



OECD WORKSHOP ON BUSINESS AND CONSUMER TENDENCY SURVEYS

**Evaluating the impact of disaggregated survey panel responses on
Business Tendency Survey Results**

**GM Pellissier, Bureau for Economic Research (BER)
DG Nel, Centre for Statistical Consultation, Stellenbosch University
South Africa**

Rome, September 2006

*/CIRET06Paper,submitted 03/07/2006

28th CIRET Conference, Rome, September 2006

Session: III Special Topics

XXX

Evaluating the impact of disaggregated survey panel responses on Business Tendency Survey Results

GM Pellissier *

DG Nel **

Abstract

The Bureau for Economic Research(BER) at Stellenbosch University, South Africa, has been conducting IFO type business tendency surveys(BTS) in the SA business environment since the early 1950's. These surveys are based on panels of participants from the respective economic sectors. Respondents to the surveys participate on a voluntary basis. In order to maintain panel representation, survey panels are regularly updated with new participating members. The implications are that business tendency survey results are based on the feedback of old/new, regular/irregular participating panel members.

It is generally accepted in BTS practice that there should be no measured response differences between those respondents participating on a more regular basis as those results measured from less active participants. However, the question arises as to the impact on the survey results generated by different categorized participation of survey respondents based on individual response rates.

This paper endeavours to differentiate between the survey results generated by categorized participation of survey respondents according to the following three groups of response rates: (i) the Regulars, those respondents participating most of the time i.e. more that 80% response rate, (ii) the Irregulars, those respondents participating on a response rate less than 80% but more than 60% and (iii) the Occasionals, those respondents participating on a less than 60% response rate.

For purpose of this study the panel of respondents to the BER's quarterly surveys in the Building, Manufacturing and Retail sectors were traced for a specific survey quarter for each individual respondent over a 16 time period of ongoing surveys. The numbers of responses over

* Bureau for Economic Research(BER) ** Centre for Statistical Consultation at Stellenbosch University, South Africa

the sample period were noted and the original panel disaggregated into sub-panels according to the above-mentioned three response categories. Normal BER survey runs were implemented for each of the three categorized groups over the sample period 2001q2:2005q1

Research findings under the hypothesis of no differences between the survey results of regular, irregular and occasional respondents were analyzed for survey questions covering Business Confidence, Business Activity and Purchasing Prices. Statistical analysis by *Repeated measures Anova* confirmed in most cases the notion that there would be no measured response differences between those respondents participating on a more regular basis as to those results measured from less active participants. Cyclical evaluations of the respective survey results would also be supportive of the hypothesis of no differences. However, substantial differences were noted in terms of levels of responses.

Key Words: Disaggregated survey panel response, Repeated measures Anova

JEL Classification: C80

1. Introduction

The Bureau for Economic Research(BER) at Stellenbosch University, South Africa, has been conducting IFO type business tendency surveys(BTS) in the SA business environment since the early 1950's. These surveys are based on panels of participants from the respective economic sectors. Respondents to the surveys participate on a voluntary basis. In order to maintain panel representation, survey panels are regularly updated with new participating members. The implications are that business tendency survey results are based on the feedback of old/new, regular/irregular participating panel members.

It is generally accepted in BTS practice that there should be no measured response differences within the survey panel between those respondents participating on a more regular basis as those results measured from less active participants. However, the question arises as to the impact on the survey results generated by different categorized participation of survey respondents based on individual response rates. As far as can be deduced, the matter has not been researched by BTS institutions.

It was suggested, in a response put forward by the BER at the OECD(2005) workshop on BTS methodology, that the BER should further the subject within the BER's survey environment. This paper endeavours to differentiate between the survey results generated by categorized participation of survey respondents according to three groups of response rates within the panel of responses to the BER's quarterly surveys in the Building, Manufacturing and Retail sectors of the South African economy, and based on three survey questions covering business confidence, prices and activity.

2. Research objectives, Hypothesis and Methodology

The purpose of this study is to differentiate between the survey results generated by categorized participation of survey respondents according to the following three categories of response rates :

1. the Regulars, those respondents participating most of the time i.e. more that 80% response rate,
2. the Irregulars, those respondents participating on a response rate less than 80% but more than 60% and
3. the Occasionals, those respondents participating on a less than 60% response rate (this group also includes most of the natural attrition in panel membership).

2.1 Survey Runs

To differentiate between the respective categorized response results of Regular, Irregular and Occasional respondents, each unit was evaluated by separately re-running the applicable BER quarterly survey program in the Building, Manufacturing and Retail sectors for each survey quarter.

2.1.1 Survey Sample

The individual respondents to the BER's business tendency surveys in the respective sectors for the second and third quarters of 2001 were each aggregated into research samples(panels) as set out

in Table 1. These samples was taken as the point of departure in tracing each individual panel member's respective survey responses for each survey quarter over the sample period 2001q2:2005q1.

Table 1. Survey sample panel membership

Survey	Panel	Response Groups		
		Regular(A)	Irregular(B)	Occasional(C)
		A≥80%	60%≤B<80%	C<60%
Building	261	42(16,1%)	55(21,1%)	164(62,8%)
Manufacturing	478	74(15,5%)	99(20,7%)	305(63,8%)
Retail	406	75(18,5%)	95(23,4%)	236(58,1%)

There does not seem to be any big differences between the response rates of the three categorized sectoral survey groups. On average 17% of any panel seems to qualify as Regular(Group A), 22% as Irregular(Group B) and 61% as Occasional(Group C) respondents. Of interest is that 13(5,0%) of the Building, 26(5,4%) of Manufacturing and 29(7,1%) of the Retail sector's panel members participated in all surveys over the sample period.

2.1.2 Survey Results

The BER's normal quarterly survey programs were re-run over the sample period 2001q2:2005q1(16 survey quarters) for the respective sectors, based on separate inputs of Regular, Irregular and Occasional respondents. BER survey results are quantified according to the 'Net Balance' principle of 'weighted' responses - the methodology regarding the various surveys of the BER is well documented – see Stuart (1987) and De Jager (1995).

