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Structural Change, Poverty Reduction and Industrial Policy in the BRICS

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FOREWORD

This publication comes at a time of major shifts in the world economy. The decade following the turn of the new millennium has been characterized by the emergence of the BRICS countries—Brazil, the Russian Federation, India, China and South Africa—which have come to account for a significant share of economic growth, demand expansion, industrial production and wealth creation in today's world. The success of these regional economic powers in achieving sustained economic growth and poverty reduction has become a reference point both for developing countries to emulate and for industrialized countries to regain economic dynamism.

What can other countries learn from the BRICS's development experiences? To answer this important question we need to disentangle the similarities and diversities that characterize the development patterns of the BRICS. All BRICS countries share some commonalities, for example, their rapid structural change and improved economic performance in the 21st century, as well as their role as significant sources of regional demand and production, accumulation of industrial capabilities, regional technical cooperation and South-South technology transfer.

Despite these commonalities, the structural transformation of the BRICS's economies has differed in terms of direction, speed and economic outcomes. While the manufacturing sector has been the engine of growth, employment generation and poverty reduction in China, services have played a more important role in India, and recently in Brazil. Like the Russian Federation and South Africa, Brazil has also made use of its abundant natural resources to support its growth. Sustaining the pace of economic growth in the years to come will require an even stronger role for manufacturing in all BRICS countries.

These experiences suggest that there are multiple paths that different countries can take to achieve economic development and poverty reduction. Differences in the stage of development, accumulation of technological capabilities, resource endowments, history and policy may generate divergent patterns of structural change and may have very different impacts on poverty. It is therefore crucial to identify how these conditions have promoted or at times restrained economic development in the BRICS in order for developing countries to draw relevant implications for their own development contexts.

Numerous studies document East Asia's success story, the conditions that led to the region's growth and the possible policy implications for other regions. In contrast, systematic and comparable analyses on the newly emerging BRICS economies are still scarce, although such studies are indispensible in the context of the current global economic situation. The present report is an attempt to fill this gap, focusing on the issues of structural change, sustainable industrial development, employment and poverty. To gain greater insights into these issues, in-depth country analyses and thematic comparative studies are presented, which add new perspectives to the interpretation of facts. Furthermore, the report draws policy implications and derives lessons from the BRICS countries' experiences.

It is my sincere pleasure to note that the analysis and lessons contained in this report are the result of a major effort that has brought together the expertise of UNIDO, UNU-MERIT and academics from around the world, as well as inputs from representatives of the BRICS countries themselves. I hope that the findings of this report are useful for developing countries to better understand the BRICS experiences and to formulate their own industrial development strategies and approaches.

Kandeh K. Yumkella

Director-General, UNIDO

FOREWORD

The impact of the five BRICS countries on the global economy is substantial, not only because of their sheer size, but also because of the trade and other economic relations they have with other countries. Their rapid development and growth performance in the 21st century has impressed policymakers and researchers alike. This is why UNIDO and UNU-MERIT decided to join efforts and launch a project that probes the underlying nature of structural change in the BRICS countries. The two institutions brought together a large group of researchers, resulting in the collection of an abundance of new insights which are summarized in this report.

Although the use of the BRICS label suggests that these countries share common characteristics, the differences between them are probably much larger than their commonalities. This report investigates both the similarities and differences between them, with the primary aim of unearthing how industrial and other policies have contributed to the success of the BRICS countries. We sincerely hope that countries around the globe can draw valuable lessons from the BRICS experience and that this report proves useful in the broader context, helping governments implement policies aimed at structural change and the reduction of poverty.

