Promoting Research and Development in the South African Pharmaceutical Industry

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Abstract

South Africa is experiencing tremendous threats to its population’s health and life expectancy because of a surging HIV/AIDS epidemic and other diseases prevalent primarily in Sub-Saharan Africa. As of 2007, the provision of pharmaceuticals globally in terms of quantity and type is not sufficient to address the crisis of care and cure. To address these issues effectively, South Africa needs a strong, local pharmaceutical industry, which can only be achieved by investing in R&D within its borders. This paper draws on economic theory, existing research, and my own field study to analyze the best way to promote R&D in South Africa. While foreign direct investment, government subsidies, global donations and agreements are all candidate solutions, the evidence points in favor of foreign direct investment as the best driver for the future growth of the pharmaceutical industry in South Africa.

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1 Introduction

While the pharmaceutical industry and government of South Africa have been severely criticized for their handling of the HIV/AIDS epidemic, a crisis of care and cure continues. The drugs available globally for delaying advancement of HIV conditions and limiting the detrimental effects of AIDS are expensive and difficult to administer to the masses of infected patients, leaving many untreated and allowing AIDS to contribute to 52.3% of deaths in 2004\(^1\) and projections of 2 million children orphaned by AIDS by 2010.\(^2\) These statistics are a small sample of the devastating scenario often painted by AIDS activists, grass roots organizations, medical councils, the WHO, and economists. Moreover, HIV/AIDS is not the only medical problem facing South Africa and its neighboring countries as infectious and parasitic diseases run rampant while the developed world is primarily free of any of these ailments.

Access to healthcare, pharmaceuticals and vaccinations constitute basic human needs in the 21\(^{\text{st}}\) century. The requirements of Sub-Saharan Africa in terms of pharmaceuticals are unique, owing not only to the prevalence of particular diseases but also to the genetic make-up of the region’s population. Unfortunately, the current system for pharmaceutical development and procurement fails to fulfill the needs of the region sufficiently. South Africa’s medical training is exemplary, and the government maintains strong intellectual property rights, creating both the means and incentives to develop pharmaceuticals; thus, South Africa has the potential to develop an R&D hub for the region. Exploiting this opportunity should be a policy priority for the South African government as well as the international community.

The aim of this paper is to describe the pharmaceutical market in South Africa and to analyze different approaches of increasing the research and development of drugs in South Africa. Foreign direct investment (FDI), government subsidies, and global donations vary in effectiveness towards achieving this end, and strategies should reflect their most opportune roles. By employing economic theory to explain possible effects of each of the previous policies, I develop expectations of the outcome of each case. Applying the theory to previous empirical studies on relevant subjects and the information I collected through interviews with stakeholders of South Africa’s pharmaceutical industry, I determine the probable impacts of each of these practices on developing a thriving R&D center.

\(^1\) World Health Organization (2005) though these figures have been contested by other organizations, looking at the HIV/AIDS epidemic. For example, the South African Medical Research Council (MRC) measured 25.5% of deaths within South Africa were attributable to HIV/AIDS in 2000 in their study (2006, p. 6) which uses the ASSA2000 method in protest to WHO figures. While the two documents refer to different years and thus the figures are not directly comparable, the very large difference in figures demonstrates that the WHO and MRC employ different methods of calculating deaths as a result of AIDS.

\(^2\) Bureau for Economic Research (2000)
For example, using the information I acquired by interviewing representatives of each of the major pharmaceutical trade associations in South Africa, including Maureen Kirkman of the Pharmaceutical Manufacturer’s Association (PMA), Val Beaumont of Innovative Medicines of South Africa (IMSA), Raseela Inderlall of the National Association of Pharmaceutical Manufacturers (NAPM), and Lawrence Reiter of the South African Clinical Research Association (SACRA), I consider role of the private sector within the industry. In addition, I apply information from interviews with representatives of the public sector, encompassing the Department of Health, Statistics South Africa, and the South African Patent Office, and numerous articles to resolve the question of whether government subsidies complement or substitute R&D expenditure and innovation. Furthermore, I consider the international community in the years since the turn to the 21st century, including very active and wealthy donors with strong interests in health issues and Sub-Saharan Africa. I consider all of these elements with the framework of Trade-Related Aspects of Intellectual Property Rights (TRIPs) agreement, legislation enforced by the World Intellectual Property Organization (WIPO) to help developing countries strengthen international property rights (IPR) among other aims.

In South Africa, pharmaceutical companies’ FDI encompasses manufacturing and marketing primarily, though clinical research fulfils a niche R&D need. It is important to build on the strong reputation developed by clinical research organizations (CROs) in other R&D fields through FDI, as technological spillover from multi-national corporations (MNCs) to the host country companies provides the opportunity for domestic companies to improve and grow at faster rates, visible through increased efficiency in production. Government subsidies and charitable funding not from pharmaceutical corporations suffer from asymmetric information from the industry, which affects their priorities and incentives for innovation differently than industry members. Therefore, it is integral to determine whether these two methods help or hinder developing an R&D industry in South Africa and thus future discoveries.

Section two of the paper starts with an overview of South Africa. Section three follows with an illustration of the pharmaceutical market operating within the country. Next, in section four, is a discussion of the reasons South Africa should pursue developing R&D capabilities within its domestic and foreign pharmaceutical companies. In section five, I consider each of the three approaches to increase R&D and analyze them in relation to the existing situation in South Africa, foreign interest, and international agreements. I present opportunities for further research in section six. I conclude with section seven, finding that while government subsidies and charitable contributions may play a role in promoting R&D development in South Africa, the onus is on the pharmaceutical private sector to create the opportunity and means through FDI.
2 South Africa’s Recent History

Prior to the fall of Apartheid in 1994, the South African economy suffered from severe distortions owing to an ethnically based systematic discrimination of population. The apartheid system allowed for an economy that generated wealth for only a small fraction of the population at the expense of the majority, based on race. The apartheid system led to a boycott of South Africa internationally; the UN decreed rule by apartheid unacceptable through Resolution 1761 (1962), instated a voluntary arms embargo (1963) leading to a UN mandated arms embargo (1977) and additional trade embargos issued by 25 nations (latter half of the 1980s). Already in the late 1970s foreign companies had begun divesting their South African businesses and limiting trade with South Africa. The Nordic countries were especially active in their protests, and their companies enacted the strongest sanctions against the apartheid regime.

However, as compared to other business sectors, the international pharmaceutical industry continued to operate in South Africa as drugs were considered a necessary humanitarian good. Nevertheless, two pharmaceutical companies, wanting to disassociate themselves from the apartheid regime, left South Africa during the boycott. Sterling Winthrop divested its South African holdings to Kodak, which were later bought by Adcock. Merck sold its interests to Adcock directly, forming a company called Logos, with a buyback clause; Merck exercised this option and returned to South Africa as MSD, controlling the same facilities it had previously owned, but not until after the fall of apartheid.

In the 1980s, the main export industries of South Africa, agriculture, mining, and manufacturing, experienced significant slowdown as the sanctions imposed on them limited demand for their products. At the same time, increasingly violent exchanges occurred between P.W. Botha’s security forces and the native population, as the government embarked on a policy of censorship as it sought to tighten its control over the country. However, owing to the increased instability, economic sanctions, and a proportionally shrinking white population, it became clear that the apartheid system was unsustainable. Recognizing the need for change, F.W. de Klerk, began his rule as the head of state in February of 1990, with a new agenda for the Afrikaner government: apartheid was officially abolished, political parties besides the Afrikaner National Party were allowed, a new constitution was written and passed, a Government of National Unity took over, and in 1994 democratic elections open to all races were held, electing the African National Congress (ANC) to power.

