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IMPACT OF ETHICAL SALES BEHAVIOR, QUALITY AND IMAGE ON CUSTOMER SATISFACTION AND LOYALTY: EVIDENCE FROM RETAIL BANKING IN EGYPT

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ABSTRACT

Amidst increasing competition and deregulation, retail banks are looking for ways to differentiate their services in the eyes of their customers and to attain high levels of customer satisfaction and loyalty. Due to the high customer welfare implications of financial services and the significant role of a bank's sales employees in this regard, ethical sales behavior plays an important role as a source of customer satisfaction with a bank's services and of loyalty to the bank. This study examines the dimensions of ethical behavior by bank employees and how they impact levels of customer satisfaction and loyalty. Moreover, the roles of perceived service quality and bank image are also examined, due to the salience of these constructs in the literature. Based on a thorough review of the literature, a conceptual model is developed and tested on a sample of retail banking customers of eight prominent banks in Egypt. The results show a significant impact of ethical sales behavior on both customer satisfaction and loyalty. Managerial implications for retail banks are drawn.

JEL: M310

KEYWORDS: Ethical Sales Behavior, Satisfaction, Loyalty, Retail Banking, Egypt, Quality, Image

INTRODUCTION

In service industries, differentiation is in many cases a key competitive response. Competing based on price is sometimes a viable option, but there are limits on the extent to which a business may base its competitive edge on price, especially in highly competitive markets. Ethical behavior of contact employees, or salespeople, is often a key differentiating factor for service businesses, in which the interaction with the salesperson holds high welfare implications for the customer (Belas, 2012). Conceptual models in services marketing have shown that ethical sales behavior results in high customer satisfaction and loyalty. In highly competitive markets, customer loyalty is a valuable asset, as loyal customers tend to repeat business with the company and spread positive word of mouth as they recommend the company to friends and acquaintances. Customer loyalty is thus an avenue to increasing profitability and gaining market share by fostering long-term relationships with customers (Wray et.al. 1994; Auh et. al. 2007). Moreover, ethical sales behavior will save the company liability costs that result from deliberate or inadvertent malpractice by its salespeople (Boadecker et. al., 1991).This paper examines the impact of ethical behavior of salespeople in the retail banking sector in Egypt. The issues of ethical sales behavior and its effects on customer satisfaction and loyalty are well documented in the financial services industry. It is important for the industry to create an atmosphere of trust, in which customers feel confident in the

knowledge and advice they receive from salespeople and the handling of their money with integrity (Roman, 2003).

Over the past few decades, there have been significant changes in the financial services industry. With deregulation of banking, competition has heightened among banks, and between banks and other financial service providers. Moreover, customers have become more sophisticated and their preferences have evolved while bank distribution systems have expanded due to advances in technology (Byers & Lederer, 2001). Increasingly, banks are seeking to differentiate themselves in their customers' eyes, as price competition reaches its limit (Thornton & White 2001; Ishaq 2011). Retail banks have developed 'bankassurance' strategies, in which banks team up with insurance companies to create profit-making opportunities and cater to a wider range of customer needs (Gardner et.al, 1999). With these developments, there has been a greater focus on making sales rather than giving excellent service, and customer problems and complaints heightened as a result (Rankin, 2004; Lee et. al., 2012).

The increased focus on growing the bank's sales has put more pressure on bank sales employees to make more sales, as their performance measures focus on the quantitative aspect of their outcomes. This has often come at the expense of service quality and in some cases, has lured sales people to exercise sales practices that are unethical. As sales people strive to close a sale, even at the expense of the bank's customers, customer satisfaction with the performance of bank sales people has suffered. The conceptual model developed in the current study explores the ethical behavior of the retail bank's frontline employees, who interact directly with customers and are responsible for promoting and selling the bank's products. The model relates ethical behavior of sales people to customer satisfaction and customer loyalty. The model improves on previous conceptualizations by adding perceived service quality and perceived bank image as independent variables that also affect customer satisfaction and loyalty. Thus the study offers an integral model linking ethical sales behavior with perceived quality & image, and empirically testing their impact on satisfaction and loyalty in the consumer banking industry.

Context of the Study

Retail banking comprises individuals and small business deposits, investments, financing, guarantees and transactional services. The services offered include: savings and checking accounts, mortgages, personal loans, debit cards and credit cards. Financial services in general are highly abstract and therefore customers depend on the knowledge and expertise of salespeople for direction and advice (Howe et. al., 1994). The banking sector has witnessed major changes over the past decades in a move toward deregulation around the world. In Egypt, there have also been significant changes in the banking sector. Starting out with a number of large public sector banks suffering from high inefficiency, disempowered management and significant politicization, the financial sector scene started to change with the open door economic policies of the seventies. The ERSAP (Economic Restructuring and Structural Adjustment Program) of 1991 further moved the sector towards greater liberalization and privatization. This reform program resulted in significant changes such as carrying out independent audits of state owned banks, tackling the issue of the large number of non-performing loans, and getting one of the state owned banks ready for privatization. The most significant reforms in the banking sector happened over the past decade, since the initiation of the Financial Service Reform Program in 2004, which mainly focused on consolidation and liberalization.

The reform program of 2004 resulted in significant changes in the Egyptian banking sector. A large number of bank mergers and acquisitions took place, the government sold sizable portions of its shares in joint venture banks and small banks were either merged or acquired by larger more establishes ones. The reforms presented foreign banks with an opportunity to enter Egypt and left the banking sector more consolidated and efficient (Mohieldin & Nasr 2007). As a result, there was a reduction in the number of banks (41 commercial banks) and a burgeoning of bank branches (CBE 2014). With this, competition among banks increased. As price competition reached its limits, retail banks have strived to expand their product

offerings and differentiate their services and products to their clients. With the increased competition and pressure to deliver financial objectives, unethical behavior by bank salespeople has been on the rise. The Central Bank of Egypt (CBE) has to deal with customer complaints, which peaked in 2008 (Amcham, 2008). Furthermore, the CBE has been pushing banks to get their acts in order, and to improve their positions in terms of non-performing loans. The CBE took aggressive action against banks that violated market norms and regulations (Amcham, 2008). With the developments described above, the role of ethical sales behavior and the negative impact of ethical failures on customer satisfaction and loyalty is highly relevant and timely for the financial services industry in Egypt. Moreover, the study is relevant for the context of retail banking in other countries as well.

Following this introductory section, the relevant literature is reviewed and the constructs of the model are developed based on previous literature as well as in depth interviews with retail banking experts. The relations between the constructs are presented as concluded from the literature and the proposed hypotheses are developed. In the following section, the data collection is described in addition to the sample size and response rate and an overview of the study methodology is presented. The results of the analysis follow, first presenting the measurement model validation, followed by the results of the conceptual model and the hypotheses testing. Conclusions, managerial implications and directions for future research are presented last.

LITERATURE REVIEW AND MODEL DEVELOPMENT

Ethical Sales Behavior

Oftentimes, the customer's relationship with the service organization, in this case the bank, is completely undertaken through the salesperson (Crosby et. al., 1990), who promotes and sells the bank's products and advises the customer on the most suitable products that match the customer's needs. There is a lot of pressure on salespeople in the retail banking market, as they are responsible for generating their department's revenues through selling the bank's products. Sales managers usually stress objective or productivity-related performance measures, such as sales volume, sales calls, or other output measures. Most salesperson appraisal systems do likewise (Roman, 2003). In practical terms, pursuit of short-run objectives could jeopardize the long run goal of most selling activity: establishing ongoing relationships with buyers (Dwyer, Schurr, & Oh 1987). This added pressure might lead the sales person to engage in unethical sales behavior when dealing with a customer. Sales managers have an important role to play in ensuring an ethical selling environment, starting from the recruitment of salespeople to communicating clear ethical standards and training the sales team (Hunt & Vitell 1986; Wotruba 1990; McClaren 2000; Pettijohn et. al., 2011)).

Business ethics is a sub-discipline of applied philosophy and over thousands of years, philosophers have strived to define and explain ethics and ethical behavior. The philosophical discourse continues until the present day. Acting ethically refers to behavior based on a moral philosophy that acts in a good rather than bad way, or in a just/fair rather than an unjust or unfair way (Boatright, 2012). Philosophers that have adopted a teleological approach to ethical behavior look to the consequences of the behavior to determine if it is ethical or unethical. Deontological approaches claim that what makes an action ethical is the intrinsic nature of the action regardless of its consequences (Boatright 2012). Consequently, our construct of interest, ethical sales behavior, is a construct that has neither an agreed definition nor a universally validated way to consistently judge and classify sales behavior into ethical and unethical (Lagace et al., 1991; Tumipseed, 2002). For the purpose of the current research, we will define unethical sales behavior as behavior through which the salesperson realizes short term gains at the expense of the bank customer (Dubinsky et al., 1991; Futrell et al., 2002). Examples of such unethical sales behavior include lying or misrepresenting information regarding the banks products, their benefits to the client, their availability or lying about the competition. Moreover, unethical sales behavior includes situations where the salesperson uses

manipulative influence and high pressure sales techniques and sells to the client products that the client does not need, or that do not adequately match the client's needs (Hoffman et al., 1991; Lagace et al., 1991; Wray et al., 1994; Howe et al., 1994; Tansey et al., 1994; Cooper & Frank 2002).
Several models investigating ethical sales behavior have tackled the issue from the perspective of the seller and the seller's company. These models are based on the theory of reasoned action (TRA) and its later reincarnation, the theory of planned behavior (TPB) (Azjen, 1985; Azjen & Fishbein, 1980). Later models explore the individual, organizational and situational factors that lead people to behave ethically or unethically (Ferrell & Gresham, 1985; Leonard et. al., 2004). In this study, we will tackle the issue of ethical sales behavior from the perspective of the customer. In this regard, Roman (2003) and Roman & Ruiz (2005) are relevant starting points. These models look at the perceptions of customers on the ethical behavior of their sales people and relate this to customer satisfaction, trust, commitment and loyalty. In our model, we focus on the impact of ethical sales behavior on customer satisfaction and loyalty. The conceptual development of these constructs is explored next.

Customer Satisfaction

Customer satisfaction is an overall evaluation of the customer's experience with the service providing company (Anderson & Sullivan 1993), in our case the retail bank. The services literature has pointed to three facets or objects of customer satisfaction: customer satisfaction with the core service, customer satisfaction with the service provider, the salesperson, and customer satisfaction with the organization, in this case the bank (Roman, 2003). There is evidence in the literature for a lack of discriminant validity between customer satisfaction with the sales person and customer satisfaction with the company (Roman & Ruiz, 2005). In the case of retail banking, the service is completely provided through the contact employees of the bank, its salespeople. Often, to the customer the employee is the bank (Zeithaml & Bitner, 2000). For the purpose of this study, we aggregate the measure of customer satisfaction, and we include in it items that refer to the customer's satisfaction with the core service and with the bank.

Customer satisfaction occurs when customers' expectations regarding the service or product are met or exceeded. When the product/service the customer receives falls short of their expectations, there is dissatisfaction (Andreassen & Lanseng, 1997). In financial services generally, customers would expect the institution to be trustworthy with their money and to manage it in the customers' best interest. In retail banking, customers would normally expect salespeople to be truthful and to give them accurate information. Moreover, customers do not expect salespeople to pressure them into buying products/services they do not need (Ishaq, 2011). Customers mainly form their expectations based on the sales person's presentation (Cadotte et al., 1987). The more ethical the sales behavior, the more accurate the customers' expectations of the service and the less the gap between expectations and performance that is the cause of dissatisfaction (Howe et. al., 1994; Tansey et al. 1994). The positive relation between ethical sales behavior and customer satisfaction has been documented in the literature (Siddiqi, 2011). Thus we postulate that customers are satisfied when they perceive the salesperson to be acting ethically.

H1: Ethical sales behavior as perceived by the customer directly and positively affects customer satisfaction.

Customer Loyalty

Oliver (1999) defined customer loyalty as 'a deeply held commitment to re-buy or re-patronize a preferred product or service consistently in the future, despite situational influences and marketing efforts having the potential to cause switching behavior' (p. 392). This means that customers must perceive the bank as better than competitors, and must like the bank better than competitors (affective loyalty). Re-buying or re-patronizing means that customers must have an intention to continue using the bank's services in the future (conative loyalty). In other words, affective loyalty is related to customers' attitudes towards the bank while conative loyalty is related to customers' behavioral intentions towards the bank in the future (Petrick, 2005;

Wu, 2011). Financial services in general, and retail banking in particular are sectors where customer loyalty is key to garnering higher market share and therefore increasing profitability. Loyal customers are valuable assets for a bank as loyalty means that the customers will remain with the bank, and will further recommend the bank to others (Churchill, 2000; O'Loughlin & Szmigin, 2006). Due to the high competition and the low switching costs in retail banking, loyalty is an important objective that a bank strives to achieve (Liu et. al., 2011).

Customers will become loyal to the bank if they are satisfied with the service they receive through their repeated interaction with the bank's contact employees – the bank's salespeople. Several models in the literature have postulated customer satisfaction with the service provided and with the company providing the service (in our case the bank) as an antecedent to customer loyalty (Dick & Basu, 1994; Reichheld, 1996; Heskett et al.,1997; Seto-Pamies, 2012). This has also been validated with regard to customer satisfaction with the brand and brand loyalty (Fornell, 1992; Samuelsen *et al.,* 1997). With respect to banks, Methlie and Nysveen (1999) have shown that customers who are satisfied with a bank develop positive feelings toward the bank, which increases the probability that they will remain customers of the bank in the future. The same result has been tested for other service industries (Hu et. al., 2009). Hence, our second hypothesis:

H2: Customer satisfaction has a direct and positive effect on customer loyalty.

When customers perceive that salespeople are behaving ethically, this is expected to have a direct effect on customer loyalty. Unethical sales behavior has been described in the literature as short term oriented actions that prioritize expediency over social responsibility (Dubinsky et. al., 1993). This unethical behavior has been reported to negatively affect future purchase intentions (Roman, 2003; Trawick et. al., 1991). On the other hand, ethical sales behavior fosters long-term relationships with customers (Gundlach & Murphy, 1993) and therefore results in customer loyalty (Siddiqi, 2011).

H3: Ethical sales behavior has a direct and positive effect on customer loyalty

Previous authors who have studied the impact of ethical sales behavior on customer satisfaction, trust and loyalty have included ethical sales behavior as the only exogenous construct affecting the endogenous (dependent) constructs (Roman, 2003; Roman & Ruiz, 2005). Upon reviewing the literature more extensively, and after deep contemplation into the context of financial services, the authors have extended the previous model specifications to include perceived quality of service and perceived corporate image as additional exogenous constructs. The conceptual and empirical review of the two added constructs is presented next.

Perceived Quality of Service

The quality of the service, as perceived subjectively by the customer, is an overall assessment of the service provided (Parasuraman et.al., 1988). Although the literature contains numerous definitions for perceived service quality, there seems to be agreement on the idea that service quality should be defined and measured from the perspective of the customer (Parasuraman et.al., 1988). There are many dimensions of service quality including, but not limited to, timeliness of the service, the willingness of the employees to help the customer, courtesy, knowledge of the employees, the physical facilities and individualized attention (Parasuraman et.al., 1988; Chun-Chang, 2012). Some authors have proposed that service quality is identified in the gap between customer expectations and actual service performance (Gronroos, 1984; Lewis & Booms, 1983; Bitner, 1990; Bolten et.al., 1991). In service businesses, the contact employees are the service, as everything happens through them (Zeithaml & Bitner, 2000). Thus, the contact employees will be primarily responsible for the customer's perception of the service quality (Parasuraman et al., 1985; Kelley, 1992).

The literature draws a direct and positive relationship between perceived quality and customer satisfaction and positions perceived quality as antecedent to customer satisfaction and loyalty (Anderson & Sullivan, 1993; Farrell et al., 2001; Ganesh et al., 2000; Khurana, 2014; Khan & Fasih, 2014; Gallarza et. al., 2013). The mediating effect of customer satisfaction in the relation between perceived quality and customer loyalty has also been documented (Kim, 2011; Srivastava & Rai, 2013). This turns out to be an important relation in our context, the financial services industry in Egypt.

H4: *Perceived quality of the service has a direct and positive effect on customer satisfaction.*

H5: *Perceived quality of the service has a direct and positive effect on customer loyalty to the bank.*

Perceived Company Image

The perceived image of the company, in our case the bank, is an impression in the customer's mind (Gray & Smeltzer, 1985; Zimmer & Golden, 1988) and constitutes subjective knowledge (Boulding, 1956). It can be defined as an attitude toward the company (bank) (Hirschman et. al., 1978) formed as a result of both experience and communication. The company image is partly created as a result of the company's communication, in the form of advertising and public relations, which helps the customer form an internal image that represents his/her attitude or impression on the company. In addition to communication, the customer's perceived image forms as a result of his/her experience with the company in buying and consuming its product or using its service and interacting with company employees in the process (Andreasson & Lanseng, 1997). Similar to self-schema, the perceived company image has an important function as it simplifies decision rules for the customer and may therefore influence purchase decisions (Markus, 1977; Aaker, 1991). Choice of service provider, especially when service attributes are difficult to examine before purchase, are facilitated and influenced by the perceived image of the company the customer has formed (Andreassen & Lanseng, 1997).

The effect of perceived corporate image on customer satisfaction has been empirically validated (Andreasson & Lindestead, 1998; Palacio et. al., 2002). The mediating role of customer satisfaction in the relationship between corporate image and customer loyalty is also documented (Abd-El-Salam et. al., 2013; Richard & Zhang, 2012).

H6: Perceived bank (corporate) image has a direct and positive effect on customer satisfaction.

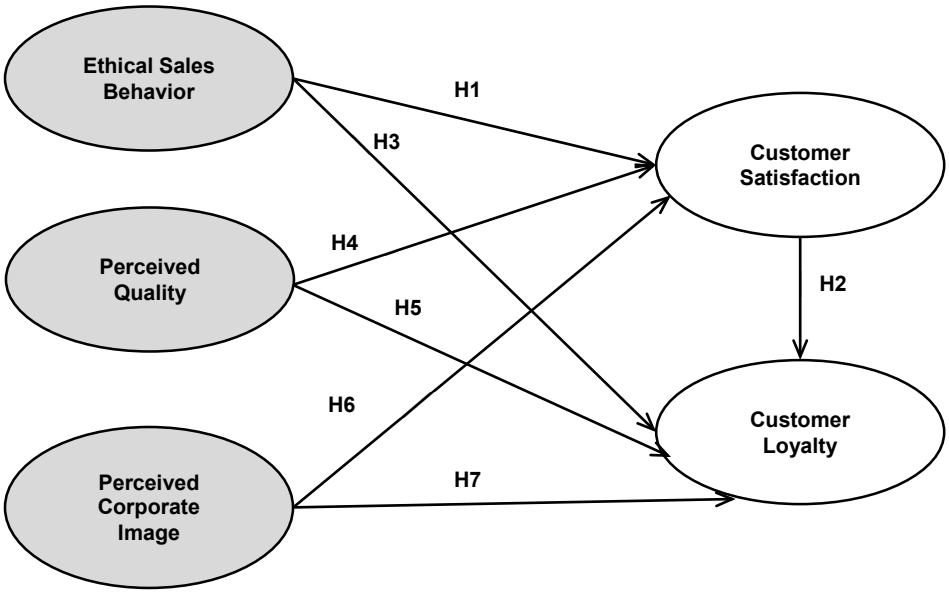
H7: Perceived bank (corporate) image has a direct and positive effect on customer loyalty.

Figure 1 illustrates the conceptual model developed above and indicates the hypotheses to be tested.

DATA AND METHODOLOGY

The current study uses a mix of qualitative and quantitative methodology. The initial phase involved extensive semi-structured interviews with Egyptian banking experts and top managers to validate the research constructs and their operationalization. The sample of experts interviewed was selected based on judgmental (purposive) sampling. The survey items were designed based on the relevant literature and validated through the expert interviews.

Figure 1: The Conceptual Model of Ethical Sales Behavior



The figure illustrates the conceptual model, where ethical sales behavior, perceived quality and perceived corporate image are positively related to customer satisfaction and customer loyalty.

The second phase of the research involved administering the survey to a sample of customers of eight prominent retail banks in Egypt, some of which are multinational and some local. The banks were picked through convenience sampling, according to the researchers' connections and are among the most prominent retail banks in the country. The sampled banks represent around twenty percent of the total number of commercial banks in Egypt. For these reasons, the researchers believe the sampling frame error to be minimal, and thus convenience sampling is reasonably justified. From each of the eight banks, members of the data collection team were present at several of the bank's branches to pick a sample of customers to be surveyed, from among those who walked into the bank branch. Customers who walked in were asked if they were willing to be interviewed, and upon their consent, the data collection team members administered the survey face-to-face. The data collection resulted in 409 complete survey responses, out of a total of 470 customers approached, which gives a response rate of 87%. The response rate is exceptionally high because of the nature of the data collection procedure, where customers were approached and those who consented filled out the survey on the spot. Thus, 409 responses were used to run the measurement and structural model using structural equation modeling (SEM) on Lisrel.

Following Roman (2003), ethical sales behavior is operationalized over 5 items asking about the extent to which the salesperson is perceived to lie, give answers whilst lacking knowledge, give an overly rosy of products to make them appear more favorable than they really are, and apply pressure selling techniques to sell to the customer products (s)he doesn't really need. Perceived service quality is operationalized as an overall evaluation by the customer in addition to three items asking about the extent to which the service meets the need of the customer, is free of deficiencies as well as the gap between customer expectations and service performance (Cronin et. al., 2000). The items of perceived corporate image are based on the conceptualization of Flavian et.al. (2005) and Palacio et. al. (2002) and include the bank's reputation, image vis a vis competitors and overall impression of the customer regarding the bank. Customer satisfaction is operationalized on both core service and company dimensions. Following Roman (2003) and Voss et. al. (1998), the customer satisfaction construct is reflected in four items that include repeat patronage of the service, quality of the personal encounter and an overall evaluation of all prior experiences with the bank. Loyalty's operational measures include positive word of mouth, recommendation of the bank to others and repeat transactions with the bank. All variables were measured based on a 5-point Likert scale.

RESULTS

The data analysis followed Anderson and Gerbing's (1988) two step approach in which the analysis task is divided into two steps; the first step is a confirmatory measurement or factor analysis specifying the relations of the observed measures to their posited underlying construct and the second step is a confirmatory structural model that specifies the causal relations of the constructs to one another as posited by theory. In this regard, LISREL 8.72 was selected as the software tool used in the analyses.

Analysis of the Measurement Model

The evaluation of the measurement model consisted of confirmatory factor analysis to assess four classes of tests: unidimensionality tests, convergent validity, reliability, and discriminant validity (Anderson & Gerbing, 1988; Steenkamp & Van Trijp, 1991). Confirmatory factor analyses were further used for measures purification whereby items involved in high residuals were removed, which further improved the model fit and constructs' validity and reliability. The overall model fit statistics in LISREL are within the generally accepted thresholds and suggest an acceptable goodness-of-fit (χ^2= 111.32, DF =44; χ^2/df =2.53; RMSEA=0.061; NNFI=0.98; CFI=0.99; GFI=0.96; AGFI=0.92; SRMR =0.034) and all loadings were substantial and highly significant. Moreover, construct reliability values exceeded the recommended threshold of 0.60 (Bagozzi & Yi, 1988). Accordingly with all the analysis performed on the measurement model, unidimensionality might be suggested. Because unidimensionality is a necessary, but insufficient condition for construct validity (Anderson & Gerbing, 1988), the following paragraph addresses the issues of reliability, convergent validity and discriminant validity.

Reliability of the measurement model was judged by computing the composite reliability for each of the constructs. As seen from Table 1 below, composite reliability is above Bagozzi and Yi's (1988) suggested threshold of 0.6. Hence, reliability for the constructs present in measurement model was judged to be adequate. Since reliability is a necessary but not a sufficient condition for validity as a set of items can be reliable without exhibiting convergent validity (Steenkamp & Van Trijp, 1991), the following discussion will highlight the convergent validity of constructs.

To assess convergent validity, correlations between the items and the construct exceeded 0.5 (Hildebrandt, 1987). Further, Table 1 shows that all the average variances extracted (AVEs) were above 0.5 (Fornell & Larcker, 1981). We obtained evidence of discriminant validity as all AVEs exceeded the squared multiple correlations between the respective constructs (Ping Jr., 2004) with the exception of the correlation between loyalty and perceived corporate image, loyalty and satisfaction and satisfaction and perceived corporate image. Furthermore, correlations between constructs significantly differed from unity including correlation between loyalty and perceived corporate image, loyalty and satisfaction and satisfaction and perceived corporate image, which had squared correlations higher than the variance extracted. Hence, this presents further evidence of discriminant validity (Anderson & Gerbing, 1988; Bagozzi & Phillips, 1982; Steenkamp & Van Trijp, 1992; Ping Jr., 2004).

A test of common method variance was performed for additional scrutiny of the validity of the results since common method variance was described as one of the main sources of systematic measurement error (Podsakoff et. al., 2003). Initially several ad-hoc design considerations were followed as recommended by Podsakoff and Organ to reduce common method bias, such as protecting respondent anonymity, reducing evaluation apprehension, counterbalancing question order, and improving scale items, as also suggested by Podsakoff et. al. (2003). A post-hoc statistical patching up further complemented this effort. In this regard, Harman's single factor test was used (Podsakoff et. al., 2003). The basic assumption of this technique is that if a substantial amount of common method variance is present, either (a) a single factor will emerge from the factor analysis or (b) one general factor will account for the majority of the covariance among the measures. The Harman's single-factor test when applied to this research resulted in the absence of one

general factor that emerges from the analysis in addition to the absence of one general factor that accounts for the majority of the covariance among measures.

Table 1: Measurement Model Reliability and Average Variance Extracted

Construct	Item	λ	θδ	Variance Extracted A $VE = \frac{\sum_{i=1}^{n} \lambda_i^2}{\sum_{i=1}^{n} \lambda_i^2 + \sum \Theta_i}$	Variance Extracted B $VE = \frac{\sum_{i=1}^{n} \lambda_i^2}{n}$	Composite Reliability $\rho_c = \frac{(\sum_{i=1}^{n} \lambda_i)^2}{(\sum_{i=1}^{n} \lambda_i)^2 + \sum \Theta_i}$
ETHICAL SALES BEHAVIOR	ESB1	0.87	0.23	0.592	0.591	0.810
	ESB2	0.81	0.35			
	ESB4	0.6	0.64			
PERCEIVED CORPORATE IMAGE	PCI1	0.78	0.39	0.640	0.640	0.842
	PCI2	0.81	0.35			
	PCI3	0.81	0.34			
SATISFACTION	SAT2	0.83	0.34	0.613	0.618	0.760
	SAT3R	0.74	0.44			
LOYALTY	LOYAL1	0.79	0.37	0.659	0.657	0.794
	LOYAL3	0.83	0.31			
PERCEIVED QUALITY	PQUAL2	0.73	0.46	0.690	0.690	0.815
	PQUAL3	0.92	0.16			

The table shows the composite reliability measures for the model constructs.

