

## **Industry Concentration in South African Manufacturing Industry: Trends and Consequences, 1972-96.**

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*ABSTRACT: This paper examines industry concentration for the South African manufacturing sector over the 1972-1996 period, for the three digit industry classification. The paper notes both the high level of industry concentration in South African manufacturing, and a rising trend in concentration across a wide range of industries. The paper further explores the impact that industry concentration has on a wide range of indicators of industry performance. We find that increased concentration serves to lower output growth, raise unit labour costs, and to lower labour productivity. The impact on employment, total factor productivity and investment rates based on bivariate examinations of the data are ambiguous. The paper concludes by examining the impact of concentration on employment and investment rates using a dynamic heterogeneous panel estimation methodology. We find that increased concentration unambiguously lowers employment. For investment rates, increased inequality of market share serves to raise investment rates, while falling firm numbers for any given inequality of market share lowers investment rates. The difference can be interpreted as the distinct impact that the pursuit of managerial objectives (large market share promoting further productive capacity expansion) and that market contestability (under falling numbers of firms in an industry, monopolistic incentives to curtail productive capacity rise) have on investment.*

JEL Classification: L11, L5, L6, D29, D49

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### **1.0 Introduction**

The study of industrial concentration in the South African manufacturing sector has been largely neglected in the past. While notable exceptions exist,<sup>1</sup> concentration has featured less in the debate on South African industry characteristics and performance than the exceptionally high degrees of concentration might suggest it should. The lack of availability of concentration ratio data series has surely hindered research in this field. This paper is aimed at providing an initial exploratory analysis of concentration within South African manufacturing, by extending data on concentration to the 1972-96 period. We explore trends in concentration over this time, and extend the analysis to a preliminary consideration of its impact on industrial performance.

<sup>1</sup> See for example Du Plessis (1989), Fourie and Smith (1989), and Leach (1992).

We focus on two measures of concentration, namely the Gini coefficient and the Rosenbluth index. We analyse the changes in these measures over the period and investigate patterns of association between the concentration measures and our indicators of industry performance. We find that for the 24 industries considered, in almost all sectors, less than 5% of firms account for over half the industry output. We also find that there has been considerable change in the relative rankings of industry concentration over the period under study. These high levels of concentration and their dynamic nature clearly warrant further investigation.

The paper considers the direction of association between the concentration measures and a range of indicators of industry performance. The initial focus of the analysis is on bivariate associations. What emerges from these results is that there are numerous interactions between our two concentration measures and other variables. What is also evident is that the concentration measures generally drive the measures of economic performance and not vice versa. ARDL cointegration analysis further suggests that higher industry concentration serves to lower output growth and labour productivity, to raise relative unit labour cost, while the impact on employment, investment rates and total factor productivity are ambiguous.

The paper therefore also considers the relationship between concentration and both employment and investment rates in multivariate specifications, employing panel estimation techniques. The findings are that increased concentration lowers employment in South African manufacturing industry. For investment, the implication is that rising market share increases investment if sufficient rival firms remain in the market. By contrast falling market contestation as measured by the number of firms in the industry serves to strongly decrease the investment rate. One interpretation of this contrasting evidence is that increasing market share promoting investment rates is evidence of the presence of managerial objectives in South African manufacturing industry. By contrast, where small firm numbers have already been obtained, and hence market contestation is diminished, monopolistic incentives to reduce productive capacity emerge.

Section 2 of the paper introduces the data and methodology employed in the study. Section 3 presents the descriptive evidence on concentration. Section 4 considers the bivariate associations between concentration and a range of industry performance indicators. Section 5 presents econometric evidence on the impact of concentration on employment and investment rates. Section 6 concludes.

## **2.0 Data and Methodology**

In order to obtain a consistent set of concentration indexes over the 1972-96 period, data had to be compiled for a number of years from raw data provided by Statistics South Africa (StatsSA) on request.

The compilations are based on tables published by StatsSA in the Census of Manufacturing. For 3 digit SIC manufacturing industries, Table 6 of the Census of Manufacturing shows the cumulative percentages of gross output, accounted for by

cumulative percentages of firms. These tables were available in the 1976, 1979 and 1985 manufacturing censuses. The tables for the 1988, 1991, 1993 and 1996 censuses were not published in the original censuses, but were compiled by StatsSA on request. The required data for the 1972 census was taken from Leach (1992).

Discrete measures of concentration consider only a limited number of firms in an industry.<sup>2</sup> These frequently used measures, such as the percentage of industry size accounted for by a certain number of firms in the industry have the advantage that they are easy to calculate as they depend on only one point on the concentration curve. If concentration curves of industries under study intersect, there will be ambiguity in determining which industry is more concentrated relative to another. Summary concentration measures in contrast to the discrete measures take into account all the firms in the industry. Two of the more prominent “summary” indices of concentration are the Herfindahl and Rosenbluth indices. The basic differences between the different summary measures of concentration lie in the weights assigned to the market shares of firms in calculating the respective indices (Needham, 1978). Changes in the size distribution of firms will produce changes of different magnitudes in the various indices. The Herfindahl Index will be relatively insensitive to changes in small firms’ shares, while the Rosenbluth index will react strongly, due to the different weights assigned to small firms by each index.

Another class of concentration indices is given by relative concentration measures. These are in contrast to the absolute measures such as the Herfindahl or Rosenbluth measures. Relative concentration measures can be depicted using Lorenz curves and they focus attention on the degree of inequality of firm sizes. Gini’s concentration measure which we use in the present study is the ratio of the area between the Lorenz curve and the line of absolute inequality. This measure is bounded by 0 for equal sized firms and 1 for an industry in which there is only one firm. Again the basic differences between relative and absolute measures of concentration lie in their weighting schemes. Absolute concentration measures are weighted *sums* of the firms’ shares, while relative measures are weighted *averages* (Needham 1978).

In the international literature concentration measures such as the Herfindahl index have become the most widely used. Unfortunately, for South African industry the Herfindahl index while currently published by StatsSA, is unable to be computed on the basis of the data available for earlier manufacturing indexes. The Herfindahl index is defined as:

$$HI = \sum_{i=1}^n (ms_i)^2$$

where  $ms_i$  is the market share of firm  $i$ , and  $n$  denotes the number of firms in the industry. This measure is bounded by  $1/n$  under equal firm size and 1 when only 1 firm is present in an industry. The unavailability of the market shares contributed by firm  $i$  in the historical manufacturing census precludes the computation of the Herfindahl

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<sup>2</sup> Typical examples of such measures are given by the occupancy count – the number of firms producing a given percentage of output - and the four firm concentration measure.

index for South Africa. Previous authors interested in concentration in South African industry have therefore resorted to the use of the Rosenbluth and Gini indexes.<sup>3</sup>

In the interests of providing some continuity to the debate surrounding concentration, and in order to be able to obtain a consistent series over the past three decades, we follow suit in the present study.

In the present study the Gini coefficient was calculated as the area between the Lorenz curve and the line of equal distribution of industry production. Since the cumulative percentages [0, 5, 10, ..., 100] of firms given in the manufacturing censuses are evenly spaced, a technique of numerical integration known as the Simpson's one-third rule was used to approximate the Lorenz curve. Simpson's one-third rule is based on the fact that any three points determine a unique quadratic polynomial. Thus the Lorenz curve can be approximated by successive arcs of quadratic polynomials through successive sets of 3 known and equidistant points on the curve. This provides one quadratic estimating the curve over the range 0 to 10, another from 10 to 20, with the 10<sup>th</sup> quadratic estimating the curve from 90<sup>th</sup> to the 100<sup>th</sup> percentile of firms. The area under the Lorenz curve can then be estimated by summing the areas under each quadratic, and from this the area between the Lorenz and the line of equal distribution follows trivially.

Formally Simpson's one-third rule can be written as:

$$\int_{x_0}^{x_2} f(x)dx = \frac{h}{3}(f_0 + f_1 + f_2) \quad (1)$$

where  $h$  represents the interval width (5% or 0.05 in the case of the manufacturing census data), and  $f_i$  is the percentage contribution to output of firms at the 3 points at which each successive arc is being estimated. The rule is applied separately to each 10 percent interval and the area under the curve is obtained by summation of the individual results.

Linear interpolation was used to calculate the Gini for the years in which a manufacturing census was not published.

The Rosenbluth index is defined as:

$$R = \left\{ 2 \sum_{i=1}^n (ims_i) - 1 \right\}^{-1} \quad (2)$$

where  $ms_i$  is the market share of the  $i$ th-ranked firm and  $n$  the number of firms (see the discussion in Leach 1992). The measure is bounded by  $1/n$  when firms are of equal size and tends to 1 the more unequal are firm sizes.

As noted by Leach (1992) the Rosenbluth index of concentration can also be expressed as a positive function of the Gini coefficient and a negative function of the number of firms:

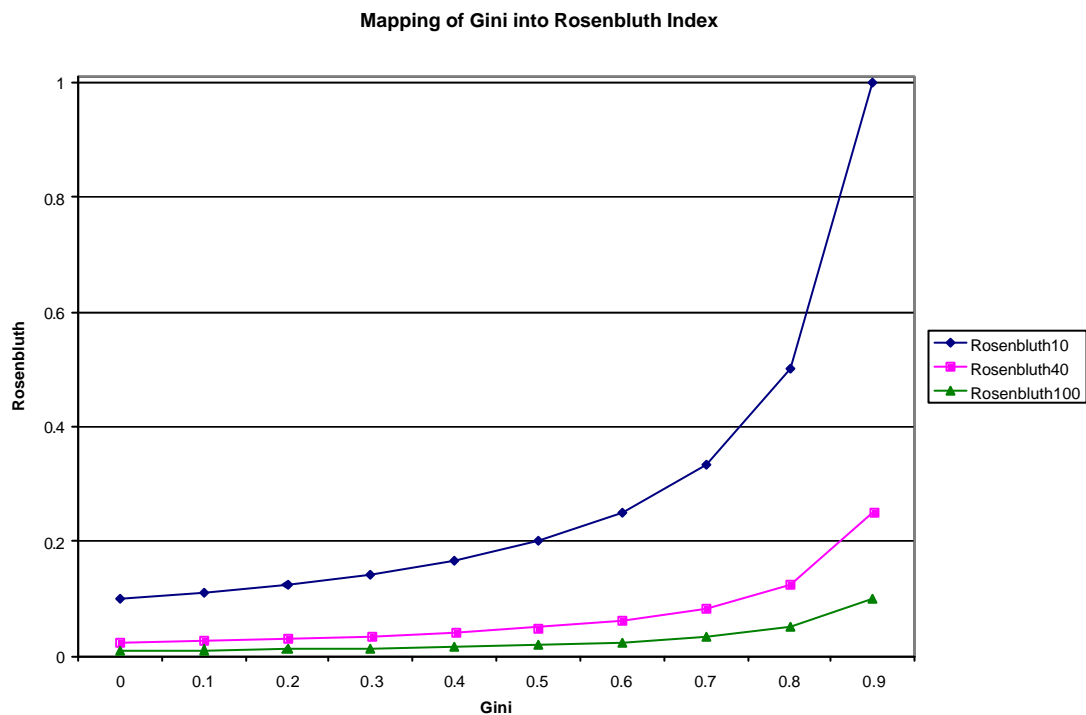
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<sup>3</sup> Du Plessis (1989) and Fourie and Smit (1989) employ the Gini coefficient as a measure, and Leach (1992) uses both the Gini measure and the Rosenbluth measure of concentration.

$$R = \{n(1 - G)\}^{-1} \quad (3)$$

where  $G$  is the Gini coefficient and  $n$  is the number of firms in the industry. In the present study the Rosenbluth index was computed using (3).

