Do suppliers benefit from supply chain sustainability programs?
--- The case of Wal-Mart

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Short Abstract
Many studies have shown that sustainability initiatives within individual firms increase their financial performance; however, the impact on the firms' suppliers is not clear. We conduct an event study to investigate whether supply chain sustainability initiatives (SCSIs) of a buying firm are related to suppliers' performance. The analysis is based on the shareholder value effects (as measured by stock market reaction reflected by abnormal returns) on Wal-Mart's direct suppliers associated with Wal-Mart's announcements SCSIs. Wal-Mart is renowned for its ability to organize the supplier base and optimizing supply chain settings and it has implemented many SCSIs. We find a significant positive relationship between suppliers' performance and SCSIs enforced by the buying firm and this expands our understanding of sustainability benefits from firms to supply chain partners while providing support for collaboration on sustainability between supply chain actors.

Keywords: Supply chain sustainability, event study, suppliers and buyers, finance

Topic: Sustainability, supply chains, outsourcing and procurement

Methodology: Empirical work

Introduction
While sustainability within firms is linked to higher operational performance due to the improved firm reputation amongst 'ethical and responsible' consumers (Becchetti et al., 2012), better market access and an ability to charge premium prices (Scholtens and Dam, 2007), and thus increases share prices of the firms, we do not know if firms achieve higher performance from supply chain sustainability initiatives (SCSI). The SCSI is a sustainability commitment which requires awareness of the full product lifecycle, ranging from the conduct of upstream suppliers to the disposition of obsolete products (Fiksel, 2010). On one hand, supply chain sustainability seems increasingly necessary to manage risks within the supply chain, improve efficiency and market appeal (Shrivastava, 1995; Carter and Rogers, 2008). However, it is unclear if supply chain sustainability pays off for the participating firms as it is not stated who gets which benefits and who carries which costs within the supply chain. In this paper, we investigate the financial performance effects of supply chain sustainability initiatives

initiated by buying firms (downstream, the customers in the transaction; the 'customer firm') on their suppliers (upstream; the 'supplying firm') to identify if suppliers benefit from SCSIs.

Although the SCSIs by buying firms can result in pressure on suppliers to make substantial investments in sustainability within their firm, buying firms rarely make concrete promises how they will reward such increased sustainability by suppliers. Consequently, it is unclear if suppliers achieve higher financial performance by meeting the requirements that buying firms impose through the SCSIs. This confusion forms a theoretical gap: why and how do SCSIs by buying firms influence suppliers' performance? This research gap needs to be addressed to develop a fuller understanding of the SCSIs in supply chain dyads. The confusion leaves supply chain managers a dilemma. While suppliers' managers hesitate to implement the SCSIs as the benefits or costs are unknown, managers from buying firms find hard to convince their suppliers as the evidence of benefits is lacking. This paper analyzes both the theoretical gap and the practitioner dilemma to provide contribution to future theoretical development and business practice.

In this paper, we conduct an event study to investigate how supply chain sustainability initiatives by buying firms affect suppliers' financial performance. Event studies examine the behavior of firms' stock prices around corporate events (Kothari and Warner, 2007). Assuming rationality in the marketplace, the effects of an event will be immediately reflected in stock prices (MacKinlay, 1997). We expect that suppliers will benefit from supply chain sustainability initiatives proposed by buying firms and accordingly their stock price will rise when buying firms announce such initiatives. Additionally, we explore three factors which may impact the extent of the stock price reactions. First, we expect that supplier' firm size positively influences their stock price, because larger firms can enjoy economies of scale and scope. Second, we expect that suppliers' own self-enforced sustainability initiatives positively affect their stock price, because they are less likely to make additional investments in sustainability. Third, we expect that the resource dependence setting is of influence to the stock price reaction.

We distinguish the effects of the two central tenets of resource dependence theory (Pfeffer and Salancik, 1978): total dependence and power imbalance. As total dependence (i.e., the sum of resource dependence of buyer and supplier) is higher, stock prices react more positively, because higher total dependence promotes relationships between buying firms and suppliers that are more likely to be mutually beneficial (Gulati and Sytch, 2007). We predict that as power imbalance (i.e., the difference in resource dependence) is higher, stock prices react more negatively, because greater power imbalance stimulates more conflict and less interest in their relationship to perform the supply chain sustainability initiative (Casciaro and Piskorski, 2005).

To test our hypotheses, we study Wal-Mart and its main suppliers. The case of Wal-Mart is well suited to study the reaction of suppliers to supply chain sustainability initiatives for two reasons. First, Wal-Mart has increased its supplier sustainability efforts and has announced several supply chain sustainability initiatives over the last years. Abundant data are thus available which can be used for our study purpose. Second, the suppliers are known to be responsive to requests by Wal-Mart and the stock market is known to follow such developments. Therefore, we expect that stock price reactions of suppliers to supply chain sustainability announcements by Wal-Mart should be detected, if the effect exists. Our sample includes 69 main suppliers and 12 sustainability announcements of Wal-Mart.

In this paper we make two contributions. First, we expand the understanding of how sustainability affects firm performance. While most papers focus on the benefits of

sustainability initiatives within firms, this article investigates the impact of sustainability initiatives over a supply chain; that is, we focus on the impact of decisions made by one firm on their suppliers. Second, we try to identify factors which may influence the extent to which suppliers benefit from supply chain sustainability initiatives. We provide insights to which extent the effect of SCSI is generalizable for all firms and to which extent it differs for firms.

The paper is organized as follows. In the next section we review literature concerning study supply chain sustainability and its moderating factors and we present the hypotheses to be tested. In methodology section, we discuss the use of event study methodology and we present the cross-sectional regression approach to test the moderating factors. The following section is devoted to the test results. The paper closes with the concluding discussion.

Theoretical framework

Supply chain sustainability initiatives

Today, the financial community has recognized that sustainability contributes to individual firms' shareholder values through cash flow improvement, improved assets utilization, customer satisfaction, and brand recognition. Moreover, in search of strategic advantages, many firms are expanding the scope of their sustainability initiatives to encompass their full supply chains (Fiksel, 2010). Carter and Rogers define a supply chain sustainability initiative as the strategic, transparent integration and achievement of a focal company's social, environmental, and economic goals in the systemic coordination of supply chain business processes for improving the long-term economic performance of the focal company and its supply chain (Carter and Rogers, 2008). This definition suggests that SCSIs require awareness of the full product supply chain, ranging from the conduct of upstream suppliers to the disposition of obsolete products (Fiksel, 2010). Furthermore, it states that at the intersection of social, environmental and economic performance, there are activities that focal companies can engage in which positively affect that natural environment and society, and result in long-term economic benefits and competitive advantage for the firms and the supply chains. While it is clear that focal companies which initiate the SCSIs can benefit, there is little existing literature addressing if and how the supply chain partners, especially suppliers, profit from SCSIs.