Table 2: Average Variance Extracted and Squared Correlation Measurement Model

Construct	Ethical Sales Behavior	Perceived Corporate Image	Satisfaction	Loyalty	Perceived Quality
ETHICAL SALES BEHAVIOR	**0.592**	0.281	0.563	0.490	0.314
PERCEIVED CORPORATE IMAGE	0.530	**0.640**	**0.792**	**0.656**	0.292
SATISFACTION	0.750	0.890	**0.613**	**0.774**	0.449
LOYALTY	0.700	0.810	0.880	**0.659**	0.384
PERCEIVED QUALITY	0.560	0.540	0.670	0.620	**0.690**

Average Variance Extracted appears in the Matrix Diagonal. Correlation Matrix appears below the diagonal. Squared correlations appear above the diagonal

Analysis of the Structural Model

Having assessed the measurement model, the structural relations were added. The equations for the structural relations are shown below:

$SAT = \gamma_1$ (ETHSB) + γ_2 (PQUAL) + γ_3 (PCIMG)

$LOYAL = \beta_1$ (SAT) + γ_4 (ETHSB) + γ_5 (PQUAL) +γ_6 (PCIMG)

In terms of the overall model fit, the model's goodness of fit indices are within thresholds indicating good fit: $\chi 2$ = 111.60 (p=0.000), DF=51, $\chi 2$/df=2.188, RMSEA= 0.054, GFI = 0.96, AGFI= 0.93, NNFI= 0.99, CFI= 0.99 and standardized RMR = 0.034. These results suggest that overall the model fits well to the data. Table 3 below shows the results of the hypotheses testing for the structural model.

The results presented in Table 3 show ethical sales behavior (ϒ=0.34, t =6.53) perceived corporate image (ϒ=0.64, t =12.24) and perceived quality (ϒ=-0.12, t =-2.37) as significant predictors of satisfaction explaining 90% of the construct variance with perceived corporate image as the strongest predicator of satisfaction. As for the predictors of loyalty, satisfaction (β=0.49, t = 2.024) was found to be the only

predictor of loyalty, explaining 79% of its variance. Perceived quality, perceived corporate image and ethical sales behavior failed to have a significant direct relationship with loyalty. These results present satisfaction as a mediator of the relationship between ethical sales behavior, perceived corporate image and perceived quality on one side and loyalty on the other side. This could be further corroborated in Table 4 whereby the indirect effect of ethical sales behavior, perceived corporate image and perceived quality represents the biggest part of their total effect on loyalty.

Table 3: Structural Relations and Hypothesis Testing

Parameter	Path	Estimate	SE	t-Value	R^2	Hyp.	Result
Ethical Sales Behavior →Satisfaction	γ	0.34	0.05	6.53 **		H1	Supported
Perceived Quality →Satisfaction	γ	0.12	0.05	2.37 **		H4	Supported
Perceived Corporate Image →Satisfaction	γ	0.64	0.05	12.24 ***		H6	Supported
					0.90		
Satisfaction →Loyalty	β	0.49	0.24	2.024 **		H2	Supported
Ethical Sales Behavior →Loyalty	γ	0.16	0.12	1.38		H3	Not Supported
Perceived Quality →Loyalty	γ	0.08	0.07	1.18		H5	Not Supported
Perceived Corporate Image →Loyalty	γ	0.25	0.21	1.20		H7	Not Supported
					0.79		

, **, * indicates significance at the 10, 5 and 1 percent levels respectively. The table shows the values of the path coefficients, their significance tests and the R-squared measures for the structural model.*

Table 4: Effect Decomposition

Parameter	Direct Effect	Indirect Effect	Total Effect
Ethical Sales Behavior →Satisfaction	0.34	0.00	0.34
Perceived Corporate Image →Satisfaction	0.64	0.00	0.64
Perceived Quality →Satisfaction	0.12	0.00	0.12
Ethical Sales Behavior →Loyalty	0.16	0.17	0.33
Perceived Corporate Image →Loyalty	0.15	0.31	0.56
Perceived Quality →Loyalty	0.08	0.06	0.14
Satisfaction →Loyalty	0.49	0.00	0.49

This table shows the decomposition of the total effects to direct and indirect effects in the relation between ethical sales behavior, perceived corporate image and perceived quality on the one hand and customer loyalty on the other. When the indirect effect is larger than the direct effect, this may indicate the presence of a mediating construct, in this case satisfaction.

Power Assessment

As highlighted by Diamantopoulos and Siguaw (2000), statistical power assessment is an important but often neglected issue in model evaluation. Statistical power tests the probability that an incorrect model will be rejected. For the proposed model, and to assess the power associated with testing for exact fit, tables compiled by MacCallum, Browne and Sugawara (1996 p.144) were used. In order to attain a minimum power of 80% which was deemed sufficient by Diamantopoulos and Siguaw (2000) there must be a minimum sample size. In the case of this research, degrees of freedom are 51 and hence the minimum sample size for exact fit is 200. Given that the sample size for this research is 409, it can be inferred that the power of the analysis is good.

The analysis shows support for the main hypothesis of this study, which is that ethical sales behavior is a significant predictor of customer satisfaction and loyalty. Although a direct relationship between ethical sales behavior and loyalty was found to be statistically insignificant, the mediation effect of customer satisfaction on the relation between ethical sales behavior and loyalty has been demonstrated. This means that ethical sales behavior will result in customer loyalty through its effect on customer satisfaction. Similar results have been found for the impact of perceived service quality and perceived bank image on customer

satisfaction and loyalty. Perceived quality and image have not shown significant direct relations to customer loyalty; however their impact on loyalty is mediated through customer satisfaction.

CONCLUDING COMMENTS

This paper has examined the impact of ethical sales behavior on customer satisfaction and loyalty in the retail-banking sector in Egypt. The conceptual model has included the impact of perceived service quality and perceived corporate image as important predictors of satisfaction and loyalty, as is widely documented in the services marketing literature. Customer loyalty is an important objective to attain in the financial services context, as loyalty implies that customers will continue to deal with the bank and will recommend the bank to other customers. In turn, this will reap positive impacts on market share and profitability. The results of the analysis have shown that customer satisfaction is positively affected by a high degree of ethical behavior, as well as a positive customer perception of bank image and service quality. The results have also shown that customer satisfaction is the primary predictor of loyalty.

These results have important implications for a retail bank's sales managers and marketing function as a whole. Apparently, communication and public relations efforts that strive to build a favorable image for the bank and the quality of its services are necessary but insufficient in attaining satisfied and loyal customers. Ethical behavior by a bank's contact employees is shown to be an important predictor of customer satisfaction, which calls for special attention by sales managers. Managers have an important role to play in setting ethical standards for sales person behavior, communicating those standards and training employees accordingly. Moreover, the findings of the study have serious implications that call for bank managers to revisit how they evaluate the performance of salespeople and how they structure sales incentives. If measures of sales performance focus solely on sales targets and quantitative elements, salespeople may act in an unethical manner. This in turn will jeopardize corporate communication and marketing efforts aimed at building a favorable image and cultivating a loyal customer base. Qualitative assessment of sales person behavior with customers must accordingly be factored in performance evaluations.

Another important implication of the study's results is the need to embed the concepts and standards of ethical sales behavior in the bank's culture. This can be attained when managers themselves set and example and model ethical behavior in their own actions. Furthermore, ethical standards may be embedded as criteria in the recruitment process to ensure that incoming sales people have a minimum understanding of the elements that constitute ethical sales behavior. Moreover, the customers' interest should be placed at the heart of the selling process, and sales people should be trained to be accurate and knowledgeable in the information they convey to customers and to deliver on their promises so that customer expectations are met. These policy implications, if taken seriously, promise to enhance a bank's customer satisfaction, which translates into a long term relationship marked by customer loyalty, according to the findings of the current study.

For future research, it would be informative to conduct qualitative research to explore the retail bank customers' deeper perceptions of what constitutes ethical and unethical sales behavior and the reasons behind their perceptions. Looking at ethical sales behavior from the point of view of the sales person may also be a worthwhile direction for coming studies. Extending the current research to other financial services like insurance and financial brokerage would further extend the findings of the current study. Finally, it would be interesting to explore some variables that may moderate the relationship between our independent constructs and customer satisfaction and loyalty, such as customer knowledge about the service.

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DETERMINING OPTIMAL FLOW-TIME SCHEDULES FOR THE MULTIPLE-PRODUCT BATCH-FLOW PROBLEM

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ABSTRACT

We explore the problem of batch flow production scheduling on a single machine with deterministic demand and arrivals over a finite horizon. The objective of the production system is to minimize total flow-time over the horizon to reduce in-process inventory levels and to enable a company to compete on reduced lead-times. Prior research has established optimal single job batch quantities. However, with multiple jobs on the shop floor, a job may incur wait time, thus the optimal local batch size for a given job may not result in global minimization of the total flow-time over all jobs. Our algorithm provides optimal results for batching with different products in a capacitated production environment. Numerous recommendations for further research are presented.

JEL: M11

KEYWORDS: Scheduling, Single Machine, Batch, Flow-Time, Lead-Time

INTRODUCTION

Past research has demonstrated the impact of production-batching (or lot-sizing) decisions have on time-related performance measures when demand is deterministic, but batch sizes are flexible. One area of this research looks at batching jobs together for processing (e.g., Baptiste, 2000; Coffman, Yannakakis, Magazine, & Santos, 1990; Logendran, Carson, & Hanson, 2005; Chen, Du, & Huang, 2011; Logendran, deSzoeke, & Barnard, 2006, Ng, Cheng, & Kovalyov, 2003; Van Der Zee, 2007). A second, related, area of research looks at breaking a job into batches, i.e., batching products on a single machine along with the resultant effect on flow-times. Santos and Magazine (1985), Dobson, Karmarkar, and Rummel (1987), and Naddef and Santos (1988) studied the subject of batching to minimize flow-times on a single machine. Potts and Van Wassenhove (1992) used the term "lot-sizing" to refer to the decision on how to break a given job into smaller batches. A sub-topic of each of these papers involved determining and scheduling production batches when completed products are not available for movement until all items in a batch are complete. This situation was referred to as the batch-flow (BF) problem. All of these papers showed that the single-product batch-flow problem could be solved optimally.

Later, Shallcross (1992) presented a more efficient algorithm for solving the single-product batch-flow problem. Then, Mosheiov, Oron, and Ritov (2005) presented an integer solution to the single-product batch-flow problem. Yang (2009) extended the single-product case to include learning effects using a forward dynamic programming algorithm. Bukchin, Tzur, and Jaffe (2002) extended the single-product case for a two-machine environment. Dobson et al. (1987) explored sequencing batches to minimize flow-time on a single machine. They investigated three scenarios: 1) the item-flow problem where transfer batches may be of size one only, 2) a batch-flow problem for a single product where transfer batches are the same size as

processing batches, and 3) a batch-flow problem for multiple products with processing and transfer batches the same size. They assumed that all setups performed before processing parts are independent of the prior part type processed (sequence-independent). They used a simple index rule for the item-flow problem. Because transfer b atches of size one are an inefficient use of resources, the authors looked at two variations of batch-flow problems where transfer batches were the same size as processing batches were. For the single product batch-flow problem, they assumed a setup time before each batch and found the optimal batch quantities to process. This single product formulation, although not very useful in realistic multi-product production environments, did allow insights into batch sizing and sequencing to be used for the multiple-product case. Finally, Dobson et al. (1987) solved the optimal number of batches and the quantities in those batches. They suggested using heuristics to make local batch improvements, but did not remove batches explicitly from the production sequence to reduce the total flow-time for all jobs.

The previous research has been limited in that the more difficult multiple-product case (with jobs consisting of different products with different unit processing and setup times) has not been solved optimally in any of the papers, though heuristics have been presented (e.g., Dobson et al., 1987). In addition, the previous research assumed that all jobs would be available for processing at time zero. Although providing essential insight into the batch-flow problem, the previous research left unexplored the more realistic issue of multiple jobs with non-zero release dates (or times within a day) over a finite time horizon. When analyzing production capacity over a finite horizon, applying the scheduling formulas from the earlier papers may result in wait times for arriving jobs. These wait times, in turn, would increase total flow-time over all of the jobs; therefore, different scheduling methods must be not applied.

We investigate how to achieve optimal flow-time schedules in this complex environment. We extend and expand upon the prior work of Dobson et al. (1987) by looking at the most difficult, and realistic, scenario – the multiple-product batch flow problem. We illustrate how scheduling issues may result when using the optimal batch sizes calculated in prior research. Those batches are optimal only if no subsequent jobs are ready to be processed until after the first job is finished completely. However, if jobs are ready and waiting, we want to provide guidance on how to determine whether reducing the number of batches (effectively by removing setups on earlier jobs) could reduce wait time of later jobs, thus resulting in global flow-time reduction. To provide fuller coverage of potential scenarios that a scheduler may encounter, we show how to process batches of identical size, discrete batch quantities, and jobs where batches are not allowed to be commingled (e.g., government materials). We examine scenarios where all jobs are released at time zero (as in Dobson et al. (1987) and with spaced inter-arrival times. We also extend the commingled batches in Dobson et al. (1987) to solve the situation where products must be kept segregated throughout processing. We develop an algorithm to sequence work optimally under all of these scenarios. We simulate diverse production environments to demonstrate that our proposed method does, indeed, outperform the prior methods presented in the literature.

The use of different scheduling methods is an important area to investigate further because inventory and throughput are related to scheduling decisions. Little's Law states that flow-time equals inventory divided by throughput. If we can reduce flow-time over the horizon, we are able either to lower average inventory on hand or to increase throughput (parts produced by time), or both. Having inventory in the form of raw materials or work in process is money tied up that needs to be borrowed. Alternatively, inventory incurs an opportunity cost. Throughput is the rate that the system makes money. If throughput were increased, we would be able to produce value-added products more quickly; thus, we could sell them sooner and be better off financially according to the time value of money. Being able to use the same machine to process all products required, but more quickly, could reduce money tied up in inventory, and increase customer service levels and revenue. The remainder of this paper is organized as follows. The next section provides a literature review of the batch-flow problem structure and the results of prior research for the single-machine case. Next, we present the data and the methodology used to study the specific batch-flow problem

formulation examined in our paper. The subsequent section discusses the results from implementing our proposed algorithm. The paper closes with concluding comments.

LITERATURE REVIEW

The issue examined in our paper is a single-machine production loading and scheduling problem with deterministic system parameters. The single-machine problem is well researched and best presented by Dobson et al. (1987). In their model, they assumed that a known quantity of items is available for processing at a machine. This quantity is to be divided into batches for producing and transferring the items from the machine. After a batch is completed, it is removed from the machine and available for movement. The next batch then can be started. In this formulation, production batches and transfer batches are the same size. Because of the time required to move the completed products off the machine, each batch incurs a transfer time to remove the batch and to transfer it to the next work center, during which the machine is non-productive and not available to process the next batch. Using the terminology of Cheng, Mukherjee, and Sarin (2013), this transfer and removal time would have the same effect on flow-time that a sublot-attached setup would have. One example in which process and transfer batches are equal is found in shops where movement of batches between machines might be accomplished using containers such as pallets or carts (Webster & Baker, 1995). A second example provided by Coffman et al. (1990) considered pick and place machines loaded with chips of various sizes that are inserted into circuit boards. Upon completion, each circuit board is loaded onto a cart by the operator of the pick and place machine. Then, the operator of the pick and place machine periodically stops production and moves the cart to a soldering machine. Our research focuses on the single machine problem, with *n* jobs in an over-capacitated situation for both the single-product and the multiple-product cases. The formulation used in this paper for the single-product case follows:

i = the number of batches of a product in a job.
d = the number of items in a job.
p = the unit processing time for each unit in a job.
s = the removal and transfer time for each batch of a job. Alternatively, this term may be used for setup time before running an individual batch.
M = an upper bound on the number of batches for a job.

If q_i = quantity of items processed in batch *i*, the batch-flow problem for the single-product case [BF1] can be formulated as:

$$\min \sum_{i=1}^{M} q_i \sum_{k=1}^{i} (s + pq_k) \tag{1}$$

$$\sum_{i=1}^{M} q_i = d \tag{2}$$

$$\text{Where } q_i \geq 0, i = 1,..,M$$

Dobson et al. (1987) showed that the optimal number of batches (k^*) to solve [BF1] is found using the following:

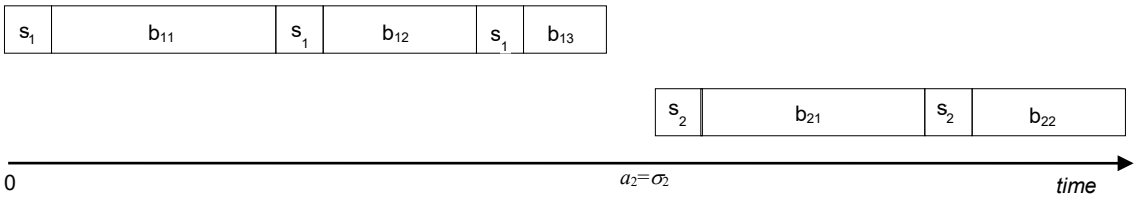
$$k^* = \left\lceil \sqrt{\frac{1}{4} + \frac{2dp}{s}} - \frac{1}{2} \right\rceil \tag{3}$$

The optimal size of each batch (q_i^*) is found using the modified formula in the second heuristic from Dobson et al. (1987). This modification is used such that the optimal number of batches from (3) could be used ($k' = k^*$), or any k' less than k^* could be used to produce fewer batches at the expense of increased job flow-time.

$$q_i^* = \frac{d_i}{k_i} + \frac{s}{p}\left(\frac{k_i - 1}{2}\right), i = 1,..,k' \quad (4)$$

In (4), d_i is the demand remaining after $i - 1$ batches have been scheduled, $k_i = k' - (i-1)$ and the quantity for batch $i = \max(q_i^*, 0)$ to ensure positive quantity values. The batches per job are scheduled in non-increasing order. This ordering of batches may seem contrary to traditional scheduling methods based on the shortest processing time (SPT) concept, where the smallest processing time requirements are handled first. However, it does follow that when demand is heavy at a machine, larger batches should be produced first to decrease the size of the queue rapidly. As demand lessens, batch sizes could be decreased to concentrate more on individual item flow. These quantities produced from (4) also are supported by the findings of papers on the repetitive lots concept (Jacobs & Bragg, 1988) and lot streaming (Cheng et al., 2013; Kalir & Sarin, 2000; Ramasesh, Fu, Fong, & Hayya, 2000, Glass & Possani, 2011). Figure 1 illustrates the batching structure created by (3) and (4). The notation b_{ij} in Figure 1 represents the i^{th} batch in job j. For ease of understanding, we have used s_1 to represent the setup time before running each batch of product 1 and s_2 to represent the setup time before running each batch of product 2 However, the s terms may represent transfer times between operations in many businesses. The job arrival time is represented by a_j and the job processing start time is represented by σ_j.

Figure 1: Two-Job Schedule without Capacity Issues



This figure shows two jobs—Jobs 1 and 2. Job 1 is broken down into Batches 1, 2, and 3. Before each batch in Job 1 is run, a setup occurs. Job 2 is broken down into Batches 1 and 2. Before each batch in Job 2 is run, a setup occurs. As shown above, Batch 3 of Job 1 would be completed before Job 2 arrives. Hence, Job 2 would not incur wait time.

The batch flow-time is found by multiplying the quantity in each batch by the batch completion time. The total flow-time for a job is the sum of all batch flow-times using (1). Though Dobson et al. (1987) focused on choosing both the optimal number of batches and the batch sizes, (4) also could provide the optimal batch sizes given any value of k to which one might be restricted. If, for some reason, the scheduler were limited to breaking the processing requirement into a non-optimal number of batches (i.e., k'), the optimal batch sizes could be found by applying Equation (4) repetitively. For illustration, assume that job 1 arrives at time 0, with demand (d) of 21 units, batch setup time (s) of 25, and processing time per unit (p) of 5. From (3), the value of 2.44 would have a ceiling function applied, setting the optimal number of batches (k^*) to 3. We would set k' to our optimal k^* initially to compute the job flow-time. We then would use Equation (4) three times (i = 1, 2, 3) to calculate the appropriate batch quantities, as follows:

Step 1: Demand Remaining = 21 & Batch Quantity = 12.
Step 2: Demand Remaining = 9 & Batch Quantity = 7.

Step 3: Demand Remaining = 2 & Batch Quantity = 2.

Identical Batch Sizes

Dobson et al. (1987) also assumed that the scheduler is free to select arbitrary sizes for the different batches. Realistically, however, a scheduler might be limited to scheduling batches of as nearly identical size as possible. In that case, it can be shown that the optimal number of batches k^{**} is found by:

$$k^{**} = \left\lfloor \sqrt{\frac{2dp}{s}} \right\rfloor \tag{5}$$

The optimal batch sizes (q^{**}) all are set initially at:

$$q^{**} = \left\lfloor \frac{d}{k^{**}} \right\rfloor \tag{6}$$

The remaining x units would be assigned one each to the first x batches. For example, if $d = 75$, $p = 1$, and $s = 2$, then $k^{**} = 8, q^{**} = 9, x = 3$. The resultant batch sizes would be 10, 10, 10, 9, 9, 9, 9, and 9, with a total flow-time of 3,825.

Discrete Batch Sizes

Often, batch sizes calculated from (4) are non-integer. For discrete products, the quantities could be modified according to Mosheiov, Oron, and Ritov (2005) and Mosheiov and Oron (2008). For example, we could revisit our original example with job 1 with demand (d) of 21 units, setup time (s) of 25, and processing time per unit (p) of 4 (rather than 5). From (3), the optimal number of batches (k^*) would equal 3. We would set k' to our optimal k^* to compute the flow-time. Again, we would use (4) to calculate the appropriate continuous batch quantities. Next, the fractional units would be calculated as $q_i - \lfloor q_i \rfloor$. We then would use (7) to find the sum of fractional units to determine the number of batches (B) to round up to integer values.

$$B = \sum_{i=1}^{k^*} \left(q_i - \lfloor q_i \rfloor \right) \tag{7}$$

The B batches with the highest fractional portions would have a ceiling function applied. Next, the remaining ($k' - B$) batches would have a floor function applied. In the case where more than one batch had the same highest fractional portion, the ceiling function would be applied to the earliest of those batches. For our example, B =1 ([13.25 – 13] + [7 – 7] + [.75 – 0]). Batch 3 has the highest fractional portion of .75, so a ceiling function would be applied to make it a quantity of 1. The remaining two batches (1 & 2) would have a floor function applied to their quantities. The integer batches that produce the optimal flow-time for this job would be 13, 7, and 1 (as shown in Table 1). Note: For integer batches, it is theoretically possible to have a tie with other batch quantity values for minimum flow-time.

Table 1: Converting Fractional Batch Quantities to Integer Values

i	Demand Remaining	Batch Quantity q_i	Fractional Value	Integer q_i
1	21	13.25	0.25	13
2	7.75	7	0	7
3	0.75	0.75	0.75	1

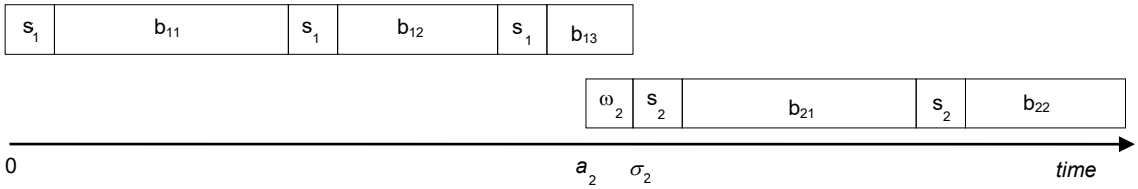
This table shows how to convert fractional batch quantities to integer values. We use the demand remaining in Equation (4) to calculate the continuous batch quantities. Next, we determine the fractional value for each batch. After that, we use Equation (7) to determine the number of batches to round up to integer values. Given that B = 1, we search for the one batch with the highest fractional value (Batch 1) and round its quantity up to an integer value. Then, we round down the quantities for the remaining batches with fractional values.

DATA AND METHODOLOGY

Problem Formulation

Dobson et al. (1987) provided many important results, including optimal formulas for the single-product batch-flow problem. However, they did not address how production capacity limits could affect multiple-product batching decisions and the resultant flow-time over a finite horizon. Also, they assumed that items arrive in groups for processing (hereafter, these groups are referred to as "jobs"), with the first job ready at time zero and the remaining jobs ready at known arrival points in the future. Finally, they did not provide guidance on how to sequence jobs when multiple jobs are ready to be processed at the same time. We fill in these gaps with our proposed model. To demonstrate the impact of capacity constraints, consider the two-job example in Figure 2, where each job is represented by a horizontal bar, with the length of the bar representing the processing time requirement of the job. Clearly, if all the jobs could be batched individually and processed completely before the next job arrival, then (3) would suffice to calculate the number of batches per job. However, consider when the processing time requirement of all the jobs approaches capacity over the horizon (or a portion of it). In that case, breaking up the jobs into batches, with the additional setup time required for each batch, may induce wait times for later jobs. For example, assume that job 2 arrives before the last batch of job 1 finishes.

Figure 2: Two-Job Schedule—Job 2 Arrives before Job 1 Finishes



This figure shows two jobs—Jobs 1 and 2. Job 1 is broken down into Batches 1, 2, and 3. Before each batch in Job 1 is run, a setup occurs. Job 2 is broken down into Batches 1 and 2. Before each batch in Job 2 is run, a setup occurs. As shown above, Batch 3 of Job 1 would not be completed before Job 2 arrives. Hence, Job 2 would incur wait time.

Because waiting time (denoted ω_j for job *j*) would increase the flow-time for a job, applying Equation (3) to determine the number of batches for each job in isolation may not result in minimum total flow-time over all of the jobs in the schedule. In that case, another method must be found to minimize total flow-time across all jobs. In this problem, multiple jobs are scheduled to arrive over a finite horizon at a single machine for processing. Each job contains multiple identical items, and different jobs may contain different products with unique processing and transfer times. Processing time requirements for the jobs are approaching, or exceeding, capacity over the horizon. The jobs are to be processed in a batch-flow method, i.e., no items in a batch are ready for movement until the last item in the batch is complete. The scheduler is free to choose the number and the size of batches for each job, and the objective is to minimize total flow-time over all

jobs over the time horizon. Other assumptions of the model include the following: Job and machine characteristics are not alterable in the short term (i.e., there is no way to increase the machine capacities or to reduce product setup times, etc.). For notation, time zero is indexed at the arrival of the first job. Let there be *n* jobs to schedule for processing. Let *j = 1,..., n* index the jobs in the order of their arrival. Let k_j be the number of batches that job *j* is broken into, and $i = 1,..,k_j$ index the batches for job *j* in processing order. Also, let q_{ij} = the quantity processed in the i^{th} batch of job *j*, σ_{ij} = the start time of the i^{th} batch of job *j*, and τ_j = the completion time of job *j*. Assume that the following are known and fixed:

d_j = the number of units in job *j*.
p_j = the unit processing time for each unit of job *j*.
s_j = the transfer time (or setup time) of a batch of job *j*.
a_j = the arrival time of job *j*, measured from time zero.

The multiple-product problem now can be written as:

$$\min \sum_{j=1}^{n} \sum_{i=1}^{k_j} q_{ij} * \left[\sigma_{1j} - a_j + \sum_{m=1}^{i} \left[\left(q_{mj} * p_j \right) + s_j \right] \right] \tag{8}$$

s. t.

$$\sum_{i=1}^{k_j} q_{ij} = d_j \tag{9}$$

$$\tau_j = \sigma_{1j} + \left(d_j * p_j \right) + \left(k_j * s_j \right) \tag{10}$$

$$\sigma_{11} = 0 \tag{11}$$

$$\sigma_{1j} = \max[\tau_{j-1}, a_j], \qquad j > 1 \tag{12}$$

$$\sigma_{ij} = \sigma_{1j} + \sum_{m=1}^{k_j - 1} \left[\left(q_{mj} * p_j \right) + s_j \right], \qquad i > 1 \tag{13}$$

$$q_{ij} > 0, \qquad \forall i, j \tag{14}$$

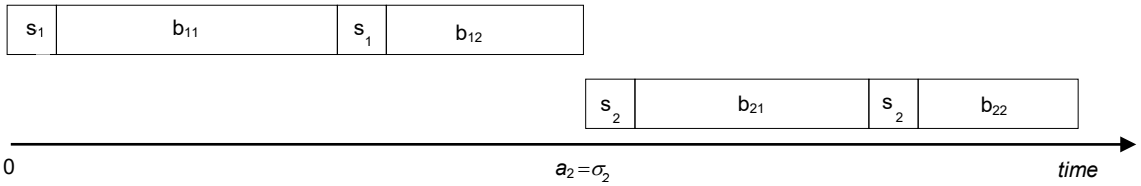
The first constraint ensures that all items are processed. The next four constraints ensure proper job start times based on processing precedence. The definition of τ_j is provided to simplify notation. The next section presents an algorithm developed to solve this problem. This algorithm is built upon the optimality properties of Equations (3) and (4) extended to the multiple-product problem. First, the logic behind the algorithm is explained, followed by a brief discussion of relaxation of the arrival/waiting constraint. Next, the algorithm is formally stated.