Figure 1 demonstrates the relationship between the Rosenbluth and Gini measures of concentration. A number of points are worth noting about the two indexes. First, while there is a clear functional relationship between them, it is a non-linear one. A rising level of production inequality as measured by the Gini results in increases in the Rosenbluth index, but at an increasing rate (Rosenbluth is convex in the Gini). Second, the Rosenbluth index responds strongly to changes in the number of firms present in the industry, which the Gini does not. Thus for a Gini coefficient of 0.9, a tenfold increase in the number of firms present in production will lower the Rosenbluth index tenfold, even though production is equally concentrated under the computations.<sup>4</sup>



**Figure 1: Relationship between Gini coefficient and Rosenbluth concentration index. In Rosenbluth $_x$ ,  $x$  denotes the number of firms involved in the comparison.**

<sup>4</sup> Leach (1992: 395) does not consider the Gini coefficient a measure of concentration, merely one of inequality of the distribution production - since the measure does not adjust for the number of firms that produce the concentrated output. Of course this argument assumes that unequally distributed production across firms is contestable no matter how small the firms mounting the contestation. Which may or may not be true.

Due to differences between the 4<sup>th</sup> and 5<sup>th</sup> editions of the Standard Industrial Classification for all economic activities (SIC) the approach of Kayemba (2000) was adopted in combining industry codes, to make comparisons between sectors feasible. The South African classification convention follows SIC which first appeared in 1970 (Kayemba 2000). Revisions in the classification system have led to several discrepancies emerging across the different manufacturing censuses. The new classification was used for the 1993 and 1996 censuses. The results for the petroleum industry are problematic. Until the 1993 manufacturing census the Petroleum Industry (SIC 353) was combined with Other Manufacturing (SIC 390). This was done for political reasons and the decision to disaggregate the results was taken and implemented only from the 1993 Census of Manufacturing onwards. Data on the Tobacco industry (SIC code 314) was only available for two of the censuses, and the sector had to be dropped from analysis due to data unavailability. Thus we are left with 24 industries that we examine in detail.

### **3.0 Changes in Concentration, 1972-96**

We report results for the Rosenbluth absolute summary measure of concentration, the Gini relative summary measure of concentration, as well as the discrete measure of concentration provided by the proportion of production contributed by specified percentages of all firms in an industry.

The evidence from the discrete concentration measure and the Gini coefficient is strictly consistent, indicating a high and rising level of industry concentration. The evidence from the Rosenbluth measure is more muted in indicating rising concentration – though nevertheless evidence in favour of high and rising concentration remains present.

We begin with the discrete measures of concentration, by considering the proportion of output accounted for by some given percentages of firms. Table 2 reports the results. In the interests of parsimony we report results only for 3 censuses, and we report the percentage of output produced by 5, 10 and 15 percent of all firms in a specific industry. What is notable is that in all three census years, in almost all of the sectors the largest 5% of firms produce more than 50% of output. By the 1990's, there is no manufacturing sector in which 5% of the firms do not produce at least 50% of total output. And the largest 10% of firms produce at least 50% of output for all three manufacturing censuses under consideration.

For a number of sectors, the largest 5% of firms have been able to increase the proportion of output they contribute strongly from the 1970's to the 1990's. Figure 2 shows that in Rubber & rubber products, Beverages, Glass & glass products, and Other industries, the largest 5% of firms have been particularly successful in raising the proportion of output over the sample period. But the upward trend has been general across most manufacturing industry, so that by 1996, 4 sectors had the largest 5% of firms contribute more than 80% of output.<sup>5</sup> And only 6 sectors had the largest 5% of firms contribute less than 60% of output.<sup>6</sup>

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<sup>5</sup> Motor vehicles, Rubber, Beverages, Other industries.

<sup>6</sup> Electrical machinery, Furniture, Textiles, Clothing, Footwear, Plastics.

Independently of any summary concentration measure, therefore, it is clear that South African manufacturing industry maintains a high level of concentration, with a small proportion of firms dominating production in almost all sectors.

Summary measures serve to confirm the evidence – though more unambiguously in the case of the Gini than the Rosenbluth measure.

Table 3 shows the trends in the Gini coefficient as a measure of concentration both in level terms and industry rank. Here and for the Rosenbluth parsimony restricts results to the years 1972, 1980, 1990 and 1996. The evidence here further supports the result from the discrete concentration measure that suggests increased concentration in the South African manufacturing industry, by demonstrating increasing inequality in the distribution of productive activity over the sample period. 22 sectors show increased inequality between 1972 and 1996. Only 2 sectors have shown a decrease in their Gini coefficient over the same time period.<sup>7</sup> Looking at the relative rankings, there has also been a noticeable shift within the sectors. Only 2 of the 24 sectors,<sup>8</sup> showed no change in their relative rankings. Of all the sectors 9 have had a negative change in their rank, indicating an increase in inequality between 1972 and 1996 relative to other manufacturing sectors.<sup>9</sup> The positive change for the remaining 12 sectors indicates decreased inequality over this time period.

The results from the Rosenbluth measure are more mixed. Table 4 reports the trends in the Rosenbluth index in level terms and in industry rank. The evidence confirms an increase in the level of concentration in some manufacturing sectors, though there is also countervailing evidence. 7 of the sectors show a positive change between 1972 and 1996,<sup>10</sup> an indication of increased concentration. The remaining 17 sectors have become less concentrated over the same time period.

It is notable that the increases in concentration as measured by the Rosenbluth have been most prevalent in already concentrated industries. Figure 3 demonstrates that 3 of the 5 most concentrated sectors in South African manufacturing were amongst those that reported an increase in concentration over 1970-96, and 6 of the 7 sectors reporting an increase in concentration lie in the 50% of sectors above the mean level of concentration

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<sup>7</sup> Electric machinery, Other transport equipment.

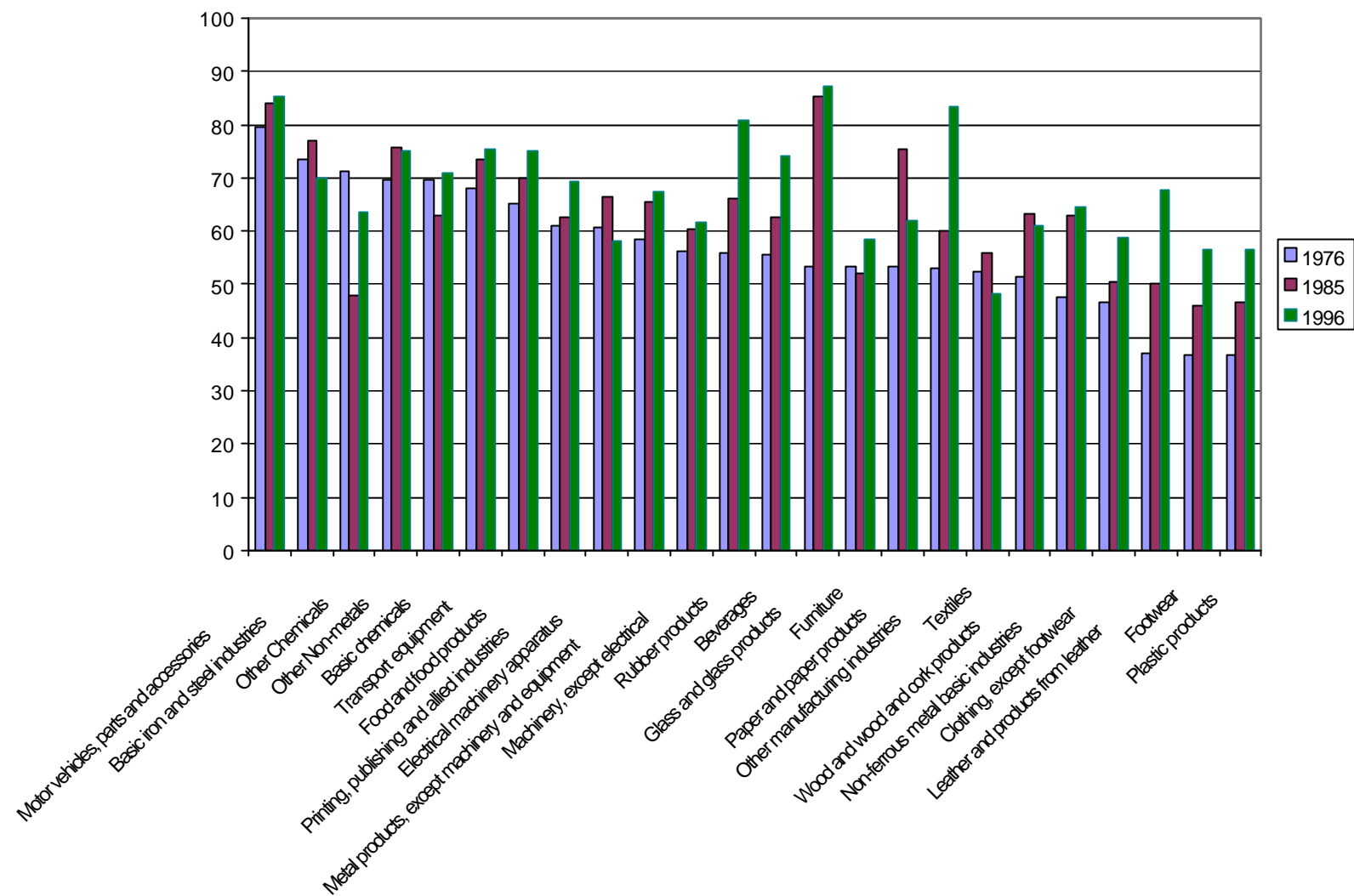
<sup>8</sup> Other Chemicals and Motor Vehicles.

<sup>9</sup> Food, Leather & leather products, Wood & wood products, Paper & paper products, Basic chemicals, Plastics, Glass & glass products, Basic non-ferrous metals, Other industries.

<sup>10</sup> Food, Beverages, Leather & leather products, Basic chemicals, Glass & glass products, Basic iron & steel, and Basic non-ferrous metals.

