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Volatility Transmission between Oil and LME Futures

Jaehwan Park
An analyst at the Public Procurement Service in Daejeon, Korea.

ABSTRACT

This paper investigates the volatility transmission between oil and base metals to assess the possibility of hedge strategy across commodity markets. In order to identify the volatility linkage of oil to the base metals, the bivariate GARCH model is applied using daily returns data period over 2000-2016. It is found that evidence of volatility transmission between oil and base metals is somewhat strong with a 1% significant level. This result suggests the investment idea of commodity hedging strategy of cross-market is important.

Keywords: volatility transmission, univariate GARCH, bivariate GARCH

1. Introduction

A base metal refers to industrial metals or non-ferrous metals, which are mostly used in durables goods' manufacturing process. The industrial metals mean for widely utilizing in economic activity, so that those volume growth implies the state of manufacturing business cycle (Hammoudeh & Yuan, 2008). The oil, which is the key indicator in global commodity market, plays in the important role of the global economy and associated business cycles. Ratti &Vespignani (2013) showed that the effect of an unanticipated supply shock on global oil production is very persistent and highly significant. They pointed out that the historical contributions of shocks in global real aggregate demand to real oil prices are of comparable size. Both oil and base metals futures markets have been attracted commodity funds such as CTAs (Commodity Trading Advisors) and even some hedge funds.

Ewing & Malik (2013) examined the linkage that might exist between the volatilities in oil and gold in a way of the volatility dynamics between two major commodities to support the idea of cross-market hedging. They found strong evidence of significant transmission of volatilities between in these asset prices. Given that Ewing & Malik (2013) result, the question arises of whether there has been volatility transmission from oil prices to base metals. In particular, oil markets often trigger a cost-push in inflation front. Classical macroeconomic theory suggests higher oil prices generate upward pressure in inflation (Hooker, 2002). The role of oil prices can possibly link to other commodity outputs and even capacity utilization ratio in manufacturing industry. Wu et al. (2011) found statistically significant volatility spillovers from oil prices to corn futures prices1, which revealed somewhat time-varying. Oil prices are also complements and substitutes in consumption, and inputs in production of others (Hammoudeh & Yuan, 2008). While Ewing & Malik (2013) focused on gold of inflation hedge characteristics, this paper concentrates on base metals of industry activity itself, paying attention to which volatility in base metals prices impacted by external shocks from oil prices.

This paper studies the volatility dynamics of oil and LME2futures to identify the statistical linkage between the volatilities in base metals prices and oil prices using daily data from January 4, 2000 to December 30, 2016. The reason for analyzing the period after 2000 is because commodities were first considered as an alternative asset class in the asset management industry starting in 2000. (Cheng & Xiong, 2014). This paper employs univariate and bivariate GARCH model to examine volatility dynamics of base metals and oil futures. The empirical results suggest LME futures market volatility statistically link to oil futures market volatility.

This paper is organized as follows. Section 2 reviews the literature on the volatility of commodity futures market.

Section 3 presents the empirical methodology introducing the univarate and bivariate GARCH model. Section 4 reports empirical results. The summary and implication are in Section 5.

2. Literature Review

Commodity price volatility is a crucial element in option pricing formulas for futures contracts and financial market risk assessment as a futures market valuation tool. Haigh & Holt (2002) investigated

oil futures market volatility spillovers between markets (crude oil, unleaded gasoline and heating oil) using multivariate GARCH model. They found somewhat significant reductions in uncertainty, when the volatility spillovers between markets were considered. Indeed, they presented that incorporating realistic assumptions regarding to co-movement of prices directly into the hedging strategy yielded substantial rewards in terms of risk reduction. Malik & Hammoudeh (2007) found significant volatility and shock transmission among US equity, Gulf equity and oil markets through a multivariate GARCH technique. Using univariate GARCH models Ewing & Malik (2010) revealed that oil shocks had a strong initial impact on volatility but dissipate very quickly under structural breaks. They concluded that the behavior of volatility in oil prices was important for derivative valuation and hedging decisions.

Batten & Lucey (2010) reported the volatility structure of gold futures using intraday data with GARCH methodology and showed significant variation in volatility across the trading day on NYMEX (New York Mercantile Exchange), although volatility was slightly positively correlated with volume. Wu et al. (2011) found strong evidence of significant spillovers from oil prices to corn futures prices. They found that corn markets had become far more connected to oil markets after the introduction of the Energy Policy Act of 2005. Since then US biofuel production had gone through a rapid expansion in response to higher energy prices. They showed that oil prices transmitted positive volatility spillovers into corn prices, so that movements in corn prices were more energy-price-driven, as long as the ethanol-gasoline consumption ratio exceeded a critical level. Within this condition, the cross-hedging strategy between corn and oil provided slightly better hedging performance compared with traditional hedging in corn futures markets alone.

LME market front, few studies exhibited market volatility. Figuerrola-Ferretti & Gilbert (2008) considered dynamic representation of spot and three-month aluminum and copper volatilities. Using bivariate FIGARCH model, they showed that spot and three-month aluminum and copper volatilities followed long memory process, but no evidence that the volatilities processes were fractionally cointegrated. Park & Lim (2018) examined whether the price volatility of the LME changed within a sample period (January 2000-June 2016) to check the possibility of time varying volatility. They reported that the LME's volatility was somewhat larger post-crisis compared to pre-crisis for all base metals except nickel. They argued that somewhat serious inflow of investment money to the LME futures market had substantially changed volatility pattern.

3. Methodology

3.1 Univariate GARCH Model

This paper applies the GARCH (1, 1) model given as:

$$R_t = \mu + \rho R_{t-1} + \varepsilon_t \quad (1)$$

$$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1} \quad (2)$$

where R_t means the corresponding oil or base metals return series. ε_t is normally distributed white noise and h_t represents the conditional variance, which depends on the mean volatility level (ω), the noise from previous period (ε_{t-1}^2), and the conditional variance from the previous period (h_{t-1}). The coefficients of α and β imply that noise from previous period and volatility from previous period respectively. The sum of α and β suggests the level of volatility persistence. Notice that this sum is close to one as long as high frequency data is used, that implies shocks are somewhat highly persistent.

3.2 Bivariate GARCH Model

The bivariate GARCH (1, 1) model given as:

$$H_t = C'C + B'H_{t-1}B + A'\varepsilon_{t-1}\varepsilon_{t-1}'A \quad (3)$$

where C is a lower triangular matrix with three parameters and B is a square matrix of parameters, which implies the current levels of conditional variances and past conditional variance respectively. A is a square matrix of parameters, which represents how conditional variances are affected with past squared errors.

Rewritten equation (3) in terms of each equation gives:

$$h_{11,t} = c_{11}^2 + b_{11}^2 h_{11,t-1} + 2b_{11}b_{21}h_{12,t-1} + b_{21}^2 h_{22,t-1} + a_{11}^2\varepsilon_{1,t-1}^2 + 2a_{11}a_{21}\varepsilon_{1,t-1}\varepsilon_{2,t-1} + a_{21}^2\varepsilon_{2,t-1}^2 \quad (4)$$

$$h_{22,t} = c_{12}^2 + c_{22}^2 + b_{12}^2 h_{11,t-1} + 2b_{12}b_{22}h_{12,t-1} + b_{22}^2 h_{22,t-1} + a_{12}^2\varepsilon_{1,t-1}^2 + 2a_{12}a_{22}\varepsilon_{1,t-1}\varepsilon_{2,t-1} + a_{22}^2\varepsilon_{2,t-1}^2 \quad (5)$$

Equation (4) and equation (5) represent that the conditional variances are transmitted through the two time series each other, which imply how shocks affect across oil and base metals over time. (Bollerslev & Wooldridge, 1992)

4. Empirical Results

4.1 Data

This paper uses daily futures prices for oil (denote oi) from January 4, 2000 to December 30, 2016, which trades on NYMEX of the three-month futures contracts which is the benchmark nearest expiration contract on the market. Prices for oil futures data obtained from Reuters. Notice that the three-month futures contracts are the most liquid, so that futures prices are more responsive to the market information and future expectation. The LME data are used for base metals, which include copper (cu), aluminum (al), lead (pb), zinc (zn), tin (sn), and nickel (ni). The benchmark futures price

for base metals is the expiration contract of 3 months (3M), which is also obtained from Reuters over same period. Hence, this study utilizes daily data for the closing three-month futures prices.

Table 1 reports the descriptive statistics of daily log returns data over the sample period. The six base metals returns series are somewhat leptokurtic. The skewness and kurtosis measures show that the price change distributions are asymmetric and fat-tailed (excess kurtosis). The volatilities, given in the second row of Table 1, correspond to the standard deviation of daily log returns over the period and that of nickel is the largest but that of aluminum is the lowest.

Table 1. Summary Statistics

	oi	cu	al	pb	zn	sn	ni
Mean	0.00023	0.000198	-0.000028	0.000268	0.000084	0.000270	0.000085
Standard deviation	0.021232	0.016854	0.013199	0.200009	0.018569	0.017278	0.023250
Skewness	-0.120939	-0.095907	-0.219071	-0.237140	-0.189190	-0.176257	-0.142131
Maximum	0.121150	0.118804	0.059130	0.126751	0.096563	0.142533	0.130603
Minimum	-0.121607	-0.104002	-0.074373	-0.128495	-0.108322	-0.114346	-0.181060
Kurtosis	5.559868	7.471589	5.189371	6.74522	5.961389	9.301117	6.5654
Jarque-Bera	256.69 (0.000)	417.16 (0.000)	241.12 (0.000)	390.85 (0.000)	308.98 (0.000)	552.79 (0.000)	352.37 (0.000)

Note: The total observation contains 4,030 obs. (January 4, 2000~December 30, 2016; daily data). The natural logarithm data are applied in returns calculations.

Jarque-Bera statistic is for checking normal distribution. Actual probability values are in parentheses.

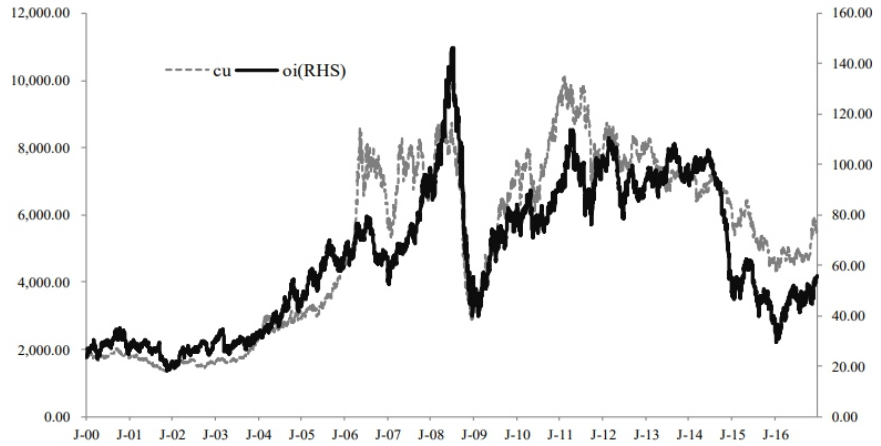
The analysis of Pearson correlation coefficients between oil and base metals over the period reports in Table 2, in terms of providing some preliminary analysis. Ewing & Malik (2013) found that the correlation between both the returns series of oil and gold was 0.20. It is found that the correlation between both the returns series of oil and base metalsfutures over sample period is somewhat higher of range between 0.25 of tin and 0.35 of copper. This higher correlation may explain the possibility of co-movement each other and important degrees of industrial usages. Notice that Tang & Xiong (2012) found that the return correlation among major commodities in recent years increased. They showed that oil had low return correlations with cotton and live cattle before 2004 and that the correlations rose to 0.5 since then due mainly to financialization by major commodity funds. Silvennoinen & Thorp (2013) reported that financial activity by institutional investors and exchange traded funds (ETFs) in commodity securities markets had grown substantially since 2000. In particular, rises in oil prices have influenced increases in base metals outputs, which affect base metals returns and volatility through this simple transmission channels.

Table 2. Correlation Matrix

	oi	cu	al	pb	zn	sn	ni
oi	1.00						
cu	0.35	1.00					
al	0.31	0.71	1.00				
pb	0.28	0.64	0.56	1.00			
zn	0.27	0.73	0.66	0.67	1.00		
sn	0.25	0.51	0.44	0.45	0.46	1.00	
ni	0.26	0.60	0.52	0.50	0.56	0.45	1.00

Note: The sample consists of 4,030 observations. All correlation coefficients of oil and base metals reveal statistical significance at least at the 1% level except zinc.

Figure 1 shows the daily price behavior in oil prices and copper prices over the sample period. The figure implies synchronized boom and bust cycles driven by the Chinese massive infra investment and the global financial crisis by Lehman Brothers bankruptcy with similar pattern. Once again, both commodity prices surged until mid-2011 thanks to the unconventional monetary policy of the FRB (Federal Reserve Board)'s QE (Quantitative Easing) and fell upto early 2016 due mainly to rise in supply by major global mining companies such as Glencore, Rio Tinto and BHP Billiton etc.Park & Lim (2018) presented that the price fluctuation of lead is largest among six base metals, while the changes in aluminum prices are lowest within similar data period (January 2000-June 2016).



Description: The solid line is oil prices (NYMEX) over the January 4, 2000 and December 30, 2016 of 17 years, while the dotted line is copper prices (LME)

4.2 Empirical Results

Results obtain from estimation of univariate GARCH model report in Table 3. It is found that key parameters to be statistically significant with 1% significance level, which means the price volatilities of both oil and base metals are somewhat time-varying. The volatility persistent reveals high level. The robust mean-revision phenomenon finds at copper with 5% significance level, while lead reveals somewhat positive coefficient ρ with 5% significance level.

