AN EXAMINATION OF AFRICA'S PARTICIPATION AND PERSPECTIVE IN GLOBALIZATION FROM THE TECHNOLOGICAL VIEWPOINT

BY

ADEGBOYE, BABATUNDE ARAOYE

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NIGERIA.

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DECLARATION

I hereby declare that this Thesis has been executed by me and that is a record of my research work. It has not, to the best of my knowledge, been submitted or accepted in any previous publications for a higher degree. All sources of information have specifically been acknowledged by means of references.

_____ _____

ADEGBOYE, Babatunde Araoye Date

Candidate

CERTIFICATION

This Thesis titled "AN EXAMINATION OF AFRICA'S PARTICIPATION AND PERSPECTIVES IN GLOBALIZATION FROM TECHNOLOGICAL VIEWPOINT" by ADEGBOYE, BABATUNDE ARAOYE meets the Regulations governing the Award of the Master of International Affairs and Diplomacy (MIAD) of the Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

_____ _____

Dr. P A Odofin Date
Research Supervisor

_____ _____

Dr. U M Ka'oje Date
Head of Department

_____ _____

Professor S A Nkom Date
Dean, Postgraduate School

DEDICATION

To the Glory of God

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I sincerely acknowledge God for seeing me through the completion of this programme. To Him be the Glory ever.

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- B A Adegboye, PhD (Elect. Eng'g)

ABSTRACT

The study aims at examining Africa's participation and perspective in globalization from the technological point of view with an attempt to establishing how developing countries can derive the best benefit from it. Following a theoretical overview of the basic concepts and review of relevant literatures, analysis was made of the extent to which World Trade Organization (WTO) agreements, particularly the technology-related provisions, could enlarge the capabilities of African countries to procure and develop modern technologies. Empirical literatures were in turn reviewed, which served as the basis for proposing research agenda to study the resulting empirical implications, ultimately to identify specific technology policy issues that African countries should emphasize in the continuing debate on the effect of global market integration. Finally, the study draws conclusions and recommends a programme framework, which would aid in the pursuit of the research agenda proposed.

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CHAPTER ONE

GENERAL OVERVIEW OF THE STUDY

1.1 INTRODUCTION

Globalization is a powerful change mechanism without clear definition, explicit objectives or an agreed operational framework. Yet while complex and disorderly, it is increasingly clear that nothing about globalization is arbitrary because the changes it produces are the results of commercial, political and economic drives. It is also difficult to predict the future course of globalization, however some trends seem apparent: the pace of globalization is clearly accelerating with a continuous 'free' flow of information, investment capital, ideas, products and services between countries.

A fundamental challenge posed by global markets is that they are inherently disequalizing, which means that they make rising inequality more likely rather than less. Yet accessing and participating in the global economy has become one major factor influencing the development process of individual countries. Therefore, considering globalization just as a threat or a problem has particularly negative consequences for developing countries. The big challenge for these countries is not to be swallowed up by the globalization process but to seize the opportunities it may open for the benefit of their own development and avoid as much as possible its risks.

One of the forces that push globalization is technological development. Science-based technological advancement has also been a long-term driving force for modern economic growth. Traditionally, in the high-income countries, the national setting has enabled technology development: institutions, investment, regulations, academics, social/cultural priorities. Increasingly, however, such development is driven by factors beyond the national setting - *the global economy*. Yet the technological opportunities offered by the global market cannot be

equally seized by developing countries. Technological innovations are increasingly created in response to market pressures and not the needs of the poor populations in those countries, where more than four billion people live on less than, say, three dollars a day and face basic subsistence problems.

Increasingly, scientific and technological co-operation have become pieces of the global machinery and have come to play an important role in bridging the gap between the different parts of this still fragmented world. Here we have at hand powerful tools to support national development strategies and link them with global development goals.

For a number of decades, the conventional approach to co-operation for development had been to adapt technologies, often driven by the convenience of their owners or their promoters, to specific needs in developing countries. However, it is now recognized that this transfer of technology has not been effective for overcoming critical ecological barriers to development such as Malaria, Chagas and Trypanosomosis (Millennium Project Report, 2005), nor, say, for developing a sustainable and efficient use of the natural resources, with which many of these countries are generously endowed.

Simple access to technology does not automatically mean that sustainable and desirable solutions can be adopted and adapted to local conditions or that they will lead to expanded technological capability. Therefore, developing countries need to adopt comprehensive technology development strategies in their national development processes, including the respective policy, process and legal frameworks. The analysis underpinning such strategies should identify which technologies are critical for the immediate and longer-term future, what technologies are most likely to become obsolete or be replaced and what trends in technological innovation may influence technology development.

The primary function of such strategies is to help meet the requirements of national goals and priorities as identified by the countries themselves, furthering endogenous technological innovation and production; but they should, at the same time, strengthen the capacity of these countries to fully participate in the definition of global development policies and strategies in order for the latter to be of truly global benefit. These decades of experience have brought about important changes in the approach to co-operation for development. Interestingly, there is a trend in the development community towards increased national focus, taking into account specific country conditions.

A major indicator in this regard is the Paris Declaration on Aid Effectiveness (High Level Forum, 2005), which reflects a new consensus on international development that calls for strengthened partnerships with developing countries based upon defined national development strategies reflecting the specific needs, interests and priorities of each partner country. This consensus is reflected as well in the new EU Strategy for Africa (Commission for the European Communities, 2006), which proposes the establishment of an EU-African Partnership for Infrastructure to support and initiate programmes and trans-African networks that facilitate interconnectivity at the continental level for the promotion of regional integration. Strong national scientific and technological institutions in the regions are expected to play a decisive role in achieving the EU goal of helping to build an environmentally sustainable future for Africa.

Ownership is being adopted as a fundamental principle for international co-operation because it is widely understood that development policies and strategies cannot be imposed from the outside. For example, the vision of good governance, respect for human rights, gender equality and empowerment of civil society, embraced by the African Union and NEPAD, are now at the center of EU commitment to Africa and will likely guide co-operation with other regions. However, the

consensus on ownership does not yet incorporate a robust understanding that sustainable solutions to development problems and opportunities must be owned by the countries facing the challenges.

1.2 STATEMENT OF THE RESEARCH PROBLEM

It is not sufficient for developing countries to state their needs and formulate their requests; they must have the capabilities and infrastructure to advocate, analyze, postulate, test, validate and adapt solutions to meet their unique and specific circumstances. The new cornerstone strategies for international development must recognize that unique and differentiated circumstances determine the choices available to developing countries for advancement and participation in the globalized marketplace. They must also recognize the critical importance of institutional capacity development, including national scientific and technical capacities that enable developing countries to utilize the resources and participate in the benefits of economic integration. Given these new initiatives and the opportunities for more effective cooperation, it is of course imperative that developing countries, in their turn, recognize the importance of sound and sustainable national scientific and technological institutions and of the civil and administrative reforms that ensure advantageous and stable environments for sustained and successful efforts by their own scientific-technological communities.