		1976			1985			1996		
	5%	10%	15%	5%	10%	15%	5%	10%	15%	
<b>Food and food products</b>	65.29	80.26	87.38	70.12	84.28	89.92	75.16	85.35	90.13	
<b>Beverages</b>	55.64	71.38	77.65	62.68	77.88	83.74	74.26	87.55	91.05	
<b>Textiles</b>	52.29	67.85	77.38	55.92	72.95	82.34	48.11	63.72	72.84	
<b>Clothing, except footwear</b>	46.75	63.85	73.79	50.58	66.74	76.14	58.68	72.78	79.68	
<b>Leather and products from leather</b>	37.17	51.78	63.20	50.25	70.20	78.73	67.86	84.24	88.69	
<b>Footwear</b>	36.73	53.09	65.30	46.08	62.06	69.85	56.42	68.00	75.46	
<b>Wood and wood and cork products</b>	51.35	66.97	76.34	63.34	75.43	81.82	61.10	73.49	80.00	
<b>Furniture</b>	53.39	66.98	75.15	52.12	65.48	73.75	58.38	71.19	78.41	
<b>Paper and paper products</b>	53.36	65.34	74.37	75.43	84.08	87.69	62.05	74.13	80.46	
<b>Printing, publishing and allied industries</b>	60.99	71.63	78.44	62.45	73.22	79.38	69.25	78.46	84.16	
<b>Basic chemicals</b>	69.55	79.31	85.20	62.88	78.40	84.90	70.79	82.59	88.72	
<b>Other Chemicals</b>	71.32	80.89	86.63	47.99	64.30	74.89	63.43	81.32	87.83	
<b>Rubber products</b>	55.97	79.30	87.60	66.16	83.77	87.18	80.85	86.38	89.32	
<b>Plastic products</b>	36.55	54.87	66.44	46.63	63.48	73.61	56.67	70.69	77.81	
<b>Glass and glass products</b>	53.46	78.93	88.08	85.40	87.42	90.12	87.31	90.28	92.91	
<b>Other Non-metals</b>	69.60	81.72	87.09	75.83	84.20	88.44	74.96	82.83	87.25	
<b>Basic iron and steel industries</b>	73.48	82.97	88.19	76.93	86.42	91.51	69.89	82.52	89.50	
<b>Non-ferrous metal basic industries</b>	47.60	70.83	81.13	63.07	77.37	85.16	64.66	80.19	87.55	
<b>Metal products, except machinery and equipment</b>	58.48	70.58	77.73	65.47	76.39	82.46	67.34	76.03	81.32	
<b>Machinery, except electrical</b>	56.14	71.56	79.46	60.24	72.68	79.14	61.79	73.35	79.84	
<b>Electrical machinery apparatus</b>	60.77	75.10	82.79	66.58	80.62	86.28	58.26	72.56	79.84	
<b>Motor vehicles, parts and accessories</b>	79.42	87.46	90.72	83.90	89.96	92.64	85.19	92.85	95.00	
<b>Transport equipment</b>	68.01	83.07	89.98	73.37	83.10	87.44	75.27	82.26	88.17	
<b>Other manufacturing industries</b>	53.15	69.30	78.19	59.90	74.63	81.85	83.38	88.37	91.67	

**Table 2. Contribution to output, by given percentage of firms.**



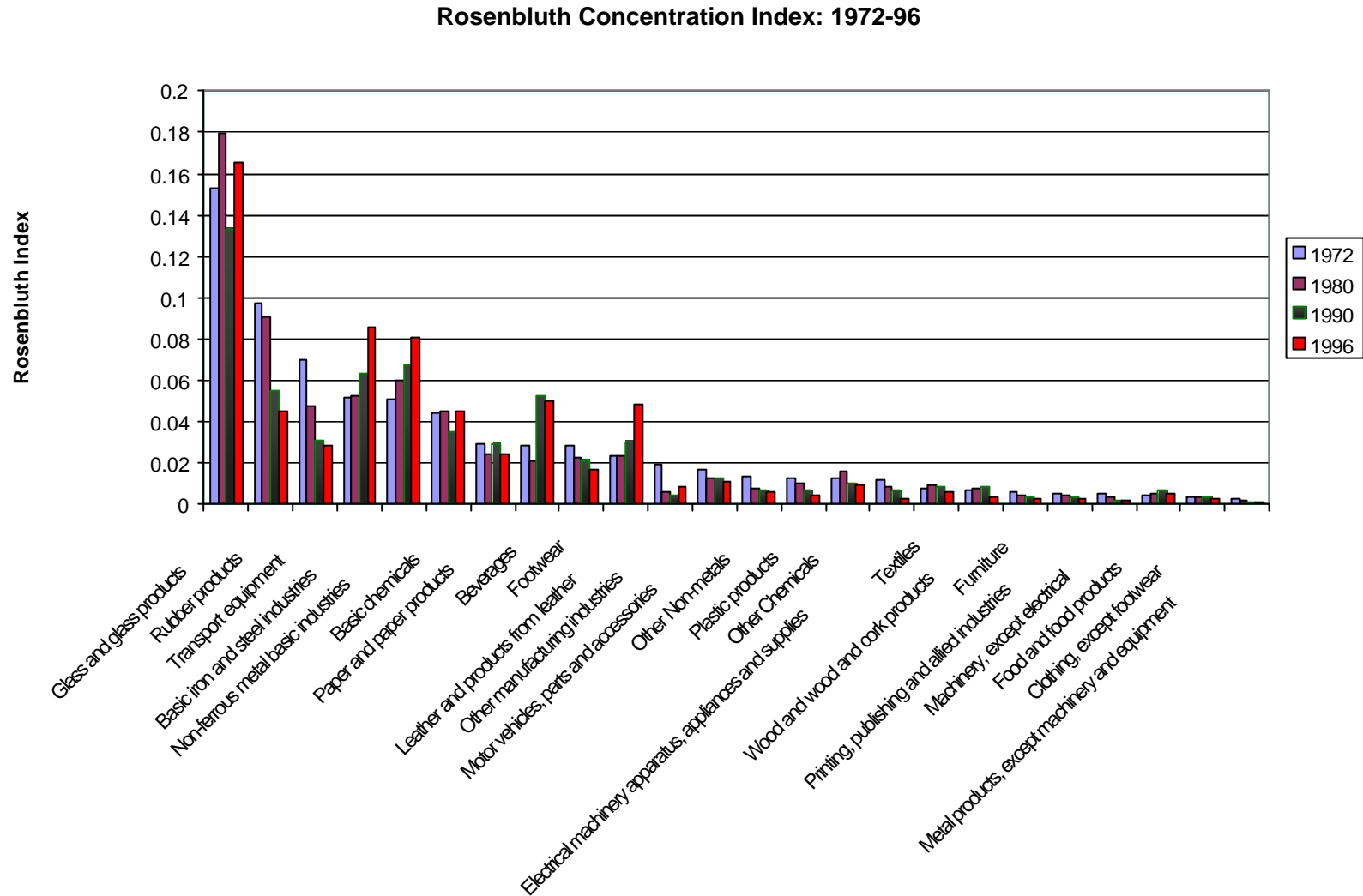
**Figure 2: Proportion of Output Contributed by Largest 5% of Firms**

Low rank indicates high concentration	1972	1980	1990	1996	Change 1972-96	1972	1980	1990	1996	? rank 1972-1996
Food and food products	0.8180	0.8701	0.9028	0.8843	0.0663	7	6	2	5	-2
Beverages	0.8480	0.7834	0.8856	0.8778	0.0298	4	20	5	7	3
Textiles	0.7610	0.8297	0.8555	0.7616	0.0006	18	13	12	24	6
Clothing, except footwear	0.7850	0.8003	0.8109	0.8023	0.0173	13	17	20	18	5
Leather and products from leather	0.6670	0.7562	0.8143	0.8669	0.1999	24	22	18	10	-14
Footwear	0.7040	0.6974	0.7867	0.7713	0.0673	22	24	24	23	1
Wood and wood and cork products	0.7110	0.8030	0.8380	0.8031	0.0921	21	16	14	17	-4
Furniture	0.7570	0.7696	0.7890	0.7905	0.0335	19	21	23	21	2
Paper and paper products	0.7520	0.8031	0.8864	0.8893	0.1373	20	15	4	4	-16
Printing, publishing and allied industries	0.7860	0.7963	0.8288	0.8354	0.0494	11	18	16	15	4
Basic chemicals	0.8150	0.8682	0.8552	0.8786	0.0636	9	7	13	6	-3
Other Chemicals	0.7770	0.8737	0.8363	0.8561	0.0791	14	5	15	14	0
Rubber products	0.8310	0.8603	0.8715	0.8763	0.0453	5	8	8	8	3
Plastic products	0.6910	0.7399	0.8048	0.7800	0.0890	23	23	22	22	-1
Glass and glass products	0.8280	0.8431	0.8814	0.9162	0.0882	6	10	6	2	-4
Other Non-metals	0.7960	0.8744	0.8682	0.8621	0.0661	10	4	9	12	2
Basic iron and steel industries	0.8550	0.8954	0.8907	0.8723	0.0173	3	1	3	9	6
Non-ferrous metal basic industries	0.7760	0.8502	0.8634	0.8615	0.0855	15	9	11	13	-2
Metal products, except machinery and equipment	0.7850	0.8248	0.8117	0.8141	0.0291	12	14	19	16	4
Machinery, except electrical	0.7690	0.7939	0.8073	0.7936	0.0246	17	19	21	20	3
Electrical machinery apparatus, appliances and supplies	0.8150	0.8429	0.8680	0.7973	-0.0177	8	11	10	19	11
Motor vehicles, parts and accessories	0.8860	0.8936	0.9129	0.9181	0.0321	1	2	1	1	0
Transport equipment	0.8730	0.8895	0.8781	0.8637	-0.0093	2	3	7	11	9
Other manufacturing industries	0.7735	0.8326	0.8279	0.8978	0.1243	16	12	17	3	-13

Table 3. Gini Coefficients. Levels and rankings.

<b>Ranks:</b> Low rank indicates low concentration	<b>1972</b>	<b>1980</b>	<b>1990</b>	<b>1996</b>	<b>Change: 1972-96</b>	<b>Rank 1972</b>	<b>Rank 1980</b>	<b>Rank 1990</b>	<b>Rank 1996</b>	<b>? rank 1972-96</b>
<b>Food and food products</b>	0.0046	0.0050	0.0071	0.0051	0.0005	22	19	16	16	-6
<b>Beverages</b>	0.0282	0.0208	0.0528	0.0502	0.0220	8	10	5	4	-4
<b>Textiles</b>	0.0081	0.0094	0.0086	0.0062	-0.0019	17	14	14	15	-2
<b>Clothing, except footwear</b>	0.0039	0.0039	0.0035	0.0031	-0.0008	23	22	21	19	-4
<b>Leather and products from leather</b>	0.0238	0.0233	0.0305	0.0485	0.0247	10	8	8	5	-5
<b>Footwear</b>	0.0281	0.0225	0.0214	0.0171	-0.0110	9	9	10	10	1
<b>Wood and wood and cork products</b>	0.0065	0.0081	0.0087	0.0039	-0.0026	18	16	13	18	0
<b>Furniture</b>	0.0064	0.0046	0.0033	0.0031	-0.0033	19	20	22	20	1
<b>Paper and paper products</b>	0.0294	0.0242	0.0297	0.0242	-0.0052	7	7	9	9	2
<b>Printing, publishing etc.</b>	0.0055	0.0040	0.0037	0.0031	-0.0024	20	21	20	22	2
<b>Basic chemicals</b>	0.0440	0.0451	0.0349	0.0448	0.0008	6	6	6	7	1
<b>Other Chemicals</b>	0.0127	0.0161	0.0102	0.0096	-0.0031	15	11	12	12	-3
<b>Rubber products</b>	0.0971	0.0909	0.0548	0.0449	-0.0522	2	2	4	6	4
<b>Plastic products</b>	0.0130	0.0100	0.0073	0.0044	-0.0086	14	13	15	17	3
<b>Glass and glass products</b>	0.1533	0.1798	0.1333	0.1657	0.0124	1	1	1	1	0
<b>Other Non-metals</b>	0.0139	0.0079	0.0070	0.0064	-0.0074	13	17	17	14	1
<b>Basic iron and steel industries</b>	0.0515	0.0529	0.0630	0.0860	0.0345	4	4	3	2	-2
<b>Basic non-ferrous metal industries</b>	0.0507	0.0601	0.0673	0.0811	0.0304	5	3	2	3	-2
<b>Metal products,</b>	0.0025	0.0021	0.0014	0.0013	-0.0012	24	24	24	24	0
<b>Machinery, except electrical</b>	0.0049	0.0032	0.0022	0.0017	-0.0032	21	23	23	23	2
<b>Electrical machinery</b>	0.0119	0.0084	0.0069	0.0031	-0.0088	16	15	18	21	5
<b>Motor vehicles</b>	0.0166	0.0123	0.0128	0.0108	-0.0058	12	12	11	11	-1
<b>Transport equipment</b>	0.0697	0.0474	0.0311	0.0281	-0.0416	3	5	7	8	5
<b>Other industries</b>	0.0196	0.0059	0.0045	0.0083	-0.0113	11	18	19	13	2
<b>AVERAGE FOR ALL INDUSTRIES</b>	<b>0.029</b>	<b>0.028</b>	<b>0.025</b>	<b>0.028</b>	<b>-0.002</b>					

Table 4. Rosenbluth Concentration Index. Level and ranking.