Multiple-Product Algorithm

Given that Equations (3) and (4) provide the optimal continuous batches for the single-product unconstrained problem, the results from Dobson et al. (1987) provide a good starting point for solving the multiple-product problem. First, consider the two-job problem illustrated in Figure 2. Given any start time for each job, the batches shown (assumed to be calculated from Equation (4)) would minimize each job's individual flow-time. Given that, it is obvious that the only way to reduce flow-time further would be to reduce the wait time for the second job ($\omega_2 = \sigma_2 - a_2$). Because job 2 cannot start until job 1 is completed, the only way to reduce the wait time for job 2 would be to reduce the makespan of job 1, thereby allowing job 2 to start earlier than currently scheduled. The current makespan of job 1 is $\left(d_1 * p_1 \right) + 3s_1$. The

processing time required by job 1 cannot be changed; however, the total transfer time associated with job 1 could be reduced by reducing the number of batches in job 1 (k_1). Each reduction in k_1 would reduce the total transfer time of job 1 and the makespan of job 1 by s_1. If a batch were removed from job 1, its flow-time normally would increase. Note: Because this is a discrete schedule, reducing the number of batches by one from the computed optimal value occasionally could result in no change in flow-time. For example, assume that job 1 in the two-job problem represented in Figure 2 is rescheduled into two batches, thus removing a batch from job 1. The revised schedule is depicted in Figure 3. Decreasing the number of batches in job 1 is not optimal for that job (i.e., removing a batch increases the flow-time for job 1). However, the resultant reduction in transfer time decreases the wait time for job 2, reducing the total flow-time of job 2, which in turn, may reduce the total flow-time over all jobs. In this example, job 2 can start immediately when it arrives ($\sigma_2=a_2$) after the re-batching of job 1.

Figure 3: Reduction of *k* for Job 1 Eliminates Wait Time for Job 2



This figure shows two jobs—Jobs 1 and 2. Job 1 now is broken down into fewer batches—Batches 1 & 2. Before each batch in Job 1 is run, a setup occurs. Job 2 still is broken down into Batches 1 and 2. Before each batch in Job 2 is run, a setup occurs. As shown above, Batch 2 of Job 1 now will be completed before Job 2 arrives. Hence, Job 2 will no longer incur wait time.

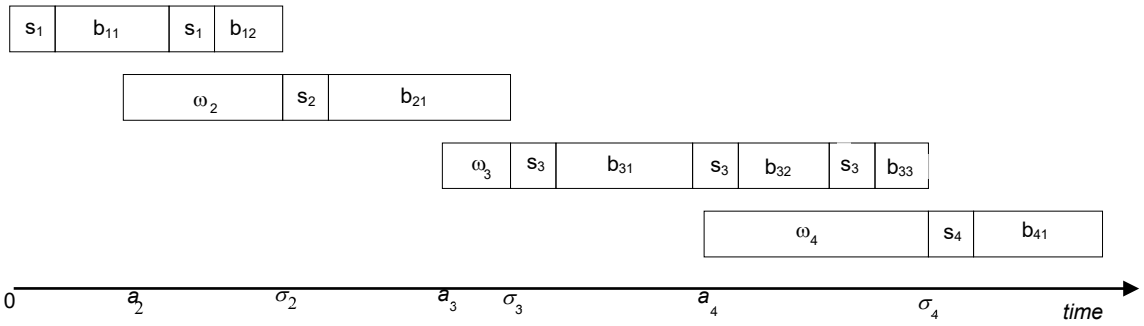
Generally, as a function of k_j, optimal job flow-time is convex, increasing left of k^* from Equation (3). However, ω_2 will decrease by $\delta_2 = \min\{\omega_2, s_1\}$, and the flow-time for job 2 will decrease by $\delta_2 * d_2$. If a reduction in k_1 results in a net increase in total flow-time for all jobs, there is no way to reduce total flow-time, and the current schedule is optimal. However, if a reduction in k_1 results in a net decrease in total flow-time over all jobs, this change should be made. In that case, job 1 would be rescheduled using (4) with $k_1 = k_1^* - 1$. If ω_2 were still positive, the rescheduling process would repeat as long as it results in a decrease in total flow-time, setting $k_1 = k_1^* - y$, where y is the number of batches removed from job 1. When $\omega_2 = 0, k_1 = 1$, or a reduction in k_1 results in an increase in total flow-time, the process stops, and the current schedule is optimal. The same logic could be extended to problems with more than two jobs. Figure 4 shows an example four-job problem where the wait time of jobs 2, 3, and 4 may be reduced by removing a batch from job 1.

For further illustration, assume a schedule with two jobs. Job 1 has $d = 200$, $p = 25$, $s = 100$ and arrival time by default set at $t = 0$. Job 2 has $d = 100$, $p = 1$, $s = 100$, arrival time $t = 2{,}000$. Using (3) and (4), we calculate the optimal number of batches and their respective quantities. In this example, $k_1^* = 10$, $k_2^* = 1$, $\sigma_2 = 5{,}000$, and $\omega_2 = 3{,}000$. From this, we can produce the data in Table 3, shown in Figure 5. The two lemmas below are demonstrated in Figure 5.

Lemma 1: Flow-time for downstream jobs may decrease linearly if wait time is reduced by eliminating batches from an upstream job. Eliminating y_j batches from the calculated k^* in Equation (3) for an upstream job j can decrease the flow-time of downstream jobs. Let this reduction of flow-time for downstream jobs from job j be represented by r_j^y, with an upper limit of:

$$\hat{r}_j^y = \min(w_{j+1}, y_j * s_j) * \sum_{m=j+1}^{n} d_m \qquad (15)$$

Figure 4: Representative Four-Job Schedule



This figure shows four jobs broken into batches deemed optimal given prior research methods. However, as scheduled, Jobs 2, 3, and 4 incur wait time, which may increase the total flow-time. We propose that reducing the number of batches (setups) in upstream (earlier) jobs may decrease the total flow-time over all jobs.

The actual value of r_j^y depends on the structure of any specific problem and can be found from the resultant batch schedule for any value of y. As a function of y, r_j^y is stepwise linear, non-decreasing from $y = 1$ to $k_j^* - 1$. Its value would be calculated for increasing values of y_j (# of batches removed from job j). Removing a batch from an upstream job j may remove $\min\{s_j, \omega_{j+1}\}$ from downstream jobs. Flow-time reduction for downstream jobs is the wait time removed per job multiplied by the demand (number of units) for that job. As long as there is remaining wait time for job $j + 1$, removing more batches from job j (increasing y_j) can reduce flow-time of the downstream jobs. The two-job example presented above is used to show this flow-time reduction of a downstream job in Table 2 and Figure 5, where the x-axis is the number of batches removed (y_1) from the $k_1{}^*$ calculated in (3) for job 1. The line labeled "Incremental r" on the graph in Figure 5 shows the incremental reduction in flow-time for job 2 from removing the y^{th} batch from job 1 ($r_1^y - r_1^{y-1}$). This equals zero for $y = 0$ and any value of y for which there is no reduction in ω_2 . However, in this example, job 2 still would incur waiting time even if we removed all nine batches possible (recall that $k_1^* = 10$) from job 1.

Table 2: Batch Scheduling Results from Example Problem

y	k_1	Job 1 Total Flow	Job 2 Total Flow	Job Set Total Flow	g_1^y	r_1^y	$g_1^y - g_1^{y-1}$	$r_1^y - r_1^{y-1}$
0	10	643,500	620,000	1,263,500	0	0	0	0
1	9	643,575	610,000	1,253,575	75	10,000	75	10,000
2	8	644,100	600,000	1,244,100	600	20,000	525	10,000
3	7	645,850	590,000	1,235,850	2,350	30,000	1,750	10,000
4	6	649,850	580,000	1,229,850	6,350	40,000	4,000	10,000
5	5	658,000	570,000	1,228,000	14,500	50,000	8,150	10,000
6	4	674,000	560,000	1,234,000	30,500	60,000	16,000	10,000
7	3	706,275	550,000	1,256,275	62,775	70,000	32,275	10,000
8	2	779,900	540,000	1,319,900	136,400	80,000	73,625	10,000
9	1	1,020,000	530,000	1,550,000	376,500	90,000	240,100	10,000

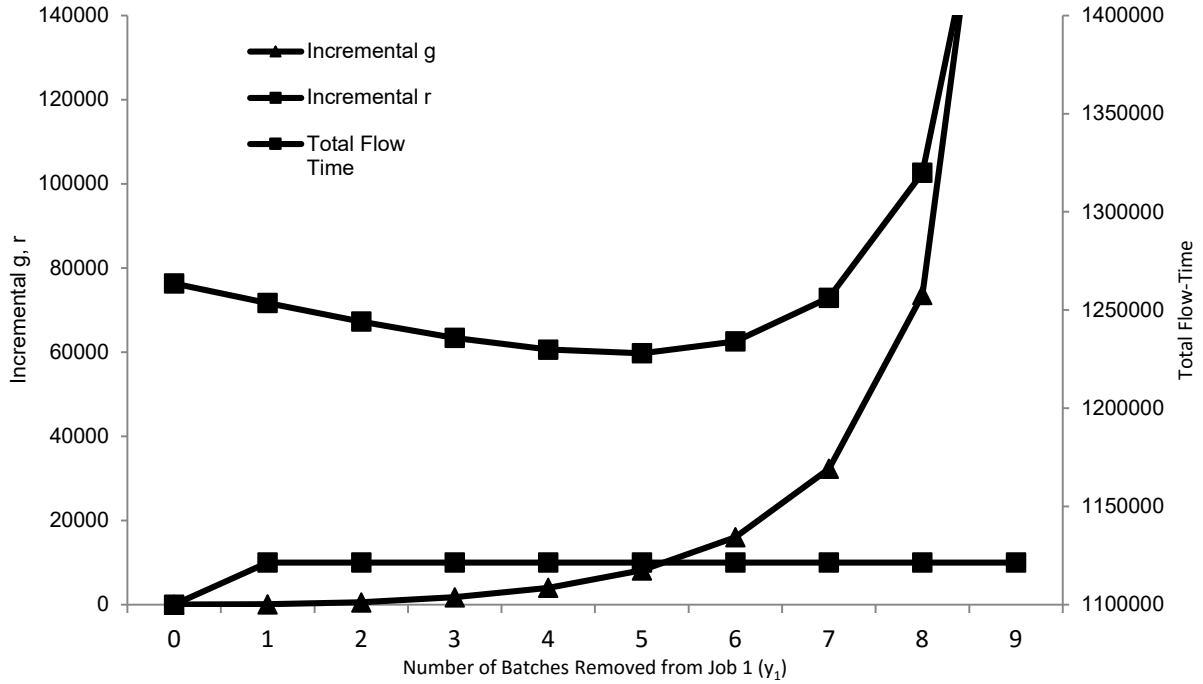
This table shows a numerical example with two jobs, each job's local (individual) flow-time, and total flow-time over all jobs after removing y setups from job 1. The cumulative increase in the local flow-time of job 1 due to removing setups (i.e., decreasing the number of batches from the optimal) is shown as g. The corresponding cumulative reduction in local flow-time for all downstream batches (job 2) is shown as r. The last two columns show the incremental effect on the g and r terms due to removing one more setup (batch) from job 1.

Lemma 2: Flow-time for a given job increases geometrically with the number of batches eliminated from the optimal k for that job as determined with (3). Removing batches for job j increases the flow-time for job j by delaying the completion of the original quantities of the $k_j{}^*$ - y batches. Let z_{ij}^y denote the incremental batch quantity for batch i on job j after reducing the number of batches by y (i.e., z_{ij}^y is the

quantity increase to batch *i* of job *j* as the total demand needs to be satisfied using fewer batches (k_j^y) than the optimal(k_j^*)). Let $k_j^y = k_j^* - y$, and q_{ij} denote the original batch quantities for the k_j^* batches as determined by (3) and (4). For job *j*, the increase in flow-time (g_j^y) is given by Equation (16). Equation (16) follows from algebraic manipulation of the flow-times with k_j^y batches minus the flow-time with k_j^* batches.

$$g_j^y = \sum_{i=1}^{k_j^y}\left[q_{ij} * p_j * \sum_{x=1}^{i} z_{xj}^y\right] - \sum_{i=k_j^y+1}^{k_j^*}\left[q_{ij} * \sum_{x=1}^{i}\left[(q_{xj} * p_j) + s_j\right]\right] + \sum_{i=1}^{k_j^y}\left[z_{ij}^y * \sum_{x=1}^{i}\left[\left(\left(z_{xj}^y + q_{xj}\right) * p_j\right) + s_j\right]\right] \quad (16)$$

Figure 5: Net Change in Flow-Time as Batches Are Removed



This figure shows the individual effects of local flow-time for job 1 increasing (incremental g), flow-time of downstream jobs decreasing (incremental r), and the combined total flow-time net result. As long as the slope of the total flow-time is negative, removing a batch (and its setup) from an upstream job results in a net reduction in total flow-time over all jobs.

From Equation (4), batch quantities increase for remaining batches of a given job when its *k* is reduced. In addition, as the number of batches removed (*y*) increases, z_{ij}^y increases at an increasing rate for the remaining batches. The first term in Equation (16) is the incremental additional flow-time for the first k_j^y batch's original quantities caused by waiting for the additional processing time of their increased batch sizes (*z* increments). The second term is the removal of flow-time from the original last *y* batches because we are no longer using k_j^* batches, but rather are using $k_j^y = k_j^* - y$ batches. The final term adds back the flow-time for the additional z_{ij}^y units to be processed in each of the new k_j^y batches. The incremental effect of Equation (16) is shown in Figure 5. The line labeled "Incremental g" shows the incremental increase in the flow-time of job 1 by removing the y^{th} batch from job 1 ($g_1^y - g_1^{y-1}$). By comparing both incremental lines, we can see how large *y* should be to minimize total flow-time. As long as the incremental *r* is greater

than the incremental *g* for a particular value of *y*, removing the y^{th} batch will reduce total flow-time for the entire schedule. Similar logic to that shown above for $n = 2$ can be applied to scheduling a multiple-product problem with $n > 2$. Consider the representative batch schedule shown in Figure 4 ($n = 4$), and assume the batches shown are optimal for each individual job. Because there is wait time for jobs 2 through 4, reductions in k_1, k_2 or k_3 will decrease the flow-time of the respective downstream job(s). Given this starting schedule, reducing k_1 will provide the greatest decrease in downstream flow-time. As k_1 is decreased, it eventually will stop being the best candidate for reduction as ω_2 is eliminated or the increase in flow-time for job 1 becomes so large that another k_j becomes the better choice for reduction. As long as at least one ω_j remains positive, there is a potential for benefit from reducing an appropriate k_{j-1}. For any $\omega_j = 0$, there will be no possible benefit from reducing k_{j-1}.

Proposition 1: After k_j^y is found for any job *j* such that the net total flow-time of all jobs does not decrease, further reductions in k_j^y can only further increase total flow-time.

Proof: Let $k_j^{y'}$ be the first number of batches evaluated (smallest *y*) where the total flow-time of all jobs does not decrease. This means the incremental increase in g_j^y is no longer fully offset by the incremental increase in r_j^y. From Lemma 1, r_j^y increases linearly, and from Lemma 2, g_j^y increases geometrically as k_j^y is decreased from k_j^*. Therefore, no number of batches less than $k_j^{y'}$ can further decrease total flow-time. By evaluating these net total flow-time trade-offs, an improved final solution could be found from the original one shown in Figure 4. Proposition 1 allows us to specify our algorithm. A logical method of evaluating and choosing reductions in k_j is presented in §4.3.

Discussion on Relaxation of Arrival Times

In the current model, jobs are processed in the order of their arrival. However, which job should be selected if two jobs are waiting at the completion of the current job, or arrive at the same time?

Proposition 2: If two jobs are ready at the same time, then if $d_2(k_1 s_1 + p_1 d_1) > d_1(k_2 s_2 + p_2 d_2)$, schedule job 2 first. Otherwise, schedule job 1 first.

Proof: The proof follows from algebraic manipulation of the flow-times of the two cases:

$A = d_1(k_1 s_1 + p_1 d_1) + d_2(k_1 s_1 + p_1 d_1 + k_2 s_2 + p_2 d_2)$ when job 1 is processed before job 2, and $B = d_2(k_2 s_2 + p_2 d_2) + d_1(k_1 s_1 + p_1 d_1 + k_2 s_2 + p_2 d_2)$ when job 2 is processed before job 1. Comparing A with B and simplifying leaves the inequality $d_2(k_1 s_1 + p_1 d_1) > d_1(k_2 s_2 + p_2 d_2)$ to indicate that job 2 should proceed before job 1 to minimize total flow-time.

Similarly, for *m* jobs waiting to be processed on the machine, the job *j* with the highest value of $d_j(k_i s_i + p_i d_i) - d_i(k_j s_j + p_j d_j),\ i, j = 1,..,m,\ i \neq j$, is processed first to minimize the total flow-time equations over all jobs competing for the same capacity. Similarly, for the remaining *m-1* jobs, the next highest value of $d_j(k_i s_i + p_i d_i) - d_i(k_j s_j + p_j d_j),\ i, j = 1,..,m-1,\ i \neq j$ is then processed, with repeated application of that equation until there is only one job left to sequence.

Algorithm Statement

Because total flow-time is a function of k_j (the only variable in the problem), a simple type of search method (i.e., marginal analysis) was chosen to drive the multiple-product algorithm. The starting point for the algorithm is the solution where the number of batches for each job (k_j) is set at the optimal level (k_j^*) determined from Equation (3) from Dobson et al. (1987) for a single job. Next, each job is analyzed (beginning with job 1), subtracting one batch at a time until there is no more reduction in total flow-time, there is no more wait time in the system, or k_j has been set to one batch. This algorithm is applied to the first $n - 1$ jobs. From Proposition 1, we can set a general upper bound on the number of iterations of the algorithm until the optimal solution is achieved.

$$U = \sum_{j=1}^{n-1} k_j^* \tag{17}$$

Algorithm Steps

Calculate k_j^* and q_{ij}^* for each of the $j = 1,\ldots, n$ jobs using (3) and (4)

Set $k_j = k_j^*$ for all j
Set $j = 1$
Set $r_j^0 = g_j^0 = 0$
For each job j, $j = 1, \ldots, n\text{-}1$
For $y = 1$ to $k_j^* - 1$

Calculate batch sizes from (4) and resultant schedule

Calculate g_j^y and r_j^y
If $g_j^y - g_j^{y-1} > r_j^y - r_j^{y-1}$, then exit loop, 'no more reductions possible'
Set $k_j = k_j^y$
Next y
Next job j

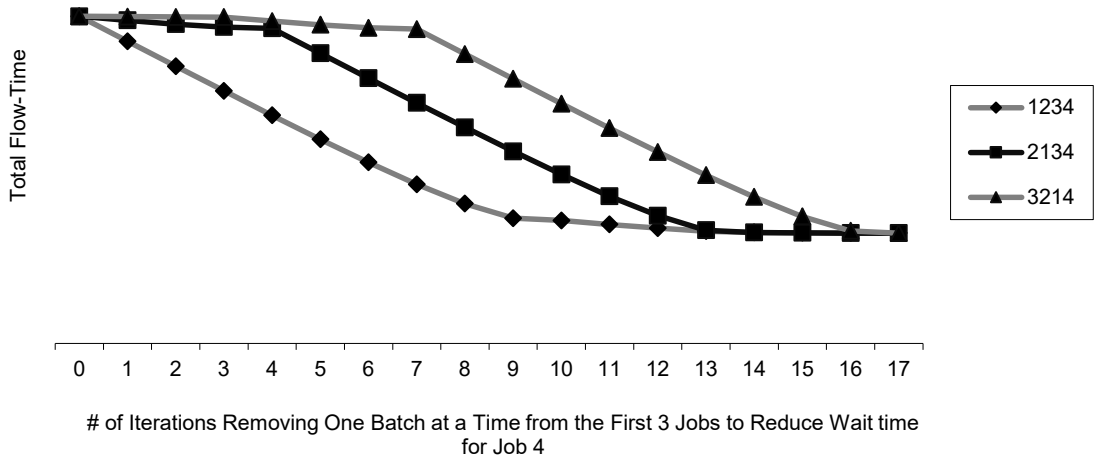
Although our proposed algorithm analyzes jobs in sequential order, this is not necessary to achieve the optimal flow-time in a fixed number of iterations (as bounded by Equation (17)). Figure 6 shows a four-job example, with the first three jobs ready to process at the same time and the fourth job released later (thus always scheduled last). The figure shows the effect on total flow-time by applying the algorithm to reduce setups on the first three jobs for three different sequences. The *x*-axis specifies the number of batches removed from the original $k_j^*, j = 1,\ldots,n-1$, batches calculated using Equation (3). Although not drawn in the figure (for readability, only three sequences are shown), investigating all six possible sequences of the first three jobs for setup reduction has the same final flow-time effect. Therefore, the order in which jobs are investigated with our formulae does not affect attainment of the optimal flow-time. The next section describes the experimental design. This is followed by a section that re-examines the commingled batches all arriving at time 0, as done in Dobson et al. (1987). The final sections are our conclusions and recommendations for further research.

Experimental Design

To test the effectiveness of the multiple-product algorithm for the case where commingling of products is not allowed, the following experimental factors were considered:

Number of problems: 1,000
Number of jobs/products per problem: Randomly generated as U(2, 100)
Number of units in a job (demand): U(1, 1,000)
Unit processing time for each unit of a job: U(1, 50) minutes
Transfer time for a batch within a job: U(1, 100) minutes
Inter-arrival times between jobs: U(1, 1,000) minutes.

Figure 6: Flow-Time Reduction Per Iteration For Various Job Sequences (Four-Job Scenario)



This figure shows an example with three jobs available for processing at the same time, with a fourth job arriving later. If when using Equations (15) and (16) we determine that removing a batch setup from an upstream job results in a net reduction in total flow-time, that setup should be removed. The three lines in the figure show the effect on total flow-time from removing all possible additional setups (beyond the required first setup) from each of the first three jobs in three sequences: Jobs 1-2-3-4, Jobs 2-1-3-4, and Jobs 3-2-1-4. For example, in the job sequence 1-2-3-4, all additional setups (beyond the first setup required for each job) would be removed from Jobs 1, 2, and 3. Each of these jobs would be processed with a single setup (batch) required for each job. Regardless of the sequence analyzed, minimum flow-time for the four jobs is achieved. The order in which jobs are examined for removing setups does not matter when using our algorithm.

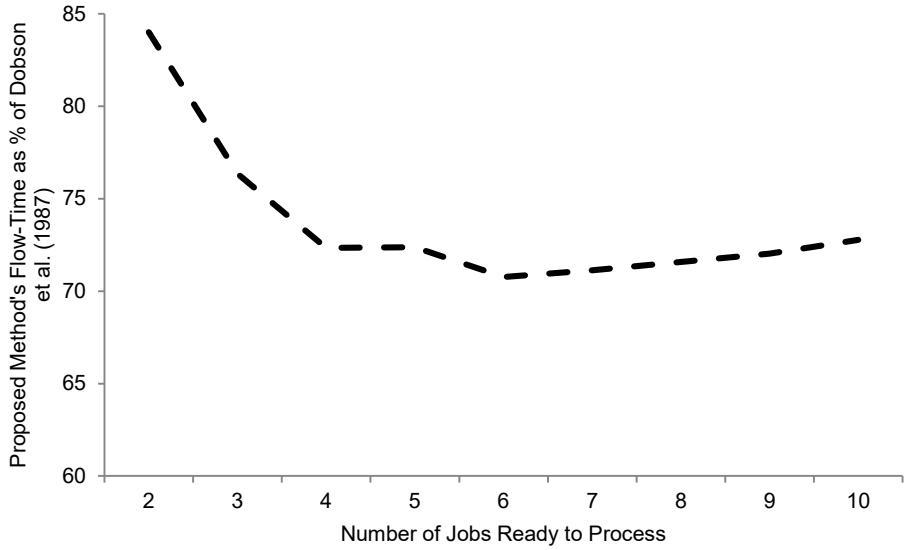
We used a Visual Basic program to generate the 1,000 problems. For each problem, the algorithm was applied and the total flow-time was determined. Because, Dobson et al. (1987) assumed commingled batches and no inter-arrival times, we are demonstrating here just that our method achieves the optimal global flow-time quickly. In Section 6, we compare our proposed algorithm with Dobson et al. (1987) under scenarios mimicking what they used.

RESULTS AND DISCUSSION

As noted in our experimental setup, we allowed commingling (intermixing) of batches from different products, and sequenced these batches according to Conway et al. (1967). We used our new algorithm to calculate the *g* and *r* parameters to find batch setups that could be removed (increasing the local flow-time for a particular job, but resulting in a global reduction in flow-time). Figure 7 shows the results of 10,000 simulated scenarios. The *x*-axis shows the number of products to be produced and the y-axis shows what percent of Dobson et al.'s (1987) method flow-time our new method achieved. As can be seen, our method

achieved a better than 26% reduction in flow-time (averaged over all 10,000 test cases) from the original algorithm proposed by Dobson et al. (1987). When there were only a few jobs to investigate for potential setup reductions, sometimes there were no improvements that could be made (i.e., with two products, a few scenarios did not have an opportunity for our method to improve upon Dobson et al. (1987)). However, with more jobs, there were more opportunities to apply our new algorithm to reduce total flow-time substantially.

Figure 7: Proposed Method's Flow-Time As % of Solution Using Dobson Et al. (1987) Algorithm



This figure shows the total flow-time our method achieved compared to that presented as optimal for the single-product case in Dobson et al. (1987). Given that Dobson et al. (1987) computed batch sizes for a single job only, their algorithm cannot be optimal when more than one job is available on the shop floor. We simulated 10,000 production schedules varying from 2 to 10 jobs available simultaneously. With only 2 or 3 jobs in a production schedule, there was less wait time to eliminate using our method. However, as more jobs (4 or more) were available, removing setups from upstream (earlier) jobs resulted in total flow-time reductions. As the figure shows, our total flow-time was less than 75% of the flow-time that would have resulted from applying the algorithm presented originally by Dobson et al. (1987).

As can be seen, our proposed method achieved a better than 26% reduction in flow-time (averaged over all 10,000 test cases) from the original single-product algorithm proposed by Dobson et al. (1987). When there were only a few jobs to investigate for potential setup reductions, sometimes there were no improvements that could be made (i.e., with two products, a few scenarios did not have an opportunity for our method to improve upon Dobson et al. (1987)). However, with more jobs, there were more opportunities to apply our new algorithm to reduce total flow-time substantially.