B. Verspagen

Bart Verspagen
Director UNU-MERIT

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This report is based on a series of background papers commissioned by UNIDO for a project entitled: *The Untold Story: Structural Change for Poverty Reduction - The Case of the BRICS*. Experts involved in the preparation of the background papers for the report included Nobuya Haraguchi and Gorazd Rezonja (UNIDO) (Chapter 2 and Sections 4.2, 5.3 and 5.4); Wim Naudé (UNU-MERIT and Maastricht School of Management, The Netherlands), Alejandro Lavopa and Adam Szirmai (UNU-MERIT) (Chapter 2 and Section 5.2); Dante Mendes Aldrigh and Renato Perim Colistete (University of São Paulo, Brazil) (Section 3.2); Boris Kuznetsov, Andrei Yakovlev and Vladimir Gimpelson (Higher School of Economics, National Research University, the Russian Federation) (Section 3.3); Aradhna Aggarwal (National Council of Applied Economic Research, India) and Nagesh Kumar (Economic and Social Commission for Asia and the Pacific) (Section 3.4); Miaojie Yu (Peking University, China) (Section 3.5); Ximing Yue (Renmin University, China) (Section 3.5); David Kaplan (University of Cape Town, South Africa) (Section 3.6); Michiko Iizuka (UNU-MERIT), Eva Dantas (Science Policy Research Unit, University of Sussex, UK) and Isabel Maria Bodas Freitas (Politecnico di Torino, Italy) (Section 4.3); Yanyun Zhao (Renmin University, China) (Section 5.2); John Weiss (University of Bradford, UK) (Section 5.3); Fred Nixson (University of Manchester, UK) (Section 5.4); Ruth Rama (Instituto de Economía y Geografía/Consejo Superior de Investigaciones Científicas, Spain) (Section 5.4); and Michele Di Maio (University of Naples, Italy) (Section 6.2). The report also builds on a previously published paper on the BRICS by Gjalt de Vries, Abdul Erumban, Marcel Timmer, Ilya Voskoboynikov and Harry X. Wu (2011). A complete list of background papers is included in Annex V of this report.

The report benefitted considerably from discussions of the background papers at a workshop jointly organized by UNU-MERIT and UNIDO in Vienna on 16-17 August 2012. Special thanks go to the representatives of the Permanent Missions to UNIDO who attended the workshop, to Justin Yifu Lin (Professor and Honorary Dean, National School of Development, Peking University and

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List of Acronyms

ABDI	Brazilian Industrial Development Agency
ASI	Annual Survey of Industries
BIS	Bank for International Settlements
BNDES	Banco Nacional de Desenvolvimento Economico y Social
BRICS	Brazil, the Russian Federation, India, China, South Africa
CAF	Comparative Advantage Following
CCMT	Climate Change Mitigation Technologies
CNY	Renminbi Yuan
CSO	Central Statistical Organization
ECLAC	Economic Commission for Latin America and the Caribbean
EU	European Union
EUROSTAT	Statistical office of the European Union
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GHG	Greenhouse Gases
GVC	Global Value Chains
GW	Giga Watt
IBGE	Brazilian Institute of Geography and Statistics
ICT	Information and Communications Technology
IPAP	Industrial Policy Action Plan
ISI	Import Substitution Industrialization
ISIC	International Standard Industrial Classification
IT	Information Technology
JV	Joint Venture
MERIT	Maastricht Economic and Social Research Institute on Innovation and Technology
MLE	Medium and Large Enterprise
MNE	Multinational Enterprise
MIC	Military-Industrial Complex
MVA	Manufacturing Value Added
MW	Mega Watt
NEDLAC	National Economic Development and Labour Council
NIPF	National Industrial Policy Framework
NIS	National Innovation System
NSS	National Sample Survey
OECD	Organisation for Economic Co-operation and Development
PDP	Production Development Policies
PITCE	Policy for Industry, Technology and Foreign Trade
PND	Plano Nacional de Desenvolvimento
PoC	Province of China
PPP	Purchasing Power Parity
PV	Photovoltaic
RoK	Republic of Korea
R&D	Research and Development
SADC	Southern African Development Community
SAR	Special Administrative Region
SME	Small and Medium-Sized Enterprise
SOE	State-Owned Enterprise
TFP	Total Factor Productivity
TOE	Tonnes of oil equivalent
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization
ULC	Unit Labour Costs
UK	United Kingdom
UNU	United Nations University
US	United States
USPTO	US Patent and Trademark Office
VS	Vertical Specialization
WIOD	World Input-Output Database
WTO	World Trade Organization

EXECUTIVE SUMMARY

This report investigates the structural economic transformation of a group of countries known as the *BRICS* (Brazil, the Russian Federation, India, China and South Africa). Within just 20 years, the BRICS economies have come to account for a substantial part of global GDP, world manufacturing value added and global manufacturing exports. The average growth rate of the BRICS between 2001 and 2010 was twice as high as the OECD's average, and while exports have certainly played a key role—especially for China—their growth rate is now increasingly driven by domestic consumption, investment and productivity growth. The BRICS countries' sustained economic growth, increasing significance as global markets and production hubs, and successful poverty reduction efforts make them a reference point both for developing countries seeking to emulate the BRICS's accomplishments and for industrialized countries struggling to regain economic dynamism.