**Figure 3: Concentration by industry, 1972-96, Rosenbluth Index**

The ranking of the sectors (according to Rosenbluth) also reveals the presence of considerable shuffling of sectors in their relative rank ordering of concentration. Only 3 of the 24 industries under study showed no change in their relative ranking of concentration,<sup>11</sup> while a number of sectors exhibit strong changes. Of all the sectors 9 have had a negative change in their rank, indicating an increase in their relative concentration.<sup>12</sup> The remaining 12 sectors exhibit positive changes in their rank, or a decrease in their level of concentration relative to other industries.

Two factors explain the differences between the results to emerge from the Rosenbluth and the Gini measures.<sup>13</sup> First, recall that only the Rosenbluth measure takes into account the number of firms in an industry. Second, and critically, the Rosenbluth concentration measure is noted for its sensitivity to the presence of small firms with little market share – a factor that has favoured the use of the Herfindahl index internationally. Thus, the Rosenbluth index may well serve to understate the degree of concentration – though it is useful in capturing the effect of market entry.

The balance of the evidence remains. South African manufacturing industry has historically been highly concentrated, and evidence suggests that the trend has been to increase, not decrease concentration.

It remains to establish what, if anything, can serve to explain the rising concentration, and what impact such rising concentration has had on manufacturing sector performance.

#### **4.0 Patterns of Association**

An immediate question that presents itself is whether the two measures of concentration presented in this paper are of significance to other dimensions of the economy. Only where concentration exercises a significant impact on economic performance or where it is itself the outcome of other aspects of economic activity is it of general analytical interest.

In this section of the paper we therefore extend the analysis in two additional directions. The procedure followed is explicitly atheoretical. We examine test statistics that provide some insight into the nature of the association between variables, both in terms of direction of association, and the sign of the association. Throughout, analysis is conducted at the three digit sectoral level. Examination is of the association between each of the Rosenbluth and Gini concentration measures, and output (as measured by value added), employment, total capital stock, investment, growth of total factor productivity,

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<sup>11</sup> Metal products, Glass & glass products, Wood & wood products.

<sup>12</sup> Footwear, Furniture, paper & paper products, Printing, Basic chemicals, Rubber, Plastics, Other non-metal industries, Machinery, Electrical machinery, Other transport equipment, Other industries.

<sup>13</sup> Note that the differences also extend to industry rankings on the two measures. For instance, while the most concentrated industry as measured by the Rosenbluth index in 1996 is Glass and Glass products, the Gini coefficient consistently identifies the Motor vehicles sector as the one subject to the most unequal production (except in 1980 when the Basic Iron and Steel industry is most unequal).

relative real unit labour cost,<sup>14</sup> the ratio of gross operating surplus to value added, and labour productivity (as measured by the ratio of value added to total employment).

In order to explore the directions of association between the variables included in this study, we consider the use of the test statistic proposed by Pesaran, Shin and Smith (1996, 2001) (hereafter PSS) F-statistics.<sup>15</sup>

Suppose that the question is whether there exists a long run relationship between the set of variables  $y_t, x_{1,t}, \dots, x_{n,t}$ . Univariate time series characteristics of the data are not known for certain. The PSS approach to testing for the presence of a long run relationship proceeds by estimating the error correction specification given by:

$$\Delta y_t = \mathbf{a}_0 + \sum_{i=1}^p \mathbf{b}_i \Delta y_{t-i} + \sum_{j=1}^n \sum_{i=1}^p \mathbf{g}_{j,i} \Delta x_{j,t-i} + \left( \mathbf{d}_1 y_{t-1} + \sum_{k=2}^{n+1} \mathbf{d}_k x_{k,t-1} \right) + \mathbf{e}_t \quad (4)$$

The order of augmentation,  $p$ , is determined by the need to render the error term white noise, and is chosen from the set of all feasible lag structure combinations by means of an information criterion.<sup>16</sup> The test proceeds by computing the standard F-statistic for the joint significance of  $\mathbf{d}_1 = \mathbf{d}_2 = \dots = \mathbf{d}_{n+1} = 0$ . The distribution of the test statistic is non-standard, and influenced by whether the  $x_{i,t}$  are I(0) or I(1). The critical values are tabulated by Pesaran, Shin and Smith (1996), with  $x_{i,t} \sim I(0) \forall i$  providing a lower bound value,  $x_{i,t} \sim I(1) \forall i$  an upper bound value to the test statistic. The test statistic is computed with each of the  $y_t, x_{1,t}, \dots, x_{n,t}$  as the dependent variable. Where the estimated test statistic exceeds the upper bound value, we reject the null of  $\mathbf{d}_1 = \mathbf{d}_2 = \dots = \mathbf{d}_{n+1} = 0$ , and infer the presence of a long run equilibrium relationship. Where the estimated test statistic lies below the lower bound value, we accept the null, and infer the absence of a long run equilibrium relationship. The test is indeterminate either where the computed test statistic lies between the upper and lower bound values (in which case it is not clear whether a long run relationship between the variables is present), or where more than one variable is confirmed as the outcome variable of a long run equilibrium relationship (in which case the long run relationships between the variables would not be unique).<sup>17</sup>

Results are reported in Table 5. What emerges from our test results is that there are numerous significant interactions between our concentration measures and output growth, employment growth, investment, TFP, relative real unit labour cost, GOS/GDP and output per labourer. For only one sector (Printing, publishing and allied industries) do we find no pattern of association.

<sup>14</sup> This data was kindly supplied by Edwards and Golub (2002).

<sup>15</sup> See also the discussion in Pesaran (1997) and Pesaran and Shin (1995a, 1995b).

<sup>16</sup> For instance Akaike.

<sup>17</sup> The test is analogous to a Granger causality test, but in the presence of non-stationary data. Of course, there exist an array of tests designed to establish the univariate time series characteristics of the data. The tests are not always conclusive, however. This renders the PSS F-test suitable in the current context.

		GDP Growth	Empl. Growth	Invest Total	Invest Mach.	TFP	RULC	GOS/GDP	Y/L
Food	Xi	1.32	3.89	9.53**	10.47**	2.80	4.19	3.83	6.89**
	Rosen	5.57*	2.70	2.07	3.38	6.74**	5.50*	0.62	5.21*
	Xi	2.80	29.40**	3.26	9.83**	2.62	3.86	2.92	2.84
	Gini	1.93	1.77	2.81	1.47	1.69	1.63	0.94	2.23
Beverages	Xi	8.49**	1.46	4.78	3.49	9.76**	9.62**	5.85**	8.79**
	Rosen	3.43	2.01	1.15	3.39	5.64*	2.12	0.69	3.56
	Xi	6.14**	1.90	4.15	3.99	7.36**	2.80	3.97	4.34
	Gini	0.91	2.78	4.56	1.20	0.64	1.35	4.70	5.68*
Textiles	Xi	2.82	7.10**	10.84**	11.21**	4.67	0.95	0.03	0.91
	Rosen	0.08	3.84	0.92	1.81	0.56	7.79**	6.17**	2.29
	Xi	3.12	3.83	5.56*	5.06*	5.11*	1.67	0.69	5.66*
	Gini	2.06	4.39	1.64	1.54	1.45	1.20	6.56**	2.20
Wearing apparel	Xi	4.47	3.49	5.87**	3.68	4.97*	0.06	0.36	2.72
	Rosen	0.07	0.50	1.43	1.02	0.05	1.65	10.28**	0.05
	Xi	3.52	2.08	5.42*	4.99*	4.48	8.74**	0.90	0.70
	Gini	1.50	2.14	4.31	3.52	1.47	3.96	3.46	6.69**
Leather	Xi	13.35**	3.93	3.59	3.46	7.84**	0.95	6.82**	7.31**
	Rosen	0.99	3.59	2.35	2.50	1.52	3.00	3.59	2.19
	Xi	11.10**	0.65	3.03	4.00	6.26**	2.47	1.24	3.09
	Gini	2.82	1.44	0.57	1.01	1.44	0.49	1.10	2.55
Footwear	Xi	11.56**	5.02*	6.48**	3.36	7.48**	0.07	3.52	1.54
	Rosen	0.69	3.04	0.08	0.51	0.22	3.06	4.83	0.45
	Xi	4.01	5.66*	4.83	5.54*	2.93	2.35	6.73**	3.78
	Gini	3.91	0.84	0.77	0.45	1.96	2.42	4.76	0.35
Wood	Xi	6.40**	4.43	4.44	4.20	6.07**	0.58	1.64	4.72
	Rosen	2.05	3.95	1.13	0.75	1.34	2.24	3.61	0.69
	Xi	5.68*	6.07**	4.61	5.21*	7.77**	1.64	2.52	1.37
	Gini	6.38**	3.75	5.95**	5.28*	9.26**	2.49	2.16	2.03
Paper	Xi	4.74	1.35	3.17	2.63	1.05	1.81	3.42	1.19
	Rosen	2.06	4.48	1.11	0.87	2.05	7.64**	3.01	0.66
	Xi	6.14**	0.47	2.64	2.17	6.46**	3.34	4.03	3.71
	Gini	1.81	2.68	2.56	3.36	3.81	1.49	2.48	3.76
Printing	Xi	3.63	5.27*	2.23	3.24	3.17	1.49	3.42	4.15
	Rosen	1.35	1.06	1.32	1.30	1.24	2.79	3.01	0.95
	Xi	5.04*	2.35	2.99	3.48	5.37*	2.87	4.03	3.76
	Gini	0.49	1.18	0.08	0.30	0.53	0.37	2.48	0.22
Basic chemicals	Xi	3.28	0.95	9.94**	24.64**	21.87**	9.77**	3.02	7.76**
	Rosen	9.92**	6.94**	5.01*	3.31	4.64	3.19	4.89	4.97*
	Xi	3.83	0.68	3.26	2.63	6.34**	2.06	3.68	1.20
	Gini	7.26**	6.68**	8.87**	6.76**	7.57**	4.91	7.58**	6.43**
Other Chemicals	Xi	2.37	2.66	6.15**	4.70	2.57	0.83	3.02	4.90
	Rosen	4.51	1.19	0.88	1.10	5.93**	6.63**	4.89	0.75
	Xi	1.83	2.15	2.85	4.76	2.74	1.33	3.68	3.91
	Gini	4.65	5.48*	6.02**	6.31**	5.15*	2.97	7.58**	4.66
Rubber	Xi	5.48*	2.70	0.10	3.86	3.59	0.11	25.34**	3.49
	Rosen	0.02	0.08	0.10	0.98	0.14	10.18**	0.24	1.80
	Xi	4.53	7.74**	7.04**	5.01*	2.42	3.56	19.67**	2.08
	Gini	2.50	1.30	1.89	0.70	1.81	1.27	2.21	0.81
	Xi	8.25**	6.39**	7.03**	2.59	9.36**	0.41	0.12	5.95**