CONLUDING COMMENTS

Our proposed method addresses the multiple-product batch scheduling problem from a global flow-time minimization perspective. Dobson et al.'s (1987) method for determining optimal batch sizes is applicable only if jobs are never waiting to be processed on the machine. If jobs are waiting, it may be that removing a setup (moving away from the optimal number of batches calculated by Dobson et al. (1987)) could decrease the flow-time for processing all jobs over the production horizon. We have shown how our method can handle jobs where batches may be commingled or where they must be segregated (e.g., Department of Defense jobs). We have provided guidance on how to modify the number of batches per job if identical batches need to be processed given resource constraints. We also have shown how to convert fractional batch quantities to discrete ones. Finally, we have provided a rule for deciding which job to begin processing, if multiple jobs are waiting to minimize total flow-time. Our new method provides the minimum

flow-time globally, by recognizing that local increases in flow-time may be more than offset by flow-time reductions for jobs processed later. Similar to the Dobson et al. (1987) article that inspired it, our research provides interesting insight into the multiple-product problem, and the algorithm developed is an important initial contribution to the problem. However, as this was an introductory study, the model defined herein was restricted, and leaves open many avenues for future research into the topic. This section presents suggestions for such research. The current model has restrictions, that when relaxed, make for a tougher and more interesting problem. Some of those restrictions are discussed below.

Include Sequence-Dependent Changeover Times in Addition to Transfer Times - The current model assumes sequence-independent setup (transfer) times. In many processing environments, though, changing from one item to another requires the machine to undergo some configuration changes -- usually referred to as a changeover. With the current model restrictions, the addition of changeover times between products would have little impact on the system (merely extending the system wait times), and no impact on the solution procedure. However, if the scheduler were allowed to choose from waiting jobs, changeover times would affect which job to choose. For example, if two jobs were waiting and one were the same item as the current job, no changeover time would be required for that job. This would give that job a flow-time advantage over the different type job, an advantage that would have to be weighed against other considerations (e.g., which job arrived first, which job is larger, etc.). The impact of this relaxation would vary based on what other changes are made to the model. Simchi-Levi and Berman (1991) investigated applying a traveling salesman algorithm for this problem.

Limit the Allowable Transfer Batch Size – Our model assumes that any transfer batch size is acceptable, allowing batch sizes as small as a single unit and as large as need be. In a practical application setting, that assumption probably would not hold. For example, if this were a pharmaceutical setting and the machine bottles pills, there probably would be a standard basic material handling platform (e.g., tray, bin, etc.) that could hold a specific number of bottles. Assuming the machine could automatically move that platform to a larger movement container (e.g., a pallet), a reasonable restriction on transfer batch size would be to allow batches only in multiples of the basic handling platform. In a large processing environment, even the ultimate movement container might limit the transfer batch size (e.g., batches no larger than a pallet).

This paper examined the issue of batch flow production scheduling on a single machine with deterministic demand and arrivals over a finite horizon. The objective of the model is to minimize total flow-time over the horizon. Because the problem appeared complex in mathematical form, a linear search algorithm was developed to solve this problem. It was demonstrated in Proposition 1 that due to the convex nature of the optimal total flow-time curve, the algorithm does, indeed, provide optimal results. A general upper bound on the number of steps required for the algorithm to find the optimal solution was presented. In Section 6, we demonstrated the robustness of our proposed method. Specifically, using a similar environment to that in Dobson et al. (1987), we showed a significant reduction in total flow-time over a wide range of jobs compared to prior results. Finally, numerous recommendations for further research were presented.

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THE INFLUENCE OF EMPLOYEE GOAL ORIENTATIONS AND EMPLOYEE SELF-EFFICACY ON PERCEIVED SERVICE QUALITY

Jamie J. Bodouva

ABSTRACT

The purpose of this study is to enhance service quality research by examining whether hotel employees attitudes, motivations and behaviors had an effect on perceived service quality. In the recent years, interests in service marketing and practice have become of great importance. The role of the individual service employee has become paramount to the service delivery process (Singh, 2000). A conceptual framework was developed and data was gathered from one 4-Diamond hotel. 184 responses were ultimately used for analyzing, which resulted in an 81% response rate. A full structural model was tested on the hypotheses (both the magnitude and the direction) once the measurement model was obtained. A non-significant path was eliminated and a revised model was tested against an alternative model. Fit indices were assessed for acceptable fits with all three models. Overall, the results of the proposed path model were supported. The relationship between employee self-efficacy and performance orientation was the only hypothesis not support. This study identified that learning and performance goal orientations effects on perceived service quality were mediated by self-efficacy and they both had direct and indirect influences on each other, with the indirect path being stronger.

JEL: M3, M1

KEYWORDS: Employee Attitudes, Employee Motivations, Employee Behaviors, Perceived Service Quality, Self-Efficacy, Goal Orientation

INTRODUCTION

In the recent years, interests in service marketing and practice have become of great importance. The role of the individual service employee has become paramount to the service delivery process (Singh, 2000). The attitudes and behaviors of contact employees have been empirically tested to influence a customers' perception of service quality (Bowen and Schneider, 1985). Formulating efficient and valued services requires an understanding of employee attitudes, abilities, behaviors and motivational factors that affect performance outcomes (Bowen and Schneider, 1985, Bitner, 1990, Hartline and Ferrell, 1996, Humborstad, et al., 2014).

Decision makers must recognize the behavioral influences within the organization in order to determine how employees interpret and react to the practices, policies, and procedures of the work environment (Levin, 1995). It is believed that individual goal orientations motivate employees to behave in response to certain circumstances and events (Ames and Archer, 1988, Swift et al., 2014). Researchers have found that employee goal orientations can be affected by internal and external factors, which in turn, produces a variety of behaviors that effect employee perceived service quality (Gist and Stevens, 1998, Malik, 2012). Self-efficacy has also been shown to be a mediating factor in determining levels of motivation with specific application to employee task performance (Bandura, 1986).

Recent attention from academic research has focused on individual goal orientations as motivational predictors of employee service behaviors (Colquitt, et al., 2001, Lee et. al., 2006, Porath et al., 2006). Empirical research and theory hold that an individual's goal-oriented behaviors contribute to one's ability to increase performance (Gellatly and Irving, 2001, Colquitt, et al., 2000, Humborstad, et al., 2014). Strong interest has been shown in literature as to the gap between goal-oriented behaviors and performance outcomes (Dweck, 1986, Dweck and Leggett, 1988, Button, 1996). Dweck (1986) defines goal orientation as an individual's predisposition, or motivational orientation toward a task or learning situation. The framework that is the most popular comprises of two motivational constructs: *learning* and *performance*, both of which hold different response patterns (Dweck, 1986). Goal orientation literature states that individual's set goals, works at obtaining these goals, and adjusts their behaviors accordingly, to achieve desired outcomes (Locke and Latham, 2004).

Within the hotel industry, the concept of the service employees motivational behaviors relating to their service quality, is a vital component in remaining competitive and profitable (Mill, 1985). As the delivery of service is highly variable, hotel organizations are dependent on their service employees to try to maintain consistency in their provision of quality service (Cairncross and Kelly, 2008). In order to comprehend what behaviors motivate service employees, it is important first to understand the sources of motivation and any factors that may mediate or moderate this relationship (Bandura, 1990). How an individual determines the selection of their goals (i.e., learning or performance) is the subject that leading hotel organizations recognize as a key component to their success (Lee-Ross, 1998, Lee et al, 2006).

The following section provides a review of literature on employees learning and performance goal orientations, self-efficacy as a mediating variable and perceived service quality. Followed by the section on the data and methodology procedures, along with the results of the tested hypotheses. The last section discusses the conclusions, managerial and academic implications and offers recommendations for future research.

LITERATURE REVIEW

Quality of service delivered to customer is critical to becoming or remaining successful. The attitudes and behaviors of service employees have been shown to affect the customers' perceptions of service (Bowen and Schneider, 1985). Given the interactive experience between the service, employee and the customer, organizations are struggling to provide exceptional service quality (Schneider and Bowen, 1999). Within the hotel industry, the intense competition and declining economy has led hotel organizations to improve strategies in their service delivery to gain a competitive advantage (Stevens et al., 2007). Kandampully (2002, p. 11) stated "of all the challenges facing the hospitality establishments today – including intense competition, globalization, and technological innovation – the single most pervasive and pressing challenge is the ever increasing demand of customers for service quality."

Goal orientation is usually described as an individual predisposition, or motivational orientation, that one has, towards an achievement situation (Dweck and Leggett, 1988). The objective of motivation research is to understand how the individual determines the "selection activation and sustained direction of behavior toward certain goals" (Bandura, 1990, p.69). Motivation has been a popular construct and goal orientation is one of the predominant models that seeks to explain why people behave the way they do. An extensive amount of research over the past decades has substantially supported that goal orientations have an effect on individual response patterns in a variety of achievement related situations (Button et al., 1996). Goal orientation literature suggests that there are two motivations for achievement: *learning orientation* (mastery) and *performance orientation* (ego), both orientations produce different response patterns (Dweak and Elliot, 1983, Dweck and Leggett, 1988, Preenen, 2014). Individuals with a learning orientation are intrinsically motivated and achieve through acquiring new skills, knowledge and mastering these situations and tasks. These individuals seek out challenges, maintain performance when presented with difficult

situations, and evaluate levels of task mastery to reflect their progress (Sujan, 1994, Bouffard et al., 1995). Performance orientation results in extrinsic motivation and individuals achieve competence by seeking favorable evaluations relative to others, avoid challenges, and when presented with obstacles, performance declines (Diener and Dweck, 1978, Ames and Archer, 1988, Dweck and Leggett 1988).

Organizational research suggests that relationships between goal orientation and performance outcomes are mediated by self-efficacy (Kanfer, 1990, Phillips and Gully, 1997, Steele-Johnson et al., 2000). According to Stajovic and Luthans (2000) and Momeni et al. (2014), an individual's sense of efficacy in their abilities to perform a job that translates into higher job performance. Much of the research on the effects of goal orientation and performance outcomes has been conducted by Kanfer's (1990, p.60) framework, he states, "that goal orientation was considered an individual difference and distal motivational factor that affects performance outcomes through proximal motivational status, particularly self-efficacy." Therefore, according to Kanfer's framework, many researchers believe that the effects of goal orientation on job performance to be mediated by self-efficacy (Phillips and Gully, 1997, Steele-Johnson et al., 2000). Bandura (1986), states that individual's must have the innate ability to achieve a domain-specific task in order for self-efficacy to be a significant predictor of performance.

Bandura (1997) also emphasized the importance of a strong relationship between efficacy assessment, the task, and the outcome being measured, so that the efficacy levels, strength, and generality can be accurately identified. In 2003, Pietsch et al. conducted a study to test the relationships among situational motivation behaviors, self-efficacy, and performance in a high school setting. Results from various factor analysis models showed that self-efficacy is a strong mediating variable in measuring performance on a specific task. Pintrich (2000), believes that this direction of thinking is based on the fact the different goal orientations would trigger specific patterns of self-efficacy responses. Learning goals create similar effects on a person's perceived competence, and, in turn, induce them to adopt adaptive patterns of learning. However, performance goals may create two different types of learning patterns, 1) goal oriented people with high perceived competence apply adaptive ways of learning, and 2) when people have lower self-efficacy beliefs of their capabilities to perform the tasks, they are inclined to resist patterns of learning (Dweck and Leggett, 1988, Swift, et al., 2010, Ajala, 2013).

Research demonstrates that job performance is an individual's overall performance/task proficiency or as performance on specific dimensions, such as the quality and quantity of work. Job performance is multidimensional and a product of (1) environmental and organizational variables, (2) individual attributes, abilities, and skills, (3) the individual's particular attitudes, perceptions, and motivation to perform (Olson and Borman, 1989). Service quality is one of the most prominent areas of research in service management and marketing (Gronroos, 1990, Fisk, et. al., 1993). The origins of service quality are based in the confirmation/disconfirmation paradigm (Gronroos, 1992). Accordingly, as customer consumes a product, they compare the quality they have experienced to that of their prior expectations, which leads to an emotional reaction manifested in the satisfaction/dissatisfaction with the products or services purchased (Woodruff et al., 1983). Lewis and Booms (1983, p.99) defines service quality as "a measure of how well the service level delivered matches customer expectations. Delivering quality service means conforming to customer expectations on a consistent basis." The service quality literature views expectations as consumer desires or wants that they feel a service provider *should* offer rather than *would* offer (Oliver, 1977).

The role of service quality is known to be a crucial determinant for the success of an organization. Parasuraman et al., (1988, p. 42) defines service quality as "perceptions resulting from a comparison of consumer expectations with actual service performance." Klaus (1985) asserts that quality service is a variable of the skills, attitudes and personal traits of the service provider. Likewise, service quality literature has consistently shown that the dominating determinate of service quality is the employees' perceived ability to be able to handle customers in a flexible manner and have a level of competency in their job

positions (Reardon and Enis, 1990, Parasuraman, Zeithamal, and Berry, 1990, Agus, et al., 2007). According to a Liao and Chuang (2004), service quality relies on the employees' delivery and when employees' deliver the quality of service to the customers, customers will have a more positive evaluation of the organization.

A review of the service quality literature highlights the important dimensions of service quality. Bitner (1992) suggests that when choosing alternatives in the levels of service quality that customers rely on cues and evidence of service. Cronin and Taylor (1992) explain that service quality is antecedent to customer satisfaction and customer satisfaction has an impact on buying intentions. The definitions of quality, according to (O'Neill, 2001) can be unified as one construct of consumer-perceived quality, where quality can be defined only by customers and occurs where an organization supplies goods and services to a specification that satisfies the customer's needs. However, since the quality of goods can be measured by objective measures, they are considered tangible; it is the intangible measures of service quality that makes this unified concept more difficult and relatively challenging (Najjar and Bishu, 2006). Bitner (1992) concluded that service quality includes, in most cases, the means of delivery and an interaction of service employees. Zeithaml and Bitner (1996, p. 164) state, "employees who actually perform the service have the best possible point for observing the service and identifying impediments to quality. Customer-contact personnel are in regular contact with customer, and thereby come to understand a great deal about customer expectations and perceptions." Oliver (1997) acknowledged that there are two aspects of service quality 1) the product or service being evaluated and 2) the person who is evaluating. Therefore, the perceptions of quality are known to be unique to the individual experience. It is the ever-changing perceptions and expectations of the customer that is relative to evaluating and defining levels of quality (Lovelock, 2001). Research consistently emphasizes that competitive advantage is obtained through a constant form of analysis to determine service quality initiatives and improvements and it is through this process that signifies an organizations commitment to service quality (O'Neill, 2001).

Gronroos (1983a, p.24) defines perceived service quality as the "outcome of an evaluation process where customers compare their expectations with the service they perceive to be received." In 1983, Gronroos developed a framework to explain service quality using the traditional concepts from the Satisfaction/Dissatisfaction model. He defined two basic dimensions of service quality as either: *technical* and *functional*. Technical quality is *what* the customer actually receives from the interaction with the service provider. Functional quality is the *how* the technical quality is delivered to the customer. Researchers propose that the *functional quality* variable is of more a rational nature and is therefore closely related to the service employee-customer interaction then the *technical quality* dimension which will not count for the total quality which the customer perceives has been received (Gronroos, 1982, 1990, pp. 37-38). According to Zeithaml, Parasuraman, and Berry (1988, p.15), perceived service quality is viewed as "a global judgment, or attitude, relating to the superiority to the service" and define it as the gap between expectations of service quality and the delivered service quality. Past research states, that perceived service quality can be difficult to define and measure because of the unique properties of service being intangible, heterogeneity, and inseparable of production and consumption. The studies in measuring perceived service quality have been directed to meet or exceed the external customer's expectations, and have looked at service quality as a measure of how the delivered service levels compare to consumer's expectations. Hamer (2006) and Malik (2012) suggests that in practice there should not be "under-promising and over-delivering" but in fact, lesser consumers' expectations (i.e. under-promise) and deliver an elevated level of service (i.e. over deliver).

DATA AND METHODOLOGY

The service marketing literature has emphasized the importance of service employees in the service delivery process (Schlesinger and Heskett, 1991, Haskett et al., 1994). Researchers have determined that service quality delivery is more important in service organizations in comparison to other organizations due to the

intangibility, heterogeneity, and inseparability of services (Parasuraman, Zeithaml, and Berry, 1985). Service employees are vital to service organizations and have the ability to influence customer's perceptions of service quality (Bitner et al., 1994).

The main objective of this study was to examine whether certain behavior orientations and motivations of service employees affect service quality delivery, as seen from the perceptions of the employee. Although research has focused on various service quality attributes, there has not been a study that explores the effects, particularly of employee goal orientations, on perceived service quality. More specifically, the evidence provided by research examining individual traits in predicting performance supports the argument that the role of various individual orientations is both significant and influential (Colquitt et al., 2000). Since goal orientations produce the intentions of behavior which are represented by different ways of approaching, engaging, and responding to job tasks, it is therefore important to investigate the relationship between these individual orientations and how they affect service quality. Based on the literature review and directed by the research questions, the following hypotheses were proposed:

H_{01}: Employee learning goal orientation does not influence perceived service quality.
H1: Employee learning goal orientation does positively influence perceived service quality.

H_{02}: Employee performance goal orientation does not influence perceived service quality.
H2: Employee performance goal orientation does positively influence perceived service quality.

H_{03}: Employee self-efficacy does not influence employee learning goal orientation.
H3: Employee self-efficacy does positively influence employee learning goal orientation.

H_{04}: Employee self-efficacy does not influence employee performance goal orientation.
H4: Employee self-efficacy does positively influence employee performance goal orientation.

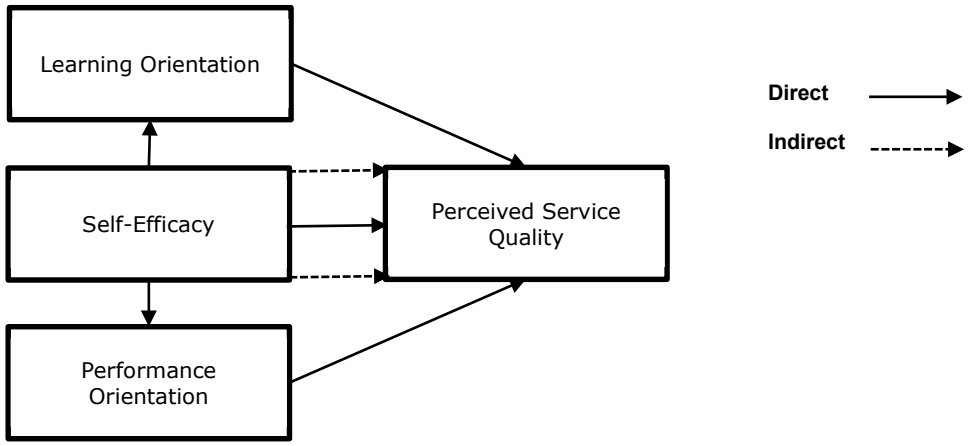
H_{05}: Employee learning goal orientation does not influence perceived service quality as mediated by self-efficacy.
H5: Employee learning goal orientation does influence perceived service quality as mediated by self-efficacy.

H_{06}: Employee performance goal orientation does not influence perceived service quality as mediated by self-efficacy.
H6: Employee performance goal orientation does influence perceived service quality as mediated by self-efficacy.

H_{07}: Employee self-efficacy does not lead to greater perceived service quality.
H7: Employee self-efficacy does positively lead to greater perceived service quality.

A Theoretical Framework (see Figure 1) was constructed showing the relationships of employee learning and performance goal orientations, employee self-efficacy and perceived service quality (see Figure 2). This model was studied from the perspective of the employee and how behaviors and attitudes affect service performance.

Figure 1: Theoretical Framework



This Figure shows the theoretical model constructed and the direct or indirect relationships of the variables

Measurement instruments were assessed for both reliability and validity. All measures used in this study are taken from empirically proven, valid and reliable instruments from marketing, management, and psychology literature with alpha rating between 0.76 and 0.97 (Jones, 1986, Parasuraman et al., 1990, Sujan, 1994, Hartline and Ferrell, 1996 Ripley, 2003*).* However to assess the construct validity, factor analysis was utilized to "confirm or refute" components of scale items (Churchill, 1979). Content and face validity was evaluated through the literature review and by a small sample of hotel service employees (Nunnally, 1978, 1994). Structure Equations modeling (SEM) was used to test the proposed model and taking into account that SEM analysis requires a large sample size (Bentler, 1990), a large chain 4-Diamond hotel was utilized to initiate the random sample within a seven day period in the fall of 2008. (N=225) two hundred and twenty- five hotel service employees were surveyed and the overall response yielded 184 (81.7%) responses that were coded and used for the data analysis.

RESULTS

The descriptive statistics of the service employee sample consisted of 79 (42.7%) males and 105 (56.8%) females. The results showed the majority of the respondents were females and males with a High School Diploma (see Table 1). In addition, 136 (73.5%) respondents reported to work full-time and 48 (25.9%) to work part-time. 50 (27%) were employed by the hotel less than a year, 95 (51.4%) were employed by the hotel 1-3 years, and 39 (21.1%) were employed by the hotel over 3 years. 20 employees (10.8%) were in the hotel industry less than a year, 100 (54.1%) were in the hotel industry 1-3 years, and 39 (21.1%) were in the hotel industry over 5 years. Further testing was performed to analyze the relationship between employee gender and the employees' position; it was found that the females largely held the positions of Front Desk/Customer Service/Management and Housekeeping, while the positions of Concierges/Bell Staff, Security & Maintenance were dominantly held by males (see Table 2).

Table 1: Descriptive of Employee Gender & Employees' Education

Gender	Sample All	Less High School	High School Diploma	College Degree	Graduate Degree
Female	79	10	60	27	3
Male	105	22	34	25	2
Total	**184**	**32**	**94**	**52**	**5**

This table shows the Descriptive break down of gender education of the employees. Sample All column indicates the full sample size without regards to education held.

Table 2: Descriptive of Employee Gender & Employees' Position

Gender	Sample All	Value 1	Value 2	Value 3	Value 4	Value 5	Value 6	Value 7
Female	79	26	20	19	10	5	0	1
Male	105	23	9	17	9	30	7	8
Total	**184**	**49**	**29**	**36**	**19**	**35**	**7**	**9**

This table shows the Descriptive break down of Gender against the particular employee positions. Sample All column indicates the full sample size without regards to position held. Value 1. Front Desk/Customer Service/Management, Value 2. Housekeeping, Value 3. Food/Beverage/Room Service, Value 4. Reservations/Sales, Value 5. Concierges/Bell Staff, Value 6. Security & Value 7. Maintenance

Prior to testing, the full structural model, a series of confirmatory factor analysis's (CFA) were performed separately to evaluate individual parameter, after assessing each construct individually and removing items that had large residuals and/or wanted to load on other constructs, resulted in a decrease of items. All items in the service quality construct had significant loading factors greater than 0.50 and were retained. The descriptive statistics: mean, standard deviations, ranges, and reliabilities all demonstrated good reliability. Reliability estimates for the final measurement model reported that each construct contains an acceptable internal consistency (i.e., 0.70 and above), (Nunnally, 1978). Outputs for distribution for each scale reported some degree of negatively skewed distribution, which was an indication that the sample offered positive responses.

To ensure that the constructs were not measuring the same concept or ideas, each construct was examined with one another, in pairs. To test for discriminant validity, two models were tested for possible pair of estimates constructs. The first model had the correlation parameter between each pair at 1.00 and the other had no constraints. Chi-Square ($\chi 2$) values for both models were reported with the degrees of freedom. Table 3 indicates estimated correlations between the factors were not excessively high providing support for the discriminant validity. A significantly lower chi-square value for the second model indicates that discriminant validity has been achieved. It is important to indicate that with discriminant validity tests being conducted do not define the indirect and direct paths, but the relationships the constructs have on each other two by two. The results of the correlations generated were also not expected to be consistent with the actual model correlation results. Therefore, having some indication of correlation at this level was a positive sign that relationships do exist between the model's variables, although all possess discriminant validity.

Table 3: Discriminant Validity and Correlation Values

Construct	Correlation Value	$\chi 2$ W/Corr. Fixed	Df	$\chi 2$ W/Corr. Free	Df	Sig.
1-2	0.31	42.6	6	25.9	9	0.00
1-3	0.34	28.6	9	20.2	6	0.00
1-4	0.46	21.8	9	11.7	6	0.01
2-3	0.37	40.9	6	20.5	4	0.00
2-4	0.65	16.5	4	9.0	4	0.00
4-6	0.39	21.8	4	6.0	4	0.00

This shows the Discriminant Validity and Correlation Values estimates correlations between each other in pairs
** Learning Orientation = 1, Performance Orientation = 2, Self-Efficacy = 3 & Service Quality = 4 * p <0 .05, ** p <0.01, *** p<0.001*

In addition, Maximum Likelihood estimation method was used in this study and known to be less sensitive to the violation of normal distribution assumptions, than other estimation methods. For SEM analysis, statistically significant large factor loadings indicate convergent validity. All constructs had relatively high loadings (statistically significant at $p < 0.05$), ranging from 0.60 to 0.87, which supports the evidence of convergent validity.

The measurement model must be empirically satisfactory before proceeding to hypotheses testing (Muliak and James, 2000). This study presented the appropriate measurement model with a series of confirmatory

factor analyses. The full structural model was tested next including, both the appropriate measurement model, the hypothesized relationships among the latent variables, and the goodness-of-fit indices. Table 4 presents standardized direct, indirect, and total effects of all independent and dependent variables. As expected, most relationships were found to be direct. Most importantly, learning and performance orientations indicated significant indirect effects ($\beta = 0.456$ and $\beta = 0.367$), as well as, direct effects ($\beta = 0.176$ and $\beta = 0.118$) on service quality as mediated by self-efficacy. Learning and performance orientation also indicated direct effects on service quality without a mediating variable, although with performance orientation it was a negative outcome. Self-efficacy indicated significant direct effects on service quality ($\beta = 0.467$) and self-efficacy had a direct negative effect on performance orientation ($\beta = -0.376$).

Table 4: Standardized Estimate for Direct, Indirect, and Total Effects

Dependent Variable	Predictor	Direct Effect	Indirect Effect	Total Effect
Learning Orientation	Service Quality	0.244***	0.001	0.245
Performance Orientation	Service Quality	0.153***	0.00	0.153
Self-Efficacy	Learning Orientation	0.430***	0.03	0.460
Self-Efficacy	Performance Orientation	-.0376***	0.00	0.376
Learning Orientation	Self-Efficacy, Service Quality	0.176	0.456***	0.887
Performance Orientation	Self-Efficacy, Service Quality	0.118	0.367***	0.632
Self-Efficacy	Service Quality	0.467***	0.03	0.497

This table shows the Direct, Indirect and Total effects of all Independent and Dependent variables
** p <0 .05, ** p <0.01, *** p<0.001*

The overall fit of the structural model was very good; the chi-square indicates that the model was not a good fit with the p-value (0.15) above 0.05. As mention previously, the Chi-square test has been known to be sensitive to sample size, which provides little guidance in determining the extent to which the model does not fit in studies where the sample size is large. Therefore, it was more beneficial to rely on other fit indices. All the other fit indices indicated that the proposed model fits well to the data. The values of all the fit indices were above the recommended values. $\chi 2\ (122) = 348.20$, $p > 0.01$, $\chi 2 / df = 2.8$, GFI = 0.91, AGFI =0.90, NFI = 0.91 and the SRMSR = 0.048.

After testing the proposed structural model, modifications were made to achieve a better fit to the data. The proposed model generated one non-supported hypothesis, this paths coefficients is *self-efficacy and performance goal orientation*. A revised structural model was constructed eliminating the non-supported path. A comparison of the outcomes were examined, there were only slight differences with the revised model and the proposed model. The paths of the revise model reported to have less effect on each other than the proposed model. The overall fit indices indicate that there was a good fit with all the fit indices and all were within the recommended ranges. A Chi-square differences test was used to compare the proposed and revised models (dropping one path). The results did not indicate a good fit and the p-value (0.18) was above the 0.05 threshold. Therefore, based on the results the proposed model had a better fit between the nested models.

