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The Firm Value Impact of Recycling Transportation

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1. Introduction

Over the past several decades, firms have increasingly engaged in activities to improve the environmental sustainability of their operations (DeBono, 2004). A number of these activities have taken the form of programs to recycle, reuse, and recover the firms’ products from consumers once the products finished serving the customers’ needs (Ruriani, 1990). These programs are typically designed to reduce waste and improve the environmental sustainability of operations. The new emphasis on recovery, reuse, and recycling programs and the costs associated with those programs has led to a new set of challenges for firms; especially when firms must consider the financial viability of these programs.

The challenges by firm’s implementing recovery, reuse, and recycling programs include logistical issues with used product recovery, disposal issues with unrecovered products, and the financial costs associated with recovery, processing, and disposal (Walley and Whitehead, 1994). Recovery, reuse, and recycling programs require products at the end of their useful lives to be collected from consumers, transported to a location for processing, and the either be recycled, reused, or disposed of (Krause, 1998). The transportation costs associated with the recovery of these products can be significant and often determine the financial viability of efforts to improve environmental sustainability (King and Lenox, 2001a). The financial viability of the programs is also impacted by the allocation of a program’s transportation costs, as the burden of these costs can be placed on either the consumer, the firm recovering the products, or shared between the parties. Many of the issues associated with these programs have been widely investigated in the literature, however the impact of the transportation costs associated with the collection and return of products from consumers on firms has not been widely investigated.
This investigation uses the event study method to examine the financial impacts of sustainable recovery, reuse, and recycling programs that involve transportation of the used consumer products. Specifically, the event study method allows us to determine the shareholder wealth impact of public announcements of environmental programs that include the transportation of used products. The results of the event study are then used to quantify the effects of these programs on firms and to investigate if the various cost allocation policies result in different impacts on firms.

The paper is organized as follows: In the next section, we review existing literature and theoretically develop our study. In Section 3 and 4, we discuss the selection of our sample data and describe the research methodology. We discuss the results in Section 5 and summarize our findings in Section 6.

2. Theoretical Development

Improving the environmental sustainability of operations has increasingly become a priority for firms over the past 15 years (Atlee and Kirchain, 2006). The new focus on environmental issues has dramatically increased the number of recovery, reuse, and recycling programs implemented by firms across the globe. The focus has also led to tremendous growth in the body of research into the improvement of sustainability.

A significant body of existing research has focused on the logistical issues associated with the recovery of used products from consumers for processing; these systems and associated activities are typically referred as reverse supply chains, closed-loop supply chains, or reverse logistics (Guide and Van Wassenhove, 2002). An examination of the literature identifies several themes in the existing research. The first theme of empirical research that our literature review
identified is the use of case examples to assist in the development of mathematical optimization models (Guide et al., 2005, Savaskan and Van Wassenhove, 2006, Schultmann et al., 2006). The models leverage real-world examples of recycling and recovery systems to improve the models’ accuracy and applicability to real world issues. Other empirical studies address strategic and policy issues associated with product recovery and recycling (Corbett and Van Wassenhove, 1993, Guide et al., 2003, Guide and Van Wassenhove, 2002, Lomardi and Goldstein, 2001). These works address high-level issues faced by managers and policy makers designing and implementing consumer product reuse systems. The literature review only identified a single large scale purely empirical investigation focused on product recycling and reuse issues (French and LaForge, 2006). In that study, French and LeForge survey 141 firms to identify the sources of recovered products, the types of materials recovered, and the reuse decisions made by firms. The study finds a wide range of emphasis on recycling and recovery amongst the sample of firms, a diverse set of materials targeted for reuse, and a need for additional research into the planning and scheduling of recycling and recovery systems.

In the literature, most studies into the impact of recycling and recovery programs focus on the optimization of tactical systems and do not consider the impact of these programs on firm value. In contrast, our study measures the impact of product recycling and recovery programs on firms’ financial and market performance. This effort will use publicly reported financial data to determine if recovery programs and differences between the transportation decisions made by firms implementing those programs are associated with differences in firm valuation and performance. The impact on firm valuation is measured using the event study method which estimates the change in a firm’s stock price that results from public announcements concerning the firm’s recycling programs. Firm performance relative to competitor firms across multiple
financial dimensions will be assessed by measuring the ROA performance [Return on Assets: which is a measure of the ratio of net income versus firm assets, which determines how effective a firm is at utilizing its resources to generate earnings], the ROS [Return on Sales: which measures the ratio of income versus total sales to determine the how profitable a firm is], and Tobin’s q [which measures the market value of a firm versus the firm assets that garners insight into the shareholders value impacts of recovery and recycling transportation systems.]