		GDP Growth	Empl. Growth	Invest Total	Invest Mach.	TFP	RULC	GOS/GDP	Y/L
	Xi	6.68**	18.52**	3.24	2.85	4.20	2.11	2.04	2.90
	Gini	2.88	1.18	2.12	2.02	2.86	3.88	2.02	2.19
Glass	Xi	3.70	7.55**	1.88	0.56	0.29	4.43	6.19**	0.28
	Rosen	2.10	4.89	2.35	2.48	1.68	10.45**	2.85	2.56
	Xi	4.57	2.41	1.70	1.42	1.86	2.87	7.07**	2.73
	Gini	0.52	0.30	0.29	0.05	0.42	0.74	3.29	0.12
Other Non-metals	Xi	5.84**	2.33	2.31	4.89	3.10	2.69	7.05**	5.05*
	Rosen	3.18	6.86**	9.61**	3.40	2.85	4.82	10.64**	4.40
	Xi	6.99**	2.23	1.77	3.95	3.85	2.52	6.76**	3.11
	Gini	3.42	2.76	3.22	3.21	3.57	3.41	2.31	2.89
Basic iron & steel	Xi	10.53**	1.36	9.70**	8.67**	6.47**	14.42**	2.85	5.25*
	Rosen	1.35	0.56	0.12	0.22	1.06	0.08	3.87	3.02
	Xi	8.65**	6.47**	3.24	2.54	8.92**	7.91**	2.01	1.06
	Gini	4.86	2.34	1.36	4.21	3.37	1.28	2.85	7.85**
Basic non ferrous metals	Xi	1.88	1.29	3.30	4.17	4.73	2.93	7.05**	1.41
	Rosen	0.20	1.98	0.31	0.85	1.34	0.03	10.64**	0.23
	Xi	3.64	4.13	1.90	3.90	8.85**	6.05**	6.76**	2.18
	Gini	6.54**	6.73**	4.47	4.42	5.13*	6.12**	2.31	4.52
Metal products	Xi	3.23	4.94*	1.33	1.91	4.97*	1.47	3.12	1.58
	Rosen	0.57	0.77	1.51	2.21	0.61	1.71	1.24	5.02*
	Xi	3.74	9.79**	1.70	2.63	3.77	2.25	5.06*	1.47
	Gini	2.83	2.58	2.47	2.82	3.86	2.81	1.68	5.20*
Machinery	Xi	2.73	6.56**	6.28**	2.71	1.59	2.58	1.99	2.53
	Rosen	2.22	2.16	2.15	2.17	2.31	2.29	2.38	1.43
	Xi	3.35	3.50	2.58	2.54	2.30	1.80	0.95	0.71
	Gini	2.31	1.02	1.32	3.64	2.78	6.25**	2.97	3.45
Electrical machinery	Xi	4.59	6.35**	5.28*	7.26**	5.25*	2.77	19.51**	0.83
	Rosen	0.00	2.50	0.04	0.28	0.08	0.34	3.23	3.48
	Xi	2.23	2.81	5.48*	7.65	4.00	1.57	2.75	1.13
	Gini	0.78	2.05	0.75	0.73	0.66	0.80	1.70	5.82**
Motor	Xi	4.23	4.86	3.53	2.71	4.54	1.15	0.31	3.46
	Rosen	1.95	1.58	1.52	1.74	2.08	2.60	4.08	1.85
	Xi	3.73	5.80**	5.49*	5.40*	4.32	1.25	1.71	4.87
	Gini	2.66	1.86	1.28	1.15	1.98	1.65	1.64	1.77
Other transport	Xi	4.21	4.26	1.47	2.71	2.79	-	2.92	1.65
	Rosen	3.25	1.63	7.81**	1.96	3.20	-	1.49	1.60
	Xi	3.53	5.51*	2.13	2.59	1.41	-	2.91	1.62
	Gini	3.00	2.12	9.62**	3.20	3.03	-	3.35	3.56
Furniture	Xi	3.08	12.23**	2.25	2.99	2.89	2.40	14.66**	5.47*
	Rosen	3.38	2.54	2.49	2.43	3.64	3.51	2.59	3.95
	Xi	2.64	6.07**	3.06	4.00	3.02	3.93	19.21**	0.64
	Gini	1.55	1.84	1.82	1.08	0.75	0.36	7.28**	5.01
Other manufacturing	Xi	3.08	12.23**	2.25	2.99	2.89	3.51	0.39	5.47*
	Rosen	3.38	2.54	2.49	2.43	3.64	2.40	2.67	3.95
	Xi	2.64	6.07**	3.06	4.00	3.02	3.93	2.40	0.64
	Gini	1.55	1.84	1.82	1.08	0.75	0.36	3.52	5.01*

**Table 5:** PSS ARDL FTests for Direction of Association. Rosen denotes the Rosenbluth index. Gini denotes the Gini coefficient.  $X_i$  denotes the relevant economic development indicator specified. \* Indicates indeterminate outcome. \*\* Indicates presence of a long run relationship.

Table 5 allows us to analyse the patterns of association between the 2 concentration measures and our indicators. We will consider each of our concentration measures and indicator variables in turn. Looking at the Gini measure, for output growth we find that for 6 sectors it is the Gini that drives output growth, for 3 sectors the direction of association is reversed and for 2 sectors the association could be simultaneous. For employment growth, the Gini forces employment growth for 9 sectors, for 2 sectors employment growth forces the Gini and for 3 sectors the results are ambiguous. For total investment we find that in 1 sector the Gini forces total investment, for 4 sectors it is total investment that forces the Gini and for 4 sectors the results are ambiguous. For investment in machinery, in 2 sectors Gini is the forcing variable, in 2 sectors Gini is the outcome variable and in 1 sector the result is ambiguous. For TFP the direction of association runs from Gini to TFP in 7 sectors, while for 2 sectors the direction of association is reversed and for 4 sectors it is ambiguous. For relative real unit labour costs, there are 4 sectors in which the Gini is the forcing variable, 2 in which the Gini is the outcome variable and none in which the direction of association is ambiguous. For GOS/GDP we have 5 sectors where GOS/GDP is the outcome variable and 4 in which the Gini is the outcome, while for a remaining 1 sector the results are ambiguous. Finally for output per labourer we have 1 sector in which the Gini is the forcing variable, 4 sectors in which the Gini is the outcome variable and a further 4 sectors for which the results are ambiguous.

Looking at the Rosenbluth measure, for output growth we find that for 7 sectors it is Rosenbluth that drives output growth, for 1 sector the direction of association is reversed and for 2 sectors the association could be simultaneous. For employment growth, Rosenbluth forces employment growth for 7 sectors, for 2 sectors employment growth forces Rosenbluth. For total investment we find that in 9 sectors Rosenbluth forces total investment, for 2 sectors it is total investment that forces Rosenbluth and for 2 sectors the results are ambiguous. For investment in machinery, in 5 sectors Rosenbluth is the forcing variable. For TFP the direction of association runs from Rosenbluth to TFP in 7 sectors, while for 2 sectors the direction of association is reversed and for 4 sectors it is ambiguous. For relative real unit labour costs, there are 4 sectors in which the Rosenbluth is the forcing variable, 5 in which Rosenbluth is the outcome variable and 1 sector in which the direction of association is ambiguous. For GOS/GDP we have 8 sectors where GOS/GDP is the outcome variable and 4 in which Rosenbluth is the outcome. Finally for output per labourer we have 6 sectors in which Rosenbluth is the forcing variable, 1 sector in which Rosenbluth is the outcome variable and a further 6 sectors for which the results are ambiguous.

While we find evidence of interaction between a number of industries, the degree and sign of the interactions vary widely across the different industries. To analyse the degree of interaction we follow the approach of Fedderke and Schirmer (2003). Degree of interaction is defined as the number of our indicators that interact with either of the concentration measures employed. Thus the strength of the interaction is not taken into account. Table 6 reports the “high impact” sectors, for which we find an interaction between the concentration measures and 8 or more of the indicators as well as “low impact” sectors, which exhibit interactions with 7 or less indicators.

We see from the table that for the majority of sectors are classified as “low impact”, indicating that concentration is typically associated with a few of the indicator variables.

From Table 7 we also see that the channels of association are industry specific. The general finding is that concentration *forces* the indicators of industry development – though in a few instances industry concentration appears to be the *outcome* of industry development – see also Table 8. For example for Beverages, concentration seems to have an impact on output growth, while for the Basic Chemicals sector the direction of association is reversed.

As a final step in our descriptive analysis we consider the signs of the association implied by the PSS F-tests. The signs of association are obtained from the associated ARDL cointegration analysis. Tables 7 and 8 present the findings, summarising the direction of association as well as the sign of association. Since the specifications examined here are clearly underspecified, we note, but attach less importance to the significance of regressors, than to the sign implied by the bivariate association.

