SOUTH AFRICAN TRADE IN HIGH TECHNOLOGY PRODUCTS

1. EXECUTIVE SUMMARY

The production of and trade in high technology products has always been seen to be important for both developed and developing countries. For developed nations these products are a source of significant exports, off-setting their loss of competitiveness in traditional low technology products. For developing nations, mastery of these products represents a necessary step on their industrialisation path. It is also an important means of protecting their external balance as their own consumption of these products burgeons and as they too lose competitiveness in traditional sectors as wage levels rise in their economies. On top of this, the high tech sectors are the fastest growing in the world economy and so represent an enormous opportunity for growth. It is for these reasons that South Africa should develop its high tech trade potential.

To formulate sensible policy to develop high tech trade, there is a need to accurately define and measure high tech trade in the country. This paper uses a method developed by the US Bureau of the Census which avoids the normal measurement pitfalls of aggregation by allocating products to high tech fields at a very detailed level. In this way, the inclusion of low tech products due to aggregation is avoided. The fields include biotechnology, life sciences, opto-electronics, computers and telecommunications, electronics, computer integrated manufacturing, material design, aerospace, weapons and nuclear technology.

As is to be expected, South Africa has a large trade imbalance in high tech products ($3 747.4 million in 1995) due to weak export performance. This is the result of a) distorted incentives favouring the servicing of the local market, b) lack of economies of scale, c) domination of multinationals interested in local sales, d) good but not widespread technological capabilities, e) sanctions (especially the weapons sector), and f) protected and hence unnaturally profitable traditional sectors drawing capital away from high tech. However, there has been a gradual removal of some distortions through trade liberalisation and the end of sanctions, combined with greater incentives to export. From 1991 to 1995, exports have been growing at an average of 11.8% - above the 9% growth in imports. The impact of liberalisation appears to have been less significant in high technology products compared to other sectors as growth in imports was below the general trend from 1994 to 1995 and much of the growth can also be associated with the establishment of a cellular network. This may be because tariff levels were already low in many high tech fields and so the degree of liberalisation is negligible or alternatively, it may be too early in the liberalisation process to be seeing any significant import penetration. What is significant is that much of the exports by South Africa's high tech sectors is in high tech products and not the low tech products that also fall in these sectoral classifications. This demonstrates not only real technological capability behind South Africa's export success, but also an inability to compete in the large low tech end where wage levels are a more important determinant of export success than technological capability.

An analysis of the actual products traded, reveals that computer and telecommunications products not only account for almost half of imports (48%), they are also the fastest growing. Life sciences (16%), aerospace (13%) and electronics (9%) were the only other sectors with significant shares. The pattern of exports shows weapons is the largest contributor (36.5%) but there is a far more balanced product structure with high and growing shares for

computers and telecommunications (20.9%), aerospace (17.7%), life sciences (7.8%) and computer integrated manufacturing (7.2%). An examination of the trade balance for each product reveals that only weapons has a positive balance ($112 million) while the biggest contributor to the deficit on the high tech account is computers and telecommunications ($2 billion or 54% of the deficit).

An analysis of regional trade shares provides some interesting results. South Africa's imports are dominated by Europe with a 54% share, followed by Asia and the Americas with 19% each. Europe is also the major destination for South African exports of high tech products, accounting for 40%, followed Africa (26%) and the Americas (15%). Surprisingly, exports of high tech products to Asia were low (9%) even though they make up over a quarter of total exports from South Africa.

In conclusion, this study reveals a few key factors in South Africa's high tech trade, namely:

- technological capabilities and not low wages lie behind SA's growing competitiveness in these sectors,
- South Africa demonstrates international competitiveness in the weapons trade (a successful infant industry development policy), and
- the sector that poses the biggest concern is the rapidly growing computers and telecommunications sector,

Strategies need to emerge to improve the size and competitiveness of all high technology sectors because South Africa needs to move significantly into the export of high technology products if it is to avoid losing its trade competitiveness from either lower wage countries closing the technological gap or from shifts in the world structure of demand. The urgency of this move is open for debate, but its inevitability is not.

1. INTRODUCTION

The production and trade of high technology products has always been seen to be important for both developed and developing countries. For developed nations these products are a source of significant exports, off-setting their loss of competitiveness in traditional low technology products. For developing nations, mastery of these products represents a necessary step on their industrialisation path and a means of protecting their external balance as their own consumption of these products burgeons. The importance of high technology products increases with their continually rising share in total world demand. A country's trade in high technology products is also an important indicator of its level and depth of technological capabilities[1]. In turn, these capabilities reflect the level of development of the country and its ability to use technology as a competitive tool in other sectors of the economy - an application which is necessary for retaining some competitiveness in these sectors as average wages rise.

The best assessment of a nation's capabilities in high technology products is to measure their trade in such products. Trade statistics will reflect a country's ability to produce these products at an internationally competitive level while production levels may merely reflect the ability of a country to protect these sectors from competition. It is also necessary to ensure that actual high technology products are being measured, and not low technology products which form a part of high technology industries. For instance, South Africa exports a considerable amount in the motor vehicle industry yet a significant proportion of these exports are leather seats - a low technology product.

[1] Technological capabilities consist of both the capital stock that a firm has invested in as well as the knowledge that a firm possesses in the form of human capital and skills.

The purpose of this research paper is to measure and then analyse South Africa's trade in high technology products using a technique developed by the US Bureau of the Census. This technique differs from conventional methods in that it tries to avoid the usual aggregation pitfalls of including low technology products from high technology sectors in the assessment. The next section of the paper takes a brief look at the importance of trade in high technology products. Section three provides an analysis of the differences between the conventional methods of measuring high technology trade and the tool developed by the US Bureau of the Census. Section four then presents the results of applying this technique to the South African trade data along with an analysis of their significance. In the final section conclusions are drawn and potential policy interventions suggested. The various appendices contain details of the techniques used and results gained.

2. THE IMPORTANCE OF TRADE IN HIGH TECHNOLOGY PRODUCTS

Much of the industrial strategising in South Africa in the recent past has concentrated on the existing traditional low and medium technology sectors of the economy. This is understandable as these sectors comprise the bulk of the economy and are undergoing a difficult adjustment as they become increasingly exposed to international competition. Yet it is time for the policy-makers to take a serious look at the high technology sectors of the economy as their performance will have a significant bearing on the future economic development and trade performance of the country. This section takes a brief look at the importance of the high technology sectors for the country's competitiveness and external trade balance.

A. Country Competitiveness

The international competitiveness of a country is best measured by its trade performance. In recent years our understanding of the role of technology and of the technological intensity of a product in determining trade flows has improved enormously. Theoretical work that touches on this issue are the product cycle models including Vernon (1966), Krugman (1979) and Dollar (1986), the technology gap models of Krugman (1981) and Dosi et al (1990), and the Ricardian trade model of Dornbusch et al (1977). Probably the most relevant to the debate around high technology trade is the elegant model of Krugman (1982) which falls into the technology gap literature and which concentrates on the interplay between technology and wage gaps. The basic assumptions of the model are:

- there are many countries which can be ranked according to their differing technological capabilities
- technological acquisition takes the form of improved productivity in producing existing products only
- products can be ranked according to their technological intensity. The greater the technological intensity, the greater the productivity gap resulting from a given technological gap between countries.
- wages are determined by the intersection of a given labour supply and a labour demand which is dependent on the overall level of output for all markets.
- each product will be produced by the lowest cost producer. Product cost is determined by the interplay of productivity and wage rates.

Similar to the Hecksher-Ohlin model, the pattern of trade in this model depends on an interaction between country and product characteristics. In a two country scenario, if the productivity gap outweighs the wage gap for a given product, then the more technologically advanced country will produce the product. Naturally the opposite scenario also holds. Therefore, for a given wage gap, the more technologically advanced country will produce the more

technology-intensive products as the resulting productivity gap for these products is larger. From this basis one can derive a number of results. First, if the technology gap widens, this will widen the productivity gap which will allow the more technologically advanced country to take over production of some marginal products from the less advanced country. This capturing of a higher share of total output will cause the wage gap to increase[2]. Second, if the technology gap narrows, this will narrow the productivity gap allowing the less advanced country to take over production of some marginal products from the more advanced country. The greater share of total output will result in a narrowing of the wage gap. So what does this mean for South Africa's competitiveness and the importance of its high technology trade?

In a simplified form, the argument is as follows. As economic development takes place within the country, average wages will increase in response to the growth in output. As average wages increase, the country will lose its competitiveness in the low-technology, labour-intensive, tradable products. This process can be slowed for a period through the application of technology to the production process. This will create a productivity gap that outweighs the wage gap with lower wage countries. As UNCTAD (1996: 112) cites for the Asian example:

> *"As income increases and the domestic market begins to grow, rising labour costs and the entry of lower-cost producers progressively erode the export competitiveness of many labour-intensive manufactures. This can be offset, in part, by new investment and export opportunities in higher-level niches in traditional industries, such as textiles and clothing, created through improved design and marketing."*

However, the scope for such gains may be limited for many products and the long-term decline of these products is inevitable if development proceeds and wages continue to increase. To avoid the loss of employment and decline in relative wages associated with this loss of output, the country needs to shift production into more technology-intensive products. In so doing, not only do South African enterprises replace output lost at the low end, but they also create higher paying jobs enabling average incomes to rise. This shift into more technologically intensive products not only includes moving up the sectoral 'value-chain' as advocated by the Industrial Strategy Project[3], but also includes a sectoral shift from low-technology sectors to high technology sectors. The reason for this is that the greater the technological intensity of the product, the greater the productivity gap with the lower wage countries. The significance of this process is already clear with the long-term decline of South Africa's low technology sectors already in progress (e.g. clothing and textiles, footwear).

