A canonical correlation analysis of the impact of social capital on market performance of Sesame in Nasarawa State, Nigeria

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The study utilized canonical correlation analysis to determine the impact of social capital on market performance of sesame. A random sample of 100 middlemen consisting of 40 wholesalers and 60 retailers was proportionately drawn from rural and urban sesame markets in the three agricultural zones of Nasarawa State. Data analysed included, market performance variables such as net marketing margin, farmer's share and return on investment, while social capital variables were value of assets achieved through collective action, amount of credit and number of marketing information both from social relationships. Results showed a high degree of association between market performance and social capital variables. The important variables that made sizeable relative contribution were net marketing margin, farmer's share, return on investment (market performance variables), amount of credit and number of marketing information both from social relationships (social capital variables). Furthermore, the degree of association between the two sets of variables was predicted by the redundancy index of the two variables. Proper use of these variables by marketers will inevitably ameliorate the intractable constraints of the marketing system of sesame in Nasarawa State. Public policy intervention revolves around facilitating desirable relationships in existing social organizations.

Key words: Sesame, canonical correlation, redundancy index, social capital, net marketing margin, farmer's share, return on investment.

INTRODUCTION

Sesame is an important export farm produce in Nasarawa State. The bane for harnessing the full potential of the crop for steady agricultural and economic development has been largely associated with a poorly developed produce marketing system. Low initial investment/capital, high transportation cost, poor storage facilities, limited access to formal credit, heavy imposition of taxes/levies and to some extent, ineffective dissemination of information were identified by Achike and Anzaku (2010) as constraints affecting market performance of sesame in Nasarawa State. These constraints are traces of a poorly developed marketing system and tackling them becomes necessary for improving sesame marketing system. The concept of social capital is imprecise, illusive, multidimensional and context-dependent and lends itself to multiple definitions, interpretations and uses (Fafchamps and Minten, 1999; Daniel et al., 2003; Gotschi et al., 2006; Sabatini, 2006). Social capital embodies social dimensions such as social networks, trust, reciprocity, social norms and collective actions which can be harnessed for the wellbeing of individuals and the entire society. Social capital has the potential to facilitate the accrual of economic benefits to individuals and groups. Thus, social capital includes the specific benefits of belonging to a group and the collective value of all social networks of mutual benefits (Putnam, 2000; Perreault et al., 2003). Several examples of the use of social capital as an important integral factor in facilitating productive activity and economic success.
have been cited in the literature. Specifically, social capital has been identified as one of the many inputs that can be used along with others such as labour, physical and human capital to improve market performance (Fafchamps and Minten, 1999; Beugelsdijk and Schalk, 2003). As noted by Fafchamps and Minten (1999), traders could use relationships in organization to overcome obstacles such as poor market institutions, high search costs and imperfect asymmetric information that are typical of commodity markets in developing countries. Evidence by Fafchamps and Minten (1999) further indicates that social capital enables traders to deal with each other in a more trustworthy manner by granting and receiving credit, exchanging price information and economizing on quality inspection. The role of social capital being capable of sustaining capacity for collective action especially in the supply of public goods was emphasized (Johnson et al., 2002; Sabatini, 2006). Fafchamps and Minten (1999) used appropriate social capital indicators and performers proxies applicable to their situation to empirically establish the impact of social capital on the performance of agricultural trade in Madagascar. In their analysis, each of the performance proxies was regressed on the set of social capital variables identified. Similar analysis related social capital to ethnic business performance in Canada (Perreault et al., 2003) and productivity of agro-enterprises in Colombia (Johnson et al., 2002). Canonical correlation analysis is suitable for simultaneous prediction of multiple dependent variables from multiple independent variables in order to quantify the strength of their relationships. The present study explored the use of canonical correlation analysis.