Table 3. Univariate GARCH (1, 1) Estimation

		coefficient	S.E.	z-statistic	p-value
oi	μ	0.0006	0.0027	2.34	0.019
	ρ	-0.0255	0.0160	-1.60	0.111
	ω	0.000001	0.0000002	3.65	0.000
	α	0.1274	0.0111	11.43	0.000
	β	0.8549	0.0142	60.08	0.000
cu	μ	0.0002	0.0002	1.16	0.245
	ρ	-0.0395	0.0178	-2.21	0.027
	ω	0.000004	0.000001	3.27	0.001
	α	0.1257	0.0083	15.02	0.000
	β	0.8623	0.0106	81.27	0.000
al	μ	0.000004	0.0001	0.02	0.982
	ρ	-0.0318	0.0170	-1.86	0.062
	ω	0.000001	0.0000001	1.43	0.153
	α	0.0787	0.0082	9.51	0.000
	β	0.9150	0.0108	84.55	0.000
pb	μ	0.0003	0.0002	1.42	0.136
	ρ	0.0352	0.0165	2.13	0.033
	ω	0.000001	0.0000001	6.62	0.000
	α	0.1472	0.0106	13.89	0.000
	β	0.8392	0.0099	84.06	0.000
zn	μ	0.0002	0.0002	0.99	0.321
	ρ	-0.0075	0.0167	-0.45	0.651
	ω	0.0000003	0.0000001	3.80	0.000
	α	0.1397	0.0099	14.11	0.000
	β	0.8575	0.0099	85.82	0.000
sn	μ	0.0001	0.0002	0.58	0.563
	ρ	-0.0005	0.0167	-0.03	0.973
	ω	0.0000008	0.0000001	7.88	0.000
	α	0.1711	0.0077	22.08	0.000
	β	0.8162	0.0088	91.82	0.000
ni	μ	0.0002	0.0003	0.86	0.390
	ρ	-0.0138	0.0170	-0.81	0.416
	ω	0.00001	0.000003	3.69	0.000
	α	0.0930	0.0085	10.85	0.000
	β	0.8811	0.0133	66.24	0.000

Note: The model: $R_t = \mu + \rho R_{t-1} + \varepsilon_t, \quad h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1}$

The impact results of oil return variable on LME metals returns with GARCH effects report in Table 4. The oil impacts on base metals show positive impact with 1% statistical significance. For example, a 10% rise in oil return increases the nickel return of 2.4%. The sum of and measures the volatility persistent, which indicates to be close to one. This is consistent across metals of the largest 0.9936 of zn and the lowest 0.9735 of sn. It is found that the fluctuation of oil impacts on statistically significant movement on base metals, even though they are traded at different markets.

Table 4. Univariate GARCH (1, 1) Estimation

		coefficient	S.E.	z-statistic	p-value
cu	μ	0.0001	0.0002	0.87	0.382
	ρ	0.1859	0.0095	19.55	0.000
	ω	0.00001	0.000001	3.61	0.000
	α	0.1171	0.0086	13.56	0.000
	β	0.8635	0.0118	72.64	0.000
al	μ	-0.0001	0.0001	-0.45	0.651
	ρ	0.1551	0.0082	18.76	0.000
	ω	0.000002	0.0001	1.51	0.132
	α	0.0685	0.0081	8.41	0.000
	β	0.9202	0.0127	72.25	0.000
pb	μ	0.0003	0.0002	1.28	0.199
	ρ	0.1668	0.0112	14.82	0.000
	ω	0.000001	0.0000001	6.61	0.000
	α	0.1348	0.0097	13.88	0.000
	β	0.8495	0.0096	87.94	0.000
zn	μ	0.0002	0.0002	1.02	0.305
	ρ	0.1496	0.0098	15.15	0.000
	ω	0.000001	0.000001	3.88	0.000
	α	0.1367	0.0096	14.15	0.000
	β	0.8569	0.0105	81.47	0.000
sn	μ	0.0001	0.0002	0.57	0.569
	ρ	0.1249	0.0094	13.29	0.000
	ω	0.00001	0.000001	9.47	0.000
	α	0.1658	0.0077	21.48	0.000
	β	0.8077	0.0097	83.22	0.000
ni	μ	0.0002	0.0003	0.63	0.531
	ρ	0.2422	0.0141	17.13	0.000
	ω	0.00001	0.000001	3.10	0.002
	α	0.0859	0.0081	10.57	0.000
	β	0.8927	0.0127	69.77	0.000

Note: The model: $R_t^{LME} = \mu + \rho R_t^{oil} + \varepsilon_t, \quad h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1}$

While this paper motivation is to model the volatility transmission between oil and base metals returns, it is now to explore the bivariate GARCH model, which reports in Table 5. In case of zinc (zn) the convergence of bivariate GARCH does not achieve, so that this paper reports the empirical results except zinc. It is found that estimated coefficients in the ARCH and GARCH matrices are highly significant and have large magnitudes, which implies volatility persistence once again. This high level of volatility persistence is consistent with early studies using somewhat high frequency data. (Ewing & Malik, 2013) Both oil and base metals volatilities are significantly affected and volatility in its own market in the previous period, which is consistent with univariate GARCH models. Furthermore, the volatility in either oil or base metals is directly affected by volatility from the other market, which is somewhat strong result against the Ewing & Malik (2013). Notice that they found that both the gold and oil volatility affected across markets volatilities with consideration of incorporating structural breaks. However, this paper shows highly significant volatility transmission between oil and LME futures return series without any artificial allowing structural break. I believe these results are more robust compared to Ewing & Malik (2013). Under the finding results, the market shock transmission between oil and LME futures is found. Within the results, the hedging decisions across the oil and LME futures

are very useful to deal with market risk, because both commodity markets is affected by news and market shocks in its own market and indirectly affects across markets exist.

Table 5. Bivariate GARCH (1, 1) Estimation

	cu	al	pb	sn	ni
C(1,1)	7.96×10^{-7}	1.16×10^{-6}	1.37×10^{-6}	1.08×10^{-6}	1.23×10^{-6}
C(1,2)	-9.25×10^{-9}	1.11×10^{-7}	4.53×10^{-8}	3.44×10^{-8}	2.94×10^{-7}
C(2,2)	6.14×10^{-7}*	6.89×10^{-7}**	1.49×10^{-9}	2.05×10^{-8}	4.21×10^{-6}***
B(1,1)	0.9470***	0.9429***	0.9417***	0.9403***	0.9387***
B(1,2)	0.9689***	0.9714***	0.9758***	0.9749***	0.9681***
B(2,2)	0.9485***	0.9558***	0.9605***	0.9503***	0.9457***
A(1,1)	0.0514***	0.0544***	0.0555***	0.0576***	0.0592***
A(1,2)	0.0279***	0.0244***	0.0208***	0.0214***	0.0261***
A(2,2)	0.0486***	0.0400***	0.0393***	0.0521***	0.0461***
log-likelihood	21,820.85	22,443.42	21,049.52	21,543.27	20,098.22

Note: a. ***, ** and * represent statistical significance levels at 1%, 5% and 10%, respectively.

b. The model: $H_t = C'C + B'H_{t-1}B + A'\varepsilon_{t-1}\varepsilon'_{t-1}A$

5. Summary and Implication

This study exhibits the volatility transmission from oil futures prices to base metals futures prices to explain the role of uncertainty in commodity futures market. It is found that volatility transmissions between oil and base metals are significant and have similar impacts, which are strong evidence of shock transmission between the oil and base metals. The finding in this study implies that base metal futures market investors may indirectly rely on oil futures market volatility. Under this result, the behavior of volatility in oil and LME futures prices applies to hedging decisions across the commodity markets is useful.

The modeling of volatility prediction to calculate the appropriate valuations of commodity derivatives is important because conditional volatility is highly persistent across the commodity based on the results in this paper. The analysis provides valuable information on risk management in both oil and base metal market to illustrate the importance of time variation model.

Further studies regarding this issue should focus on the checking of possibility of hedge strategy across metal futures markets between base metals and precious metals such as gold, silver, platinum and palladium.

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The Importance of Customer Relationship Management in the Local Government Authorities in Zimbabwe

Douglas Chiguvi1, Elvis Madondo, & Zenzo Dube3
1Senior Lecturer, Marketing Programmes, Entrepreneurship Department, BA ISAGO University P. Bag 149, Gaborone, Botswana
2Faculty of Management Sciences, Durban University of Technology, P O. Box 1334, Durban 4000, South Africa
3 Head of Entrepreneurship Department: BA ISAGO University, P. Bag 149, Gaborone,

A B S T R A C T

The aim of the study was to to ascertain the respondent's familiarity with the knowledge and importance of customer relationship management in the local government authorities, as well as to ascertain the extent of the relationship they have with citizens from acquisition, development, retention and termination of the relationship. Explanatory research approach and judgemental sampling were employed. Questionnaire was used to collect data from twenty one local government authorities in Zimbabwe. The findings of the study revealed that customer relationship management forms a powerful strategy that local government authorities should apply to manage long-term relationships with their key stakeholders. The researchers concluded that the local government authorities should establish and maintain long lasting relationships with their stakeholders, in order to be competitive and attract investment.

Keywords: customer relationship management, local government authorities

1. Foreword

Customer Relationship Management (CRM) is now a necessity not an option in many organizations. AI-Khouri (2012: 34) states that CRM is an important concept in all businesses because it helps entities to be customer centric and responsive, citizen-centric and efficient. Christopher and Payne (2013) assert that today's markets are highly contested and they are competitive. Therefore, organizations must spend significantly in customer relationship management. This assertation was also echoed by Bohling, Bowman, LaValle, Mittal, Narayandas, Ramani and Varadarajan (2006) who avowed that management should build and develop strong relationships with their clients. Mohammadkazem, Shirazi and Aarabi (2016) and Hussain (2016) also corroborate that CRM is today's engine of improving the business performance. Creating good relationships clients is important because it increases good quality of information as well as, helping organizations to understand their clients much better, thus helping local government authorities to deliver customized products and services to the clients. This sentiment was also expressed by Chamelta, (2006) who mentions that good CRM ensures that companies drastically change towards a reliable CRM Strategy.

Local government authorities should deliver excellent service in order to increase customer satisfaction. Kamalian, Ya'ghoubi and Baharvand (2013) echoed that CRM helps to reinforce relationships between organizations and their clients and as a result it emboldens innovation within the organization. Nicoletti (2016) posits that for CRM Strategy to be successful, it must be citizen oriented and should be developed from that perspective. It must be customer centric rather than focusing on the requirements of the business. The current snags with local government authorities in Zimbabwe are many. The researcher has observed that employee culture towards CRM is poor. The workers' attitude and mentality towards client is negative. This means that for CRM Strategy to be efficacious there is need of change in public organizations' inner culture and also there is great need of reorientation of the vision by their state bodies. The approach and character of staff must change, allow a citizen-directed service, and eliminate bureaucratic procedures and focus more on the actual needs of the citizens.

Local government authorities must put the people at the epi-centre of all their operations (Larsen, and Milakovich, 2005). Rababah, Mohd, and Ibrahim (2011: 22) purport that in order to serve and retain

loyal customers; organizations need to understand their customers. Historically, the local authorities used to focus on production and selling and did not focus on market needs and wants. Pollard, Young and Gregg (2006 cited in Dhman, 2011: 35) indicate that CRM is now highly considered in the public sector because the citizens want excellent services. This is not an exception for local government authorities in Zimbabwe, hence the need for this study to pinpoint the factors needed for the victory of CRM Strategy.

Municipalities should prioritize a consistent improvement of the life and well-being of society, through innovation, active participation as well as dynamic and a supportive economic agency (Keramati, Saremi, and Afshari-Mofrad,2011). Duque, Varajao, and Dominguez, (2013) explain that public organizations need to be citizen centric and adopt responsive leadership. They should also eliminate procedures which do not add value. With this view in mind, the implementation of the CRM Strategy in public organizations and municipalities in Zimbabwe need to be customer oriented. Information needs to be customized and there is need for effective communication. Through interaction with clients the municipality can learn more about the habits of its citizens and thus enable strategic decision-making. Duque et al., (2013) affirmed that local authorities must meet customers' expectations at the right time and latest technologies must be adopted in order to allow citizens to communicate at any time and place.

2. Literature Review

The local government authorities in Zimbabwe are in a transition of moving away from mass marketing to customized marketing. The winners will claim market dominance if they can fully satisfy their customers. This competition will enable businesses to increase their purchase volumes and revenue, and attract new investment. It will also generate for new business references and prospects for identification. The local government authorities, who understand their clients, are prosperous and the citizens are more willing to do business with the authorities.

Customer relationship management is fundamental for municipalities as much as it is for private companies. It would ensure and optimize the relationships between companies and their clients. Xavier, Gouveia and Gouveia (2004 cited in Duque et al., 2013) indicate that organizations which are not able to interact with their clients are finding it difficult to establish effective long lasting relationships with them. This infers that effective communication is needed to establish rapport with clients in the local government authorities in Zimbabwe. Duque et al., (2013) mentioned that many CRM Strategy failures are due to poor interactions between organization and stakeholders.

Customer Relationship Management Definitions

Although the literature is full of CRM definitions, it is relatively novel to the arena of marketing in the local government authorities in Zimbabwe. Buttle (2009) believes that the CRM can be viewed differently by different people and it can be used in different situations. However, some people refer to the CRM as customer relationship marketing. The available literature on the CRM defines CRM differently thereby leading Winer (2001: 91) commenting that it means diverse things to different people. Peppard, (2000) defines CRM as a tactic to the field of marketing which incessantly use refined information concerning the existing clients to predict the future requirements of the market. In this system, current information is constantly and continuously gathered and refined. The information relates to both current and future customers. Swift (2001: 12) defines the CRM is about influencing client behavior through well-expressed communications in order to increase retention, profitability, acquisition and loyalty with clients. This definition is client centric but excludes other communication tools to establish relationships. Buttle (2004:34) defines CRM as a principal organization plan that incorporates both internal and external networks with clients. CRM is a product deriving from relationship marketing and improving customer retention through relationship management (Zineldin 2006: 431). Gummesson (2008) sum it up by positing that CRM is about understanding the customers.

The Emergence of Customer Relationship Management

According to Ahmad, Hussain, Shafique and Abbas (2015: 95) CRM was popularized in the 1980s. This concept forced organizations to start to foster relationships with customers with the assumption that businesses that understand and place their client‘s needs at their heart are likely to be prosperous and successful. Hussain (2016) states that the business might lose customers it has today if they fail to lock them in. This means that CRM essential in today‘s business. It helps organization to lure, understand and to offer clients better services (Goodhue, Wixom and Waston, 2002). A corporation can achieve higher profitability by augmenting customer loyalty rather than spending more time on recruiting new customers (Hussain and Hussain, 2015). The CRM has long been known by earliest merchants to be ideal for building and retaining relationships with customers (Foss, Stone and Ekinci, 2008). CRM can be used by the local authorities as a tool to acquire, nurture and retain clients. Bull (2003) argued that CRM is extremely required among businesses today due to increased global competition. Dhman (2011) explains that the emphasis of CRM is to establish long lasting collaborations and partnerships with customers. Even though CRM is not easy to apply, it has grown to play a major role in the business as it helps corporations to gain competitive advantage, and in so doing increase profitability (Hussain et al., 2015). CRM enables organizations to understand their customers and this knowledge help the management to develop the CRM Strategy.

Evolution of CRM of the Local Government Authorities

Traditionally local government authorities were production oriented. However, there is a paradigm shift to customized marketing. Traditionally, most local government authorities were considering themselves as monopolist who can do whatever they want without clients‘ consideration. They were production oriented and less focus was directed towards customer requirements. However, today the playing field has changed as more affluent clients are demanding better products and services from their local government authorities. There is increased competition for the "Supremely elite". Also in recent years from 2000, citizens across all cities and municipalities, especially from high and medium density locations, are more demanding and want best services from the local government authorities. They want better tarred roads, good sewage drainage systems, consistent garbage collection and clean running water, street lights and efficient services. In order to meet these Critical Success Factors must be considered to warrant effective execution of the CRM Strategy from local government authorities. The CRM has the power to help the local government authorities to rapidly and acquiescently promote growth. The drive to putting into practice CRM initiatives is becoming crucial as a result of public demand for government to offer improved services delivery (Schellong, 2005).