The immediacy of this threat depends on whether the lower wage and less technologically advanced countries are even able to produce the more technologically advanced products. If not, then they will be unable to compete regardless of the size of the wage differential. However, over time capabilities will be developed in these countries, and by that time South Africa needs to have progressed up the product ladder in order to maintain its competitive position in the world. The lesson from this exercise is that a technologically stagnant country in a progressing world will lose world market share to both more and less technologically advanced countries unless there is a compensating downward adjustment in the wage rate.

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[2] This will of course reduce the net gain as the production of some marginal products then move back to the less advanced country.

[3] See "Improving Manufacturing Performance in South Africa", Industrial Strategy Project, 1995

B. Changing Structure of World Demand

In the trade models that were discussed above, it was assumed that the structure of world demand remains constant. Even under this scenario it was shown that South Africa needs to move up the sectoral chain towards high technology products as the country slowly loses competitiveness at the lower end. Yet the changing structure of world demand away from the traditional low and medium tech sectors towards high technology sectors makes this shift in competitive advantage even more urgent. This shift implies that even if South Africa retains its competitiveness in the low and medium technology sectors, it will still see its share of world exports decline as the share of those products in total world trade declines. To avoid this, South Africa must establish a market presence in the high technology sectors which are more dynamic.

What is driving this shift to high tech? A number of primary forces can be seen to be driving this shift to high tech. First, there is significantly more new product innovation occurring in the high technology fields than in the traditional sectors. These new products create new markets which then compete with established products for the growing income of consumers. A good example is the information technology (IT) sector where most of today's products consumed did not exist 20 years ago. These products may even act as substitutes for traditional products, providing a further push to their decline. Second, high technology products are more income elastic than traditional low and medium technology products. Therefore as consumer incomes grow, a greater proportion will be spent on high tech products. Third, the competitive upgrading and growing sophistication of all sectors of the economy has been affected through the increasing use of high technology products. The primary beneficiary has been the information and telecommunications sectors yet other sectors have not been excluded. For instance, biotechnology is playing an increasingly important role in agriculture.

How significant is this shift? The significance of this shift to high tech is best shown through a number of very revealing statistics. The Economic Commission for Latin American Countries (ECLAC) Comparative Analysis of Nations (CAN) determines the dynamism of OECD imports which comprise around 70% of total world imports. The purpose is then to analyse what proportion of a specific country's exports are in these sectors in order to determine the dynamism of their exports and their potential future growth. The obvious lesson here is that countries need to enter the dynamic sectors or else decline in export performance is imminent. As reported in UNCTAD (1996: 126), the study reveals that of the products within the group considered dynamic,

> *"...many of the products involved are in high-technology sectors; from 1963 to 1993, high tech imports into OECD countries grew by over 180 per cent, compared to only 40 per cent for medium technology goods and a decline of 12 per cent for low-technology goods."*

This difference in import growth rates to the most important markets in world trade is remarkable. This trend is also evident in the most important high technology field, namely information and communication technologies (ICTs). The World Trade Organisation (WTO) estimates that trade in computer and telecommunication products plus telecommunication services was worth over $1 trillion in 1996 and is roughly equivalent to total world trade in agriculture, automobiles and textiles[4]. To further reinforce this point, it is estimated that annual spending by US companies on IT equipment outstrips their spending on all other capital equipment[5].

[4] WTO Focus, No. 17, March 1997

[5] Talero, E. & Gaudette, P. (1995) 'A Proposal for a World Bank Group Vision and Strategy', in *Information Technology for Development*, IDRC, December

The implications of these trends for South Africa is simple. Unless the country begins to become competitive in the high technology sector, not only will our share of world exports decline, but imports are also likely to increase significantly as our own demand for these high technology products increases. The result? A rapidly growing current account deficit.

3. MEASURING HIGH TECHNOLOGY TRADE

To formulate sensible policy around South Africa's high technology industries, there is a need to first accurately define and then measure the country's high technology trade. As with all economic variables, the definition and measurement of high technology trade is open to debate. Part of the purpose of this paper is to present and calculate for South Africa a new technique for measuring high technology trade developed by the United States Bureau of the Census. This section takes a look at the conventional approach to measuring high technology trade and then contrasts this with the US Bureau of the Census technique. The problems with both techniques are exposed.

A. Conventional Methodology

The common approach to defining high technology products is to utilise industry-level data and employ some form of technology input measure to determine the technology embodied in an industry. Some common measures include the ratio of research and development expenditures to sales, the ratio of scientific and engineering personnel to total employees, the quantity of modern capital (capital equipment less than 6 years old) or a combination of all of these[6]. Once the scores for all industrial sectors are available, the high technology sectors are those that represent the top scores on the technology index measure. The point on the technology index at which a product ceases to be a high technology product and becomes a low or medium technology product is still open to debate. For instance, the European Union (EU) will consider motor-vehicles and chemicals as high technology while the Foundation for Research Development (FRD) will consider these two sectors medium technology.

As Abbott et al (1989) eloquently point out, there are two problems with this standard approach - one conceptual and the other related to data issues. The conceptual objection is that there is no differentiation between process and product technological input. If technology is applied to the processing of a low technology product for whatever reason, then this product could end up being falsely classified as a high technology product. An example they use is the petroleum industry where complex refining techniques can now be used to reduce environmental damage and wastage. This has led to the sector being included in some definitions of high tech even though the product itself is not high tech[7]. An example in the South African case may be mining where considerable R&D has been performed to determine optimal extraction techniques. As R&D has not been highly significant in other sectors of the economy, it may be that mining is defined as high tech through this methodology.

On the data side, because the technology input measures are only available at a high level of aggregation, the analysis must assume all products within the aggregated industry are either high or low tech[8]. This can lead to very misleading results as most high technology industries contain numerous low technology products. For instance, office machines is often included as a high technology industry yet this classification contains items such as calculators and cash

6 Doms, M.E. and McGuckin, R.H. (1992: 344)

7 See Abbott et al (1989) pp. 3

8 Doms, M.E. and McGuckin, R.H. (1992: 344-5)

registers which are not necessarily high technology. The significance of this point is demonstrated firmly in the South African motor vehicle industry (a medium technology sector) which has experienced a recent explosion in exports. It turns out that a highly significant proportion of these exports is in leather seats for BMWs world-wide, products which can hardly be considered high technology.

B. US Bureau of the Census Method

The US Bureau of the Census approach was developed in order to overcome the shortfalls of the conventional approach. The spur for the development of this methodology was the measured decline in the competitiveness of the US economy in high technology products in the 1980's. The concern with this prompted an investigation of the measurement technique which exposed the flaws outlined above[9]. To overcome these problems, The US Bureau of the Census went about developing list of technological fields which were commonly defined as producing high technology products. The fields that they came up with were Biotechnology, Life Sciences, Opto-electronics, Computers and Telecommunications, Electronics, Computer Integrated Manufacturing, Materials Design, Aerospace, Weapons and Nuclear technology. This process effectively removed the problem of including high technology processes under the high technology product categories.

After defining these ten high technology fields, researchers within the department assessed the detailed products that fall within these listings to decide if they were high technology or not. The purpose of this was to remove the aggregation problems that plagues the conventional approach. Although this process is a subjective approach, it should be reasonably accurate given the various reviews from outside sources that were conducted (including product sensitivity analysis) and its eight year existence which has seen many iterations[10]. Although this process has proved lengthy, it has effectively avoided the problems of the standard approach and should therefore provide a far more accurate assessment of a country's performance in high technology products. This is particularly important for policy-making in both developed and developing countries. For instance, developed countries may see the balance on their high tech trade account decreasing only to find that inroads have not been made at the high tech end but in low technology products in high technology sectors. For example, comparative results of the this and the standard technique on US data revealed differences in the trade balance of almost $20 billion in 1989[11]. For developing countries the opposite may hold. They may see an improved performance in their high technology trade only to find that a significant proportion of it is in low technology products in high technology sectors. Either way, accurate information is necessary for understanding the state of play.

C. The Influence of a Staged Production Process

Despite the technique that is favoured by the policy-maker, there remains one fundamental problem with both techniques that is of particular relevance to developing countries. The production process for any product can be broken down into a number of stages, each with a varying degree of technological complexity. Whichever technique one chooses, both cannot hope to differentiate stages of the production process when trade statistics are compiled for either completed products or any parts thereof. The implications for developing countries is that they may end up performing the low tech and labour intensive components of the high technology product production chain while the

[9] See Abbott et al (1989) pp. 1

[10] Doms, M.E. and McGuckin, R.H. (1992: 345)

[11] See Abbott et al (1989) pp. 7

other components may remain in the industrial countries. The recent UNCTAD Trade and Development Report (1996) makes exactly this point:

> *"What appears to be a jump from the lower skill and technology range to the upper range in exports in Malaysia and Thailand consequently reflects, to a large extent, an increasing division of labour amongst East Asian countries whereby the second-tier NIEs assume the less demanding and more labour-intensive assembly stages." (pp. 121)*

This international division of labour is evident in South Africa too. For example, we perform the final assembly of personal computers and then re-export them. This process is neither skill intensive nor adds much value to the final product. One way to detect this is through a comparison of exports and imports of a country. As the UNCTAD report notes,

> *"...imports of parts of automatic data processing equipment in 1994 were close to 80% of export value of finished products in Thailand and more that 95% in Malaysia, compared to less than 30% in the Republic of Korea and Singapore...".*

Yet this approach may not be useful for a country like South Africa because the local market is so significant that imports tend to outweigh exports anyway. However, it should be noted that in a number of high tech sectors South Africa is the marketing channel to Southern Africa because of the excellent infrastructure in SA and the existence of the requisite skills to provide product support services to prospective buyers. There will therefore be some relationship between imports and exports.