The political changes in the early 1990s set South Africa on a new path with a better future for its multiracial population further supported by the return of many foreign companies to the country. The more significant outcomes include the government’s redistribution programs that strive to reduce gaps in living standards between the white minority and the African majority. The Reconstruction and Development Program (RDP) is a basic needs program which carries out the redistribution of

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1 Wikipedia, History of South Africa in the Apartheid Era
wealth in South Africa through the government budget. For its sustainability the program depends on economic growth at a level of 5% annually, aided by a change in the government’s trade and industry policy. Provisions include the following: reducing tariff levels, abandoning export subsidies, supporting small and medium-sized firms, increasing the technological level, education and training of the labor force, and creating incentives for private investment.

In addition, the government has undertaken measures targeting the previously discriminated population through a program called Black Economic Empowerment (BEE). In order to encourage businesses to include minorities in their workforce, the government has developed a BEE scorecard. Based on seven key criteria, including ownership, management control, employment equity, skills development, corporate investment in development, corporate social responsibility and procurement, a company is ranked as being either a BEE enterprise and if so, to what degree. In order to qualify for certain government contracts a company must be a BEE enterprise, and one with a higher BEE score may receive a mandate from the government for that reason only. While this is an anti-competitive regulation across most industries, including pharmaceuticals, considering the history of apartheid in which minorities were not allowed to attend universities, there is an argument that the long-term benefits of BEE as a training program for minorities may outweigh the costs of the legislation to companies. However, businesses, particularly those operating in agricultural, mining and manufacturing, which face much competition on world markets, are threatened additionally by the relatively high cost and low productivity of labor as compared to the Asian economies, for example.

While South Africa has a strong infrastructure and relatively stable democracy in place, the economic future of South Africa is far from certain as the country by the end of the apartheid system had already encountered new problems that have continued to threaten its development. Of particular note is the spread of the HIV/AIDS virus among South Africans, which has subjected both the South African government and the pharmaceutical industry to severe criticism internationally for failing to address the epidemic sufficiently, denying on death certificates that AIDS was involved and not providing anti-retroviral drugs to help the HIV-infected population at a price easily affordable to all, respectively.

Many independent entities, especially charities and non-governmental organizations (NGOs) as well as foreign governments and inter-governmental organizations (IGOs) have responded to the need for help within South Africa’s health sector, donating drugs, personnel and other resources, calling upon pharmaceutical manufacturers to aid the ailing population charitably, and putting pressure on the South African government to take responsibility for the rising HIV/AIDS epidemic. In addition, members of these groups offer many “solutions” for South Africa’s highly burdened health sector, including free drugs, encouragement of parallel trading, patent buy-outs by international donors, and a loosening of intellectual property rights. However, short-term solutions in which the South African health system receives free products are short sighted. While the afore-mentioned policies may yield immediate gains, they will not provide a method for South Africa and its health service to advance beyond a

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4 Employment equity should reflect the population; therefore by 2015 the workforce should be 70% black. Interview with Val Beaumont, 8 May 2006.
system of subsistence reliant on the whims of the outside world. Instead, South Africa must invest in its own pharmaceutical industry to create an infrastructure capable of serving its needs.
3 The Pharmaceutical Market of South Africa

3.1 Health Problems

According to the World Health Organization (WHO) the proportion of South Africans suffering from and dying from HIV/AIDS is extremely alarming. These rates are fuelling animosity toward the pharmaceutical industry as anti-retroviral drugs (ARVs) exist but are not distributed to South Africa’s population in meaningful numbers. The lack of pharmaceuticals available to the population is often interpreted by citizens of developed countries as the fault of the pharmaceutical companies. However, according to the PMA, the drugs are in the country but are awaiting adequate distribution networks for treatments to be allocated to patients⁵ as ARVs require professional administration.

In addition to HIV/AIDS, other diseases prevail in South Africa. Figure 1 indicates what proportion of the population dies as a result of each ailment, providing a snapshot of the health problems to which South Africa is subject. While the middle figures and some of the final rows show conditions prevalent in developed countries, most of the ones at the beginning are not prevalent in the G7 countries, for example.

<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>% of total deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 HIV / AIDS</td>
<td>52.3%</td>
</tr>
<tr>
<td>2 Cerebrovascular disease</td>
<td>4.5%</td>
</tr>
<tr>
<td>3 Ischaemic heart disease</td>
<td>4.0%</td>
</tr>
<tr>
<td>4 Lower respiratory diseases</td>
<td>3.5%</td>
</tr>
<tr>
<td>5 Interpersonal violence</td>
<td>2.8%</td>
</tr>
<tr>
<td>6 Tuberculosis</td>
<td>2.1%</td>
</tr>
<tr>
<td>7 Road traffic accident</td>
<td>2.0%</td>
</tr>
<tr>
<td>8 Diabetes mellitus</td>
<td>1.8%</td>
</tr>
<tr>
<td>9 Chronic obstructive pulmonary disease</td>
<td>1.4%</td>
</tr>
<tr>
<td>10 Hypertensive heart disease</td>
<td>1.3%</td>
</tr>
<tr>
<td>11 Trachea, bronchus, lung cancers</td>
<td>0.9%</td>
</tr>
<tr>
<td>12 Asthma</td>
<td>0.9%</td>
</tr>
<tr>
<td>13 Nephritis and nephrosis</td>
<td>0.9%</td>
</tr>
<tr>
<td>14 Oesophagus cancer</td>
<td>0.8%</td>
</tr>
<tr>
<td>15 Self-inflicted injuries</td>
<td>0.7%</td>
</tr>
<tr>
<td>16 Protein-energy malnutrition</td>
<td>0.6%</td>
</tr>
<tr>
<td>17 Inflammatory heart diseases</td>
<td>0.5%</td>
</tr>
<tr>
<td>18 Low birth weight</td>
<td>0.5%</td>
</tr>
<tr>
<td>19 Birth asphyxia and birth trauma</td>
<td>0.5%</td>
</tr>
<tr>
<td>20 Cirrhosis of the liver</td>
<td>0.4%</td>
</tr>
</tbody>
</table>


⁵ Interview with Maureen Kirkman, 9 May 2006.
Figure 2, projects South Africa’s life expectancy past year 2016, both with and without AIDS projections as there is great discrepancy in calculating the effect of HIV/AIDS on the population. This table employs the ASSA2000 method in contrast to the WHO’s method of measurement.6

![Figure 2: South African Population Projections](chart1)

Source: Bureau of Economic Research, ‘The Economic Impact of HIV/AIDS’

3.2 Pharmaceutical Industry in South Africa

Pharmaceutical companies in South Africa engage in R&D, manufacturing, sales, and marketing of both branded and generics drugs. Historically, the pharmaceutical industry also engaged in R&D, contributing to 11% of the sector’s activity.7 However, “From 1997-2003, there was a common perception that Intellectual Property Rights are not as important in this industry as in others.”8 The result was IPR in all other industries in South Africa on a developed country level while the pharmaceutical industry underwent numerous court battles, resulting in a declining trend of R&D expenditure that in 2006 had declined to 0.7% from the previous year’s 1.2%.9 The remaining R&D is for clinical research efforts.

Until the end of 2003, the PMA collected annual performance statistics for the pharmaceutical industry, represented by 87 companies, a fair reflection of the number

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6 See footnote 1 for an explanation of differing projections.
7 Of this 11% R&D contribution, MNC’s conducted about 75% while local companies conducted the remaining 25%, interview with George Djolov, CHAMSA, 2 May 2006
8 Interview with George Djolov, CHAMSA, 2 May 2006
9 Interview with George Djolov, CHAMSA, 2 May 2006
of companies operating within the sector. The top performers in terms of market share in South Africa’s pharmaceutical companies are all foreign. Some of the main players are: Pfizer, GSK, MSD Merck., AstraZeneca, Johnson & Johnson, Bristol-Myers Squib, Novartis Pharma, Roche, Abbott, Boehringer-Ingelheim, and Eli Lilly.