Canonical correlation analysis facilitates the study of interrelationships between sets of multiple dependent variables and multiple independent variables. Social capital has enormous potential for improving the performance of the marketing system of sesame and indeed other crops characterized by especially inadequate information dissemination and poor funding (Chikwendu, 2003; Ike and Chukwuji, 2005; Ajani, 2005). Social capital is a relatively cheap resource that can be explored with other inputs as a strategy for improving market performance of sesame. The specific objective of the study was to principally determine the impact of social capital and other control variables on market performance of sesame.

MATERIALS AND METHODS

Study area

The study area was Nasarawa state. It is located between latitudes 7° 45’ and 9° 25’ N and between longitudes 7° and 9° 37’ E Greenwich meridian (Marcus and Binbol, 2007). The state is a major producer of sesame, rice, cassava, melon, yam and groundnut. Sesame has been a major cash crop produced in commercial quantities in Doma, Lafia and Nasarawa Local Government Areas of the State. Sesame production and land area cultivated annually in the state were estimated at 41570 metric tons and 46710 ha, respectively (NADP, 2010).

Sampling technique

Sampling was preceded by a reconnaissance survey and a list consisting of a sampling frame of 112 wholesalers and 213 retailers was determined. The sampling frame comprised small, medium, and large scale middlemen.

A random sample, consisting of 40 wholesalers and 60 retailers was proportionately drawn from the main rural and urban sesame markets in the three agricultural zones of Nasarawa state.

Data collection

Primary data for the study reflecting social, physical human capital variables and labour which could have impact on market performance were collected by trained enumerators through the use of questionnaire. The study was designed primarily to determine the impact of social capital on market performance beyond its possible interactions with labour, physical and human capital. Hence, the use of labour, human and physical capital as control variables. Locations were added to control for differences in competition and business environment across space. The social capital indicators considered important and used in the analysis included amount of credit from social relationships such as friends, relatives, social contact and membership of organizations (represented as AOCFSC), number of market information from social relationships such as friends, relatives, social contact and membership of organizations (represented as NOIS) and value of assets/physical infrastructures achieved through collective action (represented as VOATCA). As there is no universally accepted measure of social capital, the choice of variables depended largely on what the researchers considered relevant to the prevailing market situations. Market performance variables selected for the study were net marketing margin, farmer’s share and return on investment. Both net marketing margin and farmer’s share are components of marketing margin. A decrease in the value of one will lead to an increase in the other. Their separate considerations are important because net marketing margin accrues to the middlemen as profit, while farmer’s share is a measure of operational efficiency of middlemen and economic power of farmers. Return on
investment is an important consideration for determining long-run competitiveness and investment in new market opportunities. Human capital consisted of education and experience, while physical capital comprised the equipment commonly used by middlemen. These equipment include calculators, weighing scales, wheelbarrows, displaying wares, winnowers, mobile phones, motorcycles and even vehicles.

Data analysis

The main analytical technique employed in the study was canonical analysis. The general form of canonical analysis adapted by Hair et al., (1998) is stated as:

\[ Y_1 + Y_2 + Y_3 + \ldots + Y_n = X_1 + X_2 + X_3 + \ldots + X_M \tag{1} \]

(metric, non metric) \quad (metric, nonmetric)

Where:

\[ Y_{1+} Y_{2+} Y_{3+} \ldots + Y_{N+} = \text{dependent variables. These constitute a linear combination of a set of original variables that form the unobserved or latent canonical variable or variate.} \]

\[ X_{1+} X_{2+} X_{3+} \ldots + X_{M+} = \text{independent variables. These constitute a linear combination of a set of original variables that form the unobserved or latent independent canonical variable or covariate.} \]