To find the answer of this question, we study Wal-Mart and its suppliers. Wal-Mart has actively engaged in SCSIs for many years and regularly announces sustainability activities covering all three aspects (social, environmental, economic performance) in the SCSI. For instance, on 31st January 2008, Wal-Mart announced that it was implementing a packaging scorecard, indicating that Wal-Mart would score all suppliers' packaging in terms of environmental protection. On 2nd December 2008, Wal-Mart launched a Green Jobs Council, which was driving collaboration among a variety of suppliers that are focused on America's most valuable resource: the American worker. There are quick responses from the suppliers to the requests due to the market power of Wal-Mart. Hence, we believe that these SCSI announcements from Wal-Mart can substantially influence its supply chain.

Effects of SCSI on supplier stock prices

To investigate whether SCSIs of buying firms benefits suppliers, we study the effect of SCSIs on suppliers' stock prices through event studies, as the easiest indicator of changes in performance to measure is stock market reaction (Brown and Warner, 1985). The efficient market hypothesis asserts that stock prices will respond rapidly to the

information contained in public announcements, and that the market's response will include the capitalization of future costs and benefits associated with this event. Event studies were introduced to accounting and financial economists in two landmark papers by Ball and Brown (1968) and Fama et al. (1970). Since then, the method has been adopted by researchers outside of the accounting and finance disciplines (Corrado, 2011). In supply chain literature, researchers have demonstrated a link between events associated with supply chains and stock market performance. Hendricks and Singhal (2005) use stock market reaction to study the effect of supply chain glitches; Papadakis (2006) investigates financial performance following supply chain disruptions; Mitra and Singhal (2008) investigate how involvement in supply chain integration through industry exchanges are perceived by investors; and the market perception of the impact of the appointment of new supply chain and operations management executives was investigated by Hendricks, Hora, and Singhal (forthcoming). Together, these studies indicate the efficacy and power of event studies as applied to the operations and supply chain discipline and this gives us confidence that the method is also appropriate to investigate the impact of SCSIs on the market's perception of the value of Wal-Mart's suppliers.

Literature points out that there are costs and benefits for suppliers when it comes to the SCSIs. The primary cost is the implementation cost. To meet the SCSI practices of buying firms, suppliers have to make considerable cultural and capital investments which include designing sustainable products, transforming production lines, improving working conditions, changing the input resources, and recycling products. These can be significant investments which may be time-consuming to implement. Moreover, collaborative efforts in SCSIs may represent transaction-specific investments in buying firms by suppliers and thus may lead to higher transaction costs, or even sunk costs to suppliers (Gimenez and Sierra, 2013). However, there are many benefits to suppliers in SCSI. First, suppliers' strategic and cultural investments can create new sustainable technology and knowledge transfers which can lead to a difficult-to-replicate competitive advantage for suppliers themselves (Carter and Dresner, 2001). Second, coordinating sustainability compliance improves the suppliers' relationship with buying firms. The SCSIs create greater collaboration, sharing of monitoring information and reinforcement of remediation expectations between suppliers and buying firms (Carter and Roger, 2008). Third, suppliers are able to manage risks. The SCSI enables suppliers to prevent image and reputation damage resulting from product, environmental waste, and worker and public safety (Shrivastava, 1995). Finally, buying firms should be willing to pay more for sustainable products and at a certain point they may only want to buy sustainable products, so the premium prices are able to set by these suppliers to obtain the higher profits (Siegel and Vitaliano, 2007).

Overall, because there are significant benefits associated with SCSI, we expect that costs of SCSI on suppliers are outweighed by the benefits. The SCSI has a positive effect on suppliers' performance, which will be reflected in the suppliers' stock prices. This leads to the first hypothesis:

H1. The announcements of Wal-Mart supply chain sustainability are positively related to the stock market reaction of suppliers.

Differences in stock price reactions

We expect the stock price reactions of suppliers to announcements of SCSI to differ based on following factors: firm size, resource dependence setting, and self-enforced sustainability. Next, we describe these factors and their expected influence.

Firm size

Firm size is traditionally assumed to be among the key determining factors of corporate competitiveness and ability as evidenced by a wealth of literature on the subject (Führer and Michel, 2004). Prior research on Corporate Sustainability Reporting (CSR) or environmental management has found firm size significant (Gallo and Christensen, 2011). For several reasons, we expect that the larger the supplier is, the more positive the stock price reaction of the supplier to an SCSI announcement is. First, larger firms presumably have more slack resources in the form of human and financial capital which are required in the SCSI (Gallo and Christensen, 2011). With sufficient funds and manpower to respond to stakeholders and to react to the sustainability-related pressures, larger suppliers can devote time and attention to sustainability-related details and to researching and implementing contemporary practices. Such firms also leverage experience and advance their maturity in sustainability practices (Reefke et al., 2010). Second, larger suppliers have cost advantages. Large firms generally produce large volumes (i.e., economies of scale) of many products (i.e., economies of scope). Moreover, large firms are able to produce more outputs with equal inputs (i.e., technical efficiency) and higher profits (i.e., price efficiency) (Lau and Yotopoulos, 1971). Hence, they are able to absorb the increasing operation costs in short-run caused by SCSIs. In addition, larger firms have been in business longer and thereby have huge capacity and capability for knowledge acquisition (Nooteboom, 1993). In the financial market, these points may convince investors that larger firms have more advantages than smaller firms. Therefore, our second hypothesis is:

H2. Stock prices of suppliers will react less positively to SCSI announcements when the firm size of suppliers is smaller.

Resources dependence: Power imbalance and total dependence

The resource dependence of a firm on another firm reflects how beneficial it is for the firm to secure resources from another firm (Pfeffer and Salancik, 1978). There are two distinct theoretical dimensions of resource dependence: power imbalance, or the dependence differential between two organizations; and, total dependence, or the sum of their dependencies (Casciaro and Piskorski, 2005). We expect that the greater the total dependence between the supplier and the buying firm is, the more positive stock price reaction of the supplier to an SCSI announcement is. The higher the power imbalance between the supplier and the buying firm is, the less positive stock price reaction of the supplier to an SCSI announcement is. Total dependence indicates the total value created in the relationship of two firms. As total dependence rises and more value is to be divided, both firms have a higher incentive to cooperate, because the benefits of coordination are more likely to weigh against the costs of coordination (Paulraj and Chen, 2007). When SCSIs are initiated by the buying firm under higher total dependence, people can expect that it is mutual beneficial behavior for the supplier and the buying firm, improving the supplier performance. Power imbalance indicates the difference in dependences in the relationship of two firms. The effect of power imbalance seems opposite to that of total dependence. A large power imbalance indicates that one firm is much less dependent on the other firm than vice versa and interests in the relationship diverge if power imbalance grows. As the power imbalance in favor of the buying firm increases, the supplier faces undesirable exchange conditions and higher levels of uncertainty (Casciaro and Piskorski, 2005). Hence, under higher power imbalance in favor of the buying firm, investors will assume that SCSIs are less beneficial to the supplier as they will lower the supplier's performance. In the financial market, investors may have insight into suppliers' settings in resource dependence and

thus reactions to the SCSI announcements reflected in suppliers' stock prices can differ. Therefore, we formulate the hypotheses:

H3. Stock prices of suppliers will react more positively to SCSI announcements when the total dependence is larger.