In order to ensure validity of the revised model, an alternative revised model was presented. The revised model states that the goal orientation (i.e., learning and performance) of an employee to delivery service quality was mediated by an employees' self-efficacy. The alternative model tested whether the mediation variable of self-efficacy was necessary and then compared the results to the revised structural model. The alternate model had all constructs having direct relationships and eliminated self-efficacy as a mediating variable (the indirect variable between learning and performance goal orientation). The results demonstrated that by eliminating self-efficacy as a mediating variable, the relationships become weaker and therefore, did not produce a better fit. This suggests that the revised model was more efficient. The Chi-square test reported higher for the alternate model indicating not a good fit with a p-value (0.24) was

above the threshold of 0.05. However, the fit indices all showed to be strong and within acceptable levels. Therefore, the revised model was a better fit to the data than the alternate model.

This study failed to support one of the proposed hypotheses (i.e., hypothesis 4). The relationship between self-efficacy and performance orientation resulted in a significant negative direction. A revised model eliminated the paths of these hypotheses and was than tested for a better fit. The results indicated that there were not significant differences between the proposed model and the revised model, with both showing a strong fit with the data. Summary of Hypotheses (see Table 5).

Table 5: Summary of Tested Hypotheses

Hypotheses	Description	Results of Null Hypotheses
H1	Learning Orientation → Service Quality	Rejected
H2	Performance Orientation → Service Quality	Rejected
H3	Self-Efficacy → Learning Orientation	Rejected
H4	Self-Efficacy → Performance Orientation	Fail to Reject
H5	Learning Orientation → Self-Efficacy → Service Quality	Rejected
H6	Performance Orientation → Self-Efficacy → Service	Rejected
H7	Self-Efficacy → Service Quality	Rejected

This Table shows the results of the tested hypotheses

CONCLUDING COMMENTS

Quality of service delivered to customer is critical to becoming or remaining successful. The attitudes and behaviors of service employees have been shown to strongly affect customer's perceptions of service (Bowen and Schneider, 1985). Given the interactive experience between the service, employee and the customer, organizations are struggling to provide exceptional service quality (Schneider and Bowen, 1999). Within the hotel industry, the intense competition and declining economy has led hotel organizations to improve strategies in their service delivery to gain a competitive advantage (Stevens et al., 2007). Kandampully (2002, p. 11) stated "of all the challenges facing the hospitality establishments today – including intense competition, globalization, and technological innovation – the single most pervasive and pressing challenge is the ever increasing demand of customers for service quality."

This study proposed a framework that identifies possible factors that are likely to influence service quality in a hotel setting. Four key constructs were determined to be components of the service delivery outcome: employee learning goal orientation, employee performance goal orientation, employee self-efficacy and perceived service quality. A series of confirmatory factor analyses revealed evidence of both convergent and discriminant validity between the proposed constructs. This was followed by the analysis of the proposed structural equation model and hypotheses. Validity and reliability were also tested and discussed. This study failed to support one of the proposed hypotheses (i.e., hypothesis 4). The analysis found that the relationship between self-efficacy and performance orientation resulted in a significant negative direction. A revised model eliminated the paths of these hypotheses and was than tested for a better fit. The results indicated that there were not significant differences between the proposed model and the revised model, with both showing a strong fit with the data. By analyzing a structural model, the influences of the service delivery process can be better understood.

It is critical for organizations and managers to recognize the important role that service employee have and devise strategies that will provide positive performance outcomes. This research concluded that understanding the perceptions and motivations of the service employee could improve the service quality outcome. Practitioners can identify learning and performance goal orientations of their employees and encourage better performance through the innovation of the work climate practices and procedures. It would be more advantageous for organizations to encourage a learning orientation and in turn, produce higher

levels of self-efficacy and service quality. Perceptions of the work climate results from the employees individual experiences of the internal functions of the organization (Schneider and White, 2004). Employee evaluations of the organizations procedures and expectations of the expected service quality delivery, depends on how the employee experiences the organizations internal and external functions. Therefore, this study provides important knowledge for organizations and managers, particularly in the hotel industry, to devise strategies, which can be used to develop and improve levels of service quality.

This research has also provided meaningful constructs in predicting service quality by integrating literature from psychology, organization behavior, and marketing fields. This synergistic perspective may contribute to the academic richness of the topics and allow for further expanded studies in these areas. This study established that service quality consists of attitudes, motivations, and behaviors of the service employee. Construct validity was established and strong correlations were found among the constructs, which offers insight to the service delivery process and the effects on learning and performance goal orientations, levels of self-efficacy and perceived service quality of the employee. Furthermore, there was strong support for the mediating role of self-efficacy and the relationship between learning and performance goal orientation and perceived service quality. This is meaningful in service marketing research, because it supports the argument that a mediating variable is appropriate when linking a relationship between motivational factors and performance outcomes.

Although every attempt was made to eliminate possible limitations, this study identifies that by having all respondent's working for the same hotel, makes the findings less generalized and poses a method bias, particularly, a phenomenon known as *common method error* (i.e., variance that is attributed to the measurement method rather than to the constructs the measures represent), (Fiske, 1982). *Common method error* tends to increase hypothesized correlations, rather than represent the true relationship (Podsakoff et al., 2003). By conducting research utilizing multiple hotel setting, would decrease the potential for measurement error. Furthermore, the questionnaires for the service employees were administered and collected by a select manager and thus, may have contributed to some potential social method bias. However, to try to minimize the potential social bias (socially desirable responses), each questionnaire was ensured strict confidentiality.

Future studies should be conducted to replicate the present research with multiple hotels, with a variety of class rating and in different tourist seasons. There may be significant management differences between high/low - price/quality service quality delivery systems and employee attitudes, abilities, and performance levels, hence having different outcomes. In addition, this study only used the one-sided perception from the employee on service quality. Future research should gather data from both the employee and customer perspectives. This dyadic view would gain a better understanding of the complex nature of the relationship. Finally, further research should consider extending the findings of this study to other service settings. Testing an individual's attitudes, motivations, and behaviors in a variety of service industries would be beneficial to determine how extreme these different context outcomes are from one another.

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BIOGRAPHY

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THE ROLE OF RELATIONSHIP INVESTMENT IN RELATIONSHIP MARKETING IN NONPROFIT ORGANIZATIONS

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ABSTRACT

This study analyzes the role of relationship marketing investments for organizations in establishing relations with donors, through the mediating variables of trust, relationship commitment and donor's gratitude. Relationship investment and efforts made by organizations to establish relationships with partners was instrumental in realizing the long-term relationship. This research was conducted on philanthropy organizations in Indonesia, with 507 donor respondents. By using Structural Equation Modeling (SEM), the analysis shows that relationship marketing investment had a significant effect on commitment and gratitude, but not significant effect on trust. Relaionship Marketing Investment effect trust indirectly through the gratitude variable. The effect of gratitude is not significant on intention of donors to redonate in philanthropy organizations. The gratitude variable seems to effect intention to redonate indirectly, through a mediating variable, trust. So donor's gratitude has a direct effect on trust, and trust has a direct effect on relationship commitment. Trust and commitment have a significant effect on intention of donors to redonate. Overall, telationship marketing investment plays an important role on the relation between philanthropy organizations and donors, through the strategic role of trust and relationship commitment variables.

JEL: M31, D64

KEYWORDS: Relationship Marketing, Relationship Marketing Investment, Donor Gratitude, Trust, Relationship Commitment, Intention to Redonate

INTRODUCTION

Relationship marketing includes all marketing activities conducted through the determination, development and management of long-term relationships (Lee *at al*., 2010). By implementing relationship marketing, both non-profit and profit-organizations hope to continuously establish relationships with partners. In order to realize these relationships, the organization undertakes various activities and efforts. The activities and efforts are referred to as relationship marketing investment or relationship investment. The previous research finds that many forms of investment activities and the efforts made by organizations to build relationships with customers, are expected to impact customer trust and commitment to the organization (Moorman *et al.,* 1993, Morgan and Hunt, 1994; Sirdeshmukh *et al*. 2002; Sargeant and Lee, 2004; and Wulft *et al*., 2001), and also affects the customers gratitude (Palmatier *et al*., 2009).

In a relationship, partner trust is a factor that is required. Venable *et al*. (2005) revealed that trust and social exchange plays an important role in the donor's decision whether to donate money, time, goods or services to the organization. Similarly Sargeant and Lee (2002) note that donors have recognized the central role in

developing the relationship between donors, philanthropy organizations, and recipient of donations. Sargeant and Lee (2002) also argue that trust is the foundation for philanthropy organizations in building their organization. In addition to trust, commitment is also a variable related to the determinant in a relationship. Gundlach *et al*. (1995) revealed that commitment is an essential element for the success of a long-term relationship. Dwyer *et al*. (1987) described that relationship commitment appears in the marketing literature as an important element for maintaining long term relationships.

Trust and commitment is a key concept in social exchange theory and relationship marketing literature (Lou and Donthu, 2007). Blau (1964) explains the concept of exchange in directing attention directly on the emergence of interpersonal relationships and social interaction. Several studies using social exchange theory as a foundation for commitment and trust in relationship marketing exist (Anderson and Narus, 1990; Dwyer *et al*., 1987; Morgan and Hunt, 1994, Smith and Barclay, 1997, Garbarino and Johnson, 1999; MacMillan *et al*., 2005). According to Palmatier *et al*. (2009) customer gratitude effects trust and intentions to buy.

Based on previous research (Morgan and Hunt, 1994, Smith, 1998; Garbarion and Johnson, 1999; Sargeant and Lee, 2004; MacMillan *et al*., 2005; and Palmatier *et al*., 2009), this research positions gratitude, trust and relationship commitment variables as mediator variables in relationship marketing. The relationship marketing investment variable is treated as an antecedent on the consequences of the intention of donor to redonate. This paper analyzes the role of relationship marketing investment variables in relationship marketing in nonprofit organizations, in the context of B2C relationships. This will provide benefits in the development of the relationship marketing concept. Until now studies on the topic of relationship marketing largely focus on profit-organizations as well as in area of B2B (Arnett *et al*., 2003). The paper continues with a literature review and hypothesis development. Next, we discuss the data and methodology utilized and result of the reseach. The paper closes with some concluding comments.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Relationship Marketing. According Gronross (1994), relationship marketing aims to establish, maintain, and enhance relationships with customers and other partners, at a profit, so that the objectives of the parties involved are met. Kotler and Keller (2012) describes four key elements to relationship marketing, including customers, employees, marketing partners (channels, suppliers, distributors, dealers, agents), and members of the financial community (shareholders, investors, analysts). Gruen *et al*. (2000) writes that over the past several years, the management approach that views customer relationships as key assets of the organization has gained increased prominence in the priorities and practices of many for-profit and not-for-profit organizations. Arnett *et al*. (2003) believe that relationship marketing is a strategy that can be run in a context that involves a high degree of social exchanges in B2C marketing and nonprofit marketing. Meanwhile, McCort (1994) argues that relationship marketing at nonprofit organization devoted to seeking a long term relationship, increases loyalty of the donors.

Relationship Marketing Investment. Relationship investment is defined as consumer perception of the resources, efforts, attention has been paid by the retailer to manage and maintain a relationship with regular customers (Smith, 1998). Fruchter and Sigue (2004) define relationship investment as marketing efforts or investment performed by exchange partners to create and maintain a relationship commitment with their partners. Rusbult (1980) categorized investments into two categories, namely extrinsic and intrinsic investment. Extrinsic investment occurs when a previous interest from outside was associated with current behavior, while intrinsic investment is linked to the investment of resources spent, such as time, money, and so forth. The investment of time, effort, and other resources performed by organizations in a relationship creates a psychological bond that encourages customers to stay in the relationship and determine reciprocal expectations (Smith and Barclay, 1997).

Gratitude. Gratitude is a fundamental component of social interactions that provide the foundation for reciprocal altruism emotion (Palmatier *et al*., 2009). Gratitude has also been conceptualized as a force that helps people keep reciprocal obligations (Gouldner, 1960). Gratitude and reciprocity are essential to motivate the customer to build trust with the organization (Cialdini and Goldstein, 2004). Manifestation of customer gratitude to the organization occurs in the form of deep gratitude to the organization, respect for the organization, and pleasure in the organization. Palmatier *et al*. (2009) links the customers' gratitude variable with customer trust, and the effect of customer gratitude to sales performance outcomes. Schwartz (1967) argues that gratitude is a part of the bond that links the relationship between them. Gratitude is important to the theory of various disciplines on how social relationships will be built and prepared (Bartlett and DeSteno, 2006).

Trust. Trust has long been studied in various disciplines, including sociology, economics, and social psychology (Sargeant and Lee, 2004). Social exchange theory focuses on the role of trust in relational exchanges. Trust is a dominant variable which relates between relationship theory and social exchange theory (Wagner *et al*., 2011). A relationship of trust increases its chances of long-term orientation in the exchange (Kumar, 1996 in Luo and Donthu, 2007). Trust is a success factor in a relationship and is a key variable in social exchange theory (Morgan and Hunt, 1994). Social exchange theory postulates reciprocal actions and behavior in formal relationships to enhance trust partners exchange (Blau 1964). According to Morgan and Hunt (1994) trust is central to all relational exchanges. Trust exists when one party of the exchange partners have reliability and integrity.

Relationship Commitment. One basic tenet of social exchange theory is the relationship that evolves over time leads to a sense of trust, loyalty, and commitment (Cropanzano and Mitchell, 2005). This has long been a core commitment in the literature of social exchange (Blau, 1964). Morgan and Hunt (1994) also stated that commitment is the core of relationship marketing. Dwyer *et al*. (1987) defines commitment as a willingness to keep something that has been agreed upon, based on the willingness and readiness to explicitly or implicitly continue the functional relationship that has existed. Meanwhile, Moorman *et al*. (1993) defines commitment as a passion that goes on in the long run to maintain a valued relationship.

The Relatioship between Research Variables

The Effect of Relationship Marketing Investment to Donor Gratitude. Relationship marketing investment is seen as an activity undertaken by the organization in building and maintaining strong relationships with customers (Moorman *et al*., 1993; Morgan and Hunt, 1994). Palmatier *et al*. (2009) concluded that the relationship marketing investment has a positive effect on customer appreciation. When recipients get an item of value, then his/her gratitude rises (Tsang, 2006). In building a relationship, and often starting with an investment (eg. time, effort), and in a context non-contractual, the person/organization that started the investment incurs expenses. With ongoing costs, people are at risk that the investment does not lead to reciprocal behavior (Chiles and McMackin, 1996). This leads us to the hypothesis:

H1: Relationship marketing investment has a positive effect on doner gratitude.

The Effect of Relationship Marketing Investment to Trust. The relational forms of investment conducted by the organization is a form of hard effort/work of organizations to strengthen relationships with customers. Significant efforts of the organization in building relationships with customers, as well as the organization's efforts to devote time and effort to build relationships with customers occur (Smith, 1998). Meanwhile, Wulf *et al*. (2001) asserts that trust is the result of the investment relationship. Smith (1998), examines the effect of relationship marketing investment on trust and commitment. Donors will be more likely to believe in philanthropy organizations, if the organization has clearly demonstrated the seriousness in building and maintaining a relationship. Based on this literature we postulate Hypothesis 2 as follows:

H2: Relationship marketing investment has a positive effect on trust.

The Effect of Relationship Marketing Investment on Relationship Commitment. Relationship marketing investment has a positive effect on commitment (Smith, 1998; Sargeant and Lee, 2004). Most of the B2B and B2C research empirically concludes that relationship marketing investments influence customer trust and commitment (Moorman *et al*., 1993; Sirdeshmukh *et al*., 2002). From the research findings, Bugel *et al*. (2010) also find that relationship investment has a positive effect on relationship commitment. The relationship marketing concept postulates a positive relationship between relationship marketing investment and commitment (Fruchter and Sigue, 2004).

H3: Relationship marketing investment has a positive effect on relationship commitment.

The Effect of Gratitude on Trust. Gouldner (1960) and Houston and Gassenheimer (1987) stated the importance of the principle of reciprocity in a relationship. Komter (2004) in Palmatier *et al*. (2009) argued that the form of gratitude is an imperative force. It is a force that encourages us to get back the benefits we have received and are part of a chain of reciprocity. Palmatier *et al*. (2009) also correlate customers' gratitude with customer trust and customers' gratitude on seller performance outcomes. Young (2006) argues that gratitude is an emotional form of ongoing relationship, with an importance effect on maintaining trust in a relationship.

H4: Gratitude has a positive effect on trust.

The effect of Trust on Relationship Commitment. Research has been conducted by Morgan and Hunt (1994), Smith (1998), Garbarino and Johnson (1999), and Sargeant and Lee (2004) that shows the trust effect on commitment. Achrol (1991) identified trust as a major determinant of the relationship commitment. The importance of trust in the relationship between donors and organizations occurs because donors do not directly feel the result of a nonprofit organization. In the absence of direct consumption, the donor must have confidence in nonprofit organizations activities, giving clients an interest in nonprofit organizations (MacMillan *et al*., 2005). Geyskens *et al*. (1999) in Fruchter and Sigue (2004) found a positive relationship between trust and commitment.

H5: Trust has a positive effect on relationship commitment.

The Effect of Gratitude on Intention to Redonate. The concept of gratitude, shows the importance of the element of theory of social relations and reciprocal altruism, which has been adopted in various disciplines (Nartlett and DeSteno, 2006). Blau (1964) describes the importance of gratitude in social associations. Morales (2005) argued that directing gratitude to customers would increase their intention to pay back to the seller. In the context of the exchange, the customer will be aware of several advantages of relationship marketing (eg, effort, respect, reward), then they will feel grateful and will buy more (Palmatier *et al*., 2009).

H6: Gratitude has a positive effect on donors intention to redonate.

The effect of Trust on Intention to Redonate. Camarero and Garrido (2011) generated findings that a donor with a high level of confidence will redonate in the future. Waters (2008) findings correlates with the willingness of donors confidence to contribute. Garbarino and Johnson (1999) found no effect of trust on the intention of donors to donate in the future. Naskrent and Siebelt (2011) identified trust as a variable with a central role in influencing donors intention to redonate.

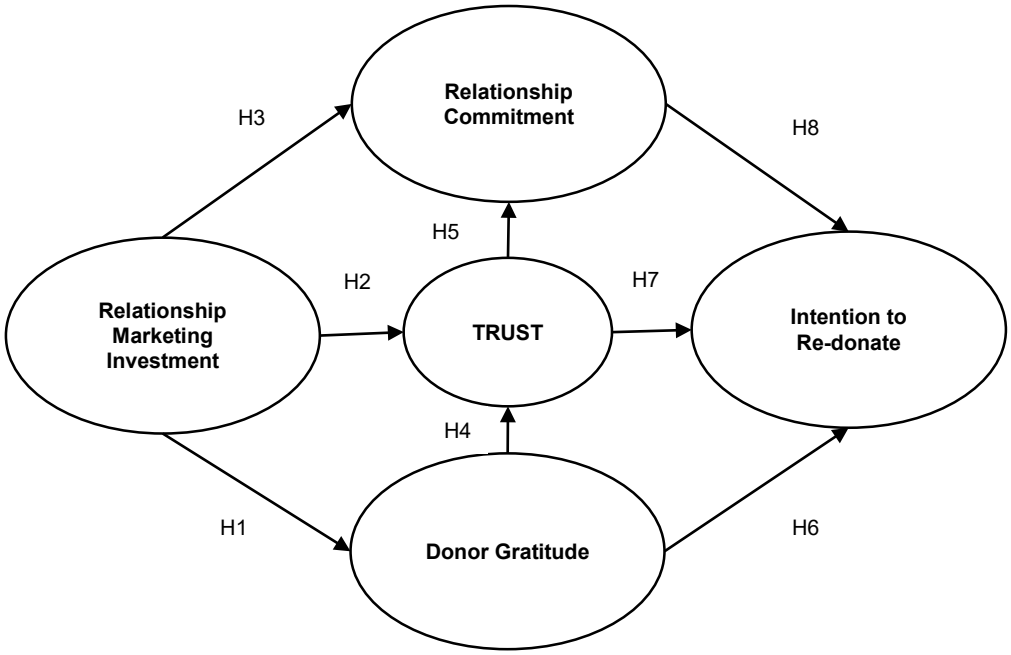
H7: Trust has a positive effect on donors intention to redonate.

The Effect of Relationship Commitment on Intention to Redonate. Blau (1964) argues that people are expected to have a commitment to their social relations, group, and organization. Garbarino and Johnson (1999) showed that customers who have a high relationship orientation, trust and commitment are the main intermediary constructs in success of relationship compared with satisfaction. Lacey and Morgan (2007) findings show that a significant relationship commitment to customers increases their intention to become repeat customers. Waters (2008) obtain a finding that correlates with the willingness of donor commitment to donate. Naskrent and Siebelt (2011) argued that commitment is a core variable in influencing donors to redonate, as well as in leading donors to have a stronger desire to continue the exchange relationship.

H8: Relationship commitment has a positive influence on intention to redonate.

Figure 1 shows the relationships specified by the model. The hypotheses are each are each indicated within the figure.

Figure 1: Model Specified Relationships



This figure shows the research model, which describes the relatioship between the variables are relationship marketing investent, donor gratitude, trust, relationship commitment, and intention to re-donate.

DATA AND METHODOLOGY

Variables used in this study consisted of an exogenous variable that is relationship marketing investment, and endogenous variables, consisting of donor's gratitude variable, trust variable, relationship commitment variable, and variable of intention to redonate.

Relationship marketing investment is a perception on the investment activities undertaken by the organization in building and maintaining strong relationships with customers (Moorman *et al*., 1992). Trust is confidence in the integrity and reliability of the exchange partner (Moorman *et al*., 1993). Relationship commitment is an enduring desire to maintain a valued relationship (Moorman *et al*., 1992). Gratitude is a type of affective response when a person receives "kindness" of others (McCullough *et al*., 2001 in

Palmatier *et al*., 2009). Intention to redonate is donors intention to behave in the future, to assess whether they are to redonate or not (Garbarino and Johnson, 1999).
The instrument used in this study is a questionnaire. Measurements was made on each construct using a Likert scale containing a 5-level response to the proposed statement. Sample units were in the form of individuals, namely individual being a donor to philanthropy organizations in Indonesia. Data were collected using a cross-sectional approach, in which surveying was done by distributing questionnaires to a number of respondents directly. In this study the analytical techniques used Structural Equation Modeling (SEM).

Questionnaires were distributed to as many as 625 individuals. The questionnaires were completed by some 578 individuals, implying a response rate of 92.48%. Some 71 questionnaires were not useable. Reasons for removal of these responses include (1) the respondents did not fill out the questionnaire in full, (2) a statement of overall respondents answered indicators of research with a choice of all the left-most column (strongly disagree), and (3) respondents answered a statement for overall indicators research with all the rightmost column options (strongly agree). Thus, in the end the number of responses processed was 507 (87.72%). The data collection process took as long as 8 weeks.

RESULTS

Data collected and processed included 507 observations. From the results of normality testing, the data were normal, according to the criteria described by Morgan *et al*. (2004), that data satisfy the normality test if the skweness value is less than plus or minus one (<+ / -1.0). Validity test results for the five constructs used in this study are valid, with the lowest factor loading of 0.066 (first indicator for relationship commitment variable). This is in accordance with the criteria suggested by Hair *et al*. (2010) that an indicator is valid if it has a factor loading greater than +0.50. Reliability test results for all five variables exceeds 0.70. Similarly, the reliability test results showed reliable results, consistent with provisions expressed by Hair *et al*. (2010). Cronbanch's alpha technique is used. The generally agreed upon lower limet for Cronbach's alpha is 0.70 (Hair *et al*., 2010).

This model uses the validity and reliability testing. The validity test is conducted on the discriminant validity, convergent validity and nomological validity. Discriminant validity assesses the extent to which a construct is not correlated with other constructs, so a construct is completely different from other constructs (Malhotra, 2010; Hair *et al*., 2010). Hair *et al*. (2010), explains that discriminant validity is achieved when Average Variance Extracted (AVE) exceeds the square correlation estimate. The largest estimate of the square correlation is trust-gratitude (0.494), the second largest is relationship commitment-trust correlation (0.419). From discriminant validity of the test results, it appears the results satisfy discriminant validity. The AVE is calculated using the formula:

$$AVE = \frac{\sum Standard\ Factor\ Loading^2}{n} \quad (1)$$

(Hair *et al*., 2010), where n is the number of indicators of constructs concerned. The results of calculation of AVE for each construct can be seen in Table 1.

Table 1: The Calculation of Average Variance Extracted

Construct	Σ Stand. factor loading^2	n	AVE
Relationship marketing investment (RMI)	1.772	3	0.591
Relationship commitment (RC)	1.693	4	0.423
Trust	2.173	4	0.543
Donor gratitude (Gratitude)	2.082	3	0.692
Intention to redonate (Intention)	1.805	3	0.602

This table shows the result of calculation of Average Variance Estracted (AVE) used to determine discriminant validity. From the calculation, the largest estimate of the square correlation is 0.494 (telationship between trust and gratitude). Validity is achieved when AVE > the square correlation estimate.

Convergent validity is construct validity which measures the extent to which a construct was positively correlated with other constructs (Malhotra, 2010; Hair *et al*., 2010). Hair *et al*. (2010) explains that convergent validity is achieved when the standardized loading estimate should be 0.5 or higher. From the test results, all the relationships between constructs have indicators $\geq$ 0.5. This indicates the fulfillment of convergent validity, as shown in Table 2.

Table 2: Testing for Convergent Validity

Relation between Construct and Indicators	Weighted Factor	Remark
r1 ← RMI	0.830	Valid
r2 ← RMI	0.910	Valid
r3 ← RMI	0.505	Valid
t1 ← Trust	0.672	Valid
t2 ← Trust	0.737	Valid
t3 ← Trust	0.794	Valid
t4 ← Trust	0.740	Valid
rc1 ← RC	0.589	Valid
rc2 ← RC	0.700	Valid
rc3 ← RC	0.677	Valid
rc4 ← RC	0.631	Valid
g1 ← Gratitude	0.810	Valid
g2 ← Gratitude	0.868	Valid
g3 ← Gratitude	0.820	Valid
i1 ← Intention	0.706	Valid
i2 ← Intention	0.851	Valid
i3 ← Intention	0.763	Valid

This table shows the testing for convergent validity. The second column shows the weighted factor is more than 0.5. These findings indicate that all relationships between contructs and their indicators are valid.

Next we discuss results of the reliability test. Hair *et al*. (2010) describes the achievement of reliability requirements of a construct, when the construct reliability (CR) is 0.7 or higher. The formula to calculate the CR is

$$AVE = \frac{\sum Standard\ Factor\ Loading^2}{\sum Standard\ Factor\ Loading^2 + \sum ei} \quad (2)$$

Where ei is the error. The analysis shows all constructs have a CR $\geq$ 0.7, as shown in Table 3.

Table 3: The Calculation of Construct Reliability

Construct	(Σ Stand. Factor Loading) ^{2}	Σ ei	(Σ Stand. Factor Loading) ^{2} + (Σ ei)	CR	Remark
RMI	5.040	0.755	5.795	0.870	Reliable
RC	6.744	1.403	8.147	0.828	Reliable
Trust	8.661	1.057	9.718	0.891	Reliable
Gratitude	6.240	0.502	6.742	0.926	Reliable
Intention	5.382	0.680	6.062	0.888	Reliable

This table shows the calculation of construct reliability (CR). From the formula of CR, we get the number of CR in the fifth column. All of construct have CR more than 0.7 so we conclude they are reliable.

Next we examine the overall model. From the absolute fit, the value of GFI, RMSEA, RMR, and Cmin/DF is good. For incremental fit measures, we see the values of NFI, CFI, and TLI are good. Meanwhile, from the the parsimony fit measures, it appears the value of AGFI and PNFI is good, as shown in Table 4.

