Mediating Effect of Resource Transfer in the Relationship between Acquisition of Competitive Industrial Networks and Innovation Diffusion for Product Co-Creation

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ABSTRACT

This paper explores the hypothesis relating to the mediating effect of resource transfer in the relationship between acquisition of competitive industrial networks and innovation. It has been established in the first research hypothesis that the competitive industrial networks are driven by both external (state economic policies, infrastructure, intellectual property rights, public-private partnership, cultural linguistic distances and internal factors (human capital, managerial capital, information capital, financial capital and network capital). Empirical results support the prediction that resource transfer mediates the relationship between acquisition of competitive industrial networks and innovation. In this second set of hypothesis, it is argued that the ultimate effect of the acquisition of competitive advantage is to drive innovation such as product co-creation but this is mediated by resource transfer. The results shows that competitive industrial network, positively relates to resource transfer and thus proofs to be relevant or significantly contribute to the predictor set with a structure coefficient of .83 The plausible explanation is that the competitive industrial networks acquired from internal and external factors helps to facilitate resource transfer among firms in the cluster which ultimately propels them to achieve innovation.

Key Words: Resource, Transfer, Relationship, Acquisition, Competitive, Industrial Networks, Innovation Diffusion, Product Co-Creation

INTRODUCTION

This paper explores the hypothesis relating to the mediating effect of resource transfer in the relationship between acquisition of competitive industrial networks and innovation. It has been established in the first research hypothesis that the competitive industrial networks are driven by both external (state economic policies, infrastructure, intellectual property rights, public-private partnership, cultural linguistic distances and internal factors (human capital, managerial capital, information capital, financial capital and network capital). It is argued that the ultimate effect of the acquisition of competitive advantage is to drive innovation such as product co-creation but this is mediated by resource transfer. In other words, the competitive industrial networks acquired from internal and external factors helps to facilitate resource transfer among firms in the cluster which ultimately propels them to achieve innovation. It is thus postulated that;

H1: Resource transfer mediate the relationship between acquisition of competitive industrial networks and innovation diffusion for product co-creation
Exploratory Factor Analysis and Reliability

Exploratory Factor analysis was conducted to examine the factor structure of each of the three variables (competitive industrial networks, innovation diffusion for product co-creation and resource transfer). In accordance with Hair, Ringle, and Sarstedt (2011), it was decided that in order to reduce the number of items and to facilitate interpretation, principal component analysis with the orthogonal rotation (varimax rotation) was used. This was performed for the measures of competitive industrial networks, innovation diffusion for product co-creation and resource transfer. Secondly, the reliability of the scale was equally measured with Cronbach alpha criterion to find out if all the indicators of the scale will measure the same construct. Each measure had satisfactory internal consistency with a Cronbach’s alpha value above .70. The KMO and Bartlett’s test for sample adequacy was also performed to assess the communalities of the indicators. Cross loadings of factor indicators were adequately checked to find out the extent of correlations among the factor indicators, that is convergent and discriminate validity were checked to find out the internal consistency of the factor indicators’. The factors demonstrate sufficient convergent validity, as their loadings were all above the recommended minimum threshold of 0.350 for a samples size of 300Hair et al. (2011). The factors also demonstrate sufficient discriminant validity, as the correlation matrix shows no correlations above 0.70 and there are no problematic cross-loadings. The number of factors indicators for each construct was determined, based on the eigen-value greater than 1 criterion. Items were retained if they loaded above 0.50 on the factor.

Finally we modelled a canonical correlation analysis to determine the relationship between the dependent variable (diffusion for product co-creation), and independent variable (competitive industrial networks) and the mediating variable (resource transfer). CCA is most appropriate when a researcher desires to examine the relationship between two variable sets. For CCA to make theoretical sense as a multivariate analysis there should be some rationale for why the variables are being treated together in variable sets. For example, a researcher may have four different measures of attributes in the predictor variable set, three different measures of attributes in the criterion variable set and three measures of attributes in the mediating variable. The research question of interest, then, would be whether there is a relationship between these attributes as multi operationalized in the variable sets. In contrast, if the researcher only had one criterion measure of dependent, independent and mediating variables, then multiple regressions would be conducted. If only one variable set were available, then the researcher may choose to conduct some sort of factor analysis to synthesize the variables. If more than one variable exists in both sets, then CCA may be the analysis needed. The model also has the ability to minimize the threat of committing Type 1 error. It allows for simultaneous comparisons among the sets of variables rather than requiring many statistical tests be conducted(Thompson, 1993). Another reason is that, this technique can be used instead of other parametric tests in many instances, making it not only an appropriate technique to use but a comprehensive technique as well. As has been demonstrated by (Henson, 2001)and (Thompson, 1993), virtually all of the parametric tests most often used by researchers (e.g., ANOVA, MANOVA, multiple regression, Pearson correlation, t test, point-biserial correlation, discriminant analysis) can be subsumed by CCA as special cases in the GLM. This is not to say that CCA should always be used instead of these other methods because, in many cases, this may be a long, tedious way to conduct an otherwise simple analysis.

