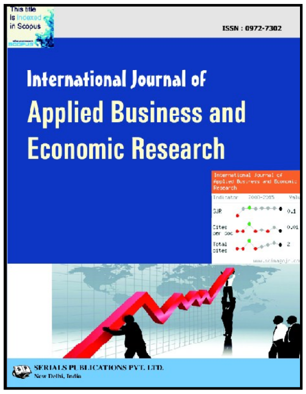

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Supply Chain Performance Likelihood on the Phenomena of Technological Social Systems

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Abstract: This article analyzes the impact of the bullwhip effect of external isomorphic pressures exerted by competitors, trading partners and customers on supply chain performance. It further determines the likelihood of supply chain performance targets impacting the interactive equilibrium point between the technological and social systems network. Logistic regression analysis is used to determine the strength of the relationship and the odds between supply chain business performance targets and the proportion of consumer demand using a set of predictors from a sample size of 448. The directionality of the relationship reveals that inventory positioning and policy, information sharing and electronically-enabled supply chain management are more effective mitigation factors in the likelihood of improving business performance targets on the propensity to overcome the deleterious influence of bullwhip effect.

Keywords: Bullwhip effect, Information sharing and e-SCM systems, Inventory positioning

INTRODUCTION

Fast moving consumer goods (FMCG) enterprises epitomize the rapid transfer of information and active communication along the supply chain network. In the retail sector, retailers constantly look beyond their organizational boundaries to evaluate and integrate the resources and capabilities of their suppliers and customers in a synchronized information flow. The retailer anticipates that a cascading inventory level has a deleterious effect, increasing the likelihood of independent constructs like stock-outs and backlogs/forward buying, inflated orders, capacity utilization and poor customer service. The South African supply chain redundancy approach to supply chain partners rests on an integrated, sustainable and resilient supply chain network. The article analyzes how this order policy could be optimized to reduce the bullwhip effect and oscillations in inventories under different customer demand conditions as FMCG enterprises target African markets. This would enable supply chain management to focus on the flow of physical products from suppliers through manufacturing and distribution all the way to retail outlets and customers (Simchi-Levi, Kaminsky and Simchi-Levi, 2008: 1). Addressing bullwhip effect using the optimization approach increases responsiveness to demand, decreases volatility in inventory replenishment and ensures the stability of supply chains using inventory position information and permissible delays in vendor order placement lead time (Li and Liu, 2013: 707). Tanweer, Li, Duan and Song (2014:289) describe bullwhip effect as "a continuous conundrum, addressing the shift of a seemingly steady inventory demand into enhancing demand fluctuation in upstream supply chain". The assumption is that effective supply chain management integrates internal and external supply chain resources, optimizes resource allocation and production processes, and improves supply chain efficiency.

THEORETICAL FRAMEWORK

According to the institutional theory, external isomorphic pressures from competitors, trading partners, and customers induce firms to engage in certain supply chain management practices (Sodero, Ravinovich and Sinha, 2013). Organizational isomorphism refers to "the assimilation of organizations that co-exist in similar environmental conditions" (Dacin, 1997; Deephouse, 1996). DiMaggio and Powell (1983) and Mizruchi and Fein (1999) identify three characteristics of isomorphic processes: they are coercive as they are exerted by formal and external pressures; mimetic as they mimic the performance, structures and practices of other firms and normative as they conform to shared norms and collective expectations. Although Chong and Zhuo (2014:48) emphasize the importance of improved collaboration with suppliers and customers before considering the technological structure, electronic supply chain integration (Tai, Ho and Wu, 2010) enables organizations to share real time information seamlessly and reduce the risk of bullwhip effect (Lee, Padmanabhan and Whang, 2004; Koh, Demirbag, Bayraktar, Tatoglu and Zaim, 2007). In understanding the connectivity of supply chain partners, the social network theory also identifies the pressures that a supply chain partner's economic actions are embedded in as coercive, mimetic or normative, and posits that their outcomes are substantially influenced by the ongoing pattern of the relationship (Granovetter, 2005; Galaskiewicz, 2011). Better positioning of the supplier in the supply network offers access to the novel information and innovative ideas embedded in such a network (Kim, 2014) while reciprocally enhancing the performance of a buying firm, often the retailer. The network theory regards any system as a set of interrelated actors or nodes (Tate, Ellram and Golgeci, 2013:266), including individuals, firms, countries and other participants in the network (Borgatti and Li, 2009:2). Cooperative game theory is useful in designing a supply chain network or a virtual enterprise as it enables the selection of an optimal coalition of partners to manage the phenomenon of bullwhip effect (Hennet and Arda, 2008:19).