Table 4: Goodness of Fit

GOF Criterion	Result
Absolut Fit Measures	
Chi-square (X^2)	293.931
Degree of freedom	111
Probability	0.000
GFI	0.935
RMSEA	0.057
RMR	0.019
Normed Chi-Square (CMIN/DF)	2.648
Incremental Fit Measures	
NFI	0.922
CFI	0.949
TLI	0.938
Parsimony Fit Measures	
AGFI	0.911
PNFI	0.752

This table shows the Goodness of Fit Index. There are absolut fit measures, incremental fit measures, and parsimony fit measures. The result indicates that the model is good.

Finally, we examine the structural model. In SEM, the result is a structural model specification used to test the hypothesized theoretical model (Hair *et al*., 2010). In this study there are eight structural relationships between the constructs as described in the research hypothesis. By using a one tail t-test with a significance level α 95%, then the influence of a construct to other constructs is significant if the value of t-statistics show the number is greater than 1.64, as shown in Table 5.

Table 5: The Calculation for Structural Model

Hypothesis	Causal Relationship	Unstandardized Regression Coeficien	Standardized Regression Coeficien	t Value*	Remark
H1	RMI → Gratitude	0.096	0.138	2.714	Significant
H2	RMI → Trust	0.009	0.012	0.286	Not Significant
H3	RMI → RC	0.058	0.097	2.021	Significant
H4	Gratitude → Trust	0.730	0.720	11.871	Significant
H5	Trust → RC	0.527	0.696	8.897	Significant
H6	Gratitue →Intention	0.086	0.103	1.331	Not Significant
H7	Truat →Intention	0.168	0.208	2.084	Significant
H8	RC →Intention	0.187	0.192	2.434	Significant

This table shows the calculation for stuctural model. From this table indicates that six hypothesis are significant, and two hypothesis are not significant. The final figure in each cell is the test statistic from the t statistic test. indicate significance at the 5 percent levels respectively.*

CONCLUDING COMMENTS

From Table 5, it seems that of eight hypothesis tested, six hypotheses are supported, and two hypotheses are not supported. The supported hypotheses are H1, H3, H4, H5, H7, and H8. Thus the research model is supported empirically, because the criterion variables (ie intention to redonate) can be explained by its antecedends. H1 is supported, implying that various efforts made by the philanthropy organization is perceived by donors as an organization effort which is determined by maintain relationships with customers. This leads to a feeling of gratitude of customer to organizations for what has been done by the organization. The finding of this research is in line with the findings of research carried out by Palmatier *et al*. (2009) in profit-oriented organizations. Thus, the findings are consistent with principles embodied in the theory of exchange. That is, social exchange tends to cause people to feel a sense of duty, gratitude, and trust (Blau, 1964).

From testing H2, relationship marketing investment does not influence trust significantly. Donors perception of the organization's efforts to strengthen relationships with customers does not lead to donors trust of philanthropy organizations directly. From the finding of this study, it shows that the effect of relationship marketing investment to trust is indirect, that is mediated by donors gratitude variable. This implies that various efforts made by organization cause donors gratitude to the philanthropy organization. Thus, the findings of this study support the findings of Palmatier *et al.* (2009). However, our findings contrast the finding of previous researchers (Ganesan, 1994; Wulf *et al.*, 2001) that the relationship marketing investment significant effects trust. This is probably due to the fact that the gratitude variable was not included in the model of research.

The H3 test results show that relationship marketing invesment has a significant effect on relationship commitment. That the formation of donor commitment to philanthropy organizations is due to customer perception of the various efforts made by the organization to build relationships (Fruchter and Sigue, 2004). Palmatier *et al*. (2009), reveals that relationship marketing investment is an activity to build and maintain strong customer relationship. Our findings reinforce the positive effect of relationship marketing investment on relationship commitment, similar to findings from previous studies (Hocutt, 1998; Smith, 1998; Sprecher, 2001; Fruchter and Sigue, 2004; Sargeant and Lee, 2004).

Hypothesis 4 is supported, meaning that a deep gratitude to the organization, respect for the organization, and pleasure in organizations resulting that the donors trust in the organization. These findings support the findings of previous researches, that gratitude influences trust (Palmatier *et al*., 2009). As suggested by Cialdini and Goldstein (2004) that gratitude and reciprocity are essential to motivate customer to build trust within the organization. It is also similar to that described by Dunn and Schweizer (2005) that positive emotions like gratitude have a significant influence on increasing trust.

The result of H5 testing is significant, meaning that the presence of donor trust in philanthropy organizations led them to commit to the organization. The importance of trust in the relationship between donors and organizations is because donors do not directly feel the result of a nonprofit organization (MacMillan *et al*., 2005). In a relationship, when trust exists, most likely the level of commitment will also be high (Geyskens *et al*., 2004 in Fruchter and Sigue, 1999). This suggests that trust and commitment in nonprofit organizations is a central issue in establishing relationships with donors. Morgan and Hunt (1984) argue that trust and commitment are the core of relationship marketing. The findings of this research is no different from previous research in both the profit-oriented organizations (Morgan and Hunt, 1984; Achrol, 1991; Moorman *et al*., 1992, Smith, 1998) and nonprofit organizations (Garbarino and Johnson, 1999; Sargeant and Lee, 2004).

Test results do not support H6. The effect of gratitude on the intention to redonate is indirect, that is through the mediator trust variable. It means that the donor who was grateful to the organization will cause donors

to redonate when donors have trust in the organization. This further confirms the important role of the variables of trust in relationship marketing in nonprofit organizations as expressed by Garbarino and Johnson (1999), MacMillan *et al*. (2005) and Waters (2008). This finding is in contrast to the findings of research conducted by Palmatier *et al*. (2009) in profit-oriented organizations, who found that gratitude significantly effects customer purchase intention.

Tests support H7, meaning that a sense of trust that has been embedded in the minds of the donors leads to their intention to redonate to philanthropy organizations. This supports previous research findings that donors with the highest level of trust have intention to redonate at the future time (Garbarino and Johnson, 1999; Waters, 2008; Camarero and Garrido, 2011; Naskrent and Siebelt, 2011). Finally the finding of testing on H8 show that the relationship commitment has a significant influence on intention to redonate. The findings in this study are in accordance with the argument of Naskrent and Siebelt (2011) that commitment is a core variable in influencing donors to redonate, as well as leading donors to have a stronger desire to continue the exchange relationship. This finding also supports previous research conducted by Dwyer *et al*., (1987) and Waters (2008). Thus, we conclude that the role of relationship investment in nonprofit organizations in the context of relationship marketing is very important. It is important not t forget to include trust and relationship commitment variable as mediating variables consistent with research conducted by Morgan and Hunt (1994) about the Key Mediating Variables (KMV).

From these findings, we recommend that managers of philanthropy organizations should enhance and continue to take various investments/activities to build relationships with donors. Because of the analysis results it appears that trust and commitment to the organization is caused by relationship marketing Investment conducted by the organization. This research is conducted on donors who gave their donation to philanthropy organizations engaged in various sectors, including health, education, poverty, and so forth. We recommend further research on philanthropy organizations that have more specific targets, such as just education, just the arts sector, or maybe just the health sector. In addition, further research could also examine other consequences of trust and relationship commitments, parhaps including a cooperation variable.

In this study, data were cross-sectional. Therefore caution is necessary in making conclusions. Causal relationship between the study variables were tested in the research model. Further study is recommended to examine a range of different times in investigating causal relationships between variables. By doing so it may be possible to get better results in testing causal relationships between variables of the study.

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EXPORT INHIBITORS IN THE FIRST STAGE OF THE INTERNATIONALIZATION PROCESS: EVIDENCE FROM MEXICO

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ABSTRACT

This paper identifies export inhibitors in the first stage of the internationalization process of companies. Evidence indicates export inhibitors have the strongest effects on small and midsized manufacturing companies (SMEs) in the state of Michoacán, Mexico. Some 191 managers or owners of different industrial SMEs were interviewed for this study. I found the lack of information about government agencies involved in the export process, lack of knowledge about government support for companies intending to export, lack of information about international agreements that Mexico has and lack of information about the procedure to export are export inhibitors with the strongest impact on the surveyed SMEs. One possible explanation for this finding could be that information is not effectively reaching key stakeholders. This implies it is necessary for the Mexican government to develop new strategies that allow information to accomplish its goal. By doing so, companies may broaden their horizons through international markets.

JEL: M16, M31, M39, M51, P33

KEWORDS: Export Barriers, Export Obstacles, International Business, Exports, Internationalization Process of the Firm

INTRODUCTION

Exports offer significant opportunities for growth to SMEs. SMEs can respond to opportunities to expanding its market, or address problems it may face in the domestic market. However, this is an activity that is not being developed by all manufacturing SMEs in Mexico. Only 6.7% of existing companies have export activities, a figure that falls to 5% in the state of Michoacán. For this reason the present investigation examines problems these companies have with exports. It is often the case that difficulties encountered by firms keep them from achieving their international goals or inhibiting their will to participate in export activities.

The issues surrounding exportation have been studied in various countries and with different kinds of companies. Understanding the relevant issues may help determine the reason why many companies are not able to export or incur financial losses, or why exporting companies are unable to exploit their potential to the fullest (Leonidou, 1995). Previous studies have shown that some barriers are created within the company and are generally associated with resources at the organization's disposal or with the approach given to marketing of exports. Others stem from external circumstances both in their own countries and in the countries they are trying to reach (Leonidou, 1995; Fillis, 2002; Smith, Gregoire & Lu, 2006). These problems appear at any stage of the companies' internationalization process and can be different from one company to the next (Kedia & Chhokar, 1986; Leonidou, 1995; Smith et al., 2006). But, they can also have different effects on companies that find themselves in the same stage of the internationalization process (Pinho & Martins, 2010) or in the same industry (Tesfom, Lutzb & Ghauric, 2006).

Internationalization has been studied extensively. However, a considerable number of the studies consulted contemplated the same variables, methodology and measuring tools for both exporting and non-exporting companies. The results show that these problems affect each group differently (Kedia & Chhokar, 1986; Moini, 1997; Smith, et al., 2006; Pinho & Martins, 2010). This study, therefore, joins the existing literature on the subject and finds which export inhibitors in the first stage of the companies' internationalization process has the strongest impact on manufacturing SMEs in the state of Michoacán. For that reason, this research focuses solely on inhibitors faced by non-exporting companies. Consequently the methodology, measurement tools and variables are used only on SMEs which do not export, leaving aside any issues that may be faced by exporting companies. I do this because it has been mentioned in Michoacán that 95% of manufacturing SMEs do not have export activities, which makes it crucial to identify the relevant characteristics of these companies.

This work is initially composed of a review of the literature in which the first stage of the companies' internationalization process and the problems and inhibitors for exports affecting non-exporting companies are addressed. Next, there will be an analysis of the methodology used, followed by the results of field work which will gives place to the discussion. The paper closes with some concluding comments.

LITERATURE REVIEW

First Stage of the Internationalization Process of Companies

Johanson and Wiedersheim-Paul (1975) are credited as the first to carry out studies on the internationalization process of companies. Their model has four sequential stages where the resources and the commitment to foreign markets are increased as more experience in international commerce is gained. However, they do not mention why companies decide to go international and how the process begins (since the companies which were the subject of their study already took part in export activities). Additionally, they do not discuss factors which may influence this process (Andersen, 1993). For this reason, to this day, models are being created to analyze the internationalization of companies from the moment they serve only domestic demand and have no interest in exporting until the moment in which they are consolidated abroad.

Several models coincide in that the first stage of the process of internationalization of companies is characterized by the companies focusing on serving the domestic market (Bilkey & Tesar, 1977; Wiedersheim-Paul, Olson & Welch, 1978; Cavusgil, 1982; Hodgkinson, 2000; Jansson & Sandberg, 2008; Scherer, Gomes & Kruglianskas, 2009). At this stage firms do not have any intention of exporting, of processing unsolicited orders originating abroad (Bilkey & Tesar, 1977; Crick, 1995); or being comfortable in their domestic market and uninterested in international demand (Leonidou & Katsikeas, 1996). Hence the companies have no exporting experience, lack knowledge of suppliers abroad and feel highly uncertain about international business (Jansson & Sandberg, 2008), resulting in a very limited gathering of information (Wiedersheim-Paul, Olson & Welch, 1978). Those companies which do export do it by processing an unsolicited order (Haar & Ortiz-Buonafina, 1995). It is often the buyers who take care of all the logistics work needed to transport the goods to their country since the seller ignores or may not even possess distribution channels, nor does it carry out exporting strategies nor commercial operations. In this way, sales made to foreign customers are done exactly as if they had been made to a consumer in their own country (Leonidou & Katsikeas, 1996).

Johanson & Vahlne (1977) point out the internationalization process starts with the detection of an opportunity abroad or as an answer to solve problems there may be with the domestic market. This drives the companies' directors to make international-oriented decisions using whatever international business knowledge they own. Knowledge influences international actions to a larger degree than other kinds of actions (Reid, 1981), considering that decision makers tend to form expectations or opinions on the

profitability and risks of exports and that such expectations reflect the knowledge that the managers have by way of their own experience or that of another company (Cavusgil, 1981).

Problems for Non-exporting Companies in the First Stage of the Internationalization Process

In the first stage of the internationalization process for SMEs, the company's owner plays an exceedingly important role in the decision making process for the entrance into international markets (Reid, 1981). The design of export strategies, the marketing and the undertaking of business with clients abroad all depend on the owner (Leonidou, Katsikeas & Piercy, 1998). Hence, many obstacles faced in the first stage of the internationalization process of companies fall on the decision maker. Any inability to deal with problems in the stage immediately before exporting can cause a passive attitude toward foreign operations (Smith et al., 2006). Additionally, studies have shown that companies which do not export tend to have bigger problems in the pre-export stage, (Smith et al., 2006; Pinho & Martins, 2010). Therefore, the stronger the perception of the importance of the barrier, the more unlikely the decision to export (Pinho & Martins, 2010), even to the point of choosing to remain in the domestic market (Colaiácovo, 1996; García, 2000; Smith et al., 2006). In the case of companies which already are exporting, the problems faced are usually on the operational side (Smith et al., 2006; Pinho & Martins, 2010).

Leonidou, (1995) and Fillis, (2002) agree that the main problems for non-exporting firms are in the pre-export stage. For this reason it is necessary to identify the relevant differences between non-exporting companies and exporting companies. By doing so it will be possible to design programs aimed at encouraging exportation (Kedia & Chhokar, 1986). It is also necessary to address the need to eliminate the inhibiting effects that represent obstacles to exporting by non-exporting companies (Kedia & Chhokar, 1986; Moini, 1997; Leonidou, 1995; Smith et al., 2006; Liargovas & Skandalis, 2008; Pinho & Martins, 2010) with the purpose of having more of them enter international markets. This export-inhibiting effect may be eliminated in stages prior to exporting through consulting and guidance (Leonidou, 1995); a complete understanding of all obstacles (Kedia & Chhokar, 1986); export programs which provide information, knowledge, experience and essential resources (Liargovas & Skandalis, 2008). A mentorship program can provide help to firms that find themselves in the process of exporting (Moini, 1997). Next we identify several problems associated with non-exporting companies in the reviewed literature:

Negative experiences in exports. Several authors remark that experience with exports is central to starting an internationalization process since positive experiences with exports can be the basis for success in this activity (Pinho & Martins, 2010). Positive experiences may represent a crucial difference in e expectations the company has (Kedia & Chhokar, 1986). On the other hand, Colaiácovo (1996) mentions that negative experiences with exports can cause a company to decide not to enter international markets or to give up exporting activities.

Comfortable position in the domestic market. Julian & Ahmed (2005) found that emphasizing the domestic market is a barrier that stops companies from looking or wanting to export. Having large volumes of sales (Fillis, 2002), business and a satisfactory performance in general in the domestic market leads to companies not being interested in international markets (Colaiácovo, 1996). Additionally, that the company's manager is focused in meeting the demands of the domestic market results in a blind spot regarding international markets which leads to his or her decision making not being oriented toward taking advantage of business opportunities abroad (Kyvik, Saris, Bonet & Felício, 2013).

Refusal for lack of capability. Occhipinti (1998) states there are companies that have the perception that they lack the capabilities needed to export even before making an evaluation to know if they really have such capabilities, and for that reason exports are not part of their strategic planning.

Lack of knowledge. Reid (1981) states that the main problem for companies that want to export is lack of knowledge. This lack of knowledge can be reflected initially in knowledge they have about international markets. Studies done by Kedia & Chhokar (1986) and Da Silva & Da Rocha (2001) found that lack of knowledge of international markets was an important barrier for non-exporting companies. Lack of knowledge about the procedure for exporting is another obstacle that has a strong adverse effect on non-exporting companies (Kedia & Chhokar, 1986; Moini, 1997; Shih & Wickramasekera, 2011). The awareness companies have of positive expectations as well as of the advantages that managers have by exporting is important to explain their behavior towards international trade (Bilkey & Tesar, 1977). A lack of knowledge about the benefits produced by export activities leads to non-exporting business people making deliberate decisions not to export. Those who do not export but are aware of the benefits of exporting work hard to do so and enter into international business (Shih & Wickramasekera, 2011).

Lack of information. Czinkota, Ronkainen & Moffett (2007) point out that information is crucial for executives who wish to enter international markets. Similarly, Minervini (2004) suggests that information forms the basis of every exporting project since the companies' decision to go international is related to the opportunities afforded by international markets and access the companies have to information (Santos & García, 2009). However, one of the main problems faced by firms is how to acquire the information needed to analyze international markets (Moini, 1997). In addition a failure to identify, select and contact these markets due to the inefficiency of the information can be problematic (Katsikeas & Morgan, 1994). Many companies are not familiar with national and international sources of information. In addition they lack a clear idea about the amount of specific information required (Leonidou, 2004). This lack of information can be extended to public and private programs for the advancement and support of internationalization activities (Pérez & Camarero, 2007).

Risk. Both the companies' behavior and their decision making are influenced by the perception of risk which accompanies any activity (Claver, Rienda & Quer, 2008). When an activity is associated with exports, managers formulate expectations about the profitability and the degree of risk implied in marketing abroad based on their own knowledge or on the experience of other companies (Cavusgil, 1981). The perception of risks associated with internationalization vary depending on the characteristics of the owners and/or executives (George et al., 2005, quoted by Claver, Rienda & Quer, 2008, p. 458). Likewise, companies perceive greater risks according to the degree to which they assume a greater commitment to international business. For this reason, firms that find themselves in the first stage of the internationalization process perceive lower risks related to international activity (Claver et al., 2008). The resources, the national and international macro context of the activities of the company and the supervision of management interact with and influence the perception and evaluation of risks associated with each level of international commitment in the decision making process (Liesch, Welch & Buckley, 2011). When companies perceive general risks and obstacles, their internationalization process advances more slowly (Kahiya, 2013) because the perception of risks is associated with difficulty in obtaining information and unfamiliarity with foreign markets (Jung & Bansal, 2009).

Uncertainty. Uncertainty is usually larger in international activities, compared to activities the company carries out in its domestic market (Johanson & Vahlne, 1978). These activities, added to the management and resources that the company assigns to its internationalization, have a direct influence on the perception of uncertainty and, of course, in the international commitment to export adopted by the company (Liesch, Welch & Buckley, 2011). Entering into foreign markets creates risk due to uncertainty and such activities are harder to control (Jung & Bansal, 2009). This is because confusing experiences, ignorance and other simply irrational behaviors exert an influence on the decision maker and on his or her perception of uncertainty. This can increase or decrease relative to a starting position (Liesch, et al., 2011) which in this case is the first stage of the process of internationalization.

Lack of time for export activities. In small companies, all decisions usually go through one person who lacks the time to carry out activities other than those he or she has in the domestic market. But, if a company's management wishes to enter into international markets, they must be willing to dedicate enough time to the tasks required for exports (Leonidou, 2004).

METHODOLOGY

The sample for this project was 262 manufacturing SMEs in the state of Michoacán taken from a universe of 826 SMEs which are non-exporting companies regardless of whether they processed any orders coming from abroad. To obtain the representative sample, the data base of the *Directorio Estadístico Nacional de Unidades Económicas* (National Statistic Directory of Economic Units or DENUE) offered by the *Instituto Nacional de Estadística y Geografía de México* was used. The confidence level calculated for the sample was 95% and the percentage of error was 5%. In order for all SMEs to have the same chance of being selected regardless of their industrial activities, a stratified probability sample was used. To determine the strata, the Industrial Classification System of North America from 2007 was used. In Mexico, *the Ley para el Desarrollo de la Competitividad de la Micro, Pequeña y Mediana Empresa* (Development of Competitiveness for Micro, Small and Mid-sized Businesses Act) indicates that the size of industrial SMEs is determined according to the following categories: companies with 11 to 250 workers, a range of yearly sales of $4.01 million to $250 million pesos and a combined maximum between 95 and 250 points obtained from the following formula: company score = (number of workers) X 10% + (annual sales balance) X 90%, which should be equal or below that of the combined maximum limit for their category.

The measurement tool used in this investigation was a questionnaire. In first instance, a dichotomous question was used to know if the company had ever processed an order from abroad. A Likert scale with 5 points (1 = Definitely; 2 = Probably; 3 = Undecided; 4 = Probably not; 5 = Definitely not) was used for the rest of the questions. This measurement was used for the elements of satisfaction with the experience, risk, uncertainty, safety inside the domestic market, sufficient sales, sufficient business, evaluation of the company, suitability to export, availability of time and lack of information. For example, to know if the companies consider exports to be risky they can answer 'definitely' or 'probably' in the risk factor). For the knowledge element the 5 points on the scale were (1 = Completely; 2 = Plenty; 3 = Regular; 4 = Little, 5 = Nothing), meaning that a company can know little or nothing about the process of exporting. A pilot test was done to determine the instrument reliability from which an Alpha coefficient of Cronbach of 0.890 was obtained.

The field work was carried out in the months of July and August of 2012, successfully obtaining 191 contacts (which represents a response rate of 73%). For the execution of the work, the companies were visited directly to find the proper people to answer the questionnaire in their own facilities with the hope of getting the largest number of answers. The proper person to answer the questionnaire is the manager or owner of the company, given that they make strategic decisions in the firm.

A t test was made with the data obtained to observe the different perceptions of the export inhibitors offered by non-exporting companies that have processed orders from abroad and non-exporting companies for which no orders have come from abroad, or which have been unwilling to process such orders. Afterward, the data was analyzed through descriptive statistics to identify which inhibitors most affected both groups of non-exporting companies. Additionally, a correlation and multiple linear regression was carried out to observe the connection and the percentage of variation that exists between the inhibitors proposed and the fact that companies do not export, as well as to determine how the dependent variable behaves in relation to the group of independent variables proposed.

RESULTS AND DISCUSSION

The results obtained from the t test can be seen in Table 1. The first two columns show the median and standard deviation for companies that did not receive and therefore did not process orders from abroad. The two following columns show data from companies which did process orders from abroad. The last column shows the t value contrasted by both groups of companies. The data indicates there isn't much of a difference in the perception of the inhibitors between companies which have responded to inquiries originating from abroad and companies that have received no inquiries originating from abroad.

Table 1: Descriptive Statistics of Export Inhibitors

Descriptive Statistics of Export Inhibitors					
	Did Not Receive Orders from Abroad		Processed Order from Abroad		
Company Related Inhibitors	72%		28%		T value
	Mean	S.D.	Mean	S.D.	
Negative experience in exports	2.36	0.23			
Risk	3.21	1.17	3.21	1.32	0.24
Uncertainty	3.14	1.09	3.25	1.27	-0.79
Security in the local market	3.07	1.49	2.70	1.58	1.22
High level of sales in the local market	4.00	1.38	4.36	1.19	-0.53
High level of business in the local market	3.87	1.46	4.38	1.16	-1.49
Lack of knowledge about international markets	4.12	1.34	3.38	1.62	2.02
Lack of knowledge about the benefits of exporting	4.42	1.02	3.77	1.37	2.40
Lack of knowledge about the procedure to export	4.46	0.95	3.15	1.36	4.53
Lack of knowledge about government support for companies intending to export	4.60	0.79	4.13	1.21	1.59
Lack of knowledge about governmental advice for companies intending to export	4.58	0.78	4.13	1.23	1.46
Evaluation done to find out if the firm has the ability to export	4.42	1.25	3.42	1.73	3.30
Consider their business has the ability to export	2.13	1.31	1.30	0.67	3.64
Lack of time to learn about the process to export	2.18	1.18	1.74	0.94	1.50
Lack of time to do business abroad	3.40	1.42	2.68	1.42	2.11
Lack of information about exports of products similar to those of the firm	4.37	1.21	3.40	1.61	2.94
Lack of information about the procedure to export	4.50	1.05	2.85	1.65	5.15
Lack of information about government agencies involved in the export process	4.18	1.28	3.38	1.61	2.09
Lack of information about overseas sales opportunities	4.29	1.28	3.64	1.55	2.77
Lack of market research in another country	4.79	0.70	4.09	1.51	2.73
Lack of information about international agreements that Mexico currently has	4.41	1.15	3.70	1.58	1.75
Lack of information about potential distributors	4.44	1.12	3.57	1.62	1.34
Lack of information about international trade shows	4.23	1.25	3.53	1.65	1.84
Lack of information about the financing offered by banking institutions for companies that are exporting	4.19	1.29	3.74	1.60	1.86
Lack of information about the financing provided by the Mexican government to firms intending to export	4.31	1.22	4.13	1.39	0.13
Lack of documental information about international business	4.46	1.10	3.92	1.60	1.97

Source: Prepared by the author based on data compiled through field work.

However there are two inhibitors with a marked difference. Lack of information about the procedure to export, had a t value of 5.15. Lack of knowledge about the procedure to export had a t value of 4.53. By observing this result we consider that companies which have processed orders originating from abroad have a larger need for information about international markets perhaps due to an intention of looking for orders in these markets and exporting their products on their own. These firms therefore are more prone to searching for information and turning it into knowledge.

Another factor which does not have such a marked difference but is nevertheless important is the perception showed by the companies capabilities for exporting. The resulting t value is 3.64, which shows that companies which have processed orders coming from abroad perceive themselves as having the necessary capabilities to satisfy demand abroad through exportations. Companies which have not filled orders originating from abroad, stated having the capability to develop exporting activities less frequently.

The above result has to do with evaluations carried out to know if a firm has the capability to export. It reports a t value of 3.3. This means that companies which have processed orders originating from abroad are more prone to making an evaluation to know if they have the capabilities for exporting as one more activity in their company. This may be due to the positive opinion they have about international business and the benefits that these have for companies which do export. For this reason, they attempt to identify, through an evaluation, if they are capable of meeting demand from abroad on a permanent basis. On the other hand, companies which have not received and/or processed orders from abroad reported doing less evaluations to know if they have the capabilities needed to export. Therefore, companies in this group which declared having the necessary capabilities for export activities, did so with plenty of optimism but without technical knowledge about those capabilities.

Table 2 shows the mean and the standard deviation of the inhibitors for exports of companies which processed orders from abroad. The results show a ranking of inhibitors to exports which most affect this group of companies as follows: 1) High level of business in the local market with a mean of 4.38; 2) High level of sales in the local market with a mean of 4.36; 3) Lack of information about the financing provided by the Mexican government to firms intending to export with a mean of 4.13; 4) Lack of knowledge about government support for companies intending to export with a mean of 4.13; and 5) Lack of knowledge about governmental advice for companies intending to export with a mean of4.13.

Table 2: Inhibitors for the Companies That Received Orders from Abroad

Processed Order from Abroad	Mean	Rank
High level of business in the local market	4.38	1
High level of sales in the local market	4.36	2
Lack of information about the financing provided by the Mexican government to firms intending to export	4.13	3
Lack of knowledge about government support for companies intending to export	4.13	4
Lack of knowledge about governmental advice for companies intending to export	4.13	5
Lack of market research in another country	4.09	6
Lack of documental information about international business	3.92	7
Lack of knowledge about the benefits of exporting	3.77	8
Lack of information about the financing offered by banking institutions for companies that are exporting	3.74	9
Lack of information about international agreements that Mexico currently has	3.70	10

Source: Prepared by the author based on data compiled through field work.