4. SOUTH AFRICAN TRADE IN HIGH TECHNOLOGY PRODUCTS

A. Derivation of the Data

The South African data on high technology product trade was calculated using the methodology of the US Bureau of the Census. A list of internationally standard Harmonised System (HS) codes was obtained for each of the ten technology fields considered high technology. As the product listings do change slightly over time, the 1995 listing was obtained from the US Bureau of the Census. These HS codes were then applied to the South African Customs and Excise data for the period 1991 to 1995. Although the codes obtained were at an extremely detailed ten-digit level, they were applied at the six-digit level to the South African data. This provided sufficient disaggregation to make the process worthwhile by eliminating the aggregation problems of the conventional methodology. As there were doubts over the accuracy of the data at a lower level of disaggregation, it did not seem useful to go to a lower level. Even at the six-digit level, the often used 'catch-all' category listed as 'other' occasionally had a significant proportion of the four-digit group. The only technological field where this level of detail was not followed was in 'Weapons'. Detailed Customs and Excise data for the weapons categories did not exist and so the aggregate volumes of trade in these products was taken from the Armscor Annual Report 1996. Customs and Excise data for the years prior to 1991 was only obtainable at the four-digit level to keep trade secrecy in the sanctions era which made the exercise for that period futile.

The complete listing of HS codes used appears in appendix one along with a description and the high technology product category. Also included is those sub-categories of each four-digit group that were excluded from being

listed as high technology products. Closer scrutiny of the exclusions at a six-digit level demonstrate the potential usefulness of this methodology. Some examples are:

- Nuclear - the HS code 2844 is listed as containing 'Radioactive chemical elements and radioactive isotopes and their compounds' yet it includes natural uranium and spent fuel elements of nuclear reactors - products which are not high tech.
- Computer Integrated Manufacturing - all HS codes for machine tools at the four-digit level contain both high tech computer numerically controlled (CNC) machines and the older, lower tech, non-CNC machines.
- Computers - the HS code 8470 includes the high tech point-of-sale terminal cash registers along with lower tech calculators, postage-franking machines and non-computerised cash registers.
- Telecommunications - the HS code 8544 includes the high tech optical fibre cable along with every other type of low tech insulated wire cable.
- Life Sciences - the HS code 9018 covers 'Instruments and appliances used in medical, surgical, dental or veterinary sciences' which includes low tech items such as syringes and needles.

Aside from tracking the volumes and trends of South Africa's trade in high technology products, the calculation of South Africa's high technology trade using this methodology also permitted one to compare the results with the conventional measurement approach. This could then expose what proportion of our trade in high technology sectors was in fact high technology products and not low technology products. To make the calculation for the conventional approach, the FRD definition of high tech sectors was taken[12].These included aerospace, pharmaceuticals, electrical equipment, electronics, data processing and office equipment and scientific instruments. It is noticeable that there is considerable overlap between these categories and the 'technology fields' of the US Bureau of the Census approach. The exception is the exclusion of weapons, which was added to the listing for the purpose of comparison. The overall volumes of trade was calculated by assigning Standard Industrial Classification (SIC) codes to each sector and then taking the total trade figures for each SIC code. These are already calculated by the CSS and presented in the South African Customs and Excise Trade Statistics for each year. Appendix two contains the assigned SIC codes for each high tech sector. For the weapons sector, the same Armscor information was used. This did not pose a problem as it was already aggregated and did not exclude lower tech products.

It should be noted that although all attempts have been made to ensure that the process has been as accurate as possible, it is still open to problems. First, experts will disagree over the classification of products according to the US Bureau of the Census methodology or the implications of calculations at only the six-digit level. Second, the trade data from customs and excise may be inaccurate in terms of value and classification. Third, the comparison with the conventional trade measure may suffer from an imperfect overlap in categories. Noting these potential areas of dispute, the paper proceeds to present and analyse levels and trends in the data. The full base data for all categories for all years is contained in appendix two. Note that dollar values have been used throughout in order to correct for exchange rate movements.

B. An Overview of South Africa's Trade in High Technology Products

As to be expected, South Africa has a large trade imbalance in high technology products (HTPs). Table 1 reveals that in 1995 exports of HTPs reached only $784.5 million while imports amassed to $4,531.9m. The resulting trade

[12] See FRD Science and Technology Indicators 1995, pg. 75

deficit of $3,747.4m was in stark contrast to a positive overall trade balance of $1,495.1m in that year. Noticeable too is the fact that in 1995 HTPs made up only 2.8% of total exports while they accounted for 16.9% of total imports. This difference expressed itself as an import-to-export ratio of 5.8 to 1. Although an imbalance in trade in HTPs is to be expected[13], what is surprising is the poor export performance considering the depth of technological knowledge that does exist in the economy. This is in contrast to countries like Malaysia and India which lack some of South Africa's expertise yet outperform the country in high tech exports. One can put forward a number of possibilities in this regard. First, the inward orientation of the economy prior to some trade liberalisation around 1994, created through over-valued exchange rates and tariff walls, served to distort incentives towards the domestic market. Second, in many high technology products where economies of scale are important, the domestic market was too narrow to make production feasible (e.g. computer hardware). Third, in some high tech sectors the local market is very significant which means that the limited number of local producers did not need to seek out export markets in order to grow (e.g. defence and software)[14]. Fourth, the high tech sectors in South Africa are, with the exception of defence, largely dominated by multinationals whose primary interest is in the local market and not exports. This extends to technology licensing from abroad where restrictive clauses on exports are common. Fifth, although South Africa has significant technological capabilities, these are not widespread throughout the population which hinders mass production of these HTPs. Lastly, the continued profitability of lower technology sectors under a protective regime has limited the amount of local capital that has been attracted to the high technology fields and hence limited local production.

Table 1: Dollar value of HTPs and their share of total trade (1991-1995)

	1991	**1992**	**1993**	**1994**	**1995**
Exports ($m)	489.9	420.6	579.2	602.2	784.5
Imports ($m)	3,160.3	3,019.1	3,193.8	3,764.0	4,531.9
Trade Balance ($m)	-2,670.4	-2,598.4	-2,614.6	-3,161.8	-3,747.4
Export Growth (annual)	na	-14.1	37.7	4.0	30.3
Import Growth (annual)	na	-4.5	5.8	17.9	20.4
Deficit growth	na	-2.7	0.6	20.9	18.5
Exports as a % of Imports	15.5	13.9	18.1	16.0	17.3
HTPs as a % of total Exports	2.1	1.8	2.4	2.4	2.8
HTPs as a % of total Imports	18.1	16.4	17.7	17.7	16.9

[13] South Africa's comparative disadvantage in technology-intensive products was proved by both Moura Rouge (1984) and Scerri (1990) using a factor-proportions trade model.

[14] The lack of a significant local market has been put forward as a reason why India has developed such a substantial export market in software. The logic is that exports were a necessary outlet for software personnel in the country as their own country lagged behind.

Source: South African Customs & Excise Trade Statistics & Armscor Annual Report 1996

However, the country is undergoing a transition which extends into the economy. Trade liberalisation began to take place in 1994 and continues apace. It is therefore interesting to understand what are the current trends in the export and import of HTPs, what impact has trade liberalisation had on South Africa's performance in these products, and what proportion of SA's trade in high technology sectors is in fact in HTPs and not low technology products.

What are the trends? The data does reveal that South Africa's trade performance in HTPs is improving slightly. Exports have grown at an average rate of 11.8% for the period 1991 to 1995, which is well above the average annual growth in imports of 9.0% and significantly better than the average annual growth in all exports of 4.8% for the same period. In fact in 1993 and 1995 the growth rate on the previous year was over 30%. This has meant that the ratio of exports to imports has improved slightly from exports representing only 15.5% of imports in 1991 to 17.3% in 1995. Exports of HTPs has also increased from 2.1% of total exports to 2.8% while imports of HTPs has seen their proportion of total imports actually fall from 18.1% in 1991 to 16.9% in 1995. These movements are positive and point to improvements in South Africa's competitiveness in HTPs in terms of both exports and production for the domestic market. To understand what is causing exports of HTPs to start growing at these speeds, one need only look at the changes in the economy that have eliminated some of the previous barriers. The move towards a more export orientated trade stance through the dropping of tariffs and the revaluation of the Rand have provided a definite incentive for local producers to enter the export market. The end of sanctions has also made this path a little easier to follow now. This change has been reinforced by changes in the domestic market for two large high tech sectors - defence and telecommunications. The dramatic drop in the defence budget forced weapons producers to look elsewhere in order to survive while the phasing out of exclusive long term supply contracts by Telkom has had a similar effect on local telecommunications equipment manufacturers. In terms of resource allocation, capital has started to leave some of the lower technology sectors whose profitability has taken a severe knock from rising global competition. Much of it has moved to the high tech sector - a trend noticeable in the performance of the JSE technology stock index. Finally, the high tech products have also become more cost competitive in the international market with the assistance of export incentives under the General Export Incentive Scheme (GEIS). This is being phased out and it would be interesting to examine the change in export performance once these are removed completely. However, to keep it all in perspective, the improvements in exports have been off a low base, which means that the trade deficit in HTPs has still mushroomed at an average rate of 8.5% per annum since 1991.

