DOI: http://doi.org/10.4038/caj.v3i0.40

Exploring Relationship between Freight Forwarder Selection and Size of the Organization: Multinomial Regression Analysis

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***Abstract*- Global economy tends to focus on more imports and exports, where businesses needs more and more support from 3PL providers to smooth their complicated business processes. When it comes to international business, there are a lot of regulations and steps to be followed. Starting from making a booking with the carrier, reserving space, negotiating better rates, equipment reservations, fumigation, obtaining certificates, clearing, and border regulations are few events involved. As a solution to the complicated processes freight forwarders came in to industry so that the business can focus on their core activities while forwarders involve in the transport and logistics processes. Hence the purpose of this study is to explore the relationship between freight forwarder selection and size of the organization and help to improve the service quality of the freight forwarding industry and identify whether there is a relationship between the frequencies of using forwarders with the size of organization. In order to carry out the research a questionnaire survey was developed using prior research, articles and distributed among the sample of 250 shippers which was selected out of the 1557 exporting companies in 23 industries in Sri Lanka. Multinomial Regression analysis was used to analyse data and Pseudo R-Square method was use to further confirm the relationship in between the dependent and independent variables. Findings identified a relationship between factors with organization size and the frequency of using freight forwarders. It is recommended to the policy makers of freight forwarding companies to consider the relationship and focus more on large scale organizations to enhance their profit and build relationships with the flourishing companies.**

***Keywords*- Freight Forwarder, shipper, International Business, Multinomial Logistic Regression**

I. INTRODUCTION

With Globalisation imports and exports play a vital role in every economy. When considering the Sri Lankan economy, revenue of $10.5 billion was indicated from exports in 2015 with a 5% of industrial production growth rate. Out of the $ 223 billion GDP in 2015, 20.5% were from exports. Processing of rubber, tea, coconuts, tobacco and other agricultural commodities, clothing, textiles; cement, petroleum refining, information technology services and construction can be considered the industries in the country. From these textiles and apparel, tea and spices; rubber manufactures; precious stones; coconut products, fish play a major role in the export industry. Sri Lankan export partners are considered to be US, India and Germany.

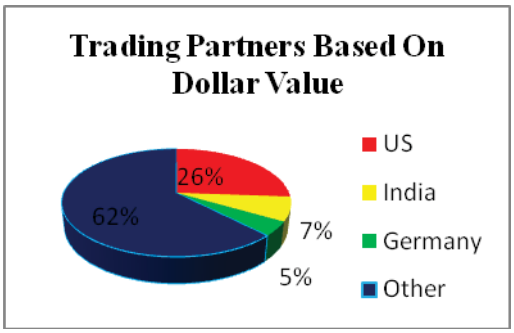

Figure 1.1; Trading Partners Based On Dollar Value

Source: World Fact Book 2015 [1]

Though it creates lot of opportunities for the business owners, the process they have to handle is a bit complicated since they have to deal with different parties like shipping lines, container yards, cross border regulations, customs, local transporters and especially with documentation.

Negotiating better rates with shipping lines and reserving space is not an easy task to do on their own especially for the small scale business operators. As a result freight forwarders or logistics specialists came on stage to smooth the process of imports and exports. As per the shippers requirement they provide an end to end solution to deliver cargo to its destination [1]. For professionalising the forwarding industry Sri Lanka Freight Forwarding Association (SLAFA) was established in 1981.Being the apex body for the 108 members SLAFA is a member of regional freight forwarding body Federation of Asia Pacific

Air cargo Associations (FAPAA) and the international freight forwarding body FIATA [2].

Consequently it is essential to have a better understanding in between shipper and freight forwarder (as well as a good partnership). Forwarder need to understand the flow of the customer and customer should be willing to provide required information to forwarder to maintain the partnership, Hence both parties can go for win win situations[3].

In addition this study helps to identify the frequency of using a freight forwarder with the size of organization with considered factors by shippers when selecting a freight forwarder .

II. METHODOLOGY

Multinomial Logistic Regression

Multinomial regression is the linear regression analysis used when the dependent variables are considered to be nominal. This model is a simple extension of binomial logistic regression model. This is used to describe the relationship between the nominal dependent variable and one or more continuous (interval or ratio) independent variable[25]. Further this method is only used when there are more than two nominal dependent variables.