The literature review failed to identify any existing empirical studies that investigate the transportation and logistics systems that support recycling and recovery systems. This study addresses the gap by examining market the impacts on market valuation for a large scale sample of firms participating in recycling and recovery projects.

The financial impact of recovery, reuse, and recycling programs on firms has been investigated in a number of previous studies. These studies can be grouped into two main categories: those that posit that programs that improve sustainability are beneficial to firms and those that predict that such programs negatively impact firms. The arguments that predict a positive impact tend state that efforts to improve the environmental sustainability of firms’ operations result in reductions in waste. These waste reductions lead to improved efficiencies which lead to improved business performance (King and Lenox, 2001b, Klassen and McLaughlin, 1996). Contrary to these arguments, a separate body of research argues that the costs associated with programs that improve firms’ environmental sustainability are very high relative to the benefits they create. Therefore, this stream of research argues that the high costs of sustainability programs can result in a negative impact on firm performance (King and Lenox, 2001a, Walley and Whitehead, 1994). The recovery, reuse, and recycling programs examined in this study involve the collection of used goods from consumers which are then transported to a
location for processing. Predicting the impact of these programs is difficult since both arguments discussed above apply to these programs. The programs included in our study will reduce waste and increase the reuse of components and materials which may result in operational efficiencies and positively benefit firms. However, these programs will also have significant costs associated with the collection, transportation, and processing of used goods. Due to the lack of a clear argument in favor or against the benefits of these programs, we test two hypotheses concerning the impact of the programs on firm value:

_Hypothesis 1: Announcements of recovery, reuse, and recycling programs by a firm will have a positive effect on the stock market value of the firm._

_Hypothesis 2: Announcements of recovery, reuse, and recycling programs by a firm will have a negative effect on the stock market value of the firm._

In our study, the allocation of costs associated with the used goods’ collection and transportation systems take three forms. In the first case, all of the transportation and collection costs are encumbered by the firm. In this situation, the firm manages the collection process and pays the majority of the costs of retrieving the used goods and the consumer bears none of the costs. An example of this case is an ink jet manufacturer that provides customers with a pre-paid mailing envelope that the customers use to mail used cartridges back to a processing site. The second scenario is the opposite of the first, in this scenario the customers are required to personally arrange the collection and pay for the transportation out of pocket. An example of this program requires consumers to physically bring a used personal computer to a local processing center for recycling and processing. The third approach of sustainability programs
involves consumers and firms sharing the collection and transportation costs of the programs.

An example of this is a program that requires consumers to transport the goods to a central collection point where then the goods are shipped to a processing site by the firm. In this study, we examine programs that fit into all three of these scenarios and we therefore will investigate if the different program structures lead to differences in market reactions to the programs.

3. Sample Selection

The Wall Street Journal (WSJ), the Dow Jones News Service (DJNS), the PR Newswire (PR) and Business Wire (BW) were searched to identify public announcements of recycling, recovery, reuse programs for consumer goods that involved the transportation of the goods. The study identified announcements released between 2003 and 2008. Keywords used in the search process included “recycle”, “reuse”, “recovery”, “sustainable”, and “green.” This process identified 112 relevant announcements. The text of these announcements was then scrutinized and 52 announcements were removed as they did not reflect programs of the type this study intends on investigating. This resulted in a final sample of 60 public announcements that were utilized for our event study.

Examples of announcements are provided below:

Source: Business Wire
19 March 2003

“Dell (Nasdaq:DELL) announced today that it is enhancing Dell Recycling (formerly Dell Exchange) to enable customers to order home pickup of unwanted notebooks, desktops, monitors, and other select computer equipment for $15 per unit. The service is available for continental U.S. customers online beginning March 25. Customers can learn more about the home pick-up service at www.dell4me.com/recycling.”
"Boeing Co., which posted a 29% jump in quarterly profit thanks to brisk demand for airplanes, is setting up a network of companies to recycle some old jets that its new models are replacing."

