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## **SUSTAINABLE SUPPLY CHAIN MANAGEMENT IN INTEGRATED ECONOMY: EXCHANGE BETWEEN ENVIRONMENT AND COST FUNCTION**

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### *ABSTRACT*

*The aim of this research is to investigate the effect of sustainable supply chain management on cost function and environmental function. The research population consists of all production managers, green space managers, logistic managers, operational managers, purchasing managers, sales managers and supply chain managers of Yazd manufacturing companies. The researcher used the Cochran sample size formula in a limited population for sampling and the 111 units were analyzed statistically. To analyze the hypothesis of the research, Structural Trademark Modeling Method and LISREL software were used. The results of the research indicate that four hypotheses have positive impact on environmental function: sustainable purchase, sustainable distribution, sustainable design and investment recovery, also the results show that sustainable purchase, sustainable distribution, sustainable design and investment recovery have negative impacts on the cost function.*

**Keywords:** Sustainable Purchase, Sustainable Distribution, Sustainable Design, Investment Recovery, Cost Function, Environmental Function, Manufacturing Companies in Yazd.

### **INTRODUCTION**

Over the past few decades, supply chain management (SCM) issue has been considered more and has reached a point where covers not only economic, but also environmental and social goals (Gimenez et al., 2012). This change is mainly due to the government environmental laws and public awareness towards the environment and their desire for products that are environmentally sustainable (Tan et al., 2014; Brandenburg et al., 2014). Sustainable Supply Chain Management (SSCM), that supports environmental sustainability and sustainable production, became an important debate in academic and industrial circles. Knowing this, companies began learning sustainable supply chain management (Su et al., 2015). Nowadays, with growing concern about environmental sustainability, companies should take the right direction against this issue, otherwise they risk the reputation and value of their stocks (Tseng et al., 2015).

The current agenda forces companies to look at the economy beyond the traditional view and embark on a three-pronged environmental, social, and economic approaches (Carter & Easton, 2011; Gimenez et al., 2012). From the perspective of developing economies, present manufacturing companies in developing countries give more attention to green approaches, because both government regulations have become harder and also people and competitors have become more aware of this issue (Goindan et al, 2014). From this perspective, manufacturers in

emerging markets have implemented a variety of sustainable supply chain management, such as green purchases and eco-friendly designs that reduce the impact of their work on the environment (Carter and Easton, 2011). It helps companies to succeed in the regional marketplace and compete in the global marketplace. However, due to lack of sufficient internal resources, many present companies in developing markets have problems in implementing sustainable supply chain management (Palraj et al., 2008).

In contrast, the companies have established a joint cooperation with their partners to provide their required green resources. Creating such cooperation can affect the performance of partners. New concerns have emerged about whether sustainable supply chain management helps improve financial performance and profitability (Rao and Holt, 2005; Zhou et al., 2013). Due to limited researches, the current knowledge about the impact of using sustainable supply chain management in emerging economies is limited (Jyarama and Eutator, 2015). Few studies have been done about the effects of sustainable supply chain management on economic and environmental function in emerging economies, and such studies have not succeeded in reaching a definite answer. That's why we need more and better researches on this issue.

## RESEARCH BACKGROUND

Hydarpour and Gharni (2015) conducted a study on the impact of environmental accounting on financial and operational indicators. As economic growth, the pressure on natural systems and resources of the planet intensifies. The unfortunate fact is that the economy continues to grow, but the environment that the economy depends on it does not grow. The aim of this study is to investigate the impact of environmental accounting on financial and operational indicators and determine the accounting place and statue. In this study to confirm or disapprove of hypothesis, t-student test has been used. To check the expected level with real level, the Friedman test has been used. The results indicate the effect of environmental accounting on financial and operating indicators of companies, including the amount of manufacturing companies' production, reduction of waste production, technical assistance outside the organization to manufacturing companies, the type of goods produced and the ratio of debt service to total debt of manufacturing companies.