In this model dummy coding is given to all variables and for having M categories in dependent variable will have M-1 dummy variables. Generally reference category is coded as "0".

In order to carry out a multinomial logistic regression model following assumptions are need to be made.

1. Observations Yi are statistically independent of each other
2. Observations Yi are a random sample from a population where Yi has a multinomial distribution with probability parameters:$\pi_i^{(0)}, \pi_i^{(1)} \dots \dots, \pi_i^{(c-1)}$
3. As with binomial logistic regression, we have to set aside one category for a base category (hence the C - 1 parameters π)

The logit for non-referential category j= 1, 2, …., (C-1) against the reference category 0 depends on the values of the explanatory variables as per the below equation [1].

$$log\frac{\pi_i^{(j)}}{\pi_i^{(0)}} = \alpha^{(j)} + \beta_1{}^j x_{1i} + \beta_k{}^j x_{ki} \quad (1)$$

For each j= 1, 2, …, (C-1) $\alpha^j, \beta_1{}^j, \beta_k{}^j$ are unknown population parameters.[5]

III. ANALYSIS

Multiple regression model was developed to identify the relationship between the frequency of freight forwarders being used and the size of the organisation. Table III-A shows the summery of the case.

III-A Case Processing Summary

		N	Marginal Percentage
Frequency of freight forwarders are being used	high	107	48.6%
	medium	94	42.7%
	low	19	8.6%
number of employees	large	95	43.2%
	medium	90	40.9%
	small	35	15.9%
Valid		220	100.0%
Missing		1	
Total		221	
Subpopulation		3	

As per the table III-A, 48.6% responses are from high users of freight forwarding service while 8.6% is from low frequency users. Out of 221 responses 95 are from large scale organisations and 90 are from medium size organisations.

III-B Model Fitting Information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	53.593			
Final	23.590	30.003	4	.000

Table III-B shows whether the coefficients of the model are zero or whether the coefficients are statistically significant. P value is shown as .000 in the table III-B which is less than 0.005.Hence it can be known as full

model statistically significant and predict the dependent variables.

III-C Likelihood Ratio Tests

Intercept Only	53.593			
Final	23.590	30.003	4	.000

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Table III-C shows the statistically significance of the independent variable. Having a 0.000 value for the sizes of the organisation which is less than 0.005 indicate independent variable is statistically significant.

III-D Parameter Estimation

Frequency of freight forwarders are being used[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
high	Intercept	.799	.401	3.958	1	.047			
	[size=1.00]	1.245	.568	4.803	1	.028	3.471	1.141	10.565
	[size=2.00]	1.599	.724	4.875	1	.027	4.950	1.197	20.474
	[size=3.00]	0[b]	.	.	0	.	.	.	.
medium	Intercept	-.405	.527	.592	1	.442			
	[size=1.00]	1.986	.671	8.763	1	.003	7.286	1.956	27.133
	[size=2.00]	3.296	.793	17.252	1	.000	27.000	5.701	127.875
	[size=3.00]	0[b]	.	.	0	.	.	.	.

a. The reference category is: low.

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	[size=3.00]	0[b]	.	.	0	.	.	.	.

a. The reference category is: low.

Interpreting β for Continuous X

Holding the small size of organisations constant, large size organisations multiply the odds of using high frequency of freight forwarders rather than low frequency by 3.471.

Holding the small size of organisations constant, medium size organisations multiplies the odds of using high frequency of freight forwarders rather than low frequency by 4.950.

Holding the small size of organisations constant, large size organisations multiplies the odds of using medium frequency of freight forwarders rather than low frequency by 7.286.

Holding the small size of organisations constant, medium size organisations multiplies the odds of using medium frequency of freight forwarders rather than low frequency by 27.000.

Interpreting β Between Non Reference Categories of X

The odds for large size organisations using high frequency of freight forwarders rather than low frequency are 0.701 times [exp (1.245- 1.599) = exp (-0.354) or 3.471/4.950] than the odds of medium size organisations.