H4. Stock prices of suppliers will react less positively to SCSI announcements when the power imbalance is larger.

Self-enforced sustainability

Self-enforced sustainability indicates that the supplier has implemented their own sustainability practices prior to the SCSI announcements. Many studies have found the positive relation between corporate sustainability and firm performance (Ngwakwe, 2009). We expect that the more self-enforced sustainability the supplier has, the more positive stock price reaction of the supplier to an SCSI announcement is. There are two reasons. First, these suppliers face lower implementation costs of SCSI. Many suppliers hesitate to perform the SCSIs because of costs which are including training employees, changes in production, and buying new facilities. Suppliers which have been sustainable face lower levels of these costs. Second, the suppliers with self-enforced sustainability have less risk of losing the business of buying firms which value sustainability. Compared to the suppliers who are not yet engaged in sustainability, sustainable suppliers have the necessary technical and organizational experience and knowledge, and are able to fulfil the sustainability requirements of buying firms. Consequently, such sustainable suppliers are favored by buying firms. In the stock market, investors will view these suppliers more positively than those which have not exhibited sustainability. This leads to the hypothesis:

H5. Stock prices of suppliers will react more positively to SCSI announcements when the self-enforced sustainability is higher.

Methodology

Sample

In this paper, we use Wal-Mart and its main suppliers to answer the research question. The case of Wal-Mart is well suited for two reasons. First, supply chain management is the primary competitive advantage of Wal-Mart. Their supply chain system is generally regarded as efficient and they have an approach to supply chain management that has long emphasized visibility through the sharing of information with their suppliers (Heying and Sanzero, 2009). Second, Wal-Mart has abundant experience with SCSIs. Early in 1989, Wal-Mart requested recyclable or biodegradable packaging from suppliers and earned goodwill among environmentalists as the first major retailer to discuss environmentalism and make environmentally biased changes (Heying and Sanzero, 2009). Wal-Mart has established 14 Sustainability Value Networks to "green" its supply chain. Nowadays, sustainability is built into its business and is aligned with its model, mission, and culture (Heying and Sanzero, 2009).

The efficient sustainable supply chain management of Wal-Mart contributes to the observation of financial performance changes on suppliers to the SCSI announcements in the media.

To identify sustainability announcements of Wal-Mart, we searched their corporate website's Press Room using the string "topic: sustainability" from January 2008 to September 2011, as the data on these years are available and this period gives us sufficient number of announcements and includes most important SCSI announcements

in recent years. We found a total of 89 announcements concerning the sustainability made by Wal-Mart. To distinguish the announcements that impacted the supply chain (rather than relating to other parts of the business), we evaluated each announcement and rated each from 1 to 5, where 5 indicates that the researcher believes the announcement will have a high impact on the suppliers and shows the most concrete of plans presented by Wal-Mart. We accepted announcements whose scores are 4 and 5. We had 13 announcements as our data. As two separate 5-score announcements were made on July 16th 2009, stock market reactions to these SCSI were concomitant; thus, 12 separate events were identified.

To observe the impact of announcements on stock prices, we identify suppliers significantly dependent on Wal-Mart by identifying those whose annual revenues to Wal-Mart were higher than 10%; the effect of the SCSI would be most apparent on such firms' stock prices. To find such suppliers, we searched companies' 10-k forms from the database of US Stock Exchange and Security Commission by using string "search for text: Wal-Mart" and year from January 1st 2009 to November 1st 2011. We identified 92 firms that qualified as having greater than 10% annual sales to Wal-Mart. To derive the stock prices of these firms, we used Datastream. However, there were 23 firms found either dead or unavailable in Datastream. Only 69 firms' full daily stock price data were downloaded. Furthermore, we collected NASDAQ stock composite data from Datastream to reflect the market portfolio prices.

In sum, our study thus investigates how the 12 announcements by Wal-Mart mentioned above impacted the stock price of these 69 suppliers.

Event study

Through the event study, we investigated how the stock price of the 69 suppliers reacted to the 12 SCSIs by Wal-Mart. We studied changes in stock prices for the event window 10 days before and 10 days after the SCSI announcements. For this event window, we captured the stock price changes on the announcement days and watched for changes happening before and after while not neglecting effects caused by information leakage and by information delay. We refer to the announcement day as day 0 or t_0, and the 10 days before and 10 day after the announcement day are t_{-10} and t_{10}, respectively. First, we explain how we calculated the stock price reaction to the event that cannot be explained from normal stock price fluctuations (i.e., the Abnormal Return (AR) at t=0). Thereafter, we explain how we tested if this AR is significant. Finally, we demonstrate how we calculated the cumulative abnormal return (CAR) which combines the ARs from several days around the event date, and its significance. The combined results of AR and CAR verify hypothesis 1.

Size of abnormal returns

The research requires calculation of abnormal returns in general terms and in two specific models: mean model and market model.

Abnormal return is the actual ex post return of the security minus the normal return of the firm, where the normal return is defined as the expected return without conditioning on the event taking place. AR calculations used equation (1):

$$AR_{it} = R_{it} - E(R_{it}|X_t) \quad (1)$$

Where AR_{it} , R_{it} , $E(R_{it}|X_t)$ are the abnormal, actual, and expected returns respectively for firm i during period t. The special term in this formula is X_t. It is the benchmark of the stock returns that provides the basis for the normal returns. In the different specific models, it presents differently.

To calculate the accurate normal returns, an estimation period must be defined. We use day -100 to day -20. This estimation period is large enough to confirm that the standard normal return can be achieved, and it has 20 days away from the announcement days to prevent any abnormal returns biasing the normal returns.

While many specific models have been developed to calculate the abnormal returns, we opted to apply the two most common models: the mean model and market model.

The formula for mean model is equation (2):

$$AR_{it} = R_{it} - \overline{R_t} \tag{2}$$

Where $\overline{R_t}$ is the average normal return over the estimation period.

The final term in this model causes it to differ from the general model. The mean model mainly tries to find abnormal return by using actual returns minus the average returns over the estimation period; this is reflected by the change from X_t to reflect the mean values of normal returns as a benchmark.

For the market models, two formulas must be applied.

The market model posits a linear relationship between the return on a stock and return on the market portfolio over a given estimation period (Mitra and Singhal, 2008). In this model, different from the mean model, the benchmark is the market portfolio. To have the benchmark, we use equation (3):

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \tag{3}$$

Where R_{it} is the return of stock, R_{mt} is the market portfolio on day t and $\alpha_i, \beta_i, \varepsilon_{it}$ are intercept, slope and error term for each firm. By running the ordinary least-squares (OLS) regression, we are able to have the $\widehat{\alpha_i}, \widehat{\beta_i}$ for each firm respectively. Using the final market model formula below, the abnormal returns can be calculated.

