An International Comparison of Manufacturing Productivity in South Africa, 1970-1997*

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Abstract

This paper gives a quantitative interpretation of South African industrialization process in an international perspective. After a description of the development of the South African industry, a binary comparison of manufacturing output and productivity between South Africa and the US is presented. The industry-of-origin approach is used to convert US and South African input- and output data in the same currency as an alternative to the exchange rate. Comparing quantity and value data from the manufacturing censuses of both countries, unit value ratios (UVRs) are constructed for the benchmark year 1993. Subsequently, comparative labour factor productivity levels for total manufacturing and 13 manufacturing branches are estimated for 1993. Value added per person employed varies between 10 and 40 percent between industries. Finally, using national time series, the benchmark is extrapolated back- and forwards over the period 1970-1997 to study relative catch-up and/or stagnation.

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1 Introduction

The last decennia South Africa has gone through a period of economic and social turbulence. After years of sometimes bloody debate, the first democratic elections in 1994 marked the end of the apartheid system. In the same year, GDP growth per capita became positive again after almost 8 years of economic crisis. The new government faces now the difficult task to define an industrial strategy to put the economy on a new path of economic growth and development. Growth is absolutely necessary to solve the poverty problem of the, mainly, black population. The distribution of wealth between blacks and whites is extremely unequal. "If the white 12 percent of the population were a separate country, as it was in the imagination of the apartheid's engineers, its standard would rank 24th only a little behind Spain according to the United Nations human development index. Black South Africa, by contrast, would rank 123rd, just above wretched Congo" (The economist, 1994).

One of the main tasks of the government will be to improve the performance of the South African manufacturing sector. Currently, after almost seven centuries of protectionist policies, South Africa is confronted with a highly inefficient industry, hardly able to compete in the international market. Additionally, the apartheid system generated all kinds of bottlenecks, especially in the labour market, decreasing the economic performance of manufacturing. With the abolishment of apartheid and the commitment to liberalize its trade policy according to WTO regulations in 1994, South Africa has taken its first steps towards improvement.

In this paper we analyse the historical performance of the South African manufacturing sector in an international context. We believe that this type of research can offer valuable contributions to formulate industrial policies to increase current growth. Labour productivity levels for total manufacturing and 13 manufacturing branches are estimated for the period 1970-1997 in comparison to the USA, being the world technology leader. The study is part of the International Comparisons of output and Productivity (ICOP) project carried out at the universities of Groningen and Eindhoven. Within the project the industry-of-origin approach has been developed to convert outputs and inputs in the same currency, as an alternative to the exchange rate.

After a brief overview of the industrialization process in South Africa, in section three several approaches to international level comparisons are discussed. Section four, describes the ICOP industry-of-origin approach, the methodology applied in this paper. In section five to seven, the ICOP industry-of-origin approach is applied on a binary comparison between South Africa and the USA. Comparing quantity and value data from the manufacturing censuses of both countries, unit value ratios (UVRs) are constructed for the benchmark year 1993. Subsequently, comparative labour factor productivity levels for total manufacturing and 13 manufacturing branches are estimated for 1993. Finally, in section eight and nine, using national time series, the benchmark is extrapolated back- and forwards over the period 1970-1997 to study relative catch-up and/or stagnation.

2 The South African Industrialization Process[2]

In this section the industrialization process of South Africa is briefly summarised. We have distinguished four different phases of industrial development. These are described next.

2.1 First Steps to Industrialisation, ... -1925

The first steps to industrialisation in South Africa were set in the last quarter of the nineteenth century. The first discovery of diamonds and gold triggered the establishment of related industries, such as the manufacture of explosives, cement and engineering. The next 40 years industrialization was limited to the mining areas. A dispersed population and various conflicting tariffs and monopolistic policies of the autonomous areas in South Africa

[2] The sections on industrialization up to 1970 are to a large extent based on Lumby (1981a, b). For the others sections use has been made of several sources mentioned in the text..

prevented the introduction of large-scale manufacturing. Rapid industrial expansion came with end of the First World War. Because imports were restricted, South Africa was forced to set up basic industries. Low foreign competition also made it easier for local entrepreneurs to set up new factories. Between 1915 and 1919 the number of firms increased by 45% from 3638 to 5287. After the war, increased foreign competition caused an economic downturn in South Africa.

2.2 Period of Import Substitution Industrialization, 1925-1970

In 1924, the Pact government, an alliance between the former opposition of farmers and workers, came into power. The new government was confronted with a growing number of white unemployment, caused by the recession. To solve this problem, two lines of policy were introduced, which have marked the development of the South African economy up to date. First, a deliberate policy to reserve jobs for whites in the labour market was initiated. 'From the mid-1920s a formal colour bar was erected that not only reserved the best jobs for whites but also instituted a "civilized labour policy giving whites precedence when competing with Africans for unskilled work" (Lundahl, p. 3, 1999). Discriminatory policies were even amplified with the election of the National Party in 1948. Since then, a full-scale policy of *apartheid*, systematically favouring whites above blacks throughout society, was implemented. One of the most influencing laws in this respect was the Bantu Education act, which made it virtually impossible for blacks to enter secondary schooling or higher (Lundahl, 1999).