There is a significant generics sector that in 1994 provided 40% of pharmaceuticals by volume and 22% by value. In 2001, generics accounted for a 45% share of the volume and a 35% share of the value, indicating an increase in demand for generic drugs.\textsuperscript{10} For the public health service in South Africa, there is a mandatory generic drug prescription policy when a generic is available as a substitute. The National Association of Pharmaceutical Manufacturers (NAPM) represents generics producers, of which Aspen Pharmacare, a domestic company, is by far the market leader. Aspen Pharmacare conducts R&D operations, though historically these have focused on reverse engineering, which are not the focus of this paper. The company, however, intends to increase its R&D capabilities though these may be necessary steps to maintain the ability to carry out licensing agreements.\textsuperscript{11}

While IPR have improved for the sector since 2003, the inconsistent history does not bode well for attracting FDI from MNCs in R&D. Therefore, as most of the country’s domestic companies have neither the size nor the scope to conduct revenue-generating R&D as recommended by the findings of Henderson and Cockburn (1996), companies should start out with smaller scale investments. This approach can prove fruitful, as Okada and Kawara (2004) found in their study of the Japanese pharmaceutical industry’s research productivity, pharmaceutical development itself does not yield the only opportunity for advance, as “downstream production techniques such as drug delivery system (DDS) may be one of the advantageous technological fields in Japanese pharmaceutical research in near future.”\textsuperscript{12} Similarly, South Africa has developed a niche business within the field of R&D with visible success; the companies are Clinical Research Organizations which perform clinical trials.

Generating about one billion USD a year in revenue, clinical trials comprise the resources spent on R&D within the South African pharmaceutical industry. The entire industry for clinical trials is composed of about 2000 staff spread across pharmaceutical companies, clinical research organizations, academic institutions, and other support organizations. Most of the purely CRO businesses operating in South Africa are small operations, with five to ten members of staff and are a part of a larger, international company. The main companies are Quintiles, Triclinium, and Criterium. Clinical trials in South Africa are usually conducted on new drugs, ones on which original research continues to be pursued in order to determine safety, efficacy, dosages (how much, how often), for the condition for which the trial is designed.\textsuperscript{13} Figure 3 shows the breakdown of clinical trials by therapeutic class conducted in South Africa. The vast proportion of them is conducted on infectious diseases, which as shown in section 3.1 is a significant concern in Sub-Saharan Africa.

\textsuperscript{11} www.aspenpharmacare.co.za
\textsuperscript{13} Based on an interview with Maureen Kirkman, of the PMA on 9 May 2006 in Midrand, South Africa.
Safety and reliability are very important in the pharmaceutical industry, and the reputation of South Africa’s standards is compelling. For example, clinical research trials out of South Africa are very highly respected by foreign authorities, according to a study conducted by the Department of Trade and Industry (DTI). However, there was an incident at the University of Cape Town in which a new ARV drug had been developed unethically and improperly, had been approved to receive royalty payments, which resulted in the cancellation of the agreement and the resignation of the lead researcher, Kotwal.

Figures 4 and 5 indicate the significant difference between South Africa’s import and export trading partners in the pharmaceutical industry. While it makes sense that South Africa imports drugs from developed countries considering the significant skill set and financial outlays required to develop pharmaceuticals, it could be more surprising that the country’s neighbors, particularly Zimbabwe, are so dependent on South Africa’s exports.

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14 Cited by Maureen Kirkman, 9 May 2006
15 Correspondence with Niccoli Nattrass,
Figure 4: Import Origins for South African Pharmaceutical Products

Top 10 Import Origins for South African Pharmaceutical Products
(Percentage of Total Imports by Value 1999-2000)

Source: PMA Annual Report May 2002 – April 2003

Figure 5: Export Origins for South African Pharmaceutical Products

Top 10 Export Destinations of South African Pharmaceutical Products
(Percentage of Total Exports by Value 1999-2000)

Source: PMA Annual Report May 2002 – April 2003
Figures 6 and 7 illustrate the increasing demands for pharmaceuticals in South Africa, while production capabilities decrease, largely a result of factory closures in the years 1997-2000. Nevertheless, figure 7 shows a slowing domestic industry at a time of increasing demand.

**Figure 6: South African Pharmaceutical Imports and Domestic Demand**

![Graph showing the share of imports in total South African domestic demand for pharmaceuticals.](image)


**Figure 7: Growth in South African Pharmaceutical Production**

![Graph showing the annual growth rate in production for the South African pharmaceutical industry.](image)

Source: PMA Annual Report May 2002 – April 2003
3.3 The Consumption of Pharmaceuticals

Since June 2004, all consumers in South Africa, regardless of race or economic class face the same price for pharmaceuticals through the Single Exit Price (SEP). The argument for this change was that prices for pharmaceuticals were perceived to be much higher than those of other countries like Brazil. However, a more thorough inspection of the South African pharmaceutical pricing system yields an important discrepancy. While users of the private healthcare system of South Africa paid very high prices for pharmaceuticals, the public sector accessed drugs either at cost or at world lows on par to those charged to Brazilians.\footnote{Interview with Duncan Reekie, 1 May 2006} To judge whether this difference in pricing between the different client groups was fair, consider the following classification of the relevant economic classes in figures 8 and 9:

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**Figure 8: Income per capita for individuals with access to Private Healthcare, 2000**

<table>
<thead>
<tr>
<th>Country</th>
<th>Income per Capita (in PPP), USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>34,100</td>
</tr>
<tr>
<td>UK</td>
<td>23,550</td>
</tr>
<tr>
<td>Germany</td>
<td>24,920</td>
</tr>
<tr>
<td>Denmark</td>
<td>27,250</td>
</tr>
<tr>
<td>Netherlands</td>
<td>24,970</td>
</tr>
<tr>
<td>Australia</td>
<td>25,850</td>
</tr>
<tr>
<td>Brazil</td>
<td>7,300</td>
</tr>
<tr>
<td>South Africa</td>
<td>36,288</td>
</tr>
</tbody>
</table>


**Figure 9: Income per capita for individuals with access to Public Healthcare, 2000**

<table>
<thead>
<tr>
<th>Country</th>
<th>Income per Capita (in PPP), USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Africa</td>
<td>316</td>
</tr>
<tr>
<td>Low income countries</td>
<td>1,980</td>
</tr>
</tbody>
</table>

4 Why Pursue R&D?

In order for an industry to continue to grow, it must pursue R&D successfully. With a well-trained medical community and a good reputation at the stage of clinical trials, South Africa has a comparative advantage within the pharmaceutical industry against its neighboring countries. Moreover, establishing a research base for this sector in South Africa will increase incentives and abilities to address the health problems prevalent in Sub-Saharan African countries. An R&D trend, allocating almost all R&D capabilities within the Triad comprised of the United States, Europe, and Japan, is unable to meet the entire world’s demands for heterogenous drugs and therefore requires expansion to other countries. In addition, the lack of opportunities available for capable medical research staff within South Africa encourages an exodus of trained individuals from a developing country to developed ones, thereby wasting South Africa’s resources.

Figures 10 and 11 show R&D investment levels by sector and the corresponding headcounts; the numbers demonstrate that the bulk of R&D investment is made by the business sector.

