UNIVERSITY OF CAPE TOWN

An Analysis of Industry Concentration in South African Manufacturing, 1972-2001

Johannes Fedderke[1] and Dietmar Naumann[2]

Working Paper Number 26

[1] School of Economics, University of Cape Town
[2] School of Economics, University of Cape Town

An Analysis of Industry Concentration in South African Manufacturing, 1972-2001

Johannes Fedderke* and Dietmar Naumann†

September 2005

Abstract

ABSTRACT: This paper explores the trends in industry concentration of the South African manufacturing industry over the period from 1972 - 2001, with a primary focus on developments post 1996. Across all sectors of the manufacturing industry, concentration is found to have decreased. The analysis of bivariate associations yields several results. Amongst others, sectors which are highly concentrated (as measured by the Rosenbluth index) are more likely to exhibit lower employment growth. This is consistent across all ten census years. This paper also provides support for earlier results that low investment rates can in part be attributed to high levels of concentration.

JEL Classification: L11, L5, L6

KEYWORDS: Concentration, Manufacturing, South Africa, Investment.

1. Introduction

In a recent study by Fedderke and Szalontai (2004), using manufacturing census data from 1972 to 1996, the overall level of industry concentration was found to be high and increasing. Since then, Statistics South Africa (Stats SA) has published the Large Sample Survey of the Manufacturing Industry which contains data for the manufacturing industry for 2001. The current study aims to extend the body of research into industry concentration in the South African manufacturing industry by using this newly released data to estimate the most recent concentration measures and to establish whether previously identified trends persisted.

Three measures, namely the C5% index, the Gini index and the Rosenbluth index, are used to explore changes in concentration, focussing on the developments of the most recent period. The results on the levels and changes in concentration across the various measures are

*School of Economics, University of Cape Town

†School of Economics, University of Cape Town

compared and examined for consistency. Further, to establish whether industry concentration is systematically related to other aspects of the economy, bivariate associations between the Gini and Rosenbluth indices and a selection of industry performance indicators are analysed.

Following Fedderke and Szalontai (2004), the current paper also considers the impact of concentration on investment into new machinery and equipment. The results are compared to those of Fedderke and Szalontai (2004), employing the same pooled mean group estimator allowing for dynamic heterogeneity across sectors utilized in the earlier study.

Section 2 provides a discussion of the various measures of industrial concentration, while section 3 presents a review of previous findings on industry concentration in South African manufacturing. Section 4 introduces the data used in the paper. An analysis of the trends in industry concentration within the manufacturing industry is presented in section 5, while Section 6 deals with industry concentration and associations with aspects of industry performance. Section 7 investigates the impact of concentration on investment while section 8 concludes.

2. Measures of Concentration

To allow comparability of the results of this study with previous findings on industry concentration we follow Fedderke and Szalontai (2004) in using the C5%, Gini and Rosenbluth indices as our measures of industry concentration. The Herfindahl-Hirschmann Index, which is recognised as a more suitable measure of concentration, unfortunately cannot be computed with the data provided by Stats SA.

The C5% index is defined as the cumulative market share of the largest 5 per cent of firms within an industry. Fourie and Smit (1989) argue that this presents an intuitive indication of relative concentration while also noting that the number of firms which constitute this group can vary considerably (Fourie and Smit, 1989: 247).

The Gini concentration measure is defined as the ratio of the area between the Lorenz curve and the line of absolute equality ($y = x$) to the area below the line of absolute equality. To allow the calculation of the Gini coefficient, we follow Leach (1992) and Fedderke and Szalontai (2004) in estimating the Lorenz curve using Simpson's one-third rule. Once the Gini index has been calculated we use it to calculate the Rosenbluth index, as this can be shown to be to be a function of the Gini index (G) and the number of firms (n) in the industry (Marfels, 1971),

$$R = \{n(1 - G)\}^{-1} \tag{1}$$

Equation 1 allows the computation of the Rosenbluth index for the complete period under review. This was not possible using the standard definition of the Rosenbluth index, as it requires data on individual firms' market share which is not available for earlier census years. For a fuller discussion on the individual concentration measures see Fedderke and Szalontai (2004). It should also be noted that when n, instead of referring to the number of firms, refers to the number of plants, all measures of concentration are biased downwards to the extent that firms can have multiple plants.

3. Previous Findings on Concentraton in South Africa

Fourie and Smit (1989) find an increase in average concentration for the period from 1972 to 1982. The authors use the Gini coefficient, a measure of relative concentration. The authors find that approximately half of the sectors (which account for roughly 70% of output) show a persistent upward trend, while none show a persistent downward trend in the Gini index. Further, they find that when using a weighted average (with the share of total output being each sectors' weight) the increase in average concentration is even more pronounced, indicating that increases in concentration in the relatively larger sectors was stronger. An increase in the clustering of sectors with a Gini index above 0.8 from 36% in 1972 to 65% in 1982 is also noted. When using an import adjusted Gini index, average relative concentration falls significantly from around 0.8 to 0.54 over the period with the authors concluding that "the effective extent of relative concentration is lowered significantly by foreign competition" (ibid, 1989: 248). Fourie (1996: 100) later notes that the import adjusted concentration measure depends on trade patterns and cyclical factors - limiting its value for long term trend analysis. To put their findings into perspective the authors indirectly compare them with international findings on industry concentration (the use of different measures due to unavailability of data inhibits the direct comparison) and find that other countries exhibit no real trend, while their industry concentration was already at a high levels.

In his study on absolute and relative concentration in the South African Manufacturing Industry of period from 1972 to 1985, Leach (1992) finds that industry concentration (using the Rosenbluth index) decreased for 18 out of 26 sectors. Inequality amongst firms (relative concentration) in terms of output increases for all but three sectors during the same period. Leach also finds that the decrease in the average Rosenbluth index is statistically significant at the 5% level, while the increase in the average Gini index is significant at the 1% level. Leach notes that the 80% occupancy count (OC, the number of firms responsible for 80% of output) decreased for 16, increases for 9 and remains unchanged for one sector - the average change in the OC was however not statistically significant at the 10% level, and thus did not indicate any trend. Leach argues that the OC's failure to indicate a positive trend lends further support for his hypothesis of decreased concentration.

Leach (1992) explains that the negative correlation of the changes in the Gini and Rosenbluth indices is due to changes in the number of firms. The discussion of concentration measures noted that the Rosenbluth index is inversely related to the number of firms in an industry. During the period under investigation Leach reports a 46% increase in the average number of firms per industry (which is statistically significant at the 1% level). Leach further determines the separate effects of changes in inequality and the number of firms clearly illustrating the dominating effect of change in the number of firms on the Rosenbluth index. Leach argues that there is "room for preferring the result obtained from the Rosenbluth index (i.e. decreasing trend), on the argument that summary measures of concentration are superior to discrete measures, or for preferring the result obtained with the 80% occupancy count (no trend), on the argument that the Rosenbluth index is overly sensitive to the number of firms" (Leach, 1992: 395). He reaches the conclusion that on the basis of the results obtained, "that there has been no increase in concentration - and perhaps a decrease" for the period 1972 to 1985 (ibid, 1992: 396). Leach thus disagrees with Fourie and Smit's earlier conclusion that "concentration" has increased. This divergence of conclusions inevitably stems from the fact that Leach does not use Gini coefficient as the measure of concentration, as he also finds a statistically significant increase of the average Gini index over the period

The level of research into the field of industry concentration in South Africa had been largely constrained due to lack of data. Fourie (1996) studied the trend in industry concentration between 1982 and 1988 using a variety of measures (including the Herfindahl) after having convinced the predecessor of StatSA to provide him with the necessary data. The emerging picture was one of high and moderately increasing concentration for the comprehensive set of measures (ibid, 1996: 106). Fourie further invalidates Leach's (1992) findings of a decrease in concentration when using the Rosenbluth index (the net decline of the Rosenbluth between 1972 and 1988 is not statistically significant). As Leach (1992) pointed out, the decline in the Rosenbluth was to a large extent due to the increase in the number of firms. On this note he quotes Needham (1978:128) that the Rosenbluth index will be preferred by persons who feel "that small firms contribute significantly to the patterns of behaviour in an industry". Fourie also notes that the exclusion of imports has an upward bias on the concentration measures while ignoring the regional and spatial context is likely to have a downward bias.

Fedderke and Szalontai (2004) use the contribution to output by the largest 5% of firms (C5%), the Gini and the Rosenbluth index in their study of the trends in industry concentration for the period from 1972 to 1996. The authors find that both the discrete measure (C5%) and the relative measure (Gini index) provide strictly consistent results - high and rising industry concentration. They further note that over the period, for almost all sectors the largest 5% of firms account for more than 50% of output and that by 1996 there is no sector where these firms account for less than 50%. An increase in the Gini is found in 22 out of the 24 sectors included in the study while two sectors (Electrical Machinery and Other Manufacturing Industries) are found to display a decrease. Their results on the Rosenbluth index are less clear, with 17 sectors showing decreased concentration while concentration increases for the remaining seven sectors. The authors also note that increases in the Rosenbluth index were most prevalent in already concentrated sectors. Moreover, the authors mention the downward bias of the Rosenbluth (due to inordinate weighting of small firms) but commend its usefulness in capturing the effect of market entry. They conclude that industry concentration is high, while the trend has been towards even higher concentration.