Both metric and non-metric data can be used for either the dependent or independent variables. The canonical correlation is optimized such that the linear correlation between the two variables is maximized. Standardized canonical coefficients are obtained by applying a linear equation to the original (observed) dependent variables to create a single unobserved or latent dependent variable and another equation to the original (observed) independent variables to create a single unobserved or latent independent variable (Sherry and Henson, 2007). The model specifications of the study are as stated:

\[ Y_{1+} Y_{2+} Y_{3} = X_{1+} X_{2+} X_{3+} X_{4+} X_{5+} X_{6+} X_{7+} X_{8+} \ldots \tag{2} \]

Where:

\[ Y_1 = \text{net marketing margin (₦)(naira)} \]
\[ Y_2 = \text{farmer's share (％)} \]
\[ Y_3 = \text{return on investment (％)} \]
\[ X_1 = \text{amount of credit (₦) obtained from social relationships such as relatives, social contacts and membership of organizations (represented as AOCFSC).} \]
\[ X_2 = \text{number of market information obtained from social relationships such friends, relatives, social contacts and membership of organizations (represented as NOIS)} \]
\[ X_3 = \text{value of assets (₦) achieved through collective action (represented as VOATCA)} \]
\[ X_4 = \text{education (years)} \]
\[ X_5 = \text{experience (years)} \]
\[ X_7 = \text{equipment (₦)(naira)} \]
\[ X_8 = \text{location (dummy)} \]

\[ Y_{1} \text{ to } Y_{3} \text{ are market performance indicators, } X_{1} \text{ to } X_{8}, \text{ social capital and control variables.} \]

The statistical package for social science (SPSS) output used in the interpretation included Wilks' lambda statistic, canonical correlation coefficients and their squares, canonical weights and structure correlation coefficients. The redundancy index (RI) was computed using the formula:

\[ RI_y = \frac{\sum r_i^2}{n} \times R_i^2 \ldots \tag{3} \]

\[ RI_x = \frac{\sum r_i^2}{n} \times R_i^2 \ldots \tag{4} \]

Where:

\[ RI_y = \text{Stewart-Love redundancy index of the dependent variate of the first function} \]
\[ RI_x = \text{redundancy index of the independent variate of the first function.} \]
\[ R_i^2 = \text{canonical correlation coefficient squared} \]
\[ r_i^2 = \text{structure correlation coefficient of the } i^{th} \text{ variable squared} \]
\[ n = \text{number of variables in each variate} \]

For situations where more than one function is significant, the overall RI of each variable is the sum of redundancy indexes of all the functions.

RESULTS

Measures of overall model fit for canonical correlation analysis

The test statistics of the full model are presented in Table 1. Wilks' lambda (Λ) test statistic of 0.03956 shows that the full model is statistically significant at p < 0.001. This is an indication that the canonical model has sufficiently explained the relationship between the dependent and independent variable sets. Wilks' λ is the most commonly used test statistic, although other tests such as Pillai's, Hotelling's and Roy's with somewhat different theoretical framework can also be used to yield similar results. Wilks' lambda is a test of the significance of the differences between the means of the respective groups. A value
Table 1. Evaluation of the full canonical model relating social capital to market performance of sesame.