The report consists of seven chapters. The introductory chapter presents the main arguments for the importance of manufacturing as an engine of economic growth for low and middle income countries. Chapter 2 provides comparative data on economic development and structural change in the BRICS. The next chapter describes the five countries' individual experiences with structural change and examines changes in the share of manufacturing in GDP and exports as well as in productivity across industries. The changes in employment and poverty as a result of structural transformation are considered as well. Chapter 4 assesses the sustainability of the BRICS's industrial development in terms of energy efficiency and production, and diffusion of renewable energy technologies. The global dimension of the BRICS countries' economic development, including their position in global value chains and the role of foreign direct and domestic investment, is explored in Chapter 5. The role and approach to industrial policy in BRICS countries is then analysed in Chapter 6. Chapter 7 concludes.

Structural economic transformation, defined as the development of an economy's structure from low productivity, labour intensive activities to higher productivity, capital and skill intensive activities, is essential for economic growth and development. It also reduces a country's vulnerability to external shocks and poverty by fostering economic diversity. Manufacturing plays a special role as an engine of growth and driver of technological progress in the economy due to the strong linkage and spillover effects into other sectors of the

economy. While the manufacturing sector has contributed to growth in all BRICS economies, it has by far contributed the most to China's impressive growth. The service sector has played a more important role in India, and recently in Brazil and South Africa. Economic growth in the Russian Federation, South Africa and Brazil has also benefitted from their abundance of natural resources.

A gradual shift has taken place in the BRICS from labour intensive to capital (and higher skill) intensive manufacturing, with the structure of China and India's manufacturing exports witnessing the most drastic changes. The export structure in both countries has shifted from labour intensive and low-tech products (such as food and beverages and textiles) to capital intensive and high-tech products (metal products, machinery and electrical equipment in China and chemicals in India). Similar changes in the structure of manufacturing exports—albeit less drastic—have taken place in Brazil and South Africa, where transport equipment, machinery and electrical equipment make up the bulk of exports. In the Russian Federation, by contrast, manufacturing exports have exhibited little change as they were already concentrated in capital intensive goods.

Growth and structural change have contributed to the reduction of poverty in all BRICS countries to varying degrees. The decline in poverty has been highest in China where the manufacturing sector absorbed a large number of migrant workers from rural areas. Factors such as the increase in labour compensation per employee, high aggregate growth rates and the contribution of services have contributed to a significant reduction of poverty in Brazil. In the Russian Federation, the more moderate reduction of poverty is largely attributable to wage growth in the non-market service industries. The poverty rate in India and South Africa has decreased to a lesser extent due to the dominance of low productivity employment in India and to the decreasing share of manufacturing in GDP and employment, low productivity and the large wage gap between skilled and non-skilled workers in South Africa.

The sustainability of the BRICS's industrial patterns poses a significant challenge, as countries with a large population and a rapid increase in GDP per capita usually have high levels of carbon emissions. The replacement of fossil fuels with renewable energy sources is therefore crucial. There are considerable differences among the BRICS in terms of the intensity and composition of the use of renewable sources of energy. For example, the diffusion of production and use of wind and solar photovoltaic (PV) technologies has developed rapidly in both China and India, while such technologies are less widely used in the other BRICS countries due to differences in the capabilities of producers and

adopters, natural resource endowments (e.g. the abundance of fossil fuels in South Africa or the availability of hydro energy in Brazil), national policies (e.g. availability of nuclear technology in the Russian Federation and South Africa), market conditions and other factors such as the relative lack of sunlight in the Russian Federation. Considering that energy demand is rising rapidly in the BRICS, the countries' installed capacity to produce renewable energy will need to be enhanced significantly in the near future, if growth in the BRICS is to be sustainable.

The BRICS countries have been particularly successful in attracting foreign direct investment (FDI). A large part of FDI inflows in China is focused on manufacturing, while the bulk of FDI in Brazil, the Russian Federation and South Africa is oriented towards the exploitation of natural resources, particularly mining. In India, by contrast, FDI primarily flows to the service sector (financing, real estate and business services). Integration in global value chains (GVCs) brings with it a number of benefits, such as the generation of jobs, the strengthening of business linkages and technology and skills transfers. However, at present, only China is well integrated in global value chains, thus there still is substantial room for new opportunities for the other BRICS countries.

The industrial policies in the BRICS focus on internationalization, including export promotion and the attraction of FDI, and on capability development, namely technological upgrading and learning. Those countries in which industrial policy has enhanced the country's latent comparative advantages, facilitated foreign investment and technology transfer, and whose policies are adapted to changing external circumstances have been most successful in achieving economic growth and progress.