The problem of this research, therefore, is to examine the technological influence on globalization and how it affects Africa with a view to establishing how developing countries can derive the best benefit from it. Insights from the ideas that would be obtained and from the empirical literature will suggest specific research agenda of immediate relevance to policy formulation as well as for democratizing global economic relations. Conclusions would be drawn from insights from this study, which should prove useful in analyzing the qualitative implications of technical aid, particularly that directed to technologically disadvantaged sectors of a country’s economy.

1.3 AIMS AND OBJECTIVES

The research is aimed at examining Africa's participation and perspective in globalization from the technological point of view and with attempt to establishing how developing countries can derive the best benefit from it. To facilitate this, the research will consider two objectives:

1. To analyze the extent to which World Trade Organization (WTO) agreements, particularly the technology-related provisions, could enlarge the capabilities of African countries to procure and develop modern technologies;
2. To propose research agenda to study the resulting empirical implications, ultimately to identify specific technology policy issues that African countries should emphasize in the continuing debate on the effect of global market integration.

1.4 SCOPE OF THE STUDY

The research will focus on the review of empirical literatures, which will serve as the basis for proposal of the research agenda. This consists of the intellectual property rights and technology, the models of learning by doing and technological leapfrogging. The research also considers research and development and looks into process innovation and vertical differentiation. It will, as well, draw insight from the empirical studies, proposes the research agenda, draws conclusions and recommends a programme framework, which would aid in the pursuit of the research agenda proposed.

1.5 BASIC RESEARCH ASSUMPTIONS

The specific issues raised so far in research linking trade and technology is as varied as the models that have been developed to address them. Often the answers depend on the particular assumptions made about the nature of the economic environment. In this research, we make the following assumptions:

1. We are concerned with the endogenous creation of comparative advantage through technology, but under the economic environment of free trade and perfect patent protection, which is taken to mean the complete policing and enforcement of intellectual property rights;
2. This endogenous creation of comparative advantage can occur in two main ways: through research and development (R&D) and through learning-by-doing (LBD).

1.6 METHODS OF DATA COLLECTION

This research will rely on the use of secondary data, which involves data collection from empirical literatures. These will be synthesized into a qualitative content analysis. The research will begin with the review of the relationship between intellectual property rights and technology and then examines the two ways in which comparative advantage can be endogenously created.

1.7 LIMITATIONS OF THE STUDY

The constraints will be lack of sufficient time, resources and limited access to sufficient information. The conclusion will be based on the analysis of empirical literatures.

1.8 THE ORGANIZATION OF THE CHAPTERS

For the purpose of clarity, consistency and balanced concept and analysis, this research is organized into five chapters. Chapter One gives the general overview of the research, statement of problems, aims and objectives, scope of the study, basic research assumptions, methodology and limitations of the study. Chapter Two provides the theoretical framework and review of related literatures. Chapter Three provides the review of the empirical literatures, which will serve as the basis for proposal of the research agenda. Chapter Four draws Insight from the Empirical Studies

and proposes the Research Agenda while Chapter Five draws conclusions and recommends a programme framework, which would aid in the pursuit of the research agenda proposed.

CHAPTER TWO

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 INTRODUCTION

While it is now fashionable to talk about Africa's need to be part of globalization, it is obvious that Africa generally is having a difficult time coping with the demands of globalization. There is little comfort to be gained from a World Bank statement that notes that in 1999, for the fourth year in a row, most African economies continued to grow – that growth comes on the heels of two decades of either stagnation or negative growth. Indeed, the 1999 World Bank annual report notes that although growth in Africa in 1998 was significant (5% growth in 13 countries) and stronger than in many other parts of the developing world, it was lower in 1997 due to weaker international commodity prices and barely enough to keep up with population growth. Africa's overall GDP growth in the 1990s was only 2%, reflecting slow-progress, or none at all, in large countries like South Africa, Nigeria and the Democratic Republic of Congo (World Bank, 1999).

African governments will need to actively encourage the participation of civil society in the debate on economic policy, and to seek the broad support of the population for the adjustment efforts. To this end, governments will need to pursue a more active information policy; explaining the objectives of policies and soliciting the input of those whom the policies are intended to benefit (Stanley Fischer, 2001).

2.2 THEORETICAL FRAMEWORK

Globalization involves the growth of multinational corporations (businesses that have operations or investments in many countries) and translational corporations (businesses that see themselves functioning in a global marketplace). The international institutions that oversee world trade and

finance play an increasingly important role in this era of globalization (Giddens, Anthony 1996-7).

Historically, the current phase of globalization is similar to the process of economic integration among nations, which began in the mid – 1800's and ended in WWI. During that period, the artificial barriers to economic exchange among countries were few and as a result, the flow of goods and capital across borders as well as migratory flows of people were few (Kavjilit Singh, 1999:5).

With regards to regional specialization, Globalization is marked by the increasing relegation of Third World labour to unskilled activities. EPZ's, which use cheap, unskilled labour, are often localized islands of economic isolation within their countries (Kubolajeh Logan 2004:11).

In addition, Global cultural homogenization has succeeded in integrating a small segment of Third World Societies into the global family, while effectively disconnecting them socially and culturally from their counterparts in their own countries. As a consequence, Third World Societies are being dichotomized in terms of standards of living, quality of life and lifestyles (Huntington, S. 1996).

The realities of political economy must be acknowledged when discussing globalization and its implications for Africa. We have to start our analysis, while noting that unlike other regions in the global economy today, Africa still suffers from the most acute problems of underdevelopment. After two decades of SAP, it is generally accepted that the 1980s' was a lost decade for Africa in terms of socio-economic development. The economic regression has been steepest in war-torn polities like Democratic Republic of Congo, Liberia, Sierra Leone, Congo-Brazzaville, Angola and Sudan. The annual mean rate of growth of per capita income in the region was 0.8% in the 1970's. This slumped to -2.2% (negative) per year from 1980 to 1989 and in the last decade, there

has been a slow recovery which by no means comes close to compensating for earlier declines (Ravenhill, 1993).

While some other developing regions have been able to profit from increasing levels of trade by diversifying production and trading partners, Africa for the most part has not. The region essentially has been bypassed by the conspicuous transformation in commodities traded globally (that is, manufactures and information technologies). This can be demonstrated by the fact that between 1990-1995, the region's share in the trade of developing countries fell from 10.9% to 6.4%, while its share with the European Union (EU) fell from 3.3% in 1992 to 2.8% in 1995 (Sachs, Jeffery: 1998).

Heyden et al remarked that while the current discourse on globalization is centered on new technologies and systems of production, Africa's economy is still heavily dependent on traditional primary exports, which continue to face the vagaries of global price fluctuation. Thus, structurally, Africa of the new millennium (2000) may not be too different from Africa of the year 1960, the year that became known as Africa year because of the large number of African countries that became independent (Hyden, Goran and Bratton, M. (eds): 1992).

2.3 LITERATURE REVIEW

Davids and Verbong (2007) use the case of Philips Electronics to explain that successful international knowledge transfer depends on the active role of firms, in particular their ability to recognize the value of new, external information and to assimilate and apply it to commercial ends; this ability is called the *absorptive capacity*. The Philips case underscores the findings in most studies in this field that a solid knowledge-base is essential for absorptive capacity because it enables a company to scan the environment for external knowledge and then to assimilate that

acquired knowledge. There is a continuous interaction between internal knowledge-building and external knowledge-acquisition.