Jalili and Sedaghat (2014) conducted a research on the relationship between environmental and financial functions on Tehran Stock Exchange. The present study has investigated the relationship between environmental and financial functions in the listed companies in the Tehran Stock Exchange during five years. The statistical society of this research was companies accepted in the Tehran Stock Exchange during the period of 2009- 2013, that at the time of the research, the number was equal to 300 companies operating in 34 industries, of which 100 companies were selected as samples. The research data was collected from the information available in the audit firm, financial statements and company notes were also collected. Data were analyzed using descriptive and inferential statistics using Pearson correlation coefficient regression analysis. The reliability of the research data confirmed with the Dickey Fuller method for calculating data.

Esfahbodi et al. (2016), conducted a research entitled Sustainable Supply Chain Management in growing economies: an exchange between cost function and environmental function. By field survey of 128 manufacturing companies, 72 companies in China and 56 in Iran, this study was conducted on the effects of implementing a sustainable supply chain management on the cost



and environmental function of these developing countries. Using multiple regression analyzes, the results show that there are many similarities between these two economies. The results showed that the use of sustainable supply chain management in both countries increased the environmental function but it does not necessarily improve the function. According to our findings, companies within growing markets should use sustainable supply chain management with a more open view to minimize the interaction between cost function and environment function. Marie Ados et al. (2016) conducted a study entitled “The Impact of company trends on sustainable supply chain management”. Based on shareholder theory, we test and introduce an interactive model that brings together the cornerstones of the company and the implementation of the sustainable supply chain, and the interactions between the various cornerstones of the company, based on their relationship with the sustained work. We tested our hypothesis with the help of a two-phase survey of 149 US service and production manager. Our findings have indicated that the environmental and cultural orientation of a company affects the sustainability of its purchasing and its sustainable supply activities, while local approach only makes use of sustainable purchasing activities in companies. The results also show that environmental and cultural effects of local approach will affect sustained purchasing activities and sustainable supply activities. While the community-based approach modifies the effect culture-based approach positively. In addition, our findings indicate that the form of company business affects the relationship between culture-based approach and sustainable purchasing activities and sustainable supply activities.

## THEORETICAL FRAMEWORK AND RESEARCH HYPOTHESES

Sustainable supply generally refers to an environmental purchasing approach which ensures that the purchased product is consistent with environmental standards. Sustainable supply emphasis on the replacement of materials from appropriate sources, as well as waste reduction (Min and Galle, 2001). This requires close collaboration with suppliers in order to produce a sustainable environmental product or service (Carter & Carter, 1998). Suppliers involvement is very vital in improving the environmental function of developing companies, because they are aware of the type of materials and can confirm that they are green (Su, et al., 2015). That's why big companies are looking for cooperation with their suppliers. Therefore, the following hypothesis is raised:

***H1: Sustainable supply has a positive and direct relationship with the environmental function.***

Due to the strict rules and demands of customers most of the major manufacturers have a steady supply policy with their local suppliers (Zhou et al., 2010; Feizipour and Mehrjardi, 2014). At many times, the company is looking for interagency cooperation with the suppliers who have the necessary materials for green production. This kind of collaboration enables the company to provide sustainable environmental products or services. Therefore, interdependence with the supplier is very important in the company cost structure. Therefore, the following hypothesis is suggested:

***H2: Sustainability has a positive and direct relationship with cost function.***

Designing a logistics network has a high importance in the structure of sustainable supply chain management (Lakshmimeera and Palanisamy, 2013). Most of the manufacturing companies have adopted new broadcasting methods that support environmental programs such as less movement, minimalistic empty paths, more direct routes, and better use of location (Zhou et al.,



2013). In addition, many companies use foreign environmentalists (Zhu and Sarkis, 2007). Therefore, the following suggestions are made:

***H3: Sustainable distribution has a positive and direct relationship with environmental function.***

The sustainable broadcasting addresses environmental issues related to sustainable displacement, storage, storage control, warehousing, packing, and set location decisions which should have the least impact on the environment and generate little carbon. Green packing, such as size, shape, and gender, are important because they affect the shape of the transfer (Soring & Muller, 2008). Companies can use better packing and rebuild storage because it reduces the materials usage, and saving costs, improves the use of storage and reduces the required activity for movement. Therefore, the following hypothesis is suggested:

***H4: Sustainable distribution has a positive and direct relationship with cost function.***

According to Zhou et al. (2007), sustainable design is the most important subset of sustainable production that can be measured. Several previous studies (Zhou et al., 2008; Greene et al., 2012) state that the use of sustainable design represents a sustainable production approach because it reflects green activities within the production process. With a similar approach, we show that the use of sustainable design, means the use of stable production. Sustainable design means designing a product or service taking into account the environment. Sustainable design tries to reduce the negative impact of products in their life cycle on the environment. Therefore, the following hypothesis is suggested:

***H5: Sustainable design has a positive and direct relationship with environmental function.***

In a growing economy, like Iran, world laws have made governments to be ensure that companies are also considered environment while designing (Zhou and Sarkis, 2007; Soltani et al., 2015). It is worth noting that many companies in Iran want to work with suppliers to be able to adapt the environmentally friendly design better. To access resources, expertise and green capabilities, companies interacting with partners (Jyarama and Oytator, 2015). Eco-friendly design can have cost-effective performance (Green et al., 2012). Therefore, the following hypothesis is presented:

***H6: Sustainable design has a positive and direct relationship with cost function.***

Reverse logistics is the opposite of supply, and is the process of collecting goods used for the possibility of recycling or reproduction (Lai et al., 2013). Zhou et al. (2008) argue that the value recovery process in reverse logistics is not only limited to the proper recycling of products, but sale of surplus products and assets will also help. Effective selling surplus can be achieved through investment recovery methods. In general, investment recovery includes retrieval of unused product value, or asset without return through proper reuse (Zhou et al., 2008). Therefore, two hypotheses are suggested below:

***H7: Investment recovery has a positive and direct relationship with environmental function.***

***H8: Investment recovery has a positive and direct relationship with cost function.***

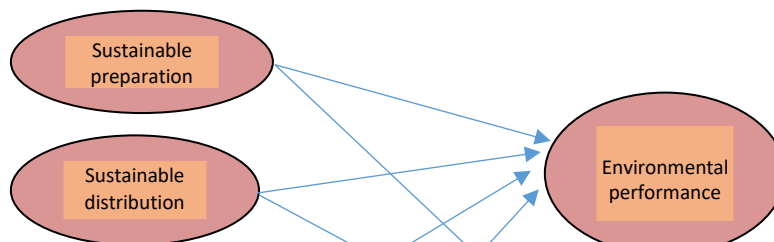


Figure 1. Conceptual Model (Esfahbodi et al., 2016)

## RESEARCH METHOD

In terms of purpose and collecting information, this study has scientific-descriptive nature. Among the correlation methods this study has conducted by covariance analysis and structural equations has been used. The statistical society of this study includes all senior managers, assistants, financial experts in Yazd's manufacturing companies, the volume of number of society is about 156.

The statistical sample consists of a limited number of individuals who describe the main characteristics of the society. In this research, the sample size was calculated by using the Cochran formula and the sample number was determined based on this relationship. the sample number calculation is based on the following formula. The Cochran sample size formula has been used with a limited population, to determine the statistical sample size. The sample size calculating formula is as follow:

$$n = \frac{NZ^2 \cdot p \cdot q}{(N - 1)e^2 + Z^2 \cdot p \cdot q}$$

in which: n = statistical sample size; N= statistical society size; Z= normal variable amount corresponding to the confidence level for the 95% confidence interval, which is 1.96.; p = probability of success (5.); q= p - 1 probability of failure (5.) and e= permissible error value that is equal to "5%".

$$n = \frac{N(Z)^2 \cdot .5 \cdot .5}{(N - 1)(.05)^2 + (Z)^2 \cdot .5 \cdot .5} = \frac{156 \cdot 0.9604}{155 \cdot 0.0025 + 0.9604} = \frac{149.8224}{1.3479} \cong 111$$

According to the value obtained from the Cochran formula, 111 questionnaires were distributed and the sample size was considered equal to 111. For determining the validity of this research, a questionnaire was used that other researchers had been used in their research before, however, with the advice of the supervisor and number of other experts, the validity of the questionnaire



was confirmed, So, it can be said that the research questionnaire has a good validity. On the other hand, factor loads are also calculated and this indicates the validity of the research tool.