LITERATURE REVIEW

Supply Chain Optimization and Performance

Fu, Ionescu, Aghezzaf and Keyser (2014:21) describe supply chain optimization as a "set of approaches utilized to efficiently integrate supply chain partners for lean-based transformation process and efficient distribution in the right quantities, locations and time in order to minimize system-wide costs while satisfying service level requirements". The premise underlying supply chain management (SCM) is that the performance of a single company depends on its ability to maintain effective and efficient relationships with its suppliers and customers (Chen and Paulraj, 2004; Croom, Romano and Giannakis, 2000). The paradigm shift to supply chain scale requires a technological, production, and management framework that enhances the supply chain's capabilities and agility within the clockspeed. Agile supply chain competitiveness calls for accelerated responsiveness, resilience, and reliability and strong relationships amongst supply chain partners (Yusuf, Musa, Dauda, El-Berishy, Kovvuri and Abubakar, 2014:500). Flexibility is one of the most prominent antecedents of agility (Conboy, 2009). It involves "the competence to identify changes in the environment, commit resources quickly to new courses of action in response to change, and recognize and act promptly when it is time to halt or reverse such resource commitments" (Shimizu and Hitt, 2004). According to Qrunfleh and Tarafdar (2014:345), flexibility is the extent to which the supply chain partners effectively and quickly adapt to changes in the market (Vickery, Calantone and Droge, 1999); while supply chain integration is "the extent to which activities, communication and decision-making in the supply chain are coordinated together" (Stock, Greis and Kasarda, 2000); and flex-responsiveness to customers is the extent to which supply chain partners respond in a timely manner to customers' needs and wants (Chen and Paulraj, 2004). Chengalur-Smith, Duchessi and Gil-Garcia (2012:60) describe business performance targets (or benefits) as "the degree of operational (more efficient inventory planning policy – positioning and levels, frequencies of order replenishment and increased product and material resources availability), financial (reduced supply chain and inventory costs) and other advantages that companies realize through improved information sharing and supply chain integrated electronic business systems leveraging". This article adopts these definitions to describe supply chain business performance outcomes, particularly the operational perspective and the advantages that accrue, including information sharing, inventory management and electronically-enabled supply chain management systems to examine their impact in controlling supply chain demand order variability. It also examines supply chain business performance outcomes in relation to different strategies to promote competitiveness, including price and cost efficiency (price volatility), optimum customization and responsive flexibility (supply chain agility) to capture the long-term behavior of organizations in the FMCG industry.

Electronic Integrated Supply Chain Systems

The concept of lead time pooling seems to reduce inventory while keeping it close to customers between the inventory hub and the consumption cycle, enhancing supply chain performance. In clustering the lead times for multiple inventory locations, a consolidated distribution strategy attempts to keep inventory close to customers while hedging against the second form of uncertainty. The guiding principle is willingness to share real-time information on future strategic initiatives with supply chain participants in order to collectively satisfy customer demands faster and more efficiently while reducing the risks relating to inventory positioning and provision of supplies to given customer zones in a timely and efficient manner (Sadghiani, Torabi and Sahebjamnia, 2015:95-114). Systems integration promotes flexibility, agility, efficiency and quality to meet consumer demand, shorten lead-times and provide excellent customer service by mitigating the oscillator effect. Integration implies the creation of proper conditions for various components (independent of the level of autonomy) to enhance dialogue, links, collaboration and cooperation. While the terms collaboration and integration are used interchangeably in relation to the supply chain as "tight coupling process between supply chain partners" (Cao and Zhang, 2011:163-180), supply chain integration means "the unified control (or ownership) of several successive or similar process formerly carried on independently" (Flynn, Huo and Zhao, 2010:58-71). Yu and Chiu (2010:2891) argue that the "effective supply chain management is not achievable by any single enterprise, but instead requires a virtual entity by faithfully integrating all involved partners, who should come up with the insightful commitment of real-time information sharing and collaborative management". Bowersox *et al.* (2013:359) describe supply chain integration in terms of customers, internal processes and suppliers as "a demonstration of strong commitment to the supportive capabilities of segmentation, relevancy, responsiveness and flexibility. Customer integration develops intimacy with competency to build lasting competitive advantage while competency in supplier integration results from performing the capabilities seamlessly in internal work processes and blending operating processes and activities with those of supply chain partners to meet increasingly broad and demanding customer expectations".

RESEARCH PROBLEM AND OBJECTIVES

Demand order variability has a tendency to manifest upstream in the supply chain, negatively impacting the achievement of supply chain business performance targets. This article firstly analyzes the impact of bullwhip effect on supply chain performance arising from the external isomorphic pressures exerted by competitors, trading partners and customers. Secondly, it seeks to determine the strength of the relationship and the odds between supply chain business performance targets and the proportion of consumer demand order variability using a set of predictors. Finally it examines the impact of supply chain performance targets on the interactive equilibrium point between the technological and social system network.