<table>
<thead>
<tr>
<th>Multivariate tests of significance</th>
<th>Wilks’ lambda</th>
<th>Approximate F statistics</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test statistic</td>
<td>Value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wilks’ lambda</td>
<td>0.03956</td>
<td>22.04981</td>
<td>0</td>
</tr>
<tr>
<td>Pilli’s trace</td>
<td>1.15461</td>
<td>7.11707</td>
<td>0</td>
</tr>
<tr>
<td>Hotelling’s trace</td>
<td>19.47974</td>
<td>71.15518</td>
<td>0</td>
</tr>
<tr>
<td>Roy’s</td>
<td>0.95058</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Eigen values and canonical correlations</th>
<th>Eigen value</th>
<th>Percent</th>
<th>Cumulative percent</th>
<th>Canonical function</th>
<th>Coefficient (R&lt;sub&gt;c&lt;/sub&gt;)</th>
<th>Canonical correlation coefficient squared(R&lt;sub&gt;c2&lt;/sub&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.237</td>
<td>98.752</td>
<td>98.752</td>
<td>1</td>
<td>0.975</td>
<td>0.951</td>
<td></td>
</tr>
<tr>
<td>0.216</td>
<td>1.11</td>
<td>99.862</td>
<td>2</td>
<td>0.422</td>
<td>0.178</td>
<td></td>
</tr>
<tr>
<td>0.027</td>
<td>0.138</td>
<td>100</td>
<td>3</td>
<td>0.162</td>
<td>0.026</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimension reduction analysis</th>
<th>Canonical function</th>
<th>Wilks lambda statistic</th>
<th>Approximate F statistics</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>to 3</td>
<td>0.03956</td>
<td>22.04981</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2 to 3</td>
<td>0.80063</td>
<td>1.51191</td>
<td>0.11</td>
<td></td>
</tr>
<tr>
<td>3 to 3</td>
<td>0.97379</td>
<td>0.40829</td>
<td>0.872</td>
<td></td>
</tr>
</tbody>
</table>

Source: Analysis of survey data.

close to 1 means there is no difference, whereas a value close to 0 means there is a difference between the groups. An F test is then carried out to facilitate the interpretation of the significance of the differences between the variables. The bivariate correlation between the dependent and independent canonical variates yielded three canonical functions otherwise called dimension or simply variates, equal to the number in the smaller variable set. The result of the dimension reduction analysis shows that only the first function was significant at p < 0.001 and therefore useful for interpretation. Accordingly, the canonical correlation coefficient (R<sub>c</sub>) of 0.975 of the first function is an indication of a high degree of association that existed between the dependent (market performance) and independent (social capital / control) variables. Even the squared canonical correlation coefficient (R<sub>c2</sub>) of 0.951, representing the amount of shared variance between the variates can be regarded as high. The significant canonical function with eigen value of 19.237, accounted for 98.752% of the variance between the variates.

Contribution and importance of social capital/control variables to market performance indicators

The canonical weights of the dependent (market performance) and independent (social capital/control) variables of the only significant function are presented in Table 2. Canonical weights are also called standardized canonical coefficients. The relative contribution of the dependent variables to the dependent variate in order of decreasing magnitude of the canonical weights are net marketing margin (0.916), return on investment (0.093) and farmer’s share (0.003). The variables with the highest canonical weights on the independent variate were labour (0.733) and NOIS (number of market information from social relationships such as friends, relatives, social contact and membership of organizations) (0.280). Out of the six remaining variables with low canonical weights, AOCFSC(amount of credit from social relationships such as friends, relatives, social contact and membership of organizations), VOATCA (value of assets/physical infrastructures achieved through collective action), and location were inversely related to the independent variate.

The canonical loadings or structure coefficients (r<sub>c</sub>) were the outcome of simple correlation between the dependent/independent variables and their respective variates. Using the rule of thumb for considering canonical structure coefficients of 0.30 and above as being part of the canonical variable, net marketing margin (0.999), farmer’s share (-0.970), return on investment (0.942) for the dependent (market performance) variate and labour (0.994), NOIS (0.948), AOCFSC (0.607), equipment (0.373) and education (0.304) for the independent (social capital/control) variate were the important variables in the interrelationship. The remarkable differences in coefficients of variables and the negative signs which appear in some and disappear in others between canonical loadings and weights were possibly due to the existence of high multicollinearity. Multicollinearity could make canonical weights typically unstable. The redundancy index presented in Table 2 represents the amount of variance in the dependent set of variables explained by the variables in the independent
Table 2. Canonical weights, loadings and estimated redundancy index of the significant function.