Elements of CRM

There are four key generic elements of CRM are:

Long lasting relationships

The aim of CRM is to form long lasting profitable relationships with clients (Grönroos, 1989). To achieve this goal two

way communication is required with clients. Effective communication with clients promotes long lasting associations with customers (Baran, Galka and Strunk, 2008). CRM escalates customer service expectations and enables organizations to exhibit greater customer recognition and treatment. Long lasting relations only exist when clients trust the organization. This assertation was also echoed by Egan (2008) who stated that when client‘s requirements and expectations are met, clients may have a sense of allegiance to the organization. This infers that local government authorities in Zimbabwe should start to build long lasting relationships with the citizens to ensure the victory of CRM Strategy.

Decoying gainful clients

The goal of CRM is to find and lure the most profitable clients. The ultimate aim is to maintain and grow the relationship, through cross-selling and up-selling. CRM seeks to increase the customer lifetime value with trustworthy clients. Satisfied and faithful clients are easy to convince to buy more and to bring new clients to the organization (Baran et al., 2008; Buttle, 2004). Trust is essential for customer relationship management. This entails that the local government authority‘s resources should be used in

such a manner that will fortify and keep gainful clients and simultaneously grow less profitable clients to gainful customers.

Customer management

CRM is not only about acquiring clients but the focus must be directed to the good management of clients. Good management of clients enables organization to maximize the lucrative lifetime value of the relationship. If clients are managed effectively, they grow and stay longer in the organization. Loria and Obeng (2005) advised that good management of customers facilitates CRM Strategy. Customer relationship management escalates customer service expectations and enables organizations to exhibit greater customer recognition and treatment. This means that CRM give organizations a competitive advantage (Baran et al., 2008). Customers feel secured if the organizations show affection to them. This infers that local government authorities in Zimbabwe should show love to their clients if they are to achieve CRM strategy.

CRM as a system

Customer relationship management should be viewed as a system. This means that effective CRM should involve all the components of the organization including inputs, processes and output. All the elements of the organization must work together in order to build total customer value and satisfaction. Disunity among the facets of the enterprise will destroy long lasting relationships with clients. This means that local government authorities in Zimbabwe should view the CRM Strategy as a system. Due diligence and strategic alignment and focus is required to ensure the victory of CRM Strategy.

Customers of the Local Government Authorities

The core idea of marketing is to satisfy the customer requirements and always to plan within ambit of the customers.

According to William and Aakers (2002) it is disastrous to define organizations by their products but must be defined according to clients‘ requirements. This implies that prospective and existing clients should be prioritized by the organizations. Clients include all people and organizations that are doing business with the local authority. The most common clients of local authorities are citizens, businesses and visitors among others (Kavaratzis and Ashworth, 1990). Table 2.0 shows different types of clients for the local government authorities.

Table 2. Types of Clients for the Local Government Authorities

Source	1	2	3	4
Types of Clients according to (Van den Berg *et al.,* (1999), Ashworth and Voogd 1990, Braun 2008)	Citizens	Businesses	Visitors	Residents
Types of Clients according to (Kotler, *et al.,* 1993, 2004, Braun 2008)	Residents and workers	companies and industry	Visitors	Export markets
Types of Clients according to (Kotler *et al.,* 2002, Rainisto 2003, Braun 2012)	New residents	investors	Tourism and Hospitality	Foreign investors
Types of Clients according to (Braun *et al.,* 2013, 2008)	Prospective residents	Prospective companies	Potential visitors	Potential investors

In summary, there are four core customer groups of the local government authorities which include existing and potential residents, visitors, companies and investors (Braun, 2008). For some cities the customer groups are shown in figure 2.0.

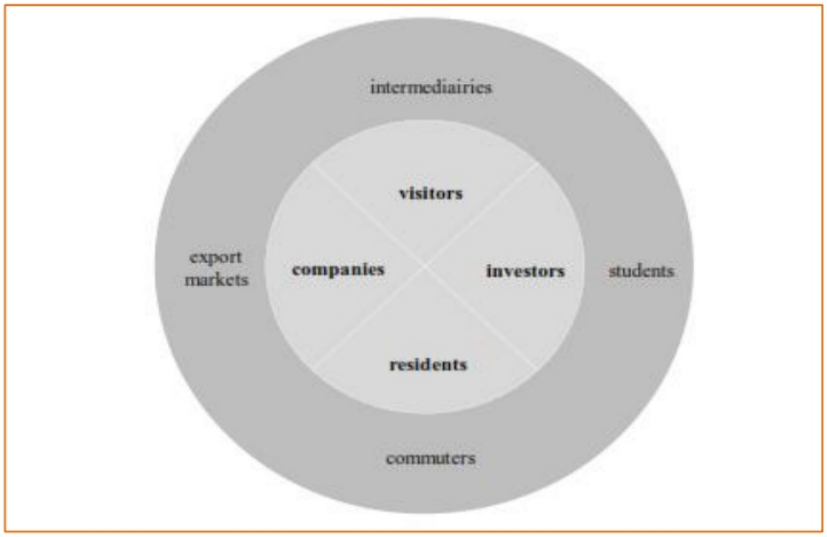

Figure 2. The customers of the local government authorities

Source: (Braun, 2008)

Residents

The initial set of customers‘ covers residents and potential residents and outline what those residents will be looking from the local government authority. The most obvious response will be a _place to live‘. This _place‘ is where their homes and jobs are, that is the area from where they commute to their workplace. It is also a place where they raise children, shop, and exercise, participate in sport, study and so on (Van Den Berg and Braun, 1999). From a client-based point of view, citizens desire and appreciate the surroundings with access to amenities in order to live comfortably and satisfactorily.

Companies

A second set of customers are companies. Van Den Berg et al., (1999) explain that companies need a place where they can conveniently do business and easily pursue their objectives. From company-based point of view, companies aspire to do business in an affordable and smart environment with low charges

for services such as taxes, rates and so on. They also expect favorable by-laws and efficient services.

Visitors

A third set of customers are visitors. Braun (2008) points out that, unlike the residents and companies, visitors have no intention of settling in the city but just to visit. Therefore, the city becomes the visitor's temporary terminus. The visitors only go there to search for an attractive environment, safe accommodation (hotel, apartment, camping, family's house et cetera), and accessible facilities or locations. The local government authorities should be able to provide such facilities in order to increase council revenue and customer satisfaction. Visitors may also be attracted by buildings and public amenities such as cafeterias, parking services, rest-rooms, and transport stopovers and other. They might as well prefer a central or a peripheral accommodation. Business visitors give priority to the accessibility to their business appointment while leisure visitors might prefer conveniences to services. Some visitors to some extent value potential business opportunities or places where they can do business. The local authorities should put in place those expectations when planning their CRM Strategy.

Investors

A fourth set of customers are slightly different from the other three aforementioned. Braun (2008: 58) argues that investors should be regarded as the fourth general category of urban customers. He argues that indeed companies and their owners' households are investors. These financiers usually prefer to settle in a city or attractive business environment. Some investors may not necessarily settle in a place where they invest. These include financial establishments like banks, insurance companies, pension funds etc. It is vital for the local government authorities to provide attractive investment opportunities in order to attract investors.

Factors Which Have Led to CRM of the Local Government Authorities

Intense Competition

The private sector and the local government authorities (LGAs) are all taking efforts to appeal to and preserve the customers. They now consolidate in one place all efforts to provide better customer service leading to delighted customers. These include new technologies, research facilities, globalized services, and new products.

Well Informed Citizens

Nowadays citizens residing in places administered by the local government authorities are

knowledgeable and cognizant of their rights and what they should get from the service providers. This was necessitated by the advent of new technology, as today‘s citizens are well informed. This suggests that local government authorities must listen and provide what is needed to warrant victory of CRM Strategy.

Decline in Brand Loyalty

There is a degeneration brand loyalty lately with customers frequently switching over to better and new introduced available competitive products and services. As a result, the local government authorities have to upscale their operations and procedures in order to guarantee victory of CRM Strategy.

Barriers to Effective CRM in the Local Government Authorities

They are numerous factors that inhibit effective CRM in the local government authorities and chief among them include:

Audience selection: In contrast to the private sector organizations, most local government authorities do not choose their customers. Quite often they are forced to deal with citizens who do not qualify for the service or benefit they provide, and as a result those citizens resist local authorities‘ reforms. This significantly increases the cost of acquisition and of continuation of services. This is the reason why most local government authorities incur huge costs and expenditure at the expense of the revenue targets.

Poor coordination: local government authorities often experience the interagency problem of being poorly coordinated internally and across departments and geographies. Lack of standardization of policies and procedures across local authorities‘ divisions is an obstacle towards effective CRM. There is need for harmonization of policies to ensure consistency and team work spirit among different facets of the local authority.

Lack of resources: Local government authorities are also affected by lack of resources for designing, building and optimizing the CRM. It also faces the problem of losing employees to the private sector who are attracted by higher salaries paid by the private sector. This problem widens the skills gap in the local government authorities.

Long time make decisions: Local government authorities are beginning to understand that customer relationships management does not only involve technological development. It also involves better service delivery. The slow recognition CRM programmes in the local government authorities is caused by the fact that only very senior managers are qualified to make change. This is because the senior managers in local government authorities tend to take longer time to make decisions and to act on these decisions. This challenge is a barrier towards effective CRM Strategy.

Lack of performance measures: The measurement culture tends to be activity and content based

because of lack of knowledge of the process, service and value measures. Customer perceptions on the quality of service delivery are often not taken into consideration. Instead, the public service tends to penalize ―bad news‖, measures or to avoid or disregard negative customer perceptions. An effective customer relationships management programme quires strong ―honesty‖measures and improved implementation and performance measures. The organization should be able to measure its improvement and to tell whether these improvements are recognized by the customers. Poor performance measures are an obstacle towards effective CRM Strategy.

Outsourcing challenges: National and the local government departments usually outsource functions and processes in order to reduce costs or to finance replacements of large IT systems. The agreements signed for outsourcing the functions or processes tend to focus more on the performance criteria than on the customer. As a result, there is slow improvement in the customer service and in the re-engineering of processes that interface the company and the client (Hewson, 2003). Local government authorities do not have their own CRM department which is a barrier towards effective CRM Strategy.

Advantages of CRM for the Customers of the Local Government Authorities

Customers could remain loyal to urban councils if they received greater value for their money. They could also receive the following benefits, among others:

Enjoy confidence Benefits

Customers prefer to keep service providers they have considerably invested. The local government authorities make the high service provider switching cost by penalizing customers for cancelled agreements. The customers also pay for time and psychological costs when they switch service providers. Customers can therefore get more time for other priorities by preserving a good relationship with a service provider (Rootman, Tait, and Bosch, 2008; Zeithaml et al., 2006). This benefit is vital for both new the local and foreign investors because they need trust the local authorities before they can invest their money

Social benefits

Clients need a sense of belongingness. Local government authorities should promote team building programmes to unite citizens. The aim of CRM is to build networks and collaborations which eventually promote unity and increase social benefits to the community. The local authorities need to cement their relationships with customers through dialogue and instant feedback.

Special treatment benefits

Good CRM enables clients to get the services at reduced costs and other incentives like free serviced

land, low tariffs, free street lights and other amenities at low cost. Good CRM strengthen long lasting relationships with clients and consequently it attracts clients to pay for services they get form local authorities promptly and without delay and less resistance.

3. Research Methodology

This study followed a realism research paradigm. This is because realists believe that reality is real and assume that a real world can exist outside the human mind (Guba and Lincoln, 1994). Descriptive research design and Judgmental sampling was employed. The researchers used judgmental sampling to select respondents who have knowledge and expertise in line to study area of the research. The study used respondents from 21 local government authorities in Zimbabwe who are working in Marketing and PR departments together with the heads of council departments. From each the local government authority the management members; Town Clerk, Marketing and PR officers and heads of department managers were used in the study. Raosoft software sample size calculator was used to determine the sample size at 95% confidence level with 0.05. Questionnaire was employed to collect the data form 197 respondents and the questionnaire was administered and conducted in a way that respondent‘s privacy was respected. Since the research data was random, raw, mutually exclusive, and drawn from a large enough sample, chi square test was employed to determine whether the sample data was consistent in the study. SPSS was employed to process quantitative data and the analyzed data was presented in form of tables and charts for easy readability and understanding of the research findings.

4. Data Findings

Importance of Customer Relationship Management

This section aims to ascertain the respondent‘s familiarity with the importance and knowledge of customer relationship management in the local government authorities in Zimbabwe.

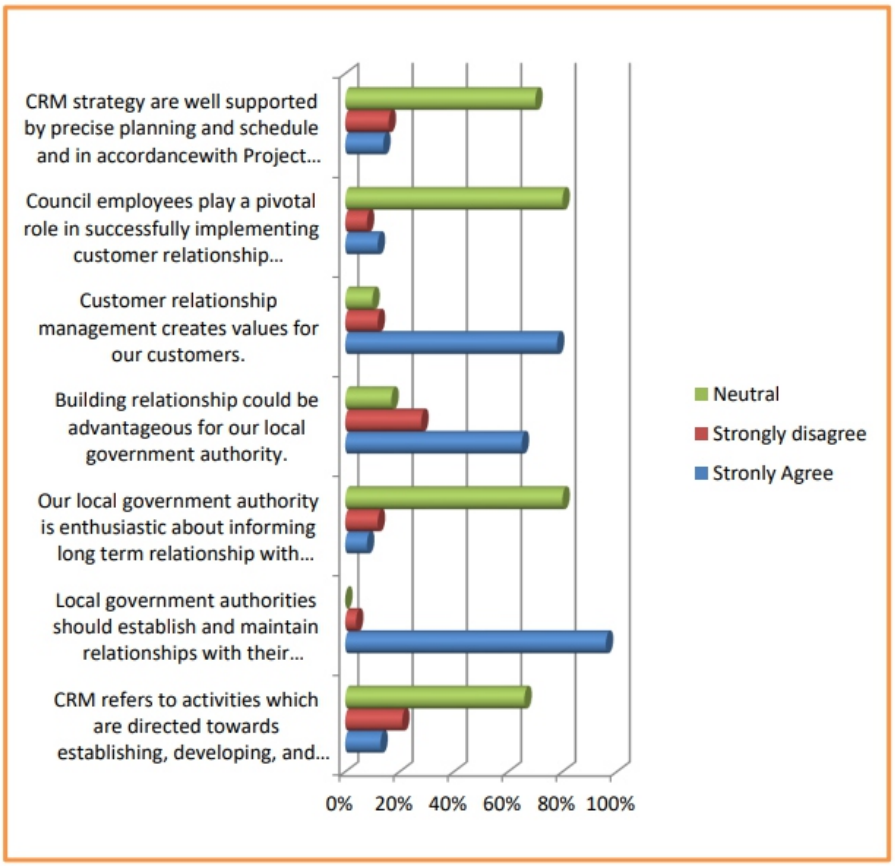

Figure 4. Respondent‘s level of understanding on customer relationship management

The researchers have found out that many council employees do not know the meaning of customer relationship management. The results Figure 4.0 depict that only 13% of the respondents were familiar with the definition of CRM and about 66% of respondents were neutral and 21% totally were clueless on the meaning of CRM. This result demonstrates that CRM is relatively new in the local government authorities in Zimbabwe and majority are not sure of what exactly it is. However, majority of the respondents (96%) strongly agreed that the local government authorities should establish and maintain relationships with their stakeholders. The result demonstrates that the CRM is vital for the success of the local government authorities in Zimbabwe.