RESEARCH METHODOLOGY

Research Design and Data Collection

An exploratory research design was adopted (Cooper and Schindler, 2008:140) to guide the data sources, data collection, sampling methods and measurement, and statistical analysis. A cross-sectional quantitative approach was employed to analyze the data, and a self-administered questionnaire was used for data collection. Organizations in retail sales, logistics, warehousing, marketing, manufacturing and information technology hubs were the units of analysis; as such, managers (senior and functional levels) including supervisory level (non-managerial) were the subjects. This study adopted the positivism paradigm to gather information using quantitative methods consisting of surveys and to analyze the data. A survey instrument was constructed based on the literature reviewed to establish its content validity. While it could be argued that objective scales are more insightful, the study used subjective scales because of the multi-sectorial nature of the survey (demographic, dichotomous and 5-point Likert scale data). To enhance face and content validity, the pre-formulated thematic instrument (Sekaran and Bougie, 2009:197) (bullwhip effect, information sharing, inventory positioning and optimization strategies) was pre-tested with key industry practitioners and academics in relevant disciplines. The respondents' anonymity and confidentiality was assured, enhancing their willingness to freely express their opinions.

Data Sampling Methods and Size

Nonprobability sampling in the form of purposive or judgment sampling was used to select the sample. In this approach, the researcher selects sample members that conform to certain criteria (Cooper and Schindler, 2008: 397). Convenience sampling was used to promote heterogeneity; targeting respondents of different ranks and departments ensured a representative sample. Snowball or referral sampling yielded the majority of potential respondents (Welman, Kruger and Mitchell, 2005: 69). Retailers (downstream supply chain) and suppliers (mid and upstream supply chain) in the selected FMCG industry constituted the population of 800 representatives in five major retail chain stores in eThekwini Metro, South Africa. Approximately 300 suppliers to these retail groups in food (dairy, frozen, canned and general), beverages (hot and cold), and personal health care were considered. The sample size of 456 (260 retailers and 196 suppliers) was arrived at in line with Sekaran's (2003:295) recommendation that sample sizes of larger than 30 and less than 500 are appropriate for most research. In accordance with Sekaran (2003:294) and Bartlett, Kotrlik and Higgins (2001:48), with a population of 800 retailers and 300 suppliers, the sample size was 260 and 196, respectively with an alpha of 0.05 and a degree of accuracy of 0.05. The alpha value or level of significance (0.05) was employed as the threshold value for declaring statistical significance. The final sample size was 448 respondents with a return rate of 98% [(448/456) 100]. According to Krejcie and Morgan (1970) researchers typically set a sample size of about 500 to optimally estimate a single population parameter; this will construct a 95% confidence interval with a margin of error of about ± 4.4 % for large populations. The relevant letters (gatekeeper's letter, ethical clearance certificate, and informed consent) were shown to gatekeepers when the researcher applied for permission to enter their domain.