Market model is equation (4):

$$AR_{it} = R_{it} - \widehat{\alpha_i} - \widehat{\beta_i} R_{mt} \tag{4}$$

The last two terms indicate the market portfolio as benchmark; by using the actual returns minus the benchmark, abnormal returns can be found.

Significance of abnormal returns

To test our hypothesis 1, we delineate two ways of significance test in this section.

Under the null hypothesis that announcements have no impact on market values, we use simple Z- test formula to find the significance of the abnormal returns for the mean model, as the equation (5).

$$Z\ value = \frac{\overline{AR_t}}{\sqrt{\sigma^2}} \tag{5}$$

Where $\overline{AR_t}$ is average abnormal return per day and σ^2 is the variance of abnormal return and calculated as in equation (6) and (7):

$$\overline{AR_t} = \frac{1}{N}\sum_{i=1}^{N} AR_{it} \tag{6}$$

$$\sigma^2 = \frac{1}{N^2}\sum_{i=1}^{N} \sigma_i^2 \tag{7}$$

However, a disadvantage of the formula is that bias can occur if variances of individual daily abnormal returns are different from one another as it uses average daily abnormal returns. In the market model, owing to calculation procedures, this bias could be substantial. To avoid this bias, we use an alternative test statistic in the market model where we aggregated standardized abnormal return which means each observation is weighted in inverse proportion of the standard deviation of the estimated abnormal return (Khotari and Warner, 2007).1

Standardized abnormal returns are defined as equation (8):

$$AR'_{it} = AR_{it}/S(AR_i) \quad (8)$$

Where $S(AR_i)$ is the standard deviation of the abnormal return and calculated in equation (9):

$$S(AR_i) = \sqrt{\sigma_i^2} \quad (9)$$

And significance can be tested using equation (10):

$$z\ value = \frac{\overline{AR'_{it}}}{1/N} \quad (10)$$

The main difference of standardized abnormal returns from the previous one is that every individual abnormal return is divided by its own standard deviation (or "standardized") before calculating the average daily abnormal returns. Hence, the accuracy is improved.

Size of cumulative abnormal returns

Measuring and testing CAR indicates the sum of daily abnormal returns over the period under observation. CAR can be used to prevent the bias caused by information leakage or delay before or after the announcements, if abnormal returns on days other than on day 0 are detected.

The equation (11) for the CAR:

$$CAR(t_x, t_y) = \sum_{t=t_x}^{t_y} AR_t \quad (11)$$

Significance of cumulative abnormal returns

To test the null hypothesis that the mean CAR is equal to zero, we define the variance of CAR as equation (12):

$$\text{var}\ (CAR(t_1,t_2)) = \frac{1}{N^2} \sum_{i=1}^{N} \sigma_i^2\ (t_1, t_2 \quad (12)$$

Where, $\sigma_i^2(t_1, t_2)$ indicates the variance of abnormal returns for individual firms over period t_1 and t_2.

[1] We also use the first approach to test the significance of AR in the market model, but the results are less significant than standardized abnormal returns, and more different from the mean model. It is presented in the appendix.

To test the hypothesis 1 in CARs, we set first the value of a two-tail 5% confidence interval of Z test as 1.65 and -1.65. According to the transformation of Z test formula below, we can have the series values of upper and lower boundaries of 5% confidence interval by using equation (13) and (14).

$$\text{upper boundary} = 1.65 * \sqrt{\text{var}(\text{CAR})} \quad (13)$$

$$\text{lower boundary} = -1.65 * \sqrt{\text{var}(\text{CAR})} \quad (14)$$

Combining the three curves-CARs, upper boundaries and lower boundaries in line graphs, the trend of CAR can be detected. Any point on CAR curve moves beyond the upper or lower boundaries can be identified as significant value. Three CAR windows (-3, 1) (-1, 1) (-1, 3) are defined. As there is no information indicating whether announcements are leaked or sunk before or after the publishing dates and whether markets absorb the announcements quickly or slowly, these three windows cover stock market effects before, in, and after the announcements to ensure the research does not miss any impact from an announcement.

Cross-section regression

Factor measurement – firm size
Prior work on CSR and environmental management has found total asset, Fortune 500 ranking, and revenue to be significant indicators for firm size (Gallo & Christensen, 2011). Because of these empirical precedents, we chose revenue or net sales to represent firm size in this research.

Factor measurement – self-enforced sustainability
There are many indices scoring or remarking the sustainability performance of companies, but few of them are available. We used the KDL Global Socrates index to collect our sustainability data. This index covers companies' sustainability reports in terms of environment, social and employees. We used overall sustainability scores of firms to capture self-enforced sustainability. Nevertheless, 52 out of our 69 firms' data were available and so in the test of hypothesis 5 we used these 52 firms' data.

Factor measurement – total dependence and power imbalance
Power imbalance is dependence differential between two organizations, and total dependence is the sum of their dependencies (Casciaro and Piskorski, 2005). Thereof, we define their formulas as:

Power imbalance can be calculated as in equation (15):

$$P_i = D_i - D_{wi} \quad (15)$$

Total dependence can be calculated as in equation 16:

$$T_i = D_i + D_{wi} \quad (16)$$

Where:

$$D_{wi} = PS_{wj} * \frac{S_i}{TS_J} \quad (17)$$

Where P_i is the power imbalance value for supplier i. T_i is the total dependence value for supplier i. D_i is the dependence of supplier i on Wal-Mart, and D_{wi} is dependence of Wal-Mart on supplier i. PS_{wj} is the percentage of shares of industry j in Wal-Mart, S_i is the net sales for supplier i and TS_J is the total sales of industry j. The second term in the last equation presents the market share of supplier i in its own industry.

US total sales data in each industry was established using the database "EU KLEMS Growth and Productivity Accounts". Owing to the availability, there was little data after 2007. We do not believe that this biases results as the changes in the data each year were small and thus we expect the same results from data before 2007 to hold true for the following years. While this is before the Global Financial Crisis (GFC), which saw falling sales in many industries, the overall sales did not decrease significantly during the GFC. The EU KLEMS accounts document rates of change in US total output during 2008, 2009, and 2010 as 2.87%, -7.5%, and 5.06%, respectively.

Regression models

To test the hypothesis 2, 3, 4, and 5 we develop the following models.

Model 1: $AR_{0mean} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3$

Model 2: $AR_{0market} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3$

Where $AR_{0mean}, AR_{0market}$ are dependent variables showing abnormal returns at day 0 in mean and market models, respectively. x_1 is the firm size. x_2 is the total dependence. x_3 is power imbalance. In both model 1 and 2, we use 828 entries (12 events and 69 firms per event).