Ravesteijn (2007) discusses globalization and technology development, focusing on colonial state formation and civil engineering development in colonial Indonesia, the former Dutch East Indies. Globalization, understood as the process of absorbing people all over the world into one global network of economic and other ties, began roughly when Europeans started exploring the world through sailing the oceans (from the fourteenth century onward). The subsequent processes of colonialism and imperialism are stages in the unfolding globalization process. Technology made this globalization possible, but also developed in connection with it. Dutch East Indies state formation took place between 1800 and 1950, and civil engineering works were dominant in the technology involved. Dutch engineers in public service constructed 67,000 kilometers of roads, 7,500 kilometers of railways, many large bridges, modern irrigation systems covering 1.4 million hectares of rice fields, several international harbors, and 140 public drinking water systems in the archipelago. With these public works, Dutch engineers constructed the material base of the colonial and postcolonial Indonesian state. His paper shows that the case of Dutch civil engineering in Indonesia contradicts the idea that globalization implies a simple processes of diffusion from the West. Dutch East Indies civil engineering development appears to be a process in which Western technology had to be adapted to local natural, social, and cultural conditions, and was shaped by a variety of Western and non-Western actors.

Weeks and Davis (2007) use a comparative case-study analysis to develop a model of interorganizational innovation. Innovation within outsourcing contexts is embedded within relational and environmental factors that have not been fully explored in prior literature. Yet, efforts to promote innovation within such contexts may be considered a special case of the diffusion of technology across institutional boundaries. Hence, the model derived from the case

studies describes the factors necessary for successful technology and knowledge transfer within information-technology outsourcing environments. The model consists of four components: the client, the supplier, the relationship, and the innovation outcomes. Within each of these components, they describe process and resource elements that influence the success of technology- and knowledge-transfer efforts. Finally, the interdependencies extant in the model are explored for a more complete understanding of the phenomena under examination.

Stiglitz's discussion (2003) focuses on the economic dimensions of globalization and tries to relate them in a more positive way to development. He concludes that the countries that have been most successful have had a comprehensive technology policy, including education, research, and finance. Asia is, infact, the most striking example of that success. But the US as well has had, over the years, a comprehensive technology policy, one involving education, research, and finance.

Bement (2006) talked about the role of frontier research and education in confronting the new challenges of our increasingly integrated world. New ideas and information emerge from every region of the globe and are transmitted with the speed of light. Research networks today are crisscrossing the globe, eclipsing geographic, disciplinary and time barriers. In short, we are now confronted with the "globalization" of science and engineering. On the other hand, science and engineering have always been international. The character of the scientific enterprise dictates openness and sharing. Today's computer and communications technologies simply make it orders of magnitude easier and faster, and even, more competitive. Most of the world's scientists and engineers are only a mouse click away. In his view, this globalization of science and engineering has not only led to stiff competition for ideas, but also for science and engineering talent and for leadership in turning knowledge into applications. To grasp how all-encompassing technology is, we must view every technological innovation in the larger context that includes both how people

use the technology and the affect of its exploitation upon people and institutions. Taken together, these two perspectives map how technology can transform the world. Bement concludes by creating a reminder on the larger context. That context is a world in which we hope to identify common problems and forge common solutions. The promise of globalization in the broadest sense is a world empowered by education, made safer, healthier and more secure through technology and enlightened by knowledge in the service of society.

In his attempt to identify several important cleavages that seem to run through the critical review of literature on the globalization of Information Technology (IT) and that are also found at the intersection of other technology-society issues (Mesthene), Ernest (2003) opined that IT amplifies other global trends that also challenge traditional state prerogatives. Because local cultural, institutional, and economic conditions differ so greatly, predicting any constant set of results for conflict and cooperation is impossible. Some states will adjust quickly, get ahead of the global IT curve, and respond creatively to new challenges as opportunities to better listen to, serve, and support their citizens. Their sovereignty may thus be enhanced. Other states, dreading changes prompted in part by IT, will provoke violence through their recalcitrance. These have some research and policy implications. First, there is a manifest need for serious and rigorous cross-national research that will consistently test the same hypotheses relating IT to various societal outcomes, in two or more countries. As part of such an effort, one needs to develop objective and sophisticated indicators of both diffusion and social impacts. The International Telecommunications Union (ITU) has developed indicators for telephone penetration, but there is no counterpart for the newer technologies. Second, there is a lack of serious national case studies of the expansion of IT in developing countries, especially using a single analytic framework.

Manuel Castells (1999) examines the profile of capitalism tooled by new information and communication technologies that are at the root of new productivity sources, new organizational

forms, and the construction of a global economy. This is centred around multinational corporations, global financial markets and a highly concentrated system of technological research and development. He stresses the extreme flexibility of the system, which allows it to link up everything that is valuable according to dominant values and interests, while disconnecting everything that is not valuable, or becomes devalued. This simultaneous capacity to include and exclude people, territories and activities is based upon a capacity to network. He summed that information and communication technology is the essential tool for economic development and material well-being in our age; it conditions power, knowledge and creativity; it is, for the time being, unevenly distributed within countries and between countries; and it requires, for the full realization of its developmental value, an inter-related system of flexible organizations and information-oriented institutions. In a nutshell, cultural and educational

development conditions technological development, which conditions economic development, which conditions social development and this stimulates cultural and educational development once more. This can be a virtuous circle of development or a downward spiral of underdevelopment. Moreover, the direction of the process will not be decided by technology but by society, through its conflictive dynamics.

In a United Nations Conference on Trade and Development, information and communication technologies (ICT) was identified to have had a profound effect on the way economic activities, including R&D, are organized, enabling firms to allocate tasks on a global scale through intra-firm information networks. At the same time, keeping up with new developments in ICT is a major challenge for developing countries wishing to accelerate their economic development.

Given the place of Africa in globalization as reviewed from the literatures presented, the present research sets out to critically examine globalization from the technological perspective and

focuses on the possibility and need to suggest specific research agenda of immediate relevance to policy formulation and advice in Africa and for democratizing global economic relations.

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CHAPTER THREE

AFRICA'S PARTICIPATION AND PERSPECTIVES IN GLOBALIZATION: TECHNOLOGICAL VIEWPOINT

3.1 INTRODUCTION

This chapter provides the review of the empirical literatures, which will serve as the basis for proposal of the research agenda. This consists of the intellectual property rights and technology, the models of learning by doing and technological leapfrogging. The chapter also considers research and development and looks into process innovation and vertical differentiation.

3.2 INTELLECTUAL PROPERTY RIGHTS AND TECHNOLOGY

The implementation of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) in principle adds another inescapable obligation to the commercial policy of member countries. African countries struggling to elevate their technological base need to scrutinize carefully the "tying of hands" implied in TRIPS so that they can be clear on where their interests lie with regard to the enforcement of this component of WTO agreements. This is also important to the management of intellectual property, where the goal should be to choose the terms and conditions that maximize the value of the intellectual property, not the terms and conditions that maximize its protection.