4. The Data

The two concentration measures are computed from the output distributions across the number of establishments (i.e., the cumulative contribution to output by the cumulative percentage of establishments active in the given sector). For the years 1972, 1976, 1979, 1985, 1988, 1991, 1993 and 1996 the data stems from the manufacturing census while the most recent data (2001) stems from the Large Sample Survey of the South African Manufacturing Industry.[1] These output distributions were provided by Stats SA.[2] The dataset compiled by

[1] For simplicity, all years will be referred to as census years, regardless of whether the data stems from a census or a survey.

[2] The author is grateful to Ria Louw from Stats SA for compiling the required output distributions on request.

Fedderke and Szalontai (2004) (for the period 1972 to 1996), extended by the newly available data, is used for the present study.

Changes in the method used to classify the various industrial activities of the economy into a set of clearly defined categories, the Standard Industrial Classification (SIC) system, result in some categories failing to be consistent over the period analysed. To avoid discontinuities in the data series caused thereby, Kayemba (2000) proposes a way of aggregating SIC 3-digit categories into clusters that provide consistency, and thus allow comparison over the sample period. Fedderke and Szalontai's use of the above procedure is followed in this analysis.[3] Due to unavailability of the required data, be it for political or confidentiality reasons, the Petroleum, Other Chemicals and Tobacco sectors are excluded from the current study, with 23 sectors remaining.[4]

In section 6, bivariate associations between the concentration indices and measures of industry performance are investigated. The source of the data on output and investment for the period from 1972 to 1997 is WEFA and is included in the dataset used by Fedderke and Szalontai (2004). For the period beyond 1997 the source is Time Series Explorer (TSE) while StatsSA provided the necessary data for 2001.[5] Data on employment also comes from TSE. Nominal and effective tariff data as well as measures of import penetration and export orientation were kindly provided by Lawrence Edwards. As sources vary, the data may fail to be consistent, thereby possibly affecting the findings.[6]

---

[3]See Appendix A for a description of the aggregation of 3-digit sectors into clusters.

[4]Note that Fedderke and Szalontai (2004) included Other Chemicals - a potential source of difference between the two studies.

[5]See the Data Appendix for an explanation as to how the time series were extended to 2001.

[6]This is a serious limitation to any analysis of the Large Sample Survey, which included information only on capital and output, but not on employment. This limits our ability to explore the impact of concentration on employment, and for the sake of consistency forces attention to be paid to the investment relation that

The additional data required for section 7 again comes from various sources. INet-Bridge is the source of the interest rate and inflation data, while data from the South African Reserve Bank and WEFA are used to calculate sector specific depreciation rates, required to calculate a measure of user cost (see data appendix). The Penn World Tables provide the data required to compute a measure of systemic uncertainty.

5. Trends in Industry Concentration

The data from the Large Sample Survey refers to establishments (i.e., plants). The reader should thus keep in mind that, as noted above, the measures of concentration are biased downwards to the extent that firms have multiple plants.

5.1. The C5% Index

As suggested above, the cumulative percentage of output accounted for by the dominant 5% of firms (C5%) provides an intuitive indication of the level of relative concentration in an industry. Table 1 presents the C5% values for the 23 sectors as well as the number of firms that account for this share of output for 1976, 1985, 1996 and 2001. While the number of sectors where the C5% was greater than 50% had been steadily increasing since 1976, it is evident that this trend did not continue beyond 1996. For the 1976 census data, in 17 sectors (accounting for approximately 92% of output) the largest 5% of firms accounted for more than 50% of output (the average C5% value across all 23 sectors being 56%) .[7] This number increased to 21 sectors (accounting for approximately 97% of output) in 1985 where the top 5% of firms accounted for, on average, 64% of output.[8] By

is included in the present study.

[7] Only the following had C5% values below 50% in 1976: Clothing (except footwear), Leather and products from leather, Footwear, Plastic Products, Non-ferrous metal basic industries

[8] Only Footwear and Plastic Products remain below 50%

1996, the largest 5% of firms accounted for more than 50% of output in 22 sectors (where these accounted for around 97% of output), with only the Textile sector having a C5% value of below 50%. By 2001 the picture had changed significantly. In only 13 out of a possible 23 sectors did the top 5% of firms account for more than 50% of industry output (on average 54%), while these 13 sectors constituted 71% of total output.[9]

The data thus suggests a clear reversal of the increasing trend in the C5% index after 1996, with the average (and weighted average) proportion of output associated with the 5% of dominant firms in 2001 falling to levels very close to those in 1976, around the 55% and 60% mark respectively.

The C5% increased in all but two sectors (Furniture and Basic Chemicals) between 1976 and 1985. In the following period, 1985 - 1996, the C5% of only 4 sectors did not increase (Textiles, Wood and Cork Products, Other Non-Metals and Electrical Machinery Apparatus). From 1996 to 2001 the dominant 5 *per cent* of firms in only four sectors were able to increase their market share beyond the levels of 1996.[10] The market share associated to the group of dominant firms in these four industries was around 75%.

The evidence suggests that the South African Manufacturing Industry tended towards high and increasing industry concentration between 1976 and 1996, with the straight and weighted average share of output associated with the dominant 5% of firms in each sector for 1976, 1985 and 1996 being 56, 64, 68 and 60, 67, 69 *per cent* respectively. This trend fails to continue beyond 1996, with a marked decrease in the straight and weighted average market share to 54 and 61 *per cent* respectively.

[9] The industries with C5% values below 50% in 2001 are: Leather and Leather Products, Plastic Products, Clothing (except footwear), Textiles, Machinery (except electrical), Wood and Wood and Cork Products, Footwear, Rubber Products, Metal Products (except machinery and equipment), Printing and allied industries

[10] These are: Beverages, Paper and Paper Products, Basic Iron & Steel Industries and Non-Ferrous Metal Basic Industries

A further point of interest concerns the trend in the number of firms which make up the group of 5 *per cent* of largest firms. Both the range and average of this group continuously increases from 1976 through to 2001. From 1996 to 2001 the number of firms composing the 5% group decreases only in the case of four sectors (Clothing, Basic Chemicals, Furniture and Basic Iron and Steel Industries) while the balance of sectors experience further increases in the number of firms. Jointly, increases in the number of firms in this group and decreasing C5% values for 2001 thus point to decreasing industry concentration post 1996 - a greater number of firms now account for a smaller share of output than had been the case earlier. The 23 manufacturing sectors can be categorised into one of three groups:

1. an increased C5% value and a decreased number of firms making up the group of 5% of largest firms (n),
2. an increased C5% value and increased n, and
3. a decreased C5% and increased group of 5% of firms.

Only the Basic Iron and Steel Industries sector falls within the first category, which unambiguously indicates an increase in concentration. Three sectors fall within the second category (Beverages, Paper and Paper Products and Non-Ferrous Metal Basic Industries). Although the group of 5% of dominant firms accounts for an increased proportion of output, the size of this group has increased too, the effect on concentration is thus ambiguous. The remaining 19 industries fit into the third category of decreased C5% values and increased groups of firms, unambiguously pointing towards decreased concentration.

5.2. The Gini Index

Looking at the Gini index a similar picture emerges. Table 2 presents Gini index values of the 23 sectors for five census years across the period under investigation - namely 1972, 1979, 1988, 1996 and

2001.[11] These suggest that concentration has increased in the period between 1972 and 1988 by demonstrating increasing inequality in the distribution of productive activity (Fedderke and Szalontai, 2004: 7), remained stable between 1988 and 1996 and decreased over the period from 1996 to 2001. Simple and weighted averages (the weight being the share of output contributed by the specific sector) summarise these findings - both increase between 1972 and 1988, are stable between 1988 and 1996 and decrease for the last period. The fact that the weighted averages of the Gini exceed the straight averages for each year also suggests that larger sectors (as defined by output) are, on average, more concentrated.

Focussing on the period from 1996 to 2001 for which new data is available it can be seen that the Gini index decreased from 1996 levels for all sectors. The average change between 1996 and 2001 levels is -0.175, which is considerably larger (in absolute terms) than any previous change in the index (the second largest average change in absolute terms is of much smaller magnitude at 0.032 between 1976 and 1979). The fact that the time period between the last two censuses (5 years) is smaller than the other periods reported makes these results even more significant as the decreases in inequality are of substantial magnitude across the board. Even the Basic Iron and Steel Industries sector, which was earlier identified as being the only sector for which the C5% increased between 1996 and 2001, shows a decrease in the Gini index (even if it is the smallest decline in the Gini index for any sector).