The expansion and growth of the BRICS economies will face several challenges in the future, including continued or increased attraction of FDI, "green" industrialization to reduce carbon emissions and to achieve sustainable growth, further technological upgrading and the boosting of innovation of national firms.

CHAPTER 1: INTRODUCTION AND OVERVIEW

1.1 Introduction

This report examines the structural transformation of a group of economies known as the BRICS (Brazil, the Russian Federation, India, China and South Africa). The emergence of the BRICS reflects an ongoing change in the international economic order. The BRICS now account for a substantial part of global gross domestic product (GDP), global manufacturing value added (MVA) and global manufacturing exports. Their increased economic weight has led to a realignment of international economic institutions and given an increased voice to emerging economies in international affairs. The BRICS also act as regional economic leaders in their respective regions (Brazil in Latin America, China in East Asia, India in South Asia, the Russian Federation in Central Asia and South Africa in Africa).

Structural economic transformation, defined as the evolution of an economy's structure from low productivity traditional activities (such as in traditional agriculture) to higher productivity modern activities (such as in manufacturing and services) has been a *conditio sine qua non* of economic growth and development ever since the first Industrial Revolution. Such transformation is desirable not only as a source of higher productivity growth and per capita income, but also to achieve greater diversity of the economic structure, which decreases a country's vulnerability to poverty and external shocks. The role of the manufacturing sector in the process of structural change deserves special attention. It has long been considered a sector that plays a key role in economic development, although there is an ongoing debate about whether it continues to play this role in the present and will do so in the future (Szirmai et al., eds., forthcoming).

Many low and middle income countries today depend on the benefits of continued structural economic transformation. How such structural economic transformation can be marshalled remains at the forefront of the international development agenda, and has led to a resurgence in interest in industrial policy in both developing and in donor countries as well as in international organizations. Structural economic change requires policies that promote the

development, adoption and use of technologies to change what an economy produces and how it does so. Specialization, productivity and growth increase trigger further processes of agglomeration, specialization and technological advances. Countries can either acquire technologies for industrial production externally (through trade or the activities of multinational enterprises) or domestically (through indigenous or local innovation and investment in productive capacity and scale).

Over the last 30 years, the BRICS have been quite successful in achieving structural economic change and poverty reduction, albeit not to the same degrees. Their experiences may offer important lessons for low and middle income countries striving to achieve structural change and the growth of dynamic sectors such as manufacturing. To date, however, despite a large and growing body of literature on the economies of the BRICS, no systematic and comparative empirical analyses have been carried out—to the best of our knowledge—on the nature of structural change in the BRICS for the period since 1980. The comparative role and significance of manufacturing as an engine of growth in the BRICS, and the differences between and changes within the countries' manufacturing sectors has also not yet been studied in depth. There is growing debate over the sustainability and relevance of the example set by the BRICS, and whether it makes sense to refer to them as a group at all, as well as to what extent their structural transformation has had a significant and sustainable impact on poverty reduction. The present report aims to address these gaps.

1.2 The Importance of Structural Economic Transformation and Manufacturing Growth

Before providing a short overview of the contents of the individual chapters, we briefly summarize the main arguments for the proposition that manufacturing is an important engine of economic growth for low and middle income countries seeking to accelerate growth, to catch up and reduce poverty (see Szirmai, et al., eds., forthcoming). The first argument asserts the existence of an empirical relationship between the share of the manufacturing sector in value added and the level of economic development in developing countries. This relationship is curvilinear (e.g. Rodrik, 2009). As GDP per capita rises, the share of manufacturing increases until it reaches a peak. Beyond an optimum, the share of manufacturing declines as the service sector assumes a more important role in high income economies. A second empirical relationship is that between the share of manufacturing in GDP and the rate of economic growth. There is

qualified econometric and historical evidence that such a relationship exists.

This second argument relates to productivity. Assuming that value added per worker in manufacturing is higher than in the agricultural sector, the transfer of resources to manufacturing carries a productivity bonus. The productivity bonus can be static. However, it can also be dynamic if the transfer of resources takes place from less to more dynamic activities and sectors. The productivity bonus is not, of course, necessarily restricted to manufacturing.

The third argument focuses on capital accumulation. One typical difference between a low and a high income economy is that the latter has a higher level of capital per worker. Thus, capital accumulation is one of the hallmarks of development. Though capital accumulation can take place in many sectors (agriculture, mining, construction, infrastructure and services), the manufacturing sector is assumed to entail special opportunities for accumulation. The evidence on this assertion is mixed. Other economic sectors are sometimes more capital intensive than manufacturing.