Secondly, the Pact government commenced an explicit policy of import substitution. Through the introduction of Customs Tariff Act No. 36, industries were shielded from competition by quantitative restrictions and other protectionist measures. In line with import substitution policy, large parastatal companies, like the Iron and Steel Corporation of South Africa (ISCOR), the electricity generator, ESKOM and the oil and energy company, SASOL, were set up. Another aim of import substitution industrialization was to achieve greater economic independence. Furthermore, it was recognised that the mining sector on which the economy mainly depended as a source of foreign exchange, needed to be replaced in the long run. Industrial output went up by 41 percent in the next four years. The contribution of manufacturing to total output increased from 11.9 percent to 14.1 percent while the share of mining and agriculture both declined.

Besides a period of depression in the beginning of the thirties caused by the world economic crisis, between 1925 and 1970 South African manufacturing grew rapidly with on average 5 to 6 percent a year. Up to the Second World War, the textile and clothing industries were the fast growing sectors, followed by paper and printing, wood and furniture, and food and beverages. Together, they accounted for almost 60 percent of the total manufacturing production. These were also the industries, which received the largest protection. Other relatively fast growing industries were the chemical and metal industry, driven by growth in the mining industry to which they are strongly linked. After the Second World War the manufacturing sector started to mature. The share of more technological advanced industries, transport and general machinery, metal and chemical industry expanded rapidly, at the cost of basic consumer goods industries, except for the paper industry. The share of the food, beverages and tobacco industry declined from 32 percent in 1945 to 14 percent in 1976.

2.3 Period of Stagnation and Transition, 1975-1993

1975-1993 was a period of stagnation and economic crisis in South Africa. The growth of GDP per capita steadily declined from 2.6 percent in 1975 to almost zero in 1986. From 1990 to 1993, the growth rate was even negative, putting the economy in a severe economic crisis. Clearly, the weaknesses of the industrialisation policy pursued over the last five decades were revealed. Import substitution policy had created capital-intensive inefficient industries producing at high cost. Furthermore, the manufacturing sector was still highly dependent on exports of gold to provide its foreign exchange. Only a small part of manufacturing output was exported while the rapid expansion in the previous decades had been accompanied by

increasing imports of raw materials and machinery. For example, in 1964 the plastics industry imported 70 percent of its intermediate goods and the clothing and car industry both 60 percent. A combination of fluctuating gold prices and increasing imports kept on causing balance of payments problems.

Policy makers started to realize that import substitution was no longer sustainable as a device for future growth. An attempt was made to switch to export led growth. In 1972, the Export Development Assistance was introduced to stimulate exports (Peter Fallon, Luiz a. Pereira De Silva 1994). Additionally, quantitative restrictions were replaced by tariffs and a more appropriate exchange rate policy was chosen to liberalise trade. However, because of the ambiguous nature of most reforms, no real progress was made until the end of the 80s (Carolyn Jenkins 1999). Exports increased from 3.6 percent a year between 1972 and 1983 to about 10 percent over the period 1984-1990 (Peter Fallon, Luiz a. Pereire De Silva 1994). In 1990, the General Export Incentive Scheme (GEIS) was set up to help South African exporters overcome the price disadvantage they have in international markets. Exporters obtain a tax-free financial subsidy based on their value of exports and the local content in the products under GEIS.

Besides the import substitution policy, also the apartheid system was putting a brake on further economic growth. Before, the policy had fuelled the mining and agriculture sector with low wage black labour, establishing a fast growing capital intensive 'white' manufacturing industry. The transformation to a more technologically advanced industrial structure demanded more high skilled labour, which was lacking due to the apartheid regime. According to the population census of 1985, 25 percent of black workers had received no schooling while 99 percent of whites had obtained four or more years of schooling ((Peter Fallon, Luiz a. Pereire De Silva 1994). Additionally, the limited mobility of the black population due to the creation of homelands created more problems in the labour market.

2.4 Period of Recovery 1994-...?

After a turbulent period of social and economic disruption, the first democratic elections were held in 1994, which marked the end of the apartheid system. From 1994 to 1996, GDP per capita grew slightly again with 0.8 to 1.3 percent. The engine behind this recovery was increasing production in the manufacturing sector. A part of the growth was caused by rising foreign demand after all international sanctions were withdrawn, the other part by increased domestic demand.

The new government set up the Reconstruction and Development Programme (RDP), which defined the economic and social agenda up to 1999.[3] Besides, an elaborate basic needs programme, to promote redistribution and education, the document acknowledged explicitly that future growth should be achieved through trade liberalisation and increased competition. In accordance with this view, an agreement was signed to liberalize South African trade according to the WTO regulations in 1994. Within five years, tariff reductions should be reduced considerably and all quantitative restrictions on imports must be abolished. Also the import subsidies under GEIS have to be phased out within a certain period. The effect of these reforms is that the average nominal tariff on manufacturing will be decreased with 10.4 percent from 16.6 to 5.8 percent. Reductions especially apply to the tobacco, clothing, motor vehicles, textiles and footwear industry (Merle Holden 1996). Up to now, already a large number of protectionist barriers have been eliminated in accordance with the WTO rules. Other polices set up by the government to stimulate industrial output and exports are credit facilities and technological and marketing assistance. In 1996, a new economic strategy was formulated by the government, Growth, Employment and Redistribution (GEAR). The programme follows the same lines as the RDP, only now there is more emphasis on stimulating investment. (Mats Lundahl 1999)

[3] The RDP was originally formulated by the ANC and taken over by the new government after the elections (Mats Lundahl 1999).