DATA ANALYSIS

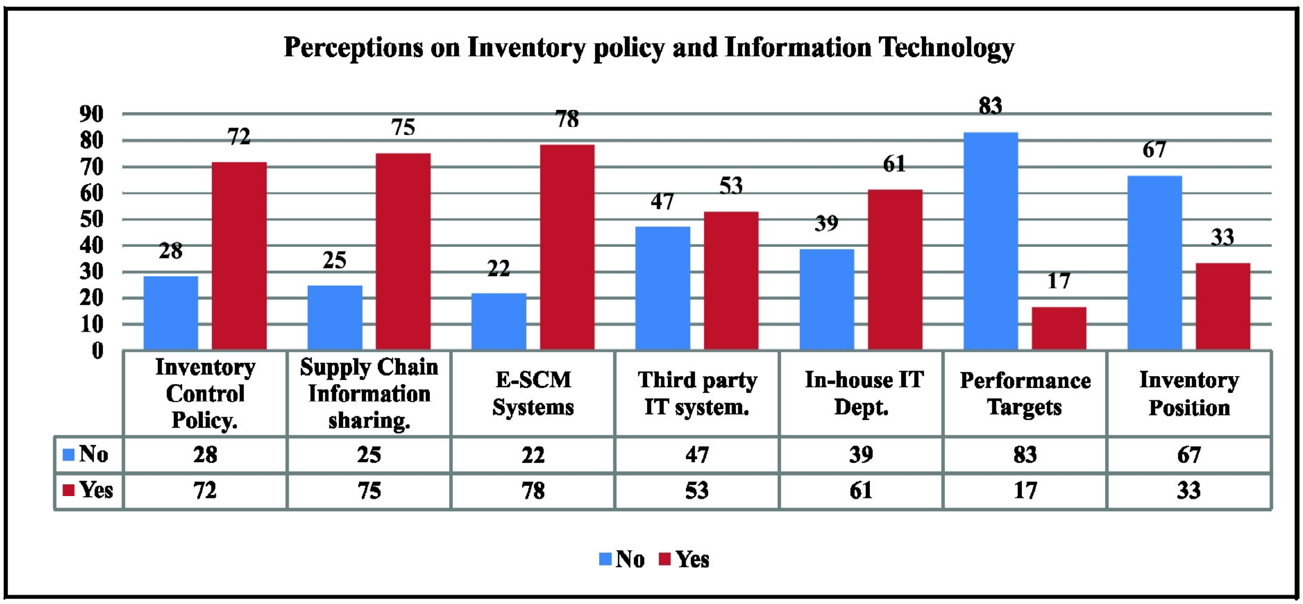

Figure 1: Perceptions on inventory policy and information technology

Figure 1 shows general perceptions of inventory policy and the effects of information technology. Seventy-two per cent of the respondents agreed that inventory control policy at retail level often results in customer demand variability towards the upstream. Supply chain information sharing (75%) and electronic supply chain management systems (78%) were considered by the overwhelming majority of the respondents to promote and enhance supply chain communication to mitigate bullwhip effect. A surprising finding was that most of the respondents did not feel that demand order variability influences business performance targets and customer service levels. Furthermore, 67% of the respondents identified channel alignment in the supply chain as a hindrance to coordinating inventory positioning. A large number of respondents (61%) indicated that their organizations had in-house information technology departments, and 53% stated that they gathered and managed their inventory using third party information technology. This study sought to determine whether supply chain performance targets are achieved through sound inventory control, information sharing and electronic management systems.

Bivariate Analysis

This section on inferential statistics employs cross tabulation and chi-square to estimate the characteristics and relationships between variables. The chi-square (χ^2) statistic is used to test if the relationship is statistically significant as the researcher applies stringent criteria (0.05) for declaring significance level. The chi-square (χ^2) test as a measure of the alignment between two sets of frequency measures uses the following formula:

$$\text{Chi-square } (\chi^2) = \Sigma\, [(E\text{-}O)^2/E]$$

(Where Σ= sigma, O = observed frequency, E = expected frequency)

This section examines the statistical measures used to make logical inferences about the population at 95% confidence level.

Table 1
Bullwhip Effect and Business performance targets.

Does bullwhip effect have significant influence on business performance targets?				*Business performance targets*		
				Yes	*No*	*Total*
Bullwhip Effect	Strongly Agree					
		% of Total		50.0%	6.5%	56.5%
	Agree					
		% of Total		28.8%	7.8%	36.6%
	Neutral					
		% of Total		2.5%	.7%	3.1%
	Disagree					
		% of Total		1.6%	.7%	2.2%
	Strongly Disagree					
		% of Total		.4%	1.1%	1.6%
		% of Total		83.3%	16.7%	100.0%
			Chi-Square Tests			
			Value	df		Asymp. Sig. (2-sided)
Pearson Chi-Square			24.049[a]	4		.000
Likelihood Ratio			19.408	4		.001
Linear-by-Linear Association			20.076	1		.000
N of Valid Cases			448			

Table 1 shows that 78.8% of the respondents strongly agreed that business performance targets are influenced by increased consumer demand order variability moving upstream in the network. The hypothesis indicates: $\boldsymbol{H_{01}}$: *The bullwhip effect has significant influence on supply chain business performance targets.* $\boldsymbol{H_{A1}}$: *The bullwhip effect does not have a significant influence on supply chain business performance targets.* The statistics show the value of chi-square (24.049), and degree of freedom (4), $p < 0.05$, (0.000). There is a statistical relationship between bullwhip effect and influence on business performance targets as consumer demand order shows variability upstream in the network.

Logistic Regression Analysis

Logistic regression analysis is described as an approach that is similar to multiple linear regression, except that the dependent variable is taken into account as categorical. It allows one to predict a discrete outcome such as group membership from a set of variables that may be continuous, discrete, dichotomous or mixed (Tabachnick and Fidell, 2007:437). According to Garson (2012), logistic regression applies maximum likelihood estimation (a method used to calculate the logit coefficients) after transferring the dependent into a logit variable as the natural log of the odds of the dependent equality having a certain value or not. The natural log of the odds of an event being equal to the natural log of the probability of the event occurring is divided by the probability of the event not occurring:

$$\text{In [odds (event)]} = \text{In[prob(event/prob(nonevent)]}.$$

In an equation: $z = b_0 + b_1x_1 + b_2x_2 + \ldots.\ b_kx_k$, where z is the log odds of the dependent variable = In[odds(event)] and z also known as logit or log odds; b_0 as constant; and b as logistic regression coefficients (or parameter estimates) with k independent (x) variables. The objective of logistic regression analysis is to understand the strength of the relationship and the odds of supply chain business performance targets impacting consumer demand order variability that is associated with the set of categorized predictors. Dichotomous data (Yes or No) was used to establish the relationship between the independent variables and the probability of occurrence. The parameter â in the equation determines the rate of increase or decrease of the curve: when $\beta > 0$, $\pi(x)$ increases as x increases; when $\beta < 0$, $\pi(x)$ decreases as x increases; and when $\beta = 0$, the curve flattens to a horizontal line (Tabachnick and Fidell, 2007). The odds ratio of the model for categorical data denotes that for a probability of success π, the odds of success are defined to be: odds = $\pi/(1-\pi)$ (for instance, if π (probability success) = 0.8, the probability of failure is 0.2 and the odds equal 0.8/0.2 = 4.0) while the success probability itself is the function of the odds: π = odds/(odds + 1). In terms of 2x2 tables, within row 1 the odds of success are $odds_{1\,=}\,\pi_1/(1-\pi_1)$, and within row 2 the odds of success equal $odds_{2\,=}\,\pi_2/(1-\pi_2)$. This translates to a new equation: $\theta = [odds_1/\ odds_2] = [\pi_1/(1-\pi_1)\ /\ \pi_2/(1-\pi_2)]$. The test statistic uses the ratio of the maximized likelihoods:

-2log [(maximum likelihood when parameters satisfy H_0) / (maximum likelihood when parameters are unrestricted)]

The significance test for the final model chi-square (after the independent variables have been added) is the statistical evidence of the presence of a relationship between the business performance targets as a yardstick for bullwhip effect and the combination of the major predictor variables (inventory positioning, information sharing, and electronic supply chain management systems) and sub-dimensions of these major variables. This demonstrates logistic regression with a dichotomous dependent variable (business performance targets). The set of categorical predictor variables anchored by 'yes' or 'no' includes optimal inventory positioning, coordinated inventory policy, integrated information sharing, e-SCM systems, third party IT system and in-house IT system. Green (1991) proposes a general rule of thumb to determine the minimum sample size to test the R^2 and significance tests on the regression coefficients. The author suggests that the minimum sample should be greater that 50 + 8k for the former and greater than 104 + k for the latter, where k is equal to the number of independent variables. Therefore, the sample of 448 respondents exceeds the minimum requirements for applying regression models.

Table 2
Full Model of Business Performance Targets

Omnibus Tests of Model Coefficients

		Chi-square	*Df*	*Sig.*
Step 1	Step, Block, and Model	26.423	6	.000

Model Summary (Pseudo R-square)

Step	*-2 Log likelihood*	*Cox & Snell R Square*	*Nagelkerke R Square*
1	378.351[a]	.057	.096

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	*Chi-square*	*Df*	*Sig.*
1	15.039	8	.058

Classification Table[a]

	Observed		Predicted		
			Business performance targets.		
			Yes	*No*	*Percentage Correct*
Step 1	Business performance targets.	Yes	371	2	99.5
		No	69	6	8.0
	Overall Percentage (a. The cut value is .500)				84.2

Variables in the Equation

		B	*S.E.*	*Wald*	*df*	*Sig.*	*Exp(B)*	*95% C.I.for EXP(B)*	
								Lower	*Upper*
Step 1[a]	Inventory Position(1)	.591	.272	4.729	1	.030	1.806	1.060	3.076
	Inventory Policy(1)	.584	.276	4.470	1	.034	1.794	1.044	3.083
	Information Sharing(1)	.772	.283	7.456	1	.006	2.164	1.243	3.767
	E-SCM Systems(1)	.489	.300	2.655	1	.103	1.630	.906	2.933
	Third Party IT(1)	.369	.266	1.926	1	.165	1.447	.859	2.437
	In-House IT(1)	-.162	.280	.333	1	.564	.851	.491	1.473
	Constant	-2.504	.286	76.424	1	.000	.082		

a. Variable(s) entered on step 1: Inventory Position, Inventory Policy, Information Sharing, e-SCM Systems, Third Party IT, In-House IT.

Logistic Regression Model

A logistic model provides a better fit to the data as it demonstrates better performance than the intercept-only model. Individual parameter estimates are tested by the likelihood ratio test and the Wald statistic. Goodness-of-fit statistics assess the fit of a logistic model against the data in terms of inferential tests such as Pearson chi-square test and the Hosmer-Lemeshow (H-L) test and descriptive measures such as the provision of two R^2 indexes defined by Cox and Snell and Negelkerke R squares. Table 2 shows the set of results with highly significant $p < 0.05$ (0.000) and the chi-square value (26.423) with six degrees of freedom. The model shows an overall indication on a 'goodness of fit' test over and above the Block 0 results without the predictors entered into the model. In adding new variables to the model, the -2 log likelihood (a measure of how well the model explains variations in the outcome of interest; also known as deviance) has been reduced by 26.423 (chi-square value) with 6 degree of freedom. In the omnibus tests of model coefficients, the output shows that the researcher's model is significantly better than the intercept only (Block 0) model. According to Tabachnick and Fidell (2007:485) the chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model whereby, the reduced model is formed by omitting an effect from the final model, and hypothesized all parameters of that effect as 0.