Due to limitations imposed by data unavailability, the independent variable "self-enforced sustainability" can only be tested on 624 entries (12 events, 52 firms per event). Therefore, we create models 3 and 4, where x_4 is the self-enforced sustainability:

Model 3: $AR_{0mean} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4$

Model 4: $AR_{0market} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4$

These four models test how the benefits of SCSIs vary among the suppliers in terms of abnormal returns on day 0. Moreover, after testing the hypothesis 1, we suspect that markets absorb the information from announcements of Wal-Mart SCSIs slowly and after the announcement dates. Specifically, stock market reaction of suppliers to the SCSIs exists both on day 0 and 1, as we detect significant abnormal returns on both days. Hence, to prevent bias, we use CAR (0, 1) as the dependent variable to retest our hypotheses 2 to 5. In Model 5 to 8, the only dependent variable is changed to CAR (0, 1), and independent variables are the same as in models 1 to 4:

Model 5: $CAR(0,1)_{mean} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3$

Model 6: $CAR(0,1)_{market} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3$

Model 7: $CAR(0,1)_{mean} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4$

Model 8: $CAR(0,1)_{market} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4$

Results

Abnormal returns and CARs

In hypothesis 1 we expect that the announcements of Wal-Mart supply chain sustainability are positively related to the stock market reaction of suppliers. To test this

hypothesis, using our sample of 828 firms, we calculated the abnormal returns by the mean model and the market model from the 10 days (day -10) before the announcement day (day 0) to the 10 days (day 10) after the announcement day (Table 1).

The results show that abnormal returns on day 0 in both models are positive and significant. In the mean model, the mean abnormal return on day 0 is 0.54 % and is significant at the 1% level based on a two-tailed test (P-value is 0.0022). In the market model, the mean abnormal return on day 0 is 6.7% and is significant at the 10% level based on a two-tailed-test (P-value is 0.0562). The stock market reaction on the day before the announcement (day -1) and after the announcement (day1) are not statistically significant on reported measures, except on day 1 in the market model. Overall results in table 1 indicate marginally significant positive stock market reactions of the suppliers to announcements of SCSIs by Wal-Mart.

Table 1 – Mean and Market abnormal returns

DAY	AR MEAN	Z VALUE	Standardized AR MARKET	Z VALUE
-10	-0.00939	-6.34303	-0.10328	-2.97176
-9	-0.00377	-2.54689	-0.0618	-1.77823
-8	-0.00523	-3.53718	-0.20379	-5.8641
-7	0.00283	1.91481	0.002445	0.07036
-6	0.00695	4.69682	-0.00817	-0.23517
-5	-0.00086	-0.58601	0.002464	0.07089
-4	-0.0036	-2.46932	-0.06417	-1.8466
-3	-0.00273	-1.84934	-0.07039	-2.0256
-2	0.01037	7.00574	0.150677	4.33572
-1	-0.00104	-0.70714	0.005217	0.15011
0	0.00540	3.64946	0.06666	1.91813
1	-0.00095	-0.6466	0.062835	1.80808
2	-0.00217	-1.46757	-0.06557	-1.88672
3	0.00501	3.38796	-0.0894	-2.57243
4	0.00569	3.84931	0.134659	3.87481
5	0.00119	0.80768	-0.04794	-1.37952
6	0.00644	4.35511	-0.01086	-0.31254
7	0.00297	2.00684	0.063025	1.81353
8	0.00053	0.36392	-0.05969	-1.71759
9	-0.00134	-0.91007	-0.03273	-0.94185
10	0.00722	4.87893	0.02319	0.66729

We find that results between the mean model and market models sometimes differ significantly. The finance literature states that the results should normally be similar. We thought the differences might be originated by the market portfolio in market model, and we changed the market data from the NASDAQ composite to the S&P 500 composite, but the results do not alter much. However, we find the results of both models are similar, as shown in Figure 1; this indicates that although individual results may be different, both models provide evidence of significant and positive stock reactions of suppliers to the announcements of SCSIs by Wal-Mart. However, there are multiple other days during the window where abnormal returns are observed (Figure 1). While this presents a non-normal distribution of abnormal returns, this does not

invalidate the results as Brown and Warner (1985), Dyckman et al. (1984), and Strong (1992) provide evidence that non-normality of daily abnormal returns has little effect on event study tests. Furthermore, there is an absence of significant abnormal returns one day before and after our Day 0 (Figure 1). Therefore, we are confident that the findings of this study are not affected or biased by this non-normal distribution of abnormal returns.

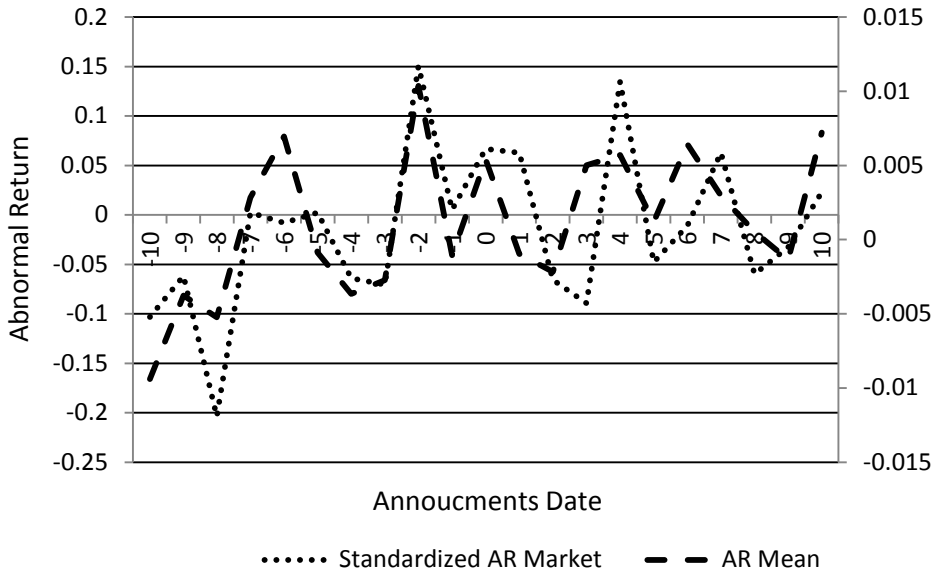

Figure 1 – Results Comparison between Two Models

To not neglect any effect caused by information delay or leakage and avoid any bias in following calculations, we conduct the CAR in three event windows: (-1, 1) (-1, 3) (-3, 1) as shown in Figures 2-5. As stated that any curve beyond the upper or lower boundaries of 5% confidence interval proves a significantly positive or negative relationship between CARs and announcements.