Figure 10: South African in-house R&D expenditure and headcount by sector

<table>
<thead>
<tr>
<th>Sector</th>
<th>2003/04</th>
<th>2001/02</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R mn</td>
<td>%</td>
</tr>
<tr>
<td>Business Enterprise</td>
<td>5,591</td>
<td>55.5</td>
</tr>
<tr>
<td>Government</td>
<td>465</td>
<td>4.6</td>
</tr>
<tr>
<td>Higher Education</td>
<td>2,071</td>
<td>20.5</td>
</tr>
<tr>
<td>Not-for-profit</td>
<td>209</td>
<td>2.1</td>
</tr>
<tr>
<td>Science councils</td>
<td>1,745</td>
<td>17.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>10,083</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: www.hrsc.ax.za

Figure 11: Financing of Business Sector R&D in South Africa

<table>
<thead>
<tr>
<th>Total Business Enterprise R&amp;D</th>
<th>2003/04</th>
<th>2001/02</th>
</tr>
</thead>
<tbody>
<tr>
<td>R mn</td>
<td>5,591</td>
<td>4,023</td>
</tr>
<tr>
<td>% of total South African GDP</td>
<td>0.45%</td>
<td>0.41%</td>
</tr>
<tr>
<td>Of which is financed:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>by industry</td>
<td>80.5%</td>
<td>81.4%</td>
</tr>
<tr>
<td>by government</td>
<td>6.2%</td>
<td>8.9%</td>
</tr>
<tr>
<td>by other national sources</td>
<td>3.8%</td>
<td>5.2%</td>
</tr>
<tr>
<td>from abroad</td>
<td>9.6%</td>
<td>4.5%</td>
</tr>
</tbody>
</table>

Source: www.hrsc.ax.za

The article published by the IFPMA, entitled “Encouraging Pharmaceutical R&D in Developing Countries,” describes the need for developing countries to contribute to
growing the pharmaceutical industry well. According to the authors of the study, Webber and Gajewski, economists explain economic growth according to three factors within a country, its: productive capital, technological advance, and efficient allocation of resources. A country’s productive capital depends not only on plant, property, and equipment (PPE) within the business sector but also on human capital. Specifically in relation to the pharmaceutical industry, active pharmaceutical companies are as important as teaching hospitals and a well-educated and capable medical community. South Africa is well-endowed with these elements, as explained later in this section. Technological advance refers to research efforts, encompassing basic research, applied research, and product development; however, the necessary feature is the marketability of the findings. This argument suggests that intellectual property rights (IPR) are an important element of a dynamic industry as they serve as a driver for innovation, particularly in sectors such as pharmaceuticals. Resources are allocated efficiently through a competitive market, including international trade and a division of labor.

Therefore, one concludes that as a country’s economic development is linked to its R&D capabilities17, enhancing them should be an important element of a country’s economic strategy. Moreover, Webber and Gajewski propose that the social benefits in the addition to the economic benefits of pursuing health R&D make this field of technological advance particularly attractive and necessary to pursue. For example, innovative products could focus on the diseases affecting the populations living there while improved processes could improve standards of products, increase efficiency in production, and lower costs and prices of drugs to consumers.

The authors of the report contend that current biopharmaceutical R&D is neither sufficiently allocated nor exploited and foresee an opportunity for developing countries to contribute in the future. The R&D Triad, which refers to the USA, Western Europe, and Japan, continues to lead the world in both R&D spending and patent applications. Nevertheless, even within this small group, significant changes have occurred as companies increasingly choose to conduct their R&D in the USA over Western Europe and Japan. For example, in 1990, 73% of R&D expenditure by European companies was conducted there but by 1999 only 59% remained there.18 Most of the additional resources were spent in the USA. In Japan, the more serious problem is that output per unit of R&D input has decreased dramatically amongst Japanese companies operating in Japan.19

17 Economists use various tools to describe the need for R&D advances to maintain growth within an economy. Consider, for example, Solow’s growth model, which depends on technological progress to drive continued economic growth or Romer’s model, which endogenizes technological progress and considers the role of economic incentives in driving creators. See Jones (2001) pp. 20-51 and pp. 96-121, respectively, for descriptions of the models.
19 Moreover, according to Okada and Kawara (2004), the lower amount of R&D expenditure in Japan, followed by fewer clinical trials conducted there, may translate into Japanese firms’ being less able to compete in the future. This perception has been empirically tested by Hashimoto and Hameda (2006) through DEA analysis that has found not only a decrease in R&D expenditure but also a decrease in the efficiency of the industry in Japan across the board.
Considering the difficulties of the Europeans and the Japanese in maintaining their R&D levels, one may wonder why a developing country would choose to enter this competition. However, the pharmaceutical industry is orientated around highly differentiated products and consumer groups, and therefore provides opportunity for market entry by new goods. Nevertheless, the financial outlays to introduce a successful drug to market are staggering and may be too high for an independent company from a developing country to pursue. However, there are many opportunities for organizations to contribute at various stages of R&D and product development, allowing them to build credibility and resources for future vertical expansion. A clear starting point for South Africa in this regard is through Clinical Research Organizations (CROs) which conduct clinical trials on behalf of the largest pharmaceutical companies in the world at standards approved by the FDA and other regulatory bodies.

In addition, the arguments in favor of pursuing R&D to attain economic development do not depend only on local companies’ investments. Other sources of funding and R&D commitment could come through foreign direct investment (FDI) or government resources, which will be considered in turn in sections 5.1 and 5.2, respectively.

From a market demand perspective, the arguments in support of localized R&D are apparent. The pharmaceutical industry has often been criticized for not focusing enough on developing products appropriate for the developing world, leading to significant debate surrounding the motivations of pharmaceutical companies in their choice of R&D allocations and drug development. While the age of blockbuster drugs (1994-1999) has subsided, the continued prevalence of parasitic and infectious diseases in Sub-Saharan Africa suggests that the industry is failing to meet market demand there. Figure 12 illustrates the significant difference in the major causes of death between the Triad and Sub-Saharan Africa, and more specifically South Africa.

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20 For the years 1994-1999, the percentage of blockbuster drugs brought to market and their related R&D expenses were significant as compared to others, Charles River Associates do not observe a continued trend in the market analysis for the following five years, (Charles River Associates, 2004, p. 61).
For 2004, the overriding causes of mortality in the developed countries were cardiovascular disease and cancer; in contrast, in 2004 the WHO attributes 53% of deaths in Sub-Saharan Africa to HIV/AIDS (20%) and other infectious and parasitic diseases (33%), and 52% of deaths in South Africa to HIV/AIDS alone.

In considering the diseases prevalent in the developing region, several factors must be considered. First, while drugs may exist for treatment, they may not be accessible to the population. Possible reasons include too high a price for the pharmaceutical and a treatment methodology requirement that is impractical for the resources available through local health services. For example, HIV/AIDS medication is usually administered as a drug cocktail to be more effective and prevent future resistance, requiring supervision over patients, which the South African health service cannot provide for much of the infected population. Treatment against Helicobacter pylori, found in patients with peptic ulceration is too difficult to be practical, according to Webber and Gajewski. Furthermore, there is no vaccine to protect against malaria, which ravages much of Sub-Saharan Africa, because “Some viral diseases or more

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21 Discussed in interview with Maureen Kirkman and subject is mentioned in Webber and Gajewski (2003).
complex organisms… are simply beyond current knowledge and technology.” 22 Many illnesses are treated for which there is no cure.

In addition to the previously mentioned concerns, efficacy and dosage for a pharmaceutical is not set globally. Regulatory authorities for many countries order independent assessments of drugs before they are allowed in the market, and formulations are often different for the “same” drug in different countries. There are two main reasons for this requirement. The first is that the materials used in the production of drugs can differ; even if they were the same chemical ingredient, the source can alter its make-up, meaning that bio-equivalence tests must be conducted before a drug, its production, or importation can be approved.

The second is that the genetic make-up of people and populations differs across the world, leading to different reactions to pharmaceuticals. Therefore, ideally clinical trials for phases I, II, and III should be conducted in globally diverse regions to test the efficacy, side-effects, and dosages of a new drug. For example, a well-executed clinical trial would include Canada, Europe, South Africa, Argentina, and Japan. The genetic code of all races within South Africa or even Sub-Saharan Africa would be much more homogenous than that of Afrikaners and Northern Europeans; therefore, a drug proven effective on a group of South Africans is much more likely to be applicable to Zimbabweans than a drug proven effective on Canadians. 23 This phenomenon in drug research, referred to as pharmacogenetics, is leading to forecasts that DNA-based designer drugs will be the standard in the future. 24 Moreover, South Africa with an HIV infected population purported to represent 20% of the population is a logical choice for clinical research tests, comparing pharmaceuticals on HIV-infected and non-HIV-infected study groups to determine the drugs’ efficacy and to learn more about the properties of the auto-immune-disorder disease.