Despite the favourable overall trend over the 1991-1995 period, one needs to take a close look at the last two years under study and decide what has been the impact of trade liberalisation on trade in HTPs by South Africa. The experience of other developing countries is that opening up the economy leads to a retrogression to more traditional areas of comparative advantage. Therefore, one would expect that imports of HTPs would increase significantly which in fact they did. From 1991 to 1993 imports barely changed growing at an average of only 0.5%, but then they take off in 1994 and 1995 growing at 17.9% and 20.4% respectively. However, separating the impact of trade liberalisation from both a general upswing in the economy and political reform is difficult. In fact, one may question whether trade liberalisation has been significant at all. This is because a) numerous high technology products were

always subject to low tariffs on the understanding that local production may not take place anyway[15], and b) much of the restrictions on imports were non-trade barriers, especially the favouring of local supply in government procurement which was significant in telecommunications, energy, defence and pharmaceuticals. This perspective is supported by the fact that imports in general grew by 17.8% in 1994 and 26% in 1995 - rates higher than the growth in HTP imports. Equally significant, the issuing of two cellular network licenses in 1994 saw imports of telecommunications equipment rise from $246.7m in 1993 to $581.5m in 1994 and $681.3m in 1995 as large amounts of transmission equipment and phones were imported to establish the network. This represented 59% of the increase in HTP imports from 1993 to 1994 yet only 13% of the increase in imports from 1994 to 1995. To conclude, one might tentatively argue that trade liberalisation may not have been that significant in high tech sectors and therefore has not had a significant negative impact on South Africa's trade performance in HTPs. Alternatively, it may be too early in the liberalisation process to be seeing any significant import penetration.

What about South Africa's trade in low technology products (LTPs) within high technology sectors? Table 2 outlines South Africa's trade in LTPs and its proportion of total high tech sector trade. In terms of overall levels, South Africa runs a significant trade deficit in LTPs, but one which has remained more or less stagnant from 1991 to 1995. Exports of LTPs were 17.7% of imports in 1995, which is a similar proportion to HTPs. Closer examination of the proportion of total high technology sector trade reveals, interestingly enough, that LTPs make up only around 20% of total exports and imports in the high tech sectors in 1995. To put this in perspective, in 1988 in the US, LTPs made up 49.7% of imports in high technology sectors and 30.3% of exports[16]. One would expect a lower wage country like South Africa to perform relatively better than the US in the low technology end of the sector where wages rather than technological capability is a greater driver of competitiveness. This relative (and not absolute) advantage is reflected in a lower import percentage in LTPs for South Africa which should demonstrate that local producers are more competitive in LTPs than in HTPs in the high technology sectors. However on the export side, one would expect a greater proportion of exports being LTPs in South Africa in line with the country's comparative advantage. The poor performance may just be a symptom of the general under-achievement of South African producers in the high technology fields discussed above, or it could possibly reflect our competitive disadvantage with respect to other developing countries who have also entered these LTPs. Of particular significance may be the first and second tier Asian NICs which have entered the high tech sectors like South Africa but with considerably more export success in the mass electronics products which make up much of the LTPs in the high tech sectors[17]. The concluding scenario is similar to the one painted by Krugman (1982) presented earlier where the technologically stagnant countries get squeezed from both ends of the spectrum - losing out to the higher wage countries through a growing technology gap and losing out to the lower wage countries through a shrinking technology gap.

Table 2: Value of LTPs in high technology sectors and their share of total high tech sector trade (1991-1995)

	1991	**1992**	**1993**	**1994**	**1995**

15 Some examples include computer numerically controlled machine tools which have been subject to a zero tariff since the 1980's and computer hardware which averaged a tariff of only 15% in the 1980s and was dropped to 6% before general liberalisation. See Hodge & Miller (1997)

16 Calculated from data presented in Abbott et al (1989). No such similar data is available for other countries.

17 The first tier Asian NICs include Hong Kong, South Korea, Singapore and Taiwan Province of China while the second tier includes Malaysia, Thailand and Indonesia.

Exports ($m)	121.8	161.5	181.2	199.1	204.5
Imports ($m)	1,228.0	1,173.0	1,243.9	1,621.3	1,152.5
Trade Balance ($m)	-1,106.2	-1,011.5	-1,062.7	-1,422.2	-948.0
Export Growth		32.6	12.2	9.9	2.7
Import Growth		-4.5	6.1	30.3	-28.9
Deficit growth		-8.6	5.1	33.8	-33.3
Exports as a % of Imports	9.9	13.8	14.6	12.3	17.7
LTPs as a % of total high tech sector exports	19.9	27.7	23.8	24.8	20.7
LTPs as a % of total high tech sector imports	28	28	28	30.1	20.3

Source: South African Customs & Excise Trade Statistics & Armscor Annual Report 1996

However, changes in the economy have also had an impact on South Africa's trade in LTPs within high technology sectors, so it is important to uncover the trends in the data. Taking the period 1991 to 1995, the trend is even more positive than South Africa's trade in HTPs. Exports of LTPs have grown at an average annual rate of 12.9%, considerably more than imports which have in fact shrunk between 1991 and 1995 by an average of 1.6% per annum. This means that the deficit on the LTP trade has actually been shrinking at an average rate of 3.9% per annum since 1991. The difference in growth rates has also allowed exports to increase as a percentage of imports from 9.9% in 1991 to 17.7% in 1995. These trends would therefore suggest that South Africa is in fact becoming more competitive in the LTPs within the high technology sectors - a view supported by the dropping share of LTPs in total imports in high technology sectors from 28% in 1991 to 20.3% in 1995. This may suggest that the previous problem lay more in skewed incentive structure of the past rather than a lack of technological capability and uncompetitive wages. The changing of incentives which promoted greater investment into high technology sectors and an outward-orientated stance appear to have brought a turnaround. The trade liberalisation appears to have had a significant impact on imports in 1994 where they rose 30.3% on the previous year, but this appears to have been temporary as they shrunk back below their previous level the following year. Therefore, similar to HTPs, one must conclude that trade liberalisation has not had a visible negative impact on the LTP industry because the benefits from adjusting the domestic incentive structure outweighed the increases in competitive pressure.

C. Product Perspective

A high level perspective provides the necessary basis for a more detailed product analysis of trade in high technology products. This exercise should expose the relative strengths and weaknesses of the South African economy within the range of HTPs. Unfortunately, because there was no exact overlap in the product categories for the different methods of measuring high tech trade, the derivation of the proportion of low technology products in high tech sectors is not possible. The data here therefore reflects only the trade in HTPs as defined by the US Bureau of the Census method. The first step in the analysis is to perform a trade share analysis of HTPs. However, before embarking on such an exercise, one must recognise the limitations of such an analysis. The shares of different

products in total trade reflects not only the relative strengths and weaknesses of South Africa but also the strong influence of the product structure of local and world demand for HTPs. Analysis may therefore be limited to understanding which products account for much of our trade and so which should be targeted by policy-makers for development. Table 3 provides an inter-temporal analysis of the shares of each HTP category in total trade in HTPs.

The shares of imports of HTPs reveal that computer and telecommunication products accounted for almost half of South Africa's total imports of HTPs in 1995. Not only is the share of ICTs high, but it has increased rapidly from only 34.2% of total imports in 1991. However, when analysing these figures it should be noted that the introduction of cellular networks has had a large short term impact on HTP imports which may not be sustained. Either way, it seems that the development of this sector locally would appear to be a priority for the government if it intends curbing growing imports in HTPs. The only other products with significant shares are the life sciences (15.3%), aerospace (13.3%) and electronics (8.9%). However, these shares have remained relatively stable between 1991 to 1995 with the exception of aerospace which saw its share drop considerably from 22.9% in 1991. Yet one expects volatility in aerospace imports as it often contains major items such as completely built-up aircraft which impact heavily on the trade level and which are ordered sporadically. Significantly, the share of weapons is very low (at 3.9%) and dropping (from 10.6% in 1991), which appears out of line with its expected share in the structure of demand, suggesting a relative strength for South Africa. The share analysis of exports supports this hypothesis as weapons account for the largest portion of HTP exports at 36.5%. A healthy trend, however, is the decline of its dominance of HTP exports from a level of 58.8% in 1991. The pattern of trade in 1995 shows a far more balanced product structure with high and growing shares for computers and telecommunications (20.9%), aerospace (17.7%), life sciences (7.8%) and computer integrated manufacturing (7.2%). The diversification of exports demonstrates a relatively widespread technological capability in South Africa and is a trend that should be encouraged by the policy-makers. It is also noticeable that the leading sectors in both exports and imports is similar, implying that the structure of local and world demand for HTPs is dominated by computers and telecommunications, life sciences, aerospace and weapons. An unexpected exclusion from this list is electronics. This may be because either South Africa has a significant local industry which is able to keep out significant imports yet is unable to export competitively, or much of the electronics products are categorised in other technological fields or as low technology products.