Although numerous data series can be collated over the sample period for each survey question, differentiated into three response groups, only the categorized responses to the following three types of survey questions within each sector were identified for further analysis :

- Business Confidence
- Business Activity
- Purchasing Prices

2.2 Statistical Analysis of Survey Results

It is generally accepted in BTS practice that there should be no measured response differences between those respondents participating on a more regular basis as those results measured from less active participants. To evaluate the BTS assumption of no measured differences between categorized survey response participation, the statistical procedure of 'Repeated measures Anova' was implemented to evaluate the following hypothesis :

Hypothesis H_0 : "That the three groups of data series representing the survey responses as generated by the participating Regular, Irregular and Occasional panel members are independent samples from the same distribution i.e. are in association with each other"

For purpose of this paper, the results of the statistical analysis are grouped according to the underlying economic functions of the survey question i.e. Business Confidence, Business Activity and Purchasing Prices and analyzed according to Regular, Irregular and Occasional panel response. The primary focus will be on the interactive analysis over the total survey period, while less attention will be given to the within survey period analysis.

2.2.1 Repeated measures Anova

The purpose of repeated measures analysis of variance (RM_Anova) is to determine if significant changes occurred over time among different treatments/groups. In our situation we compare three groups of responses (Regular, Irregular and Occasional participating panel members) over a 16 time period of quarterly BTS surveys. The responses of each participating respondent observed over the survey quarters are correlated and thus not independent observations. In fact it can be regarded as a time series. Thus the responses of groups of participants will also be correlated over the survey quarters. To accommodate for this correlation structure a RM_Anova is more appropriate than a one-way ANOVA at each survey quarter or a two-way ANOVA with both survey quarters and respondents as factors, which would assume that the survey quarters are independent, which is not the case.

The repeated measures ANOVA procedure as applied here is described in detail in Dunn OJ and Clark V.A, (1987). The analysis is done under the assumption of compound symmetry, which assumes that enough power for the analysis is done here. If a completely unstructured assumption is used, the degrees of freedom for the error variances would be greatly reduced, yielding much less power. Whenever the interaction effects between Surveys and Time(Quarters) are in our case significant, then these interactions should be interpreted. Otherwise we may interpret the differences in responses due to the main effects of the Surveys and Quarters directly. (Milton JS(1990), pp 535)

2.2.2 Implementing RM_Anova analysis on categorized BER survey response data

For purpose of this paper the STATISTICA 7.1 package program algorithm of RM_Anova was implemented to test the hypothesis of similarity between the survey results generated by different respondents participation within each survey quarter, over a longitudinal period i.e. over the survey period as well as between quarterly responses. Thus there are two main effects : i) survey responses over the total period(called 'Survey') and ii) survey responses within each survey quarter(called 'Quarter'). The interactive correlation structure between Survey and Quarter needs to be defined and

we assumed a compound symmetry structure (equal correlation). If interaction is not significant (i.e. $p > 0,05$), then the main effects of Survey and Quarter may be interpreted and differences in response results among respondents be interpreted with a Bonferroni multiple comparison procedure.

RM_Anova analysis was implemented to evaluate the stated hypothesis between the disaggregated response results on three BTS questions, within three economic sectors of participants to the relevant BER surveys. Results of RM_Anova 'Survey*Quarter' analysis are displayed in graphical terms as individual quarter 95% confidence interval plots and fitted Distance Weighted Least Square lines. While results of 'Survey' RM_Anova analysis are displayed in graphical terms as individual survey 95% confidence plots and critical multiple comparisons in terms of Bonferonni p-values.

3. Analysis of survey responses evaluating Business Confidence

Business confidence as measured by the BER* is based on the following survey question :

"How do you find current Business Conditions ?"	Satisfactory	Unsatisfactory
---	--------------	----------------

* - The BER's methodology in evaluating business confidence has been covered by Pellissier(2002).

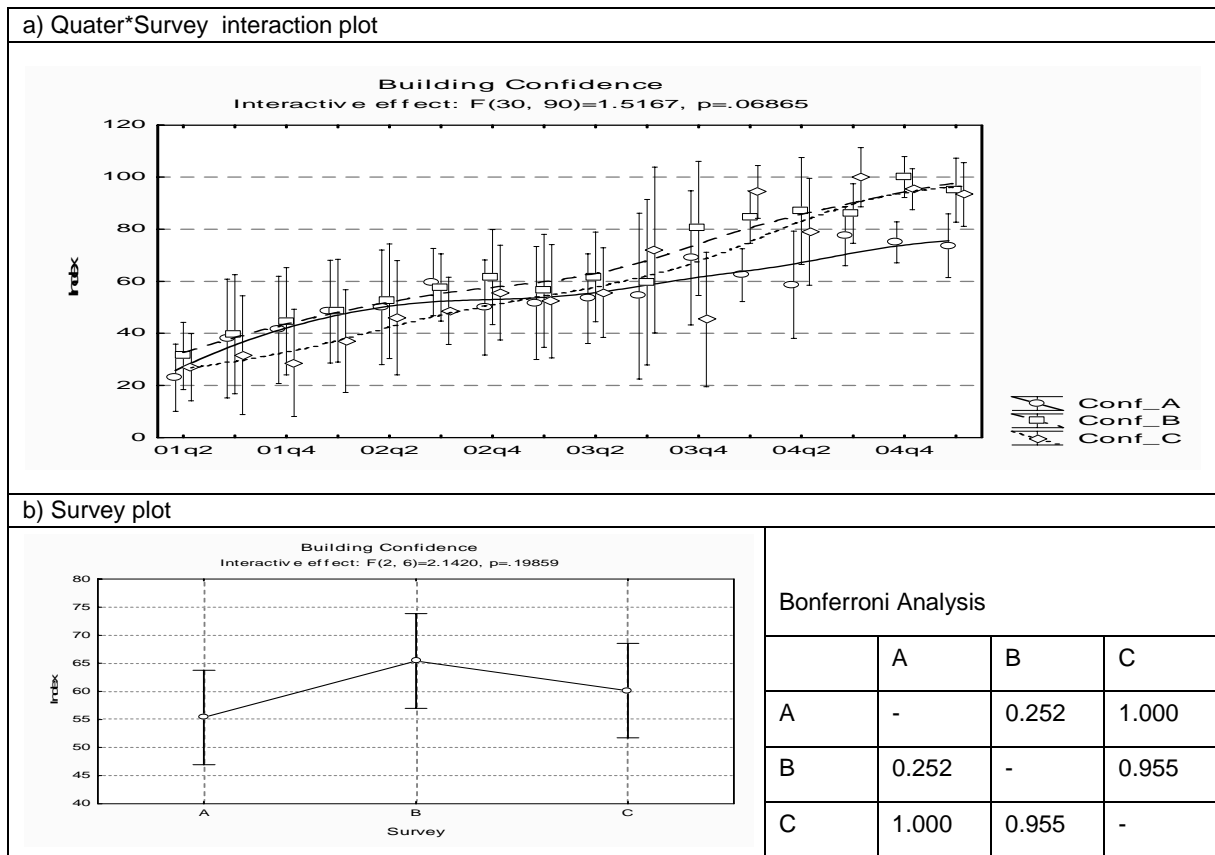
RM_Anova analysis was implemented to evaluate the stated hypothesis between the survey results on Business Confidence within the Building, Manufacturing and Retail sectors, based on the categorized response of Regular(A), Irregular(B) and Occasional(C) participants to the relevant BER surveys.

