	Large	380

Source: Processed Data

RESULTS AND ANALYSIS

The random effects model must be taken into account when conducting a meta-analysis of correlation studies. The entire variance of each study is pooled to determine its weight in the random effects model (Retnawati et al., 2018).

Summary of the Relationship between SSCM and Business Performance

This meta-analysis aims to analyze the correlation between SSCM and business performance. A random effects model was used in this analysis to address possible heterogeneity between studies. Based on the meta-analysis results in Table 2, SSCM is positively correlated with financial performance with an estimated correlation of 0.338 and a confidence interval of [0.245, 0.430], indicating a moderate positive correlation between the variables studied. P-value < 0.001, which indicates that the correlation results are statistically significant. This relationship is categorized as a strong relationship (Cohen, 1988). In line with research (Aalirezaei et al., 2018; Chiu & Hsieh, 2016; Li et al., 2016), SSCM focuses on reducing materials, waste, energy consumption, and emissions, can result in cost reduction or efficiency, thus leading to better financial performance.

Table 2. Summary of Effects and Heterogeneity

Hypothesis	r	P-Value Estimate	95% CI		I ²	Q	P-Value Heterogeneity
H1 = SSCM → Financial Performance	0.338	<0.001	0.245	0.430	98.06%	4859	<0.001
H2 = SSCM → Social Performance	0.300	<0.001	0.215	0.382	95.18%	1320	<0.001
H3 = SSCM → Environmental Performance	0.353	<0.001	0.300	0.405	93.43%	1607	<0.001
H4 = SSCM → Business Performance	0.336	<0.001	0.290	0.382	96.72%	7795	<0.001

Notes: r = corrected mean correlation, 95% CI = confidence interval, I² = Ratio of total variation in the true effect size, Q = Weighted Sum of Square, P-Value = statistical significance

Source: Processed Data

Then SSCM is positively correlated with social performance with an estimated correlation of $r = 0.300$ and a confidence interval of [0.215, 0.382]. This indicates that there is a positive correlation between the two variables being studied. The p-value < 0.001 indicates that this correlation is statistically significant and falls into the category of a strong relationship (Cohen, 1988). The implementation of employee-friendly and community-welfare-oriented SSCM practices has been shown to improve workforce

performance, build positive relationships with the community, and protect workers from exposure to pollutants (Joshi & Sharma, 2022; Çankaya & Sezen, 2018). Based on the findings of Abdul-rashid et al. (2017), this approach is believed to be able to minimize the negative impact of industry on the environment, while improving the quality of life and maintaining the sustainability of resources for future generations. However, the social dimension in SSCM still receives less attention than the economic and environmental aspects, although eco-design and supplier integration can strengthen the company's image (Geng et al., 2017).