Table 3: Share of each HTP in total trade in HTPs (1991 & 1995)

Category	**Imports**		**Exports**	
	1991	**1995**	**1991**	**1995**
Biotechnology	1.2	1.3	1.2	0.9

Life Science	15.9	15.3	5.3	7.8
Opto-Electronic	2.3	1.9	2.4	1.9
Computers and Telecommunications	34.2	48.1	17.0	20.9
Electronics	6.2	8.9	2.0	4.8
Computer Integrated Manufacturing	5.6	6.2	5.5	7.2
Material Design	0.1	0.2	0.1	0.5
Aerospace	22.9	13.3	7.8	17.7
Weapons	10.6	3.9	58.8	36.5
Nuclear Technology	0.9	1.0	0.00	1.7
Total HTPs	**100.0**	**100.0**	**100.0**	**100.0**

Source: South African Customs & Excise Trade Statistics & Armscor Annual Report 1996

Although trade share analysis is limited in the range of conclusions one can draw on competitiveness, one can complement this with a comparison of export-import ratios for each HTP category and the resulting trade balance. Table 4 contains such data and also includes the actual dollar values of trade and its growth rates to detect trends for each HTP. These reveal some interesting trends in South African HTP trade. The most striking thing is the lack of competitiveness in computer and telecommunication products which is somewhat worrying for the country. The total trade deficit in these products accounted for 53.8% of the total trade deficit in HTPs. Further, in 1995 the ratios of exports to imports, at 7.5%, was the lowest of all HTP categories. It was also one of only two sectors (the other being biotechnology) that experienced an actual decline in the export-import ratio since 1991. As for the future, the growth rate of imports at a 17.5% per annum average from 1991 to 1995, was significantly above the average for all HTPs at 9.0%. The expansion of the telecommunications network nationally and the increasing computerisation of the South African society will ensure that these trends continue and one can therefore expect continued growth in the trade deficit in ICTs. The other big contributors to the overall trade deficit in HTPs are life sciences (16.9% of the deficit), aerospace (12.4%), electronics (9.7%) and computer integrated manufacturing (5.9%). However, unlike the trade in computers and telecommunications products, all these product categories are all experiencing growth in exports that outstrips their growth in imports. Although it does not follow that the absolute size of each deficit will decrease, it at least implies that inroads are being made in terms of competitiveness in these product groupings.

Table 4: Value, balance of trade and growth rates in each HTP category (1995)

Category	Export Value ($m)	Import Value ($m)	Trade Balance ($m)	Exports as a % of Imports (1991)	Exports as a % of Imports (1995)	Average export growth rate (1991-1995)	Average import growth rate (1991-1995)
Biotechnology	6.9	59.1	-52.2	14.5	11.7	4.9	10.3
Life Science	61.4	695.2	-633.8	5.2	8.8	21.4	8.1
Opto-Electronic	14.6	86.2	-71.7	16.6	16.9	5.0	4.5
Computers and Telecommunications	164.3	2,179.7	-2,015.4	7.7	7.5	17.0	17.5
Electronics	37.9	403.1	-365.2	5.0	9.4	33.9	18.2
Computer Integrated Manufacturing	56.8	278.7	-221.9	15.0	20.4	18.8	11.3
Material Design	3.9	9.5	-5.6	8.7	41.0	65.3	26.5
Aerospace	138.8	603.1	-464.4	5.3	23.0	32.2	-4.6
Weapons	286.6	174.4	112.2	85.6	164.3	-0.1	-16.4
Nuclear Technology	13.4	42.9	-29.5	0.5	31.3	112.0	9.3
Total HTPs	784.5	4,531.9	-3,747.4	15.5	17.3	11.8	9.0

Source: South African Customs & Excise Trade Statistics & Armscor Annual Report 1996

On a more positive note, South Africa does have a positive trade balance in weapons where in 1995 South African exports represented 164% of the value of imports. However, how this may move in the future is difficult to determine. This is one sector which has experienced a decline in both imports and exports since 1995. However, exports were restricted by the protracted Armscor legal battle in the US and imports are expected to increase significantly in the near future as the Defence force shops around for equipment to upgrade the force. One would therefore expect both imports and exports to increase with an indeterminate impact on the overall balance. The other sectors with reasonably high export to import ratios are material design (41.0%) and nuclear technology (31.3%). However, absolute trade levels in both are insignificant and so are unlikely to have a major impact on trade levels either way.

D. Regional Perspective

An analysis of the regional shares of South African imports and exports of HTPs is of interest both from understanding where the country sources its imported technology, but also in assessing which export markets are currently important and which have possibly been neglected. Table 5 contains the share of each major region in the import and export of each category of HTP. This detailed analysis was only performed for 1995 and so analysis of inter-temporal shifts in trade shares is not possible. Also, as only aggregate data for weapons was available, no regional shares are calculated for this HTP category. Concentrating on HTP imports, it is not so surprising that Europe accounts for the lion's share (53.8%) of South African imports. This dominance is a reflection of a) the fact that Europe is a major producer of technology internationally, b) the historical links between Europe and South

Africa, and c) the common arrangement amongst multinationals to service Africa from a European base. It is also unsurprising that Africa and Oceania contribute little to technology imports (1.1% and 1.2% respectively), the former because of a dearth of high tech expertise and the latter because of the small number of countries in the region. Asia and the Americas account for similar amounts of total imports, both contributing 19%. It is interesting to compare the share of South African high technology imports to the share of total South African imports for each region as it reveals the relative comparative advantages of each region between low and high tech products. For example, only the industrialised regions of Europe and Americas have a greater share of high tech imports relative to total imports. This demonstrates a comparative advantage in high tech products relative to lower technology products. The opposite holds for the other three regions. A closer look at imports of individual product categories reveals quite clearly the differing regional specialisations. The highest shares by Asia are all in microelectronics fields, namely electronics (37.4%), computers and telecommunications (26%) and computer integrated manufacturing (20.4%). The Americas performs particularly well in aerospace (40.5%), opto-electronics (28.1%) and biotechnology (23.5%). Europe showed exceptional strength in nuclear technology (91.9%), life sciences (72.5%), material design (70.6%) and biotechnology(67.2%).

Table 5: Share of each region in trade of each HTP category (1995)

Category	**Imports**					**Exports**				
	Africa	**Europe**	**Americas**	**Asia**	**Oceania**	**Africa**	**Europe**	**Americas**	**Asia**	**Oceania**
Biotechnology	0.2	67.2	23.5	6.2	1.1	78.4	6.2	2.2	0.0	0.0
Life Science	0.1	72.5	16.3	7.4	2.0	39.4	28.3	11.8	5.9	1.7
Opto-Electronic	0.7	54.2	28.1	10.6	0.6	19.6	34.3	18.0	6.4	1.7
Computers and Telecommunications	0.1	51.1	15.5	26.0	1.4	33.3	43.2	9.0	7.1	1.3
Electronics	0.0	44.4	15.5	37.4	0.8	23.7	40.2	10.8	14.6	0.0
Computer Integrated Manufacturing	0.2	60.8	14.9	20.4	0.7	29.1	12.9	21.8	18.1	5.5
Material Design	3.7	70.6	14.0	3.3	0.0	4.8	65.0	3.5	8.7	0.0
Aerospace	7.3	40.8	40.5	4.1	0.0	10.2	47.3	25.3	8.6	7.1
Nuclear Technology	0.0	91.9	7.3	0.7	0.0	0.7	96.2	0.0	0.6	0.0
Total HTPs	**1.1**	**53.8**	**19.3**	**19.8**	**1.2**	**25.5**	**39.6**	**15.4**	**8.9**	**3.3**
Total Trade	**3.0**	**49.0**	**15.7**	**30.6**	**1.9**	**18.9**	**42.4**	**10.4**	**26.8**	**1.6**

Source: South African Customs & Excise Trade Statistics & Armscor Annual Report 1996

Europe is not just the primary HTP exporter to South Africa, it is also the largest market for South African HTP exports. Again one can cite historical links as playing a major role in South Africa developing these markets first, but it is also a reflection of mere size of the European demand for high technology products. In contrast the demand for HTPs in the rest of Africa is not significant, but South Africa has a definite competitive advantage in servicing sub-Saharan Africa based on geographical proximity. Not only does South Africa have greater technological capabilities than its neighbours[18], but as many high technology products require extensive servicing along with their sale, the ability of the country to provide quick backup services can be a key factor in picking a supplier. This is why many of the multinationals are using South Africa as a base to service this market. The worrying factor is that much of these exports are re-exports of imports to a South African distribution point. This is evident in the computer hardware and software industries where minimal value-added is performed. The importance of the multinational factor is possibly evident from the large share of Africa in exports from two large sectors where multinationals play a key role in South Africa - namely life sciences (39.4% of total exports) and computers and telecommunications (33.3%). The one region where South Africa appears to have performed badly is Asia. Although Asia represents 26.8% of total South African exports, it accounts for only 8.9% of HTP exports. As this is currently the most dynamic growth region in the world, it is a market that South Africa would like to enter to bolster exports.

Another interesting perspective on South Africa's HTP trade, is the product breakdown for total HTP trade with each region. Table 6 provides this breakdown for both imports and exports. The trends are similar to those already gleaned from the product share analysis. For Africa, aerospace makes up over 90% of their exports to South Africa. This may be surprising but considering the low absolute level of HTP exports to South Africa (a total of R172m only), any share analysis would appear meaningless. The majority of imports come from computers and telecommunications (43%) and the life sciences (19.1%) - sectors where multinationals are particularly active. Imports from Europe are concentrated in life sciences (21.5%) and computers and telecommunications (47.5%) while exports to the region are significant in aerospace (33.2%) and computers and telecommunications (36%). For the Americas, aerospace and computers and telecommunications make up the two most significant shares of both imports and exports, while in Asia imports and exports are again dominated by microelectronics products. A large proportion of Asian imports of South African HTPs is in aerospace, a similar scenario to Oceania where almost 60% of imports from SA are in aerospace.