3.1 Building survey response results measuring 'Confidence'

Figure 1(a) gives a visual plot of the interaction effects due to Time(Quarter) and Survey. The three survey categories evaluating building confidence are relatively parallel. The level of confidence as measured by Regulars changed as from beginning 2003, in comparison with the other two categories, from higher to lower, but not significantly since the interaction p-value is still 0,069(main effects can thus be interpreted). Individual quarter-within-quarter period LSM analysis indicates some discrepancies in survey quarters 04q1 and 04q4. Individual paired quarter-to-quarter analysis indicate in terms of Bonferonni p-values that 52% of the comparisons can be rejected as being the same.

Notwithstanding 10 index points differences in Fig.1(b), the hypothesis of equal response between categorised Regular, Irregular and Occasional participants survey results, can not be rejected on a critical p-value of 0,198. A Bonferroni multiple comparison is actually not necessary but such a procedure indicates that Regular and Occasional as well as Irregular and Occasional participants differ less on a p-value of 0,100 than Regular and Irregular ($p=0,252$) participants.

Figure 1 Interactive Building Confidence Analysis

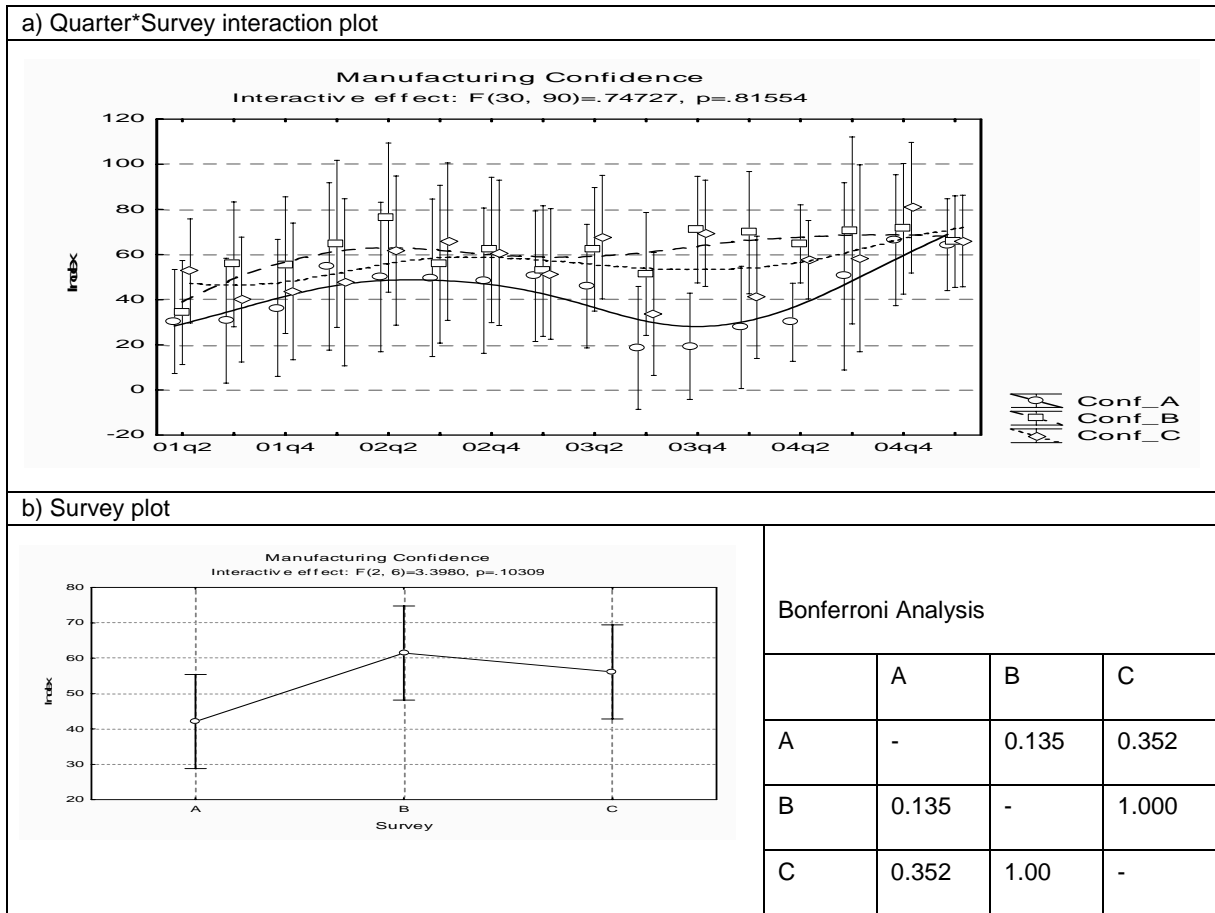


3.2 Manufacturing survey response results measuring ‘Confidence’

The interaction plots in Fig.2(a) display strong cyclical relationships between the data series representing the three survey categories evaluating manufacturing confidence. The level of confidence, as measured by Regulars, tracks in comparison to the other two categories, on a somewhat lower level. There is however no significant interaction ($p=0.815$) between Quarter and Survey and main effects can thus be interpreted. Individual quarter-within-quarter period LSM analysis indicate some discrepancies in survey quarter 03q4. Individual paired quarter-to-quarter analysis indicate in terms of Bonferroni p-values that only 2% of the comparisons can be rejected as being the same.