In 1972 almost all sectors had a Gini index greater than 0.75 (exceptions were Leather and Leather Products, Footwear, Wood and Cork Products and Plastic Products). By 1979 only the Gini index for Footwear and Plastic Products remained below 0.75. The only sector with a Gini below 0.75 in 1988 was Footwear and by 1996 all sectors had a Gini index exceeding 0.75. Again, 2001 provides a different picture. Only 8 out of 23 sectors have a Gini index greater

[11] For reasons of parsimony the analysis is restricted to these five years even though data is available for all 10 census years.

than 0.75.[12] Simple and weighted averages of the Gini index across the manufacturing industry for 2001 are 0.67 and 0.70 respectively, considerably lower than for previous years.

As noted above, the reductions in inequality of firm size between 1996 and 2001 are dramatic. Ten out of the 23 sectors report a decrease in the Gini index exceeding 0.20[13] while 19 sectors report a decrease of magnitude 0.10 or larger. Changes of such magnitude are unprecedented throughout the period under investigation.

While the tendency of decreasing inequality is evident across all sectors, it is strongest in those sectors which were relatively less concentrated in 1996. This relationship is illustrated in Figure 1 and confirmed by the Spearman's rank correlation coefficient between the Gini values in 1996 and the magnitudes of the decrease (-0.92292, significant at the 1% level). For example, the Plastic Products sector which experienced the largest reduction (-0.294) had the third lowest Gini index in 1996 and the lowest in 2001. Sectors with the least unequal distribution of productive activity in 1996 were even less unequal in 2001. On the other end of the scale, the sectors with the highest level of inequality of firm size in 1996 experience below average reductions in the Gini index for 2001.[14] The implication of this finding is that the thrust which dispersed productive activity amongst firms between 1996 and 2001 was weaker for sectors with relatively high inequality, than for sectors which already have a relatively low degree of inequality.

[12] Industries with Gini exceeding 0.75: Food and Food Products, Beverages, Paper and Paper Products, Basic Chemicals, Glass and Glass Products, Basic Iron and Steel industries, Non-ferrous metal basics industries, Motor Vehicles and accessories.

[13] These are: Textiles, Clothing except Footwear, Leather and Products from Leather, Footwear, Wood and Wood and Cork Products, Rubber Products, Plastic Products, Metal Products except machinery and equipment, Machinery except electrical and Transport equipment.

[14] Motor Vehicles, Glass and Glass Products, Other manufacturing industries, Paper and Paper Products, Food and Food Products, Basic Chemicals and Beverages

If the 2001 Gini values accurately reflect the true distribution of productive activity amongst firms then one can conclude that inequality of firm size has decreased dramatically between 1996 and 2001.

5.3. The Rosenbluth Index

The analysis of the Rosenbluth index yields some similar and some different results compared to that of the Gini index. Table 3 shows the Rosenbluth measure for the 23 sectors for the same census years as above, as well as changes in the Rosenbluth post 1996 and for the whole period being analysed.

The most obvious finding is that not one sector experiences an increase in the value of the Rosenbluth index post 1996 - this is identical to the analysis of the Gini index. Prior to 1996 the results are not as similar. The Rosenbluth data points towards increased concentration in 7 out of 23 sectors in the period from 1972 to 1996.[15] However, unlike the Gini index where all but two sectors (Electrical Machinery Apparatus and Transport Equipment) experience increases, the Rosenbluth index suggests that concentration decreases for the remaining 16 sectors.

Again, the focus of the present discussion is on the developments post 1996. Just as with the Gini index, there are substantial reductions in the Rosenbluth index. The average percentage change in the Rosenbluth index for the last period is approximately -67% ($\approx -20\%$ *p.a.*) compared to only -7% ($\approx -1\%$ *p.a.*) for the previous period. This represents a dramatic increase in the rate at which concentration declined. Only four categories are subject to a fall in the number of firms, while the rest experience large increases of which some are extraordinary.[16] Overall the number of firms in manufacturing increases by 37% over the last period. Bearing in mind the components

[15] Food and Food Products, Beverages, Leather and Leather Products, Basic Chemicals, Glass and Glass Products, Basic Iron and Steel Industries and Non-Ferrous Metal Basic Industries.

[16] Industries where the number for firms declined are Clothing, Printing and Publishing, Other Non-Metals and Furniture.

of the Rosenbluth index, collectively the substantial decreases in the Gini and increases in the number of firms aggravate the decline in the Rosenbluth index.

The largest decline in concentration occurs in the Glass and Glass Products sector where the Rosenbluth falls from 0.1657 to 0.0210, yet it remains the most concentrated sector according to the Rosenbluth as well as Gini index. Also evident from Table 3 is that the average (both straight and weighted) level of concentration in 2001 is substantially below that of 1972. In the case of the Rosenbluth index we find that the straight exceeds the weighted average level of concentration for each year, suggesting that larger sectors are generally less concentrated, which is contrary to what was noted in the analysis of the Gini index.

While previously it had been established that sectors with already relatively low levels of inequality of firm size were those that experienced large decreases in inequality, the Rosenbluth analysis yields the reverse. This is clearly noticeable from Figure 2 below. Furthermore, Table 4 provides evidence of the finding that sectors which ranked highly in terms of the Rosenbluth index in 1996 ranked highly in terms of the magnitude of the reduction in the index. For the majority of these sectors the Rosenbluth rank remained high in 2001. The Beverages sector, for example, was ranked fourth in terms of concentration in 1996, it experienced the fourth largest absolute decline in the Rosenbluth index between 1996 and 2001 and was ranked the second most concentrated sector in 2001.

Following Leach (1992), we split up the change in the log of the Rosenbluth into its individual components. The table below shows the proportion of this change attributable to either of the two components and the percentage growth in real output for the period between 1996 and 2001.[17]

The change in the market share (i.e. inequality) component accounts for, on average, 71 *per cent* of the change in the log of the

[17] Data on real output growth was not available for Basic Chemicals and Other Manufacturing Industries.

Rosenbluth while changes in the industry size (as measured by the number of establishments) component accounts for 28 *per cent*, on average. One potential interpretation of these results is that smaller firms have grown faster, relative to larger firms, as the bulk of the change in the log of the Rosenbluth is accounted for by decreasing inequality of firm size. Those sectors for which the industry size component suggests a move towards higher concentration (*i.e.*, it is negative) also generally experience a decline in real output over the period (except Furniture).

If the Gini index and the reported number of firms in each sector reflect the reality accurately, then the Rosenbluth index too indicates a significant downward shift in industrial concentration in the South African manufacturing industry.

5.4. Caveats and Qualifications of the Findings

Given the substantial nature of declines in concentration as measured by the Gini and Rosenbluth index it is important to establish the reliability of the results. The fact that all Gini values for 2001 are considerably lower than those in 1996 can be for one of three reasons. Either industry concentration, as measured by the inequality of firm size really has decreased strongly over the last 5-year period. Alternatively, the systematically lower Gini values could be a result of a changed data collection methodology (the 2001 data stems from a survey which uses a new business register as opposed to previous data which came from a census). The third reason entails a combination of generally lower levels of inequality and lower Gini values due to changed methods of data collection. As the Rosenbluth index is a positive function of the Gini, the same arguments apply.

For the 2001 Survey, a sample of 10 000 firms was drawn out of a population of approximately 34 000 firms classified at the SIC 3-digit level. The new business register used has a significantly enhanced coverage, and is based on the VAT database of the South African Revenue Service. Manufacturing groups were divided into four size groups, with large enterprise (size group 1) being completely enumerated. StatsSA added the value of output of large enterprises to the weighted totals of the other size groups to infer the total value of output.[18] Response rates to the survey are given in Table 5 below. Although these are high, they not only decrease from size group 1 to 4, but for the latter groups the sampled firms are increasingly less representative of the population.

The effect of the use of survey data on calculating the Gini index is not clear. Given that large firms (which made up almost half the sample) were completely enumerated and had a high response rate and that the largest 5% of firms accounted for an average of 54% of output (see Table 1) suggests that only the last part of the Lorenz curve, corresponding to the smallest firms, is affected by the sampling. The consequence being that the impact is constrained, though equally it is not entirely absent. The use of sampling should thus not have such a great effect on the Gini. The C5% measure, which also shows large decreases, is affected less as large firms, which by definition make up the 5% group of dominating firms, have a high response rate. These considerations all suggest that the decline in the Gini index (and thereby in the Rosenbluth index too), while potentially affected by the change in the data collection methodology, is plausibly due to decreased industry concentration.