Without doubt, a certain level of protection of intellectual property rights is necessary for the ex ante optimal amount of investment in R&D in the aggregate. However, protection is rarely perfect for a variety of reasons. Strict enforcement of patents, copyrights and licenses could be very costly. "Reverse engineering", imitation, or inventing "around the patent" might be easy. Several

explanations and product-cycle models have been developed to study this phenomenon, as well as to study the technological implications for the South of a lax enforcement.

Vernon (1966) and Krugman (1979) studied product cycles, according to which the North produces and exports newly invented goods while the South specializes in goods that have been around for a longer period. The South's specialization in more "mature" goods underscores the implicit assumption that technology spreads to low-tech countries more slowly.

Other authors such as Chin and Grossman (1990) and Deardoff (1992) have studied whether the South benefits from protecting foreign intellectual property rights, and whether not doing so is particularly harmful to the North. Chin and Grossman construct a partial equilibrium duopoly model in which it may be in the South's interest to provide no patent protection at all. In their construct, the North always suffers from a failure of the South to protect while the South typically gains by allowing imitation unless its share of the world consumption of the product is very large. Deardoff establishes a similar result for product innovation and shows that as patent protection spreads to a larger portion of the world, the marginal benefit on aggregate welfare becomes negative. Taylor and Silberston (1973) also agree that R&D protection and other incentives to engage in R&D are necessary to ensure an optimal amount of investment in research effort. However, these authors observe that a survey of 27 British companies in research-oriented industries suggests that the reduction in R&D if patents did not exist varies across industries. Schmalensee (1988) and Levin et al. (1987) make similar observations on the varying effects of patent protection across industries.

According to Taylor and Silberston (1973), the proportion of research expenditures in the two major areas of chemicals and engineering that executives view as depending on patent protection were as follows: In chemicals: pharmaceuticals (64%), other finished and speciality (25%) and

basic (5%); in engineering: mechanical engineering, of which plant, machinery and equipment (7%), components and materials (2%) and electrical engineering (negligible).

Diwan and Rodrik (1991) develop a model that explores if and when the South can use protection strategically to influence the direction of technological progress in the North. In their model, both classes (the North and the South) have different preferences over the direction that technological progress should take, meaning the type of goods that should be invented. "The North would like to develop drugs against cancer and heart disease, whereas the South benefits more from drugs against tropical diseases. Labor is cheap in the South but expensive in the North, so the North's labor-saving innovations are less useful in the South" (Diwan and Rodrik, 1991: 29). The authors derive several implications of immediate relevance to this study: One is that South negotiations can take different views for different products. In products where, a priori, we can expect fewer differences in needs and tastes between the North and the South (software and textbooks in certain disciplines), the incentive not to enforce is the greatest. In others where differences in taste and needs are strong, such as in pharmaceuticals and agricultural innovations, a failure by the South to protect would deprive the South of the opportunity to influence the development by the North of technologies more suitable to the South. But what about the incentives that innovators themselves have to transfer knowledge and technologies abroad? Why would a firm wish to locate its activities offshore where it might be at some competitive disadvantage with local firms? The answers are many: Production costs might be lower overall. It may be a viable means of serving foreign markets, net of transportation charges and tariffs. Keeping trade secrets secure is another motivation.

However, Siotis (1999) derives an opposite result in which technological spillovers are primarily localized, so that the risk of dissipation of trade secrets prevents foreign direct investment (FDI) by a technologically superior multinational corporation (MNC). Siotis's model considers the

incentives for FDI that confront MNCs in a strategic environment. His premise is that MNCs derive their competitive strength from “knowledge-based intangible assets”. He models a two-stage game in which the strategic decision of how the MNC will serve the foreign market is made in the first stage. This is followed by a Cournot game (tactical rivalry in quantities) in the second stage, conditional on the choice of how to serve the foreign market made in stage one.

Three sources of incentives for FDI emerge in equilibrium: Under the assumption that both countries are endowed with human capital, the MNC undertakes FDI to source an advantage associated with foreign location since technological spillovers could be a two-way process. When the firm contemplating the FDI is technologically well ahead of it competitors, spillovers reduce expected profit and the firm will choose to export rather than risk dissipation. When there is no distinct technological lead by the MNC, spatially bounded externalities generate an FDI-enhancing effect in that FDI always occurs.

What are the implications of these outcomes when the foreign countries are not endowed with human capital? Put differently, what is the position of an African country that has no comparative advantage in imitation, or cannot cost-effectively imitate in the new WTO world? According to Siotis (1999), the answer is that technologically laggard countries do not count (that is, influence decision making). With trade barriers out of the way, an MNC has a choice of either engaging in foreign direct investment or of serving the market through exports. This is a remarkable result: Market integration and lax enforcement of intellectual property rights could generate some benefits for countries having comparative advantage in imitation, and having an added advantage of an “attractive” market. Otherwise (that is, under a strict regime of enforcement), free trade constrains the capabilities of low-tech countries to leapfrog technologically. China is a nation that could have benefited under the first scenario and indeed may have exploited that advantage (before TRIPS).

Hortsman and Markusen (1992) also build a model of foreign direct investment showing that MNCs are most likely to emerge when the fixed costs of adding a plant or maintaining a subsidiary are small, particularly in comparison with the size of transport costs, trade barriers and fixed costs of operating a firm. It turns out that R&D expenditure is the type of firm-level fixed cost that generates economies of multi-plant production. His model highlights the indirect role of technology in inducing technology transfer by innovators (in a bid to exploit multi-plant economies). How strongly this effect operates in practice is yet to be clearly determined.

As a choice in the MNC menu of serving foreign markets, licensing comes with complications that have been well explored in the literature (Ethier, 1986; Grossman and Helpman, 1991). Being incomplete, such contracts are necessarily inefficient and riddled with agency problems. Opportunistic behaviour on the part of the licensee or the licensor can create additional costs. The licensee may exploit the technology to develop a better product. The licensor may renege on promised exclusivity. Anticipating such behaviour, the licensee may bid for less than the license is worth and so the innovator suffers dissipation in expected profits. Of course there is always the risk that both direct investment and licensing might speed up the process of imitation and diffusion. It may be that learning spillovers which may take different forms including reverse engineering and the gleaning of products and processes, are more probable when production takes place locally than when goods are imported from a foreign manufacturing base. Then the potential MNC/licensor must weigh the gains associated with having lower production costs against potential losses from a rapid erosion of its monopoly position. Evidently the focus of many of the papers in this area is on a firm's choice of how best to exploit the technological advantage it has gained. Of utmost relevance to the South is the question of how to encourage technology transfer to an indigenous base without causing the innovators to take their business elsewhere**.** Grossman and Helpman (1995) suggest that for that we need to study how knowledge is transmitted within and between firms. In other words, how technological capabilities are

actualized within economies, which the theoretical literature seeks to understand by modelling the endogenous creation of technological progress that can come either from LBD or from investments in R&D.

3.3 MODELS OF LEARNING BY DOING

Learning-by-doing is the repetition of certain production processes that may in turn allow firms and industries to discover more efficient ways of doing things - *process innovation*. When a learning experience is confined to a single plant or firm, the distinction between learning-by-doing and more formal R&D activities may not be of essence, because in both cases the firm recognizes a cost of creating knowledge, which it weighs against the potential benefits of a new or improved technique (that is, the firm fully internalizes the decision).