Theoretical considerations of CCA

Canonical correlation analysis is used in examining the relationship between two sets of variables that is the independent set which is normally denoted as X and dependent set which is also denoted as Y and any intervening effect by and external factor. Canonical correlation analysis focuses on the correlation between a linear combination of the variables in one set (independent variable set) and the linear combinations of variables in another set (dependent set of variables). The object is then to find the linear combinations;

\[ U = a_1^TX = a_{i1}X_1 + a_{i2}X_2 + ... + a_{ip}X_p \]

\[ V = b_1^TY = b_{i1}Y_1 + b_{i2}Y_2 + ... + b_{iq}Y_q \]

such that U and V have the largest possible correlation. Such a linear combination can give insight into the relationships between the two set of variables. A typical way to view canonical correlation analysis (CCA) is as an extension of the traditional multiple regressions. In such case, the dependent set (Y-set) contains one variable instead of q variables and the regression solution involves the
linear combination; \( a^TX \) which in most cases is highly correlated with \( Y \). While in the canonical correlation analysis the dependent set \((Y\text{-set})\) contains \( q \geq 1 \) variables (that is multiple variables) and we look for vectors \( a \) and \( b \) for which the correlations between the linear combinations \((a^TX\) and \( b^TY\)) is maximized. With respect to this research, \( U \) and \( V \) are the canonical variates of the dependent variable \((\text{diffusion for product co-creation})\), and independent variable \((\text{competitive industrial networks})\) \(X_1, X_2 \ldots X_p\) are the latent variables whilst \( Y_1, Y_2 \ldots Y_p\) represents the mediating variables \((\text{resource transfer})\). The parameter estimates \( a_{1},a_{2},a_{p},b_{1},b_{2},\ldots,b_{p}\) are the canonical loadings for \( X_1, X_2 \ldots X_p\) and \( Y_1, Y_2 \ldots Y_p\) respectively.

Suppose \( X \) is a \( p \times 1 \) random vector and \( Y \) is also a \( q \times 1 \) random vector that is:

\[
\begin{bmatrix}
X_{p \times 1} \\
Y_{q \times 1}
\end{bmatrix} =
\begin{bmatrix}
x_1 \\
x_2 \\
\vdots \\
x_p \\
y_1 \\
y_2 \\
\vdots \\
y_q
\end{bmatrix}
\]

Suppose further that, \( X \) and \( Y \) have means \( \mu_X \) and \( \mu_Y \) respectively and that,

\[
E[(Y - \mu_Y)(Y - \mu_Y)^T] = \sum_Y
\]

\[
E[(X - \mu_X)(Y - \mu_Y)^T] = \sum_{XY} = \sum_{YX}
\]

Then by considering the two linear combinations \( U = a_i^TX \) and \( V = b_i^TY \), the correlation between \( U \) and \( V \) is formulated as:

\[
\rho_{UV} = \frac{a^T \sum_{XY} b}{(a^T \sum_X \sum_Y b)^{1/2}}
\]

where \( \sum_X \), \( \sum_{XY} \) and \( \sum_Y \) are covariance matrices for \( X \), \( Y \) and \( XY \).

**Testing the Significance of the Canonical Correlation Coefficient**

In testing the significance of the canonical correlation coefficient, the null and the alternative hypothesis are respectively stated as:

\[
H_o : \rho_1 = \rho_2 = \ldots = \rho_p = 0
\]

\[
H_A : \rho_1 \neq \rho_2 \neq \ldots \neq \rho_p \neq 0
\]

In order to test the above hypothesis, the most widely used test statistic is the Wilk’s Lambda which is given by the relation:

\[
\Lambda = \prod_{i=1}^{p} (1 - \rho_i)
\]

The critical value \((p\text{-value})\) for the test is obtained from F-distribution with a specific level of significance \((\alpha)\). If the probability value \((p\text{-value})\) of the test is small (less than the level of significance \((\alpha)\)) then it indicates the rejection of the null hypothesis, which implies the two set of variables are dependent or correlated.