Many of the respondents acknowledged that establishing and maintaining relationships is important. However, a large number of respondents (80%) were neutral on the statement that the local government authorities are enthusiastic about forming long term relationship with stakeholders. This is an indication that the respondents were not yet sure on the preparedness of councils to implement CRM. Furthermore, many respondents (65%) inferred that relationship building could be advantageous for the local government authorities; and (78%) of the respondents strongly agreed that the CRM creates value for customers. 80% of the respondents were neutral with the assertion that council employees

are showing to their customers. The respondents felt that council employees were not ready to fully implement the CRM Strategy. Finally, 70% of the respondents were also uncertain on the assertion that CRM strategies are well buoyed by accurate planning schedule. In conclusion, the results show that the level of respondent's familiarity with the understanding and importance of the CRM is below par but all the respondents strongly agree that the local government authorities should create and retain relationships with their clients.

The chi-square p-values are shown below:

Table 4. Chi-Square Test Statistics

	Chi-square	df	Asymp.Sig
Customer relationship management discusses the activities which are focused towards creating, nurturing and retaining successful interactive relations.	169.701[a]	2	.000
The local government authorities should create and sustain associations with their clients.	160.968[b]	2	.000
The local government authority is enthusiastic about forming long term relationship with stakeholders.	181.537[b]	2	.000
Building relationship could be advantageous for the local government authority.	179.603[c]	2	.000
Customer relationship management creates values for our customers.	159.327[b]	2	.000
Council employees play a pivotal role in successfully implementing customer relationship management strategies.	157.139[a]	2	.000
CRM strategies are well buttressed by exact planning and schedule and in accordance with CRM Strategy techniques.	112.394[a]	2	.000

Chi-square tests were employed to decide whether the variances in the counting configurations per proclamation were momentous. The P Value of 0.000 signifies that the sampled data was consistent.

The relationships between the Council and Clients

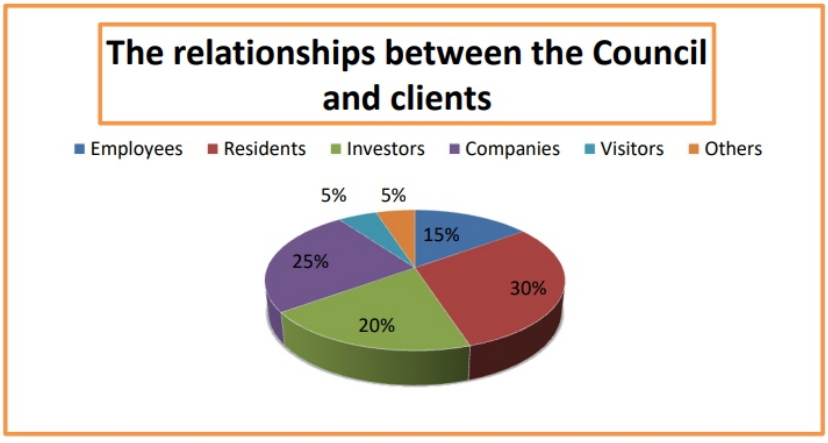

Figure 4.1. The relationships between the Council and Clients

Figure 4.1 revealed that (30%) of the councils have formed relationships with their residents, whilst

(25%) of the councils cited that they have made relationships with companies and (20%) of the councils have made relationships with the investors. Finally (15%) of the councils revealed having formed relationships with employees. (5%) of the respondents cited visitors and others respectively. The findings suggest that the local government authorities are not customer centric. This is evidence that CRM is nonexistent in the local government authorities in Zimbabwe. The findings are consistent with Moyo (2016) and Amiri et al., (2010) who contends that the CRM is much talked about, but it is invisible in action. Makumbe, (1998) further argues that the relationship between the local government authorities and stakeholders in Zimbabwe is low and in most cases non-existent. Kabangure (2016) argues that the relationship is pitiable due to lack of trust and poor service delivery by the local government authorities. This clearly demonstrates that the local government authorities in Zimbabwe have derisory relationship with stakeholders. It is vital that strong relationships are formed with all the stakeholders. The stakeholders are key customers of the local government authorities and as such they should be considered as valuable assets for the success and growth of the local government authorities in Zimbabwe.

Significance of the Customer Relationship Management

Table 4. Significance of CRM

	Not significant		Slightly significant		Significant	
	Count	Row N %	Count	Row N %	Count	Row N %
Starting relationships	0	0.0%	27	13.7%	170	86.3%
Developing relationships	0	0.0%	1	0.5%	196	99.5%
Maintaining relationships	0	0.0%	2	1%	195	99%
Ending relationships	113	57.3%	77	39.1%	7	3.6%

Importance of Starting Relationships in the Local Government Authorities

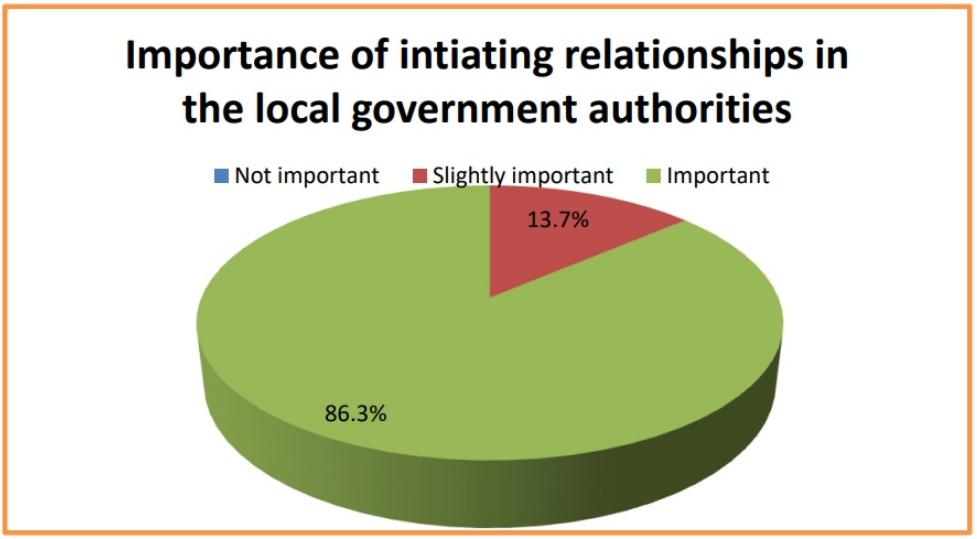

Figure 4.2. Importance of initiating relationships in the local government authorities

The result in Figure 4.2 shows that a number of the respondents (86.3%) have powerfully settled that initiation of relationships with the stakeholders in the local government authorities in Zimbabwe is important. This implies that local government authorities need to establish and develop relationships in order to achieve CRM Strategy success. This can be achieved by taking into consideration the ten identified critical success factors seriously. This means that without establishing relationships it will be difficult to achieve CRM Strategy success in the local government authorities in Zimbabwe. This result resonates with the findings by Mishra (2009) and Lambert (2010) who mentioned that customer acquisition is impossible without a strong establishment of relationships between the organization and its clients. Almotairi (2009) also echoed that without establishing a strong relationship with stakeholders CRM Strategy success is impossible. This means local government authorities in Zimbabwe must establish good rapport with their clients in order to CRM Strategy success. They need to understand customer requirements and deliver value and best services to the stakeholders in order to establish strong relationships with the customers and other publics. Abu Bakar, Saleh, and Mohamad (2011) and Taghipoor (2013) also cited that establishing relationships will also improve transparency and accountability in the business.

Significance of Nurturing Relationships in the Local Government Authorities

Figure 4.3. Significance of nurturing relationships in the local government authorities

Figure 4.3 revealed that all the respondents‘ strongly agreed that developing relationships is important in the local government authorities in Zimbabwe. This implies that local government authorities in Zimbabwe should not just focus on initiating relationships but should invest more resources in nurturing relationships with the customers. This finding correlates with Kotler (2002) and Wong and Sohal (2002) who confirms that one of the key pillars of CRM is about developing relationships with stakeholders. Al-Khouri (2012) and Tolmay and Morna (2010) also alluded that many players in the

government sector perish because management forget to develop and nurture relationships with stakeholders. This was also supported by Amiri et al., (2010) and Moreno and Melendez (2011) who postulated that many local authorities are good at establishing relationships but they forget to develop the relationship resulting to short term relationship with clients.

Importance of Maintaining Relationships in the Local Government Authorities

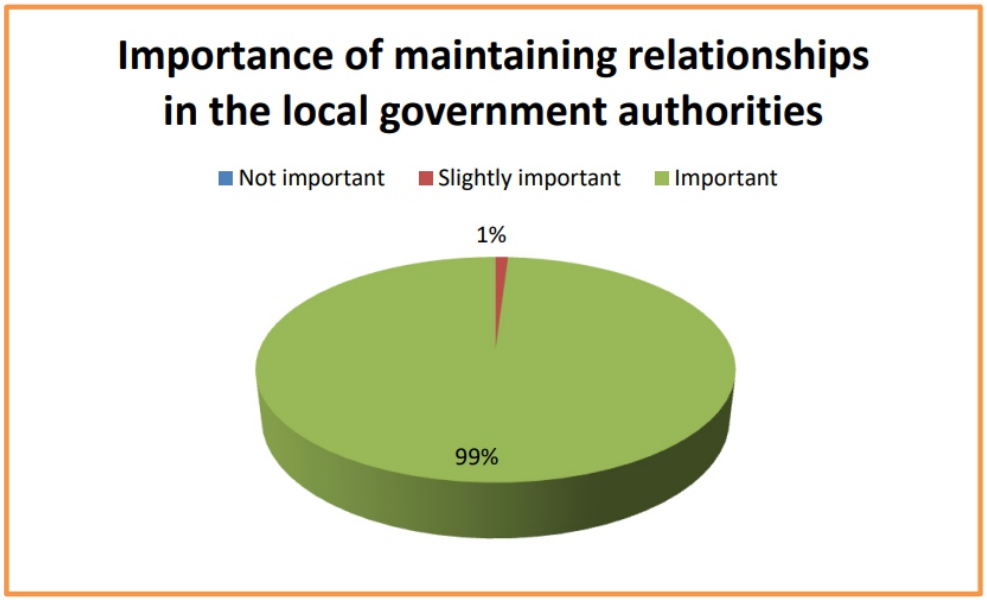

Figure 4.4. Importance of maintaining relationships in the local government authorities

Figure 4.4 revealed that 99% of the respondents agreed that it is important for the local government authorities in Zimbabwe to maintain relationships. This finding resonates with the findings by Lee (2008) who mentions that the ultimate goal of CRM is to upsurge client retention and client loyalty. This means that local government authorities must pay attention to the client and meet customer expectations, if they are to ensure and achieve CRM Strategy success (Ash worth and Voogd 1990). A study by Lee (2008) concluded that CRM retention is vital because it is expensive to acquire new customers.

In this world of competition, it is therefore vital for local government authorities to retain their profitable customers, in order to guarantee stable revenue for growth. Azari (2008), Baran et al., 2008), Bordoloi, (2000), Boulding et al.,(2005), Bull (2003), Camarero et al., (2005) and Da Silva et al., (2007) all concurred that CRM retention is important that CRM acquisition. They argued that it is cheaper to retain a loyal customer than to acquire a new customer. This means local government authorities in Zimbabwe must invest a lot in clients‘ retention. Dhman (2011) also confirmed that satisfied customers (citizens) are easy to manage and motivate compared to strangers. Local authorities must design CRM strategies to retain customers. This reduces default of payments for the services, hence increasing

revenue to the councils. The authorities must always listen to customers and put in place quick response strategies to satisfy the customers. The councils must also be innovative and improve on service delivery to enhance service quality.

Need of Ending Relationships in the Local Government Authorities

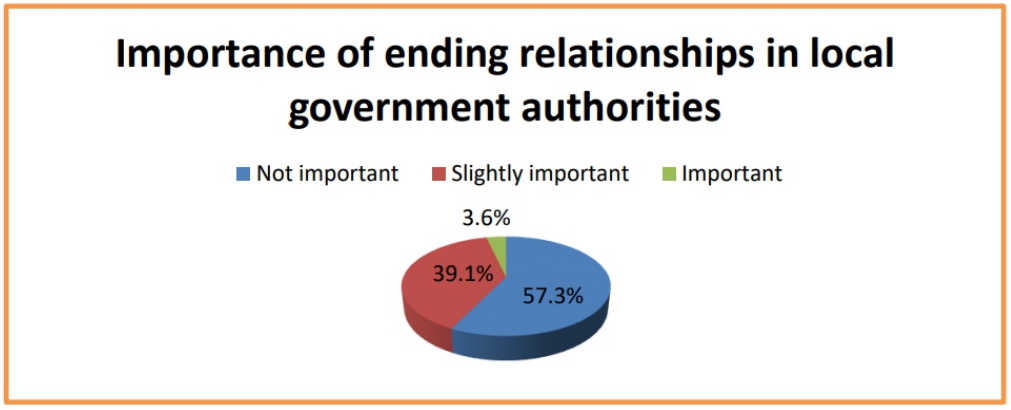

Figure 4.5. Need of ending relationships in the local government authorities

The respondents have mixed feelings as to the importance of ending relationships in local government authorities as indicated in Figure 4.5. The findings show that 57.3% of the respondents agreed that it is important to end relationships, while 39.1% confirmed that it is not important to end relationships. This means employees in local government authorities in Zimbabwe are not fully aware of the importance of CRM, since majority of the respondents agreed that it is important to end relationships. Ernst et al., (2011), Hong et al., (2002); Eid (2007) and Gronroos (1989) all cited that organizations should avoid the mistake of ending the relationships with the clients.

Hussain (2016) and Lindgreen et al., (2006) also supported the same sentiment that ending relationships with customers is dangerous as it tarnishes the image of the business. This means that local government authorities must have services recovery strategies in place in order to maintain long term relationships with customers .This implies that local government authorities need to educate all the stakeholders the benefits of CRM in order to ensure success of the CRM Strategy. The above findings are also proven by chi-square p-values calculated in Table 4.1, as depicted below on the need of initiating, developing, maintaining and ending relationships in local government authorities in Zimbabwe.