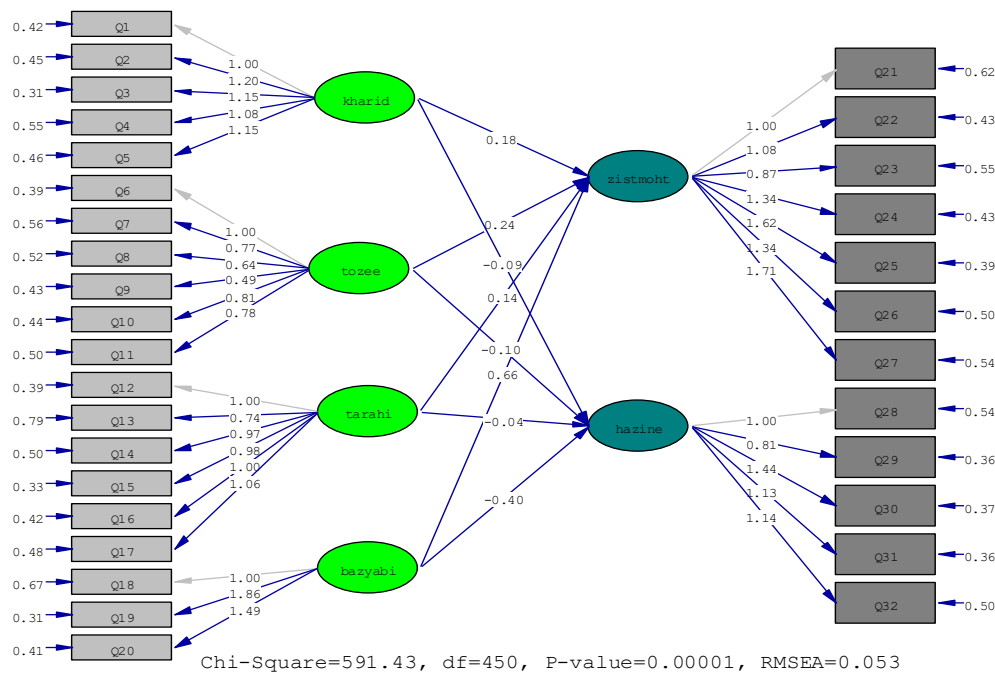
**Table 1. Cronbach's alpha coefficients for research variables**

Components	Number of questions	Cronbach's alpha coefficients
Sustainable purchase	1-5	0.772
Sustainable distribution	6-11	0.773
Sustainable Design	12-17	0.821
Investment Recovery	18-20	0.703
Environmental function	21-27	0.755
Cost function	28-32	0.758

According to the table, it is observed that the variables were assessed well by questionnaire, because the Cronbach's alpha value is greater than its minimum allowed value of 0.7. Therefore, the questionnaire validity and reliability is good, in addition, the reliability of the questionnaire was 0.841.

### FINDINGS

This research consists of two parts: descriptive and inferential statistics. In addition to extracting the frequency, percentage of responses and preparing frequency and percentage table, inferential statistics are also used to examine the research questions. Calculation has been made in the inferential statistics method for analyzing, interpreting and generalizing the results. SPSS software and Lisrel structural equations have also been used in this study. It should be noted that in all stages of the analysis, the 95% confidence level and 5% error is considered.