3 International Level Comparisons

The scope of this paper is to make a *level* comparison of output and productivity between South Africa and the US. In contrast to *growth rate* comparisons, a conversion factor is required to express outputs and inputs in the same currency before they can be compared. The most likely conversion factor is the exchange rate. Although still frequently used, there are a number of objections against its use (M. Timmer 1996). [4] Firstly, the exchange rate only represents the comparative price level of tradable goods. Secondly, exchange rates are not only determined by relative price levels. Political factors, capital movements and speculation cause the exchange rate to fluctuate heavily.[5] Thirdly, the exchange rate is a summary measure of all the price levels of all goods produced in a country. Hence, it is not suitable for industry-specific conversions.

There are two alternatives to the exchange rate, Purchasing Power Parities (PPPs), on the basis of the expenditure approach and unit value ratios (UVRs) derived by the industry-of-origin approach (B. van Ark 1996). PPPs are calculated by detailed price comparisons of a large number of final products in categories of private and public consumption and capital formation. Since 1967 the expenditure approach has been applied by the United Nations International Comparison Programme (ICP). PPPs are now produced for a large number of countries by international organisations, such as EUROSTAT and the OECD.

However, expenditure PPPs cannot be used for industry comparisons.[6] The most important problem is that PPPs are completely based on final goods, intermediate products are not covered. Furthermore, PPPs refer to prices inclusive of indirect taxes, subsidies, transport and distribution margins and imported goods while export prices are excluded.

The industry-of-origin approach is more suitable for industry and sectoral comparisons because conversion factors are estimated from the production side. Similar goods across countries are matched to compute UVRs, based on value and quantity data. The UVRs serve as proxies for relative producer prices, not available directly. A disadvantage of UVRs with respect to PPPs is that their coverage is relatively less. A limited number of UVRs are also assumed to be representative for the products not matched. Especially in comparisons between developed and developing countries, this might produce some considerable problems because some goods are simply not produced there. In addition, also differences in quality are not accounted for by the industry-of-origin approach.[7] Nevertheless, we believe that UVRs are the best possible option to convert South African and US outputs in the same currency. In this study the industry-of-origin approach developed by the Comparisons of Output and Productivity (ICOP) project will be used to compute conversion factors for various industries and the total manufacturing sector. The next section briefly summarizes the methodology, for a more elaborate overview of the industry-of-origin approach and the ICOP project see (M. Timmer 1996) and(B. Van Ark 1993), respectively.

4 ICOP industry-of-origin approach

The ICOP industry-of-origin approach is applied on a bilateral basis. The quantity and value data on goods produced, necessary to compute the UVRs, are derived from the industrial census (see next section for the sources used here). The first step in the matching process is to identify similar goods, produced in both countries. Ideally, we would like to match identical products. However, in most cases only product groups consisting of products with roughly similar characteristics, like carpets and rugs, wines and brooms and brushes, can be matched

[4] (Raphael Kaplinsky 1994) uses the exchange rate to compare the industrial performance of South Africa with other countries.

[5] A good example of the influence political factors is the depreciation of the dollar against the euro caused by the current election problems in the US.

[6] Some attempts have been made to derive 'proxy PPPs'. These are expenditure PPPs allocated to industrial sectors and adjusted for taxis, subsidies, trade margins and imported and exported goods (See Van Ark, 1996, p. 30).

[7] Mahony (1996) gives an overview of the advantages and disadvantages of both the expenditure and the industry of origin approach.

because product specific data is not published. Subsequently, the unit value (uv) of a matched product or product group i is computed by dividing the output value (o) by the number of goods produced (q):

$$uv_i = \frac{o_i}{q_i}$$

A unit value can be interpreted as the average price of a general product in a product group over the year the census has been conducted. The unit value ratio (UVR) between country X and U for a matched product i is then calculated as:

$$UVR_i^{XU} = \frac{uv_i^X}{uv_i^U},$$

U being the base country, here the US. The UVR is a proxy of the relative producer price between the two countries. After all matches have been made, the UVRs are subsequently aggregated at the sample industry, branch and manufacturing level. (M. Timmer 1996) shows that the ICOP industry-of-origin methodology can be described from a stratified sampling perspective. According to this approach, UVRs must be weighted by their respective output values on each level of aggregation to obtain theoretically sound aggregates.

A sample industry is defined as the lowest level product (group) UVRs can be compared between countries. In practice this is determined by the lowest level on which industry output data is available. Because most countries use some variation of the International Standard Industrial Classification (ISIC), sample industries generally resemble 4-digit ISIC industries. All UVRs (M) are aggregated at sample industry j, using either a Laspeyres price index, with the output value (w^U) of the base country U as weights,

$$UVR_j^{XU(U)} = \frac{\sum_{i=1}^{I(M)} UVR_i^{XU} w_i^U}{\sum_{i=1}^{I(M)} w_i^U},$$

or a Paasche price index, using the quantity weights, w^X of the other country X:

$$UVR_j^{XU(X)} = \frac{\sum_{i=1}^{I(M)} w_i^X}{\sum_{i=1}^{I(M)} \left(w_i^X \Big/ UVR_i^{XU} \right)}.$$ [8]

Next, sample industry UVRs are aggregated at ICOP branch level. In the ICOP studies, 13 standard branches are defined to make comparisons with other ICOP studies easier. The branches consist of one or more three-digit ISIC sectors or one two-digit ISIC division.