DISCUSSION OF RESULTS

This article examines the extent to which bullwhip effect is likely to influence supply chain business performance targets. The results reveal that there is a statistically significant relationship between bullwhip effect and influence on business performance targets and customer service levels. The strength of the relationship and likelihood of the odds between the supply chain business performance targets and the proportion of consumer demand order variability are aligned with a set of categorized variables. It is interesting that demand order variability does influence business performance targets and customer service levels. Could a CscD system promote superior supply chain business performance outcomes in FMCG stores? A centralized system in which each stage shows actual customer demand is compared with a decentralized system in which demand information is not shared and orders at each stage are placed by the immediate downstream neighbour. If L is the lead time, $\boldsymbol{i}$ number of period; and ρ as a correlation constant with $-1 < \rho < 1$. In a centralized serial supply chain, the variance of the orders placed by stage $\boldsymbol{i}$, denoted $\mathbf{Q}_i$, satisfies:

$$\frac{Var(Q_i)}{Var(D)} \geq 1 + \left(\frac{2\left(\Sigma_{i+1}^{k} L_i\right)}{p} + \frac{2\left(\Sigma_{i+1}^{k} L_i\right)^2}{p^2} \right)(1-\rho^{p})$$

In the centralized system, bullwhip effect exists at reduced magnitude if all supply chain members have visible demand information and use the same forecasting technique and inventory policy. In the decentralized serial supply chain with $\rho = 0$ (demands are uncorrelated across time) and $\mathbf{z}_\alpha = 0$, the variance of the orders placed by stage $\boldsymbol{i}$, denoted $\mathbf{Q}_i$, satisfies:

$$\frac{Var(Q_i)}{Var(D)} \geq \Pi_{i+1}^{k} \left(1 + \frac{2Li}{p} + \frac{2L^2 i}{p^2} \right)$$

Therefore, the increase in variability is addictive in the centralized system but multiplicative in the decentralized system (Snyder and Shen, 2011:273). Although sharing demand information can significantly reduce bullwhip effect in the centralized system, the decentralized system assumes $\rho = z_\alpha = 0$ and each stage only sees the orders placed by its downstream stage. If the retail business model represents the firm's distinctive logic for value creation and appropriation (Teece, 2010; Zott and Amit 2010), the strategy epitomizes a central, integrated, externally oriented concept of how the business will achieve these essential strategic objectives (Hambrick and Fredrickson, 2005; Gambardella and McGahan, 2010). In a world of technology-driven innovation, an electronically-enabled supply chain management system would offer real-time information sharing capabilities. Chengalur-Smith, Duchessi and Gil-Garcia (2012:58) suggest that information sharing refers to the degree to which supply chain participants share supply chain information using integrated electronic management systems to broaden information capabilities, underpin business functions and process performance outcomes. In leveraging the core competencies of partnering firms or supplier and information technologies under build-to-order supply chain (Gunasekaran and Ngai, 2009:319-334), the system offers real-time information and flexible responsiveness among the partners that will position modular inventory at the early stage of order processing.

It is important to establish the strength of the relationship and odds between the supply chain business performance targets and the proportion of consumer demand order variability that is associated with the set of predictors. Logistic regression analysis was used to predict the supply chain business performance targets or benefits from the perspective of bullwhip effect from the set of categorical variables in the context of inventory positioning and information sharing. This regression method computed the logit coefficient for maximum likelihood estimation after transferring the dependent variable into a logit variable. The survey instrument (section two) was collapsed into two categories ("Yes" or "No") for the logistic regression analysis. Supply chain business performance outcomes and targets were used as a proxy for a mitigation yardstick for bullwhip effect. The proxy statement was that demand order variability influences business performance targets and customer service levels. The respondents were asked to mark on dichotomous questions ("Yes" or "No") how likely it would be that they would consider business performance targets to gauge the extent of managing and controlling bullwhip effect. These maximum likelihood methods aimed to predict the proportion of variance in outcome that is associated with the set of predictors. What proportion of the variability in business performance targets and customer services is accounted for by inventory position, inventory policy, in-house information technology, e-SCM system, information sharing and third-party information technology? All sets of predictor variables (table 1) indicated higher frequency scoring values of "yes" against "no" from the sample of 448 respondents. This shows that the respondents concurred with the statements from the categorical predictors.