<b>High Impact Sectors</b>	<b>Low Impact Sectors</b>
<b>Interaction with = 8 Indicators</b>	<b>Interaction with = 7 Indicators</b>
Basic chemicals	Food and food products
Basic iron and steel industries	Beverages
Non-ferrous metal basic industries	Textiles
	Clothing, except footwear
	Leather and products from leather
	Footwear
	Wood and wood and cork products
	Furniture
	Paper and paper products
	Printing, publishing and allied industries
	Other Chemicals
	Rubber products
	Plastic products
	Glass and glass products
	Other Non- metals
	Metal products, except machinery and equipment
	Machinery, except electrical
	Electrical machinery apparatus, appliances and supplies
	Motor vehicles, parts and accessories
	Transport equipment
	Other manufacturing industries

**Table 6: Assessing the Extent of Interaction between Industry Concentration and Indicators of Industry Development**

<b>Outcome Variable</b>	<b>&lt;0</b>	<b>&gt;0</b>
<b>Output Growth</b>	Beverages (R* &G) Leather (R&G*) Wood (R*) Other non metals (R) Paper (G) Basic Chemicals (G) Basic Iron & Steel (G)	Footwear (R*) Basic Iron & Steel (R) Other non metals (G)
<b>Employment Growth</b>	Furniture (R&G) Other Manufacturing (R&G) Food (G*) Wood (G) Rubber (G) Plastic (G) Metal Products (G) Motor (G*)	Textiles (R*) Basic Chemicals (R) Plastic (R) Machinery (R) Electrical Machinery (R)
<b>Investment (Total)</b>	Food (R*) Plastic (R) Rubber (G)	Textiles (R) Wearing apparel (R) Footwear (R) Basic Iron & Steel (R) Machinery (R)
<b>Investment (Machinery)</b>	Textiles (R*) Electrical Machinery (R)	Food (R&G) Basic Chemicals (R) Basic Iron & Steel (R*)
<b>TFP</b>	Beverages (R* &G) Leather (R&G) Footwear (R) Wood (R&G) Paper (G)	Basic Chemicals (R) Plastic (R) Basic Iron & Steel (R&G) Basic non-ferrous metals (G)
<b>Rel. Unit Lab. Cost</b>	Beverages (R)	Basic Chemicals (R) Basic Iron & Steel (R* &G) Wearing apparel (G) Basic non-ferrous metals (G)
<b>GOS/GDP</b>	Furniture (R) Electrical Machinery (R) Rubber (G*) Glass (G)	Leather (R*) Glass (R)
<b>Output/Labour</b>	Food (R) Leather (R*) Basic Chemicals (R*) Glass (G)	Plastic (R)

**Table 7: Summary of F-tests and ARDL Cointegration Findings. <0,>0 denotes the sign of the association. (R) denotes the Rosenbluth result, (G) the result for the Gini concentration index. \* denotes statistical significance at the 10% level. Full estimation results available from the authors.**

<b>Outcome Variable:</b>	<b>Forcing Variable:</b>	<b>Outcome Variable:</b>	<b>Forcing Variable:</b>
	<b>Output Growth</b>		<b>Output Growth</b>
<b>Rosenbluth</b>	Basic Chemicals: >0	<b>Gini</b>	Basic Non-ferrous metals: <0
	<b>Employment Growth</b>		<b>Employment Growth</b>
<b>Rosenbluth</b>	Basic Chemicals: >0* Other non metals: >0	<b>Gini</b>	Wood: >0 Basic Non-ferrous metals: <0
	<b>Investment (total)</b>		<b>Investment (total)</b>
<b>Rosenbluth</b>	Other non metals: >0	<b>Gini</b>	Wood: <0*
	<b>Investment (mach.)</b>		<b>Investment (mach.)</b>
<b>Rosenbluth</b>		<b>Gini</b>	Other Chemicals: >0
	<b>TFP</b>		<b>TFP</b>
<b>Rosenbluth</b>	Food: >0 Other Chemicals: >0*	<b>Gini</b>	Wood: <0 Basic Chemicals: <0*
	<b>Rel. Unit Lab. Cost</b>		<b>Rel. Unit Lab. Cost</b>
<b>Rosenbluth</b>	Paper: >0 Rubber: <0	<b>Gini</b>	Basic Non-ferrous metals: >0
	<b>Gross Operating Surplus/GDP</b>		<b>Gross Operating Surplus/GDP</b>
<b>Rosenbluth</b>	Textiles: <0* Wearing Apparel: <0*	<b>Gini</b>	Other Chemicals: <0
	<b>Output/Labour</b>		<b>Output/Labour</b>
<b>Rosenbluth</b>		<b>Gini</b>	Basic Iron & Steel: >0 Electrical Machinery: >0

**Table 8: Summary of F-tests and ARDL Cointegration Findings. <0,>0 denotes the sign of the association. \* denotes statistical significance at the 10% level. Full estimation results available from the authors.**

The general implications of the findings from Table 7 are as follows:

- On output growth, both concentration measures are unanimous in predicting a lower growth in real output under increased concentration – with only a few exceptions. Thus for growth purposes, increased concentration appears to carry negative consequences in South African manufacturing industry.
- On relative real unit labour cost, both concentration measures predict a higher unit relative labour cost under increased concentration.
- For labour productivity (as measured by output/labour), both concentration measures predict lower labour productivity under increased concentration.

Note immediately that both the finding of rising real relative unit labour costs, and the finding of falling labour productivity carries the implication that the impact of increased concentration in South African manufacturing is not such as to raise the efficiency of production. Instead, it is more likely that concentration leads to the pursuit of managerial objectives in firms in concentrated industries, at the expense of efficiency and profitability.

- For employment growth, the bivariate results are a little more ambiguous. The Gini concentration measure reports predominantly negative correlations with employment growth,<sup>18</sup> the Rosenbluth reverses the sign. One explanation of this apparently divergent finding is that the Gini coefficient reflects directly inequality in market shares of firms. By contrast, the Rosenbluth index corrects for the number of firms in the industry. It is therefore possible that unequal distribution of market share serves to lower employment growth in industries – for any given number of firms. A falling number of firms in the industry, for any given unequal distribution of market share, may then serve to increase employment growth because management of firms is able to pursue objectives other than profit maximization without fear of market discipline. Firms are able to pursue size rather than profit-objectives, say. Such an interpretation would be consistent with the findings on relative unit labour cost, and labour productivity noted above.
- The same is true for the findings on total factor productivity – where increased concentration appears to lower efficiency gains as measured by TFP (at least on the Gini – the same is true on the *significant* Rosenbluth results, though otherwise more ambiguous results should be noted).
- Ambiguous results also emerge for both investment (some indication of an increase, some indication of a decrease) and on profitability (again with divergent indications on the direction of change). This again points to the possibility that concentrated industries may pursue an increase in the rate of return on investment, but that managerial objectives may also play a role.

In concluding the present section, we note that the general findings to emerge from the PSS F-tests, are first, that the direction of association in general runs *from* concentration *to* indicators of economic development. Second, even though the finding of relatively few associations is not surprising in the simple bi-variate formulations examined here, nevertheless a number of instructive links did emerge from the test statistics. There is an indication of lower output growth under increased concentration, but also some evidence that under increased concentration firms may come to pursue managerial objectives that may be inimical to efficiency gains and improved profitability.

The presence of ambiguous results on employment and investment rates points to the need to extend the analysis further, in order to clarify the impact of concentration on these two measures in a fuller multivariate context.

## 5.0 The impact of concentration on employment and investment

In concluding our analysis, we therefore consider the impact of concentration on employment and investment in the South African manufacturing sector in more detail. A separate paper explores the impact of concentration on the pricing power of South African manufacturing industry.<sup>19</sup> The core finding of this paper is that increased industry

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<sup>18</sup> Note that under the Gini, the implication is therefore that the decrease in output growth must in general be more than proportional to the decrease in employment growth, in order for labour productivity to fall.

<sup>19</sup> See Fedderke, Kularatne and Mariotti (2003).

concentration increases pricing power in South African manufacturing industry, and raises the mark-up of price over marginal cost.

For the purposes of the present discussion we focus on determinants of employment and investment in South African manufacturing.

### 5.1 Formulating an empirical labour usage equation.

For employment, we employ a modified methodology as reported in Hine and Wright (1998), and discussed further in Fedderke and Mariotti (2002) and Fedderke, Shin and Vaze (2003). The advantage of the methodology is that it can include a direct isolation of the labour usage effect of industry structure. Consider the production function given by:

$$Y_i = F(B_i, K_i, L_i), \quad i=1 \dots N \quad (5)$$

where  $Y_i$  denotes real output by sector  $i$ ,  $K_i$  real capital stock by sector  $i$ ,  $L_i$  labour inputs (as measured by the total number of employees) by sector  $i$ , and  $B_i$  a vector of variables that may impact on output independently of the two factor inputs. Standard assumptions governing the technology of production would allow us to solve for the labour requirements equation.<sup>20</sup>

$$L_i = G(B_i, Y_i, K_i), \quad i=1 \dots N, \quad (6)$$

Subsuming technological progress in a "Solow-residual," we here include five variables in  $B_i$ . Openness, denoted OP, and defined as the ratio of imports and exports to output, reflects the extent to which a sector is exposed to international markets. While the openness ratio could assume either sign, earlier studies have found it to be positive,<sup>21</sup> and this constitutes our weak prior. A relative price ratio, denoted RP, is defined as the ratio of the user cost of capital to real per labourer remuneration, where the user cost of capital is composed of the risk rate of return on government paper, the sector specific depreciation rate, and the corporate tax rate. We anticipate a positive sign on RP. The skills composition of the labour force, denoted SR, controls for the changing incentives to hire different forms of labour in manufacturing production. Labour demand may be switching to skilled rather than unskilled labour. Finally, industry concentration is controlled for by both the GINI and the ROSEN measures, which denote the Gini and the Rosenbluth indexes respectively.

The question we face in the current context is whether industry concentration is associated with increased or decreased job creation in South African labour markets.

Hence, we distinguish determinants of labour usage in the South African manufacturing sector using the following labour requirements long-run relationship equation:

<sup>20</sup> We require  $F_K > 0$ ,  $F_{KK} < 0$ , and monotonicity of the function.

<sup>21</sup> See Fedderke, Shin and Vaze (2003).

$$L_{i,t} = \mathbf{q}_y Y_{i,t} + \mathbf{q}_{RP} RP_{i,t} + \mathbf{q}_{SR} SR_{i,t} + \mathbf{q}_{OP} OP_{i,t} + \mathbf{q}_G GINI_{i,t} + \mathbf{q}_R ROSEN_{i,t} + \mathbf{e}_{i,t} \quad (7)$$

where all variables are in natural logarithmic transforms.

## 5.2 Formulating an empirical investment function

For investment, we extend the discussion in Fedderke (2003) – which in turn employs the investment function proposed by Dixit and Pindyck (1994), incorporating the impact of uncertainty. Empirical applications of irreversible investment models must control for the impact of uncertainty on the user cost of capital - see for example Ferderer (1993) and Guiso and Parigi (1999). One means of proceeding is to allow for an explicit impact of uncertainty on the investment relation. In the estimations that follow we allow for an explicit impact on investment by both sectoral uncertainty as well as systemic uncertainty.

We proceed with the empirical specification:<sup>22</sup>

$$I_{i,t} = b_0 + b_1 d \ln Y_{i,t}^e + b_2 d \ln uc_{i,t} + b_3 s_{sect,i,t}^2 + b_4 s_{sys,i,t}^2 + b_5 GINI_{i,t} + b_6 ROSEN_{i,t} + \mathbf{e}_{i,t} \quad (8)$$

where  $I_{i,t}$  denotes the net investment rate,  $\ln Y_{i,t}^e$  the natural logarithm of the expected output,  $\ln uc_{i,t}$  the natural logarithm of the user cost of capital,  $s_{sect,i,t}^2$  denotes sectoral uncertainty,  $s_{sys,i,t}^2$  denotes systemic uncertainty,  $GINI_{i,t}$  the Gini concentration index,  $ROSEN_{i,t}$  the Rosenbluth concentration index, and  $d$  the difference operator.

Our measure of investment is restricted to fixed capital stock strictly defined, and is given by net changes in the stock of machinery and equipment of South African three digit manufacturing sectors, expressed as an investment rate. The user cost of capital is defined as for the labour usage equation.<sup>23</sup>

The output measure to enter the empirical specification is the expected change of output - an unobservable magnitude. Various studies deal with this unobservable magnitude in different ways. In some, the actual current change in output is employed (see for example Ferderer 1993), and we adopt this approach in the present study. For the capacity utilization variable we employ the log change in a directly measured capacity utilization variable, since Stock and Watson (1998) find capacity utilization to be coincident with the cycle in output.