Based on as high as 20 index points differences in Fig.2(b), the hypothesis of equal response between Regular, Irregular and Occasional participants survey results, can almost be rejected with a critical p-value of 0,103, given a 10% significant level. A Bonferroni multiple comparison procedure indicates that Irregular and Occasional participants differ less on a p-value of 1,000 than Regular and Irregular ($p=0,135$) and Regular and Occasional ($p=0,352$) participants.

Figure 2 Interactive Analysis of Manufacturing Confidence

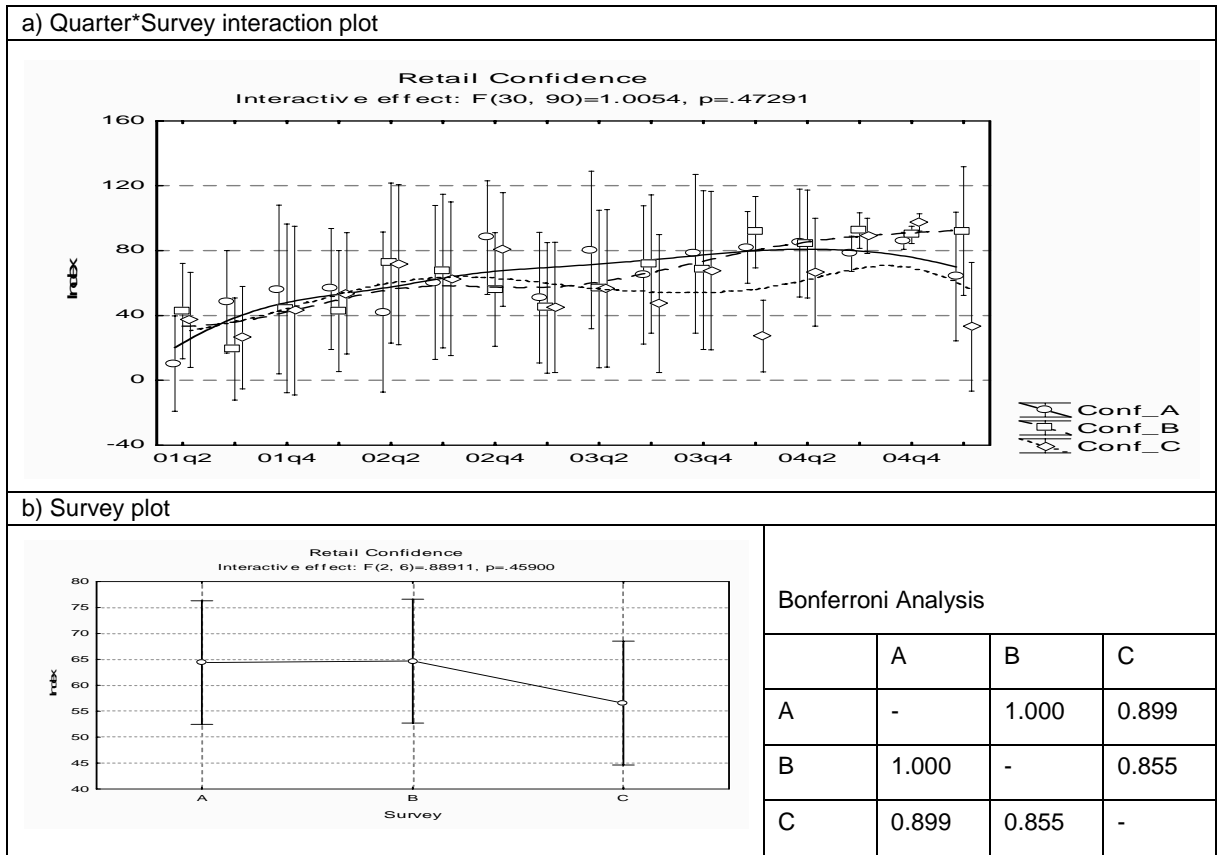


3.3 Retail survey response results measuring ‘Confidence’

It can be deduced from the interaction plots in Fig.3(a) that the data series representing the three survey categories evaluating retail confidence, seems in cyclical terms to be somewhat erratic in comparison to each other. The interactions between Survey and Quarter are however not significant with a p-value of 0,473. Some discrepancies can be noted in survey quarter 04q1. Individual quarter-to-quarter analysis indicates in terms of Bonferonni p-values that only 5% of the comparisons can be rejected as being the same.

The hypothesis of equal response between categorised Regular, Irregular and Occasional participants survey results, can not be rejected, based on a critical p-value of 0, 459 for the Survey period interrelationship. In Fig.3(b) a Bonferroni multiple comparison procedure indicates that a near perfect relationship ($p=1,000$) exists between all three pairs of participants.

Figure 3 Interactive Retail Confidence Analysis



3.4 Conclusion

Business Confidence, as measured by disaggregated panel responses to the BER's surveys in the three sectors of Building, Manufacturing and Retail seems on a statistically significant p-level of 5%, not to differentiate between the responses of Regular, Irregular and Occasional participants. However, similarity between survey responses can in the case of the Manufacturing sector marginally be rejected on a statistical significant p-level of 10%.