6. Industry Concentration and Performance

Economists' interest in industry concentration is driven by the belief that the structure of an industry is likely to be associated with other dimensions of the economy (Fedderke and Szalontai, 2004: 13). With this in mind, simple regressions of the Gini and Rosenbluth indices are performed on the following economic indicators: industry output, real output growth, investment rates, measures of import penetration and export orientation, nominal and effective tariffs, em-

[18] Weights to produce estimates are the inverse ratio of the sampling fraction, modified to take account of non-response in the survey (Stats SA, 2004).

ployment and employment growth. This is done for each of the census (or survey) years between 1972 and 2001. The results are summarised in Table 6 and illustrated in Appendix B.

It should be emphasised that the cross-sectional ordinary least squares (OLS) regressions are in no way meant to infer causality. The point of interest is purely descriptive, by establishing whether the Gini and Rosenbluth indices are systematically correlated with the economic indicators (e.g., given a high degree of output inequality in a sector, is it more likely to experience higher real output growth?) and to track the correlations on these variables over the 10 census years considered in this study. Due to the potential presence of outliers, two sets of coefficients are computed - one that includes all cross sectional observations and another where outliers are removed. Outliers do not appear to affect the analysis strongly. Owing to the small sample size, and thus low power of the regression, the statistical significance (or rather insignificance) of the coefficients is ignored.

Inequality of firm size is consistently positively correlated with sector output, while concentration is negatively correlated with output for all bar one (1996) census years. More unequal sectors are thus more likely to exhibit higher levels of output whereas the opposite is true for relatively concentrated sectors. While inequality is positively correlated with output growth for the first three and last two census years, a negative correlation exists for the censuses between 1982 and 1993. Concentration is positively correlated with output growth for the first five (and second last) census years, while it is negatively correlated for the balance of censuses.

The partial correlations between employment and the Gini index display a clear decreasing trend (positive for the first seven census years, negative for the last three). The Rosenbluth index provides a picture of consistently negative correlations with employment across all census years. Highly concentrated sectors are thus more likely to exhibit lower levels of employment. The partial correlations between the Gini and employment growth are not stable over the sample period, while sectors with high levels of concentration are more likely to exhibit lower employment growth (except for 1985 and 1988).

While generally positive, the partial correlation between the Gini index and investment rates is negative for the three census years between 1985 and 1991. The Rosenbluth is generally positively correlated with investment rates across census years, except in 1979, 1985 and 1988.

The tracking of partial correlations yields an interesting picture when looking at import penetration. The Gini index is positively correlated with import penetration, exhibiting a decreasing trend and eventually turning negative in 2001. A similar pattern applies to the partial correlation with the Rosenbluth. These results lend some support to, what Levinsohn (1993) terms the *imports-as-market-discipline* hypothesis, i.e., where intensified imports force domestic firms to behave more competitively (Levinsohn, 1993: 1), thereby decreasing the correlation between concentration and import penetration. Export orientation, the ratio of exports to output, is positively correlated with both the Gini and the Rosenbluth indices. Sectors with higher concentration (broadly defined) are more likely to be more export orientated. For both indices of concentration this partial correlation exhibits a strengthening trend up until 1996.

A clear picture emerges regarding the association between the concentration indices and rates of protection. Both nominal and effective tariffs are negatively correlated with the Gini and Rosenbluth indices. This finding is consistent across all available census years. Thus highly concentrated sectors are more likely to be associated with lower levels of trade protection across the entire period for which data is available.

7. Investment and the Impact of Concentration

Low investment levels have often been identified as a key factor in explaining suboptimal growth rates for the South African economy (Trade and Industry Monitor, 2000: 1). With this in mind, this paper follows Fedderke and Szalontai (2004), in considering the impact of concentration and inequality of firm size on investment in the South

African manufacturing industry.

The empirical specification of the investment function is derived from the first order condition for capital stock, which is solved to provide the optimal level of capital stock (Fedderke and Szalontai, 2004: 23). The investment function is as follows:

$$\begin{aligned} I_{i,t} &= b_0 + b_1 d \ln Y_{i,t}^e + b_2 d \ln uc_{i,t} + b_3 \sigma_{\sec} + \\ &\quad b_4 \sigma_{sys} + b_5 GINI_{i,t} \_ b_6 ROSEN_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (2)$$

where $I_{i,t}$ denotes the net investment rate for manufacturing sector i at time t,

$\ln Y_{i,t}^e$, the natural logarithm of expected output for manufacturing sector i at time t,

$\ln uc_{i,t}$,the natural logarithm of a measure of the user cost of capital for manufacturing sector i at time t,

$\sigma_{\sec,i,t}$,the standard deviation of ral output specified in log scale, computed over a 3 year rolling window and thus a measure of sectoral uncertainty,

$\sigma_{sys,t}$,the square of the real exchange rate distortion using international comparisons of prices (also known as the Dollar index).[19] This provides a proxy of structural distortions in the economy. The further the dollar index is away from 1, the greater the square of the distortion (i.e. the value of $\sigma_{sys,t}$), and the higher the implied level of systemic uncertainty.[20]

$GINI_{i,t}$ and $ROSEN_{i,t}$,denote the Gini and Rosenbluth indices respectively for manufacturing sector i at time t

while d represents the first difference operator.

Investment is restricted to investment in machinery and equipment, because these provide the bulk of productive capacity in the manufacturing sector. Actual current changes in output are used instead

[19] See the Data Appendix for the construction of the Dollar index.

[20] The measure of systemic uncertainty used in Fedderke and Szalontai (2004) is unfortunately not available for the period after 1997. The results reported below are thus not strictly comparable to those of the earlier study.

of expected changes in output as this is an unobservable magnitude (Fedderke, 2004: 175). This paper thus follows the approach by Ferderer (1993), Fedderke (2004) and Fedderke and Szalontai (2004). The measure of the user cost of capital employed is made up of the risk free rate of return on government bonds minus inflation plus the corporate tax rate and a sector specific depreciation rate.[21] The Gini and Rosenbluth indices are as defined previously.

The panel of data covers 23 3-digit manufacturing sectors for the period from 1972 to 2001. However due to the fact that not all variables (*e.g.*, tariffs) are available for the entire period, the number of years included varies with the specification of the individual models. As the Gini and Rosenbluth indices are only available for the ten census years, their values for the inter-census years are linearly interpolated. This method is potentially inaccurate as it assumes a one-directional development of concentration between the census years, yet it is necessitated by the lack of available concentration data for the inter-census years.

The estimation results of Fedderke and Szalontai, using the Pooled Mean Group estimator over the 1972 -1996 period are shown in Table 7, while Table 8 presents the results of the current investigation.

7.1. The Estimation Methodology: The Pooled Mean Group Estimator

The estimator is provided by the Pooled Mean Group Estimator Methodology provided by Pesaran, Shin and Smith (1999). Thus we base our panel analysis on the unrestricted error correction ARDL (p, q) representation:

$$\Delta y_{it} = \phi_i y_{i,t-1} + \beta_i^{'} x_{i,t-1} + \sum_{j=1}^{p-1} \lambda_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \delta_{ij}^{'} \Delta x_{i,t-j} + \mu_i + \varepsilon_{it} \quad (3)$$

$i = 1, 2, ..., N$, stand for the cross-section units, and $t = 1, 2, ..., T$, indicate time periods. Here y_{it} is a scalar dependent variable, x_{it} $(kx1)$

[21] See the Data Appendix for the construction of the sector-specific user cost of capital measure, particularly for the last five years of data.

is the vector of (weakly exogenous) regressors for group i, μ_i represent the fixed effects, σ_i is a scalar coefficient on the lagged dependent variable,β_i is the $kx1$ vector of coefficients on explanatory variables, $\lambda'_{ij}s$ are scalar coefficients on lagged first-differences of dependent variables, and $\delta'_{ij}s$ are kx 1 coefficient vectors on first-differences of explanatory variables and their lagged values. We assume that the disturbances $\varepsilon'_{it}s$ are independently distributed across i and t, with zero means and variances $\sigma_i^2 > 0$. We also make the assumption that $\sigma_i < 0$ for all i and thus there exists a long-run relationship between y_{it} and x_{it} :

$$y_{it} = \theta i^{'} x_{it} + \eta_{it}, i = 1, 2, \ldots, N, t = 1, 2, \ldots, T \tag{4}$$

where $\theta_i = -\beta_i^{'}/\phi_i$ is the $k\ x1$ vector of the long-run coefficient, and η_{it}'s are stationary with possibly non-zero means (including fixed effects). Then, equation (5) can be written as:

$$\Delta y_{it} = \phi_i \eta_{i,t-1} + \sum_{j=1}^{p-1} \lambda_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \delta_{ij}^{'} \Delta x_{i,t-j} + \mu_i + \varepsilon_{it} \tag{5}$$

where $\eta_{i,t-1}$where is the error correction term given by (10), and thus ϕ_i is the error correction coefficient measuring the speed of adjustment towards the long-run equilibrium.