The sample industry UVRs are calculated on the basis of a sample of matched products within an industry. An indicator for their reliability, i.e. how well they reflect the real UVR if all products in the sample industry could have been matched, is given by the coefficient of variation determined by the percentage of matched output and the homogeneity of the derived UVRs.[9] To ensure that reliable sample industry UVRs receive heavier weights

[8] See timmer (1996) how to derive Paasche and Laspeyres indices in terms of unit values, from the equations shown here.

[9] See Timmer (1996) how to compute UVR coefficient of variation.

than less reliable ones, only sample industry UVRs based on at least two matches with a coefficient of variation of less than 0.1 are weighted by sample industry output using the Paasche and Laspeyres index formulae above. All other UVRs are weighted by the output of product matched. Finally, using branch output values as weights, aggregate indices are obtained for total manufacturing.

The Laspeyres and Paasche indices, estimated at each level of aggregation, may differ due to differences in the underlying production structure of both countries. In comparisons between developing and developed countries, the Laspeyres index is generally higher than the Paasche index. This is called the Gerschenkron effect ((Alexander Gerschenkron 1952). To construct one single currency converter, the Fisher index, a geometric average of Paasche and Laspeyres indices, is used.

5 Data Sources for the 1993 South Africa/US Benchmark Comparison

5.1 South Africa

The primary data source for South African product matches is the *Census of Manufacturing, 1993*, published by the Central Statistical Service (CSS). The Census consists of twelve volumes. Only the *CSS report NO 30-01-01, Census of Manufacturing 1993, Statistics According to Major Groups and Subgroups: South Africa* and *CSS report NO 30-01-02, Census of Manufacturing 1993, Materials Purchased and Manufactured Articles Sold* (unpublished) are relevant for this study. The other publications describe manufacturing statistics by region. The Census covers all establishments conducting activities in connection with, the manufacture, processing, making or packaging of goods and commodities; the Slaughtering of animals, including poultry; and installation, assembly, completion, repair and related work. The establishments are classified according to a standard industrial classification based on the International Standard Industrial Classification (ISIC). Unfortunately, the South African census is not classified by industry codes, which causes some problems, discussed in the next section.

Aggregate data on labour, gross output and value added on industry and branch level was taken from CSS report 30-01-01. Data on quantity and value of goods produced to compute the unit values was taken from CSS report 30-01-03, which contains data on about 4000 products. For unclear reasons, product data in the tobacco industry was completely omitted.

5.2 US

The *1992 Census of Manufactures, Industry Series* published by the Bureau of the Census provides the required US data. Quantity and value data for approximately 11000 products are presented in branch specific volumes, classified according to the standard industrial classification (SIC). All establishments with one or more employee are surveyed.

Because South African data is only available for the year 1993, some adjustments have to be made to the US data. 4- to 7-digit producer price indices from the Bureau of Labour Statistics are used to update the US unit values from 1992 to 1993.[10]

Branch and industry data on labour, value added and output (shipments) are taken from the *1993 Annual Survey of Manufactures(ASM), Statistics for industry Groups and Industries.* the ASM is conducted in each of the four years between the industrial censuses. It is a sample of approximately 62.000 (the census covers approximately 380.000 establishments) largest US establishments, which cover approximately 80 percent of the total value of shipments. The data collected by the ASM is subsequently scaled up on the basis complete coverage census estimates to provide estimations for value added, labour and output in accordance with census

[10] Producer price indexes can be obtained from the Bureau of Labour Statistics through the internet: http://146.142.4.24/cgi-bin/dsrv

data.[11] Labour data is presented net of the auxiliaries and head offices, which is presented separately at the 2-digit level.

6 Problems with the South Africa/US comparison

All problems in the matching process are related to the degree of comparability between the South African and US data. In order to provide a consistent benchmark, it is required that the all outputs and inputs are standardised. The following section gives an overview, which adjustments and assumptions have to be made to reconcile the US and the South African variables.

6.1 Coverage

For both South Africa and the US, all data required to make the benchmark, output, value added and number of people employed, are taken from the same source, the industrial census. This guarantees that both inputs and outputs are comparable because they are based on the same sample of firms.

In the South African industrial census all establishments are surveyed, while in the US only firms only establishments with one or more employees are part of the census. It is assumed that the number of firms with zero employees is negligible.

6.2 Classification

Both aggregate data on labour, value added and output in CSS 30-01-01 and the products listing in CSS 30-01-03 are presented at the industry and branch level. As mentioned above, the South African industrial census lacks any codification system. Hence the only way to relate the aggregate data and the product listing is to compare the classification of branch and industry in which the products are grouped with the one used to present industry data. The two classifications are, however, slightly different. Moreover, the system used to classify the products is much broader than the industry classification. In most cases, the US classification provides a guideline to link the product listing with the industry data. Otherwise, several industries are taken together to guarantee that all products fall within its boundaries. A disadvantage is that the coverage ratio of the matches is lower, which reduces reliability.