The chi-squares p-values are illustrated in Table 4.1 below:

Table 4.1. Chi-Square Test Statistics

	Starting relationships	Nurturing relationships	Retaining relationships	Terminating relationships
Chi-square	325.030[a]	315.042[b]	279.698[b]	9.642[c]
df	1	1	1	1
Asymp.Sig.	.000	.000	.000	.009

Deducing from the results in Tables 4.0 and 4.1, very little importance is given to termination relationships. These findings affirm Miranda et al., (2005)'s affirmation that more care is directed to the creation and development of relationships compared to maintaining and terminating relationships. It is fair to ensure that equal importance is given to all the forms CRM (Little and Marandi, 2003). The local government authorities should pay attention to clients who are terminating relationships and arrange exit interviews in order to find the reasons of leaving. Hung et al., (2010) and Morrel et al., (2001) posited that feedback helps to improve and cement relationships as well as improving excellent service delivery in the local government authorities.

5. Contribution of the Study to New Knowledge

Government support in the form of grants to the local government authorities is diminishing despite the allocations of resources to the local councils in Zimbabwe. Competition in terms of provision of services and service delivery is also getting tougher between the local councils and the private sector in the areas of waste collection and provision of ancillary services. This growing evidence is a sign that the playing field and ways of doing business in the local government authorities in Zimbabwe has changed and as such connections need to be put together with stakeholders to confirm that the stakeholders are embraced in the value chain delivery system.

6. Conclusion and Recommendation

This study found that good mutual relationship enables the stakeholders to view the local government authorities as customer centric institutions. The research study also found that the local government authorities in Zimbabwe are operating with limited resources and consequently they are often under great pressures that sometimes befuddle them from giving care to their relationships with strategic stakeholders. Council employees need to be involved and enthused to support the CRM Strategy. All the stakeholders need to understand how the CRM system operates so that they will be eager to become accustomed it. It is therefore, recommended that local authorities need to train and develop their staff in order to garner their support. This will help to guarantee victory of CRM Strategy. The local government authorities in Zimbabwe must mobilize all stakeholders to rally behind CRM Strategy initiatives and projects. Also in order to survive and gain competitive advantage the local government authorities need to develop right strategies and maintain long lasting relationships with stakeholders. Resident partaking in the undertakings of the local authority is now a necessity in the local government authorities. Citizens opinions are to be treasured if excellent service quality is to be accomplished. It is therefore, recommended that the local government authorities must form partnerships with the residents and other stakeholders in order to promote mutual understanding and positive collaborations in service delivery. Currently the study result shows that there is a gap in terms of communication

between councils and their stakeholders. This infers that the local government authorities need to promote effective communication with the stakeholders and must also pay attention to clients' grievances on time. This recommendation must be taken seriously by the local government authorities because it promotes customer satisfaction and delight hence ensuring victory of CRM Strategy.

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Examining Demand Elasticities in the U.S. Differentiated Yogurt Market

Rezgar Mohammed1, Olga Murova2
1 Lecturer, Department of Animal Production, University of Duhok, Chanden Street 1, Sumail-Duhok 1063BD, Kurdistan Region, Iraq
2 Associate Professor, Department of Agricultural and Applied Economics, Texas Tech University, 301D Agricultural Sciences Building, Lubbock, TX, USA

ABSTRACT

This article applies the Quadratic Almost Ideal Demand system (QUAIDS) model to households' weekly purchases of yogurt augmented with household characteristics to analyze consumer choices and estimate demand elasticities in the U.S. differentiated yogurt market after the introduction of Chobani brand in 2005. Results show that households with a college degree are more likely to purchase Chobani and Dannon brands rather than Yoplait and private labels. Except for Dannon, demand is price elastic, while the new brand of Chobani has a higher elastic demand compared to the Yoplait brand. Branded yogurts are expenditure elastic with the highest magnitude for Chobani among brands.

Keywords: demand, elasticity, QUAIDS, yogurt

1. Introduction

The United States dairy industry delivers a large range of dairy products. The per capita consumption of dairy products has changed over the last four decades. While the consumption of fluid milk has decreased over time, the consumption of other manufactured dairy products such as cheese, ice cream, butter, and yogurt has increased (Blayney, 2010). Yogurt is the fourth largest dairy category at the retail level (Hovhannisyan & Bozic, 2013) where its popularity is on the rise in the United States. Yogurt per capita consumption has increased from 4.0 pounds per person in 1985 to 14.7 pounds per person in 2015 (United States Department of Agriculture, 2016). This increase in demand leads to an increase in yogurt sales which based on Nielsen-measured retail channels for refrigerated yogurt were $7.7 billion in 2015.

Market demand is one of the many factors that affect the profitability of a business. Decision-makers in the dairy sector, both public and private, require contemporaneous demand analysis (Maynard & Veeramani, 2003) especially after the change in per capita consumption of major dairy products in the last decades. The decision to alter the price of a product depends on both the own-price elasticity and the cross-price elasticity of a product (Hovhannisyan & Khachatryan, 2017). How consumers respond to price changes is an important question for retailers to manage and develop their future marketing strategies to maximize their profit.

Therefore, the main objective of this study is to calculate the demand elasticities of yogurt at the brand level. We believe that this study is an important one because, to the best of our knowledge, this is the first study that estimates the demand elasticities of main brands of yogurt after the introduction of Chobani. Own-price and expenditure elasticities can provide decision-makers with the necessary information to respond properly to the rapid changes in US economic, demographic and social structures. However, for the calculated elasticities to be useful for policymakers and the industry, they should be based on valid and reliable estimates. The findings of this paper can also help retailers to target consumers using their demographic information to increase sales as each group of individuals have different preferences for each yogurt brand.

There is a limited number of studies analyzing consumer demand at the brand level in the yogurt

main yogurt brands in the United States in 2015 where Chobani has the highest market share among brandsi

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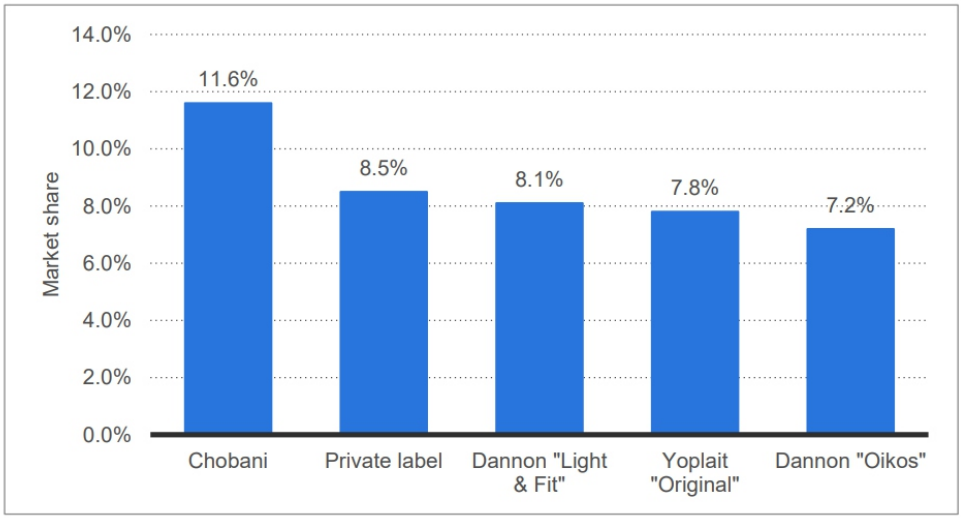

Figure 1. U.S. Yogurt Market Share for Main Brands in the United States 2015

In this study, the Quadratic Almost Ideal Demand System (QUAIDS) model is applied to 2008-2011 yogurt purchases data from 27 retailers located in Eau Claire, Wisconsin and Pittsfield, Massachusetts to estimate the demand for the main yogurt brands - Yoplait, Dannon, Chobani and the private label. Yogurt is chosen because of its fast-growing market due to greater health awareness. The availability of scanner data at the brand level and the substantial variation of yogurt and consumer characteristics, offer a good opportunity for a case study in estimating the demand elasticities. In the next section, the quadratic almost ideal demand system model is explained. Then data definitions and sources are presented following by the main findings of the study. Finally, the conclusion of this study and suggestions for future research are presented.

2. Model

The traditional approach to estimate demand systems is using the Almost Ideal Demand System (AIDS) introduced by Deaton and Muellbauer (1980). The AIDS model has budget shares that are linear functions of log total expenditure. Empirical studies on the relationships between a commodity's budget share and total expenditure which is known as the Engel curve indicate that further terms in total expenditure are required for some expenditure share equations (Lewbel, 1991; Blundell et al., 1993). Banks et al. (1997) show that a nonparametric analysis of consumer expenditure patterns suggests that Engel curves require quadratic terms in the logarithm of expenditure. They derive an extension of the AIDS model - the quadratic almost ideal demand system (QUAIDS) which also includes a higher-order total expenditure term. In this study, we estimate the demand parameters and the price and income elasticities using the QUAIDS model which has been broadly used recently by demand analysis studies

of fish and meat (Lambert et al.,2006); food (Abdulai & Aubert, 2004; Bopape, 2006; Hoang, 2018), yogurt (Davis et al., 2010), wine (Cembalo et al.,2014), and ornamental plants (Hovhannisyan & Khachatryan, 2017).

Let q_i denote the quantity of brand i consumed by a household, and define the expenditure share for brand i as $w_i = p_i q_i / m$ where p_i is the price of brand i and m is the household total expenditure, the QUAIDS model in budget shares is (Banks et al., 1997):

$$w_i = \alpha_i + \sum_{j=1}^{k} \gamma_{ij} \ln p_j + \beta_i \ln\left\{\frac{m}{a(\mathbf{p})}\right\} + \frac{\lambda_i}{b(\mathbf{p})}\left\{\ln\left[\frac{m}{a(\mathbf{p})}\right]\right\}^2 \quad (1)$$

where $\mathbf{p}$ is a vector of prices, $a(\mathbf{p})$ is a function that is homogeneous of degree one in prices, $b(\mathbf{p})$ is a function that is homogeneous of degree zero in prices, α_i, β_i, γ_{ij}, and λ_i are parameters to be estimated. Adding-up requires that $\sum_i w_i = 1$.

Notice that when $\lambda_i = 0$ for all i, the quadratic term in each expenditure share equation drops out and we are left with Deaton and Muellbauer's (1980) original AIDS model. Hence, the AIDS model is nested within QUAIDS, the AIDS specification can be tested based on the statistical significance of the λ's.

Sociodemographic variables are typically incorporated into demand system analysis through the linear demographic translation method of Pollak and Wales (1978) to control for varying preference structures and heterogeneity across households. Let $h = 1, \ldots, N$ denote households, the budget shares equations for household h can then be represented as follow[ii]:

$$w_{ih} = \alpha_i + \sum_{j=1}^{k} \gamma_{ij} \ln p_{jh} + \beta_i \ln\left\{\frac{m_h}{a(\mathbf{p}_h)}\right\} + \frac{\lambda_i}{b(\mathbf{p}_h)}\left\{\ln\left[\frac{m_h}{a(\mathbf{p}_h)}\right]\right\}^2 + \sum_{s=1}^{S} \delta_{is} z_{sh} + v_{ih} \quad (2)$$

where $z_s = (z_{1h}, \ldots, z_{sh})$ is a set of demographic variables for household h. Commodity prices are indexed with the household superscript because households in different clusters face different prices at the store level.

In most scanner-level data, prices are not observed directly and it must be calculated from the dollars paid by the household during each shopping trip where the calculated price is more likely endogenous. Since the difference between different brands of yogurt is small, we argue that the effect of price endogeneity on estimation is very small (see Chen et al.,2018 for more detail). In the same way, how much of each brand to buy and how much to spend on yogurt is another household's decision that makes the expenditure endogeneity. Expenditure endogeneity is also arising by other unobserved components in the budget share equations. Therefore, we include household income and family size as instruments in addition to the price index in the demand equation and other sociodemographic variables to augment the demand system (see Dhar, et al., 2003; Thompson, 2004; Xiong, et al., 2014). The total expenditure equation has a reduced form and is jointly estimated with the demand system:

$$\ln m_h = z'\omega_h + \vartheta \ln \mathbf{p} + k_1\, income_h + k_2\, income_h^2 + k_3\, size_h \quad (3)$$

where ω is a vector of sociodemographic variables explaining the total expenditure, and z is the corresponding conformable vector parameter vector.

Handling a large number of "zero" purchases is one of the econometric challenges in the analysis of consumer survey data (Deaton, 1997). In the differentiated yogurt market, the percentages of zero-brand consumption (censoring) are severe. Each of Chobani and private label yogurt is consumed by 32

percent of households while Dannon and Yoplait are consumed by 83 and 91 percent of households respectively. In the demand literature, several approaches are introduced to handle left-censoring after the primal approach of Kuhn-Tucker (Wales &Woodland, 1983).

Most recently, Yen et al. (2003) proposed a quasi-maximum likelihood estimator (QML) to estimate the censored demand system by dropping the n-th good equation as a residual category and estimating the resulting *n-1* equation system with the identity $\widehat{w}_{nh} = 1 - \sum_{i=1}^{n-1} \widehat{w}_{ih}$. The QML procedure had not been applied in censored demand estimation because of its computational challenge as it requires evaluating multiple probability integrals. Another disadvantage of this procedure is that the resulting estimates are not invariant to the dropped equation, and $\widehat{w}_{nh}$ could sometimes be negative (Garcia-Enriquez et al., 2016). The two-step procedure developed by Shonkwiler and Yen (1999) considers an alternative procedure that produces consistent parameter estimation. However, this procedure is less efficient than MLE (Yen and Lin, 2006). Nevertheless it remains an attractive alternative and it is still widely used in empirical literature (Sckokai & Moro, 2009; Schrock, 2012; Khaliukova, 2013; Hailu et al., 2014; Hovhannisyan &Khachatryan, 2017; Chen et al., 2018) due to its simplicity. Therefore, we apply this procedure in this paper.

Shonkwiler and Yen (1999) derive the unconditional mean of the expenditure share for yogurt brand such that:

$$E(w_{ih}) = \Phi(z'_{ih}, \tau_i) w_{ih}(\mathbf{p}_h, m_h; \psi) + \delta_i \varphi(z'_{ih}, \tau_i) \quad (4)$$

where . and . are the cumulative distribution function and standard normal probability density function, respectively, ψ is a vector containing all parameters in a particular demand equation, z_{ih} is a vector of exogenous variables governing the purchasing decision, and is a conformable vector of parameters.

with maximum likelihood estimation (MLE) or seemingly unrelated regression (SUR) where $\varepsilon_{ih} = w_{ih} - E(w_{ih} \mid \mathbf{p}_h, m_h, z_h)$. Note that the disturbance terms in equation (5) are heteroscedastic (Shonkwiler & Yen, 1999) which can be corrected for using robust standard errors (Hailu et al., 2014).