We consider the Pooled Mean Group (PMG) estimator advanced by Pesaran, Shin and Smith (1999), which allows the intercepts, short-run coefficients and error variances to differ freely across groups, but the long-run coefficients are constrained to be the same; that is,

$$\theta_i = \theta, i = 1, 2, \ldots, N \tag{6}$$

The common long-run coefficients and the group-specific short-run coefficients are computed by the pooled maximum likelihood (PML) estimation. These PML estimators are denoted by $\tilde{\phi}_i, \tilde{\beta}_i, \tilde{\lambda}_{ij}, \tilde{\delta}_{ij}$ and θ.We then obtain the PMG estimators as follows:

$$\begin{aligned}
\hat{\phi}_{PMG} &= \frac{\Sigma_{i=1}^{N}\tilde{\phi}_i}{N}; \hat{\beta}_{PMG} = \frac{\Sigma_{i=1}^{N}\tilde{\beta}_i}{N}; \\
\hat{\lambda}_{PMG} &= \frac{\Sigma_{i=1}^{N}\tilde{\lambda}_{ij}}{N}, j = 1, \ldots, p-1; \overset{\wedge}{\delta}_{jPMG} = \frac{\Sigma_{i=1}^{N}\tilde{\beta}_{ij}}{N}, j = 1, \ldots, q-1, \\
\overset{\wedge}{\theta}_{PMG} &= \tilde{\theta}
\end{aligned} \tag{7}$$

This clearly highlights both the pooling implied by the homogeneity restrictions on the long-run coefficients and the averaging across groups used to obtain means of the estimated error-correction coefficients and other short-run parameters.

We briefly discuss one important modelling issue. The PMGE is legitimate only where long run parameters are homogeneous across groups. Tests of homogeneity of error variances and/or short- or long-run slope coefficients can be easily carried out using Log-Likelihood Ratio tests, since the PMG and dynamic fixed effects (DFE) estimators are restricted versions of (possibly heterogeneous) individual group equations. However, we note that the finite sample performance of such tests are generally unknown and thus unreliable. An alternative would be to use Hausman (1978) type tests. The mean group (MG) estimator[22] provides consistent estimates of the mean of the long-run coefficients, though these will be inefficient if slope homogeneity holds. For example, under long-run slope homogeneity the PMG estimators are consistent and efficient. Therefore, the effect of both long-run and short-run heterogeneity on the means of the coefficients can be determined by the Hausman test (hereafter h test) applied to the difference between MG and PMG or DFE estimators. It is this approach that is adopted in the present study.

As long as sector-homogeneity is assured, the PMG estimator offers efficiency gains over the MG estimator, while granting the possibility of dynamic heterogeneity across sectors unlike the DFE estimator. In

[22] See Pesaran and Smith (1995).

the presence of long run homogeneity, therefore, our preference is for the use of the PMG estimator.

Finally, it is worth pointing out that a crucial advantage of the estimation approach of the present paper, is that dynamics are explicitly modelled.

7.2. The Estimation Results

In Table 8 we report results from estimation of equation (4). Estimation is by means of the PMG panel estimator for 23 manufacturing sectors.

All specifications' estimation results confirm not only adjustment to equilibrium, but relatively rapid adjustment (see the d-parameters reported, which correspond to the d-parameter of equation 7). Moreover, the Hausman tests (denoted h-tests) confirm the legitimacy of the PMG estimator by failing to reject the homogeneity restriction on the long-run coefficients for the 23 manufacturing sectors at conventional levels of significance. Given the unknown finite sample properties of the LR test statistic, we thus proceed on the assumption of long-run parameter homogeneity.

Variables perform consistently with prior theoretical expectation. The output measure is positively associated with the investment rate, and the unit cost of capital and both measures of uncertainty, sectoral and systemic, are negatively associated with investment. Of these variables, only the user cost of capital proves to be statistically insignificant, while the systemic measure of uncertainty based on exchange rate over/undervaluation, is significant at the 10% level of significance.

These findings are consistent with those reported in Fedderke and Szalontai (2004), though it is notable that the impact of both the output measure, and the sectoral measure of uncertainty (based on the volatility of demand for output), have considerably weaker impact on investment than reported in the earlier study.[23]

[23] We do not compare the impact of systemic uncertainty, since a different mea-

For present purposes, what is notable about the results reported in Table 8, is that the earlier finding of a differentiated impact on investment rates between the Gini measure of output inequality, and the Rosenbluth concentration measure, is reversed. In the present study both the Gini and the Rosenbluth measures impact investment rates negatively - with higher concentration being associated with lower investment rates - and in the case of the Rosenbluth index statistically significantly so.

In contrast to the findings of Fedderke and Szalontai (2004), who found some support for a positive impact of inequality of firm size and hence indirectly concentration on investment rates, the use of new data in the present study, extending the sample period to 2001, now suggests that industry concentration is unambiguously harmful for investment in South African manufacturing industry.[24]

8. Concluding Comments

Subject to the proviso that with the data from the Large Sample Survey the concentration measures used for this study reflects the distribution of production both accurately, and consistently with previous studies that relied on alternative data sources, the current investigation yields an unambiguous picture of significantly decreased concentration in South African manufacturing, across both the Gini and Rosenbluth index after 1996. The C5% index suggests that only

sure was employed in Fedderke and Szalontai (2004).

[24]Using appropriate interaction terms, we also investigated whether the period after 1996 was different from the preceding. Unfortunately, the small number of observations after 1996, and the implicit linear trend that is resent in the data after 1996 due to interpolation over a relatively large number of observations relative to sample size, renders these results unreliable. In addition, the homogeneity of the long run relationship that is required for the use of the PMGE breaks down under such estimations. Nevertheless, we note that the interaction terms do suggest that the impact of the Rosenbluth concentration index became more negative after 1996, while the shift to a negatively signed coefficient for the Gini occurred after 1996.

the Basic Iron and Steel Industries sector has become more concentrated. As this measure only looks at the 5% of largest firms, this finding is not necessarily in conflict with those provided by the Gini and Rosenbluth indices, as changes in relative concentration for the remaining 95% of firms may dominate the changes for the largest 5%.

Decreased inequality of firm size is most apparent in those sectors which were already relatively less concentrated in 1996. The force which dispersed the productive activity amongst establishments was thus more effective in those sectors for which the distribution of market share was relatively less skewed. By contrast to the results from the Gini measure of inequality of production, those sectors with higher values for the Rosenbluth index, however generally experienced the largest reduction in this measures of concentration, although these sectors also remained relatively concentrated.

In simple descriptive terms, higher concentration in industry appears to be positively correlated with the level of output, investment, and export orientation, but negatively correlated with employment. The descriptive evidence also supports the imports-as-market-discipline hypothesis, with higher import penetration supporting lower levels of concentration in industry. In similar vein, both nominal and effective tariff protection appears to be positively associated with industry concentration.

Low investment in machinery and equipment is often identified as a key factor in explaining South Africa's suboptimal economic growth. The findings of this study support earlier results that low investment rates can in part be attributed to high levels of concentration. Using a pooled mean group estimator, econometric evidence suggests that increased concentration affects investment in machinery and equipment negatively. What is more, this negative impact is associated with both the Rosenbluth and Gini concentration measures, though only the Rosenbluth measure is statistically significant. Thus, both an increase in inequality of firm size as well as a decrease in the number of firms for any given value of the Gini index serve to lower investment. In this respect, the present study finds that the earlier result of

Fedderke and Szalontai (2004), who found a divergent impact between the Gini and the Rosenbluth, is strengthened.

Lastly we note with some urgency that it would be beneficial for the study of industry concentration and its possible impacts on various aspects of the economy if the data required for this task would be available at shorter intervals. Five years passed between the last manufacturing census and the large sample survey (the new five-yearly survey of economic activity) - the approach of linearly interpolating the measures for the inter-census or survey years is clearly suboptimal. Further, the coverage of the large sample survey needs to be increased in order to cover the demand for labour, and employment conditions in addition to output, capital and number of establishments. South Africa had a long tradition of collecting relatively comprehensive information on manufacturing activity. It is time this was revived.