A further benefit to South Africa in creating an R&D centre for pharmaceuticals would be to lessen the ‘brain drain,’ affecting developing countries across the world. On the one hand, the increasing number of foreign doctoral candidates from all parts of the world at American universities could be encouraging for South Africa, which has suffered in its tertiary teaching sector since the fall of apartheid in 1994. Previously, University of Witswatersand had eight excellent teaching hospitals, all divided by race, but once they were de-racialized, the standards for the system dropped drastically and it became impossible to conduct quality bedside teaching. Witswatersand (one division) and University of Cape Town successfully transformed themselves into private teaching hospitals and have had more success in enforcing high quality research at the registrar level and above. 25 Nevertheless, the places available for non-quota-filling candidates 26 within the medical schools are very
limited, enforcing the trend for many to study and specialize abroad. However the risk of highly capable and talented students not returning is real; statistics show that 80% of foreign doctoral students in science and engineering intend to remain in the US following graduation, up from 50% in 1985, disheartening for the students’ native countries.27

In addition, even those who complete their studies in their home country may move abroad.28 According to a study in the spring issue of The McKinsey Quarterly in 2001, about 33% of R&D professionals from developing countries move to the US, Europe or Japan, as these markets offer better facilities, career opportunities, rewards and collaborations, as well as easier access to colleagues.29 So many medical professionals leave South Africa for the UK that Thabo Mbeki put significant pressure on the British government to limit visa opportunities and extensions to medical professions, which has led to frequently changing regulations and allowances since 2001.30 Nevertheless, in 2003 South Africans constituted 6% of Britain’s medical employees.31 In addition to the UK, significant numbers South African medical professionals immigrate to the US, Canada, Australia, and New Zealand. In 2003, South Africans constituted 10% of Canada’s hospital-based physicians, and 600 South African doctors were registered in New Zealand.32 While figures for doctors working abroad are not an exact measure of the number of pharmaceutical R&D researchers, the statistics can serve as an indicator for R&D staff, who undergo similar training. However, while there is a lack of medical personnel to serve within the South African government health sector 33, the demand for high-skilled R&D pharmaceutical professionals beyond clinical research is limited,34 showing that the incentive for researchers to move abroad is even greater.

Therefore, the economic and social welfare benefits of pursuing biopharmaceutical R&D locally are clear. It follows that South Africa with its geographic location, prevalent diseases, unmet pharmaceutical needs, sophisticated infrastructure and medical community as compared to its neighbors, is uniquely suited to become the R&D center for biopharmaceuticals for Sub-Saharan Africa. In addition, South Africa’s export trade pattern for pharmaceuticals explained in section 3.2, further demonstrates the viability of a Sub-Saharan market for South African drug innovations, improvements, and manufactures. Hereon, the discussion will turn to how South Africa should pursue this objective for its pharmaceutical industry.

27 Stated in Webber and Gajewski (2003) but does not include evidence of which year is claiming 80% of doctoral students, p.11.
28 In India, the trend is so great that the UNDP Human Development Report 2001 estimates that the loss of Indian educated students to professions in developed countries constitutes a resources loss of $2 billion a year, cited in Webber and Gajewski (2003), p. 11.
33 In 2002, 42% of medical staff positions were left unfilled (84,205 out of 197,898 provincial posts), cited in Biermann, J. (2006), p. 6.
34 Interview with Lawrence Reiter, 21 December 2006.
5 Approaches to Increase R&D

5.1 Foreign Direct Investment

Foreign Direct Investment (FDI) refers to an investor’s acquiring a controlling interest in a foreign firm or establishing a subsidiary enterprise in a foreign country. Compared to the country’s domestic producers, foreign competitors face additional barriers when operating in the host market, including increased costs incurred through managing and conducting operations internationally; unfamiliarity with domestic laws, regulations and tax codes; cultural and language differences; exchange rate risk, expropriation, and other government actions affecting foreign companies specifically; and stationing high skilled personnel abroad (Markusen et al. 1995). Therefore, it would be unprofitable for a foreign company to enter a domestic market without a clear advantage against competitors.

J. Dunning’s (1977) OLI Framework, classifies three favorable conditions necessary for a firm to engage in FDI: the ownership advantage, the location advantage, and the internalization advantage. In the case of foreign pharmaceutical companies’ entering South Africa, “ownership” could refer to each firm’s patented drugs; “location” could refer to lower factor prices such as wages, transport costs, tariff barriers, and access to consumers; and “internalization” could refer to the advantages associated with choosing FDI over licensing. The methods by which MNCs exploit these advantages are normally channeled through either horizontal or vertical integration.

For the host country, the potential effects from FDI can be classified as those inciting product market effects, factor market effects or spillover effects (Navaretti et al. 2004). In the first case, an enterprise’s increased market presence in a country through FDI may either increase or decrease competition within the host market’s industry. This impact depends on whether the MNCs goods provide greater choice for the consumer or whether the industry is already saturated by a sufficient number of firms’ providing similar products, in which case the MNC may crowd out domestic companies. However, if the MNC were to exhibit more efficient production capabilities, the consumer could benefit from lower prices for substitute goods, resulting from less efficient producers’ being driven out of the market. Monopolistic markets would be particularly susceptible to pro-competitive gains. The second set of effects relates to factor endowments and prices, with possible increased capital inflows to the host economy as well as increased demand for labor to facilitate local production. This could in turn induce higher demands for skilled or unskilled labor, thereby raising host country wages, in accordance with the Stopler-Samuelson Theorem. The third grouping, “spillovers,” refers to transfers in technology, knowledge and other learning effects as well as linkages created by MNCs working together with domestic intermediary producers to create a final product.
While the academic theory behind FDI is substantial, the empirical evidence is particularly varied, regarding the role of spillovers. Typically, the models consider the impact of FDI and technological spillovers on growth in productivity on a country-level, industry-level or individual plant-level. As D.T. Coe and E. Helpman (1995) postulate, “A country’s productivity depends on its own R&D as well as on the R&D efforts of its trade partners,” (p. 860). In their study, they focus on the link between R&D and a country’s total factor productivity and find significant impacts, based on pooled time series cross section data on 21 OECD countries plus Israel. Van Pottelsbergh de la Potterie and Lichtenberg (2000), in their econometric analysis of country-level FDI in countries including the US, UK, Japan, and several Western European ones, found no significant R&D spillovers to host countries, though they did find highly significant spillovers to the home countries.

As Braconier, Ekholm, and Midelfart Knarvik (2001) point out, country-level and to an extent industry-level analyses may omit key aspects of technology diffusion which could be observed at the firm level. In their study, they consider both the Swedish manufacturing industry as a whole and a firm-level sample composed of Swedish multinational enterprises to assess the affects of R&D spillovers on both the firm and industry levels. On neither the firm-level nor the industry-level do they find evidence that either inward or outward FDI contributes significantly to R&D spillovers that affect labor productivity in Swedish MNCs. The authors find this conclusion “somewhat surprising” and suggest it may be a result of their focusing on OECD countries, all of which have similar technological capabilities, and may thus limit the scope for observable R&D spillovers.

According to Blomström and Kokko (1998), intra-industry statistical analyses, including Caves (1974), Globerman (1979), and Blomström and Persson (1983), have been successful in identifying the existence of spillovers on an aggregate level but have failed to isolate how they occur. In Kokko (1996), a study of the Mexican manufacturing industry, the author argues that spillovers are facilitated largely by the interactions of foreign and domestic firms and may not be determined by the level of foreign presence in a host industry alone. This argument is consistent with Braconier and Sjöholm (1997) in which R&D spillovers were observed within industries but not between them, and the spillovers were particularly significant in R&D intensive sectors.