**Figure 2. Relationships between Macknoon variables according to path coefficient**

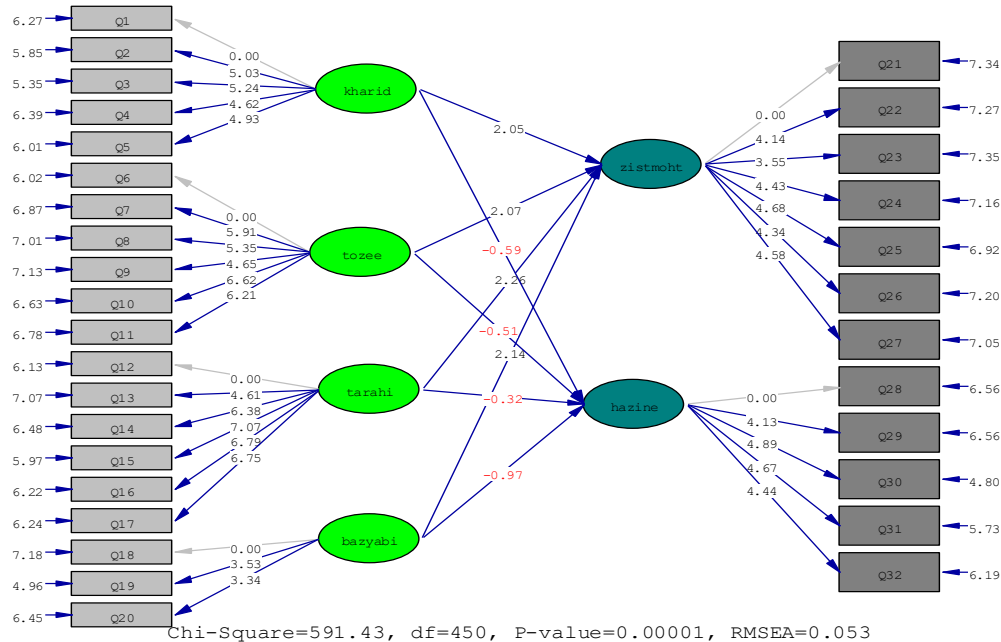


Figure 3. Relationships between the Macknoon variables according to t value

**First hypothesis testing: Sustainable purchases have impact on cost function.**

In this hypothesis, the effect of sustainable purchases has been studied on cost function, the value of T is equal to 0.59 and is in the unacceptable range of 1.96 and -1.96. Therefore, the effect of sustainable purchases on cost function was not significant. In other words, data does not support the impact of sustainable purchases on cost function.

**Second hypothesis testing: Sustainable purchase has an impact on environmental function.**

In this hypothesis, the effect of sustainable purchase has been investigated on environmental function, the value of the T is equal to 2.05 and is not within the unacceptable range of 1.96 and -1.96. Therefore, the effect of sustainable purchase on environmental function is significant and the amount of this effect with a 0.051 error is equal to 0.18, in other words, 18% of the environmental function changes are based on sustainable purchase and the positive coefficient indicates their direct relationship, therefore, by increasing environmental function sustainable purchase increases.

**Third hypothesis testing: sustainable distribution affects the cost function.**

In this hypothesis, the effect of sustainable distribution on cost function has been investigated, the value of the T is equal to -0.51 and is within the unacceptable range of 1.96 and -1.96. Therefore, the effect of sustainable distribution on cost function is not significant, and data does not support the impact of sustainable distribution on cost function.

**Fourth hypothesis testing: Sustainable distribution affects environmental function.**

In this hypothesis, the effect of sustainable distribution on environmental function has been investigated, the value of the T is equal to 2.07 and is not within the unacceptable range of 1.96 and -1.96. Therefore, the effect of sustainable distribution on environmental function is not significant, and the amount of this effect with a 0.051 error is equal to 0.24, in other words, 24% of the environmental function changes are justification based on sustainable distribution



and the positive coefficient indicates their direct relationship, therefore, by increasing sustainable distribution, environmental function increases.

***Fifth hypothesis testing: Sustainable design affects cost function.***

In this hypothesis, the effect of sustainable design has been investigated on cost function, the value of the T is equal to -0.32 and is within the unacceptable range of 1.96 and -1.96. Therefore, the effect of sustainable design on cost function is not significant, and data do not support the impact of sustainable design on cost function.

***Sixth hypothesis testing: Sustainable design affects environmental function.***

In this hypothesis, the effect sustainable design has been investigated on environmental function, the value of the T is equal to 2.26 and is not within the unacceptable range of 1.96 and -1.96. Therefore, the effect of sustainable design on environmental function is significant, and the amount of this effect with a 0.051 error is equal to 0.14, in other words, 14% of the environmental function changes are justification based on sustainable design and the positive coefficient indicates their direct relationship, therefore, by increasing sustainable design, environmental function increases.