4. Methodology

We utilize the event study method to estimate the shareholder wealth effects of announcements of programs to recycle, recover, and reuse consumer products. The event study method adjusts for industry and market-wide influences and estimates the stock market’s reaction to announcements (see Brown and Warner 1980, 1985 and MacKinlay, 1997 for a detailed description of this methodology). This methodology has been widely used in the literature to examine the impact of operational decisions on shareholder wealth (see Hendricks & Singhal 1996, 2003; Hendricks, Singhal, & Wiedman 1995). In an efficient market, as information about a firm becomes publicly available, the firm’s stock price will immediately change to reflect the shareholder wealth impacts of that information (Fama, 1998). The event study method leverages the efficient market theory and calculates the abnormal return stock return, which is the portion of change in a firm’s stock price due to the firm specific event (e.g. a public announcement) by examining the stock’s value over a short period of time after a public announcement is made. The analysis is conducted using the Eventus software program.

We use the market model event study method to estimate the abnormal returns resulting from announcements of sustainable environmental programs. The market model adjusts for the systematic risk of a stock when predicting the relationship between the return of a stock and the return of the market portfolio. The model is expressed as:

\[ r_{it} = \alpha_t + \beta_t r_{mt} + \epsilon_{it} \]  

(1)
where \( r_i \) is the stock return of firm \( i \) on Day \( t \), \( r_{mt} \) is the market return on Day \( t \), \( \alpha_i \) is the intercept parameter for stock \( i \), \( \beta_i \) is the slope of the relationship for stock \( i \) with the market return (i.e. systematic risk), and \( e_i \) is the error term for stock \( i \) on Day \( t \) which represents the portion of the return that cannot be explained by market movements. \( \beta_i r_{mt} \) is the portion of the return for firm \( i \) that is due to market overall.

Ordinary least square regression is performed over an estimation period of 200 trading days for each announcement in our sample to estimate \( \hat{\alpha}_i \), \( \hat{\beta}_i \), and \( \hat{\sigma}^2_{\epsilon_i} \) (the variance of the error term, \( \epsilon_i \).) For each event, the estimation period ran from 210 days before the event until 11 days before an event day. The 11 day buffer is short enough to prevent nonstationarity in the estimates from being a factor while being long enough to prevent an announcement from affecting the parameter estimation. The market return component of this study was estimated using an equally weighted index of all stocks traded on the New York Stock Exchange, the NASDAQ Stock Exchange, and the American Stock Exchange.

For firm \( i \)'s stock on Day \( t \), the daily abnormal return, \( A_{it} \), is calculated as the difference between the Day \( t \) actual return of stock \( i \) and the expected return for stock \( i \) on Day \( t \):

\[
A_{it} = r_{it} - (\hat{\alpha}_i + \hat{\beta}_i r_{mt})
\]  \hspace{1cm} (2)

The daily mean abnormal return for a sample of \( N \) observations, \( \bar{A}_t \), is calculated by averaging the individual abnormal returns:

\[
\bar{A}_t = \frac{1}{N} \sum_{i=1}^{N} A_{it}
\]  \hspace{1cm} (3)

To test the statistical significance of the daily mean abnormal return, the standardized abnormal return is estimated for each abnormal return. Each firm’s standardized abnormal
return, \( A_{it}^{S} \), is calculated by dividing the daily abnormal return by the estimated standard deviation of the error term:

\[
A_{it}^{S} = \frac{A_{it}}{\hat{S}_{\epsilon}}
\]  \hspace{1cm} (4)

Three tests are performed to determine the significance of the abnormal returns. The statistical significance of the mean abnormal returns is evaluated using the Patell Z test. In addition, nonparametric test statistics are also used to examine the statistical significance of the abnormal returns. The Wilcoxon Signed-Rank test is used to measure if the median abnormal return is significantly different from zero and the binomial sign test examines if the percentage of positive or negative abnormal returns is significantly different from 50%.

A variety of time periods (i.e. daily, monthly, yearly) can be examined when using the event study, however we use a two-day period in this study to reduce the risk that the observed abnormal return is be influenced by other factors (Brown and Warner, 1980, Brown and Warner, 1985). When using the two-day time period, the day and time of each announcement in the sample must be precisely identified. The first trading day during which the stock market can respond to an announcement is designated as the event day and designated as Day 0. The following guidelines are used when converting the calendar day of an announcement to event days. If the announcement is made on a trading day before the 4pm close of the stock market, the announcement calendar day is Day 0 in event time and the previous trading day is Day -1. If this announcement is made on a non-trading day or after 4pm on a trading day, then the next trading day is designated as Day 0 in event time.
5. Results and Discussion