References

Dollar, D. 1992. Outward-oriented Developing Economies Really Do Grow More Rapidly: Evidence from 95 LDCs, 1976 - 1985. *Economic Development and Cultural Change*, 1992, vol. 40, issue 3, p. 523-44

Du Plessis, P. 1981. Measuring the Concentration of Economic Power. *Journal for Studies in Economics and Econometrics*, Volume 10, p. 46 - 66

Edwards, L. and Golub, S. 2002. South Africa's International Cost Competitiveness and Productivity: A Sectoral Analysis. Report for the South African National Treasury

Fedderke, J. 2004. Investment in Fixed Capital Stock: Testing for the Impact of Sectoral and Systemic Uncertainty. *Oxford Bulletin of Economics and Statistics*, Volume 66, Issue 2, p. 165 - 187

Fedderke, J, Kularatne, C. and Mariotti, M. 2003. Mark-up Pricing in South African Manufacturing Industry, p. 1 - 34, Mimeo, Economic Research Southern Africa (ERSA), available online at http://www.commerce.uct.ac.za/economics/staff/fedderke/research [Date Accessed: 2005, 8 July]

Fedderke,J. and Szalontai,G. 2004. Industry Concentration in South African Manufacturing Industry: Trends and Consequences, 1972 - 96. p. 1 - 34, Report to the South African National Treasury, available online at http://www.commerce.uct.ac.za/economics/staff/fedderke/research [Date Accessed: 2005, 27 March]

Fourie, F.C.V.N. 1996. Industrial Concentration Levels and Trends in South Africa: Completing the Picture. *South African Journal of Economics,* Volume 64, Issue 1, p. 97 - 121

Fourie, F.C.V.N. and Smit, M. 1989. Trends in Economic Concentration in South Africa. *South African Journal of Economics*, Volume 57, Number 3, p. 241 - 256

Hall,M. and Tideman, N. 1967. Measures of Concentration. *Journal of American Statistical Association*, Volume 62, No 317., p. 162 - 168

Hausman, J.A. 1978. Specification tests in economics, *Econometrica*, 46, 1251-70

Kayemba, J.S. 2000. Combining Data Series to create longer time series: The case of South African Manufacturing Data. University of the Witwatersrand Mimeo

Leach, D.F. 1992. Concentration and Profits in South Africa: Monopoly or Efficiency? *South African Journal of Economics*, Volume 60, Issue 2, p. 143 - 157

Leach, D.F.1997. Concentration-Profits Monopoly vs. Efficiency Debate: South African Evidence. *Contemporary Economic Policy*, Volume 15, issue 2, p. 12 - 23

Levinsohn, J. 1993. Testing the imports-as-market-discipline hypothesis. *Journal of International Economics*, Volume 35, p. 1 - 22

Marfels, C. 1971. Absolute and relative concentration measures reconsidered. *Kyklos*, Volume 24, Issue 4, p. 753 - 766

Needham, D., 1969. *Economic Analysis and Industrial Structure*. New York Holt, Rinehart and Winston Inc.

Pesaran, M.H., and Shin, Y. 1995a. Long run structural modelling, Unpublished manuscript, University of Cambridge

Pesaran, M.H., and Shin, Y. 1995b. An autoregressive distributed lag modelling approach to cointegration analysis, DAE Working Paper no 9514, Department of Applied Economics, University of Cambridge

Pesaran, M.H., Shin, Y. and Smith, R.J. 1996. Testing for the existence of a long run relationship, DAE Working Paper No.9622, Department of Applied Economics, University of Cambridge

Pesaran, M.H., Shin, Y., and Smith, R.P. 1999. Pooled Mean Group Estimation of Dynamic Heterogenous Panels, *Journal of the American Statistical Association*, 94, pp. 621-634

Pesaran, M.H., Shin, Y., and Smith, R.P. 2001. Bounds testing approaches to the analysis to the testing of level relationships, *Journal of Applied Econometrics*, 16, 289-326

Pesaran, M.H. and Smith, R.P. 1995. Estimating Long-Run Relationships from Dynamic Heterogeneous Panels, *Journal of Econometrics,* 68, 79-113

STATISTICS SOUTH AFRICA. 2004. Large Sample Survey of the South African Manufacturing Census. Report 30-02-01 (2001)

TRADE AND INDUSTRY MONITOR. 2000. Joint Newsletter of the Trade & Industrial Policy (TIPS) Secretariat and the Development Policy Research Unit (DPRU), Volume 15, p. 1 - 25

Table 1: C5% Concentration Index for South African Manufacturing Industry

Sector	1976		1985		1996		2001	
	n	C5%	n	C5%	n	C5%	n	C5%
Food and Food Products	76	65.29	72	70.12	71	75.16	134	65.93
Beverages	12	55.64	9	62.68	8	74.26	21	76.27
Textiles	26	52.29	32	55.92	34	48.11	51	36.00
Clothing, except Footwear	60	46.75	61	50.58	81	58.68	75	34.18
Leather and Leather Products	8	37.17	8	50.25	8	67.86	12	27.69
Footwear	6	36.73	7	46.08	13	56.42	16	39.99
Wood and Wood and Cork Products	32	51.35	30	63.34	65	61.10	67	38.45
Paper and Paper Products	8	53.36	11	75.43	19	62.05	30	78.13
Printing, Publishing and Allied Industries	56	60.99	65	62.45	99	69.25	83	48.90
Basic Chemicals	7	69.55	9	62.88	12	70.79	23	68.55
Rubber Products	22	55.97	26	66.16	36	80.85	64	40.33
Plastic Products	3	36.55	4	46.63	9	56.67	14	30.22
Glass and Glass Products	16	53.46	23	85.40	51	87.31	58	69.74
Other Non-Metals	1	69.60	2	75.83	4	74.96	13	66.07
Basic Iron and Steel Industries	45	73.48	51	76.93	57	69.89	56	76.00
Non-Ferrous Metal Basic Industries	6	47.60	10	63.07	5	64.66	30	70.60
Metal Products, except Machinery and Equipment	4	58.48	5	65.47	4	67.34	45	47.49
Machinery, except Electrical	119	56.14	143	60.24	206	61.79	225	38.41
Electrical Machinery Apparatus	54	60.77	93	66.58	144	58.26	248	51.60
Motor Vehicles, Parts and Accessories	29	79.42	40	83.90	81	85.19	89	78.87
Transport Equipment	33	68.01	40	73.37	56	75.27	120	58.99
Furniture	37	53.39	53	52.12	78	58.38	67	56.68
Other Manufacturing Industries	7	53.15	11	59.90	13	83.38	30	50.66
Average	29	56.31	35	64.14	50	68.16	68	54.34
Average weighted by output		60.81		66.52		69.01		61.09

Notes: n refers to the number of firms making up the group of 5% of largest firms while the C5% value refers to the cummulative percentage of output attributable to that group of firms.

Source: Values for 1972 - 1996 from *Fedderke and Szalontai (2004),* Values for 2001 based on *Stats SA, Large Sample Survey (2004)*

Table 2: Gini Index for South African Manufacturing Industry, 1972-2001

Sector	**Gini Index**					**Change**	
	1972	1979	1988	1996	2001	1996 - 2001	1972 - 2001
Food and Food Products	0.818	0.872	0.900	0.884	0.752	-0.132	-0.066
Beverages	0.848	0.775	0.878	0.878	0.796	-0.081	-0.052
Textiles	0.761	0.833	0.846	0.762	0.490	-0.271	-0.271
Clothing, except Footwear	0.785	0.807	0.804	0.802	0.532	-0.270	-0.253
Leather and Leather Products	0.667	0.759	0.813	0.867	0.612	-0.255	-0.055
Footwear	0.704	0.687	0.746	0.771	0.534	-0.237	-0.170
Wood and Wood and Cork Products	0.711	0.800	0.840	0.803	0.558	-0.245	-0.153
Paper and Paper Products	0.752	0.794	0.883	0.889	0.784	-0.105	0.032
Printing, Publishing and Allied Industries	0.786	0.796	0.826	0.835	0.651	-0.185	-0.135
Basic Chemicals	0.815	0.860	0.842	0.879	0.765	-0.114	-0.050
Rubber Products	0.831	0.852	0.876	0.876	0.652	-0.224	-0.179
Plastic Products	0.691	0.722	0.797	0.780	0.486	-0.294	-0.205
Glass and Glass Products	0.828	0.870	0.880	0.916	0.813	-0.103	-0.015
Other Non-Metals	0.796	0.875	0.866	0.862	0.737	-0.125	-0.059
Basic Iron and Steel Industries	0.855	0.896	0.898	0.872	0.801	-0.071	-0.054
Non-Ferrous Metal Basic Industries	0.776	0.858	0.874	0.861	0.771	-0.090	-0.005
Metal Products, except Machinery and Equipment	0.785	0.829	0.808	0.814	0.585	-0.229	-0.200
Machinery, except Electrical	0.769	0.788	0.799	0.794	0.547	-0.247	-0.222
Electrical Machinery Apparatus	0.815	0.841	0.868	0.797	0.697	-0.100	-0.118
Motor Vehicles, Parts and Accessories	0.886	0.892	0.906	0.918	0.770	-0.148	-0.116
Transport Equipment	0.873	0.900	0.886	0.864	0.644	-0.220	-0.229
Furniture	0.757	0.773	0.784	0.791	0.676	-0.114	-0.081
Other Manufacturing Industries	0.774	0.842	0.815	0.898	0.719	-0.179	-0.054
Average	0.786	0.823	0.845	0.844	0.668	-0.176	-0.118
Average weighted by output	0.800	0.837	0.854	0.848	0.702	-0.146	-0.098

Source: Values for 1972 - 1996 from *Fedderke and Szalontai (2004),* Calculations for 2001 based on *Stats SA, Large Sample Survey (2004)*