The empirical models used in the studies mentioned previously rely on either a neoclassical approach, in which a growth in R&D stock (independent variable) promotes growth in productivity (dependant variable), or on an endogenous growth perspective, in which the level of R&D expenditure facilitates increased productivity. Braconier and Sjöholm (1997) utilized both methods in their study and found that the latter model was more effective in measuring the effects of FDI on technological spillovers.

Another approach is taken by Mansfield and Romeo (1980) who select a sample of U.S. manufacturing companies to compare the leakages of technological information
through FDI to developed countries and developing countries versus licensing or joint ventures. Compiling information through interviews with MNC CEOs, they determine how long the transfer of technology takes, through methods including reverse engineering, information provided by patents, and poaching personnel from the company which had produced the new technology. The study finds strong support of Caves’s (1974) hypothesis for FDI, that domestic firms in industries with a high MNC presence are more affected by technological spillovers than domestic firms in industries with lower one. Mansfield and Romeo’s second hypothesis, that technological spillovers will be particularly relevant in more R&D intense industries, received weaker support from the data.

While the empirical evidence is far from definitive in either proving that technological spillover occurs invariably as a result of FDI or through which channels this is best achieved – wholly-owned subsidiaries, joint-ventures, or licensing agreements – there is evidence of increased total factor productivity in South Africa’s pharmaceutical industry owing to FDI.

Rajah Rasiah compares the technological intensities between foreign and domestic firms. He finds evidence of South Africa’s ability to compete well in this sector, crediting the country’s domestic companies’ performances to the established institutions within the country. He finds significant evidence of improved factor productivity in the pharmaceutical industry, owing to increased R&D investment.35

As foreign firms show higher productivity from inputs than local firms in the pharmaceutical industry, Rasiah’s paper on South Africa supports the argument that the domestic companies have the potential to gain in technology and human capital applications, owing to FDI.

In conclusion, economic theory shows that FDI can promote further development of a sector through technological spillover, and Resiah’s work shows that this is empirically likely to occur within South Africa’s pharmaceutical industry.

5.2 Government Sponsored R&D

According to the United Nations Conference on Trade and Development (UNCTAD), R&D should be divided according to three taxonomies: basic research; applied research; and development. The first refers to creating a better understanding or increasing knowledge of a particular phenomenon without specific reference to or concern for commercial opportunities. The second serves the purpose of meeting market or business demand, focusing on product, process or service. The third refers to applying accumulated knowledge methodically towards designing and producing systems, prototypes and processes.36

35 Rasiah (2006)
36 UNCTAD (2005), p. 103.
While these definitions are important to understand on a scientific level, the objective of the government in sponsoring R&D is to stimulate it. However, this discussion of government sponsorship of R&D focuses on two types: basic research and project-specific contract R&D. Does government sponsorship of R&D promote further R&D efforts and findings within the private sector or does government funding interrupt an efficient market by “crowding out” private investment opportunities? To answer this question, it is important to consider two main types of government funding: basic research and project-specific contract R&D. David and Hall (2000) propose a model to describe the effects of government sponsored R&D on private R&D expenditure and results in both the short and long runs, and I apply their framework to analyze the potential impact of South Africa’s government’s sponsoring of R&D in the pharmaceutical industry.

David and Hall determine that there is a net gain to R&D levels through expenditures and positive results, owing to increased government R&D expenditure particularly when the initial level of spending is low relative to the overall size of the market. They describe each of the repercussions as substitutive or complementary, delineating the static and dynamic effects.

For an increase in government expenditure in R&D, there will be increased competition between the public and private sector for R&D inputs, specifically personnel, resulting in higher costs per unit of research undertaken as the elasticity of substitution for highly-specialized researchers is low in the short-run. As a result, private companies would invest less in R&D, as their rate of return has decreased, and will forego certain projects.

David and Hall specify five possible second order static effects of increased public R&D appropriation and describe the first three as substituting private R&D efforts and the last two as complementing them. As a result of public research entry, private companies may divert their preferred R&D efforts when they:

1. Believe results of the public research will bring significant changes to the field, thereby making current applied research efforts soon obsolete or unnecessary; industry participants will cease long-term R&D spending in that research area.

2. Expect public research findings to benefit competitors significantly in a particular field, thereby affecting the company’s previous advantage and inhibiting/limiting returns from a new, applied discovery; the firm will direct applied research efforts elsewhere.

Ward and Dranove (1995) suggest there are three groups: government-funded basic research, publication in medical journals, and industry-funded applied R&D. However, as other authors claim that a main difference between public research and private research is based on publications (the former is published while the latter is maintained in secrecy), this study will consider only two categories: basic and applied. In this study, advancements in processes are not considered in detail though they contribute to efficiency, ease of production and material gain in many cases.
(3) Are contracted to conduct the research by the government; the demand for the government findings replaces the demand for the company’s own R&D projects/ideas/plans.

However, public R&D spending may complement private sector investment when industry participants interpret it as evidence of future demand for the results of that type of research. The government may choose to promote the methods reached by that research. For example, if the South African government were to allocate significant resources to R&D towards understanding the HIV/AIDS virus, the industry could perceive this as a future commitment by the South African government to purchase pharmaceuticals to combat the disease, and the industry may increase efforts to find treatments and cures for it. However, according to the PMA, the South African government did not make a commitment to purchase the ARV drugs that were registered and available in the country. Since 2002, about 20% of the HIV infected population is getting ARVs; that equates to 110,000 people out of the 500,000 to 800,000 individuals who need them. Moreover, considering the Department of Health’s attempts to change clinical trials legislation to provide drugs to patients for free for life, it is unlikely that pharmaceutical companies in South Africa would interpret increases in public R&D expenditure in this way.

Alternatively, public expenditure in an R&D sector may encourage private sector participation in the research area so that industry players are well-equipped to understand and apply the new knowledge. Within the South African pharmaceutical industry, there is evidence of this behavior especially by generics companies, which must maintain R&D centers to accurately reverse engineer branded drugs, as well as by companies purchasing licensing agreements from drug developers. However, this argument does not obviously support first-run R&D efforts and would require additional evidence to support it.

In order to differentiate the dynamic effects of government R&D expenditure on private R&D investment choices from the static ones, David and Hall consider major policy swings/“shocks” such as “Star Wars” and the US Energy Department’s Synfuels program. These policies increased demand for defense-oriented and energy-specific research, respectively, which could lead to an oversubscription of students and personnel training to join these sectors of research. As a result, the real wages of R&D personnel are subject to increased volatility/are increasingly volatile, and in the aforementioned cases would have resulted most probably in an initial increase, followed by a decrease in real wages. The oversupply of trained individuals would then move to the private sector, resulting in a net gain in R&D expenditure and output there, a result of the temporary increase in government demand.

On the other hand, should the oversupply of highly-skilled workers occur at the precise point of government’s changing policy back to previous, lower demand levels, one would observe a substitution effect as all of the additional personnel would move to the private enterprises.
An example of such a sudden shift in South Africa could be the sudden influx from international donors for AIDS research but this argument will be addressed in section 5.3 on global donations. On the other hand, recognition on the part of the South African government of the epidemic proportions of this virus may generate similar levels of interest among students and young researchers. This effect could be particularly profound among individuals who have been personally affected by HIV/AIDS, either themselves infected or knowing someone who has been.

Had the South African government made a significant investment in R&D research, following the admittance that HIV/AIDS exists and is a serious problem this would be considered a sudden shift in policy. However, instead, the government has increased efforts on drug distribution and has put the onus on pharmaceutical companies to increase R&D expenditure in this field, for example by suggesting that clinical trial participants receive permanent treatment of any effective ARV medication. Therefore, the scenario for sudden, temporary increases in government funding for R&D efforts in pharmaceuticals does not have recent applicable examples. Nevertheless, understanding the ramifications of such a policy change is important to determining the best course of action South Africa’s government should follow.