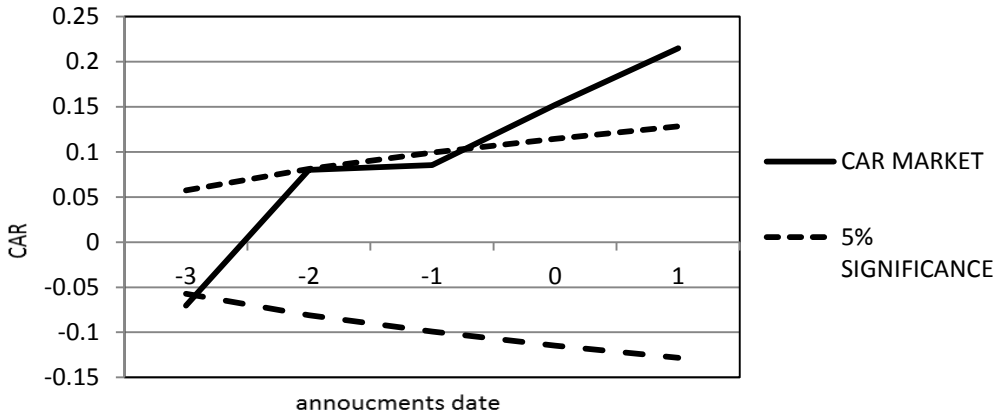

Figure 2 – Cumulative Abnormal Returns (CAR) (-3, 1) in the Market Model

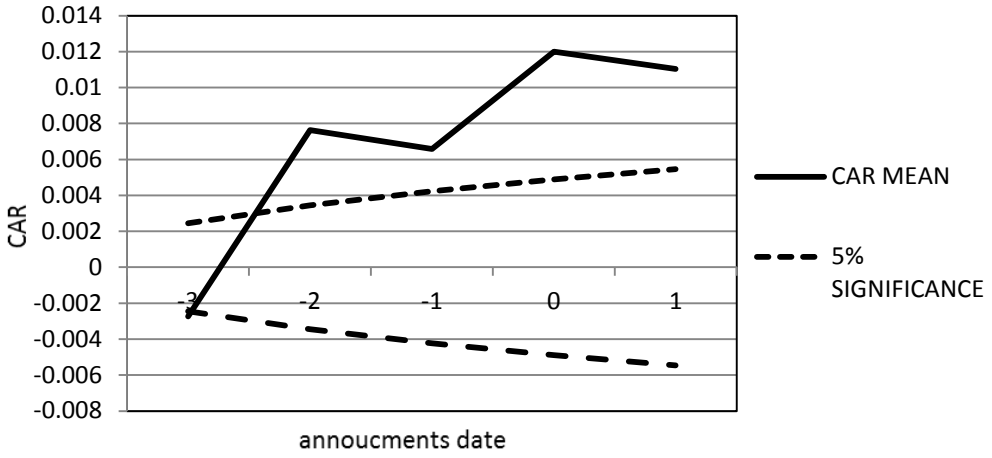

Figure 3 – Cumulative Abnormal Returns (CAR) (-3, 1) in the Mean Model

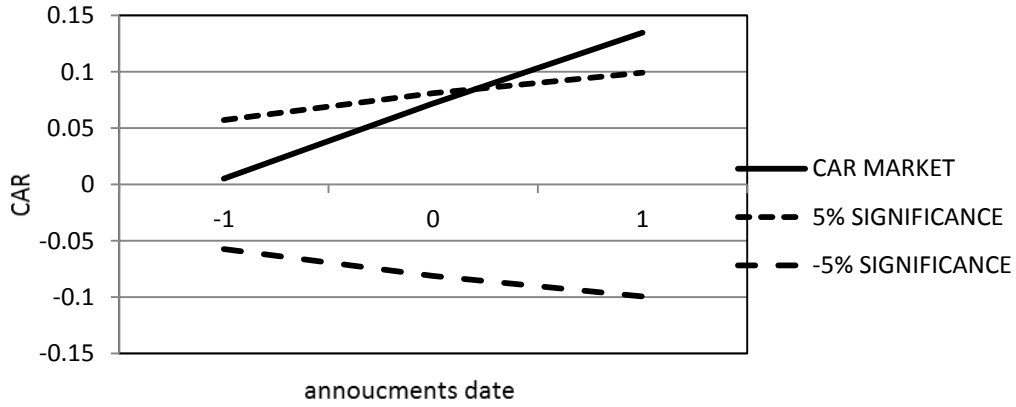

Figure 4 – Cumulative Abnormal Returns (CAR) (-1, 1) in the Market Model

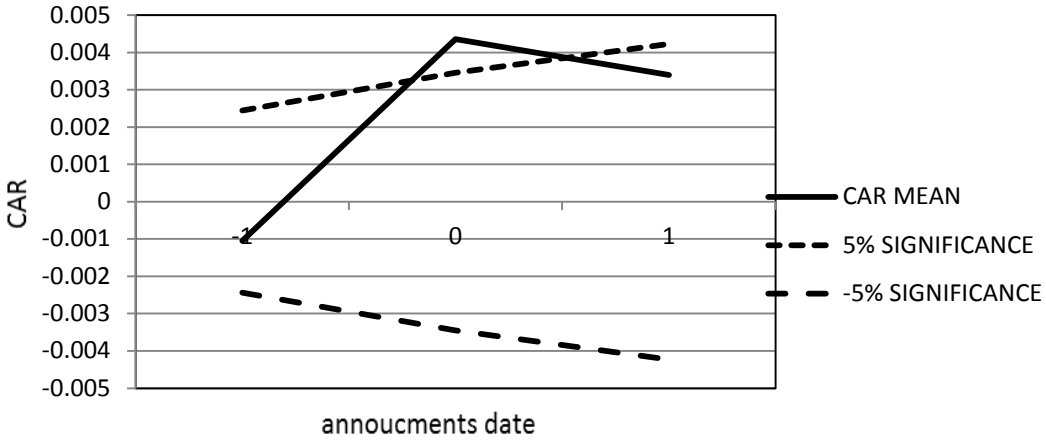

Figure 5 – Cumulative Abnormal Returns (CAR) (-1, 1) in the Mean Model

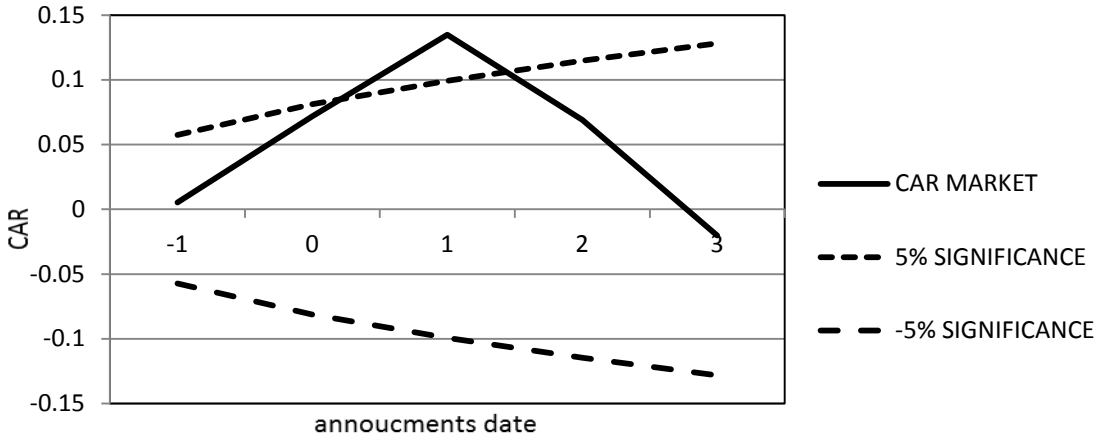

Figure 6 – Cumulative Abnormal Returns (CAR) (-1, 3) in the Market Model

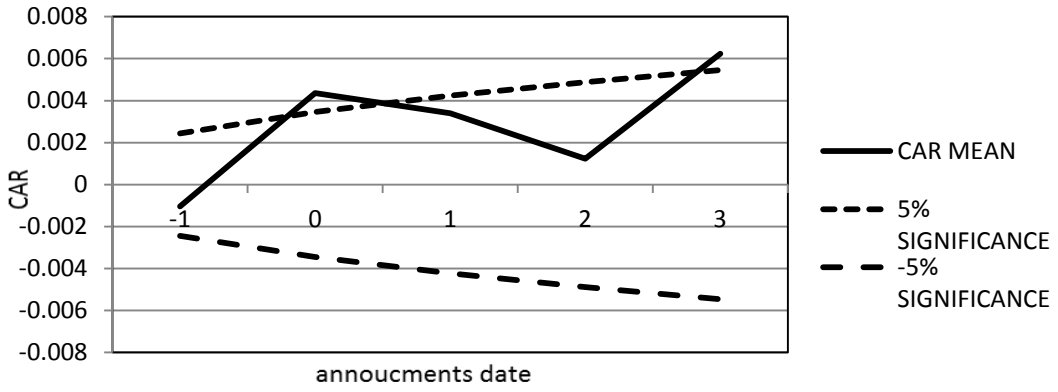

Figure 7 – Cumulative Abnormal Returns (CAR) (-1, 3) in the Mean Model

The results show that the CARs are positively significant on day 0, which supports our results in the abnormal returns. Moreover, we find positive and significant CARs on day 1 in the market model. This result suggests that there is an information delay in the market and therefore stock reaction to the information exists after the announcements. In addition, we cannot find any significant result before day 0, except in the mean model with event window (-3, 1) (Figure 3). However, because Figure 3 presents significant and positive effect two days before the announcement, we believe this exception is made by any other important announcement than supply chain sustainability. Overall, this suggests that there is no leakage of information prior to the announcement day, but information is absorbed in the market after the announcement. To prevent errors, we use both abnormal returns on day 0 and CAR (0, 1) to calculate our cross-sectional models.

In sum, our results using AR and CAR confirm that there is a positive and significant stock prices reaction on suppliers when the announcement of the SCSI is made by Wal-Mart. Therefore, our hypothesis 1 is supported.

Cross-sectional regression

Hypothesis 2-5 state that different factors might influence the size of the abnormal return to an SCSI announcement (H2: Firm size, H3: Total dependence, H4: Power imbalance, H5: Self-imposed sustainability). To test these hypotheses, we conducted cross-sectional regression analysis.

Table 2 reports the cross-sectional regression results based on 828 observations (for H2-4) and 624 observations (for H5). Results are reported for when the dependent variable is the AR on day 0 from the mean model (model 1 and 3) and from the market model (model 2 and 4). Results for models 3 and 4 include the Self-enforced sustainability variable.

Table 2 – Cross-sectional Regression Analysis for Models 1-4 (t-Values are in parentheses)

Variable	**Proxy for**	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Dependent		AR (MEAN)	AR (MARKET)	AR (MEAN)	AR (MARKET)
Intercept (β_0)	Mean Return	.006 (1.509)	.003 (.732)	.015 (1.400)	.008 (.819)
Net Sales (β_1)	Firm Size	-5.510E-11 (-.302)	-5.757E-11 (-.339)	-3.754E-11 (-.256)	-4.177E-11 (-.333)
TD (β_2)	Total Dependence	-.078 (-.378)	-.070 (-.365)	-.133 (-.804)	-.103 (-.730)
PI (β_3)	Power Imbalance	.071 (.348)	.068 (.363)	.114 (.708)	.090 (.658)