A related problem is the relation between South African and US industries and branches. After the products are matched, they are grouped in sample industries, which have to be similar in both the US and South Africa. Fortunately, because US value added, labour and output data is presented at a relatively low level of aggregation (4 digit SIC), they can be grouped in such a way that broadly defined South African industries are matched. In total 35 sample industries can be defined.

Next, the product matches are aggregated to ICOP branches. To make the branches comparable the following reclassifications are made. For the US, leather gloves and mittens (SIC 3021) is moved from the leather and footwear to the wearing apparel branch, rubber and plastics footwear (3151 SIC) from the rubber and plastics to the leather and footwear branch. For South Africa, coffins are transferred from the wood to the other industry branch and carpets, rugs and mats, cordage rope twine and netting and other textiles form wearing apparel to textile products.

One industry, household appliances, is very difficult to classify because there is no product listing available. It is assumed that this industry represented all electrical household appliances, not presented at all in the product listing, and is therefore reclassified from the machinery and transport equipment to the electrical machinery and equipment branch.

6.3 Definition of value added

As is common in productivity studies, gross value added is taken as a proxy for output produced. An alternative would be gross value of output. However, this measure involves a

[11] For more details about the scaling up procedure, see Appendix B of the Census of Manufactures

considerable part of double counting because part of the output is used as intermediate inputs in other firms and industries.

Van Ark (1993) distinguishes between two definitions of value added used in industrial censuses, census value added and gross value added, mostly applied in the national accounts. The former, used by the US, is broader than the latter because it still includes services. The South African definition is not very clear. It seems as if services are included in gross value added (called net output in the South African census). According to the Census of Manufacturing (1993, p. viii), "charges for work done, that is, repair work, installation, erection or assembly and manufacturing of goods from materials of clients" and "sales of articles manufactured by other establishments from an establishment's materials" are still part of value added. For the time being we assume that value added is similarly defined in both countries and can be compared without modifications. Both the USA and South Africa industrial census present value added at factor cost.

6.4 The employment concept

The US survey explicitly excludes head office and auxiliary employment, while this is not the case for the South African data. The US branch figures for employment were scaled up with head office and auxiliary employment, presented in the *1993 Annual Survey of Manufactures*.

Another problem is the treatment of self-employment and unpaid family workers. In the US, they are excluded in the employment definition. In the South African separate data on employment including and excluding self-employment and unpaid family workers are given.

7 The 1993 South Africa/ US benchmark

7.1 Unit Value Ratios (UVRs)

The UVRs for the 1993 benchmark, aggregated at 13 ICOP branch levels, are presented in table 1. Table 2 shows the matching details. For the electric machinery branch no matches could be made. The average of all other branches is taken as a proxy. There is many variance between the branch UVRs, varying from 1.73 Rand/$ for leather products to 5.51 Rand/$ for chemicals. The weighted average UVR for the total manufacturing sector is 3.76 Rand/$. This is about 16 percent higher than the exchange rate, measured by the comparative price level in the last column. A possible explanation for this might be the high level of protection on these industries, which breeds inefficient production. The effective protection on Textiles, apparel and Leather, chemicals of respectively 93.6 and 50.6 percent in 1989, confirm this to some extent (Peter Fallon, Luiz a. Pereire De Silva 1994). However, in case of the paper industry this explanation does not hold because it combines a relatively low of tariff rate (22.2 percent) with a relatively high comparative price level.

In total 189 matches have been made. 17% of the US output and 26% of the South African output has been matched. The coverage for the resource-based industries, in which technology is generally less advanced is reasonably high for both countries. As explained in section ?, it is easier to match products in these countries because they are standard in both countries. An exception is the wearing apparel branch. Coverage in this sector is low because US data on cloths, which makes up the largest part of wearing apparel, are not published for 1992. The coefficient of variation for the Paasche and Laspeyres index indicates the reliability of the UVRs. Obviously, reliability is less when the coverage rate is lower, such as in the Wearing Apparel rubber and other industry branches. These outcomes should be interpreted with care. Although coverage is low, the matches in the Non-metallic mineral products and the machinery and transport sector seem reliable. Overall, the coefficient of variation is 0.03% for both the Laspeyres and Paasche index. This means that the UVR for the manufacturing sector is significantly different from the exchange rate at a 95% interval.

Table 1
Manufacturing Unit Value Ratios, 1993 South Africa/US Benchmark

	Laspeyres UVR Rand/$	Paasche UVR Rand/$	Fisher UVR Rand/$	Comparative price level (a)
Food, beverages and tobacco	3.23	2.75	2.98	91.64
Textile mill products	4.57	3.48	3.99	122.80
Wearing apparel	2.87	1.99	2.39	73.50
Leather products	1.84	1.62	1.73	53.19
Wood products	2.82	2.43	2.62	80.48
Paper, printing and publishing	3.46	3.46	3.46	106.46
Chemicals	5.80	5.23	5.51	169.43
Rubber	4.66	4.02	4.33	133.11
Non-metallic minerals	2.98	2.92	2.95	90.77
Basic and fabricated metal products	4.03	2.65	3.27	100.48
Machinery and transport	5.54	5.29	5.42	166.62
Electrical machinery and equipment (b)	3.70	3.22	3.45	106.01
Other Manufacturing	2.62	2.82	2.72	83.61
Total manufacturing	4.32	3.28	3.76	115.75
Exchange rate			3.25	

Source: Own calculations, see section 5. Basic sources are CSS, Census of Manufacturing, 1993 and Bureau of the Census, US census of Manufactures, 1992. Exchange rate taken from ?
Note: (a) Comparative price level is the UVR divided by the exchange rate; (b) Average of other branches.