**Multivariate Test of Significance for the mediating effect of resource transfer in the relationship between competitive industrial networks and diffusion for product co-creation**

To examine the mediating effect of resource transfer in the relationship between acquisition of competitive industrial networks and innovation, various multivariate statistical techniques were used to test the significance of the model. The multivariate test of significance exhibits whether the full canonical model obtained is statistically significant or not by using various tests such as the Pillais, Hoteling, Wilk’s Lambda and Roys test of significance. Most researchers generally choose to interpret the results of the Multivariate test of significance on the basis of the Wilk’s lambda due to its high level of practicality. The findings or results from table mnnnn below collectively indicates that the full canonical model
across functions using the Wilk’s lambda (\( \lambda \)) =0.31489 criterion with F (15, 386.44) =8.11742, p<0.000) is statistically significant. This is result is additionally supported by the other tests (Pillais, Hoteling, and Roys test) which have their respective p-values being less than the 0.05 level of significance. Since the Wilk’s lambda represents the variance unexplained by the full model, then 1-\( \lambda \) yields the full canonical model effect or the amount of variance explained by the full canonical model. Hence for the full canonical model obtained, the effect size or the amount of variance being explained is 0.68511, which indicates the full canonical model explains a substantial portion of the variance shared between the variable sets (the dependent variable (diffusion for product co-creation), independent variable (competitive industrial networks) and the mediating variable (resource transfer)).

Table 1 Multivariate Test of Significance for the mediating effect of resource transfer in the relationship between competitive industrial networks and diffusion for product co-creation

<table>
<thead>
<tr>
<th>Test name</th>
<th>Value</th>
<th>Approx. F</th>
<th>Hypothesis Df</th>
<th>Error Df</th>
<th>Sig. of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pillais</td>
<td>0.32635</td>
<td>7.2492</td>
<td>15.00</td>
<td>426.00</td>
<td>0.000</td>
</tr>
<tr>
<td>Hoteling</td>
<td>0.44307</td>
<td>8.93889</td>
<td>15.00</td>
<td>416.00</td>
<td>0.000</td>
</tr>
<tr>
<td>Wilk’s</td>
<td>0.31489</td>
<td>8.11742</td>
<td>15.00</td>
<td>386.44</td>
<td>0.000</td>
</tr>
<tr>
<td>Reys</td>
<td>0.68511</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Eigen Values and Canonical Correlations for the mediating effect of resource transfer in the relationship between competitive industrial networks and diffusion for product co-creation**

The Eigen values and the canonical correlations on the other hand help in making decisions on which canonical function has the maximum correlation and also significant based on their respective shared variances (canonical correlation squared values). Table 2 below therefore gives the root number representing the number of canonical functions generated, percentages, cumulative percentages, canonical correlation values and the squared canonical correlation values of the respective canonical functions generated. From the table 2, it can be deduced from the column labelled “Root No.” that, three (3) canonical functions were derived from the canonical correlation analysis. Furthermore, among the three (3) canonical functions obtained from the analysis, the first canonical with the root number 1 had the largest Eigen value (0.40359), the highest canonical correlation value (0.82771) with a substantial amount of shared variance between the first and second set of variables used in the analysis (ie.68.5%). This is followed by the second canonical function (Root No. 2) which from the table 2 had an Eigen value of 0.02292, a canonical correlation value of 0.14970 with a shared variance of 2.24% between the two sets of variables. The third canonical function among the three canonical functions had the least Eigen value as well as the least canonical correlation value and the least shared amount of variance between the two sets of variables. The summary of this result points out that, the first canonical function (Root No. 1) is considered noteworthy and significant since it is the only root with the maximum correlation value and also explained a substantial amount of variance between the data sets.