The odds for large size organisations using medium frequency of freight forwarders rather than low frequency are 0.269 times [exp (1.986- 3.296) = exp (-1.31) or 7.286/27.000] than the odds of medium size organisations.

Interpreting $\hat{\beta}$ Between Non Reference Categories of Y

The odds for large size organisations using high frequency of freight forwarders rather than medium frequency are 2.099 times [exp (1.986- 1.245) = exp (0.741) or 7.286/3.471] the odds of small size organisations.

Computing Fitted Probability

Equations are needed to be developed to compute the fitted values.

Response Variable: Frequency of using freight forwarders

- Low frequency : reference category, j= 0
- High frequency : j=1 category
- Medium frequency: j=2 category

Explanatory Variables: Size of the organisation

- Small scale = Omitted reference category
- Large scale = X_1
- Medium scale = X_2

Model for the log odds of using high frequency vs. low frequency of freight forwarders

$$\log\left(\frac{\pi_i^1}{\pi_i^0}\right) = \alpha^{(1)} + \beta_1{}^1 x_{1i} + \beta_2{}^1 x_{2i}$$

Model for the log odds of using medium frequency vs. low frequency of freight forwarders

$$\log\left(\frac{\pi_i^2}{\pi_i^0}\right) = \alpha^{(2)} + \beta_1{}^2 x_{1i} + \beta_2{}^2 x_{2i}$$

When fit a logit model for each non-reference category j:

$$L_j = \log\left(\frac{\pi_{ij}}{p_{i(0)}}\right)$$ .....[log odds of a response in category j rather than the reference category 0]

Probability of response in category j can be calculated by:

$$\pi^j = \frac{\exp(L^j)}{1 + \exp(L^1) + \cdots . + \exp(L^{(c-1)})}$$

Probability of response in category 0 can be calculated by:

$$\pi^0 = \frac{1}{1 + \exp(L^1) + \cdots . + \exp(L^{(c-1)})}$$

Logit (Logistic regression coefficient) for using high frequency of freight forwarders rather than the low frequency of freight forwarders can be defined as:

$$L^{(HF)} = \log \frac{\pi_i{}^{(HF)}}{\pi_i{}^{(LF)}}$$

$L^{(HF)}$ = 0.799 + 1.245* large scale organisation + 1.599* medium scale organisation

Logit for using medium frequency of freight forwarders rather than the low frequency of freight forwarders can be defined as:

$$L^{(MF)} = \log \frac{\pi_i{}^{(MF)}}{\pi_i{}^{(LF)}}$$

$L^{(MF)}$ = -0.405 + 1.986* large scale organisation + 3.296* medium scale organisation

Probability of using high frequency can be found by the below equation

$$\frac{0.799 + 1.245 * \text{large scale organisation} + 1.599 * \text{medium scale organisation}}{0.799 + 1.245 * \text{large scale organisation} + 1.599 * \text{medium scale organisation} - 0.405 + 1.986 * \text{large scale organisation} + 3.296 * \text{medium scale organisation}}$$

Probability of using medium frequency can be found by the below equation

$$\frac{-0.405 + 1.986 * \text{large scale organisation} + 3.296 * \text{medium scale organisation}}{0.799 + 1.245 * \text{large scale organisation} + 1.599 * \text{medium scale organisation} - 0.405 + 1.986 * \text{large scale organisation} + 3.296 * \text{medium scale organisation}}$$

III-E Pseudo R-Square

Cox and Snell	.127
Nagelkerke	.151
McFadden	.074

R^2 or the coefficient of determination shows the proportion of variation in the dependent variables associated with the independent variables. As per the standard values of Cox and Snell, Nagelkerke, and McFadden need to be less than 1 to accept the R^2 value. Table III-E shows R^2 values less than 1 which means R^2 value can be accepted.

IV. Conclusions

When compared the company sizes large and medium with the high frequency of using freight forwarders significance values are .28 and .27 respectively. When compared the large company size and the medium company size with the medium frequency of using freight forwarders significance values are .03 and .000 respectively. Hence this can be concluded as frequency of using freight forwarders are depending on the company size.

V. ACKNOWLEDGMENT

Heartiest gratitude to all professionals who contributed their valuable input in this survey.

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