4. Analysis of survey responses evaluating Business Activity

Business activity as measured by the BER is based on the following survey question :

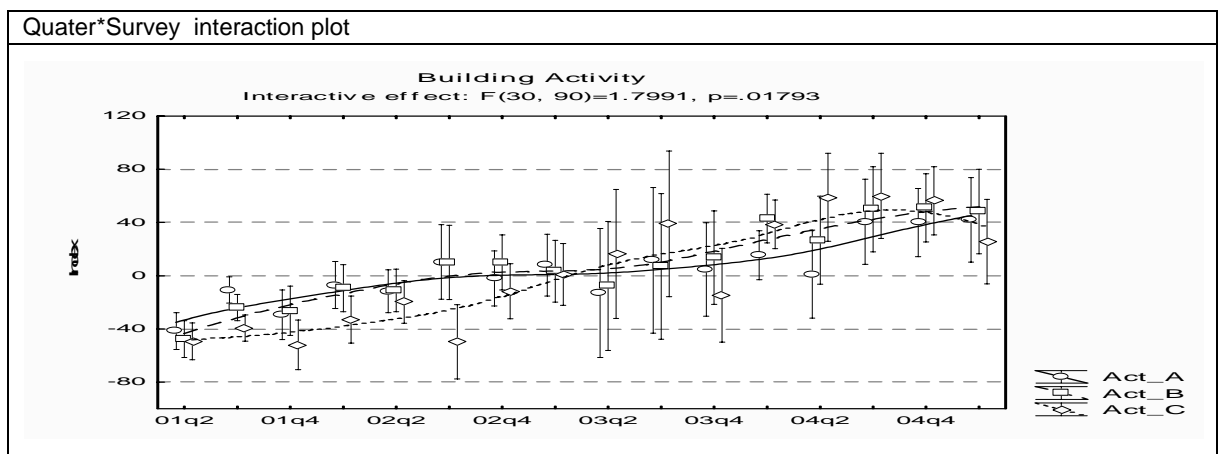
“Compared with the same quarter a year ago, are your Activity/Production/Sales(Volumes) ?”	Up	Same	Down
--	----	------	------

RM_Anova analysis was implemented to evaluate the stated hypothesis between the survey results on business activity within the Building, Manufacturing and Retail sectors, based on the categorized response of Regular(A), Irregular(B) and Occasional(C) participants to the relevant BER surveys.

4.1 Building survey response results measuring ‘Activity’

It can be deduced from the interaction plots in Fig.4 that the data series representing the three survey categories evaluating building activity seems in cyclical terms to be somewhat erratic in comparison to each other, with cyclical directional changes in 2003q1 and 2004q4. The evaluation of the Quarter*Survey period interaction effects indicate on a p-value of 0.018 that interactive(not parallel) relationships do exist between the three survey categories evaluating building activity. In terms of the RM_Anova analysis procedure the main effects of Survey and Quarter can thus not separately be interpreted. These interactions should then be analysed with appropriate Bonferroni procedures indicating that 44% of the paired quarter-to-quarter survey comparisons can be rejected as being the same, while individual quarter-within-quarter period LSM analysis indicates some discrepancies in survey quarter 02Q3.

Figure 4 Interactive Building Activity Analysis

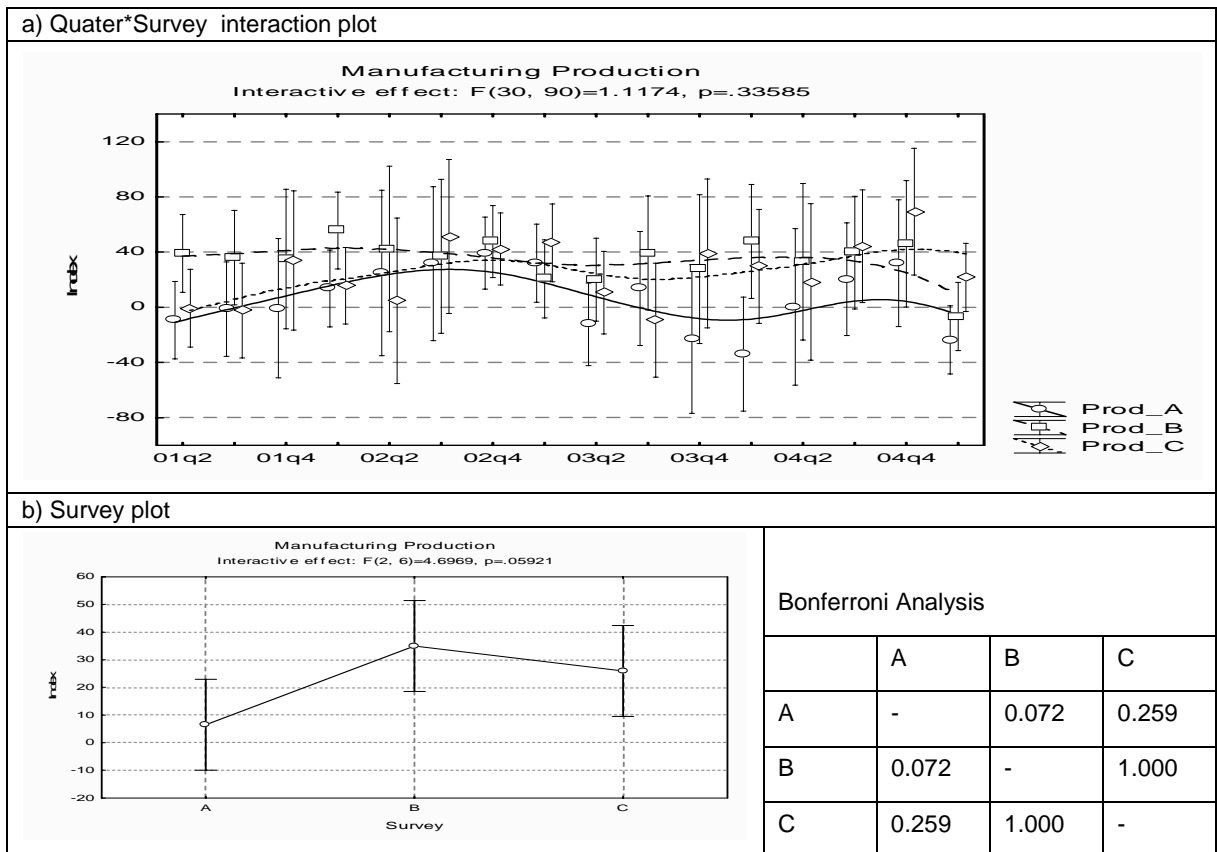


4.2 Manufacturing survey response results measuring ‘Production’

The interaction plots in Fig.5(a) display strong cyclical relationships between the data series representing the three survey categories evaluating manufacturing production. Production, as measured by Regulars, tracks in comparison to the other two categories, on a somewhat lower level. There is however not significant interaction ($p=0.336$) between Quarter and Survey to reject analysis of main effects. Individual quarter-to-quarter analysis indicates in terms of Bonferonni p-values that none of the comparisons can be rejected as being the same.