S (β_4)	Self-enforced Sustainability			.000 (-.569)	-4.621E-5 (-.295)
Sample Size		828	828	624	624
F		.290 (.833)	.322 (.809)	.780 (.538)	.613 (.653)
R^2		.001	.001	.005	.004
AdjR^2		-.003	-.002	-.001	-.002

Overall, in all four models, F-values are not significant at 10% level and R^2-values are very small for the models, and less than 5%

Opposite to our predictions, all the estimated coefficients are statistically insignificant at even 10% level all four models. All coefficients in the mean model and market model are similar, which once again proves that results in the mean model are generally the same as these in the market model.

Table 3 reports the cross-sectional regression results based on 828 observations (for H2-4) and 624 observations (for H5). Results are reported for when the dependent variable is the CAR (0, 1) from the mean model (model 5 and 7) and from the market model (model 6 and 8). Results for models 7 and 8 include the self-enforced sustainability variable.

After changing the dependent variable to CAR (0, 1), F-values and R^2-values are somewhat higher on average than those in model 1-4. Both highest values are 1.09 and 0.007 in model 8. However, we still cannot derive significant results at 10% level for any coefficient and we therefore have reason to reject the null hypotheses for hypotheses 2, 3, 4, and 5. Thus, this research provides no evidence to support:

- that smaller suppliers will benefit less from SCSIs;
- that suppliers which are dependent on the buying firm will experience greater stock price reactions;
- where larger power imbalances exist the stock price reaction of suppliers will be less positive; and,

- that self-enforced sustainability of suppliers will lead to greater stock price reactions.

Table 3 – Cross-Sectional Regression Analysis for Model 5-8 (t-Values are in parentheses)

Variable	Proxy for	Model 5	Model 6	Model 7	Model 8
Dependent		CAR (MEAN)	CAR (MARKET)	CAR (MEAN)	CAR (MARKET)
Intercept (β_0)	Cumulative Mean Return	.004 (.823)	.217 (1.502)	.017 (1.233)	.636 (1.291)
Net Sales (β_1)	Firm Size	-5.701E-11 (-.252)	-7.235E-10 (-.113)	-2.026E-11 (-.106)	-1.443E-10 (-.022)
TD (β_2)	Total Dependence	-.101 (-.394)	-6.187 (-.861)	-.171 (-.799)	-9.688 (-1.298)
PI (β_3)	Power Imbalance	.106 (.422)	5.956 (.842)	.148 (.709)	8.676 (1.194)
S (β_4)	Self-enforced Sustainability			.000 (-.577)	-.004 (-.461)
Sample Size		828	828	624	624
F		.374 (.771)	.638 (.591)	.640 (.634)	1.096 (.358)
R^2		.001	.002	.004	.007
AdjR^2		-.002	-.001	-.002	.001

Discussion and conclusion

This paper analyzes whether suppliers benefit from the supply chain sustainability initiatives of the buying firm. Through an event study, we investigate how SCSI announcements made by the buying firm impact the stock market reactions (or abnormal returns) of the suppliers. In addition, by cross-sectional analysis, this paper tries to reveal if and how the impacts on suppliers vary with firm size, resources dependence setting and the supplier's own sustainability efforts.