Table 6: Share of each HTP in total trade of HTPs per region (1995)

	Africa		**Europe**		**Americas**		**Asia**		**Oceania**	
Category	**Imports**	**Exports**	**Imports**	**Exports**	**Imports**	**Exports**	**Imports**	**Exports**	**Imports**	**Exports**
Biotechnology	0.3	4.3	1.7	0.2	1.7	0.2	0.4	0.0	1.2	0.0
Life Science	1.0	19.1	21.5	8.8	13.4	9.5	5.9	8.2	26.6	6.2
Opto-Electronic	1.3	2.3	2.0	2.5	2.9	3.4	1.1	2.1	0.9	1.5
Computers and Telecommunications	3.1	43.0	47.5	36.0	40.2	19.4	65.6	26.2	61.0	13.4
Electronics	0.3	7.1	7.6	7.7	7.4	5.3	17.5	12.5	6.2	0.0

[18] This is evident from the greater share of South African exports to Africa in HTPs (25.5%) than in all other products (18.9%).

Computer Integrated Manufacturing	0.9	13.0	7.2	3.7	4.9	16.1	6.6	23.2	3.9	19.0
Material Design	0.7	0.2	0.3	1.3	0.2	0.2	0.0	0.8	0.0	0.0
Aerospace	92.3	11.2	10.5	33.2	29.0	45.9	2.8	26.9	0.2	59.9
Nuclear Technology	0.0	0.1	1.7	6.6	0.4	0.0	0.0	0.2	0.0	0.0
Total HTPs	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
HTPs as a % of total trade	6.0	2.4	17.9	1.7	20.2	2.6	10.5	0.6	10.3	3.6

Source: South African Customs & Excise Trade Statistics & Armscor Annual Report 1996

5. CONCLUDING REMARKS

The derivation of South African trade figures based on the methodology developed by the US Bureau of the Census, should hopefully provide accurate data on trade in high technology products and overcome problems of including low technology products from high technology sectors which may mislead policy-makers. What the figures do reveal is that South Africa seems to have developed export markets in high tech sectors based on high tech products and not low tech ones - a sign that technological capabilities and not low wages lie behind SA's growing competitiveness in these sectors. However, South Africa does have a large trade deficit in HTPs which is slowly changing as some of the previous impediments to growth are removed and technological capabilities improve. Where South Africa does demonstrate definite international competitiveness is in the weapons trade, the only sector where the country has a positive trade balance. This represents a successful implementation of infant industry protection even if the reasoning behind its implementation was concerned with the sustainability of apartheid. This is an important lesson for policy-makers currently devising strategies around industrial development and the building science and technology capacity in South Africa. A closer examination of the success factors in defence may be needed. The sector that poses the biggest concern is the rapidly growing computers and telecommunications sector. Yet the recent launch of an information technology industrial strategy process for the country should at least focus government attempts to address this burgeoning deficit. Similar strategies need to emerge to improve the size and competitiveness of other high technology sectors because South Africa needs to move significantly into the export of high technology products if it is to avoid losing its trade competitiveness from either lower wage countries closing the technological gap or from shifts in the world structure of demand. The urgency of this move is open for debate, but its inevitability is not.

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Appendix 1

High Tech Products classified according to the Harmonised System at a Six-Digit Level

4 Digit HS Code	Sub-category	HS Code Description	HTP Category
2844		Radioactive chemical elements and radioactive isotopes and their compounds; mixtures and residues containing these products	
including	20	Uranium enriched in U235 and its compounds; Plutonium and its compounds	
	30	Uranium depleted in U235 and its compounds; Thorium and its compounds	
	40	Radioactive elements & isotopes & compounds	
excluding	10	Natural uranium and its compounds	
	50	Spent fuel elements of nuclear reactors	
2845		Isotopes (excluding those of 28.44); compounds, inorganic or organic, of such isotopes	02
including	90	Isotopes (excluding those of 28.44); compounds, inorganic or organic, of such isotopes	
excluding	10	Heavy water	
2914		Ketones and quinones and their derivatives	02
including	69	Quinone drugs	
excluding	(10-50)	Ketones	
	60	Qunione	
	70	Derivatives	
2918		Carboxylic acids and their derivatives	02
including	90	Other (aromatic drugs)	
excluding	10	Carboxylic acids with alcohol function	
	20	Carboxylic acids with phenol function	
	30	Carboxylic acids with aldehyde or keton function	
2921		Amine-function compounds	02
including	49	Aromatic monoamine drugs	
	59	Aromatic polyamine drugs	
excluding	10	Acyclic monoamines and their derivatives	
	20	Acyclic polyamines and their derivatives	
	30	Cyclanic mono-or poly-amines and their derivatives	
	40-50	Aromatic mono- and polyamine and their derivatives	
2922		Oxygen-function amino-compounds	02

including	19	Amino-alcohol drugs	
	29	Amino-naphthols and amino-phenol drugs	
	49	Aromatic amino-acids used as drugs	
	50	Other amino-compound drugs (e.g. aromatic cardiovascular drugs)	
excluding	(10-40)		
2924		Amide-function compounds of carbonic acid	02
including	29	Other aromatic cyclic amides used as drugs	
excluding	all (10-20)		
2928		Organic derivatives of hydrazine or of hydroxylamine	02
including	all (00)	Used as drugs	
2930		Organo-sulphur compounds	02
including	90	Other (non-aromatic organo-sulphur compounds used as drugs	
excluding	10	Dithiocarbonates	
	20	Thiocarbamates	
	30	Thiuram mono-, di- or tetra-sulphides	
	40	Methionine	
2931		Other organo-inorganic compounds	02
including	all (00)	Used as drugs	
2932		Heterocyclic compounds with oxygenhetero-atoms only	02
including	19	Aromatic compounds containing an unfused Furan ring used as drugs	
	29	Aromatic lactones used as drugs	
	90	Other (e.g. isosafrole, aromatic pesticides, etc)	
excluding	(10,20)		
2933		Heterocyclic compounds with nitrogenhetero-atoms only; nucleic acids and their derivatives	02
including	19	Aromatic drugs containing an unfused pyrazole ring	
	29	Aromatic drugs containing an unfused imidazol ring	
	39	Antidepressants, tranquilisers and other aromatic drugs containing an unfused pyridin ring	
	40	Drugs containing a quinoline or isoquinolinne ring	
	59	Antihistamines, antinauseants and other drugs containing a pyrimidine ring	
	90	Other drugs (e.g. anti-infective drugs, anti-pyretics, anticonvulsants, sedatives, etc)	
excluding	60	Compounds containing an unfused triazin ring	
	70	Lactams	
2934		Other heterocyclic compounds	02

including	30	Compounds containing a phenothiazin ring	
	90	Other	
excluding	10	Compounds containing an unfused Thiazol ring	
	20	Compounds containing a benzothiazole ring	
2937		Hormones, natural or reproduced by synthesis, and their derivatives	01
including	10	Pituitary or similar hormones and their derivatives	
	90	Other hormones and their derivatives (e.g. estrogens, steroids)	
excluding	20	Adrenal cortial hormones and their derivatives	
2940		Sugars, chemically pure; sugar ethers and sugar esters, and their salts	01
including	all (00)		
3002		Human blood; animal blood prepared for therapeutic, prophylactic or diagnostic uses; antisera and other blood fractions; vaccines, toxins, cultures of micro-organisms and similar products.	01
including	all (10-30,90)		
3004		Medicaments consisting of mixed or unmixed products for therapeutic or prophylactic uses	02
including	90	Other	
excluding	10	Containing penicillins or derivatives thereof	
	20	Pills containing tetracyclines or their derivatives	
	30	Other containing tetracyclines or their derivatives	
	40	Containing alkaloids or derivatives thereof	
	50	Other medicaments containing vitamins	
3818		Chemical elements and compounds doped for use in electronics	07
including	all (00)		
8401		Nuclear reactors; fuel elements for nuclear reactors; machinery and apparatus for isotopic seperation	10
including	all (10-50)		
8411		Turbo-jets, turbo-propellers and other gas turbines	08
including	all (10,20,80,90)		
8412		Other engines and motors	08
including	10	Aircraft engines	
excluding	20	Hydraulic power engines	
	30	Pneumatic power engines	
	80	Other	
	90	Parts	
8424		Mechanical appliances for projecting, dispersing or spraying liquids or powders	06
including	89.30.	Spraying appliances used in semiconductor manufacture	

	89.90.	Other	
excluding	all (10-30,80,90)	Includes fire estinquishers, spray guns, etc	
8427		Fork-lift trucks; other works trucks fitted with lifting or handling equipment	06
including	10.80.60	Automatic guided vehicles	
	10.90.	Other	
	20.90.	Other	
	90.90.	Other	
excluding	all (10,20,90)		
8428		Other lifting, handling, loading or unloading machinery (e.g. lifts, escalators)	06
including	90.00.10	Industrial robots for lifting,handling, loading, unloading	
	90.90.	Other	
excluding	all (10-60,90)		
8456		Machine-tools for working any material by laser or other light or photon beam	06
including	all (10-30,90)		
8457		Machining centres, unit construction machines and multi-station transfer machines for working metal	06
including	all (10-30)		
8458		Lathes for removing metal	06
including	11	Numerically controlled horizontal lathes	
	91	Other numerically controlled lathes	
excluding	all (10,90)		
8459		Machine-tools for drilling, boring, milling,threading or tapping metal	06
including	10	Way type unit head machines	
	21	Other numerically controlled drilling machines	
	31	Otther numerically controlled boring-milling machines	
	40	Othe boring machines	
	51	Numerically controlled milling machines	
	61	Othe numerically controlled milling machines	
	70	Other threading or tapping machines	
excluding	(20,30,50,60)		
8460		Machine-tools for deburring, sharpening, grinding, honing, lapping, polishing or otherwise finishing metal	06
including	11	Numerically controlled flat surface grinding machines	
	21	Other numerically controlled grinding machines	
	31	Numerically controlled sharpening machines	