Based on as high as 30 index points differences in Fig.5(b), the hypothesis of equal response between Regular, Irregular and Occasional participants survey results can, given a 10% significant level, be rejected with a critical p-value of 0,059. Separately analyzed Bonferroni values indicate on a factor of 1,000 a near perfect relationship between Irregular and Occasional participants while lesser fits are measured between Regular and Irregular(0,072) and Regular and Occasional(0,259).

Figure 5 Interactive Manufacturing Production Analysis

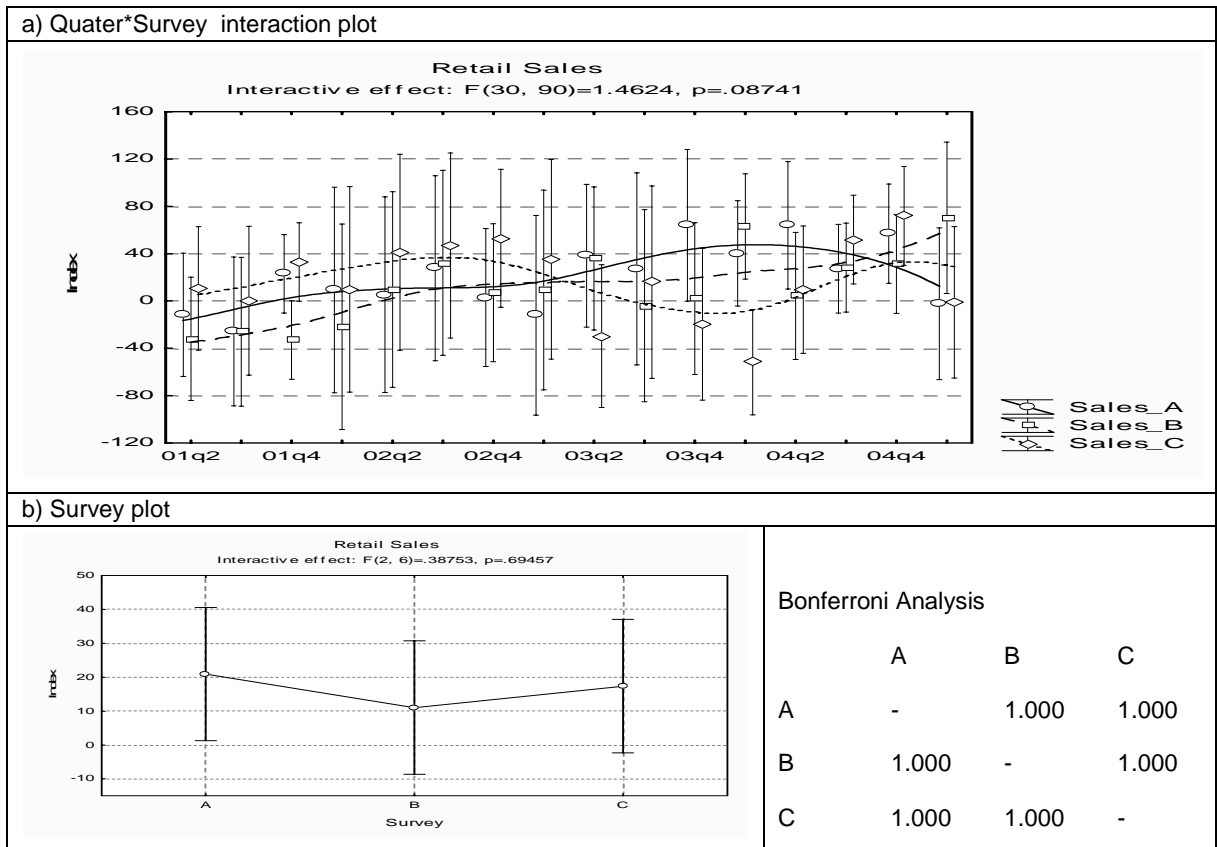


4.3 Retail survey response results measuring ‘Sales’

It can be deduced from the interaction plots in Fig.6(a) that the data series representing the three survey categories evaluating retail sales seems in cyclical terms to be somewhat erratic in comparison to each other, with cyclical directional changes in 2003Q1 and 2004Q3. The interactions between Survey and Quarter are however not significant with a p-value of 0,087 and main effects can thus be interpreted. Individual quarter-to-quarter analysis indicates in terms of Bonferonni p-values that none of the comparisons can be rejected as being the same.

The hypothesis of equal response between categorised Regular, Irregular and Occasional participants survey results, can not be rejected, based on a critical p-value of 0,694 for the Survey interrelationship. In Fig.6(b) a Bonferroni multiple comparison procedure suggest that a near perfect relationship exists between all three pairs of participants.

Figure 6 Interactive Retail Sales Analysis



4.4 Conclusion

Business Activity, as measured by disaggregated panel responses to the BER's surveys in the three sectors of Building, Manufacturing and Retail seems on a statistical significant p-level of 5%, not to differentiate between the responses of Regular, Irregular and Occasional participants in the Retail sector. Similarity between the disaggregated survey responses can however, in the case of the Manufacturing sector, be rejected on a p-level of 10%. No clear-cut interpretation can be laid down for the disaggregated responses in the Building sector.