An argument that has lost much of its weight in recent years is that of economies of scale. In the past, it could be argued that manufacturing offered special opportunities for economies of scale (and scope) compared to agriculture. Yet with the 'industrialization' of advanced agriculture, economies of scale are no longer incompatible with agricultural production. One of the prevailing arguments of development economics is that as world income increases, the share of agricultural production declines due to the low income elasticity of demand. On the other hand, there is high elasticity of demand for industrially manufactured products. Hence, economic development requires structural change and industrialization. Today, however, a similar argument can be made for the high income elasticity of demand for services compared with that for manufactured goods, especially in high income economies.

The most important argument for the special role of manufacturing derives perhaps from Cornwall (1977), who argues that the manufacturing sector is the main driver of technological progress in the economy. Manufacturing offers special opportunities for embodied and disembodied technological progress. Technological advancement originates in the manufacturing sector and diffuses to other sectors. There are strong linkage and spillover effects from manufacturing into other sectors of the economy, i.e. the relationships between sectors are two-way relationships. Hence, technological progress in software and information and communications technology (ICT) services is not possible without advancements in ICT hardware (silicon technologies,

data storage, data transport and data infrastructure). Manufacturing continues to account for the greater part of R&D expenditure. Advances in information technology (IT) software are revolutionizing manufacturing production, and this digital revolution has resulted in a global process of outsourcing and networked production which offers new opportunities for developing countries. The Cornwall tradition assumes that manufacturing is the driving force behind these interactions. Although the current literature no longer assumes that manufacturing is the only driver of growth, it is still considered a crucial sector in the economic development and catching-up process of low and middle income economies.

1.3 Overview

This report consists of five main chapters. Chapter 2 sets the stage and provides some comparative data on structural change and economic development in the BRICS. Chapter 3 describes (i) individual country experiences with structural change and changes in the share of manufacturing in gross domestic product (GDP) and exports; (ii) changes in productivity across various sectors, and (iii) changes in employment and poverty as a result of structural transformation. Chapter 4 looks at the sustainability of the BRICS's industrial development, focusing in particular on (i) energy efficiency, and (ii) the production and diffusion of renewable energy technologies. Chapter 5 deals with the major global dimensions of the BRICS's economic development, including (i) their position in global value chains (GVCs); (ii) the respective role of foreign direct investment (FDI) and domestic investment in technology upgrading and structural transformation, and (iii) the role of domestic and international demand in economic development and structural transformation. Chapter 6 includes a comparison of the role industrial policy has played in the structural transformation of the BRICS. Chapter 7 concludes with a summary of the findings.

Some of the key points made in these chapters are the following:

- The BRICS are a heterogeneous category in terms of structural change and industrialization. The most rapid growth has taken place in those countries in which structural change has been most profound and where manufacturing continues to play a significant role, such as in China and to a lesser extent in India.

- China is the BRICS country with the highest growth rate, the highest share of manufacturing in GDP and exports, and the most dynamic in terms of productivity growth. South Africa and the Russian Federation's performance tends to be weaker, and they are both experiencing relative deindustrialization.

- Since the late 1970s, Brazil's manufacturing sector has been characterized by very slow or even negative productivity growth. The country is falling behind its Asian comparators. In terms of the entire economy, Brazil has been growing rapidly in recent years, but this growth is being driven by other sectors rather than by manufacturing.

- The Russian Federation has been experiencing a process of deindustrialization since 1989, with a declining role of manufacturing and an increased role for primary resource-based extractive industries as a driver of the economy. However, despite its diminishing share in the economy, manufacturing continues to be the backbone of the Russian Federation's economy, generating and absorbing the majority of technological innovations. Manufacturing employment is more stable than output, providing some form of safety net in periods of economic crisis.

- In India, the significance of the manufacturing sector has decreased since 1980, while the role of services has grown.

- In South Africa, the growth of manufacturing has been moderate and its share in GDP has been declining. The manufacturing industries that have been losing shares in South Africa are those with a high proportion of semi-skilled and unskilled employees. While this implies that high-skilled industries are gaining in importance, the net effect has been a decline in total manufacturing employment since 1990.

- On average, structural change and industrialization has contributed to reducing poverty, particularly in China and to a lesser extent in India and Brazil. The experiences of South Africa and the Russian Federation are more mixed. In recent years, the standard of living in the Russian Federation has improved and poverty has declined, but this follows a period of dramatic decline in the standard of living during the transition period.