	40	Honing or lapping machines	
	71	Other numerically controlled	
	90	Other	
excluding	10-30,70		
8461		Machine-tools for planing, shaping, slotting, broaching, gear cutting, gear grinding or gear finishing, sawing, cutting-off and other not specified elsewhere	06
including	all (10-50,90)		
8462		Machine-tools for working metal by forging, hammering or die-stamping	06
	10	Forging or die-stamping machines	
	21	Numerically controlled bending, folding, straightening machines	
	31	Numerically controlled shearing machines	
	41	Numerically controlled punching or notching machines	
	71	Other numerically controlled	
	91	Hydraulic presses	
	99	Other	
including	all (20-40,70,90)		
8464		Machine-tools for working stone, ceramics, concrete, asbestos-cement or like mineral materials	06
including	all (10,20,90)		
8470		Calculating machines, accounting machines, postage-franking machines, ticket-issuing machines and similar machines	04
including	50	Point-of-sale terminal type cash registers	
excluding	all (10-40,90)		
8471		Automatic data processing machines and units thereof	04
including	all (10-90)		
8473		Parts and accessories for machines under headings 84.69-84.72	04
including	30	Parts for heading 84.71	
	50	Other parts suitable for two of headings 84.69-84.71	
excluding	10	Parts for heading 84.69	
	20	Parts for heading 84.70	
	40	Parts for heading 84.72	
8479		Machines and mechanical appliances having individual functions not specified elsewhere	06
including	50	Industrial robots n.c.e.	
	89.85	Machines for semiconductor assembly	
	89.90.	Other	
	90.80.	Parts for industrial robots or semiconductor assembly	

	90.90.	Other	
excluding	10	Machinery for public works building	
	20	Machinery for extraction of animal fats	
	30	Presses	
	40	Rope or cable making machines	
	60	Evaporative air-coolers	
	80	Other machines and appliances	
	90	Parts	
8504		Electrical transformers, static converters and inductors	04
including	90	Parts	
excluding	10	Ballasts	
	20	Liquid dielectric transformers	
	30	Other transformers	
	40	Static converters	
	50	Other inductors	
8514		Industrial and laboratory electric furnaces and ovens	06
including	30	Other incl. laboratory furnaces and ovens	
excluding	all (10,20,40,90)		
8515		Electric, laser or other light or photon beam soldering, brazing or welding machines	06
including	20	Machines for resistence welding (21 - automatic)	
	30	Machines for arc welding (31 - automatic)	
excluding	10	Brazing or soldering machines	
	80	Other machines & apparatus	
	90	Parts	
8517		Electrical apparatus for line telephony or line telegraphy	04
including	all (10-50,80,90)		
8519		Turntables, record-players, cassette-players and other sound recording apparatus	04
including	99	Other (incl. compact disc players)	
excluding	all (10-40,90)		
8521		Video-recording or reproducing apparatus	04
including	all (10,90)		
8524		Records, tapes and other recorded media for sound	04
including	30	Discs for laser reading systems	
	40	Magnetic tapes for reproducing phenomena (excluding sound or image)	
	90	Other (e.g. prepackaged software)	

excluding	10	Gramaphone records	
	20	Magnetic tapes	
	50	Other magnetic tapes	
	60	Cards incorporating a magnetic strip	
8525		Transmission apparatus for radio-telephony, radio-telegraphy, radio-broadcasting or television	04
including	all (10-40,80,90)		
8526		Radar apparatus, radio navigational aid apparatus and radio remote control apparatus	04
including	all (10,70,90)		
8527		Reception apparatus for radio-telephony, radio-telegraphy or radio-broadcasting	04
including	90	Other (e.g. reception apparatus for radio communications)	
excluding	10	Radio-broadcast receivers without external source of power	
	20	Radio-broadcast receivers with external source of power	
	30	Other radio-broadcast receivers	
8528		Television receivers (incl. video monitors and video projectors)	04
including	all (10-30,90)		
8529		Parts for sections 85.25-85.28	04
including	90	Other	
excluding	10	Aerials	
8534		Printed circuits	05
including	all (00)		
8537		Boards, panels, consoles, etc equipped with two or more apparatus of heading 85.35-85.36	05
including	all (10,20,90)		
8540		Thermionic, cold cathode or photocathode valves or tubes	05
including	all (10-90)		
8541		Diodes, transistors and similar semi-conductor devices	05
including	all (10-60,90)		
8542		Electronic integrated circuits and microassemblies	05
including	all (10-50,80,90)		
8543		Electrical machines and apparatus, having individual functions, not specified elsewhere in this chapter	05
including	10	Particle accelerators	
	20	Signal generators	
	90.10.	Parts for particle accelerators	
excluding	30	Machines for electroplating, electrolysis or electrophoresis	

	40	Electric fence energisers	
	80	Other	
	90	Parts	
8544		Insulated wire cable (incl. co-axial cable), optical fibre cables	07
including	70	Optical fibre cable	
excluding	(10-60)	All other cable	
8802		Other aircraft, spacecraft (incl. satellites) and spacecraft launch vehicles	08
including	all (10-60)		
8803		Parts of goods under heading 88.01 or 88.02	08
including	all (10-30,90)		
8805		Aircraft launching gear; deck-arrester or similar gear; ground flying trainers	08
including	all (10,20)		
9001		Optical fibres and optical fibre bundles; optical fibre cables; polarising material; lenses	07
including	10	Optical fibres and optical fibre bundles; optical fibre cables	
	90	Other (lenses, prisms, mirrors unmounted)	
excluding	20	Sheets of polarising material	
	30	Contact lenses	
	40	Spectacle lenses made of glass	
	50	Spectacle lenses made of other material	
9002		Lenses, prisms, mirrors and other optical elements	03
including	all (10,20,90)		
9005		Binoculars, monoculars and other optical telescopes (incl astronomical)	03
including	10.00.20	Prism binoculars for use with infrared light	
	80	Other instruments (astronomical)	
	90	Parts	
excluding	10	Binoculars	
9006		Photographic cameras	02
including	61	Discharge lamp & flashlight	
excluding	(10-60,90)		
9007		Cinematographic cameras and projectors	07
including	90	Parts for cameras	
excluding	10	Cameras	
	20	Projectors	
9010		Apparatus and equipment for photographic laboratories	06

including	40	Apparatus for the projection or drawing of circuit patterns on sensitised semi-conductor materials	
excluding	10	Equipment for qutomatically developing photographic film	
	20	Other apparatus for photographic laboratories	
	30	Projection screens	
	50	Other apparatus for photographic laboratories	
	60	Projection screens	
	90	Parts & accesories	
9011		Compound optical microscopes	02
including	all (10,20,80,90)		
9012		Microscopes (excl. optical microscopes); diffraction apparatus	02
including	all (10,90)		
9013		Liquid crystal devices and other optical devices not included under other headings	09
including	all (10,20,80,90)		
9014		Navigational instruments and appliances	08
including	all (10,20,80,90)		
9015		Surveying, hydrographic, oceanographic, hydrological, meteorlogical and geophysical instruments and appliances	03
including	all (10-40,80,90)		
9017		Drawing, marking-out or mathematical calculating instruments (e.g. drafting machines)	06
including	20	Other drawing, marking out or mathematical calculating machines (e.g. pattern generating apparatus and hand input devices)	
excluding	10	Drafting tables and machines	
	30	Micrometers, callipers and gauges	
	80	Other	
	90	Parts & accessories	
9018		Instruments and appliances used in medical, surgical, dental or veterinary sciences	02
including	10	Electro-diagnostic apparatus	
	50	Other orthalmic instruments & appliances	
	90	Other (e.g. anesthetic instruments, optical instruments)	
excluding	20	Ultra-violet or infra-red apparatus	
	30	Syringes, needles, catheters, cannulae and the like	
	40	Other instruments used in dental sciences	
9019		Mechano-therapy appliances, massage apparatus, psychological aptitude testing apparatus, ozone therapy, oxygen therapy, aerosol therapy, artificial respiration or other therapeutic respiration apparatus	02

including	all (10,20,90)		
9021		Orthopaedic appliances	02
including	10	Artificial joints	
	30	Other artificial parts of the body	
	40	Hearing aids	
	50	Pacemakers	
	90	Otther (incl. parts)	
excluding	20	Artificial teeth and dental fittings	
9022		Apparatus based on the use of X-rays or of alpha beta or gamma radiations	02
including	all (10-30,90)		
9024		Machines and appliances for the testing of properties of materials	02
including	all (10,80,90)		
9027		Instruments and apparatus for physical or chemical analysis	02
including	20	Chromatographs and electrophoresis instruments	
	30	Spetrometers	
	50	Other apparatus using optical radiations	
	80	Other (e.g nuclear magnetic resonances, mass spectrometers)	
	90	Microtomes	
excluding	10	Gas or smoke analysis apparatus	
	40	Exposure meters	
9029		Revolution counters, production counters, taximeters, milometers, pedometers and the like	02
including	20.60.	Stroboscopes	
	20.90.	Other	
excluding	(10,20,90)		
9030		Oscilloscopes, spectrum analysers and other instruments and apparatus for measuring electrical quantities	06
including	all (10-40,80,90)		
9031		Measuring or checking instruments not specified elsewhere	03
including	40	Other optical instruments and appliances (e.g. for inspecting semiconductor wafers or devices)	
	80	Othe instruments, appliances or machines (e.g. testing electrical characteristics of engines)	
	90	Parts & accessories	
excluding	10	Machines for balancing mechanical parts	
	20	Testbenches	
	30	Profile projectors	