The two main inhibitors in this group of companies have to do with high levels of business and sales in the local market, which suggests that despite the fact that companies have processed orders from abroad, they have carried out evaluations to know if they have the capabilities to export, know the procedure for exporting (as can be seen in Table 1, this is one of the inhibitors which least affect this group of companies) and have some information about international business. They don't incorporate exporting activity as one of their usual activities due to the strong presence these companies have in their local market.

In Table 3 we find the mean and standard deviation of export inhibitors which most affected companies that did not received orders from abroad. The table shows a ranking of inhibitors which have the strongest effect on this kind of company as follows: 1) Lack of market research in another country with a mean of 4.79; 2) Lack of knowledge about government support for companies intending to export with a mean of 4.60; 3) Lack of knowledge about governmental advice for companies intending to export with a mean of

4.58; 4) Lack of information about the procedure to export with a mean of 4.50; and Lack of knowledge about the procedure to export with a mean of 4.46.

Table 3: Inhibitors for Companies That Did Not Receive Orders from Abroad

Did Not Receive Orders from Abroad	Mean	Rank
Lack of market research in another country	4.79	1
Lack of knowledge about government support for companies intending to export	4.60	2
Lack of knowledge about governmental advice for companies intending to export	4.58	3
Lack of information about the procedure to export	4.50	4
Lack of knowledge about the procedure to export	4.46	5
Lack of documental information about international business	4.46	6
Lack of information about potential distributors	4.44	7
Evaluation done to find out if the firm has the ability to export	4.42	8
Lack of knowledge about the benefits of exporting	4.42	9
Lack of information about international agreements that Mexico currently has	4.41	10

Source: Prepared by the author based on data compiled through field work.

By observing the rankings obtained from the companies which processed orders originating from abroad and from those that didn't, one can see that in both groups the following inhibitors occupy the first six places: lack of knowledge about government support for companies intending to export, lack of knowledge about governmental advice for companies intending to export, and lack of market research in another country. In both groups lack of knowledge about support and guidance that the Mexican government offers to companies that wish to export is strong. This occurs despite the money that that government has invested to allow its companies to export and have international business. It is also worth noting that in both groups, the lack of market research is an important inhibitor. This shows that companies don't know who their potential clients may be and, as a consequence, represents a strong inhibitor in the first stage of the internationalization process of the firm. How can they intend to export when they don't know who to sell to?

Table 4 indicates the maximum and minimum values as well as the mean and standard deviation of each independent variable corresponding to all the surveyed companies which do not carry out exportation activities (regardless of whether they have processed orders from abroad or not), together with the multiple determination coefficient (r^2). The results indicate the inhibitors which have a strong correlation with the lack of exports are: the lack of information about overseas sales opportunities, with a correlation coefficient of 0.732. These results can lead to the presumption that if a company lacks information about sales opportunities for their products abroad it is much less likely to have the need to export. Firms sell wherever they know of a demand for their products. Lack of knowledge about the benefits of exporting was the second inhibitor which most affects the surveyed companies with a correlation coefficient of 0.728. From this finding the following question can be inferred: How can companies become interested in exporting if they are unaware of the benefits which this activity implies? The lack of knowledge about governmental advice for companies intending to export has a correlation coefficient of 0.727 and is the third most important inhibitor.

The result of this inhibitor indicates that despite the efforts made by the Mexican government to develop guidance programs so that companies that wish to export can do so, the targeted companies are unaware of these programs. One can assume that the efforts made by the government to have its companies develop export activities have been largely unproductive. The fourth and last place, the lack of knowledge about the procedure to export, has a correlation coefficient of 0.725. This figure indicates that companies which processed orders coming from abroad did not develop the paperwork nor the logistics needed to consummate the export. This finding confirms what has been concluded in previous studies about the

internationalization process of companies. These studies stated that sales that a company makes to foreign clients in the first stage are carried out as if they were domestic sales as the firm hasn't developed any activity aside from billing the items sold.

Table 4: Descriptive Statics and Correlation

Descriptive Statistics and Correlation						
	Minimum	**Maximum**	**Mean**	**D.S**	**Non-exporting Firms**	***R²***
Negative experience in exports	1.00	5.00	2.35	0.67	0.067	0.00
Risk	1.00	5.00	3.21	1.21	0.113	0.01
Uncertainty	1.00	5.00	3.17	1.14	-0.014	0.00
Security in the local market	1.00	5.00	2.97	1.51	0.123	0.02
High level of sales in the local market	1.00	5.00	4.09	1.34	0.201**	0.04
High level of business in the local market	1.00	5.00	4.00	1.41	0.154*	0.02
Lack of knowledge about international markets	1.00	5.00	3.92	1.46	0.687**	0.47
Lack of knowledge about the benefits of exporting	1.00	5.00	4.24	1.16	0.728**	0.53
Lack of knowledge about the procedure to export	1.00	5.00	4.09	1.23	0.725**	0.53
Lack of knowledge about government support for companies intending to export	1.00	5.00	4.47	0.94	0.701**	0.49
Lack of knowledge about governmental advice for companies intending to export	1.00	5.00	4.45	0.94	0.727**	0.53
Evaluation done to find out if the firm has the ability to export	1.00	5.00	4.15	1.46	0.517**	0.27
Consider their business has the ability to export	1.00	5.00	1.91	1.23	0.105	0.01
Lack of time to learn about the process to export	1.00	5.00	2.05	1.13	0.386**	0.15
Lack of time to do business abroad	1.00	5.00	3.21	1.46	0.241**	0.06
Lack of information about exports of products similar to those of the firm	1.00	5.00	4.09	1.40	0.441**	0.19
Lack of information about the procedure to export	1.00	5.00	4.04	1.44	0.707**	0.50
Lack of information about government agencies involved in the export process	1.00	5.00	3.95	1.43	0.700**	0.49
Lack of information about overseas sales opportunities	1.00	5.00	4.09	1.39	0.732**	0.54
Lack of market research in another country	1.00	5.00	4.59	1.04	0.589**	0.35
Lack of information about international agreements that Mexico currently has	1.00	5.00	4.21	1.31	0.702**	0.49
Lack of information about potential distributors	1.00	5.00	4.18	1.34	0.554**	0.31
Lack of information about international trade shows	1.00	5.00	4.02	1.41	0.543**	0.29
Lack of information about the financing offered by banking institutions for companies that are exporting	1.00	5.00	4.05	1.40	0.545**	0.30
Lack of information about the financing provided by the Mexican government to firms intending to export	1.00	5.00	4.25	1.27	0.619**	0.38
Lack of documental information about international business	1.00	5.00	4.30	1.29	0.607**	0.37

Source: Prepared by the author based on data compiled through field work.** Significance at 5%

Once the multiple determination coefficient (r^2) for each variable were obtained, an analysis and interpretation corresponding to each of the variables was carried out. From this analysis I inferred that: 1) the lack of information about overseas sales opportunities explains 54% of the reasons surveyed companies do not develop export activities, 2) the lack of knowledge about the benefits of exporting explains 53% of why surveyed companies do not develop export activities, 3) the lack of knowledge about governmental advice for companies intending to export explains 53% of why the surveyed companies do not develop

export activities, 4) the lack of knowledge about the procedure to export explains 53% of why the surveyed companies do not develop export activities.

Table 5 shows the data from the multiple linear regression. The results show the variable "uncertainty" was the most important of this analysis with a Beta coefficient of 0.171, followed by the variable "high level of sales in the local market" with a beta coefficient of 0.126, and the variable "consider their business has the ability to export" with a beta coefficient of 0.123. These variables are most important in the regression equation given that their coefficient has the largest absolute value, aside from indicating the amount of change in typical scores produced in the dependent variable for each change of a unit in the corresponding independent variable.

Finally, excluding the variables "lack of information about the financing offered by banking institutions for companies that exporting", "negative experience in exports", "lack of knowledge about governmental advice for companies intending to export" and "lack of information about government agencies involved in the export process", results in all other variables used in this investigation having significant coefficients. Therefore, they make a significant contribution towards explaining what happens with the lack of exports in the surveyed companies.

DISCUSSION

According to Colaiácovo (1996), having a negative exporting experience causes companies to reject the idea of exportation. I found that this inhibitor does not represent a significant problem given that most companies which processed orders coming from abroad pointed out that their experience had been satisfactory. Processing orders coming from abroad leads companies to gain experience and search for information related to international markets. For this reason, their position in the process of internationalization of firms may change so that they become active exporters (Bilkey & Tesar, 1977; Wiedersheim-Paul et al., 1978; Reid, 1981; Cavusgil, 1982; Czinkota, 1982; Crick, 1995; Leonidou & Katsikeas, 1996; Hodgkinson, 2000; Jansson & Sandberg, 2008). Shih & Wickramasekera (2011) point out that experience and knowledge are necessary for every company which looks to export.

Few companies consider exports to be risky, a result which echoes that of Fillis (2002). In contrast, Julian & Ahmed (2005) and Shih & Wickramasekera (2011), Ahmed, Julian, Baalbaki & Hadidian (2004) and Pinho & Martins (2010) found that the risk of exports was an important barrier. Most surveyed companies estimate that security in the domestic market is not an important inhibitor for exporting. This results reflects results obtained by Ahmed et al. (2004), but differs from that of Fillis (2002) and Julian & Ahmed (2005) where security in the domestic market turned out to be one of the strongest inhibitors to exporting. Colaiácovo (1996) found that when sales and business in the domestic market are viewed as sufficient, companies are not interested in exporting. However, this research found that having enough sales and business in the domestic market is not the inhibitor which most affected the companies in their exporting endeavors either.

Table 5: Regression Data

Model	Typified Coefficients	t	Sig.	Significance
	Beta			
Negative experience in exports	-0.008	-0.453	0.651	NO
Risk	0.103	4.128	0.000	YES
Uncertainty	0.171	6.792	0.000	YES
Security in the local market	0.100	5.468	0.000	YES
High level of sales in the local market	0.126	4.976	0.000	YES
High level of business in the local market	0.071	2.772	0.006	YES
Lack of knowledge about international markets	0.078	2.763	0.006	YES
Lack of knowledge about the benefits of exporting	0.063	2.094	0.038	YES
Lack of knowledge about the procedure to export	0.083	2.456	0.015	YES
Lack of knowledge about government support for companies intending to export	0.073	1.717	0.088	NO
Lack of knowledge about governmental advice for companies intending to export	0.041	0.935	0.351	NO
Evaluation done to find out if the firm has the ability to export	0.093	4.489	0.000	YES
Consider their business has the ability to export	0.123	7.006	0.000	YES
Lack of time to learn about the process to export	0.093	4.926	0.000	YES
Lack of time to do business abroad	0.053	2.799	0.006	YES
Lack of information about exports of products similar to those of the firm	0.061	3.399	0.001	YES
Lack of information about the procedure to export	0.074	2.547	0.012	YES
Lack of information about government agencies involved in the export process	0.048	1.678	0.095	NO
Lack of information about overseas sales opportunities	0.102	4.071	0.000	YES
Lack of market research in another country	0.057	2.562	0.011	YES
Lack of information about international agreements that Mexico currently has	0.084	3.029	0.003	YES
Lack of information about potential distributors	0.089	4.308	0.000	YES
Lack of information about international trade shows	0.075	3.678	0.000	YES
Lack of information about the financing offered by banking institutions for companies that are exporting	0.009	0.348	0.728	YES
Lack of information about the financing provided by the Mexican government to firms intending to export	0.114	4.142	0.000	YES
Lack of documental information about international business	0.108	5.088	0.000	YES

Source: Prepared by the author based on data compiled through field work.

De Clercq, Sapienza, Yavuz, & Zhou (2012) point out that internationalization is not something that comes randomly, nor does it appear because clients push companies to do so. Rather, internationalization comes as a result of a variety of sources of knowledge and styles of acquisition of knowledge. Concerning knowledge with regard to this investigation, the following subjects were studied: international markets, positive factors of foreign trade, knowledge of the procedure of exporting, awareness of government support and assistance to companies which look to export. In all cases it was found that the surveyed companies largely lack knowledge of these areas. This result confirms results described by Johanson & Widersheim-Paul (1975) regarding the lack of knowledge as one of the most important barriers to the internationalization of the companies. Regarding the lack of knowledge about international markets, my results are similar to those of Kedia and Chhokar (1986), who found it to be the second most important hindrance for non-exporting companies. Similarly, Okpara (2009) was found it to be the most important one. He also found the lack of knowledge about the benefits of exports is a strong inhibitor for companies which haven't processed orders from abroad. This result reflects that of Shih & Wickramasekera (2011) who found that lack of knowledge about the benefits of exports is a strong inhibitor for non-exporting companies.

On the other hand, for companies which have processed orders originating from abroad this is a minor inhibitor, suggesting that companies which have processed orders from abroad are aware of the benefits obtained through exporting. Regarding the lack of knowledge about the procedure to export, the data found was similar to the findings of Kedia & Chhokar (1986); Moini (1997) and Shih & Wickramasekera (2011) where non-exporting companies identified the lack of knowledge about exporting procedures as an important barrier. The lack of knowledge of advice programs w was also analyzed by Da Silva & Da Rocha (2001) who did not find, however, that it had a strong impact as a barrier for exports for the Brazilian companies. In contrast, the surveyed companies in this study frequently mentioned a lack of knowledge of the assistance offered by the Mexican government to exporting companies.

This investigation also found that surveyed companies held the belief that they can carry out export activities despite not having made the evaluation to know if they have the capabilities or not. This finding is in contrast to Occhipinti (1998) who found that many companies which were asked whether they were capable of exporting responded negatively even before having carried out the evaluation to find out if they had the physical, technological, material financial and human capabilities to do so. Companies that processed orders coming from abroad represented the majority among those who gave affirmative answers when asked whether they had carried out evaluations to know if they had the capabilities for export activities. This finding suggests that processing orders originating from abroad ignites the need in business people to know if they have the capabilities to make exports continuously and as an everyday activity within the company.

A lack of time to do business overseas didn't turn out to be a strong inhibitor in this investigation. Business people answered that they had time to learn the process of exporting, and therefore that is not an important problem either.

The findings encountered in this investigation on the lack of information for exporting resembles those found by Katsikeas & Morgan (1994); Al Hyari, Al Weshaah & Alnsour (2012); Milanzi (2012) and Nazari, Hasangholipour & Khalili (2012) who found lack of information is one of the three most important problems. The result obtained on the lack of information about distributors abroad also coincides with those of Katsikeas & Morgan (1994) and Tesom et al. (2006) who both found this problem appeared as an important one. In contrast, Trimeche (2002) showed it didn't have a strong impact. Concerning the lack of information about the support and assistance for exporting offered by governments to companies that wish to export, the result obtained in this investigation contrasts with the findings of Milanzi (2012) who found that problem has a medium amount of importance.

CONCLUSIONS

The goal of this paper was to identify export inhibitors that have the strongest effect on manufacturing SMEs in the state of Michoacán in the first stage of the internationalization process of companies. General managers and owners of 191 manufacturing SMEs were surveyed to identify which inhibitors they considered affected their interest and performance with regards to exports the most. The results were analyzed through descriptive statistic to find the frequency of the answers. The variables were correlated to know which was most related to lack of exports and a multiple linear regression was carried. The regression showed that the variable "uncertainty" was the most important in the regression equation.

Lack of information and lack of knowledge concerning exports and international trade are the strongest inhibitors for the companies studied for this investigation. This result is, to a certain degree, normal since companies transform information into knowledge and, in this case, there is a lack of both. It is important to point out that the problem is not a lack of information being offered by the federal government of Mexico. In contrast, there are several channels of both federal and state governments, as well as private ones, which offer information about exports and international trade. The problem resides in this information not reaching

the interested stakeholders. One reason could be that owners and managers are not aware of the availability of programs and information about foreign markets because they think that this information is generally centered in the domestic market and consequently of no interest to them. Because of that information about exports, as well as government programs which offer assistance for them, does not reach the key stakeholders in an efficient manner. Therefore, it is necessary to improve this programs as well as the way in which the information channels are used to increase their effectivity.

Companies that have processed orders coming from abroad have accumulated experience and knowledge from it (Ackoff, 1989). Nevertheless if they wish to consolidate their presence in international markets, it is necessary for them to look for orders themselves and search new markets in other countries with the purpose of having a continuity in their exports. This allows them to have large export activities with sustained growth through diversification and complexity of the markets, as indicated by Moori-Koenig, Milesi & Yoguel (2001); Moori-Koenig, Yoguel, Milesi & Gutiérrez (2004); Moori-Koenig, Rodríguez, Yoguel & Granados (2005); Milesi, Moori-Koenig, Robert & Yoguel (2007).

Inhibitors such as risk and uncertainty are not as important to owners and managers of the surveyed companies. This result is perhaps due to the fact that they find themselves in the first stage of the internationalization process of their companies. As they advance, the risk and uncertainty will increase and turn into problems with exports in more advanced stages (Claver et al., 2008). On the other hand, one can also see in the results that lack of time to do business abroad, security in the local market, lack of time to learn about the process to export and considering their business have ability to export are the inhibitors which least affect the companies that were measured. Therefore, companies indeed might be interested in exporting if they had adequate information and knowledge to serve other markets beside their local one, thus achieving growth and development.

The limitation of this study was related to field work. We completed only 73% of the projected sample as a consequence of not finding the proper person to answer the questionnaire in many companies. In other instances they refused to answer it due to a lack of time or unwilligness to give out such information. For these reasons one must be careful not to generalize the results.

The main reason for undertaking this investigation was to identify export inhibitors that had the strongest effect on manufacturing SMEs in the first stage of the internationalization process of companies. There remains a need for investigation about the problems and inhibitors that appear in each stage of the process of internationalization of firms as well as the extent to which they affect companies in their exporting efforts. These obstacles often prevent the organizations' progress through the stages (Leonidou & Katsikeas 1996). In addition each problem may have a different effect depending on the stage in the internationalization process (Bilkey & Tesar 1977; Kedia & Chhokar, 1986; Leonidou, 1995; Smith et al., 2006). It is also appropriate to investigate how companies that have advanced in the internationalization process of firms have solved the problems they have faced in each stage and the decisions they have made to solve them on each of the stages.

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INDUSTRIAL SECTOR EXPORTS IN COLOMBIA: EFFICIENT FRONTIER ANALYSIS

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ABSTRACT

In this paper, a comparative analysis is carried out among the industrial sectors in Colombia that have the most employees during 2000-2011. A dynamic simulation is used, and a Data Envelopment Analysis (DEA) is applied in order to obtain an overall index of technical efficiency in Colombia's industrial sectors for the use of resources. Similarly, an industrial sector efficiency ranking for exports is drawn up. This index determines the presence of unused resources, which is useful to devise strategies to support exports. The analysis is based on a Monte Carlo simulation forecast to determine the average values of the period for the input variables: number of businesses, employees, assets, and energy used to produce the output variables. That is, gross production and exports. The purpose is to compare the effectiveness of the factors of production to generate exports, and determine the possibility of improving inefficient sectors. The goal is to participate in the internationalization process in a proper way.

JEL: C51, G32, D22, C61, F14

KEYWORDS: Dynamic Simulation, Financial Analysis, DEA, Exports

INTRODUCTION

In the current scenario of economic integration and free trade liberalization, the analysis of sectorial efficiency constitute a dynamic area of research, since the competitiveness of a country or region is linked in direct way with efficiency gains that leads to improvements in productivity. During the period 2000-2011, industrial sector in Colombia accounted for an average of more than 13% of gross domestic product (GDP), 56% of total annual exports, and 13% of the employed population. Nevertheless, this sector has experienced a period of decline in their relative importance in the economy and the export's growth rate was lower than total exports rate, which may some disadvantages to articulate it to the world's current export conditions of industrial sector.

From the economics' perspective, the concept of efficiency takes into account the lowest amount of inputs (capital, raw materials, man hours, machine hours, and so on) to get to a certain amount of outputs (profits, production, value added, goals met, etc.). Therefore, efficiency involves using society's resources as efficiently as possible to meet individual wants and needs (Samuelson & Nordhaus, 2002). It also involves the best possible use that a society makes of limited resources (Gregory, 2004). Similarly, achieving the highest production at the lowest possible cost is considered efficiency (Pinzón, 2003), as well as the capacity of a system or economic agent to meet certain goals by using resources as little as possible (Simón, 2005). Previous empirical work have focused in the performance of industrial exports in Colombia. These studies show that exports have passed through a slow process of export diversification, which depend on natural resources and low-technology products (Lotero, 2007; Torres & Gilles, 2013). Using industry data, Loaiza (2012), estimates that productivity's growth is associated with the increase in foreign investment and tax incentives to the import of capital goods. At the sector level, Villalobos & Vallejo (2005), find that industrial agglomeration have positive effect on the technical efficiency in clothing sector. From a methodological

viewpoint, DEA is an analysis model through which homogeneous decision making units can be compared with regard to inputs and outputs. This generates a production or relative efficiency measure. The basic principle is to calculate the relative technical efficiency of each unit by means of a ratio that results from the quotient between the weighted sum of the outputs and the weighted sum of the inputs. The weights are determined according to Pareto criteria, where each unit's efficiency, for the input version, must be less than or equal to the unit (Charnes, et al., 1978). In this context, the purpose of this study is to compare the technical efficiency of the industrial sector exports in Colombia using a DEA-CCR input-oriented model suggested by Banker et al. (1984). In order to achieve this objective, this paper is organized in four sections, as follows: section 2 gives a literature review about the efficiency, simulation and DEA models. Section 3 present the DEA technique. Section 4 contains the results industrial sector exports and section 5 presents conclusions.

LITERATURE REVIEW

Efficiency

The word "efficiency" comes from the Latin word *efficientĭa,* which means: production, force, action. From a long-term point of view, the concept of efficiency involves getting the maximum profit at the lowest possible cost (Farrel, 1957). According to management theories, the concept is approached as the proper use of resources or available means of production. It is expressed by means of the equation $E=P/R$, where P are the resulting products, and R the resources used (Chiavenato, 2004). It is also defined as the achievement of goals with the minimum use of resources (Koontz & Weihrich, 2004). In other words, getting the best results with the lowest investment (Robbins & Coulter, 2005), or working in such a way that resources are used more properly (Reinaldo, 2002). All of the above leads to inferring that, in management sciences, efficiency is approached as a relation between the resources needed by an enterprise and the goals reached. The common ground is that there is efficiency when there is a minimum use of resources to reach a goal, or when greater results are obtained with fewer resources. It must not be confused with effectiveness, which means the extent to which goals and objectives are achieved. This means that effectiveness deals with the task of reaching intended goals, whereas efficiency means the best use of sources. Therefore, effectiveness is limited to the capacity to achieve a goal without taking into account the best use of resources in the process. As a consequence, it is possible to be effective without being efficient. The ideal condition is to be effective and efficient at the same time.

Thus, the concept is made up of two elements: technical efficiency and allocative efficiency. The focus of the former is the use of human resources or capital in the production of goods and services (Trillo, 2002), whereas the latter considers the concept of maximizing profits and minimizing costs in a production unit (Hernández de Cos et al., 1995). Based on the previous proposals, this paper uses the general definition of efficiency as the best use of available resources to get the desired results. Consequently, an entity, institution, organization or person is "efficient" when they get the desired results by means of the best use of the resources they have.

Simulation

Simulation is taken to mean the development of a system's logical-mathematical model to imitate the operation of a real process or system over time. Simulation requires the generation of a system's artificial history in order to observe that history and infer the system's operational characteristics through experimental manipulation. Two basic steps are needed in a simulation: 1) model development, and 2) experimenting. The former involves formulating logical equations that represent the system, and executing a computer program. After validating the system's model, the simulation study's second phase entails experimenting with the model in order to evaluate the system's response to fluctuations in some input variables. The words "system" and "model" are very important in the previous definition. A system is

understood as the collection of variables that interact with each other within certain limits to achieve a goal. On the other hand, the model is a representation of the system's objects, and it expresses the activities in which such objects are involved (Azarang & García, 2006). The well-known Monte Carlo sampling gave birth to simulation methods. The Monte Carlo model was a technique used by J. Von Neumann and other researchers and research military units during World War II. Since the mid 1940's, the procedure has been successfully applied in diverse business and scientific activities. The Monte Carlo model is a random process used to choose sample values based on a probability distribution. Such values are later used as inputs or operational values for a simulation model. Simulation is a means that can adapt to the analysis of many situations. Therefore, the pros and cons of using simulations are detailed in *Table 1*.

Table 1: Pros and Cons of Simulation

Pros	**Models can be modified to analyze diverse scenarios.**
	It is cheaper to improve a simulated system than a real system.
	It is easier to understand and view simulation methods than purely analytical methods.
	Analytical methods involve many assumptions and simplifications, whereas simulation models analyze more complex or detailed systems.
	In some cases, simulation is the only way to get a solution.
Cons	It takes a lot of time to develop and validate simulation models.

This table shows a summary about pros and cons of simulation. Source: Azarang & García (2006).

Data Envelopment Analysis (DEA) Models

DEA is a way to measure efficiency. It is based on the generation of an efficiency frontier whose starting point is a set of observations of a given event without the estimation of production functions. That is, a functional relation between inputs and outputs is not necessary. It becomes an excellent non-parametric alternative to obtain information from a set of observations. Parametric methods aim to obtain the best adjustment of the observations by generating a hyperplane. On the other hand, the purpose of DEA is to optimize each analysis unit's efficiency measure, and create an efficient frontier. Since it would be based on real data, it would be efficient and feasible based on the Pareto criterion (Charnes *et al.* 1957). The procedure first involves creating an empirical production frontier, and then evaluating the efficiency of each observed unit that is not limited to the efficiency frontier. From this point of view, it is a parametric model because it does not assume the existence of an input/output functional relation. It is not statistical because it does not assume that efficiency adjusts to any sort of probability distribution as do the input and output consistency tests with the production frontier implemented by Hanoch & Rothschild (1972) (The tests mentioned above have the sole purpose of proving the validity of certain hypotheses about the production function, such as quasi-concavity, monotonicity and homothetic, based on the observations about inputs and data avoiding any parameterization of the production function (Hannoch & Rothschild, 1972:256).), and Sengupta (1987).

The evaluation criterion is based on the hypothesis that a productive unit belongs to the production frontier when it generates more out of an output without producing less out of the rest, and without consuming more inputs. In other words, it is efficient when it uses less out of an input, without using more out of the rest, and it generates the same products (Charnes & Rhodes, 1981). In the comparison, the efficient and technically homogeneous unit may not be real, but the linear combination of other real units. This characteristic is in line with what was proposed by (Farrell, 1957), and it features two assumptions: first, the possibility of using supplies continually. Second, the efficiency frontier is convex. The first assumption guarantees that the inputs are divisible, whereas the second guarantees that the linear combination of two or more units belonging to the feasible group also has this characteristic. When a group of real efficient units is combined to produce another fictitious efficient unit, it is considered as a reference group that enables the application of improvement strategies of inefficient units in comparison with efficiency degrees actually achieved.

In both cases, there are two options to measure efficiency: the first one is called input-oriented, and it is based on confirming the amount of inputs consumed in order to get the same output. The second one is output-oriented, which aims to reach the maximum output with the inputs. Choosing the method depends on the particular characteristics of the problem under study. The models have been widely implemented in multiple organizational and social scenarios. In finance, for instance, there is an application to measure the productivity efficiency of textile sector companies' current resources.