The literature notes that once it is recognized that knowledge spreads, the pertinent (empirical) question is to identify the universe of learning: Does learning occur from the activities of firms in the same industry within national borders, across national borders, or both within and across national borders? From local firms in other industries, or from other industries outside the national borders? To cite three examples, Irwin and Klenow (1994) investigated the existence and the geographic scope of knowledge spillovers from learning- by-doing. They found that firms do learn from the experience of others, and that learning does spill over as much across borders as it does within firms located in the same country.

Karshenas and Stoneman (1995) and Sarkar (1998) provide recent surveys of theoretical and empirical studies on technological adoption. The literature suggests adoption frequencies as crucial to understanding how technological possibilities are actualized within an economic system, as well as how effective are different economies and regions at upgrading or mimicking.

Grossman and Helpman (1995) provide a unifying perspective in a model that facilitates the isolation of the specific implications of each assumption driving the various special cases in which spillovers are limited in some way. Examples would be the cases in which spillovers are limited to a firm in a given industry, or to a cluster of industries, or to a firm operating in a given country or in a geographical area (such as an industrial conurbation).

The elements of the model may be summarized thus: All outputs are produced solely by labour, and production everywhere exhibits constant returns to scale. The labour necessary to manufacture a unit commodity in some country depends not only on the commodity- specific productivity of labour "intrinsic productivity"), but also on the technical know-how ("accumulated knowledge") available. In these models, the accumulation of knowledge occurs simply in the course of manufacturing output.

3.3.1 COMPLETE INTERNATIONAL SPILLOVERS

This is the case of bi-directional spillover benefits. Technical information flows readily across international borders and the experience of local producers contributes just as much to the overall knowledge base (that is, as much at home as abroad). Although industry specific, learning is external to firms in the industry. Learning is proportional to cumulative industry output globally. In this case, learning (technical progress) is neutral to comparative advantage and hence does not influence the pattern of trade. Nonetheless, trade may affect national rates of productivity (since manufacturing increases knowledge) and output growth across all time horizons.

3.3.2 NATIONAL SPILLOVERS

Basically, firms are assumed to learn more from the experiences of other domestic producers than from firms abroad. So, learning increases productivity in own goods (locally manufactured tradeables) to the total exclusion of foreign rivals. Similar results obtain in the foreign country.

The comparative advantage widens and the initial trade pattern gets locked into place. The lesson is that *history matters* since the initial pattern of specialization depends on both intrinsic productivity and industry know-how. Some of these models that analyse a two-good world (say, high-tech goods and low-tech goods), with complete or incomplete specialization, raise the possibility that countries lagging in technological development and having an initial comparative advantage in "non-dynamic" sectors might want to use trade policy to alter the pattern of specialization (to "break out").

Grossman and Helpman (1995) note that a laggard small country at the margin of competitiveness in the faster growing sector would gain from a policy-induced switch. Both these authors and Rodriguez and Rodrik (1999) note that the trade-off between the static efficiency loss from the intervention and the dynamic gains (from productivity boost) favour intervention. The key issue here is that intervention needs to be "time bound" and predictably so. According to Rodrik (1992), once firms reach the world technological frontier and the learning effects are exhausted, the protection should be stopped. Unfortunately, asymmetric information between the protected group and the policy makers generate perverse incentives.

As policy makers can only observe imperfectly how well the protected firms appear to be doing, firms have an incentive to misrepresent their position relative to the technological frontier. All too often, temporary protections become permanent under political pressures. Rodrik sees the prevalence of a "soft-policy" regime as a powerful argument for eschewing selective protection of industries and downplaying the discretionary element in trade policy. A central message is that policy success in this regard (measured in terms of net welfare position) will depend significantly on the qualitative dimensions of trade policy and the nature of the state. He cautions that as policies are not implemented in a vacuum, their consequences are mediated through the state and

markets to produce qualitatively different outcomes from that primarily envisaged. Hence the analyst must be aware of these conditioning influences.

Krugman (1987) makes a slightly different point about policy in his analysis of two large countries with numerous goods. Under the assumption of localized spillovers in learning, each country has an incentive to subsidize production of a few goods near the margin of competitiveness so that it can gain technological advantage in their production. Hence it expands its range of manufactures, continues to boost productivity and creates more employment. The implicit assumption is that protection is for only a short term. The incentive to nibble at products, or slice out sectors, continues for a while. Observationally, trade protection is seen to endure while this phenomenon, which Krugman dubbed the "narrow moving band", continues. The protection does not last indefinitely, as eventually the wage differential between the countries becomes sufficiently large that the marginal social cost of the next slice exceeds the expected value of the discounted future stream of benefits.

3.3.3 INTER-INDUSTRY SPILLOVERS

Models in this category examine the implications for inter-sectoral learning when there are differential contributions to knowledge from industries. Using a case in which learning takes place only in the course of producing one good although productivity is imparted equally in each of the two sectors, a particular specification of the model yields an equilibrium in which an exogenous improvement in the productivity of the technologically disadvantaged sector can lead to a decline in growth rate (Grossman and Helpman, 1990, for instance). Moreover, if a country happens to accumulate more of the factor specific to the disadvantaged sector, it also can generate the effect noted above. As an example, one can think of a sector investment programme (delivered as aid) that is targeted to the disadvantaged sector. Or, one can imagine as well, a boost in export (from the disadvantaged sector) brought on by free trade. Under free trade in a

technologically-driven world, high-tech countries may be altogether too willing to forgo competition in the low-tech sectors. Conceding these sectors to developing countries in a free trade regime will, in our context, dynamically lead to a decline in growth.

3.3.4 INDUSTRY CLUSTERS

The possibility that industrial conurbation might gravitate to particular nations was first noted in Posner (1961). He argued that this dynamic process might occur if LBD generated spillovers within but not between clusters, with these spillovers limited in their geographic reach. The intuition is that if a country initially produces a large quantity of any one good in a cluster, then the learning spillovers from this activity will tend to confer a dynamic comparative advantage in other industries in the same cluster (consistent with the forces of inter-industry spillovers discussed in the preceding section). This occurs even if productivity in the neighbouring industries is low initially. Here again, history would seem to matter, for then a country that has an initial comparative advantage in producing the most popular good or goods in a cluster would tend, over time, to gain competitive advantage in producing the remaining less-popular goods. Resting basically on the same principles, this prediction is similar to Krugman's "narrow moving band", according to which sectors are sequentially sliced off, or products are systematically nibbled off.

3.4 TECHNOLOGICAL LEAPFROGGING

Bresiz, Krugman and Tsiddon (1993) identify conditions under which a country that begins technologically behind may eventually surpass its trading partner, only to be overtaken again in a subsequent phase of the periodic steady state. This pattern obtains because new and superior technologies, arriving exogenously in their model, may be adopted by the lagging country even though they are not profitable in the leading country.