Table 3: Rosenbluth Index for South African Manufacturing Industry, 1972-2001

Sector	Rosen Index					Change	
	1972	1979	1988	1996	2001	1996 - 2001	1972 - 2001
Food and Food Products	0.0046	0.0051	0.0070	0.0051	0.0015	-0.0036	-0.0031
Beverages	0.0282	0.0194	0.0483	0.0502	0.0116	-0.0386	-0.0166
Textiles	0.0081	0.0099	0.0087	0.0062	0.0019	-0.0043	-0.0062
Clothing, except Footwear	0.0039	0.0040	0.0037	0.0031	0.0014	-0.0017	-0.0025
Leather and Leather Products	0.0238	0.0242	0.0300	0.0485	0.0104	-0.0381	-0.0134
Footwear	0.0281	0.0219	0.0216	0.0171	0.0067	-0.0104	-0.0214
Wood and Wood and Cork Products	0.0065	0.0082	0.0092	0.0039	0.0017	-0.0022	-0.0048
Paper and Paper Products	0.0294	0.0254	0.0300	0.0242	0.0077	-0.0165	-0.0217
Printing, Publishing and Allied Industries	0.0055	0.0041	0.0037	0.0031	0.0017	-0.0013	-0.0038
Basic Chemicals	0.0440	0.0428	0.0329	0.0448	0.0094	-0.0354	-0.0346
Rubber Products	0.0971	0.0853	0.0670	0.0449	0.0103	-0.0346	-0.0868
Plastic Products	0.0130	0.0100	0.0081	0.0044	0.0017	-0.0027	-0.0113
Glass and Glass Products	0.1533	0.2129	0.1265	0.1657	0.0210	-0.1447	-0.1323
Other Non-Metals	0.0139	0.0080	0.0073	0.0064	0.0034	-0.0030	-0.0104
Basic Iron and Steel Industries	0.0515	0.0579	0.0587	0.0860	0.0083	-0.0778	-0.0432
Non-Ferrous Metal Basic Industries	0.0507	0.0630	0.0713	0.0811	0.0048	-0.0763	-0.0459
Metal Products, except Machinery and Equipment	0.0025	0.0022	0.0015	0.0013	0.0005	-0.0008	-0.0020
Machinery, except Electrical	0.0049	0.0033	0.0023	0.0017	0.0004	-0.0012	-0.0045
Electrical Machinery Apparatus	0.0119	0.0086	0.0075	0.0031	0.0019	-0.0012	-0.0100
Motor Vehicles, Parts and Accessories	0.0166	0.0127	0.0126	0.0108	0.0018	-0.0090	-0.0148
Transport Equipment	0.0697	0.0541	0.0350	0.0281	0.0048	-0.0234	-0.0649
Furniture	0.0064	0.0049	0.0036	0.0031	0.0023	-0.0008	-0.0041
Other Manufacturing Industries	0.0196	0.0065	0.0045	0.0083	0.0020	-0.0063	-0.0176
Average	0.0301	0.0302	0.0261	0.0283	0.0051	-0.0232	-0.0250
Average weighted by output	0.0218	0.0211	0.0217	0.0265	0.0038	-0.0227	-0.0180

Source: Values for 1972 - 1996 from *Fedderke and Szalontai (2004),* Calculations for 2001 based on *Stats SA, Large Sample Survey (2004)*

Table 4: Relationship between Level and Magnitude of Change in the Rosenbluth Index

Sector	Rank		
	Rosenbluth 1996	Rank of Change 1996 - 2001	Rosenbluth 2001
Food and Food Products	15	14	20
Beverages	4	4	2
Textiles	14	13	14
Clothing, except Footwear	18	18	21
Leather and Leather Products	5	5	3
Footwear	10	10	8
Wood and Wood and Cork Products	17	17	18
Paper and Paper Products	9	9	7
Printing, Publishing and Allied Industries	21	19	17
Basic Chemicals	7	6	5
Rubber Products	6	7	4
Plastic Products	16	16	19
Glass and Glass Products	1	1	1
Other Non-Metals	13	15	11
Basic Iron and Steel Industries	2	2	6
Non-Ferrous Metal Basic Industries	3	3	9
Metal Products, except Machinery and Equipment	23	22	22
Machinery, except Electrical	22	20	23
Electrical Machinery Apparatus	20	21	15
Motor Vehicles, Parts and Accessories	11	11	16
Transport Equipment	8	8	10
Furniture	19	23	12
Other Manufacturing Industries	12	12	13
Spearman's rank correlation coefficient:			
1996 rank and magnitude of change	0.983*		
1996 rank and 2001 rank	0.878*		

* indicates statistical significance at the 1% level

Table 5 Components of Δlog(R)

Sector	Proportion of change in log(R) attributable to		% Growth in real output
	$\Delta \log n$	$\Delta \log(1-G)$	1996-2001
Food and Food Products	0.457	0.543	0.036
Beverages	0.652	0.348	0.015
Textiles	0.359	0.641	0.021
Clothing, except Footwear	-0.101	1.101	-0.120
Leather and Leather Products	0.305	0.695	0.222
Footwear	0.244	0.756	-0.352
Wood and Wood and Cork Products	0.039	0.961	0.202
Paper and Paper Products	0.418	0.582	0.141
Printing, Publishing and Allied Industries	-0.320	1.320	-0.167
Basic Chemicals	0.393	0.424	
Rubber Products	0.298	0.702	0.071
Plastic Products	0.118	0.882	0.028
Glass and Glass Products	0.612	0.388	0.061
Other Non-Metals	-0.017	1.017	-0.074
Basic Iron and Steel Industries	0.810	0.190	0.143
Non-Ferrous Metal Basic Industries	0.822	0.178	0.077
Metal Products, except Machinery and Equipment	0.099	0.901	0.093
Machinery, except Electrical	0.409	0.591	0.095
Electrical Machinery Apparatus	0.191	0.809	0.104
Motor Vehicles, Parts and Accessories	0.423	0.577	0.534
Transport Equipment	0.460	0.540	0.097
Furniture	-0.519	1.519	0.004
Other Manufacturing Industries	0.294	0.706	
Average	0.280	0.712	-

Source: TSE, Own calculations

Table 6: Sample Size and Response Rte for 2001 Large Sample Survey of the Manufacturing Industry

Size group	Total sample	Total response	Response rate
Size 1	4 780	4 327	90,52%
Size 2	3 017	2 347	77,79%
Size 3	1 496	1 088	72,73%
Size 4	707	508	71,85%
Total	10 000	8 270	82,70%

Source: Stats SA, Report 30-02-01 2001

Table 7 Results of Bivariate Regressions

Variable	Concentration Measure	Census Year									
		1972	1976	1979	1982	1985	1988	1991	1993	1996	2001
Output	Gini	8.66E-06	1.23E-05	4.45E-06	8.10E-06	6.28E-06	1.02E-05	1.19E-05	4.54E-06	4.84E-06	1.41E-05
	Rosen	-7.62E-06	-4.53E-06	-5.78E-06	-4.18E-06	-5.02E-06	-4.86E-06	-4.37E-06	-4.69E-06	-1.50E-06	-7.39E-07
Output Growth	Gini	0.036	0.014	0.004	-0.335	-0.135	-0.045	-0.163	-0.118	0.149	0.689
	Rosen	0.059	0.017	0.063	0.013	0.153	-0.039	-0.107	-0.034	0.092	-0.008
Emplyoment	Gini	2.08E-07	4.04E-07	3.44E-07	2.62E-07	2.53E-07	5.99E-08	1.06E-07	-2.64E-07	-2.37E-07	-6.25E-07
	Rosen	-4.69E-07	-3.19E-07	-4.02E-07	-2.93E-07	-3.35E-07	-3.23E-07	-3.30E-07	-4.00E-07	-4.24E-07	-7.37E-08
Employment Growth	Gini	0.081	0.318	-0.535	-0.093	0.072	-0.227	0.107	0.050	-0.104	0.241
	Rosen	-0.029	-0.542	-0.868	-0.562	0.210	0.119	-0.013	-0.034	-0.135	-0.011
Investment Rate	Gini	0.357	0.397	0.005	0.109	-0.342	-0.560	-0.077	0.451	0.192	0.704
	Rosen	0.071	0.071	-0.350	0.112	-0.218	-0.266	0.276	0.228	0.285	0.024
Import Penetration	Gini	0.069	0.148	0.142	0.057	0.091	-0.002	0.009	0.030	0.005	-0.120
	Rosen	0.010	0.047	0.058	0.023	0.021	-0.016	-0.006	0.001	0.001	-0.002
Export Orientation	Gini	-0.036	0.039	0.104	0.024	0.077	0.065	0.041	0.131	0.080	0.161
	Rosen	0.016	0.025	0.045	0.039	0.057	0.075	0.087	0.131	0.087	0.003
Nominal Tariffs	Gini						-0.258	-0.124	-0.112	-0.161	-0.504
	Rosen						-0.104	-0.094	-0.063	-0.080	-0.008
Effective Tariffs	Gini						-0.067	-0.032	-0.030	-0.048	-0.160
	Rosen						-0.032	-0.033	-0.018	-0.022	-0.003