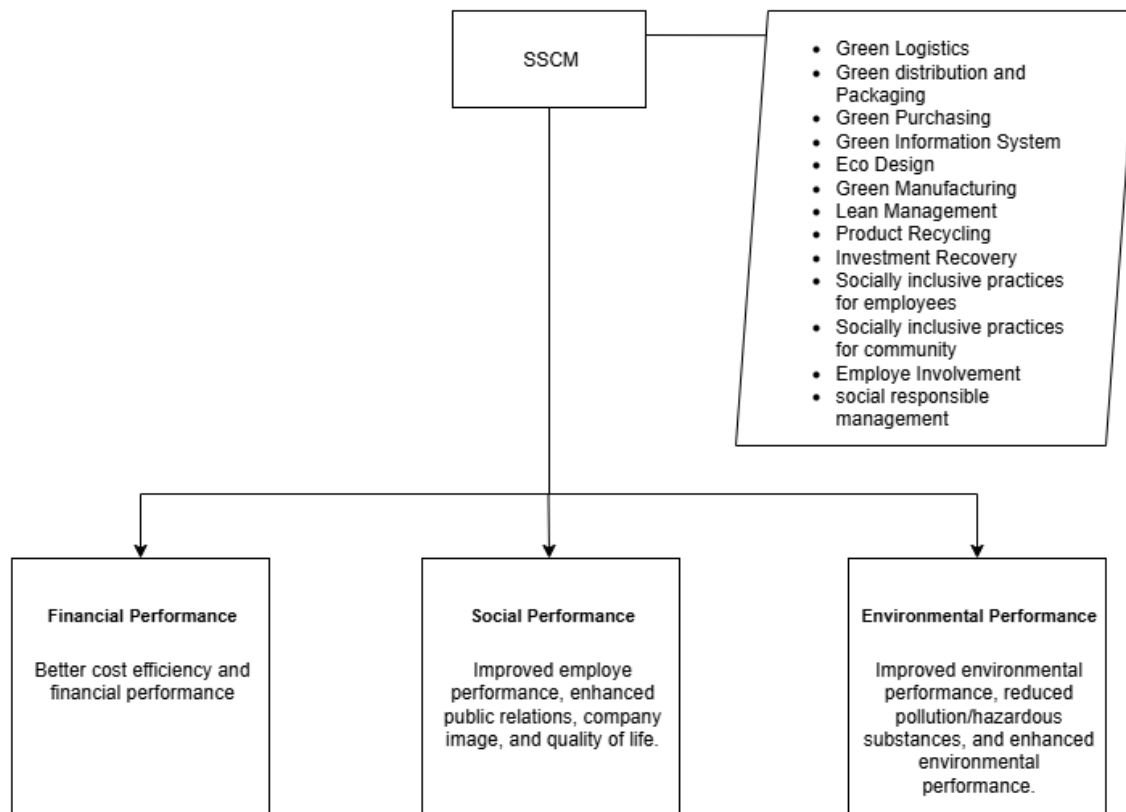


Figure 2: Impact of SSCM Implementation on Business Performance

Source: Processed Data

Furthermore, SSCM is positively correlated with environmental performance with an estimated correlation of $r = 0.353$ and a confidence interval of $[0.300, 0.405]$. This indicates that there is a positive correlation between the two variables being studied. A p-value of <0.001 indicates that the two variables are statistically significantly correlated and fall within the strong relationship category (Cohen, 1988). This is in line with research

conducted (Emamisaleh et al., 2018; Esfahbodi et al., 2016; Paulraj et al., 2017; Wang & Dai, 2018). This demonstrates that SSCM practices encompassing sustainable production, sustainable procurement, sustainable design, and sustainable distribution lead to enhanced environmental performance and significant environmental improvements, as they have the potential to reduce pollutants and strengthen overall environmental outcomes.

The overall results of the analysis of the relationship between SSCM and business performance resulted in a value of $r = 0.336$ with a confidence interval of $[0.290, 0.382]$. And the P -value ≤ 0.001 indicates that the overall relationship between SSCM and business performance is positive and significant, and is in the strong relationship category. In this case, the adoption of SSCM began to be encouraged in various countries. But SSCM implementation also faces various challenges, such as lack of funding and capital, Lack of top management commitment, lack of SSCM strategy, and Lack of technology and IT infrastructure (Gonçalves et al., 2024; Moktadir et al., 2018; Movahedipour et al., 2016).

In the random effects model, it is known that the actual effect size differs from one study to another (Retnawati et al., 2018). Heterogeneity in meta-analysis refers to the extent to which results from different studies differ from each other. In this analysis, the I^2 value of the results of the three hypotheses is $> 75\%$, indicating a high level of heterogeneity; hence, subgroup analysis is required (Govindan et al., 2020). The test results $Q = 4859, 1320, 1607$, and the overall Q test result = 7795 , with a p -value below the α value. If the p -value for Q is less than α , it can be concluded that the true effect in the study used is not the same (Retnawati et al., 2018).