The event study analysis finds a significant and negative stock market reaction to public announcements of recycling, recovery, and reuse programs. The results of the event study are detailed in Table 1. The mean abnormal return of -0.63% is significant at the 10% level (Patell Z = -1.86), the median abnormal return of -0.35% is significant at the 5% level (Wilcoxon Z = -2.01), and 60% of the returns are negative which is significant at the 10% level (Sign Test Z = -1.36). The consistency of these three measures strongly supports the contention that announcements of recycling, reuse, and recovery programs negatively impact shareholder wealth. These findings lead us to reject Hypothesis 1 and accept Hypothesis 2. The findings are possibly due to the high costs associated with the implementation of environmentally sustainable recycling programs. Although these programs reduce waste, the savings garnered by these waste reductions does not seem to outweigh the associated costs based on our findings.

Table 1 – Event Study Results

| Day 0 & 1 Abnormal Returns - Recycling, Recovery, and Reuse Program Announcements |
|---------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Sample Size | Mean Abnormal Return | Patell Z | Median | Wcox Z | % Positive | Sign Test Z |
| Recycle, Reuse, and Recovery Program Announcements | 60 | -0.63% | -1.86* | -0.35% | -2.01** | 40.00% | -1.36* |

** Significant at the 5% level (Two-tailed test)
* Significant at the 10% level (Two-tailed test)

While the mean abnormal return percentages may seem miniscule, however the magnitude of the impact becomes apparent when the change in shareholder value is examined.
The sixty announcements in our sample resulted in a total loss of shareholder value over $16.6 billion. The average firm in our sample had shareholder equity (at the time of the announcement) of $55 billion and the loss in value associated with an announcement averaged $277 million. Clearly, the impact on value associated with announcements of recycling programs is large enough that firms need to carefully consider decisions to implement them.

The allocation of costs associated with the transportation of the used consumer goods may also influence the stock market’s reaction to recycling program announcements. In our sample, there were 11 announcements of programs in which the customer was required to pay the recovery costs, 11 announcements where the firm paid the costs, and 38 announcements of programs in which the costs were shared between the consumers and the firms. While the small sample size precludes statistical testing of the differences between the market valuations of the program types, the results are included for discussion. We found that programs requiring either the consumers or firms to cover the recovery costs independently both had a negative mean abnormal return (-0.6% and -1.4% respectively.) Programs in which the costs were shared between the firm and the consumers had a slightly less negative mean abnormal return of -0.02%. These findings may be the result of a number of factors but one explanation may be that programs that share the financial burden between the firm and the consumer.

To shed further insight into our results, we compare three measures of firm performance, Tobin’s Q, ROA, and ROS, for the firms in our sample with other firms in each of their industries. To accomplish this, we utilize publicly available financial data to construct portfolios of all firms within an NAICS industry group. The firms in our sample are then compared to the portfolio of firms in their industry. We find that the firms in our sample on average have a Tobin’s Q 17% lower, a Return on Assets 92% lower, and a Return on Sales 49% lower than
their industry averages. While these differences are dramatic, it would be presumptuous to attribute the differences to be solely a result of the recycling programs implemented by the firms in our sample. However, it is worth noting that the firms in our sample consistently appear to perform at levels below their industry averages across a variety of measures. Similarly, the direction of the relationship between firms’ environmental programs and performance is difficult to establish. A counter argument can be made that firms with lower performance may have greater levels of waste and therefore those firms may be more likely to implement recycling programs.

6. Summary

This study is an empirical investigation into the impact on firms of programs to recycle, recover, and reuse used consumer products. These types of programs have become increasingly common as firm’s attempt to improve their environmental sustainability. Our examination finds that public announcements of programs of this type result in a significant negative change in shareholder value. These support previous studies that indicate that programs to improve environmental sustainability are expensive and difficult to implement so that they financially benefit firms. These results should not be interpreted as a condemnation of recycling, recovery, and reuse programs. Instead, these findings should indicate to firms that these programs do involve financial risks and encourage firms to more carefully analyze and plan these programs before implementing them.
References


Our responsibility is to provide strong academic programs that instill excellence, confidence and strong leadership skills in our graduates. Our aim is to (1) promote critical and independent thinking, (2) foster personal responsibility and (3) develop students whose performance and commitment mark them as leaders contributing to the business community and society. The College will serve as a center for business scholarship, creative research and outreach activities to the citizens and institutions of the State of Rhode Island as well as the regional, national and international communities.

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