9032		Automatic regulating or controlling instruments and apparatus	06
including	10	Thermostats	
	80	Other (e.g. Process control instruments)	
excluding	20	Manostats	
	90	Parts & accessories	
9301		Military weapons	09
including	all		
9304		Other arms	09
including	all		
9305		Parts and accessories for headings 93.01 to 93.04	09
including	all		
9306		Bombs, grenades, torpedoes, mines, missiles & similar munitions of war and parts thereof	09
including	all		
9808		Articles for NASA	08
including	all		
9810		Other original equipment manufacture	
including	all		

HTP Category Legend

01	Biotechnology
02	Life Sciences
03	Opto-electronics
04	Computers and Telecommunications
05	Electronics
06	Computer Integrated Manufacturing
07	Material Design
08	Aerospace
09	Weapons
10	Nuclear Technology

Appendix 2

High Technology Sectors

Sector	SIC Codes

Aerospace	3530
Pharmaceuticals	2423
Electrical Equipment	3120
	3190
Electronics	3210
	3220
	3230
Data Processing and Office Equipment	3000
Scientific Instruments	3311
	3312
	3313
	3320

Appendix 3

Base Data in Nominal South African Rands

Appendix3 Table 1: South African HTP Exports 1991-1995 (Rands)

	1991	**1992**	**1993**	**1994**	**1995**
Biotechnology	15,688,974	21,675,581	22,773,054	22,199,518	25,024,902
Life Science	71,931,806	106,109,866	127,699,258	143,551,796	222,790,686
Opto-Electronics	32,949,009	29,224,963	38,058,932	40,420,270	52,810,319
Computers and Telecommunications	229,753,536	283,872,378	417,095,333	357,631,201	595,908,243
Electronics	26,969,087	23,489,226	37,492,921	74,410,679	137,329,076
Computer Integrateed Manufacturing	73,761,669	78,117,113	89,816,753	129,182,521	205,893,153
Material Design	786,376	778,266	4,041,484	3,907,626	14,094,739
Aerospace	105,646,507	139,814,647	221,492,350	434,495,607	503,299,743
Weapons	794,601,716	489,631,070	887,751,862	856,768,211	1,039,456,354
Nuclear Technology	419,930	26,779,744	45,814,519	75,051,964	48,752,691

Total ATPs	**1,352,508,610**	**1,199,492,854**	**1,892,036,466**	**2,137,619,393**	**2,845,359,906**
Total Exports	**64,523,673,437**	**68,234,957,568**	**79,481,090,648**	**89,621,610,023**	**102,650,418,055**

Source: South African Customs and Excise Trade Statistics & Armscor Annual Report 1996

Appendix 3 Table 2: South African HTP Imports 1991-1995 (Rands)

	1991	**1992**	**1993**	**1994**	**1995**
Biotechnology	108,059,369	126,168,293	122,591,679	153,950,235	214,421,771
Life Science	1,386,744,157	1,546,419,593	1,786,462,998	2,128,367,699	2,521,583,860
Opto-Electronics	198,830,402	228,058,657	212,316,373	277,528,758	312,744,512
Computers and Telecommunications	2,985,262,957	3,210,077,705	4,288,167,099	6,547,003,165	7,905,655,722
Electronics	536,546,860	629,200,505	784,120,782	1,135,959,232	1,461,865,543
Computer Integrateed Manufacturing	490,491,781	528,233,434	578,685,356	779,401,444	1,010,783,334
Material Design	9,087,309	9,305,786	18,862,944	33,384,816	34,409,253
Aerospace	2,000,791,343	1,515,675,382	1,832,292,752	1,727,284,206	2,187,603,086
Weapons	927,841,474	710,852,501	780,275,298	539,478,195	632,557,126
Nuclear Technology	81,508,264	105,192,834	29,329,805	38,537,799	155,592,258
Total ATPs	**8,725,163,916**	**8,609,184,690**	**10,433,105,086**	**13,360,895,549**	**16,437,216,465**
Total Imports	**48,281,180,748**	**52,569,142,964**	**58,987,472,001**	**75,521,108,811**	**97,227,801,759**

Source: South African Customs and Excise Trade Statistics & Armscor Annual Report 1996

Appendix 3 Table 3: Regional Share of South African HTP Exports excluding weapons (1995) (Rands)

	Total	**Africa**	**Europe**	**Americas**	**Asia**	**Oceania**
Biotechnology	25,024,902	19,630,116	1,544,498	554,894	0	0
Life Science	222,790,686	87,847,429	62,956,375	26,343,827	13,090,084	3,729,273
Opto-Electronics	52,810,319	10,374,233	18,093,029	9,517,393	3,373,179	917,534
Computers and Telecommunications	595,908,243	198,419,858	257,362,067	53,764,751	41,991,738	7,988,349

Electronics	137,329,076	32,505,779	55,260,258	14,798,855	20,079,620	0
Computer Integrateed Manufacturing	205,893,153	59,954,901	26,644,934	44,797,280	37,212,723	11,336,246
Material Design	14,094,739	670,108	9,155,712	485,934	1,227,645	0
Aerospace	503,299,743	51,464,743	238,009,701	127,225,191	43,087,840	35,810,053
Weapons	0	0	0	0	0	0
Nuclear Technology	48,752,691	316,548	46,917,267	0	300,024	0
Total ATPs	**1,805,903,552**	**461,183,715**	**715,943,841**	**277,488,125**	**160,362,853**	**59,781,455**
Total Exports	**102,650,418,055**	**13,913,556,289**	**31,095,634,375**	**7,694,917,068**	**19,823,378,016**	**1,188,415,289**

Source: South African Customs and Excise Trade Statistics & Armscor Annual Report 1996

Appendix 3 Table 4: Regional Share of South African HTP Imports excluding weapons (1995) (Rands)

	Total	**Africa**	**Europe**	**Americas**	**Asia**	**Oceania**
Biotechnology	214,421,771	445,965	144,050,428	50,395,458	13,185,915	2,273,599
Life Science	2,521,583,860	1,730,122	1,828,785,065	409,843,974	185,688,304	49,513,012
Opto-Electronics	312,744,512	2,221,038	169,339,065	87,967,079	33,290,020	1,722,075
Computers and Telecommunications	7,905,655,722	5,387,566	4,042,389,504	1,227,768,164	2,052,588,595	113,431,789
Electronics	1,461,865,543	580,088	649,120,511	226,282,255	546,520,240	11,498,513
Computer Integrateed Manufacturing	1,010,783,334	1,618,896	614,871,870	150,554,811	206,180,603	7,228,932
Material Design	34,409,253	1,280,931	24,300,538	4,816,660	1,121,252	0
Aerospace	2,187,603,086	159,221,523	893,162,301	886,735,898	88,979,821	435,713
Weapons	0	0	0	0	0	0
Nuclear Technology	155,592,258	0	142,917,307	11,282,463	1,039,410	0
Total ATPs	**15,804,659,339**	**172,486,129**	**8,508,936,589**	**3,055,646,762**	**3,128,594,160**	**186,103,633**
Total Imports	**97,227,801,759**	**2,855,250,013**	**46,916,671,426**	**14,986,242,385**	**29,264,668,695**	**1,782,970,659**

Source: South African Customs and Excise Trade Statistics & Armscor Annual Report 1996

Appendix 3 Table 5: Total South African Exports in High Technology sectors(Rands)

Category	**1991**	**1992**	**1993**	**1994**	**1995**
Aerospace	119,135,241	176,632,600	234,971,129	476,335,683	533,140,291
Pharmaceuticals	66,204,423	105,077,488	110,001,043	126,719,185	279,487,635
Electrical Equipment	187,312,922	236,202,666	314,520,308	388,263,936	589,031,721
Electronics	227,842,270	289,801,725	466,689,173	444,168,845	417,594,446
Data Processing and Office Equipment	126,183,070	151,456,604	189,581,252	196,180,195	320,329,367
Weapons	794,601,716	489,631,070	887,751,862	856,768,211	1,039,456,354
Scientific Instruments	167,609,843	211,291,646	280,516,832	355,907,605	407,967,185
Total	**1,688,889,485**	**1,660,093,799**	**2,484,031,599**	**2,844,343,660**	**3,587,006,999**
Total Exports	**64,523,673,437**	**68,234,957,568**	**79,481,090,648**	**89,621,610,023**	**102,650,418,055**

Source: South African Customs and Excise Trade Statistics & Armscor Annual Report 1996

Appendix 3 Table 6: Total South African Imports in High Technology sectors(Rands)

Category	**1991**	**1992**	**1993**	**1994**	**1995**
Aerospace	1,982,509,418	1,385,787,008	1,753,271,970	1,636,631,077	2,145,378,293
Pharmaceuticals	891,369,765	1,114,319,670	1,205,116,524	1,625,534,946	2,305,992,453
Electrical Equipment	1,268,430,023	1,385,572,202	1,674,192,393	2,197,634,092	2,438,406,728
Electronics	2,627,123,824	2,776,641,538	3,423,343,342	5,512,642,367	5,087,720,926

Data Processing and Office Equipment	1,994,918,630	2,144,669,540	2,813,238,466	3,760,656,432	4,833,644,108
Weapons	927,841,474	710,852,501	780,275,298	539,478,195	632,557,126
Scientific Instruments	2,423,385,829	2,436,212,518	2,847,175,945	3,843,531,179	3,173,629,582
Total	**12,115,578,963**	**11,954,054,977**	**14,496,613,938**	**19,116,108,288**	**20,617,329,216**
Total Imports	**48,281,180,748**	**52,569,142,964**	**58,987,472,001**	**75,521,108,811**	**97,227,801,759**

Source: South African Customs and Excise Trade Statistics & Armscor Annual Report 1996