Table 2
Matching details, 1993 South Africa/US Benchmark

	Number of product matches	Coverage Ratio USA (%)	Coverage Ratio SA (%)	Coefficient of variation Laspeyres	Coefficient of variation Paasche
Food, beverages and tobacco	78	48	53	0.04	0.10
Textile Mill Products	13	44	51	0.08	0.12
Wearing Apparel	3	2	2	0.38	0.58
Leather Products and Footwear	7	70	44	0.09	0.13
Wood Products and Furniture	22	21	29	0.06	0.08
Paper Products	10	15	37	0.07	0.06
Chemicals	22	28	27	0.04	0.05
Rubber	4	7	13	0.16	0.20
Non-Metallic Mineral Products	4	7	19	0.01	0.02
Basic and Fabricated Metal Products	18	6	11	0.07	0.11
Machinery and Transport Equipment	4	0	1	0.07	0.02
Electrical machinery and equipment	0	0	0	-	-
Other Industry	4	1	2	0.20	0.12
Total manufacturing	189	17	26	0.03	0.03

Source: see table 1.

Table 3
Basic Manufacturing Data, South Africa and USA

	USA				South Africa			
	Gross value of output at factor cost mil $	Gross value added at factor cost mil $	Employment (000)	Annual hours worked per employee	Gross value of output at factor cost mil Rand	Gross value added at factor cost mil Rand	Employment (000)	Annual hours worked per employee (a)
Food, beverages and tobacco	451641	187500	1701	1939	45940	17183	222	2182
Textile Mill Products	73951	30980	635	2024	6037	2624	65	2132
Wearing Apparel	74163	37189	1016	1824	7029	3318	140	2059
Leather Products and Footwear	10621	4962	112	1869	2968	1302	41	2039
Wood Products and Furniture	141896	61970	1198	1998	6597	3098	92	2234
Paper Products	306223	176369	2253	1897	16850	7960	95	2020
Chemicals	459459	194794	1254	2018	35200	15721	105	2187
Rubber and plastics	121980	62969	962	2026	8055	3993	62	2128
Non-Metallic Mineral Products	65574	35784	494	2058	6928	3730	70	2161
Basic and Fabricated Metal Products	317522	143279	2089	2037	31258	12786	192	2226
Machinery and Transport Equipment	692572	306538	3605	2037	30679	11712	163	2090
Electrical Machinery and equipment	233343	128484	1451	1969	8732	3826	57	2148
Other Industry	179342	115450	1345	1926	3504	1356	27	2128
Total manufacturing	3128284	1486266	18114	1980	209778	88610	1330	2144

Source: Gross value of output, gross value of output and employment for the USA from 1993 Annual Survey of Manufactures(ASM), Statistics for industry Groups and Industries, annual hours worked from ?. For South Africa, Gross value of output, gross value of output and employment form CSS report NO 30-01-01, Census of Manufacturing 1993, Statistics According to Major Groups and Subgroups: South Africa. Annual hours worked from South African Statistics, 1995.
Note: (a) Based on 1992 data but aggregated to branches using 1993 labour data.

7.2 Productivity Benchmark

The UVRs in table 1 are used to convert South African and US gross value added in the same currency.[12] Table 4 presents South African value added as a percentage of US value added expressed in both prices. The geometric average of the two corresponds with a conversion made with Fischer UVRs. Subsequently, relative labour productivity levels per employee and per hour worked are estimated for all branches. The basic data underlying the labour productivity statistics is presented in table 3.

On average, South African gross value added per employee is 21.6 percent of the US level. Labour productivity on the basis of hours worked is slightly less, indicating that on average South African employees work slightly longer than their American colleagues. The productivity gap is fairly constant over the total manufacturing sector. Remarkable is the high relative labour productivity in the leather and footwear branch of 41.4 percent of the US level. This, however, is probably caused by the relatively low performance of the US, rather than that of South Africa. Furthermore, it is striking that US leather and footwear branch in the US is relatively small in comparison to its South African peer. These peculiarities with respect to this branch are also found for a range of Asian countries (Timmer, 1999). Further research is warranted to explain this.

Relatively low performance of respectively 17.5 percent and 15.6 percent of the US level is found in chemical and machinery and transport branch. These are two of the most technologically advanced branches. It might very well be that South Africa has not mastered the difficult technology involved. Another explanation for the low productivity in chemicals might be inefficient production of the SASOL, the former state company.

Table 4
Labour Productivity in Manufacturing, South Africa as % of USA, 1993.