In the omnibus tests of model coefficients, the output depicted that the researcher's model is significantly better than the intercept (Block 0) model. The pseudo R-square statistics suggested that between 5.7% and 9.6% of the variability is explained by the set of variables. The pseudo R-square statistics (table 2) suggest that between 5.7% and 9.6% of the variability is explained by the set of variables. According to Pallant (2006:167) Cox and Snell R Square and the Negelkerke R Square values (0.057 and 0.096, respectively) provide an indication of the amount of variation in the dependent variable explained by the model from a minimum of 0 to a maximum of approximately 1. Nagelkerke R^2 quantifies the proportion of explained variation in the logistic regression mode. The pseudo R square values provide information about the percentage of variance explained. The last (Hosmer and Lemeshow) test is understood as the most reliable test of model fit with a different interpretation from category one (omnibus test). The Hosmer and Lemeshow test underpinned the model at the chi-square value (15.039), degree of freedom (8) with a significance level (0.058) larger than 0.05 at an acceptable level. The classification section (Block 1) indicated the slightly improved (84.2%) percentage accuracy in classification (PAC) compared to Block 0 (83.3), indicating how well the model (Block 1) enabled the prediction of the correct category of business performance targets and customer services for each case.

The sensitivity of the model as the percentage of the group that has the characteristic of interest is correctly classified as 99.5% of the respondents stated that mitigation factors positively influence business performance targets, except in-house IT, with a negative influence. In terms of the specificity of the model, the percentage of the group without the characteristic of interest shows that 8% of respondents correctly predicted poor business performance targets from influential mitigation factors. In verifying the positive and negative predictive values, the percentages of cases that the model classifies as having and not having the characteristic of interest can be observed in this group. The positive predictive value is 84.3% (371 + 69 = 440 and 371 divided by 440 x 100 = 84.3%) while the negative predictive value is 75% (6 divided by (2 + 6) x 100 = 75%). In terms of the direction of the relationships, table 2 reveals positive relationships in inventory positioning (0.591), inventory policy (0.584), information sharing (0.772), and e-SCM systems (0.489), indicating that the more effective the mitigation factors are, the greater the likelihood of improving business performance targets and the propensity to overcome bullwhip effect.

The Wald-test revealed the variables that contributed significantly to the predictive ability of the model with three significant variables with values of less than 0.05 (inventory positioning, p = 0.030; inventory policy, p = 0.034; information sharing, p = 0.006). The Wald test examines whether or not the independent variable is statistically significant in differentiating between two groups in each of the embedded binary logistic comparisons (Tabachnick and Fidell, 2007: 451). The Wald test ($\chi^2 = B^2/S.E.^2$) reveals the variables that contribute significantly to the predictive ability of the model with three significant variables with values of less than 0.05. Although electronic supply chain management (e-SCM) systems, third party information technology (IT) and in-house IT did not contribute significantly to the model, the major mitigation factors that positively influence the business performance targets and the phenomenon of bullwhip effect are optimal inventory positioning, coordinated inventory policy among supply chain trading partners and integrated information sharing on advanced economic information. The positive B values (inventory positioning = 0.590; inventory policy = 0.584; information sharing = 0.772; e-SCM systems = 0.489) with an inverse approach suggest that a decrease in the independent value scores resulted in an increased probability of improved business performance targets. In this study, the variables measuring predictive ability depicted positive B values, indicating that the greater the improvement in business performance targets and outcomes, the less likely the business will experience the pernicious presence of bullwhip effect. In terms of effect size measures of odds ratios Exp (B) in logistic regression, the study indicated odds ratios greater than 1 corresponding to independent variables to increase the logit on the six predictor variables developed the following equation:

$$\text{Logit Model} = -2.504 + 0.591\ (\text{IP}) + 0.584\ (\text{Policy}) + 0.772\ (\text{IS}) + 0.489\ (\text{e-SCM}) + 0.369\ (3^{rd}\ \text{PIT}) - 0.162\ \text{IH IT}) + \varepsilon$$

In the Exp (B) column variables in the equation, Garson (2012) states that odds ratios are effect size measures in logistic regression, with values above 1.0 reflecting positive effects and those below 1.0 reflecting negative effects. Although the values have odds ratios greater than 1, the value of the odds ratios of less than 1 (0.851) in in-house IT range between 0.491 (lower limit) and 1.473 (upper limit) at 95% confidence resulting in statistical insignificance at $p > 0.05$ (0.564). The value of Exp (B) is 0.851 (in-house IT) which implies that for each unit increase in confidence in in-house IT the odds decreased by (0.851 – 1.0 = -0.149) 14.9% or 15%.