5. Analysis of survey responses evaluating Purchasing Prices

Purchasing Prices as measured by the BER are based on the following survey question :

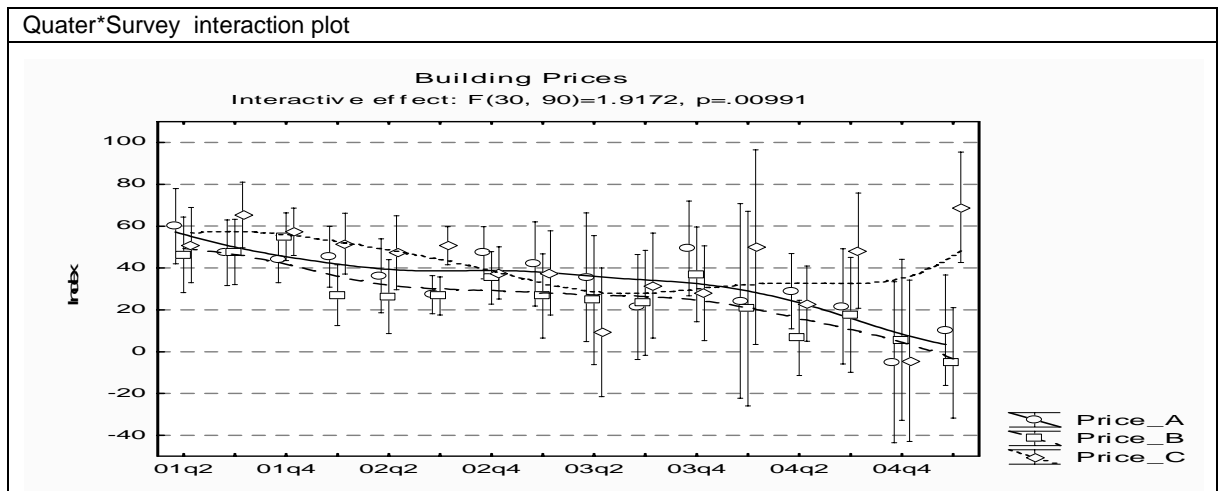
"Compared with the same quarter a year ago, is the rate of increase in the average Purchasing Prices ?"	Up	Same	Down
---	----	------	------

RM_Anova analysis were implemented to evaluate the stated hypothesis between the survey results on purchasing prices within the Building, Manufacturing and Retail sectors, based on the categorized response of Regular(A), Irregular(B) and Occasional(C) participants to the relevant BER surveys.

5.1 Building survey response results measuring 'Prices'

It can be deduced from the interaction plots in Fig.7 that the data series representing the three survey categories evaluating building prices seems, in cyclical terms to be somewhat erratic in comparison to each other, with cyclical directional changes in 2002q4 and 2004q1. The evaluation of the Quarter and Survey period interaction effects indicate on a p-value of 0.010 that interactive(not parallel) relationships do exist between the three survey categories evaluating building prices. The main effects can thus not be interpreted, meaning that the interaction between Quarter and Survey undermine individual Survey response analysis. These interactions should then be analysed with appropriate Bonferroni procedures indicating that individual paired quarter-to-quarter analysis can, in terms of Bonferonni p-values, be rejected in 18% of the cases as being the same, especially during 2004/2005 period

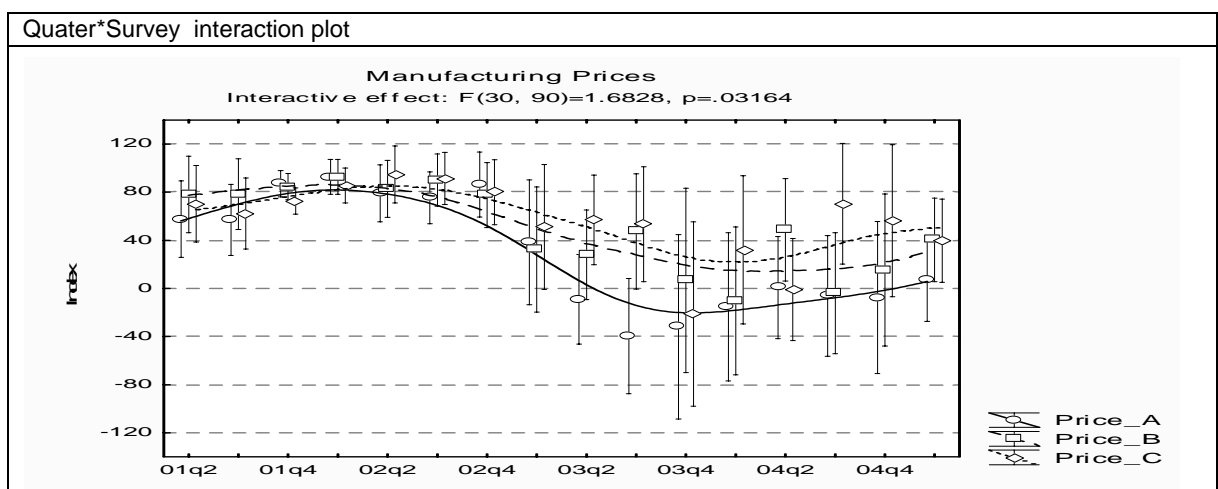
Figure 7 Interactive Building Price Analysis



5.2 Manufacturing survey response results measuring 'Prices'

The fitted lines in Fig.8 indicate that the data series representing the three survey categories evaluating manufacturing prices seem in cyclical terms to be in harmony with each other. The evaluation of the Quarter and Survey period interaction effects indicate on a p-value of 0.032 that interactive(not parallel) relationships do exist between the three survey categories evaluating building prices. In terms of the RM_Anova analysis procedure the main effects of Survey and Quarter can thus not separately be interpreted. These interactions should then be analysed with appropriate Bonferroni procedures indicating that individual paired quarter-to-quarter analysis can, in terms of Bonferonni p-values, be rejected in 40% cases as being the same, especially during the period 2003q2 to 2005q1.