Appropriate measures of risk and estimation in their presence are again the subject of an independent literature.<sup>24</sup> In order to obtain a measure of user cost uncertainty Ferderer (1993) employs a risk premium imputed to market interest rate on the basis of an ARCH

<sup>22</sup> The specification is implied by the first order condition for capital stock derived from Dixit and Pindyck (1994: ch 10). We specify only the difference equation suggested by the optimal level of capital.

<sup>23</sup> On the computation of the real user cost of capital see the discussion in Hall and Jorgenson (1967). For a more detailed treatment of the impact of taxation on investment, see Hines (1998).

<sup>24</sup> See for instance Engle et al (1987), and Pagan and Ullah (1988).

representation of the spot market yield. In the present study we employ two measures of uncertainty. The first constitutes a measure of sectoral uncertainty. Given the relatively small time run available for each manufacturing sector, ARCH representations of conditional variances are of limited use. Hence we employ a sectoral measure of uncertainty given by the standard deviation of real output specified in log scale, computed over a three year rolling window. The sectoral measure of uncertainty is thus one that measures volatility of output, but without reliance on ARCH processes.

Estimations also include a measure of systemic uncertainty provided by an index of political instability obtained from Fedderke, De Kadt and Luiz (2001), and employed in the context of investment in Fielding (2000) and Fedderke (2003). Justification of its use lies in the importance of political instability in South Africa over the 1970-97 period. The index is a weighted average of 11 indicators of repressive state responses to pressures for political reform.

Note that for both the sectoral and the systemic uncertainty variables we employ a measure of the level of uncertainty which is held to impact on investment expenditure rather than its first difference, consistent with the underlying theory. Since uncertainty raises the threshold rate of return that capital must meet to be viable, the impact of uncertainty is on the flow of capital.

### 5.3 Econometric Methodology

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:

$$\Delta y_{it} = \mathbf{f}_i y_{i,t-1} + \mathbf{b}_i' x_{i,t-1} + \sum_{j=1}^{p-1} \mathbf{l}_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \mathbf{d}_{ij}' \Delta x_{i,t-j} + \mathbf{m}_i + \mathbf{e}_{it}, \quad (9)$$

$i = 1, 2, \dots, N$ , stand for the cross-section units, and  $t = 1, 2, \dots, T$ , indicate time periods. Here  $y_{it}$  is a scalar dependent variable,  $x_{it}$  ( $k \times 1$ ) is the vector of (weakly exogenous) regressors for group  $i$ ,  $\mathbf{m}_i$  represent the fixed effects,  $\phi_i$  is a scalar coefficient on the lagged dependent variable,  $\beta_i$  is the  $k \times 1$  vector of coefficients on explanatory variables,  $\lambda_{ij}$ 's are scalar coefficients on lagged first-differences of dependent variables, and  $\delta_{ij}$ 's are  $k \times 1$  coefficient vectors on first-differences of explanatory variables and their lagged values. We assume that the disturbances  $\mathbf{e}_{it}$ '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  $x_{it}$ :

$$y_{it} = \mathbf{q}_i' x_{it} + \mathbf{h}_{it}, \quad i = 1, 2, \dots, N, t = 1, 2, \dots, T, \quad (10)$$

where  $\mathbf{q}_i = -\mathbf{b}'_i / \mathbf{f}_i$  is the  $k \times 1$  vector of the long-run coefficient, and  $\eta_{it}$ 's are stationary with possibly non-zero means (including fixed effects). Then, equation (9) can be written as:

$$\Delta y_{it} = \mathbf{f}_i \mathbf{h}_{i,t-1} + \sum_{j=1}^{p-1} \mathbf{l}_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \mathbf{d}'_{ij} \Delta x_{i,t-j} + \mathbf{m}_i + \mathbf{e}_{it}, \quad (11)$$

where  $\mathbf{h}_{i,t-1}$  is the error correction term given by (10), and thus  $\phi_i$  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,

$$\mathbf{q}_i = \mathbf{q}, i = 1, 2, \dots, N. \quad (12)$$

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  $\tilde{\mathbf{f}}_i, \tilde{\mathbf{b}}_i, \tilde{\mathbf{l}}_{ij}, \tilde{\mathbf{d}}_{ij}$  and  $\tilde{\mathbf{q}}$ . We then obtain the PMG estimators as follows:

$$\begin{aligned} \hat{\mathbf{f}}_{PMG} &= \frac{\sum_{i=1}^N \tilde{\mathbf{f}}_i}{N}; \hat{\mathbf{b}}_{PMG} = \frac{\sum_{i=1}^N \tilde{\mathbf{b}}_i}{N}; \\ \hat{\mathbf{l}}_{jPMG} &= \frac{\sum_{i=1}^N \tilde{\mathbf{l}}_{ij}}{N}, j = 1, \dots, p-1; \hat{\mathbf{d}}_{jPMG} = \frac{\sum_{i=1}^N \tilde{\mathbf{d}}_{ij}}{N}, j = 1, \dots, q-1, \\ \hat{\mathbf{q}}_{PMG} &= \tilde{\mathbf{q}}. \end{aligned} \quad (13)$$

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<sup>25</sup> provides consistent estimates of the mean of the long-run coefficients,

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<sup>25</sup> See Pesaran and Smith (1995).

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 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.

#### 5.4 Estimation Results

We report preferred results from estimation in Table 9. We control for the two concentration indexes both individually and jointly, in order to establish the sensitivity of results to the concentration measure employed.

Note that the diagnostic statistics consistently confirm the null of homogeneity of long run coefficients, while the F-coefficient confirms adjustment into the long run conditional mean value. We note that the speed of adjustment for investment is greater than that for employment.

Further we note that the long run coefficients confirm prior theoretical expectations for the standard regressors included in estimation. Thus we confirm that output demand has a positive and significant impact on employment, as well as investment rates in manufacturing. The ratio of capital to labour cost has a statistically significant impact on manufacturing employment, and confirms the now standard finding of a strong wage elasticity of employment.<sup>26</sup> Similarly, the user cost of capital exerts a significant negative impact on investment rates. The ratio of highly skilled and skilled workers to unskilled and semi-skilled workers enters negatively and significantly into the labour usage equation, suggesting that sectors that have increased the skills intensity of their labour force, have grown employment more slowly as a consequence. The implication is that the quality of labour allows one to economise on the quantity of labour in production – an intuitively appealing result. Finally, both sectoral output volatility as a proxy for sectoral demand uncertainty and systemic uncertainty impact negatively on investment – again confirming a standard finding for South Africa in the literature.<sup>27</sup>

Thus far the findings from estimation are therefore entirely standard.

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<sup>26</sup> In the current estimation the implication is of an elasticity up to -1.35 in the fully specified model. In more extensive investigations Fedderke, Shin and Vaze (2003) find an elasticity of -1.97 for the South African manufacturing sector.

<sup>27</sup> See Fielding (1997, 2000), and Fedderke (2003).

What remains is the interpretation of the impact of concentration indexes on employment and investment rates.

	lnL	lnL	lnL		Investment Rate	Investment Rate	Investment Rate
lnY	0.57* (0.03)	0.40* (0.03)	0.81* (0.08)	DlnY <sup>e</sup>	0.13* (0.03)	0.17* (0.03)	0.20* (0.03)
lnRP	0.66* (0.12)	1.28* (0.10)	1.35* (0.14)	Dlnuc	-0.09* (0.02)	-0.10* (0.01)	-0.09* (0.01)
lnSR	-0.24* (0.05)	-0.23* (0.03)	-0.38* (0.16)	s <sup>2</sup> <sub>sect</sub>	-0.20* (0.05)	-0.21* (0.05)	-0.17* (0.05)
lnOP	0.08* (0.01)	0.01 (0.02)	0.01 (0.03)	s <sup>2</sup> <sub>sys</sub>	-0.004* (0.001)	-0.004* (0.001)	-0.01* (0.001)
lnGINI	-0.03 (0.20)		-0.07 (0.29)	GINI	0.09** (0.05)		0.76* (0.09)
lnROSEN		-0.27* (0.03)	-0.10* (0.05)	ROSEN		-1.49* (0.29)	-0.62* (0.20)
F	-0.19* (0.04)	-0.22* (0.06)	-0.16* (0.04)	F	-0.54* (0.06)	-0.46* (0.08)	-0.56* (0.07)
h-test	6.46 [0.26]	8.34 [0.14]	8.35 [0.21]	h-test	11.21 [0.05]	7.41 [0.19]	8.76 [0.19]
ARDL	2,2,0,1,0,1	2,2,2,1,1,1	1,2,0,2,0,2,2	ARDL	1,3,3,3,3,0	1,3,3,3,3,0	3,2,2,2,3,2,0

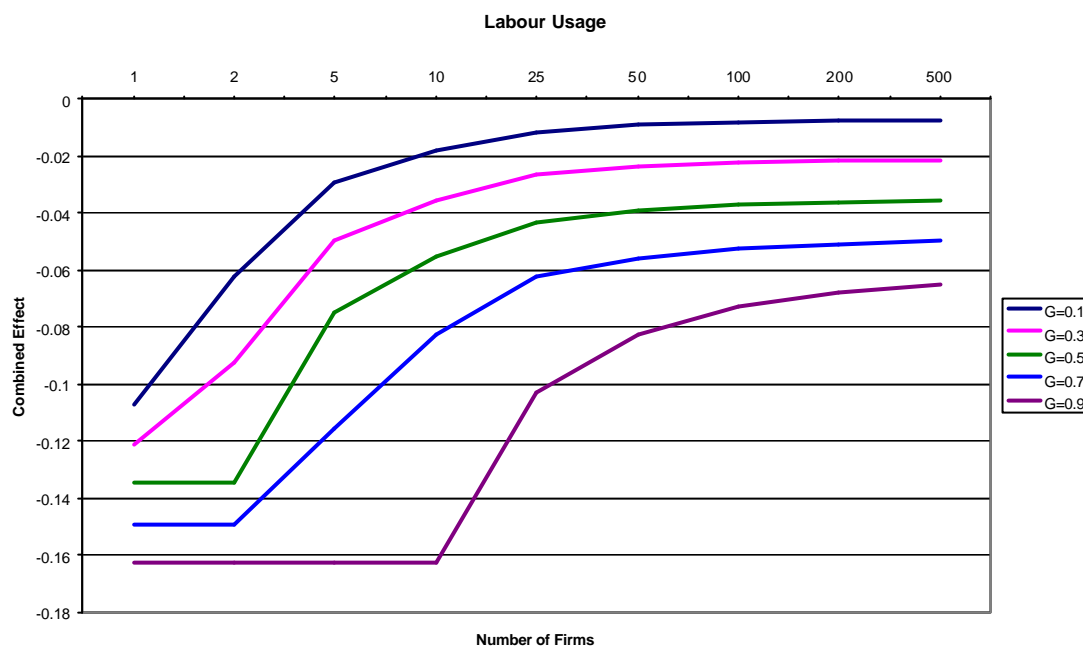
**Table 9: Estimation results for the labour usage equation and the investment function. \* denotes statistical significance. Figures in round parentheses denote standard errors. Figures in square parentheses denote probability values.**

In the case of the labour usage equation, both concentration ratios prove to carry a negative sign – though only the Rosenbluth index proves statistically significant. Increased industry concentration thus appears to unambiguously lower employment in South African manufacturing industry – with a 1% increase in the Rosenbluth concentration index leading to a decrease in employment between 0.10% and 0.27%.