Moderator Analysis

This study analyzes moderating variables that have been categorized, such as Year of publication, Country classification based on income, country, Industry, and company size. This is important because the result of $I^2 > 75\%$. Based on Table 3, the relationship between SSCM and business performance is slightly stronger in the period 2014-2019 ($r = 0.344$) than in 2020-2024 ($r = 0.289$). However, both periods show a significant positive correlation, signaling that SSCM consistently improves business performance, although the effect appears to decrease slightly in more recent studies.

Table 3. Moderator Analysis

Moderator	k	r	95% CI		SE	P- Value
Year						
2014-2019	235	0.344	0.292	0.395	0.026	<0.001
2020-2024	36	0.289	0.220	0.353	0.034	<0.001
Country Classification by						
Income						
Developed Countries	128	0.350	0.295	0.405	0.028	<0.001
Developing Countries	126	0.312	0.263	0.361	0.025	<0.001
N/A	17	0.412	-0.072	0.896	0.247	0.096
Country						
Turkey	19	0.177	0.133	0.242	0.033	<0.001
Palestine	9	0.294	0.202	0.386	0.047	<0.001
Jordan	1	0.774	0.639	0.908	0.069	N/A
South Africa	3	0.687	0.541	0.833	0.075	<0.001
Netherlands	2	0.555	-0.136	1.246	0.352	0.115
Mexico	2	0.116	0.028	0.322	0.045	0.010
China	44	0.282	0.204	0.360	0.040	<0.001
Iran	28	0.440	0.315	0.565	0.064	<0.001
UK	9	0.418	0.289	0.547	0.066	<0.001
Germany	6	0.499	0.291	0.707	0.106	<0.001
Indian	23	0.209	0.050	0.368	0.081	0.044
Indonesia	9	0.525	0.301	0.750	0.115	<0.001
Pakistan	16	0.236	0.164	0.308	0.037	<0.001
Ghana	3	0.284	0.071	0.497	0.109	0.009
Malaysia	27	0.342	0.188	0.496	0.079	<0.001
South Korea	4	0.340	0.275	0.406	0.033	<0.001
Taiwan	10	0.601	0.501	0.700	0.051	<0.001
Croatia	6	0.156	0.053	0.259	0.053	0.003
Brazil	3	0.978	0.478	1.478	0.255	<0.001
Bangladesh	5	0.330	0.086	0.574	0.124	0.008
Thailand	3	0.226	0.095	0.356	0.066	<0.001
Finland	7	0.156	0.011	0.300	0.074	0.034
Many Countries	15	0.322	0.234	0.410	0.045	<0.001
N/A	17	0.412	-0.072	0.896	0.247	0.096
Industry						
Automotive	30	0.357	0.188	0.526	0.086	<0.001
Manufacture	96	0.280	0.288	0.332	0.027	<0.001
Restaurant	9	0.452	0.356	0.548	0.049	<0.001
Consumer Goods	3	0.555	0.298	0.812	0.131	<0.001
Food	15	0.404	0.260	0.549	0.074	<0.001
Electronics	2	0.744	0.526	0.963	0.111	<0.001

Moderator	k	r	95% CI		SE	P- Value
Textile	9	0.312	0.171	0.452	0.072	<0.001
Shipping	2	0.664	0.413	0.916	0.128	<0.001
Retail	6	0.156	0.053	0.259	0.053	0.003
Maritime	15	0.409	0.163	0.656	0.126	0.001
Pharmaceutical	3	0.149	-0.059	0.357	0.106	0.160
Technology	2	0.497	0.354	0.640	0.073	<0.001
Bioenergy	1	0.491	0.268	0.714	0.114	NA
Many Industries	44	0.328	0.159	0.497	0.086	<0.001
N/A	34	0.378	0.237	0.520	0.072	<0.001
Company Size						
Large	248	0.315	0.275	0.356	0.021	<0.001
SME's	11	0.530	0.392	0.667	0.070	<0.001
Mixed	12	0.591	0.004	1.177	0.299	0.048
Notes: k = Number of Samples, r = corrected mean correlation, 95% CI = confidence interval, se = data diversity within a single sample.						