The purpose is to devise plans to enlarge installed capacity and apply for credit from the financial sector (Restrepo & Vanegas, 2009); in the same line (Ayela, 1993). In hospital management, the performance of 45 university hospitals in Brazil is analyzed in order to study the situation of such units through the technical efficiency achieved with a DEA model (Frainer, 2012). Likewise, the technical efficiency of primary care in Costa Rica during 2004-2010 is studied through traditional DEA models and Bayesian methods (Salazar, 2012). Another study is applied over a panel dataset comprised of 21 milk farms located the South Basin Abasto de Buenos Aires, Argentina (Arzubi y Berbel, 2002) In the social sphere, a model to evaluate the impact of information asymmetries on the management of social organizations is developed. To this end, DEA models were assessed based on the pillars of information economics in order to express the goals of the members of an organization: principal and agent. The multipliers estimated are understood as assessments allocated by the director and the agent of the social processes. A DEA model with asymmetrical information (AI-DEA) was developed and applied to incorporate the differences in these assessments. It was applied to the system of federal universities in Brazil. The Ministry of Education (MEC) is the director, and the presidents of the universities are considered federal agents. It was found that the DEA model enabled the evaluation of the impact of information asymmetries on the management of federal universities (Franca, 2013).

METHODOLOGY AND DATA

The model employed to measure export efficiency is DEA. With it, a concrete indicator of an economic unit (company or sector) can be obtained in relation to the best results from the rest of units in the group of observations. Setting a standard of comparison with the best results guarantees getting such results by improving a company's process and management. The units of measure are independent of the variables used in DEA models In order to make the technique more operational, and adjust it to the reality of the problem addressed, the version suggested by (Banker et al., 1984), known as the DEA-CCR input-oriented version, will be used. We consider the structure of the DEA-CCR mathematical model in order to be able to determine both the technical efficiency index of each sector, and the weightings allocated to the several inputs and outputs. The notation is as follows:

$$Min_{\theta,\gamma,\delta^+,\delta^-} Z_0 = \theta - \varepsilon(I\delta^+ + I\delta^-)$$
$$Subject\ to:$$
$$\gamma Y = Y_{0+}\delta^+ \qquad (1)$$
$$\gamma X = \theta X_0 - \delta^-$$
$$\vec{1}\gamma = 1$$
$$\gamma, \delta^+, \delta^- \geq 0$$

The industrial sector is represented by the sub-index *0*; X and Y represent the input and i output r amounts of the sector j respectively; λ reflects the weightings (unknown) allocated to the input i and output r of the sector being evaluated. Finally, θ represents the efficiency rate of the evaluated sample unit. Thus, by using a DEA model applied to the industrial sectors with the most employees in Colombia, a relative productive efficiency frontier is drawn up. In order to evaluate the units that are nor efficient, a comparison is made

with those units that are efficient, and therefore, belong to the frontier. The units are taken to be homogeneous. This means that they use similar inputs to produce the same outputs.
The result is an indicator of the factors' total productivity. This indicator is developed based on the quotient between the output and input weightings. This non-parametric technique features the special characteristic of determining the weightings used in an exogenous way. That is, the measuring technique allocates it by itself without the need to assume any kind of functional form. For the study, these weightings are determined by means of a mathematical programming model which, in its formulation, presents the relative nature of the measure obtained.

By solving the mathematical model thus defined, the values of the variables γ can be determined As a consequence, the productivity rate θ allocated to the sector evaluated can be determined as well. The process is repeated for each of the j sectors. A productivity measure will be obtained for all of them. It is important to point out that the sector whose productivity is being calculated is both in the target function and in the restrictions. This guarantees that there will always be a solution to the problem. The restrictions found are universal. That is, every company may use the same set of weights to evaluate its competitiveness, and the maximum competitiveness value obtained by any company will be 1. In short, by calculating such weightings, the various output (input) levels can be reduced to a single scale value called virtual output (virtual input). This is nothing more than the result of adding the various outputs (inputs) produced (used) by a company through the application of the weights obtained in the fractional problem. The DEA method becomes a tool able to provide a synthetic index of the sector's productivity. It takes into account the multiple dimensions and variables of production. Thus, a comprehensive vision of them can be accomplished. This is how this study, which tries to determine the best export structure for the sectors under study, achieves an adequate approach to the estimates of efficiency.

Variables Used in the Input-Oriented DEA-CCR Model

In order to develop the proposed index, a relation needs to be established between the inputs (number of firms, employees, assets, energy consumed) and outputs (exports, gross production of the industrial sectors that generate the highest rate of employment. We use annual data during the period 2000-2011. The variables used are described below:

Number of businesses (NB): the number of businesses registered in the country per industrial sector.
Employees (E): the number of employees reported by the companies of each sector in the Annual Manufacturing Survey (AMS).

Assets (AT): the monetary value of assets of the industrial sectors in thousands of millions of Colombian pesos.

Energy Consumption (EC): the energy consumed in kilowatt-hours (kW/h) by the industrial sector.
Exports (EX): the monetary value of exports in millions of dollars
Gross Production (GP): the monetary value of each industrial sector in thousands of millions of pesos

In order to compare the industrial sectors in Colombia, disaggregated data by sector is necessary. The information provided by Departamento Nacional de Estadística (DANE, 2012) solves this need with the studies of firms. All variables were expressed in Colombian pesos, except the exports in dollars.

Table 2: Sectors with the Most Employees

Sector	Sector's Description
CIIU15	Production of Foodstuffs and Beverages
CIIU24	Manufacturing of Chemical Substances and Products
CIIU17	Manufacturing of Textile Products
CIIU25	Manufacturing of Rubber and Plastic Products
CIIU26	Manufacturing of Other Non-Metallic Mineral Products
CIIU36	Manufacturing of Furniture; Manufacturing Companies
CIIU28	Manufacturing of Products Made of Metal, except Machinery and Equipment
CIIU29	Manufacturing of Machinery and Equipment
CIIU22	Editing, Printing and Record Playing Activities
CIIU21	Manufacturing of Paper and Paper Products

This table presents the International Standard Industrial Classification for industrial sector and their description. Source DANE.

Table 3: Input and Output Data per Industrial Sector for 2011

		Inputs			Outputs	
Sector	**NB**	**E**	**AT**	**EC**	**EX**	**GP**
	Sectors Analyzed with over 20,000 Employees					
CIIU15	1,771	152,675	27,407	3,102	4,768	53,715
CIIU24	827	75,554	13,496	1,769	3,053	23,390
CIIU18	1,021	60,705	1,672	130	540	5,197
CIIU25	775	53,208	6,557	1,198	751	8,099
CIIU17	419	45,972	4,635	897	564	4,873
CIIU26	499	38,502	12,022	1,716	470	9,687
CIIU28	740	37,162	2,066	241	278	4,339
CIIU36	698	33,976	1,610	195	375	3,231
CIIU22	683	33,115	2,859	181	186	4,322
CIIU29	585	31,246	1,928	148	409	3,652
CIIU19	410	21,146	602	94	260	1,574
	Sectors with Fewer than 20,000 Employees Are Not Analyzed					
CIIU21	184	17,767	6,453	1,515	550	6,045
CIIU31	181	16,816	1,641	152	318	3,186
CIIU34	208	16,229	1,322	126	416	5,751
CIIU27	186	15,576	7,741	2,787	4,404	9,764
CIIU20	202	6,502	616	79	29	788
CIIU35	58	6,487	422	30	41	2,267
CIIU23	114	6,213	14,388	906	5,152	40,911
CIIU33	90	4,095	214	19	77	353
CIIU16	4	1,071	511	15	7	678
CIIU32	18	577	23	3	55	44
TD	9,683	674,920	108,191	15,304	22,272	191,966

This table shows the inputs (NB: number of firms, E: employees, AT: assets, EC: energy consumed) and outputs (EX: exports, GP: gross production of the industrial sectors that generate the highest rate of employment during the period 2000-2011.Source: Annual Manufacturing Survey (2011).

RESULTS

Applying the data envelopment analysis implies the definition of a utility function. That is, the description of two outputs and four inputs. For the outputs, the EX and GP variables were used. Regarding the inputs, they are incorporated as general factors that determine efficiency: number of businesses, employees, amount of assets, electric energy consumed.

Table 4: Results of the DEA-CCR Input-Oriented Model

Sector	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CIIU15	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
CIIU18	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
CIIU24	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
CIIU17	0.5603	0.5786	0.5406	0.5302	0.5534	0.5497	0.6212	0.8117	0.8443	0.6360	0.5659	0.5627
CIIU25	0.5917	0.6329	0.6322	0.6093	0.6260	0.7553	0.7443	0.7045	0.7314	0.6338	0.6812	0.6050
CIIU26	0.6699	0.7238	0.7335	0.7402	0.7274	0.6897	0.7177	0.7503	0.7102	0.6698	0.6812	0.7152
CIIU36	0.6694	0.6126	0.6630	0.6630	0.6337	0.6871	0.9571	0.7328	0.9341	0.8980	0.9005	0.8474
CIIU22	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9713
CIIU28	0.7461	0.7938	0.8316	0.8316	0.8575	0.9362	0.9712	1.0000	0.9883	0.8885	0.9005	0.8665

This table exhibits the results of the DEA-CCR Input-Oriented Model; the sector CIIU15, CIIU18 and CIIU24belonging to the production frontier. And CIIU17, CIIU25, CIIU26, CIIU36 and CIIU28 have been inefficient in the period 2000-2011. Source: developed by the authors based on the AMS 2011 data on Risk Simulator

Table 4, shows that the sectors CIIU15, CIIU18 and CIIU24 are on the production frontier. On the other hand, the sectors CIIU17, CIIU25, CIIU26, CIIU36 and CIIU28 have been inefficient during 2000-2011. It is important to note that CIIU22 is out of the efficiency frontier in 2011, and the improved efficiency of CIIU36, which in the last five years reached levels of over 80%. For inefficient sectors, the probability mass function was determined in order to be able to perform the simulation. The results are shown in Figure 2 and Figure 3 in appendices.

Table 5: Results of DEA-Input-Oriented for 2011

Sector	***NB***	***E***	***AT***	***EC***	***EX***	***GP***
CIIU15	1,771.0	152,675	27,407	3.102.5	4,767.8	53,715
CIIU24	827.0	75,554	13,495	1.768.7	3,053.2	23,389
CIIU18	1,021.0	60,705	1,671.6	130.45	539.55	5,197.1
CIIU25	434.74	32,191	3,967.3	441.74	751.22	8,099.3
CIIU17	**235.78**	**18,688.9**	**2,608.5**	**321.52**	**564.27**	**4,872.8**
CIIU26	319.40	27,535	4,942.9	559.53	859.87	9,687.5
CIIU28	510.57	32,201	1,790.1	177.21	419.0	4,339.2
CIIU36	462.0	28,790	1,364.6	142.34	375.20	3,312.5
CIIU22	510.25	32,166	1,781.2	176.20	417.53	4,322.4
CIIU29	585.0	31,246.	1,927.7	148.17	409.16	3,652.2
Improvement Percentages per Sector						
CIIU15	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*
CIIU24	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*
CIIU18	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*
CIIU25	*43.91%*	*39.50%*	*39.50%*	*63.12%*	*0.00%*	*0.00%*
CIIU17	***43.73%***	***59.35%***	***43.73%***	***64.17%***	***0.00%***	***0.00%***
CIIU26	*35.99%*	*28.48%*	*58.89%*	*67.39%*	*83.13%*	*0.00%*
CIIU28	*31.00%*	*13.35%*	*13.35%*	*26.41%*	*50.77%*	*0.00%*
CIIU36	*33.81%*	*15.26%*	*15.26%*	*27.16%*	*0.00%*	*2.52%*
CIIU22	*25.29%*	*2.87%*	*37.70%*	*2.87%*	*124.03%*	*0.00%*
CIIU29	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*

This table shows as sector 17 –highlighted in black – must have an NE input of 236 for it to reach the efficient border. Thus, the current basis is reduced by 43.73%, which means 183 fewer businesses. The number of employees must be about 18,688, which is a reduction of 59.35%. The total amount of assets must go from 4,635 million to 2,208. This is a reduction of 43.73%s. The EC would go from 897 to 321. This is a reduction of 62.52%. Source: developed by the authors based on the AMS (2011) data on Risk Simulator

Table 6: Input Reduction in Numbers to Reach the Efficiency Frontier

	NB	**E**	**AT**	**EC**	**EX**	**GP**
CIIU15	0	0	0	0	0	0
CIIU24	0	0	0	0	0	0
CIIU18	0	0	0	0	0	0
CIIU25	340	21,016	2,590	756	0	0
CIIU17	**183**	**27,283**	**2,027**	**576**	**0**	**0**
CIIU26	180	10,967	7,079	1,156	390	0
CIIU28	229	4,961	276	64	141	0
CIIU36	236	5,185	246	53	0	81
CIIU22	173	949	1,078	5	231	0
CIIU29	0	0	0	0	0	0

This table presents the input reductions in numbers to reach the efficiency frontier. The sector 17 –highlighted in black – must have an NE input of 236 for it to reach the efficient border, which means 183 fewer businesses. The number of employees is equivalent to the loss of 27,283 jobs in the sector. The total amount of assets must go to 2,027 million less in assets. The EC would go to 576,000 million pesos less in consumption. Source: developed by the authors based on the AMS (2011) data on Risk Simulator

The sectors CIIU25, CIIU17, CIIU26, CIIU28, CIIU36 and CIIU22 have been inefficient in 2011. The efficiency was determined for the period 2000-2011. However, for illustration purposes, the results are presented in Table 5, but the analysis per sector is carried out for 2011, and only for CIIU17. The rest of the sectors are analyzed in a similar way. According to Table 3, which shows input and output information for 2011, CIIU17 has the following inputs: 419 businesses; 45,972 employees; assets are worth 4,635 million; and there was a consumption of 897,000 million in energy. This generated 564,000 million dollars worth of exports, and a gross production of 4,873 million. The results of the DEA model are shown in Table 5. According to these, sector 17 –highlighted in black – must have an NE input of 236 for it to reach the efficient border. Thus, the current basis is reduced by 43.73%, which means 183 fewer businesses. The

number of employees must be about 18,688, which is a reduction of 59.35%. This is equivalent to the loss of 27,283 jobs in the sector. The total amount of assets must go from 4,635 million to 2,208. This is a reduction of 43.73%, which means 2,027 million less in assets. The EC would go from 897 to 321. This is a reduction of 62.52%, which means 576,000 million pesos less in consumption. The other sectors are analyzed similarly with the information in Table 4, Table 5 and Table 6.

Table 7 features the comparison of sectors. It shows that the efficient sectors have a value of 1.0 when cross-checked. On the other hand, the inefficient sectors are compared with the efficient ones. Thus, the degree of inefficiency of, for instance, sector CIIU17, becomes evident. It should adopt the administrative practices of CIIU24 to come close to the production frontier, since it is at 28.65% of CIIU24. Likewise, Figure 1 on the right shows the efficiency present the results for CIIU17 during 2000-2011. It has always been below the efficiency frontier. It had values of over 80% in 2008, but in 2001, it sank to historical levels, and it has 56.27%. The charts for all the inefficient sectors can be viewed in Appendix 2.

Table 7: Comparison of Sectors and Weights

	CIIU15	CIIU24	CIIU28	CIIU29
CIIU15	1.0000			
CIIU24		1.0000		
CIIU17		0.2865		
CIIU25		0.3615	0.1576	
CIIU26		0.4312		
CIIU36	0.0590	0.0369	0.5817	
CIIU28			1.0000	
CIIU29				1.0000
CIIU22	0.0131	0.0029		0.8278
CIIU21		0.2932		

This table shows that the inefficient sectors are compared with the efficient ones. Sector CIIU17 should adopt the administrative practices of CIIU24 to come close to the production frontier, since it is at 28.65% of CIIU24.Figure 1 below shows the efficiency results for CIIU17 during 2000-2011. It has always been below the efficiency frontier. Source: developed by the authors based on the data provided by AMS 2000-2011

Figure 1: CIIU17 during 2000-2011

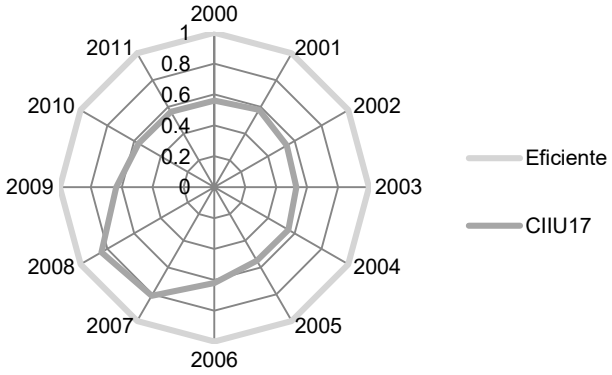


Figure 1 shows the efficiency results for CIIU17 during 2000-2011. It has always been below the efficiency frontier. Source: developed by the authors based on the data provided by AMS 2000-2011

CONCLUDING COMMENTS

We develop a comparative analysis among the industrial sectors in Colombia that generate the most employment during 2000-2011. A dynamic simulation has been used, and a Data Envelopment Analysis (DEA) was applied in order to obtain an overall index of technical efficiency in Colombia's industrial sectors in the use of resources. Similarly, an industrial sector efficiency ranking for exports is drawn up. This index determines the presence of unused resources, which is useful to devise strategies to support exports. Information was provided to determine technical efficiency improvement strategies the industrial sectors. It has illustrated CIIU17 sector, the main findings show outputs' increase and/or inputs' reduction

in the required inputs to make sectors can achieve production's frontier for 2011. The CIIU17 sector has the following inputs: 419 businesses; 45,972 employees; assets for 4,635 million; and a consumption of 897,000 million in energy.

This generated exports for 564,000 million dollars and a gross production of 4,873 million. DEA's results model shows how the CIIU17 sector should have an NE input of 236 for it to reach efficient frontier. Thus, the current basis is reduced by 43.73%, which means 183 fewer businesses. The number of employees must be about 18,688, which is a reduction of 59.35%, this is equivalent to the loss of 27,283 jobs in the sector. The total amount of assets must go from 4,635 million to 2,208. This is a reduction of 43.73%, which means 2,027 million less in assets. The Energy Consumption would go down from 897 to 321, this is a reduction of 62.52%, which means 576,000 million pesos less in consumption. A 60% of analyzed sectors were inefficient.

The main finding, shows a high percentage of the sectors must reduce their inputs (NB, E, AT, EC) to reach the efficiency frontier of production, or increase their outputs without changing the combination of inputs. The findings are key to develop plans to enlarge installed capacity, and applying for credit from the financial sector. It is imperative to check which resources are not used, and the impact they have on the generation of value. In spite of the importance that the industrial sector has in the country's development, it has weaknesses related to technical efficiency that undermine its competitiveness.

Similarly, these weaknesses increase the sector's vulnerability before new globalization challenges posed by the world's dynamics. This study provides entrepreneurs with elements to understand the importance of managing technical efficiency. Likewise, entrepreneurs will find its interpretation by means of efficiency indicators that provide information about the productivity of the sectors' current resources. In view of the value generation concepts, every single inefficient sector is undermining the value of our economy.

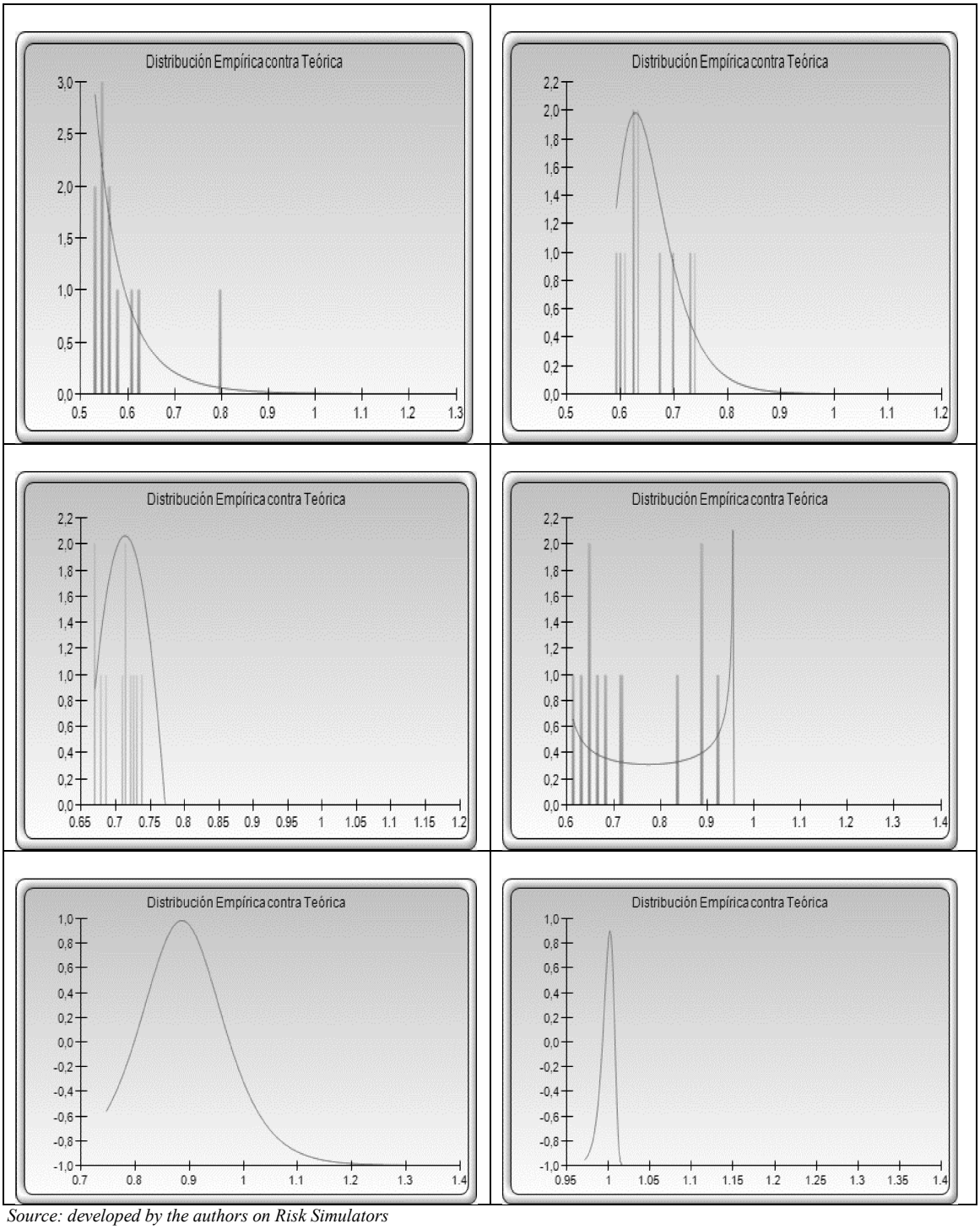
Despite the fact that EBITDA is deemed an appropriate measure to determine the generation of a company's value, problems arise when this is the only way to measure an organization's performance. One of the reasons is that it does not take efficiency into account. It is necessary to combine a company's financial performance with risk- and efficiency measures. This paper presents a non-parametric method to measure the latter. Risk-measurement is suggested as a complement to determine the real effect that it will have on value for stakeholders. Entrepreneurs must reflect carefully on the aspects mentioned above. They may be more important than the results obtained in the mere figure of cash flow and EBITDA. We conclude that inefficient sectors can improve efficiency with adopting strategic decisions suitable to obtain the best mix of resources. The spread of features of efficient firms allows improving business competitiveness the region.

Limitations: No information is available for total industrial sectors in the country for the analysis period. This situation forced to take the sample for firms with more than 20,000 employees. In the productivity analysis with DEA assumes that normal fluctuations and measuring errors are small compared to real differences between observed performances for decision making units. Comparing the results of two studies applied to different groups of samples is not significant, since the differences between the practices employed by units of each of the samples are unknown. And besides, the results are highly sensitive to the presence of measurement errors in the inputs and outputs.

Future Research: Intends to apply the model to measure efficiency companies in the sector in order to establish plans for improving export performance of firms to deal properly signing trade free agreements

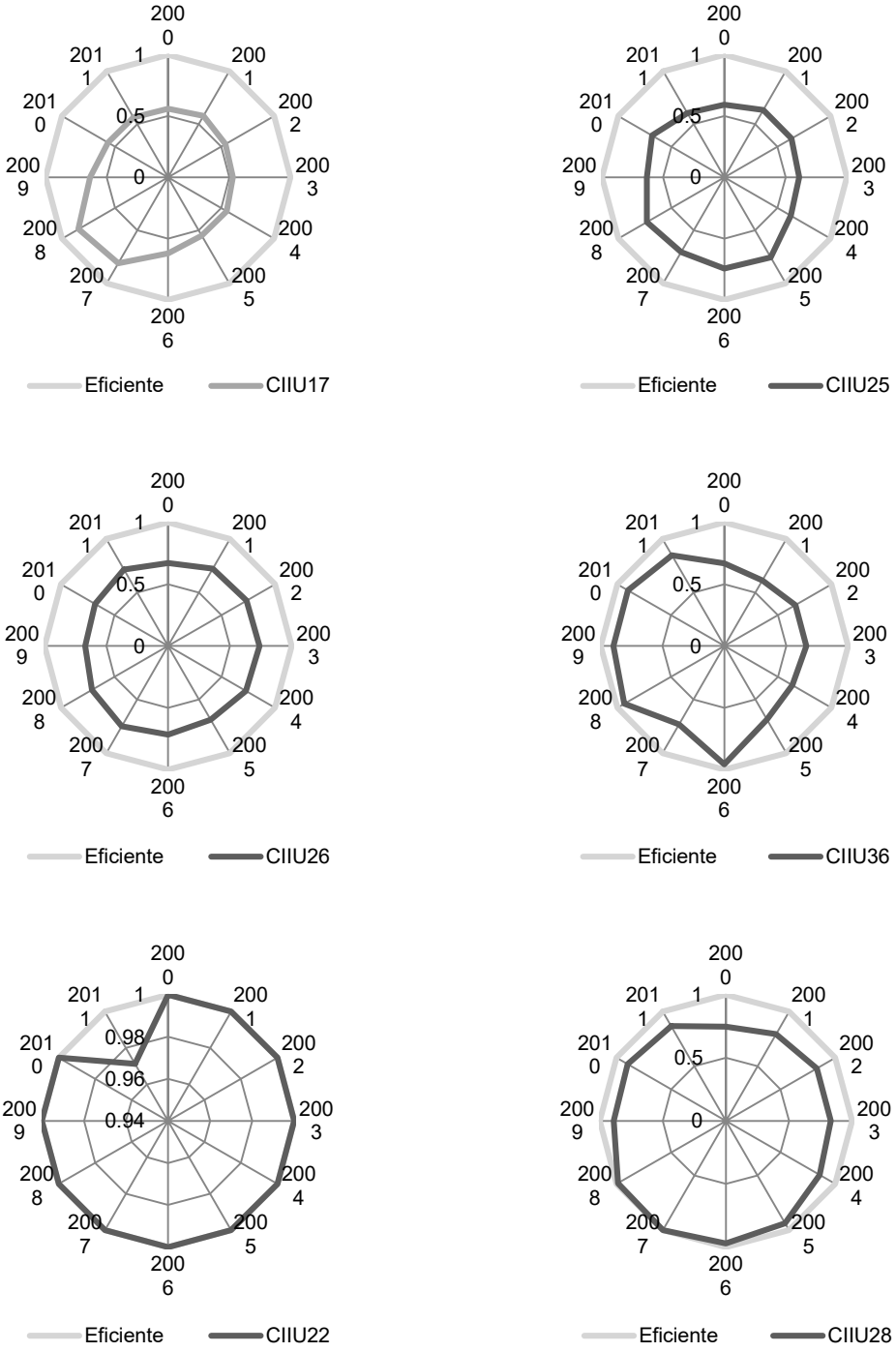
APPENDICES

Figure 2: Probability Distribution for the Inefficient Sectors



Source: developed by the authors on Risk Simulators

Figure 3: Graphic Summary of the DEA-CCR Results



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