A major drawback of Shonkwiler and Yen (1999) procedure is that the adding-up property of the demand system cannot be imposed any longer (see, Drichoutis et al., 2008). The adding-up complication using this procedure is addressed using Pudney's (1989) approach by treating one brand of yogurt as a residual category and estimates its expenditure as the difference between total expenditure and expenditure on all other yogurt brands. Therefore, private label is considered as a residual category. After imposing homogeneity and symmetry restrictions, expenditure elasticities of non-residuals categories are derived by differentiating the budget share equations of (5) with respect to ln m. Expressions are simplified using the intermediate results following Banks et al. (1997):

$$\mu_i \equiv \frac{\partial E(w_i)}{\partial \ln m} = \Phi(z_i'\hat{\tau}_i)\frac{\partial w_i}{\partial \ln m} = [\Phi(z_i'\hat{\tau}_i)].\beta_i + \frac{2\lambda_i}{b(\mathbf{p})}\left\{\ln\left[\frac{m}{a(\mathbf{p})}\right]\right\} \quad (6)$$

$$e_i = 1 + \frac{\mu_i}{w_i} \quad (7)$$

In the same way, Marshallian or uncompensated price elasticities of non-residual categories are derived by differentiating the budget share equations with respect to ln p_j. Using expression μ_{ij} , the formula for the Marshallian price elasticities can be written as:

$$\mu_{ij} \equiv \frac{\partial E(w_i)}{\partial \ln p_j} = \Phi(z_i'\hat{\tau}_i)\frac{\partial w_i}{\partial \ln p_j} \quad (8)$$

$$\mu_{ij} = [\Phi(z_i'\hat{\tau}_i)].\gamma_{ij} - \mu_i\left[\alpha_j + \sum_{l=1}^{K}\gamma_{jl}\ln p_l\right] - \frac{\lambda_i\beta_j}{b(\mathbf{p})}\left\{\ln\left[\frac{m}{a(\mathbf{p})}\right]\right\}^2 \quad (9)$$

$$e_{ij}^u = \frac{\mu_{ij}}{w_i} - \delta_{ij} \quad (10)$$

where δ_{ij} is the Kronecker delta equals 1 if $i = j$ and 0 otherwise.

Using the Slutsky equation, the Hicksian or compensated price elasticities of non-residual categories are calculated:

$$e_{ij}^c = e_{ij}^u + w_j e_i \quad (11)$$

Estimated elasticities of non-residual categories can be used to calculate elasticities of the residual category. Therefore, the adding-up theoretical restrictions from the demand theory can be met (Yen et al., 2003). Note that expenditure, the Marshallian, and Hicksian elasticities for the residual category can be calculated using the budget constraint (Yen et al., 2003):

$$\sum_{i=1}^{n} w_i\, e_{ij} = -w_j, \sum_{i=1}^{n} w_i\, e_{ij}^* = 0, \sum_{i=1}^{n} w_i\, e_{im} = 1 \quad (12)$$

3. Data

Data used in this study is household weekly purchases from 27 retailers collected by Information Resource Inc. (IRI). The data is at the chain level from the city of Eau Claire in Wisconsin and the city of Pittsfield in Massachusetts for the period 2008-2011. These datarepresents the most recent years that were available to us. This database consists of a representative panel of about 4200 households who made about 520 thousand purchases during this period. The data provides information for each product at the Universal Product Code (UPC) level, dollar amount paid, volume of purchases, retailers, and weeks. Information on product characteristics are obtained from the product category dataset, which contains information on brand, volume equivalent, flavor, fat content, and organic information. Using volume equivalent information, the volume of purchases is converted to a brand quantity and then retail prices are obtained from brand quantity and dollar amount paid information.

This study focuses on brands with the highest market shares which are Yoplait, Dannon, and Chobani

respectively, in addition to the private label which comes in the fourth place. Table 1 presents the summary statistics of yogurt brands. After dropping observations with key explanatory variables missing, the sample size is 25,372. Data is complemented with a college dummy variable equals 1 if the household head has a college degree and above, in addition to a child dummy if households have children. Income of the household and the family size are also used as instrumental variables to deal with the endogeneity bias caused by the expenditure on yogurt. This information is also obtained from the panel demographics dataset provided by IRI for the actual yogurt consumers, which are 5142 households, who made purchases during the year of 2008-2011. Table 2 presents the summary statistics of household demographic variables.

Table 1. Summary Statistics of Yogurt Prices, Quantity Purchased, and Market Shares

	Chobani	Dannon	Yoplait	Private Label
Retail prices ($/6 oz)				
	1.197	0.724	0.674	0.492
	(0.171)	(0.249)	(0.215)	(0.129)
Quantity purchased by HH (oz)				
	4.310	26.4	41.047	4.174
	(18.44)	(47.32)	(64.99)	(19.24)
Customers HH (%)				
	32.65	83.06	91.17	32.54
Market share (%)				
	6.58	30.86	57.07	5.49

Note. Numbers in parentheses are standard deviations.

Table 2. Summary Statistics of Sociodemographic of the Sample Households

Variable	Mean	Std. Dev.	Min	Max
College	0.170	0.375	0	1
Children	0.204	0.403	0	1
Family size	2.388	1.243	1	8
Income*	7.201	3.253	1	12

* in (10,000)

4. Results

4.1 Demand Parameter Estimates

Table 3 reports the estimation results from the first step probit models to interpret the sociodemographic and price effects on yogurt purchases in terms of probabilities. Even though probit models are estimated to compute the probability and the cumulative density values, this step is also aimed to show that the buying decision does not occur randomly, and to determine the variables that predict it. As mentioned in the model section, the dependent variable in the probit model is a binary variable taking a value of one if positive purchase occurs by households for a specific brand and zero otherwise; while the explanatory variables are: the household income, a dummy variable for a household head with a college degree, a dummy variable for a presence of children in a household, and log of prices.

Table 3. First Stage Probit Estimation

Variables	Chobani	Dannon	Yoplait	Private
College	0.230***	0.155***	-0.060	0.057
	(0.050)	(0.058)	(0.069)	(0.049)
Child	-0.172	0.162***	0.654***	-0.020
	(0.047)	(0.055)	(0.085)	(0.046)
Income	0.043***	0.025***	0.022***	0.012**
	(0.005)	(0.006)	(0.007)	(0.005)
In P_1	-1.156***	-0.600***	0.391	-2.319***
	(0.199)	(0.244)	(0.305)	(0.214)
In P_2	0.640***	-0.272***	-0.307***	-0.395***
	(0.083)	(0.097)	(0.107)	(0.081)
In P_3	1.090***	0.397***	-0.333**	0.401***
	(0.098)	(0.099)	(0.134)	(0.093)
In P_4	0.939***	0.425***	-0.392***	0.587***
	(0.098)	(0.113)	(0.130)	(0.095)
Constant	-0.774***	1.277***	1.169***	2.029***
	(0.243)	(0.296)	(0.371)	(0.259)

Note. Numbers in parentheses are standard deviations. ***, ** and * indicate significant at 1%, 5% and 10% respectively.

Households' head with a college degree are more likely to purchase Chobani and Dannon brands rather than Yoplait and the private label. Families with children in the household tend to purchase Dannon and Yoplait which have lower prices compared to Chobani. An increase in income will increase the probability of purchasing branded yogurt which has higher prices compared to the private label. In general, the effect of an increase in the price of the brand will decrease the probability that households buy the given brand where most parameters related to own prices are negative and significant.

Table 4. Parameter Estimates from the Nonlinear AIDS Demand System

Parameters	Coefficients	Standard Errors	Parameters	Coefficients	Standard Errors
α_1	-0.035	0.053	γ_{43}	-0.076***	0.016
α_2	0.320***	0.055	γ_{44}	0.022	0.025
α_3	0.585***	0.054	δ_{11}	0.119***	0.017
α_4	0.130*	0.068	δ_{12}	0.007	0.016
β_1	-0.116***	0.042	δ_{13}	-0.073***	0.015
β_2	-0.116***	0.037	δ_{14}	-0.053***	0.013
β_3	0.125***	0.035	δ_{21}	-0.005	0.019
β_4	0.108***	0.034	δ_{22}	-0.056***	0.020
γ_{11}	-0.484***	0.054	δ_{23}	0.029	0.020
γ_{12}	0.058**	0.023	δ_{24}	0.031	0.022
γ_{13}	0.266***	0.029	δ_{31}	0.023***	0.003
γ_{14}	0.159***	0.029	δ_{32}	0.005*	0.003
γ_{21}	0.058**	0.023	δ_{33}	-0.015***	0.002
γ_{22}	0.066***	0.023	δ_{34}	-0.013***	0.003
γ_{23}	-0.019	0.018	λ_1	0.032	0.027
γ_{24}	-0.106***	0.021	λ_2	0.058**	0.026
γ_{31}	0.266***	0.029	λ_3	-0.036	0.025
γ_{32}	-0.019	0.018	λ_4	-0.054***	0.021
γ_{33}	-0.172***	0.024	φ_1	0.263***	0.041
γ_{34}	-0.076***	0.016	φ_2	-0.283***	0.107
γ_{41}	0.159***	0.029	φ_3	0.150	0.120
γ_{42}	-0.106***	0.021	φ_4	-0.129	0.160

Note. Numbers in parentheses are standard deviations. ***, ** and * indicate significant at 1%, 5% and 10% respectively.

Parameter estimates from the nonlinear AIDS demand system are presented in Table 4. The significance of estimated coefficients of 's allows us to choose easily between the original AIDS and the quadratic AIDS model. The null hypothesis that is zero in the budget share equation is rejected for Dannon and the private label. As a result, the quadratic AIDS model is preferred for the demand estimation at the brand level in this study.

4.2 Elasticities

Elasticities are used to interpret the effect of yogurt price and household income on yogurt

purchases. An examination of the expenditure elasticities is shown in the last column of Table 5 where all the estimates, except for the Private label,are statistically significant. The positive sign of estimated expenditure elasticities indicate that all these brands can be considered as normal goods. Demand for Chobani is more than unitary elastic which makes this brand a luxury good. A 1% increase in the household income will increase household expenditure on Dannon and Yoplait by 1.2% and 1.01%, respectively. Demand on a new brand of Chobani will substantially increase by 1.67% as an income of a household increases by 1%.

Table 5 also reports uncompensated and compensated price elasticity estimates evaluated at the sample means along with the associated standard errors. Most estimates are statistically significant. Dannon has the lowest uncompensated own-price elasticity (-0.35) followed by the elastic demand of Yoplait (-1.62). The inelastic demand for Dannon reveals the popularity of this brand among yogurt consumers. Based on data from IRI in 2011, Danone comes in 84 different flavors where strawberry, blueberry, and vanilla are the most popular respectively. Chobani with the highest price among branded yogurt has the highest uncompensated own-price elasticity (-6.84). One possible reason why Chobani demand elasticity is of greater magnitude compared to other branded yogurt is the fact that Chobani was a new brand at that time and it was not very popular nationally and only 16 different flavors were offered on the market. Private label has a high uncompensated own-price elasticity (-3.43), but it is lower than the price elasticity of Chobani.

Villas-Boas (2007) found an average elastic own-price elasticity of -5.48, -5.65 and -6.15 for Dannon, Yoplait, and the private label respectively using Berry Levinsohn Pakes (BLP) model. Mehta et al. (2010) found inelastic demand of -0.6, -0.66, and -0.85 for Dannon, Yoplait, and the private label respectively using an integrated framework proposed by Hanemann model. It can be noticed that our estimates are not consistent with the elastic demand of the first study and inelastic demand for the second study. One possible reason is that each study peruses different markets during different periods. Our study investigates the yogurt market after a change in market competition by the introduction of Chobani in 2005. Compared to the former paper, after the introduction of Chobani, each of Yoplait and private labels lost their magnitude in terms of elasticity but they are still elastic while demand for Dannon became inelastic.

Table 5. Own-Price, Cross-Price, and Expenditure Elasticities Estimates

	Price Elasticities				Expenditure Elasticity
Uncompensated	Chobani	Dannon	Yoplait	Private	
Chobani	**-6.841*****	2.992***	6.367***	4.31***	1.669**
	(1.178)	(0.59)	(0.63)	(0.749)	(0.66)
Dannon	0.419***	**-0.35*****	0.478***	0.077	1.155***
	(0.156)	(0.097)	(0.111)	(0.116)	(0.149)
Yoplait	0.292***	-0.308***	**-1.616*****	-0.383***	1.019***
	(0.103)	(0.06)	(0.068)	(0.066)	(0.098)
Private	1.937	-6.076***	-5.948***	**-3.425*****	-1.007
	(1.186)	(0.905)	(0.837)	(1.048)	(0.771)
Compensated	Chobani	Dannon	Yoplait	Private	
Chobani	**-6.731*****	3.566***	7.284***	4.379***	
	(1.157)	(0.581)	(0.762)	(0.74)	
Dannon	0.495***	**-0.047**	1.113***	0.125	
	(0.149)	(0.094)	(0.147)	(0.113)	
Yoplait	0.359***	0.042	**-1.056*****	-0.34***	
	(0.098)	(0.058)	(0.091)	(0.064)	
Private	1.87	-6.423***	-6.501***	**-3.467*****	
	(1.156)	(0.909)	(1.006)	(1.043)	

Note. Bold numbers are own-price elasticities. Standard errors are in parentheses. *** and ** indicate significant at 1% and 5%, respectively.

Relationships among yogurt groups are also identified by estimated compensated cross-price elasticities. Most cross-price elasticities are positive and significant, indicating yogurt brands are substitutes, but the substitution among groups is asymmetric. An increase in the price of Chobani will increase the demand for Dannon, Yoplait, and the private label substantially, while an increase in the price of Dannon will not increase the demand for Chobani. In the same way, an increase in the price of Dannon will increase the demand for Yoplait, while an increase in the price of Yoplait will not increase the demand for Dannon.

5. Conclusion

The brand of yogurt considers an important attribute affecting consumers purchasing decisions. The main objective of this study is to estimate the demand elasticities at the brand level in the yogurt market. This study is motivated by the study of Villas-Boas (2007) where the author investigates a high elastic demand for major players in the yogurt market. This paper seeks to investigate the change in demand elasticities after the introduction of one of the recent most popular brands of Chobani. The analysis employed households' yogurt purchases from two cities in the states of Massachusetts and Wisconsin, and their demographic characteristics from IRI. Results indicate that the demand for a new brand of Chobani is substantially elastic compared to other main brands of Dannon and Yoplait. Households with a college degree are more likely to buy Chobani, while an increase in income will increase the demand for all branded yogurt.

The concept of price elasticity of demand is important for formulating government policies, like the taxation policy or the policy of protection. Any regulation that might lead to an increase in the price of milk, for example, would affect the yogurt production costs, and then its market revenues. The brand of

Chobani would be highly affected by such a policy due to its high elastic demand. The knowledge of elasticity of demand is also essential for management in the determination of price to earn maximum profit. If the demand for a product is elastic, like the Chobani brand, the producer should charge a low price, whereas, for an inelastic demand, like the Dannon brand, the producer can charge a high price for it. Furthermore, the knowledge of income elasticity is essential for management for demand forecasting of producible goods in the future. Finally, retailers can target consumers using their demographic information to increase sales as each group of individuals has different preferences for each yogurt brand. As shown in Table 3, for example, families who have children in the household tend to purchase Dannon and Yoplait than the higher-priced brand of Chobani.