<table>
<thead>
<tr>
<th>Variate/Variables</th>
<th>Canonical weights</th>
<th>Canonical loadings</th>
<th>Redundancy index</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net marketing margin</td>
<td>0.916</td>
<td>0.999</td>
<td></td>
</tr>
<tr>
<td>Farmer’s share</td>
<td>0.003</td>
<td>-0.970</td>
<td></td>
</tr>
<tr>
<td>Return on investment</td>
<td>0.093</td>
<td>0.942</td>
<td></td>
</tr>
<tr>
<td>Dependent variate</td>
<td></td>
<td></td>
<td>0.896</td>
</tr>
<tr>
<td><strong>Independent variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AOCFSC</td>
<td>-0.016</td>
<td>0.607</td>
<td></td>
</tr>
<tr>
<td>NOIS</td>
<td>0.280</td>
<td>0.948</td>
<td></td>
</tr>
<tr>
<td>VOATCA</td>
<td>-0.009</td>
<td>0.160</td>
<td></td>
</tr>
<tr>
<td>Labour</td>
<td>0.733</td>
<td>0.994</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>0.040</td>
<td>0.304</td>
<td></td>
</tr>
<tr>
<td>Experience</td>
<td>0.026</td>
<td>-0.092</td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td>0.020</td>
<td>0.373</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>-0.013</td>
<td>0.089</td>
<td></td>
</tr>
<tr>
<td><strong>Independent variate</strong></td>
<td></td>
<td></td>
<td>0.301</td>
</tr>
</tbody>
</table>

Source: Analysis of survey data.

set and vice versa. The dependent variables relating to market performance explained 89.6% of the variance in the variate for the independent (social capital/control) variables. Conversely, the independent variables relating to social capital/control variables explained 30.1% of the variance for the dependent (market performance) variables.

Discussion

From the results, the interrelationships among the specific measures of market performance and social capital/control variables can be very useful if properly harnessed for the improvement of the marketing system of sesame in Nasarawa State. The important variables to be considered in the interrelationships are net marketing margin, farmer’s share, return on investment, labour, NOIS (number of market information from social relationships such as friends, relatives, social contact and membership of organizations), AOCFSC (amount of credit from social relationships such as friends, relatives, social contact and membership of organizations), equipment, and education. The interplay of these variables which represent social capital (NOIS, AOCFSC), physical capital(equipment), human capital(education) and labour can bring about significant improvement in the marketing system of sesame. This will have to be preceded by determining the optimum level of equipment and labour needed, continual upgrading of the human capacity of market participants and facilitating them to have social relationships with others. Social capital may not generate benefits on equal basis to all market participants but harnessing it can be a starting point for the poor and other vulnerable groups who are always credit rationed and have poor access to market information. Government, non-governmental organizations and development agencies have a role to play in facilitating desirable social relationships in existing social organizations as well as providing the functional education required by marketers.

Conclusion

The result of the study showed a high degree of association between market performance and social capital/control variables. Using canonical correlation analysis, it was clear that the contribution of market performance and social capital/control variables varied. Out of the three market performance variables, net marketing margin made the highest relative contribution, while farmer’s share made the least. The social capital/control variables which contributed sizeably were labour and NOIS. However, the use of canonical structure analysis indicated that all the market performance variables (net marketing margin, farmer’s share, return on investment) and some of the social capital/control variables such as AOCFSC, NOIS, labour, education, and equipment are important in the relationship. Both canonical correlation and structure analysis complement each other for clarity of interpretation especially where multicollinearity exists as in the case of the study. Redundancy analysis showed that market performance variable (dependent variate) highly predicted the values of the original social capital/control variables. Similarly, the social capital/control variable (independent variate) reasonably predicted the values of the original market performance variables. From the foregoing, it is possible to use social capital especially NOIS (number of marketing information from social relationships) and AOCFSC (amount of credit...
from social relationships) as well as labour, education and equipment to improve the market performance of variables such as net marketing margin, farmer’s share and return on investment. Proper use of these variables by marketers will inevitably ameliorate the intractable constraints of the marketing system of sesame in Nasarawa State.

REFERENCES