Figure 8 Interactive Manufacturing Price Analysis

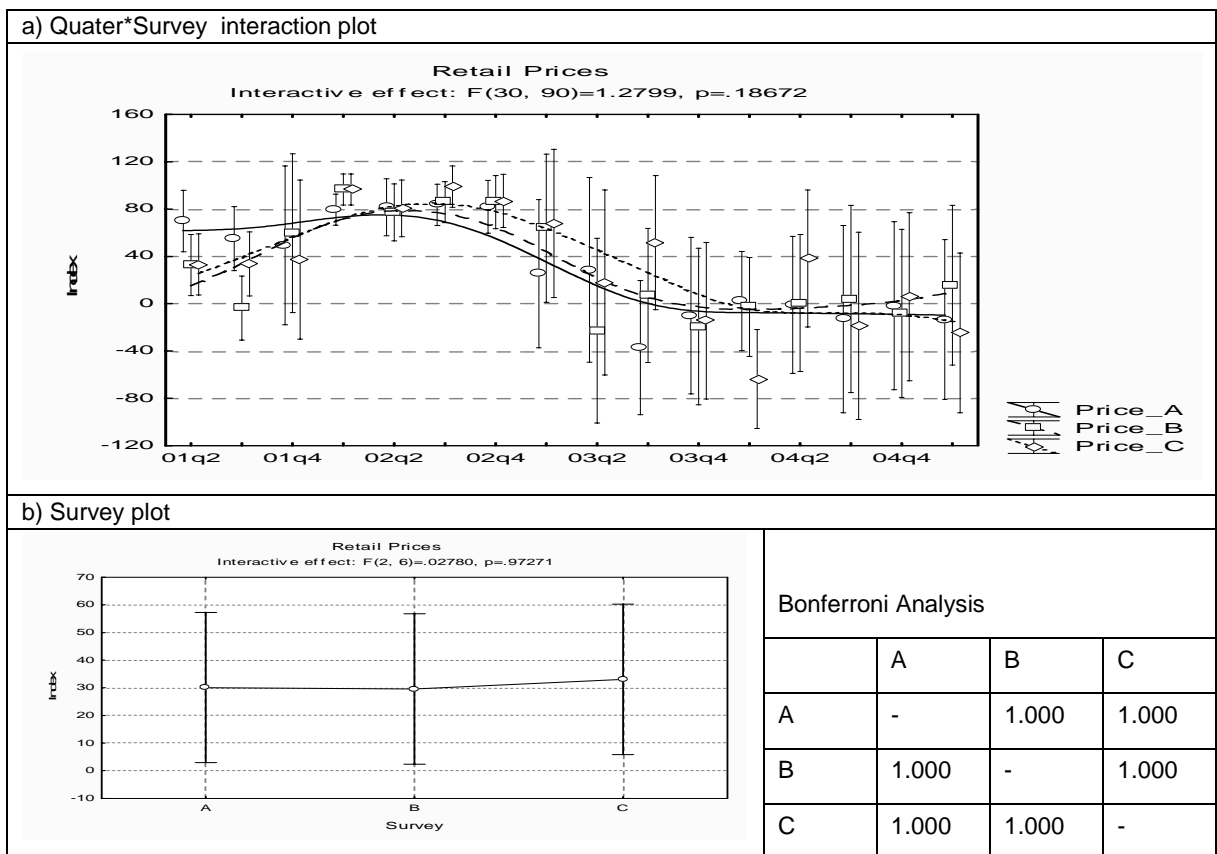


5.3 Retail survey response results measuring ‘Prices’

It can be deduced from the interaction plots in Fig.9(a) that the data series representing the three survey categories evaluating retail prices, seem in cyclical terms to be somewhat erratic in comparison to each other. The level of purchasing prices, as measured by Regulars changed as from beginning 2002, in comparison with the other two categories, from higher to lower. The interactions between Survey and Quarter are however not significant with a p-value of 0,187. Individual quarter-to-quarter analysis indicate, in terms of Bonferonni p-values, that 36% of the comparisons can be rejected as being the same.

The hypothesis of equal response between categorised Regular, Irregular and Occasional participants survey results, can not be rejected, based on a critical p-value of 0, 0,973 for the Survey period interrelationship. In Fig.9(b) a Bonferroni multiple comparison procedure display a near perfect relationship between all three pairs of participants.

Figure 9 Interactive Retail Price Analysis



5.4 Conclusion

Purchasing Prices, as measured by disaggregated panel responses to the BER's surveys in the three sectors of Building, Manufacturing and Retail seem on a statistical significant p-level of 5%, not to differentiate between the responses of Regular, Irregular and Occasional participants in the Retail sector. However, no clear-cut interpretation can be laid down for the categorized responses in the Building and Manufacturing sectors on price evaluation.

6. Summary

In this paper panel survey respondents to the BER's quarterly business tendency surveys in the Building, Manufacturing and Retail sectors of the South African economy were disaggregated into three groups of response rates: (i) the Regulars, those respondents participating most of the time i.e. more than 80% response rate, (ii) the Irregulars, those respondents participating on a response rate less than 80% but more than 60% and (iii) the Occasionals, those respondents participating on a less than 60% response rate. The responses to three survey questions covering Business Confidence, Business Activity and Purchasing Prices were analyzed within each sector.

Repeated measures ANOVA analysis over the sample period 2001q2:2005q1 of the 9 disaggregated survey panel responses, indicated that differences in survey results covering Manufacturing Confidence and Manufacturing Production were noted on a statistical significant p-level of 10%. The four cases of Building Confidence, Retail Confidence, Retail Sales and Retail Prices show in statistical terms no differentiation in their respective disaggregated survey response results. However, the three cases of Building Activity, Building Prices and Manufacturing Prices lack clear-cut statistical interpretation of their respective disaggregated survey response results.

References

- BER : *Bureau for Economic Research* , University Stellenbosch, Stellenbosch
CIRET : *Centre for International Research on Economic Tendency Surveys*, KOF/ETH, Zurich
Dunn,OL & Clark,VA (1987) : *Applied Statistics: Analysis of Variance and Regression*, J Wiley & son
De Jager, N (1995) : *An Analysis of the Business Confidence Index of the Bureau for Economic Research as a Leading Indicator of the South African Economy*, 22nd CIRET Conference, Singapore
IFO, *Ifo-Institute for Economic Research*, Munich
Milton, JS & Arnold, JC (1990) : *Introduction to Probability and Statistics*, McGraw-Hill
OECD (2005) : *Joint European Commission OECD workshop on international development of Business and Consumer Tendency Surveys*, Brussels, 14-15 November 2005
Pellissier, GM (2002) : *Measuring Business Confidence in South Africa*, 26th CIRET Conference, Taipei
Stuart, ODJ (1987) : *Final Report "Developing Economic Indicators", a study sponsored by the HSRC, Project A15/4/93*, Stellenbosch BER