Grossman and Helpman (1995) note that leapfrogging can indeed arise anytime LBD is bounded for a given product and specific to the product and country. Then, if the eventual superiority of the new arrival is not enormous, inertial forces will propel existing producers to pass over the new in favour of the "tried and tested". No single firm in the experienced country will find it profitable to switch, particularly as it is unable to internalize the externalities from learning.

However, because of its lower wage level, the firm in the lagging country could adopt the new arrival even without the benefit of any experience in the new technology. Post adoption, the firm experiences a productivity boost over time, and by virtue of superiority of the new technology, displaces the previous leader. By construction, the "laggard country" in the current technology always enjoys a comparative advantage in any new technology that may "happen along". Such a set up, in which leadership contains the seeds of obsolescence and the follower is "heir apparent", generates (in steady state) the alternating (now advantaged, next disadvantaged) technological identities of the countries. To place any great faith in the possibility of leapfrogging as a source of growth for Africa, one would first have to think hard about how often technology exogenously "happens along". It can happen, though, through licensing. It turns out that for firms in low-tech countries, possessing the opportunity to purchase inventions and innovations mimics an "exogenously arriving" technology.

The possibility of technology transfer under licensing to other firms leads to a consideration of the incentives to license (for a firm) or to license multiple firms (in the case of an independent inventor). For an independent inventor (that is, a firm specializing in R&D), it may be the only way to exploit a patent. In general, a firm will be reluctant to license a rival because the knowledge transfer might allow the rival to invent around the patent, or even to develop a superior technology (leapfrog, in our context). Closely related is the issue of "sleeping patents" or "shelving" in order to foreclose access to technology. One way around this allegation is to force

the patent holder to license others. Moreover, “shelving” should become part of WTO agreements in order to eliminate the free-rider problem that can prevent aggrieved firms from seeking redress by way of compulsory licensing. The free-rider problem arises when one firm invests in proving “shelving”, only to have other firms costlessly benefit from a successful challenge. One last point on the subject of incentives to license is the fact that licensing may also increase product market competition (and so possibly reduce expected profits) unless the licensee serves a segmented market. The global trend towards market integration narrows the set of markets that may now be considered segmented on the basis of trade barriers. Next, we turn to models that examine the connection between trade and technology when new technologies arise from planned investment.

3.5 RESEARCH AND DEVELOPMENT

The literature takes the protection of intellectual property rights as fundamental before an environment can be considered conducive to R&D. Without such protection, under-investment results as investors cannot fully appropriate the benefits of their investments, or so the argument goes. Protection can take a variety of forms: Explicitly through a grant of patents, or implicitly from imitations being a costly process, or from success at preserving trade secrets. Because proprietary rights to technology confer market power, imperfect competition is at the core of models that explore this aspect of trade. The extant model in this area is due to Ethier (1982).

Helpman and Krugman (1985) and Dixit and Stiglitz (1993) are important additions. Contributions and extensions focusing on the impact of the proprietary access to innovative technology include Grossman and Helpman (1990) and Coe and Helpman (1994). In these models, the innovation is in the proliferation of the variety of intermediate inputs. More varieties are associated with increased specialization and hence productivity. Therefore, on going innovation requires sustained increases in research productivity. The nature of the stock of knowledge determines the evolution of trade in a global economy.

3.5.1 KNOWLEDGE SPILLOVERS – GLOBAL

Whereas trade is neutral on productivity in an LBD model with complete international knowledge spillover, access to intermediate goods through trade is a substitute for international spillovers in this R&D model productivity depends on the variety of intermediates, but not on the sources. However, this is only with respect to manufacturing. The country that imports inter-mediates will lag behind in technological innovation since knowledge stock is proportional to the number of projects undertaken, and own productivity in research is proportional to that country's local stock of knowledge.

Suppose that nature smiled on a country so that it invented a disproportionate number of intermediates before trade commenced. Grossman and Helpman (1991) demonstrate that history (initial conditions) is irrelevant in determining the ultimate pattern of trade when knowledge is a global public good, as any competitive advantages due to prior experience

are bound to be short lived. Where factor compositions are uniform, trade accelerates every country's long-run rate of innovation, just as in the case of one final good and one primary factor. With global knowledge spillovers the stock of wisdom grows faster in a larger economy.

Where the countries differ in factor composition, innovation must accelerate if the differences in factor abundance are small. But if the differences are large but do not rule out factor price equalization, trade mimics an enlargement of the economy to which the human-capital poor country is now a part. Since an increase in the relative access to human capital benefits the poor country, it experiences an increase in the rate of innovation in its high-tech sector. Trade also has the effect of forcing the poor country to specialize more in the production of traditional goods than would be the case in autarky. The forces between the increase in productivity in the high-tech sector and the increased production in the low-tech sector might on balance slow the

country's rate of technological progress. A very high gain in a relatively small sector and a small decline in a large sector could on average yield a decline (much like the dependence of changes in total revenue, on the relative adjustments of price and quantity along a segment of a demand curve).

3.5.2 KNOWLEDGE SPILLOVERS – NATIONAL

Grossman and Helpman (1991) and Markusen (1991) are extant models in this area. As usual, the stock of knowledge that determines national research productivity accumulates in proportion to local research activity. A traditional consumer good is manufactured with constant returns to scale, while the high-tech product is assembled from differentiated inputs of which research generates the blueprints. Starting with equal sized countries, each always producing some of the traditional goods, competitive forces equalize wages. With wage rates always the same, prices of intermediates are the same in both countries. This implies that the R&D activity will be more profitable under a lower cost of innovation.

Since the cost of invention (by specification) depends only on wages and knowledge stocks, R&D blossoms in the country with the larger knowledge stock. Several results follow from this model: (1) Initial lead is self-reinforcing so that the leader dominates in the high-tech sector. Yet again, history matters. (2) Trade can reduce the rate of innovation in the lagging country as, post integration, competitive forces drive its resources out of R&D activities (see also Feenstra, 1990, and Matsuyama, 1992).

It is quite possible for a country with a natural comparative advantage in R&D arising, for instance from an abundance of human capital to initially lag in accumulated knowledge. In this case, its cost advantage may offset its weakness from a low base of accumulated knowledge. As well, a large country even though lacking in natural advantage and no sizeable accumulated

wisdom can overcome its history through its largeness. Helpman (1984) demonstrates that since R&D is an activity with dynamic increasing returns to scale, the benefit of size when there is a national stock of knowledge is similar to national increasing returns to scale in production.

This section shall be ended by underscoring the model predictions about the effect of trade on technological progress given country size, history and restrictions on technology dissemination.

As specified above, trade can slow a technologically laggard country's rate of innovation, if there is another sector to which its resources might be driven (as would realistically be the case). Feenstra (1990) analyses the size effect. Assuming one final-goods sector in each country, using intermediates invented in the research lab, profits (incentives for R&D) erode faster under integration for the small country, and so slow down the steady-state rate of technological progress. The enlarged market effect is conducive to the large country for which technological progress is accelerated everywhere along the transition path to steady state.

3.6 PROCESS INNOVATION AND VERTICAL DIFFERENTIATION

This involves investments to reduce production costs either through improvements in the quality of inputs or declines in the primary resource costs of manufacturing final goods. Hence the present analysis contrasts with previous discussions that dealt with models of horizontally differentiated varieties. The building blocks here are due to Aghion and Howitt (1992) and Segerstrom, Anant and Dinopoulos (1990).