Notes: Gini refers to the Gini index, while Rosen refers to the Rosenbluth index

Table 8: Fedderke and Szalontai 2004: Estimation Results

Variables	Equation 1	Equation 2	Equation 3
$d\ln Y^e$	0.57*	0.17*	0.20*
	(0.03)	(0.03)	(0.03)
$d\ln uc$	-0.09*	-0.10*	-0.09*
	(0.02)	(0.01)	(0.01)
σ_{sect}	-0.20*	-0.21*	-0.17*
	(0.05)	(0.05)	(0.05)
σ_{sys}	-0.004*	-0.004*	-0.01*
	(0.001)	(0.001)	(0.001)
GINI	0.09**		0.76*
	(0.05)		(0.09)
ROSEN		-1.49*	-0.62*
		(0.29)	(0.20)

* denotes statistical significance

Table 9: Investment Function – Estimation Results for Various Specifications, Pooled Mean Group Estimator

Pooled Mean Group Estimator: Dependent Variable: *I*		
ARDL	1,1,1,1,0,2,2	1,1,1,1,2,2
$dlnY^e$	0.030*	0.034*
	(0.016)	(0.013)
dlnuc	-0.005	-0.009
	(0.035)	(0.031)
σ_{sect}	-0.074*	-0.083*
	(0.034)	(0.023)
σ_{sys}	-0.092**	n/a
	(0.051)	
GINI	-0.051	-0.047
	(0.048)	(0.045)
ROSEN	-1.103*	-1.056
	(0.479)	(0.471)
δ	-0.674*	-0.702*
	(0.054)	(0.056)
h-test	9.97	9.75
	[0.13]	[0.08]
RLL	1167.12	1230.77
ULL	1316.65	1373.43
LR: χ^2	299.07*	285.32*

Figures in round parentheses are standard errors, h-test denotes Hausman test, Square parentheses are probability values, * denotes statistical significane at the 5% level, ** at the 10% level of significance

Data Appendix

Real Output:

For 1972 to 1997, data from WEFA was used. For 1998, 1999 and 2000, this series was extrapolated using TSE's Real Output Index (base year, 1995).

$$Y_{i,t} = Y_{1995,i} \times ROI_{i,t}$$

where $Y_{1995,i}$ is the real output value for sector *i* in 1995 (from WEFA) and

$ROI_{i,t}$ is the real output index value of sector *i* for time *t* where *t* is defined from *t=1998 … 2000.*

Sector specific depreciation rates:

Sector specific depreciation rates for machinery and equipment used in the measure of user cost were only available from WEFA till 1997. Due to the lack of manufacturing depreciation rates specific to machinery and equipment, the rates for 1998 to 2001 were estimated using data on depreciation rates of all assets and a ratio of previous machinery and equipment specific depreciation rates to aggregate depreciation rates (all assets).

$$dr_{mach,i,t} = \theta_i \times dr_{all,i}$$

where $dr_{mach,i,t}$ denotes the sector specific depreciation rate on machinery and equipment at time *t*,

$dr_{all,t}$, the depreciation rate on all assets for the manufacturing industry at time *t*, and

θ_i is defined as $\dfrac{\sum_{t=1993}^{1997} \dfrac{dr_{mach,i,t}}{dr_{all,t}}}{5}$ (*i.e.*, the average over 5 years of the ratio of industry specific depreciation rates on machinery and equipment and the manufacturing industry depreciation rate on all assets.

Dollar Index:

The Dollar index (Dollar, 1992) is defined as $\dfrac{P_{actual}}{P_{estimated}}$ where P_{actual} is the price level of the domestic country GDP relative to that of the United States and

$P_{estimated} = b_1 + b_2 GDP + b_3 GDP^2$.

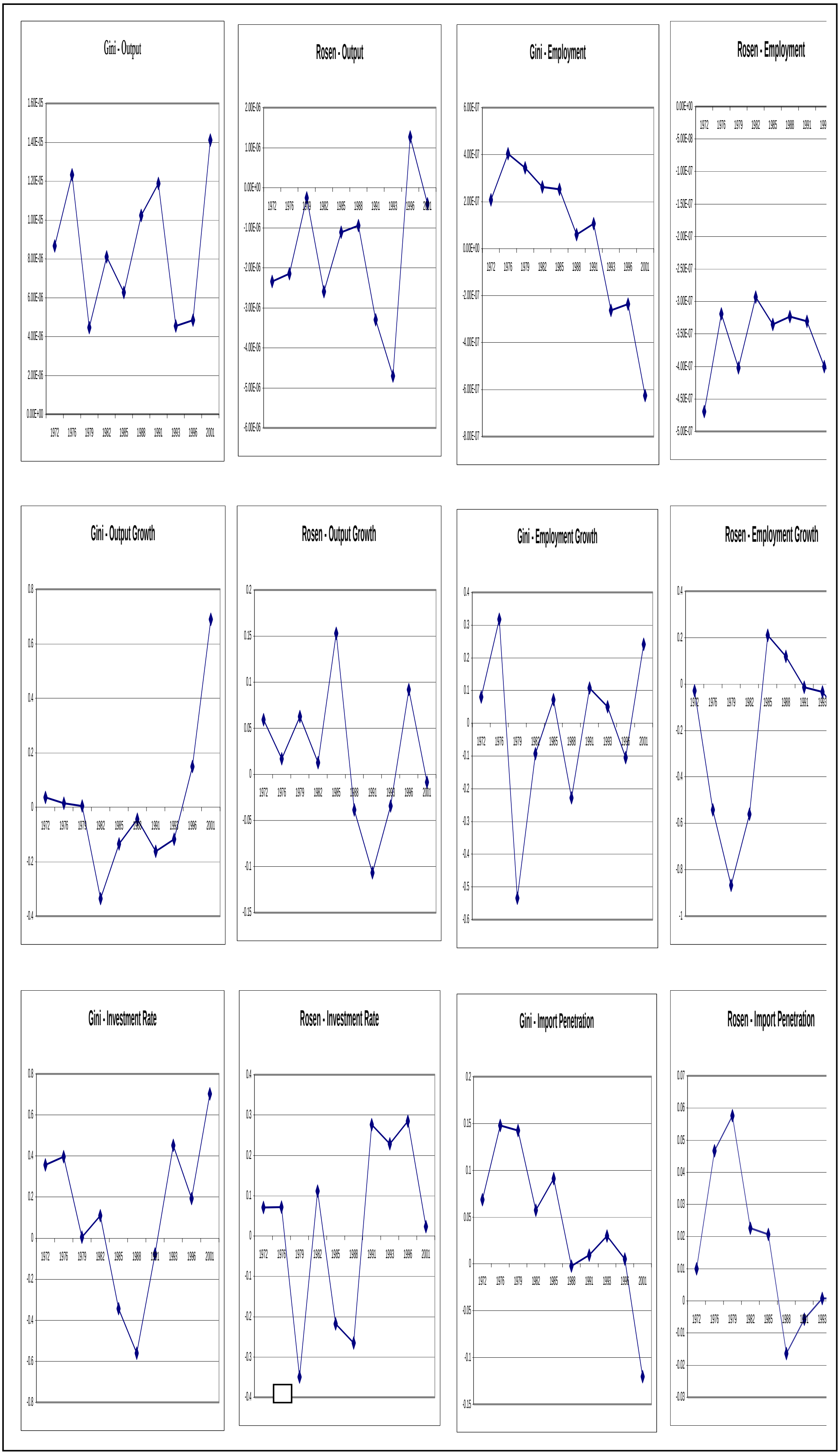
Appendix A

Table 1: Kayemba's (2000) method of aggregation of 3-digit SIC groups

Sector	3-digit SIC groups
Food and Food Products	301, 302, 303, 304
Beverages	305
Textiles	311, 312
Clothing, except Footwear	313, 314
Leather and Leather Products	316
Footwear	317
Wood and Wood and Cork Products	321, 322
Paper and Paper Products	323
Printing, Publishing and Allied Industries	324, 325, 326
Basic Chemicals	334
Rubber Products	337
Plastic Products	338
Glass and Glass Products	341
Other Non-Metals	342
Basic Iron and Steel Industries	351
Non-Ferrous Metal Basic Industries	352
Metal Products, except Machinery and Equipment	353, 354, 355
Machinery, except Electrical	356, 357, 358, 359
Electrical Machinery Apparatus	361, 362, 363, 364, 365, 366, 371, 372, 373, 374, 375
Motor Vehicles, Parts and Accessories	381, 382, 383
Transport Equipment	384, 385, 386, 387
Furniture	391
Other Manufacturing Industries	392, 395

Source: Kayemba (2000)

Appendix B
Figure 1: Tracking of Bivariate



Appendix B: Figure 2: Tracking of Bivariate Regression