David and Hall posit that governments, universities, and private companies all have proclivities in their research that can affect the other research sectors. Ward and Dranove (1995) show empirically that in the US, government funding has been directly more towards life-threatening diseases that affect fewer people while private funding has been focused on more prevalent ailments. They conclude that their findings reflect politicians’ increased subjectivity to special interest groups when compared to the market-oriented pharmaceutical companies. Nevertheless, Ward and Dranove find that a one percent increase the National Institute of Health’s (NIH) expenditure for basic research in a therapeutic category results in higher R&D private sector spending in that area of 0.57 to 0.76 percent. The authors aggregate the NIH’s spending across all categories to determine that a one percent increase results in a 1.26 to 1.71 percent greater investment in R&D by pharmaceutical industry participants.

While the study by Ward and Dranove supports the claim that public expenditure may spawn private investment, David and Hall suggest that governments may be particularly inclined to misidentify future R&D needs and left in charge of funding universities and determining their curricula, may spend significant resources training individuals unable to contribute to private sector research needs. David and Hall refer to criticisms of American university engineering and science departments in the mid and late 1980s that the institutions were producing graduates ill-equipped to fulfill the research needs of the private sector and were unable to contribute to academic research as their work would be redundant. Fortunately, for the United States, the teaching methods have adapted, credited partly with the passage of additional intellectual property legislation that allowed university researchers to seek patents for their innovations and inventions.
This argument is not unique to the United States. In their research of the pharmaceutical industry in Western Europe, Charles River Associates (2002) charge that Western European/Continental European universities are to blame for the relocation of R&D divisions of pharmaceutical companies and other R&D intensive industries to the United States. The Western European universities’ focus on basic research at the sacrifice of applied research has poorly prepared researchers for the private sector.

In South Africa, the government encourages university researchers to patent their innovations in the pharmaceutical industry, thereby mitigating this potential negative effect espoused by David and Hall. As Janusz Luterek, partner of Hahn & Hahn Inc, Intellectual Property Practitioners, explains, In South Africa, “Universities are encouraged to patent and license [their discoveries] to earn income for their survival; it is clear government policy that they do patent and make income.”

The WIPO Intellectual Handbook states,
“A patent is a document, issued, upon application, by a government office (or a regional office acting for several countries), which describes an invention and creates a legal situation in which the patented invention can legally be exploited (manufactured, used, sold, imported) with the authorization of the owner of the patent. ‘Invention’ means a solution to a specific problem in the field of technology. An invention may relate to a specific product or process. The protection conferred by the patent is limited in time (generally 20 years).”

In addition, David and Hall consider the opposite case, based on the work of Dasgupta and David (1994), in which government and specifically university funding decreases. They argue that while initially private sector real returns for R&D would increase as a result of less competition with the government sector for the ‘best’ performers and newest ideas, these effects would be short-lived. The longer-run effects of decreased demand for R&D personnel, owing to decreased government investment would result in lower wages and fewer research posts for university graduates to aspire to fill, thereby (possibly) adversely affecting the applicant pool of researchers as the more talented choose alternative academic and career paths.

The authors conclude that decreasing government expenditure in R&D will have negative effects not only on the output of government sector research but also on private sector research as personnel are less capable. Moreover, the private sector would lose the ‘free’ advances formerly provided by public sector researchers.

The solution for South Africa does not entail temporary increases in funding as policy “shocks” may prove alright if they could be well-timed but economists never get this

38 As stated by Janusz Luterek, Hahn and Hahn Inc, Intellectual Property Practitioners, e-mail: 11 January 2007.
Moreover, decreasing expenditure is not an option. Permanently increasing government R&D expenditure may not be the best solution either given the many financial responsibilities of the South African government, not least the public health service.

5.3 Global Donations

While many have protested pharmaceutical companies’ market-oriented policies in Sub-Saharan Africa and especially in South Africa, these critics should not be accused of not putting their money where their mouths are. Foreign entities, spanning charities, individuals, governments, IGOs, and corporations, have made significant donations to Sub-Saharan African countries to improve the populations’ access to pharmaceuticals, earmarking funds for South Africa, especially for its HIV/AIDS infected populace. The sums of money are substantial. For example, the Bill and Melinda Gates Foundation has provided almost $2 billion for TB, HIV/AIDS, and other sexually transmitted diseases over the six year period leading to August 2006. In 2005 alone, Americans donated $22.4 billion towards health programs and research, operating within the US and abroad. For example, in his 2003 State of the Union address, President George W. Bush called for $15 billion to be spent over five years to address HIV/AIDS, TB, and malaria outbreaks in 16 countries, including South Africa. This proposal was approved by the United States Congress and was implemented thereafter.

While the generosity of the donors is admirable, it is questionable whether the cash donations are being put to their most effective uses. The majority of programs focus on bringing drugs to the people who need them. While it is important to medicate sick individuals, such policies may yield only short-term solutions, particularly if funding commitments are for a limited period of time and according to specific objectives laid out by the relevant donors. Furthermore, at the second annual meeting of the Clinton Global Initiative, September 2006, Dalberg Global Development Advisors presented an independent analysis that indicated that a large proportion of the aid money is stuck in bureaucracies and multilateral banks. Meanwhile, critics of drug donors have complained that the money is directed at generics drugs or parallel trading measures which undermine the strength of Intellectual Property Rights (IPR). This has led a call by some for international donors to buy out patents from pharmaceutical companies on behalf of developing countries to maintain these rights.

The need for international donations at times of crisis is unquestionable, particularly in the aftermath of war, natural disaster or other sudden impact on a population’s wellbeing. However, longer-term, general financial commitments, donating an end product only (pharmaceuticals) should be viewed more cautiously. Instead, those funds, particularly when they are substantial could be directed towards pharmaceutical industry inputs rather than outputs with better results for South Africa. Donors should consider donating to universities, medical personnel training programs, and biopharmaceutical R&D programs. As an additional agent, operating within the

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40 Telephone conversation with George Djolov, 18 October 2006.
41 Garrett (2007)
42 Cited in Garrett (2007)
pharmaceutical community, donors may happen upon under-funded or ignored issues and problems. Like the government, donor agencies run by the rich and famous, though pure in intention, may suffer from asymmetric information on the needs of the industry and may misdirect funds to research efforts that are not the most competitive and likely success stories.

In contrast to the donors mentioned above, corporations operating in South Africa have taken various approaches to contributing to South Africa’s better health outcomes. Some have invested in teaching employees how to protect themselves from HIV infection and other diseases and how to care for themselves following infection, in research centers such as the Merck wing at UCT’s teaching hospital, and in various community projects in line with the Millennium Goals set by the international community.

The South African government would be better served in promoting FDI to develop the nation’s R&D capabilities and should therefore focus on making it an attractive destination for foreign pharmaceutical companies.

5.4 International Agreements

The TRIPS initiative as laid out by WIPO, is specifically geared towards developing countries to help them develop an environment in which companies that are dependent on patented products or processes will not only choose to pursue business there but will also thrive in providing the market with their new “technological transfer.” TRIPs enforce IPR within participating countries but allow parallel trading, the practice of importing goods at a lower price in one country and exporting them to another country to exploit the uneven price levels set by pharmaceutical companies worldwide. While proponents of parallel trading claim it is a method to reduce prices for high quality goods such as brand name pharmaceuticals for developing countries, the empirical evidence for this outcome is mixed. For example, a study on the EU showed that although the UK charges higher prices than other countries within the Union, the results of parallel trading resulted in minimal price decreases for patients, relative to the discrepancies observed by transfer pricing.