There exists at any given time, the latest version of an input used by firms for production. The final good is assembled from a fixed number of intermediate inputs. Other than these modifications, the structure of the model is similar to that used to explore models of horizontal product differentiation. The linkages between process innovation and growth are also similar to those found in the horizontal case. The productivity of the economy once again depends on the

accumulated investment in R&D. Hence innovation rate and growth rate of final output are both proportional to the total R&D base research activities are here also subject to dynamic scale economies. Under market integration, there is a boost to technological progress because the instantaneous probability of a breakthrough is higher when two potential winners are pooling in the race than in autarky. Another distinction of process innovation models is that international spillovers occur naturally with trade because innovations are observed or broadcast through the arrival of the "latest" input. Therefore, localization of spillovers such as may occur under horizontal differentiation does not obtain.

In summary, therefore, a small country that is a high-tech laggard may be disadvantaged by trade. But when the learning process is characterized by dynamic scale economies, the opportunity for gains from market integration may be brighter than is suggested even by static considerations of trade benefits. Evidently (as we prepare to jump into the empirical side of things), many of the answers to the questions that motivated research along the lines reviewed here turn on the nature and extent of technological spillovers. Empirical evidence on these important pivots, although still scanty, nonetheless suggests that spillovers are mostly geographically localized.

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CHAPTER FOUR

THE PROPOSED RESEARCH AGENDA

4.1 INTRODUCTION

The present chapter draws insight from the empirical studies and proposes a suitable research agenda.

4.2 INSIGHT FROM EMPIRICAL STUDIES

Many of the key issues on technology and trade cannot be meaningfully addressed without firm-level data, particularly if as Grossman and Helpman (1995) emphasize, we need to understand how know-how is transmitted within and between firms. Nonetheless, as a framework for the study of these phenomena, models of technology diffusion and adoption have been developed. Some more recent surveys of the theoretical and empirical works in this area include Karshenas and Stoneman (1995) and Sarkar (1998).

Empirical studies on adoption have usually focused on the diffusion of technology over time and on assessing the factors that determine the diffusion rate. These studies have determined that adoption of newly available technology follows a logistic curve and that the diffusion rate varies across industries and technologies. More recently, other researchers have used duration models to assess the relevance of different explanatory variables on the probability of adoption. The literature (exclusively descriptive of western industrialized nations) so far seems to have settled on the following stylized facts (Giovannetti, 2000):

(1) At any point in time, adoption frequency is asymmetric in a given industry, and (2) in the adoption of new technologies, there are highly diversified geographic patterns. There is also

mounting evidence that diffusion is localized. Among the most recent studies are Keller (2000) and Audretsch and Feldman (1996).

In general, the theoretical underpinnings of most recent empirical studies of technology diffusion can be categorized into the neoclassical equilibrium models, and the evolutionary disequilibrium models. Although the seminal research on diffusion relied on epidemic models of diffusion, it lacked theoretical rigor and soon fell out of favour among researchers in economics. The new models emphasize modelling the decision making process of adopters, and the microeconomic foundations of the dynamics of the diffusion process. The focus of these models has been primarily on how to characterize the mechanics of the diffusion process and that of the decision making procedures driving the diffusion process. Accordingly, the neoclassical equilibrium models assume rational agents with full information, while disequilibrium models rooted in evolutionary theory are based on limited information and a more open loop decision making process and diffusion dynamics. The evidence from empirical and historical studies on these alternative approaches is mixed. Sarkar (1998) notes that "As with the theoretical studies, distinct divisions, often conflicting, can be identified in existing empirical evidence, and in the technological historians interpretation of the dynamics of technological diffusion" (p. 133).

The literature makes a distinction between intra-firm and inter-firm diffusion. Intra-firm studies the level of use of technology by a firm – the proportion of firm output or the proportion of its capital stock tied to the new technology. Inter-firm is quantified by the proportion of firms in the industry using the new technology. Through a broad consideration of both the rates of intra- and inter-firm diffusion, researchers can extract the growth rate of the share of total industry output produced by the new technology. This share would be a more aggregated measure of the diffusion in an industry. Aggregating over industries provides an economy-wide measure of diffusion.

A review of the advantages of both the neoclassical and the disequilibrium models leads us to favour an eclectic approach to the study of diffusion. Under this framework, we find that the game theory approach is capable of encompassing the vital elements of both sides.

In the game theory framework, the process of diffusion is modelled as an outcome of the strategic behaviour among potential adopters. Timing is the decision parameter, which is chosen so that adoption leads to staying ahead of the pack. Game theory perspective forces a consideration of rivals' decisions, a sensible point when one recalls that competition (or spillovers, which here has the same effect as competition) reduces the expected benefits from imitation and so implicitly raises the cost of imitation. Game theory models are also capable of identifying externalities. In particular, the network models of Farrell and Saloner (1986) and Katz and Shapiro (1986) incorporate positive externalities in a more general way, rather than focusing only on informational externalities and learning. In their models, potential users are assumed heterogeneous with different preferences for the innovation. They simultaneously decide whether to switch to the innovation or stick with the status quo, given that the benefits from adoption are positively related to the number of existing adopters. In the non-cooperative equilibrium, switching strategies depends on an individual firm's preference parameter, which is increasing in adoption-propensity. Within low values, a firm will not switch regardless of rivals' behaviour in period one. For intermediate values, a firm decides to switch in the second period conditional on observing that rivals shifted in the first period. For high values, however, a firm decides to switch in period one. Therefore, in equilibrium, the diffusion profile will depend on the configuration of individual preference values. In a duopoly, if both firms have preferences that range from low to intermediate values, diffusion will be characterized by *excess inertia* where neither firm adopts the innovation. Conversely, when both preferences assume high values, the diffusion profile will be characterized by *excess momentum* whereby the firms rush to adopt. Internalizing these kinds of externalities may require the government to co-ordinate on the equilibrium.

Evolutionary theorists point to the importance of institutions and call to question the realism of rational choice in contexts where existing cultural values, moral attitudes, folkways, traditionally oriented behaviour, fear of ostracization, power relationships and vested interests may impinge on rational decision makers, causing them in many cases to stick to existing routines of behaviour rather than switching to new ones (Sarkar, 1998). These concerns can be incorporated into the models described above through the preference parameter. They can also be studied empirically as part of the imitation costs in the nature of inertial forces to be overcome. The real challenge is to surmount data problems involved in explicitly incorporating these important qualitative elements into a model. This is perhaps the reason evolutionary theories of diffusion that emphasize the influences of qualitative factors on the incentives for, and on the capabilities of, adoption rely mainly on historical descriptive methods.

4.3 THE RESEARCH AGENDA

The survey of the literature and the conceptual issues covered in this study present us with a number of research entry points. New knowledge in these areas would be critical for strengthening the technological position necessary for Africa's effective and equitable participation in the global economic system. The underlying philosophy of the proposed research programme is to add Africa's voice in shaping the emerging international regimes and to contribute to the debate or to challenge the "consensus" that has emerged without any serious consideration for its impact on Africa. This philosophy suggests a few research areas where the African Technology Policy Studies Network (ATPS) can make some meaningful contributions. Although, the incentive to engage in international relations is derived from strong domestic policies, national capabilities and ultimately a robust regional position, the research agenda should reflect these positions.