Source: Processed Data

In the context of developed countries, it shows a stronger correlation ($r = 0.350$) than in developing countries ($r = 0.312$). Firms, particularly those in developing countries, must recognize both internal and external dimensions of social responsibility in relation to achieving SSCM objectives. Moreover, findings indicate that organizations should enhance their IT infrastructure to attain optimal performance levels (Zhu et al., 2022). Furthermore, the strongest correlation was found in Brazil ($r = 0.978$), countries such as Indonesia ($r = 0.525$) and Malaysia ($r = 0.342$) also showed a strong and significant positive correlation.

The electronics industry ($r = 0.744$) and Shipping ($r = 0.664$) show the strongest correlations, signaling that SSCM is highly relevant in these sectors. Industries such as Consumer Goods ($r = 0.555$) and Restaurant ($r = 0.452$) also show strong correlations. In line with research (Li et al., 2016), managers are advised to prioritize their attention and resources on three key areas: first, adapting manufacturing processes to align with green product requirements; second, developing green information system capabilities to deliver environmental information on both products and processes; and third, enhancing green product design capabilities to create environmentally superior products.

MSMEs exhibit a stronger correlation ($r = 0.530$) compared to large enterprises ($r = 0.315$), with both relationships remaining significant. The implementation of green procurement positively stimulates collaboration between MSMEs and key stakeholders in their external environment (Mafini & Muposhi, 2017). Implementation of Six Sigma, JIT, lean Management, TQM, WMS, etc., all improve the quality of deliveries with shorter periods, thereby increasing cost reduction and maximizing the profitability of MSMEs (Joshi & Sharma, 2022).

Publication Bias

Evaluating the meta-analysis results for potential publication bias constitutes an essential step in the research process. This study employs the fail-safe N method, a technique recommended by Rosenthal, to identify and address issues related to publication bias.

Table 4. Fail Safe N

Hypothesis	Fail-Safe N	p-value
SSCM→ Financial Performance	98535	<0,001
SSCM→ Social Performance	20657	<0,001
SSCM→ Environmental Performance	99204	<0,001
SSCM→ Business performance	597449	<0,001

Source: Processed Data

The fail-safe N test result for the relationship between SSCM and financial performance is 98535, in accordance with what is stated (Retnawati et al., 2018), indicating that this study does not have publication bias because it exceeds the minimum value ($5k+10= 5(109)+10= 555$). The relationship between SSCM and social performance, with a Fail-safe N value of 20657 as stated (Retnawati et al., 2018), indicates no publication bias because it exceeds the minimum value ($5k+10 = 5(54)+10 = 280$). And the Fail Safe N test results for the relationship between SSCM and environmental performance resulted in 99204. In accordance with what is conveyed (Retnawati et al., 2018), this research is not affected by publication bias because the fail-safe N results exceed the minimum value ($5k+10 = 5(108)+10 = 550$). The identification results, as a whole, resulted in a fail-safe value of N 597449. This result is not identified as publication bias because it exceeds the minimum value ($5k+10= 5(271) = 1,365$).

CONCLUSION

The meta-analysis results indicate that the adoption of sustainable supply chain management (SSCM) is positively associated with firm performance across the three dimensions of the triple bottom line: financial, social, and environmental. The findings reveal that SSCM makes a significant contribution to enhancing financial, social, and environmental outcomes. Nonetheless, the relationship between SSCM and social performance is influenced by a stronger effect. The moderation variables also found that the evolution of SSCM consistently improved business performance, although the effect decreased slightly in new studies. Developing

countries show a stronger correlation than developed countries. The electronic and shipping industries show a strong correlation, indicating that SSCM implementation is relevant in these sectors. MSMEs also showed a stronger correlation than large companies.

This study has several limitations. First, some research data could not be included because they did not meet the criteria, hence, they could not be sampled. Second, the sample size of this study is still limited and can be explored further. Future research can explore further with a larger sample size and can further analyze the dimensions of social performance. As for published and unpublished research, it is possible to have different results with a deeper analysis of the relationship between SSCM and business performance.

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