Unfortunately, IRI provides only the demographic information for two states of Massachusetts and Wisconsin which is a big data limitation of this study. This limitation provides an interesting direction for future research to widen the geographical scope of yogurt demand study to the entire U.S. market. Another extension of this study would be assuming different supply models like the widely used Bertrand-Nash pricing model, a leader-follower (Stackelberg) framework, or a joint-profit maximization (monopoly) game, to provide the market power each brand has in the yogurt market. Yoplait maker General Mills has launched a new "French-style" yogurt called "Oui" in July 2017 which would a very interesting topic for future studies to analyze the effect of this new product's introduction to the yogurt market.

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Authors' contributions

RM analyzed the data and wrote the first draft. OM provided the data and critically reviewed the manuscript. Both authors read and approved the final manuscript.

Availability of data and material

Data are available on request to the corresponding author.

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Sustainable Marine Economic Development in Vietnam in the Period 2011-2018

Hoang Ngoc Phong1, Nguyen Cong My2, Bùi Thị Thanh Hoa3, Lê Bich Ngoc4
[1]1 Head of the topic KC 09.26/16-20, Academy of Policy and Development, Vietnam
2Secretary of the topic KC 09.26/16-20, Academy of Policy and Development, Vietnam
3 Vietnam Institute for Development Strategies, Vietnam
4Planning Development Institute, Vietnam Union of Science and Technology Associations, Vietnam

A B S T R A C T

*This work is to test the hypothesis of sustainable economic development by using a linear structural model. The structural equations in the structural model show that, the social development goals depend on economic growth and environmental protection goals, namely (Social target) = 1.22 * (Economic target) - 0.064 * (Environment target) and economic development target depend on social development goals and environmental protection goals, namely (Economy target) = 1.35 * (Social target) - 0.039 * (Environment target). The result show that both economic and social development have an adverse environmental impact that will no longer harmonize goals, reflecting the unsustainable marine economic development in the period of 2011-2018. There have many factors of unsustainable marine economic development in period 2011-2018, but mainly is low economic growth efficiency, low labor productivity and the process of urbanization does not truly create a foundation for economic development.*

Keywords: sustainable marine economy, structural equation model

1. Introduction

Vietnam is located in Southeast Asia, covering an area of 331,236 km2. According to the 2019 census, Vietnam has 96.2 million people, of which 34.36% of the urban population. The Vietnamese territory is divided into 63 administrative units, including provinces and centrally-run cities. Administratively, 28 provinces and centrally-run cities are localities adjacent to the sea, with a natural area of 126,747 km2equal to 38.26% of the country's area, see Figure 1.

Vietnam officially recognizes sustainable development as a harmonious development between the goal of economic growth and the goal of social development and the goal of environmental protection, in Decision No. 153/2004 of August 17, 2004, (Vietnam Agenda 21, 2004)

Figure 1. Map of Vietnam and 28 coastal provinces and centrally-run cities

1.1 Introduce the Problem

In the context of implementing the 2030 Agenda for Sustainable Development, it was officially implemented by Vietnam in Decision No622 / QD-TTg dated May 10, 2017 of the Prime Minister. It stated, "Sustainable development is a requirement throughout the process of national development; closely, reasonably and harmoniously combine economic development with social development and protection of natural resources and the environment, proactively responding to climate change", (The Socialist Republic of Vietnam, 2017). Then, the issue of sustainable economic development has become an urgent issue for the coastal areas.

So far, there has been no official government document that acknowledges sustainable marine economic development. However, it can be understood that sustainable economic development of the sea is similar to that of sustainable development of the whole country, which means that sustainable economic development of the marine economy is understood as harmonizing development among the goals of marine economic growth with the goal of social development in coastal areas and with the goal of protecting the marine environment.

Today, there are many doubts that the above definition of sustainable marine economy is not consistent with the definition of international organizations. So, the objective of this work is to test the hypothesis of sustainable economic development by using a linear structural model, then make discussions about reasons for unsustainable development of marine economy in Vietnam in the period 2011-2018.

This research is important, because it underlies how sustainable development is implemented. When there is no acceptance on the concept of a sustainable marine economy among implementers, so each organization or individual to act in a way according to its own interpretation, difficult to bring about good general results.

1.2 About Research Hypotheses

The research hypothesis is the relationship between the three concepts in sustainable marine economic development.

The concept of the target of marine environmental protection is expressed by 4 observed indicators, with codes ENV1, ENV2, ENV3 and ENV4. The concept of the target of marine economic growth is expressed by the three observed indicators, ECO1, ECO2, and ECO3. And finally, the concept of social development goals is expressed by three observed indicators, SOC1, SOC2, and SOC3.

The assumptions between the variables and related concepts are presented in Figure 2, where the environmental protection goal is denoted by ENV, the economic growth target is denoted by ECO and the social development goal is denoted by SOC. All three hidden variables ENV, ECO, and SOC are concepts that cannot be directly observed.

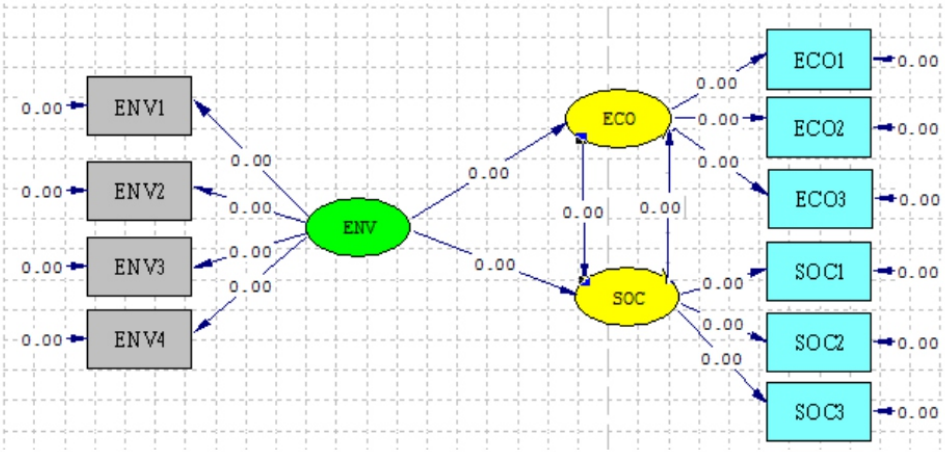

Figure 2. Assumptions about relationships among sustainable marine economic development variables

2. Research Method

The model used for this study is a linear structural equation model, abbreviated SEM (the first letter of the three English words Structural equation model). Currently, SEM is one of the most powerful research techniques applied in many fields of study such as biology, economics, education, marketing, management, chemistry as well as social sciences. But this is still a new method for research on sustainable development in Vietnam.

In the world, there have been many research projects applying the SEM model to research on sustainable development. For example, in the study on sustainable development of Bambang Juanda

et al., 2005) used the SEM model to select the set of sustainable development indicators for Indonesia. In Vietnam, there have been many research projects to apply SEM model into socio-economy, such as: Thanh Ho Quang, (2018), Tung Diep Thanh, Yen Ngoc Vo Thi (2016).

In fact, there is software supporting SEM model research with linear and non-linear relations, but this work selected linear SEM model. Because the goal of the research is to use quantitative to confirm the qualitative relationship, not going into the strong or weak level of the relationships between observed variables and between structural variables, thus using linear SEM model is acceptable.

In this research method, sustainable marine economic development is understood as a relationship with a positive or negative sign. If between the structural variables, there is also a positive sign that is sustainable development, and among the structural variables with a negative relationship, it shows that the marine economic development is not sustainable.

2.1 Overview of Marine Economic Development in the Period of 2011-2018

In a recent study by Thai Nguyen Quang, Phong Hoang Ngoc presented a detailed discussion of the concerns of the Party and Government of Vietnam, and analyzed and pointed out the strengths and challenges. Next, authors concerned the six priority marine economic development sectors in the period of 2021-2030. (Thai Nguyen Quang, Phong Hoang Ngoc, et al, 2019). Therefore, the following section will add some achievements and limit from the perspective of sustainable development in the period of 2011-2018, as follows.

In the marine economy, the agriculture, forestry, and fishery (AFF) sector maintain a good growth rate, with the gross region domestic product (GRDP) increasing an average of 7% per year. The structure of plants and animals is shifted towards improving quality and efficiency, towards responding effectively to climate change, such as sea-level rise. So that, AFF was transferring inefficient rice cultivation land and monoculture rice to shrimp, shrimp – rice. For example, some provinces in coastal area, such as Ca Mau, Kien Giang, Bac Lieu, had been transferring rice to shrimp, shrimp –rice, successfully. Other encouraging achievements include increasing the production of farmed shrimp and fish, and exploiting marine food, and increasing the total capacity of marine vessels of 90 horsepower or more. Coastal protection forests are well protected, specialized forests are expanded, increasingly effective in protecting the environment, adapting to climate change - sea level rise. (The Socialist Republic of Vietnam, 2017).

Coastal industry plays an important role in promoting the economic growth of coastal provinces and economic restructuring towards industrialization and modernization. The value added of industry increased by over 8.4% per year on average in the period of 2010-2018. Industrial production establishments have been gradually invested in building, expanding and upgrading technology and equipment, increasing the quality of goods. Coastal industry had focusing on investment in developing key industries with potential advantages such as agro-fishery processing.

Service industries grew well, moving positively to better meet the needs of production, business, and residential life. Commercial activities meet requirements for production, business, and consumption. The market and supermarket system is interested in investing, basically meeting the buying and selling needs of the people. Export activities of enterprises have many positive changes, contributing significantly to the consumption of agricultural products and the supply of production materials and equipment for other economic sectors, the market is expanded, many aspects.

Exports have penetrated the fastidious markets. Such as frozen shrimp and fish have entered the US, Japan, and EU markets. In recent years, infrastructure and tourism products in the coastal provinces and on islands have been invested, upgraded and contributing to improving the quality of tourism services. The management of natural resources, environmental protection and response to climate change has been paid more attention. Awareness of environmental protection among the people has had many positive changes, the responsibility of state management of environmental protection of all branches and social organizations has been raised; collection rate of municipal solid waste reaches nearly 88%, medical solid waste reaches 97%; strictly control the environment for newly implemented projects; concentrating resources for handling serious environmental pollution points such as garbage and wastewater. Many new technological solutions applied, environmental protection in agriculture has begun to change, gradually reducing the use of chemicals, plant protection drugs, encouraging farmers to clean their fields and collect plant protection drug bottles; Environmental violations are greatly reduced. Projects on sea dikes, sluice gates and saline intrusion, projects on forestation and nature conservation are interested in deploying investment.

The environmental monitoring work was concerned and timely raised the quality of warning information in response to significant damage reduction. Implementing the national target program on climate change response, many coastal provinces have established steering committees; In recent years, focusing on completing documents and scientific bases, promoting communication for people to grasp and understand the impacts caused by climate change. At the same time, step by step associating branch planning and investment projects with climate change scenarios of coastal provinces.

Education and training in coastal provinces continue to develop, quality is improved. The scale and network of education have been developed and expanded; facilities and equipment for teaching and learning have been strengthened, basically meeting the requirements of teaching and learning.In coastal provinces, people's health care is concerned and strengthened. The quality of medical examination and treatment and preventive medicine work has been constantly improved. Population work-family planning, protection, care for mothers, children and gender equality have improved. The work of food hygiene and safety was focused;

facilities of production, trading and food processing were regularly inspected, cared for and reminded. Primary health care for children has achieved positive results.

Based on the implementation of the National Program on Gender Equality, coastal provinces have well

implemented the objectives set out in the Plan, focusing on issues related to women's rights and interests. Coastal provinces have paid special attention to propaganda and awareness-raising on gender equality through many different forms. Highlights are activities such as training, organizing conferences and contests; communication through the mass media; building pilot models integrated with gender equality programs and projects.

In coastal provinces, cultural and press activities are increasingly rich and diversified; step by step develop and improve the quality. Building cultural environment, social and ethical standards, cultural families achieved some positive results.

The education of traditional ethics and Vietnamese family lifestyles is of community interest. The values of traditional culture, customs, and good practices are preserved and promoted. In coastal provinces, the target programs and policies supporting the poor and poor households in recent years have created positive changes in many aspects, contributing to promoting economic growth and solving many pressing in society. Mechanisms, policies, and projects are integrated to create motivations to promote the implementation of the Program on poverty reduction, gradually raising incomes and improving people's lives.

The implementation of social security policies is considered by the Party committees, authorities mass organizations in coastal provinces as a central and regular task. Mobilizing social resources to well perform the work of gratitude, gratitude, and care for social policy beneficiaries, people with meritorious services, and social protection beneficiaries.

2.2 Reasons for Choosing Observed Variables Represent the Concept of Sustainable Development Goals of Marine Economy

The indicators selected to representing marine economic growth targets, including ECO1 are investment capital per labor (unit: million dong, current price); ECO2 is the ratio of employed workers to the total population (unit :%); and ECO3 is the rate of training (unit : %).

Why choose the 3 indicators above? Because of, the advantage is that the economic indicators, such as ECO2, ECO3, are available in the provincial statistical yearbook, only ECO1 must be calculated from the investment capital and the number of employees working in the cassava economy. All this data is available in the provincial statistical yearbook.

The indicators are selected to representing Social concept, including SOC1 is per capita income per month; SOC2 is the proportion of the urban population; and SOC3 is the proportion of poor households with a multidimensional approach. The point is that all three selected indicators are available in the statistical yearbooks of coastal provinces. In addition, the simple SOC1 indicator shows labor productivity, because if the production scale increases, but the labor productivity does not increase, then the average income per head is unlikely to increase. The SOC2 indicator represents the progress of society because all civilized countries have a high proportion of the urban population. The SOC3

indicator is the multidisciplinary poverty rate. This is an indicator showing a lot of social content, such as equity in income distribution. In fax, if equitably distributed, the poverty rate may be small, although the per capita income of the coastal province is not high. The low rate of poverty is also due to society having many jobs, not leaving workers outside of growth, etc.

Regarding the environment, it is understood as a social environment and natural environment. The indicator showing the concept of the social environment is expressed by the indicator ENV1: Number of prosecuted cases per population (%). This is a broadly meaning implied indicator, for society with many individuals violating institutions, the high number of prosecuted cases proves that the society has actively made the environment more safety. This ratio is small, showing that the social environment is transparent and clear, everyone is guaranteed and the number of individuals violating institutions will be reduced.

Indicators expressing the concept of the natural environment, including ENV2 are the total capacity of fishing ships with a capacity of 90 HP or more. According to Vietnamese regulations, fishing vessels with a capacity of 90 horsepower (HP) or more are allowed to go offshore to fish. Therefore, this indicator reflects offshore fishing, having a direct impact on the marine environment. The ENV3 indicator is the fishing output compared to the total fishing and aquaculture production (unit %); ENV4 indicator is the proportion of aquaculture compared to the total fishing and aquaculture production (units %). The ENV 1 to ENV4 directly affects the marine economic environment.