4.3.1 INTERNATIONAL PATENTING REGIME AND TRIPS

The enforcement of the WTO agreements under TRIPS has serious consequences for the technological base of African countries in their fight against poverty and disease. While respecting the need for intellectual property protection, the proposed research would examine the specific provisions of TRIPS and relate them to the needs, tastes and natural endowments of selected African countries so as to understand the conditions that maximize the value of the intellectual property, as well as the terms that would minimize protection.

What would be the implications of strict enforcement of patents on reverse engineering, imitation, specialization and inventing around the patent? Are there ways in which to democratize the protection regime in some products where access is critical for sustaining and improving livelihood, as in pharmaceuticals? What of agriculture and biotechnology? What sort of influence can Africa exert in terms of the technological progress in the North in these areas? How do these relate to the incentives that innovators have to transfer knowledge and technologies abroad? There is a current debate in Africa on the edge of these issues, but it is largely lopsided and has not been motivated by research with an African perspective.

4.3.2 GLOBALIZATION, DIFFUSION AND IMITATION COSTS

Under this proposed agenda, the market integration and its impact on technological possibilities and how these possibilities are exploited within economic systems in Africa are examined. How effective are different economies and regions at the technology upgrading necessary for exploiting the gains from globalization? Studies of adoption frequencies provide part answers to these questions of critical importance to technology policy formulation and research on logistic diffusion and innovation surveys are some of the available research strategies.

Critical aspects of this agenda for determining how technology opportunities are exploited under globalization are the study of imitation and adoption costs, the study of transport and communication costs and the cataloguing (taxonomy) of technology opportunities or "innovation size", as Giovannetti (2000) indicates, where size refers to its likely impact (cost saving) on production processes. What is the international regime under which imitation can be carried out successfully? In which sectors are these most profitable for Africa? Are there loopholes in the international trade regime (WTO) that Africa can exploit? Is the globalization of technology, that is, the market for technology, becoming more competitive and hence improving the accessibility and availability of technology to developing countries in Africa? What sets of innovation policies do African countries need to put in place in order to engage meaningfully in the globalized market?

We would also explore the extent of market integration for technology by looking at logistical costs. The lower the costs, the more integrated are markets and vice versa. When markets are geographically close but subject to prohibitive logistical costs, these markets from an operational standpoint remain segregated. Other imitation related costs are schooling and on-the-job training, including labour training externalities whereby firms risk losing valuable investments in an employee upon a job change. The externalities arise because firms are unable to guarantee full appropriation of the value of their investment in an employee who can migrate to rivals' plants. These factors suggested for study are important building blocks for testing the prediction that unless imitation costs, or adoption costs, or costs of upgrading (as the case may be) are progressively reduced, adoption processes will not spread uniformly in space when markets are highly integrated. Under globalization, the implication of the foregoing prediction is that the North–South technology gap will be exacerbated by integration unless globalization comes with reductions in the costs of adoption. Are there ways of minimizing these costs without violating the WTO agreements?

4.3.3 TECHNOLOGY TRANSFER AND LOCALIZED DIFFUSION

In the globalized and WTO world, foreign direct investment (FDI) flows are supposed to reflect comparative advantage for the recipient as well as the originating country. In view of the mounting evidence that diffusion is geographically bounded, the role of foreign direct investment in technological spillovers becomes crucial. Therefore, given the mixed evidence (Markusen, 1995) as to whether the level of foreign investment is positively related to the existence of trade barriers or transport costs, the proposed research agenda includes the task of assessing the sensitivity of foreign direct investment to tariffs within the region and the implications of this for technological capabilities in Africa (such as, learning-by-doing, etc.).

This might shed some light on whether globalization would affect knowledge spillovers from MNCs by eliminating the need to overcome trade barriers through offshore location.

The proposed study would further examine whether there are particular industries, sectors or firms where FDI flows are consistent with technology transfer. Other questions are: How do firms identify important technologies in the globalized world? Do they automatically choose the right technology based on the market signals? What are the roles for government and institutions? What do these say for Africa's technological competitiveness and participation in the global market? The result of this study will provide the ammunition the continent needs, not only to be selective in FDI promotion, but also to argue at the WTO for certain special concessions for investments that have huge technological spillovers and for protection where learning-by-doing (LBD) appears greatest. A detailed analysis would also reveal the nature (firm specific characteristics including ownership structure) of the firms where spillover is consistent with poverty eradication.

END NOTES

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10. CHAPTER FIVE

11. CONCLUSION AND RECOMMENDATIONS

12.

13. 5.1 INTRODUCTION

14. This chapter presents the summary of major findings of the study following which recommendations are proposed.

15.

16. 5.2 CONCLUSION

17. The study has analyzed the extent to which the World Trade Organization (WTO) agreements, particularly the technology-related provisions, could enlarge the capabilities of African countries to procure and develop modern technologies. It also proposes research agenda to study the resulting empirical implications, ultimately to identify specific technology policy issues that African countries should emphasize in the continuing debate on the effect of global market integration.

18. The particular assumptions made about the nature of the economic environment concerns the endogenous creation of comparative advantage through technology, but under the economic environment of free trade and perfect patent protection (taken to mean the complete policing and enforcement of intellectual property rights). This endogenous creation of comparative advantage can occur through research and development and through learning-by-doing.

19. Insights were drawn from these ideas and from the empirical literature. Specific research agenda of immediate relevance to policy formulation and advice in Africa is recommended and for democratizing global economic relations.

20. The study would be useful in analyzing the qualitative implications of technical aid, particularly that directed to technologically disadvantaged sectors of a country's economy.
21.

22. 5.3 RECOMMENDATION

23. A programme framework which would aid in the pursuit of the proposed research agenda is recommended. This is possible through the formulation of a multi-disciplinary team of scientists, social scientists and lawyers. In consultation with this team as well as other experts in institutions such as the United Nations Institute for New Technologies in Maastricht, the Netherlands and the African Centre for Technology Studies, a detailed methodology for addressing the questions raised in the proposed research agenda should be developed. The research process will start with a validation/methodology workshop that will elaborate the research questions, formulate the research methodology and lay out the implementation process. This workshop will have a mix of researchers, policy makers and key actors in the NGO sector. Papers that have mapped the research questions and the methodologies in the three categories mentioned above will form the core of the workshop agenda.

24. It is expected that the implementation of the programme will be carried out by country teams who will constitute the base for fieldwork and for robust regional positions grounded on a synthesis of findings in the areas identified. Additional workshops may be required for reviewing the progress of the research and for in situ dissemination. Policy briefs and country level as well as regional dissemination exercises will be an integral part of this research process. In order to carry all the actors along, it is imperative to invite researchers and interested others to attend all the workshops. Senior African scholar in this field should be identified and tasked with the responsibility of providing the overall intellectual leadership for the programme.

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