	Gross Value added (GVA)			Employees	Hours worked	GVA per person	GVA per hour
	At South African Prices	At US Prices	Geometric Average				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Food, beverages and tobacco	3.3	2.8	3.1	13.1	14.7	23.5	20.9
Textile Mill Products	2.4	1.9	2.1	10.2	10.8	20.8	19.7
Wearing Apparel	4.5	3.1	3.7	13.7	15.5	27.2	24.1
Leather Products and Footwear	16.2	14.2	15.2	36.8	40.2	41.3	37.8
Wood Products and Furniture	2.1	1.8	1.9	7.6	8.6	25.0	22.3
Paper Products	1.3	1.3	1.3	4.2	4.5	31.0	29.1
Chemicals	1.5	1.4	1.5	8.4	9.1	17.5	16.2
Rubber and plastics	1.6	1.4	1.5	6.4	6.7	22.9	21.8
Non-Metallic Mineral Products	3.6	3.5	3.5	14.1	14.8	25.1	23.9
Basic and Fabricated Metal Products	3.4	2.2	2.7	9.2	10.1	29.7	27.1
Machinery and Transport Equipment	0.7	0.7	0.7	4.5	4.6	15.6	15.2
Electrical Machinery and equipment	0.9	0.8	0.9	3.9	4.3	21.9	20.1
Other Industry	0.4	0.4	0.4	2.0	2.2	21.4	19.4
Total manufacturing	1.8	1.4	1.6	7.3	7.9	21.6	19.9

Source: table 1 and table 3

[12] Theoretically it would be more sound use double deflation, i.e. to convert output and intermediate goods separately, to derive value added in a common currency. However, for practical and methodological reasons, only single deflation is used in ICOP studies (see Van Ark, 1993).

8 Data Sources for the Labour Productivity Comparison, 1970-1997

Next, to give an impression of the degree of catch-up or falling behind of South Africa with respect to the USA, the 1993 benchmark is extrapolated back and forward over the period 1970-1997. In this section the main data sources to perform this analysis are briefly described. The next section presents the results of the extrapolation.

8.1 South Africa

The South African time series for gross real value added and labour are taken from the *1998, Productivity Statistics*, published by the National Productivity Institute (NPI). The NPI is a non-profit organisation involved with training, advice and research related to the performance of the South African economy. The productivity statistics is an annual publication, which presents growth and productivity statistics for South Africa on industry, branch, national and international level, combining data on various sources such as the Central Statistical Service (CSS) and the National Reserve Bank. Because the NPI data is presented at a lower level of aggregation than the ICOP branches they have to be aggregated first. For value added this poses problems because the data is only presented in index form, with base year 1990, which makes direct aggregation impossible. The CSS presents gross nominal value added for the years the manufacturing census is conducted in *South African Statistics, 1995*. Unfortunately, in 1990 no census was conducted so gross nominal value added for 1991 is converted to 1990 prices with an appropriate wholesale price deflator also presented in the South African Statistics, 1995. Subsequently, gross real value added numbers on branch level are plugged into the NPI index numbers to derive value added series over the period 1970-1997. Finally, the series are aggregated to the ICOP branch used in this study. It is not possible to construct time series for other manufacturing industries because these data is not presented in the productivity statistics.

8.2 USA

The time series for gross real value added is constructed using several sources. Data for the period 1970-1977 take from a print out of the *National Income and Product Accounts of the United States (NIPA), 1929-82*, Bureau of economic Analysis (BEA), 1986, for the period 1977-1982 from various issues of the *Survey of Current Business*, BEA and for 1987-1997 from a datafile on the website of BEA.[13] There are two problems with these series. First, in 1982 a new SIC classification was introduced with changed the branch results. Primarily, the results for electrical machinery are affected as a part is transferred to precision instruments. Secondly, in the series for the last period, BEA used chain instead of standard indices to compute real numbers. The first problem can relatively easy dealt with because data based on both classifications is available to link the series. The second problem poses more difficult problems. Preliminary adjustments have been made but further research is required to provide satisfying results.

For labour, the same sources as for value added are used to derive consistent series. Similar to value added, the various time periods were linked together using data on overlapping years. In accordance with the benchmark, we used labour data representing part-time and full time employment excluding self-employment and unpaid family workers.

9 Labour Productivity Comparison 1970-1997

Table 5 shows South African labour productivity as percentage of the USA for selected years, derived by applying growth indices for value added and labour to the benchmark. Additionally, we present index numbers for each country separately in table 6. These are important to identify the sources of catching up or falling behind. Relative labour productivity is a function of the productivity changes in both functions. Hence, for example catch-up can be either caused increasing labour productivity South Africa or a decrease in the US.

[13] See http://www.bea.doc.gov/bea/dn2/gpo.htm

The bottom line in table 5 indicates that the performance of total manufacturing in South Africa fell behind in comparison to the USA. Over the period considered relative labour productivity decreased from 32.6 to 19.9, with the exception of the period around 1980 when South Africa shows a moment of catching up in all branches. The upswing is caused by decreasing labour productivity in the USA. The explanation can be sought in the oil crisis, which probably hit the USA much harder than South Africa. The largest fall in relative productivity is found over the period, 1985-1995, corresponding with the economic recession. Table 6 shows that labour productivity of the US went up with a factor 2.4 over the period 1970-1997 while South Africa increased its labour productivity by a factor 1.4. This explains the relative falling behind of South Africa over the whole period.