The scale of applied indicator includes two types, one is to use the natural unit of measurement as mentioned above, including %, monetary unit million dong per labor, and investment capital of billion. Second, normalized indicators return an index with a scale greater than or equal to zero (0) and less than or equal to one (1). Standardize by the formula: Standardized indicator i = (Ui - Mini) / (Maxi - Mini). Where Ui is the value of observations of indicator I, mini is the smallest value of observations of indicator i and Maxi is the largest value of observations of indicator i in the period 2010-2018.

The maximum reasonable estimation is done by LISREL software, the estimation results are of two types, the first is to evaluate the validity of the measurement model, using Chi-square test, model removal probability (Pr), the freedom of the model and finally the general reliability of the model.

Second, confirmatory factor analysis (CFA), which explains the path coefficients; next the appropriateness of structural models (R2), the direct, indirect and total impacts.

3. SEM Model Estimation Results and Comments

3.1 The Results

The estimation results of the SEM model, presented in Figure 3 and Figure 4 show that the model is of quite good quality: Firstly, the probability of eliminating a small model (P-value = 0.00000); and two, the errors of the model is small (RMSEA = 0.008).

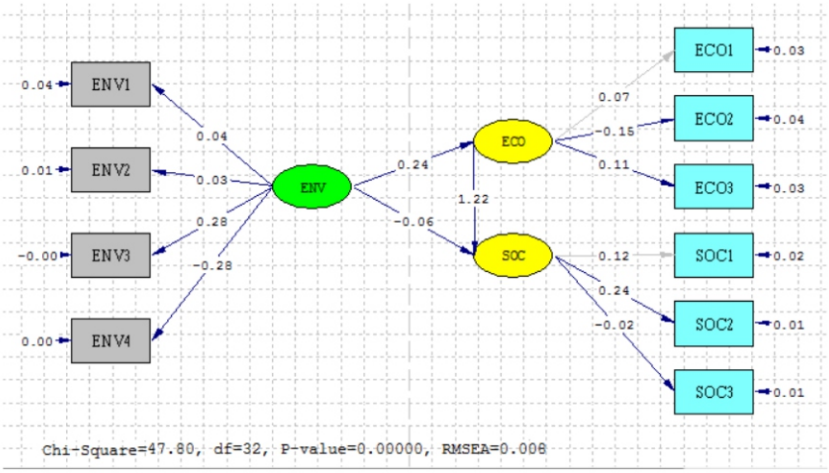

Figure 3. SEM model estimation results

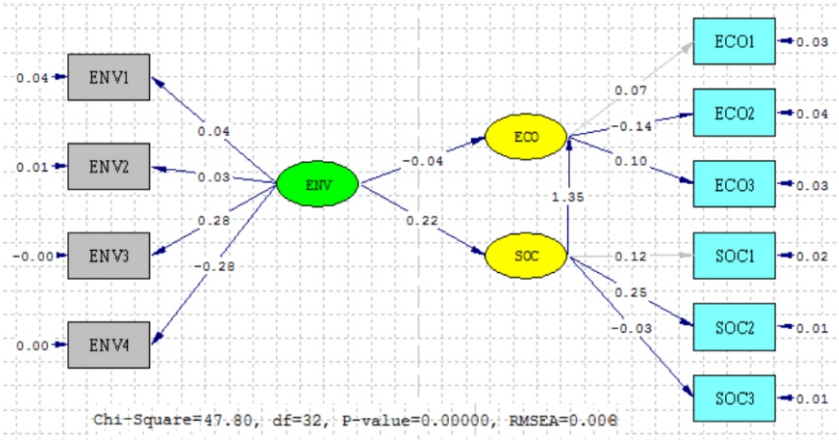

Figure 4. SEM model estimation results

The difference between the estimation results presented in Figure 3 and Figure 4 is that the relationship between the two endogenous, economic and social variables. In Figure 3, the arrow goes from economic to social. In Figure 4, the arrow goes from social to economic.

The estimation results of the SEM model also show that this model has 32 degrees of freedom, the Chi-Square test value = 47.8, Chi-square/df = 1.49, for 252 observations, the coefficient shows that the model is acceptable. As such, the model is consistent with the collected research data.

The relationship between observed variables and the conceptual variables shown in Figure 3 and Figure 4 is summarized in Table 1 as follows:

Table 1. Summary of estimated coefficients

Variable code and variable name	Linear regression equation (standardized data)	Error of variable	R^2	N^0 Figure
ECO1: investment capital per labor	ECO1 = 0.075*ECO	0.016	0.463	3
	ECO1 = 0.070*ECO	0.016	0.463	4
ECO2: the ratio of employed workers to the total population	ECO2 = - 0.15*ECO	0.026	0.534	3
	ECO2 = - 0.14*ECO	0.026	0.534	4
ECO3: the percentage of trained workers	ECO3 = 0.11*ECO	0.006	0.336	3
	ECO3 = 0.100*ECO	0.006	0.336	4
SOC1: the average monthly income per capita	SOC1 = 0.12*SOC	0.019	0.829	3
	SOC1 = 0.12*SOC	0.019	0.829	4
SOC2: the proportion of the urban population	SOC2 = 0.24*SOC	0.001	0.890	3
	SOC2 = 0.25*SOC	0.001	0.890	4
SOC3: the proportion of poor households with multi-dimensional access	SOC3 = - 0.025*SOC	0.008	0.674	3
	SOC3 = - 0.026*SOC	0.008	0.674	4
ENV1: Number of prosecuted cases compared to the population	ENV1 = 0.040*ENV	0.036	0.624	3&4
ENV2: The total capacity of fishing ships with a capacity of 90 horse powers or more	ENV2 = 0.031*ENV	0.013	0.732	3&4
ENV3: catches in relation to total catches and aquaculture.	ENV3 = 0.28*ENV	0.000	0.970	3&4
ENV4: the proportion of aquaculture compared to the total exploitation and aquaculture output.	ENV4 = - 0.28*ENV	0.000	0.980	3&4
Structural equations				
SOC = 1.22*ECO - 0.064*ENV		0.143	0.732	3
ECO = 1.35*SOC - 0.039*ENV		0.141	0.759	4

Source: Statistical data (see appendix C) and estimates using LISREL software

Table 1 summarizes the coefficients that show that all four observed variables closely related to the marine environment (such as high-value R2), proving that the observations variables have been presenting the marine environment nature. Of which, three are positively associated with the environmental concept variable (ENV), which means that the quality of the environment better as the measure of these variables increases. Particularly ENV4 variable has a negative relationship. It means that to harmonize with the environmental protection goal, we need to reduce the scale of aquaculture. This proves that aquaculture has exceeded the self-cleaning environment. To expand the scale, it is necessary to apply new science-technical measures into aquaculture.

The next, three observed variables expressing the concept of economic goals, the variable ECO1 (capital per labor) is positively related to the economic goals. Because increasing capital to labor will boost labor productivity. It is one of the three theoretical points of macroeconomics, "how to produce", the other two theoretical points are the production of "what" and "for whom".

The ECO3 indicator (the percentage of trained workers), also has a positive relationship with economic growth. Because the proportion of trained labor reflects the quality of labor, it is a direct and indirect product of training, bringing science and creativity into economic growth.

Particularly, the ECO2 indicator (the ratio of employed workers to the total population) is negatively related to the goal of economic growth. In fact, this indicator reflects the aging of the

In general, the coefficients of linear relationships between the marine economic growth target and the observed variables, although estimated in Figure 3 or Figure 4, have the same sign of a relationship, but the coefficients are different, but not big.

Among the three observed variables expressed social development goals, whether estimated in Figure 3 or Figure 4, have the same sign of relationship. In particular, indicators SOC1 (per capita income per month) and indicators SOC2 (proportion of the urban population) are positively related. Because, SOC1 represents the outcome of the production process, showing the progress of society; and SOC2 indicator represents a civilization in the development process. SOC3 (the percentage of poor households with multidimensional access) has a negative relationship with the social development goals, but this is a reasonable relationship because the society is progressive and civilized, the lower the rate of poor households.

Finally, the structural equations in the structural model show that, if estimated from Figure 3 or Figure 4, the results are very different. As estimated in Figure 3, the social development goals depend on economic growth and environmental protection goals, namely SOC = 1.22 * ECO - 0.064 * ENV. It shows that social development also has a negative impact on the marine environment.

If estimated in Figure 4, the economic growth target is a dependent variable on social development and environmental protection goals, namely ECO = 1.35 * SOC - 0.039 * ENV. It shows that economic growth target also has a negative impact on the marine environment.

Thus, the structural model has shown that economic growth goals and social development goals are inversely related to environmental protection, reflecting the unsustainable marine economic development in the period of 2011-2018.

3.2 Statistics and Data Analysis

Our research data was secondary and selected from the annual statistical yearbook (2010-2018) of 28 coastal provinces and cities. This data is publicly available. (Provincial Statistical yearbook, 2010-2018).

The data used is panel data, taken from the Statistical Yearbook of coastal provinces published from 2010 to 2018, a total of 280 observations (equal to 10 years x 28 provinces), after dropped observations without enough data for all 9 selected indicators, the remaining 252 observations were calculated. The authors used LISREL software to build covarial models and estimates.

The software calculates the relationship between observed indicator and the concept variables with a small coefficient R2, for two reasons. One is to use panel data; secondly, the selected observed indicator do not best reflect the content of the concept variables. For example, in order to show the goal of economic growth, it is necessary to select supply and demand factors, such as private and government consumption, exports and imports. But at present, there are no observational data on the demand side indicators, so this study only takes some indicators of the supply side such as investment per labor and

the percentage of employed workers who have been trained.

4. Discussion: The Causes of Unsustainable Marine Economic Development in Vietnam

As analyzed above, it shows that the development of marine economy in the period of 2011-2018 is unsustainable, due to the following subjective reasons.

4.1 Low Economic Growth Efficiency

Unsustainable marine economic development is due to low growth efficiency.

In Vietnam, in the period of 2011-2018, marine economic growth depends heavily on investment, but investment efficiency is low. One of the evaluation criteria is the ICOR coefficient, calculated from the statistical data of 28 coastal provinces, the ICOR period 2011-2015 is 5.4, the period 2016-2018 is 6.5.ICOR figures for coastal area shows that, if excluding the difference in technology level, in the period of 2011-2018, the efficiency of investment capital in the marine area are quite highly. Meanwhile, according to experience, for countries in the period of rapid growth with low technological level, for example, in period 1970-1981, ICOR of South Korea only equal 3.3 or 4.0 in period 1978-1987, 4.4 in period 1988-1992 (Gillis M., Perkins D. H, et al, 1996). The above analysis results show that the efficiency of social investment in coastal area in the period 2011-2018 is still quite low.

4.2 Low Labor Productivity

Unsustainable marine economic development is due to low labor productivity. The labor productivity (comparative price 2010, Table 2) of the four key economic regions is not much higher than the national average, even the labor productivity of the key economic region or the key economic region of the Mekong Delta shows lower performance. If converted in foreign currencies directly, the key economic region has the highest labor productivity (9,000 USD per labor), this level is only equal to 76% of the labor productivity of Thailand, 27% of Malaysia and only 8.7 % Korean in 2010. (ASEAN statistics yearbook 2010).

Table 2. Labor productivity (at constant 2010 prices)

	2010	2015	2016	2017	2018
Coastal area (Million VND/labor)	71.25	133.34	141.33	151.82	163.08
whole country (Million VND/labor)	51.01	87.83	90.67	98.63	107.29

Source: Calculated from data of statistical yearbook of coastal provinces

4.3 The Process of Urbanization Does not Truly Create a Foundation for Economic Development

In 8 years (2010-2018), the urban population of the four key economic regions increased to about 2.6 million people, but of which some urban areas and urban population increased mainly by administrative decisions, bringing farmers became urban residents. The number of people becoming townspeople is estimated at 64-65 thousand people, equal to the urban population of Hai Phong city in

2008. This is also one of the reasons leading to the budget of the concentrated cities too big for infrastructure construction without investing to support the development of businesses.

At present, most of the urban areas in key economic regions are unbalanced in terms of infrastructure, water supply, sewerage, electricity supply, health facilities, education ... overloading compared to the population size. For example, in Hanoi, after the rain, there were 50-60 points of inundation due to poor drainage, about 5% of the housing area was of very poor quality, the indiscriminate use of water led to a loss rate of up to 40 %. (Author handing from Provincial statistical yearbooks).

4.4 The Problem of Environmental Pollution Has a Significant Impact on Life

Along with rapid economic development, the problem of environmental pollution in cities, tourist centers, craft villages in rural areas of the key economic regions is increasing, causing significant impacts on living standards, persons and sustainable development, requiring urgent resolution. Because of, as follows:

- In coastal cities, due to the impact of urbanization and the movement of a large part of the population from rural areas to urban areas, the urban population is already overloaded compared to the infrastructure. The floor causes serious pollution from garbage and water sources, only Ho Chi Minh City alone, discharges about 6,000 tons of waste every day; dust concentration exceeds the permitted standard up to 1.13 to 1.31 times, etc. Most of the big cities such as Hue,

Da Nang, Ho Chi Minh City, ... the phenomenon of rainwater inundation in each heavy rain causes the sewage in the sewers to spill on the streets, causing water pollution, ground, and air.

- Many centers and industrial complexes polluting wastewater into rivers and coastal areas are quite serious, for

example along the Thi Vai town, the downstream area of Dinh River is polluted due to untreated sewage, treatment or handling is not thorough; Quang Ninh area polluted by mine wastewater and oil scum due to travel by ships and shipbuilding enterprises ... has reached an alarming level.

5. Conclusion

In general, this article is not detailed and the level of accuracy is still low, because of there is no specialized data set for this research purpose, but it cannot wait for ever. However, it opens a new direction of applying structural models to sustainable development research in Vietnam. This is very suitable for training on sustainable studies and especially Universities in Vietnam.

SEM model is also used in the environmental analysis in Vietnam less. The above is an example of application, although there are some limitations such as the set of observation indicators reflecting the economy is not considerately reliable, the R2 coefficient of some indicators is still lower then 0.5. However, this example will facilitate further sustainability studies using the SEM model. The

estimation results also show that the relationship between the concept variables is very close to each other, and consistent with the selected data (the R2of structure equations are high, both above 0.73). Through this quantitative study, data on the marine environment is very lacking, especially data on indicators reflecting marine environmental pollution such as plastic bags, wastewater from coastal cities, from Untreated coastal industry.

The results of the SEM model have confirmed that the marine economic development in the period 2011-2018 is not sustainable. This study is still simple; however, it will inform policy makers to pay more attention to sustainable marine economic development.

From this analysis, the policy implication is that the offshore fishing vessels should not be increased unless to apply science and technology solutions are suitable for the coastal context. At the same time, it is not advisable to encourage aquaculture more if there are no scientific measures to expand the carrying capacity. Currently, economic growth does not meet the needs of jobs, for sustainable development, economic growth must be faster.

Both economic and social development have an adverse environmental impact that will no longer harmonize goals, implying that the policy here is to accompany economic development with increased monitoring and impact assessment project, expansion of economic and social capacity. When grown beyond carrying capacity of the marine environment, it will have an adverse impact on the environment.

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