MANAGERIAL IMPLICATIONS

Since channel alignment in the supply chain assists in coordinating inventory positioning, improved supply chain business performance and customer service levels should assist in managing demand order variability. Vijayasarathy (2010:369) confirms that the quality of the supply chain channel relationships is an important determinant of supply chain business performance. As a critical competence in supply chain management, supply chain channel alignment describes the efficient formation of a network in which separate supply chain partners collaboratively manage intra- and inter-organizational processes to arrive at mutually acceptable performance targets. As the FMCG industry expands to other African regions and foreign competitors such as Wal-Mart use South Africa as a base, supply chain channel alignment could promote effective and efficient flows of information to regions that lack sophisticated infrastructure and enable firms to supply the required products and services, allocate resources, and offer maximum value to the customer at low cost and high speed. South Africa is becoming an entrenching trade base (acquisition transactions between Massmart and Wal-Mart; SABMiller and Anheuser-Busch InBev; and Iscor and Macsteel) for competitive alignment of channel strength on the lean upstream, mid-stream decoupling point through differentiation, and downstream supply chain agility to offer an opportunity of scaling mass-market model and expansion strategy.

Although the log-odds equation included six prediction variables, three (inventory positioning, inventory policy and information sharing) contributed significantly to the predictive ability of the model with a greater likelihood of improving business performance outcomes and customer services and the propensity to overcome bullwhip effect. As the custodian of information, if the inventory control policy at retail level is likely to cause consumer demand variability towards the upstream sites, supply chain performance improvement is required to tame bullwhip effect. In supply chain operations, timely and accurate flow of data is necessary to successfully police inventory at retail level. In a stable competitive environment, the adoption of supply chain technology is expected to assist supply chain partners with inventory control throughout the network. Broadly speaking, information technology enables effective and efficient flows to elevate the degree of visibility, connectivity, responsiveness and flexibility. This study found that integrated inventory policy processes and information system output across the supply chain improve supply chain business performance. If the retailer emerges as the custodian of economic information, downstream orders affect the inventory level and the positioning of upstream capacitated suppliers as retailers leverage upstream and downstream relationships in the supply chain to set key performance targets.

If the information sharing relates to supply chain business performance targets in the FMCG industry, there is a probability of overcoming bullwhip effect as the industry spreads its wings to the African market. Fawcett, Osterhaus, Magnan, Brau and McCarter (2008:385-368) suggest that while information sharing positively influences operational performance, the impact is stronger for businesses with higher levels of both connectivity and willingness to share information. It is therefore, essential to align channels and information using electronically-enabled connectivity and intelligent visibility among supply chain partners. This process should be accompanied by a strong commitment to exchange quality information to achieve improved supply chain business performance as a management tool to ameliorate bullwhip effect. Du, Lai, Cheung and Cui (2012:89) stress the need for the information shared to be of high quality as well as its timeliness, accuracy, adequacy, completeness and reliability to avoid demand information distortion. The supply chain's ability to adapt to different and changing African markets will depend on information technology and compatibility through share information across extended enterprises; these are important determinants of supply chain performance at both the strategic and operational level.

Since electronic supply chain management systems promote and enhance communication, it is likely that common supply chain business performance targets can be set to mitigate bullwhip effect. Kim, Cavusgil and Calantone (2005:169-178) highlight that the adoption of information technology to support supply chain communication systems has a positive influence on both intra- and inter-organizational coordination, and internal coordination has an effect on business performance. Although Vijayasarathy (2010:369) argues that technology usage in the supply chain is moderated by the environment, the quality of the channel relationships and process innovation, well-developed supply chain communication technologies enhance decision making and speed up information sharing to improve supply chain business performance. This study confirms that inventory positioning and policy, information sharing and electronic supply chain management systems are effective strategies to improve business performance targets and overcome the deleterious influence of bullwhip effect.

Foreign investors in emerging African economies support enhanced information flow through the use of electronic supply chain management applications. In South Africa, which has adequate infrastructure and conducive policies, this creates efficiencies and reduces risks such as incorrect information being forwarded when demand orders cascade up the supply chain network. Synchronized information on demand assists enterprises that use inventory aggregation under a centralized supply chain distribution (CscD) system for multiple local outlets within and beyond South Africa's borders. This enables extensive analysis of the efficacy of FMCG retail business models in terms of information sharing, inventory positioning, and electronic supply chain management within major retail outlets in South Africa.

CONCLUSION AND SUGGESTIONS FOR FURTHER RESEARCH

This article has shown that bullwhip effect has a significant likelihood of influencing business performance targets and that sharing information on customer demand can significantly manage this effect in a centralized rather than a decentralized system. In determining the impact of business performance targets on the overall supply chain, the strength of channel alignment emerged as a key factor in preventing increased consumer demand order variability upstream. Successful relationships based on trust, commitment, integrity and ethical principles are required to achieve this objective. Channel alignment based on integrity and reliability has the potential to sustain supply chain performance in the long-term. It would be interesting to investigate business performance in African countries in the FMCG industry that were instigated by foreign investment and local businesses using South Africa as a base. The findings of this study could be used to strengthen the FMCG industry and promote expansion into African markets.

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