***Seventh hypothesis testing: Investment recovery has an impact on cost function.***

In this hypothesis, the effect of investment recovery has been investigated on cost function, the value of the T is equal to -0.97 and is within the unacceptable range of 1.96 and -1.96. Therefore, the effect of investment recovery on cost function is not significant, and data do not support the impact of investment recovery on cost function.

***Eighth hypothesis testing: Investment recovery has an impact on environmental function.***

In this hypothesis, the effect of investment recovery has been investigated on environmental function, the value of the T is equal to 2.14 and is not within the unacceptable range of 1.96 and -1.96. Therefore, the effect of investment recovery on environmental function is significant, and the amount of this effect with a 0.051 error is equal to 0.66, in other words, 66% of the environmental function changes are justification based on investment recovery and the positive coefficient indicates their direct relationship, therefore, by increasing investment recovery, environmental function increases.

## CONCLUSION AND SUGGESTIONS

The findings of this study gives good answers to the research questions, the use of sustainable supply chain management in Yazd manufacturing companies improves the environmental function, but this is not true for the case of financial function. The results of this study provides interesting insights on sustainable supply chain management. The results showed that it is true that the use of sustainable supply chain management is essential for the environment sustainable supply chain management is essential for the environment, but the benefits are not achieved soon. Companies in developing countries like Yazd's manufacturing companies, should consider environmental issues with a greater focus on financial goals. This helps companies to adjust their presence in developing countries with environmental issues. In addition, this ensures win-win conditions for supplier partners and minimizes the exchange between environmental and cost functions. Our findings are consistent with most of the previous researches, otherwise, they are in line with recent researches. In this study we showed the impact of sustainable supply chain management on cost and environmental functions of Yazd manufacturing companies. In today's global market where there is strong competition, in order to achieve competitive advantage,



companies should shift their supply chain from a traditional form to a sustainable supply chain. The theoretical framework presented in this research will be useful and effective in understanding the effecting factors on financial and environmental functions of Yazd manufacturing companies.

According to the confirmation of the second hypothesis and accepting the positive impact of sustainable purchase on environmental function, the following suggestions are presented to the executives and managers of Yazd manufacturing companies:

- Labeling the product in terms of environmental issues
- Cooperation of Iran Khodro company with suppliers to achieve environmental goals
- Establishing environmental accounting for suppliers' internal management
- Having ISO 14000 certified of suppliers
- Providing the design specifications for suppliers, including informing them of the environmental requirements for the product.

According to confirmation of the fourth hypothesis, and accepting the positive impact of sustainable distribution on environmental function, the following suggestions are presented to the executives and managers of Yazd manufacturing companies:

- Collaboration with customers to consume less energy during product shipments
- Collaboration with customers for green packing
- The use of clean energy throughout the product.
- The use of clean energy during packaging.
- Updating shipping logistics and handling systems
- Monitoring the emissions of contaminants by carriers

According to confirmation of the sixth hypothesis, and accepting the positive impact of sustainable design on environmental function, the following suggestions are presented to the executives and managers of Yazd manufacturing companies:

- Product design with the ability to reduce consumables
- Product design with the ability to reduce power consumption
- Long-term usability, retrieval of materials, components, and accessories.
- Product design to prevent or reduce the use of hazardous materials.
- Collaborating with customers to Eco-friendly design
- Collaborating with customers for a clean product

According to confirmation of the eighth hypothesis, and accepting the positive impact of investment recovery on environmental function, the following suggestions are presented for the executives and managers of Yazd manufacturing companies:

- Selling additional tools and products

According to disapproval of the first, third, fifth and seventh hypotheses, and therefore disapproval of sustainable supply chain management use on the cost function of Yazd's manufacturing companies, it is suggested that:

- Companies executives become more and more familiar with the literature of sustainable supply chain management and its benefits by studying the its using effects in other countries.



- Adopting governmental policies and strategies to provide suppliers with environmentally friendly materials and purchase cost-effective materials by the supplier.

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