Table 2 Eigen Values and Canonical Correlations for the mediating effect of resource transfer in the relationship between competitive industrial networks and diffusion for product co-creation

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.40359</td>
<td>91.0892</td>
<td>91.0892</td>
<td>0.82771</td>
<td>0.68511</td>
</tr>
<tr>
<td>2</td>
<td>0.02292</td>
<td>5.17413</td>
<td>96.2605</td>
<td>0.14970</td>
<td>0.02241</td>
</tr>
<tr>
<td>3</td>
<td>0.01356</td>
<td>2.60830</td>
<td>98.8735</td>
<td>0.10689</td>
<td>0.01342</td>
</tr>
</tbody>
</table>

**Dimension Reduction Analysis for the mediating effect of resource transfer in the relationship between competitive industrial networks and diffusion for product co-creation**

The dimension reduction analysis on the other hand is employed to identify the extent to which each canonical function is able to account for the shared variance between the data sets and also allows the researcher to test the hierarchical arrangements of the functions for statistical significance. As noted from the result in the table 3 above, it can be deduced that the full model (1-3) is statistically significant and also accounted for the largest amount of shared variance between the two data sets (i.e. \( 1-\lambda = 0.68511 \approx 68.5\% \) ) with F (20, 1344.18) =8.11742. The functions 2-3 and 3-3 did not explain a statistically significant amount of shared variance between the variable sets hence significant with their respective p-values being greater than the 5 percent level of significance.

Table 3 Dimension Reduction Analysis for the mediating effect of resource transfer in the relationship between competitive industrial networks and diffusion for product co-creation

<table>
<thead>
<tr>
<th>Roots</th>
<th>Wilk's L</th>
<th>F</th>
<th>Hypoth Df</th>
<th>Error Df</th>
<th>Sig. of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 TO 3</td>
<td>0.13489</td>
<td>8.11742</td>
<td>20.00</td>
<td>1344.18</td>
<td>0.000</td>
</tr>
<tr>
<td>2 TO 3</td>
<td>0.96162</td>
<td>1.33445</td>
<td>12.00</td>
<td>1074.47</td>
<td>0.193</td>
</tr>
<tr>
<td>3 TO 3</td>
<td>0.98566</td>
<td>1.12221</td>
<td>6.00</td>
<td>614.00</td>
<td>0.347</td>
</tr>
</tbody>
</table>
Canonical correlations for the first canonical function concerning mediating effect of resource transfer in the relationship between competitive industrial networks and diffusion for product co-creation

Given the canonical correlation squared value of each function, only the first canonical function was considered noteworthy in the context of the analysis since it explained a substantial portion of the variance. The last two canonical functions only explained a smaller portion of the variance shared between the variable set after the extraction of the prior function (refer table 3). Hence a canonical correlation analysis for only the first canonical function concerning the correlation between the variables is created. In order to determine the extent to which the variables in the two sets relate to each other using the first canonical function, the standardized or the structural coefficients ($r_s$) of the respective variables are used. The results from this analysis indicated that, the variables internal factors and external contributed significantly to or relevant to the dependent set (competitive industrial network). This is due to the fact that from the table 4 these variables had their respective structure coefficient to be greater than 0.45 and also sharing larger amount of variations within the set. The other side of the equation of the first canonical function from the table 4 above additionally involves the predictor set of variables. The results from the table therefore points out that the variable competitive industrial network, positively relates to resource transfer and thus proves to be relevant or significantly contribute to the predictor set with a structure coefficient of 0.83 which were substantially greater than 0.45 and also share the largest amount of variation within the set. Finally the analysis shows that resource transfer is also positively correlated to innovation diffusion for product co-creation and this has structure coefficient of (67799) which is woefully lower than the threshold of 0.45.

**DISCUSSIONS**

Empirical results support the prediction that resource transfer mediates the relationship between acquisition of competitive industrial networks and innovation. In this second set of hypothesis, it is argued that the ultimate effect of the acquisition of competitive advantage is to drive innovation such as product co-creation but this is mediated by resource transfer. The results shows that competitive industrial network, positively relates to resource transfer and

**Note:** Structure coefficients ($r_s$) greater than 0.45 are underlined. Coefficients= standardized canonical function coefficients; $r_s$=structure coefficients; $r_s^2$ = squared structure coefficient.
thus proofs to be relevant or significantly contribute to the predictor set with a structure coefficient of .83. The plausible explanation is that the competitive industrial networks acquired from internal and external factors helps to facilitate resource transfer among firms in the cluster which ultimately propels them to achieve innovation.

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