Table 5 also shows us the evolution of relative productivity at the branch level. Three branches, food, beverages and tobacco, non-metallic mineral products and basic and fabricated metal products, show catching up, while the others are falling behind. Particularly the first two sectors seem to perform well with an increase of relative labour productivity of 8.8 and 11.3 percent respectively. The finding of (Hildegunn Kyvik Nordas 1996) that non-ferrous metals was the only sector competitive with the USA, confirms the good performance of basic and fabricated metal products branch. Furthermore, in 1994 the Columbus stainless steel plant was taken into production which probably also boosted labour productivity over the last years (Mats Lundahl 1999).

Most of the catch up of the Food, beverages and tobacco, and Metal branch is achieved during the last three years. Over the same period, also the Leather, Wood and Chemicals show a slight increase in relative performance. Both findings are in accordance with the end of the South African crisis. Overall, the wearing apparel, wood, and rubber branch performed badly in absolute and relative numbers. The wearing apparel and wood branch show even deteriorated labour productivity relative to the level of 1970 (table 6).

Finally, it must be remarked that some estimates for relative labour productivity over the period 1970-1975 are doubtful, particularly with reference to the rubber and electrical machinery branch. As explained in section 8, this is probably due to the problems in the construction of the US data for that period.

Table 5
Labour Productivity in Manufacturing, South Africa as % of USA, 1970-1997

	1970	1975	1980	1985	1990	1995	1997
Food, beverages and tobacco	19.1	18.5	20.6	20.5	21.5	21.4	27.9
Textile Mill Products	23.5	23.4	23.7	19.7	16.6	20.7	17.6
Wearing Apparel	55.5	41.3	46.2	34.2	32.4	26.2	21.3
Leather Products and Footwear	38.7	38.4	42.0	42.2	36.5	36.9	37.1
Wood Products and Furniture	45.0	41.0	42.9	29.4	26.3	26.5	28.7
Paper Products	38.2	34.9	36.3	33.8	34.5	35.6	34.1
Chemicals	22.2	22.3	24.0	17.4	18.5	18.6	20.5
Rubber and plastics	70.7	63.5	53.1	37.4	27.6	22.4	19.0
Non-Metallic Mineral Products	30.4	35.4	34.1	28.0	30.3	32.5	31.0
Basic and Fabricated Metal Products	27.3	26.7	33.7	33.2	33.6	34.6	38.4
Machinery and Transport Equipment	32.6	30.8	33.7	16.4	15.9	13.5	12.0
Electrical Machinery and equipment	72.2	70.4	62.1	48.3	35.8	15.3	12.2
total manufacturing	32.6	31.0	33.3	25.7	24.4	20.6	19.9

Source: Table 3 and Appendix ?

Table 6
Index Numbers of Labour Productivity by Manufacturing Branch, South Africa and USA, 1970-1997. (1970=100)

	South Africa	USA	South Africa/USA
Food, beverages and tobacco	213.3	146.4	145.8
Textile Mill Products	195.3	260.4	75.0
Wearing Apparel	93.4	243.0	38.4
Leather Products and Footwear	120.2	125.3	95.9
Wood Products and Furniture	96.7	151.8	63.7
Paper Products	108.3	121.2	89.4
Chemicals	169.2	182.8	92.6
Rubber and plastics	101.4	377.7	26.8
Non-Metallic Mineral Products	125.3	122.9	101.9
Basic and Fabricated Metal Products	220.4	156.5	140.8
Machinery and Transport Equipment	109.4	297.7	36.7
Electrical Machinery and equipment	127.3	753.1	16.9
total manufacturing	138.7	227.8	60.9

Source: Appendix ?

10 Conclusion

In this paper, we estimated South African labour productivity levels for total manufacturing and 13 manufacturing branches, relative to the USA for the period 1970-1997. First, industry specific unit value ratios (UVRs) were estimated by means of the ICOP industry-of-origin approach to convert real value added in the same currency. For most industrial branches as well as for total manufacturing, UVRs are higher than the exchange rate, pointing at inefficient production structure. The UVRs are applied to South African and US value added and labour data estimate labour productivity levels in the benchmark year 1993. Next, the benchmark is extrapolated with time series data to derive labour productivity levels for the period 1970-1997. South African economic performance deteriorated significantly over the last 27 years relative to the technology frontier, represented by the USA. Labour productivity levels decreased from 32.6 percent to 19.6 percent of the USA. AT the branch level, the same results are found. Except for the food, beverages and tobacco and metal branch, which perform remarkably well, all branches, are falling behind relative to the USA. South African economic history confirms the results we obtain. From 1924 to the beginning of the 70s, South Africa pursued a strict import substitution policy to build up its manufacturing industry. This development was spurred by the apartheid system, which generated the necessary resources for large capital investments by keeping wages low in mining and agriculture. The same polices which created the relatively high performing South African industrial structure also broke it down again in the period 1975-1994. Import substitution policy created inefficient industries, which are not able to compete in the international market. In addition, skilled labour is lacking due to bottlenecks in the labour market, generated by the apartheid system.

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