The evidence thus serves to clarify the simple bivariate findings reported above. In a fully specified multivariate context the ambiguity in the impact of concentration on employment disappears, and a purely negative impact of increased concentration on employment is confirmed.

In order to give readers an indication of the net total impact of concentration on labour usage, Figure 4 reports the combined impact of both the Rosenbluth and the Gini concentration measures on labour usage.<sup>28</sup> Three core features emerge from the evidence.

First, the impact of concentration on employment is always negative.



**Figure 4: Combined Impact of Concentration on Labour Usage.** Lines denote the total impact of a 1% increase in the Gini concentration measure at the specified alternate magnitudes (0.1 - 0.9) of the Gini concentration measure. The X-axis specifies alternative numbers of firms present in the market. The Y-axis measures the % change in employment that issues from the 1% change in the Gini concentration measure.<sup>29</sup>

Second, an increase in the level of the Gini at which the impact of the standard 1% increase in the Gini is established serves to increase the negative impact on employment. Thus a 1% increase in the Gini given 25 firms decreases employment by 0.1% where the Gini assumes a value of 0.9. By contrast, where the Gini is 0.5, a 1% increase in the Gini only lowers employment by 0.04%.

<sup>28</sup> Ignoring statistical significance, given equation (3), we can obtain the aggregate effect straightforwardly

from  $\frac{\hat{q}_G n G (1-G) + \hat{q}_R}{n(1-G)}$ . Note that while we still report an imputed impact of increased concentration

for  $n=1$ , of course no further increases in concentration are feasible under full monopoly. The difficulty in interpretation arises due to inference from the impact of continuous change to what is the case of firm numbers is in fact a discrete differential.

<sup>29</sup> Note that the truncation to the decrease in the  $G=0.5$ ,  $G=0.7$  and  $G=0.9$  cases arises due to the fact that the Rosenbluth index is bounded by unity.

Third, for any given level of the Gini, the impact of a 1% increase in the Gini becomes more negative the smaller the number of firms in the market – and the impact becomes more negative at an increasing rate. This is reflected in the concavity that emerges in the elasticity at any given Gini, as the number of firms declines.

It follows immediately that industry concentration is unambiguously undesirable for purposes of employment creation in South African manufacturing industry. But it is worthwhile to note that the impact of concentration may work through at least two distinct channels. The most immediate negative impact follows from an inequality of production across firms – which is what the Gini index measures. The second negative impact can be interpreted as a market contestability effect. With a falling number of firms in the market the negative impact of any given level of inequality of distribution of production, is exacerbated, and dramatically so.<sup>30</sup>

Given the concavity in the labour elasticity with respect to concentration noted above, therefore, as long as the number of firms in the market can be interpreted as a proxy of market contestability, therefore, the policy implication to follow is that the strongest potential returns for competition policy lies with ensuring market contestability, rather than by the regulation of market share. Or perhaps more immediately – ensuring that the number of firms in a market rises even to relatively low levels (5-10), serves to mitigate the impact of any inequality in market share considerably.

Competition policy therefore carries implications for means of improving welfare prospects through employment channels in South Africa also.

For investment, results are more nuanced, since the Gini and the Rosenbluth indexes carry opposite signs (Gini positive, Rosenbluth negative), and both are significant. Again, in order to aid the reader on the precise impact of changes in concentration, we represent the aggregate standardized impact graphically in Figure 5.<sup>31</sup>

In this instance note that an increase in concentration as measured by the Gini appears to *raise* the investment rate of the South African manufacturing sectors. However, a reduction in the number of firms at any given level of the Gini index *lowers* the investment rate. One interpretation of this finding is that while an increase in the market share controlled by the dominant firms may serve to stimulate investment (perhaps in order to consolidate their dominant market position), as the market becomes less contestable (with a decline in the number of potential competitors), so the incentive to

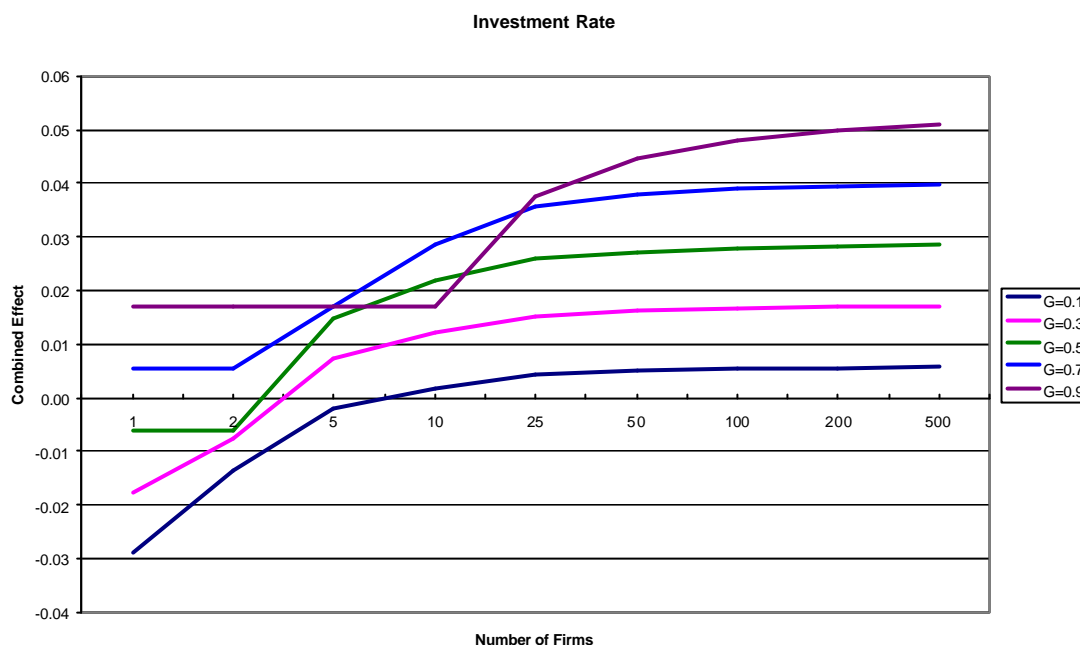
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<sup>30</sup> Since only the Rosenbluth measure is significant, taking note of the significance of the two concentration measures further strengthens this finding.

<sup>31</sup> Given equation (3), we can obtain the aggregate effect straightforwardly from  $\frac{\hat{b}_3 n G(1-G) + \hat{b}_6}{n(1-G)}$ . Note

that while we still report an imputed impact of increased concentration for  $n=1$ , of course no further increases in concentration are feasible under full monopoly. The difficulty in interpretation arises due to inference from the impact of continuous change to what is the case of firm numbers is in fact a discrete differential.

raise the capital stock declines, and monopolistic practices come to predominate. In effect, the results are consistent with the implications of the literature on the behaviour of dominant firms in the presence of a competitive fringe.<sup>32</sup>



**Figure 5: Combined Impact of Concentration on Investment Rate.** Lines denote the total impact on the investment rate of a one standard deviation change in the Gini concentration measure ( $=0.08$ ) at the specified alternate magnitudes (0.1 - 0.9) of the Gini concentration measure. The X-axis specifies alternative numbers of firms present in the market.<sup>33</sup>

We again note three core features of the evidence.

First, for investment rates the net change of an increase in concentration may be either positive or negative. Both a decrease in the Gini coefficient, and a reduction in the number of firms in the industry serve to increase the chances that the net effect be negative.

Second, the positive coefficient on the Gini is reflected in the fact that an increase in the inequality of production across firms is reflected by either a mitigated negative impact of increased concentration on the investment rate, or an increasingly positive impact on the investment rate. We have already noted the consistency of this finding with the possibility that an increase in the market share controlled by the dominant firms may further stimulate attempts to consolidate dominant market position by yet further capital expenditure.

<sup>32</sup> See for instance the discussion in Bjordal et al (1993) and Church and Ware (2000: ch4).

<sup>33</sup> Note that the truncation to the decrease in the  $G=0.5$ ,  $G=0.7$  and  $G=0.9$  cases arises due to the fact that the Rosenbluth index is bounded by unity.

Third, falling numbers of firms in an industry render the impact of rising concentration increasingly negative. As in the case of the employment effect, the impact of falling firm numbers is concave – increasing the negative impact with falling firm numbers. This evidence is thus consistent with the presence of a market disciplining effect emerging even from a relatively small competitive fringe in the industry.

While the impact of increased concentration on investment is thus more varied than it is for employment, note that the down-side potential of unequal market share together with low market contestability is potentially large. Thus where markets contain only a single firm, the investment rate could be decreased by as much as 3 percentage points. Of course the converse is that an increasing market share distribution may serve to raise investment rates.

For investment rates, therefore, everything comes to depend not so much on the level of concentration, but on the form it takes – with the strongest negative impact reserved for falling firm numbers in an industry.

In policy terms, therefore, once again the implication is that competition policy is relevant to improving investment performance in South African manufacturing industry. Moreover, as for employment effects the strongest impact on investment may well lie in improving market contestability, by improving market access for new entrant firms.

## **5 Conclusions and Evaluation**

This paper has examined industry concentration for the South African manufacturing sector over the 1972-1996 period, for the three digit industry classification. The paper notes both the high level of industry concentration in South African manufacturing, and the rising trends in concentration across a wide range of industries over the sample period.

The paper further employs the methodology proposed by Pesaran, Shin and Smith (1995, 1996, 2001) to explore the direction of association between industry concentration and industry performance. We find that the prevailing direction of association is *from* industry concentration *to* industry performance. In addition, we find that increased concentration generally serves to lower output growth, raise unit labour costs, and to lower labour productivity.

For growth purposes, increased concentration appears to carry negative consequences in South African manufacturing industry. Moreover, the finding of rising real relative unit labour costs, and the finding of falling labour productivity under increased concentration carries the implication that the impact of increased concentration in South African manufacturing is not such as to raise the efficiency of production. Instead, it is more likely that concentration leads to the pursuit of managerial objectives in firms in concentrated industries, at the expense of efficiency and profitability.

The paper concludes by examining the impact of concentration on employment and investment rates using a dynamic heterogeneous panel estimation methodology, which serves to resolve the ambiguity in the bivariate specifications through a recourse to a more fully specified set of models. We find that increased concentration unambiguously lowers employment. For investment rates, increased inequality of market share serves to raise investment rates, while falling firm numbers for any given inequality of market share lower investment rates. The difference can be interpreted as the difference that inequality of market share, and that market contestability have on investment, and the findings are consistent with expectations to emerge from the literature on the behaviour of dominant producers in the presence of a competitive fringe. In this, the findings of the present paper are thus such as to provide additional breadth to the findings already presented in Fedderke, Kularatne and Mariotti (2003) on the impact of concentration on mark-ups in South African manufacturing industry.

The findings carry some immediate policy conclusions. First, competition policy should remain on the South African policy agenda. Output growth, employment growth, labour cost structures, and labour productivity all stand to benefit from attention being paid to the degree of concentration in manufacturing industry. While findings on investment rates are more ambiguous, we note that the impact of raising the number of firms in industry is such as to raise investment rates.

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