In both the mean model and the market model in terms of AR and CAR, we find positive and significant results to support our hypothesis that the suppliers benefit from the buying firm's supply chain sustainability initiatives. Nevertheless, we find no significant relationship between stock price reaction and any of the other factors; viz., supplier firm size, resource dependence setting, and self-enforced sustainability for variation in the benefits.

Implications

There are several implications of our results. First, this paper adds to the current debate in supply chain literature on whether supply chain sustainability initiatives are beneficial for both buying firms and their suppliers. While many studies have proven the benefits of sustainability on buying firms, suppliers may suspect they pay the price and absorb the costs of SCSIs and they would be reluctant in implementations. We conclude that SCSIs by a buying firm profit suppliers. This conclusion provides academic and practical contributions. This paper expands our understanding of sustainability benefits from individual firms to the supply chain context and provides managerial support for collaboration between supply chain actors in sustainability issues. Moreover, the findings change how managers perceive supply chain sustainability. Since the SCSIs produce shared values for suppliers and buying firms, managers in both companies are convinced to cooperate in initiatives and implementations.

Second, we suggest that in future research, the sustainability practices of the buying firm should be considered as an additional factor as we suspect the poor conducts of sustainability from the buying firm may be why we cannot find the fluctuation of benefits on its suppliers. Wal-Mart's own sustainability is not good (its sustainability score is 38 and rating is CCC, which are both lowest in Global Socrates index). In the context of supply chain sustainability, Wal-Mart may not request strict evaluation of SCSIs from suppliers. Consequently, although suppliers with better resources and dependence on Wal-Mart are advantaged by SCSIs, this is not valued by investors. Finally, not all suppliers may share the benefits. Future studies may concentrate on identifying the supplier attributes that lead to gaining greater benefit from buyer SCSIs.

Limitations and future research

The primary limitation of this research is the sample size and generalizability could be strengthened by using more than a single buying firm in further research. Such studies may also investigate different supply chain systems including industrial settings rather than buying firms that are retailers. Second, our tests on the impacting factors suggest that the evaluation on SCSIs from buying firms should be inspected. In future studies, researchers should select buying firms recognized as having good sustainability conduct and should exclude the sustainability announcements regarded as being of less importance.

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Appendix

Table 4 – Comparison between Non-standardized AR and Standardized AR (Market model)

DAY	Non-standardized AR MARKET	Z VALUE	Standardized AR MARKET	Z VALUE
-10	-0.001757776	-1.2935071	-0.103275896	-2.97176
-9	-0.001607962	-1.1832618	-0.061797914	-1.77823
-8	-0.002101819	-1.5466802	-0.20379172	-5.8641
-7	-0.000158535	-0.1166625	0.002445306	0.070364
-6	-0.000263545	-0.1939365	-0.008172623	-0.23517
-5	0.000256403	0.18868076	0.002463916	0.070899
-4	0.000283262	0.20844579	-0.06417365	-1.8466
-3	-0.003213778	-2.3649453	-0.070394348	-2.0256
-2	0.00452597	3.33055648	0.15067671	4.335721
-1	-0.000329526	-0.2424904	0.005216843	0.150115
0	0.001804488	1.32788137	0.066659843	1.918136
1	0.001015785	0.74749289	0.062835398	1.808088
2	-0.001376828	-1.0131762	-0.065567978	-1.88672
3	-0.000819881	-0.6033317	-0.08939818	-2.57243
4	0.004434471	3.26322487	0.134658979	3.874811
5	-0.00220117	-1.61979	-0.047941752	-1.37952
6	0.003299994	2.42838953	-0.010861627	-0.31254
7	0.00369036	2.7156509	0.06302471	1.813535
8	-0.001615624	-1.1889007	-0.059690321	-1.71759
9	-0.002211414	-1.6273286	-0.032731597	-0.94185
10	2.59358E-05	0.01908554	0.023189973	0.667291

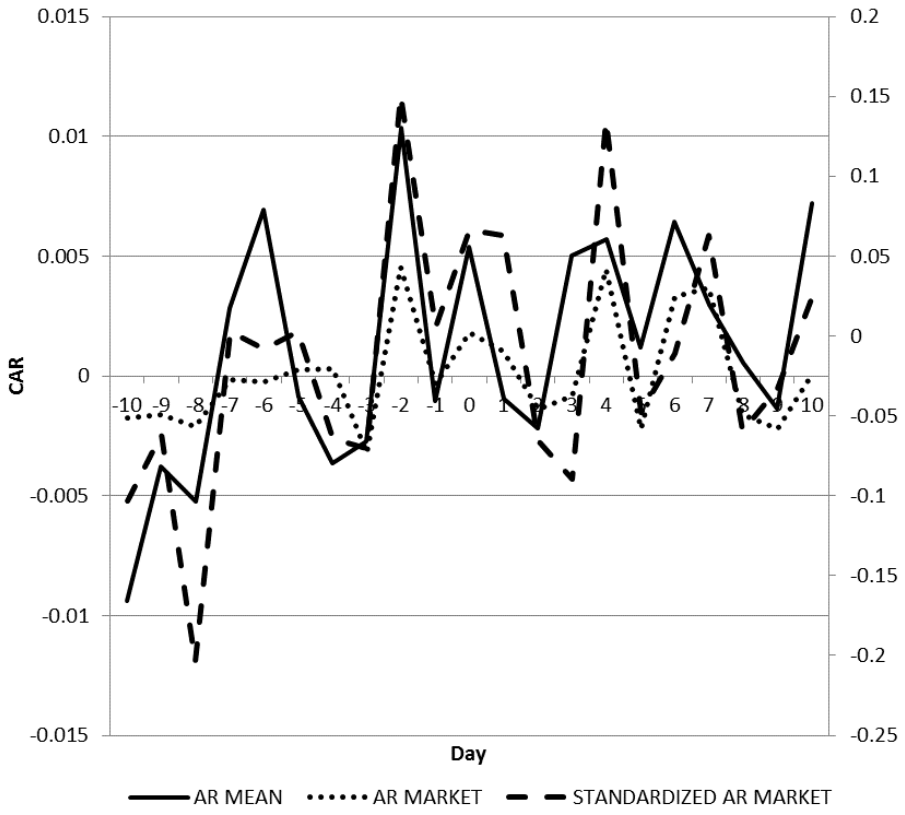

Figure 8 – Comparison between AR Mean, Non-standardized AR Market and Standardized AR Market models