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43 One should note that there are many donors and grassroots organizations incorporating different initiatives from those involving cash outlays and pharmaceutical purchases. However, for the purpose of modeling the effects of donors’ additional cash on R&D expenditure and outcomes, I treat private donations similarly to government subsidies for research, as both can advocate basic research, applied research, and ‘string attached’ research which means that researchers must focus on the project initiated by the financial supporter of the endeavor. Therefore, I conclude that the effects of donations on the industry and the private sector incentives would be similar to those of government subsidies.

44 Panos Kavanos,

45 The term “technological transfer” refers to research pursued in order to create a new good or process that will have market value, as used in the article by Marcia Angell (2004).

In South Africa, the provision for parallel trading does not affect the pharmaceutical market significantly as the SEP largely replaced demand for this practice; advocates had promoted it as a means to lower prices for pharmaceuticals in South Africa. Moreover, conducting pharmaceutical parallel trading is complicated, as different formulations are often approved in South Africa versus other countries, information to which parallel traders are not privy, creating uncertainty whether the product is as effective as the approved drug. Therefore, as the SEP lowered the price of drugs for everyone in South Africa significantly\(^{47}\), the additional requirements to conduct parallel trading safely and properly are not economically justified in South Africa.\(^{48}\)

Initially the SEP was set as the manufacturer’s price plus the distribution cost plus 14% VAT and a maximum of 26 rand for any drug costing 100 rand or more for a dispensing fee. This cap was set too low, resulting in many closures of pharmacies particularly in rural areas that could not benefit from high quantities of sales. The system in place since 15 March 2006 is a sliding scale benchmarked according to a basket of prices, based on France, Mexico, Canada, Australia and the UK as well as prices as they were set in South Africa in 2003 minus rebates and discounts plus an annual price increase (based on CPI and exchange rates) and a dispensing fee.\(^{49}\) Implementation of the SEP according to reference pricing\(^{50}\) resulted in a 21% decrease in prices, but IMSA argues that this method is a deterrent to innovation, as companies are less likely to pursue R&D when they are not free to set prices according to market forces.\(^{51}\) One could say it is even more likely that companies would not pursue R&D specific to South Africa’s needs within this climate. Therefore, the South African government should disband the SEP as it is a threat to innovation within the sector domestically.

According to the World Health Organization’s publication, *Health Technology Assessment Methodologies for Developing Countries*, increased regulation negatively impacts innovation in health care as the financial burden and risks for companies to conduct R&D and begin new ventures increase. For example, the authors, Panerai and Pena Mohr, cite increased regulation by the Food and Drug Administration (FDA) in the United States as the direct cause of annual decreases since 1966 in the rate of new pharmaceuticals being brought to market.\(^{52}\) The reputation of the Medical Research

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\(^{47}\) The SEP lowered prices by 50% across the board in its first three months of implementation. However this facilitated the beginnings of a systemic collapse in the pharmaceutical distribution network with chemists declaring bankruptcies or holding no stock throughout the country, though especially in rural areas that faced less consumer demand. Thereafter, the PMA and IMSA produced a dossier to the South African government which resulted in a 21% price decrease, based the reference pricing system described, Interview with Val Beaumont, 8 May 2006.

\(^{48}\) Information based on interview with Maureen Kirkman, 9 May 2006

\(^{49}\) The dispensing fee issue had not been resolved by May 2006, as the pharmacists and other distributors had filed court cases against the provision.

\(^{50}\) Reference pricing refers to the average of the lowest prices at which the good is available in the basket of countries, Djolov, G.G. (2003). Therefore, in a country with a mixture of public and private healthcare, the lowest price, regardless of the proportion of the population that has access to it, is used in the calculation.

\(^{51}\) Interview with Val Beaumont, 8 May 2006.

\(^{52}\) Penerai and Pena Mohr (1989), p. 10. Their paper was published in 1989; since then, the rate of decrease has been even more substantial, though authors indicate several factors may be at work.
Council (MRC) in approving clinical trials is the most relevant example of increased regulation delaying opportunity for R&D investment and positive outcomes. As the MRC can take between 18 and 24 months to approve a trial, a contract granted to a South African CRO is sometimes transferred to another country such as Canada to complete the stages of the trial more quickly. Not only does such regulation hinder the business prospects of CROs hoping to prosper, the results of a clinical research trial conducted in another region of the world may not be as indicative of effects on South Africans as one conducted in Sub-Saharan Africa.

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53 Interview with Maureen Kirkman, 9 May 2006.
6 Further Research

The opportunities for further research on R&D levels and the pharmaceutical industry in the developing world abound while the need for further empirical testing of the relevant economic theories addressed in this paper is apparent. In this section, I will list some of the questions I would like to answer and the approaches I would like to consider in future work on this subject.

An additional method to promote R&D investment beyond those discussed in this study is for the government to provide tax subsidies for companies, engaging in pharmaceutical R&D. Tax subsidies could be implemented in the following three ways:

1) R&D is expensed at a faster rate than economic depreciation
2) R&D tax credits: encourage R&D by lowering MCC and allowing firms to choose which projects to pursue (do not have the selection problem mentioned in government sponsorship)
3) Returns to foreign R&D repatriated at lower taxes

While Rajah Rasiah (2006) found evidence of increased productivity in the pharmaceutical sector of South Africa, it would be worthwhile to conduct this experiment, using another method or a more extensive dataset that is more representative of the pharmaceutical industry as a whole. Rasiah’s (2006) study included 22 firms with very detailed information on them. However, historically, the PMA has collected similar, aggregated statistics on 87 pharmaceutical companies, and it would be beneficial to get a break-down of these figures. Collecting these data was beyond the scope of this thesis. It would also be useful to conduct a comparison of how robust traditional production function approaches are in measuring changes in total factor productivity and another method, for example Data Envelopment Analysis (DEA). The DEA model could compare results to Rasiah’s, thereby providing additional empirical evidence of the existence of increased productivity in the pharmaceutical industry of South Africa. A readily available source of output data, for those traveling to Pretoria, is patent applications, which are kept accurately, divided by company, and date many years back, including the years of apartheid rule, thereby allowing for an alternative measure to annual sales.

Moreover, a larger study, comparing the pharmaceutical industries of South Africa, India, China, and Brazil and their relative efficiencies would be very interesting, as these countries are uniquely placed as middle-income economies in this sector. The establishment of a successful R&D center in each of these countries which are geographically far from one another is an opportunity to be exploited and not forgotten. Measuring how each country stacks up could offer insights into which policies and practices, including the protection of Intellectual Property rights, promote development best.
Finally, an important contribution to the existing research would be to establish a link between national health outcomes and increased productivity in pharmaceutical companies, increased home-grown R&D in pharmaceuticals, or increased R&D efficiency. Is there causality in either direction?

7 Recommendations and Conclusion

South Africa must encourage FDI to gain additional investment capital, expertise, access to international markets, and to pursue those R&D projects most important to Sub-Saharan African countries. While this has not been a primary focus of the paper, the South African government would do well in to consider revoking the SEP to create additional incentives for R&D innovation within the pharmaceutical sector. Moreover, for MNCs to have the incentive to rise to this challenge, the South African government must continue to promote intellectual property rights (IPR) and ensure an FDI-friendly environment. While international donations can help countries in crisis, longer-term financial commitments are necessary to implement lasting change. Initiatives like TRIPs should continue to create incentives among developing countries to protect IPR. In total, the unique circumstances of South Africa, a country trying to prosper through the 21st century, after the legacy of a repressive apartheid regime, a combination of the First World and Third World skill sets and purchasing powers, provide the opportunity to grow a world-class R&D industry, benefiting not only all of South Africa’s population but also that of its neighbors, and necessitate an approach to growing R&D.
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*Please note that as of 22 November 2006, the PMA and members of NAPM merged to create the Pharmaceutical Industry Association of South Africa (PIASA)