- The level of participation of the BRICS in GVCs varies by type of manufacturing and by country. Dynamic industries seem to have developed both high domestic as well as foreign production linkages, as the case of China's

manufacturing sector in general and Brazil's transport equipment industry, in particular, demonstrates.

- The BRICS account for no less than 13 percent of global FDI compared to 15 percent for all other middle income countries combined. In three of the five BRICS—Brazil, the Russian Federation and South Africa—FDI is increasingly being reoriented towards the exploitation of natural resources rather than manufacturing. In China, a significant part of FDI flows to manufacturing. In India, the importance of investment in services is increasing while it is declining in manufacturing. There are no indications, however, of foreign investment crowding out domestic investment.

- Overall, the domestic market has played a pivotal role in the absorption of the BRICS's manufacturing output. Yet the relative importance of the domestic and foreign market as a source of demand for manufacturing production differs considerably by industry type and by country. For example, foreign markets are by far the most important demand source for the Chinese textile and electrical machinery industries. The former mostly serves foreign final demand, while the latter industry's exports are evenly divided between use by foreign intermediates and final demand. Nearly half of the production of both the Russian Federation's coke & refined petroleum and the metals industries is exported, mainly in the form of intermediate inputs for foreign manufacturers.

- The BRICS have made significant inroads into the production and use of some renewable energy technologies, the installed capacity to produce wind energy has grown very rapidly in China and India since the mid-2000s and had the highest rate of diffusion amongst the BRICS. In 2010, China was the leading producer and India the fifth largest producer of wind energy in the world. The other BRICS countries trail far behind China and India and the world average. Brazil leads in the production of hydroelectric energy which supplies most of its energy needs. With regard to solar energy, the BRICS lag far behind the advanced economies, though solar energy also only plays a negligible role in the total energy supply of advanced economies.

- Appropriate industrial policies can play an important role in helping an economy transform in line with its actual and latent comparative advantage. The focus on its labour endowment was the underlying objective of the crucial economic reforms initiated in China in 1978, after years of failed comparative advantage-defying policies.

- All BRICS have undergone the same evolution from import substituting industrialization towards a more outward looking approach. All countries have experienced varying degrees of liberalization since the 1980s. In recent years, they have formulated industrial policies to promote and strengthen the manufacturing sector, but with varying degrees of success. In the Russian Federation, South Africa and Brazil, manufacturing is shrinking despite explicit policy efforts to the contrary. In China, industrial policies have been a mix of market liberalization and targeted attempts to promote industrialization through export zones, state-owned enterprises and policies aimed at technological upgrading.

Important areas for future research and current challenges remain. Foremost is the need for the BRICS to further drive structural economic transformation by stimulating innovation. Firms have to be innovative enough to adapt in an economic environment which demands more diverse and heterogeneous consumer goods, sophisticated services and globalized production systems (Sachs, 1996). As noted in Tang and Hussler (2011, p. 25) "as the latecomer approaches the technological frontier, its strategies have to shift from imitation to innovation". This is a key challenge now facing the BRICS.

Chapter 2: The Rise of the BRICS: Comparative Perspectives on Economic Growth, Industrialization and Structural Change

2.1 Introduction

Since O'Neill (2001) coined the term BRIC to describe a group of populous emerging countries consisting of Brazil, the Russian Federation, India and China, their economic development has exceeded the predictions of most economists, including those of O'Neill himself. In this report, South Africa is included in this group of countries due to its regional impact in (Southern) Africa. The acronym BRICS is used throughout the rest of this report to refer to these five countries. This chapter provides a comparative perspective on growth and structural change in the BRICS, which serves as a background for the more detailed country and thematic chapters in this report.[1]

2.2 Share in Global GDP

By 2010, the BRICS countries accounted for a quarter of global GDP in purchasing power parity (PPP) dollars (Table 2.1). The average growth rate of the five countries between 2001 and 2010 was at least twice as high as that of the OECD average, and the two most populous countries, China and India, had an average growth rate of 10.5 percent and 7.5 percent, respectively. Exports have

1 This chapter draws upon two background papers prepared for the UNIDO BRICS project: N. Haraguchi and G. Rezonja, "Industrial Structural Change in the BRICS" and W. Naudé, A. Lavopa and A. Szirmai, "Industrialization and Technological Change in BRICS: The Contribution of Multinational Enterprises and Domestic Investment". Both papers were presented at the UNIDO and UNU-MERIT International Workshop *"The Untold Story: Structural Change for Poverty Reduction – The Case of the BRICS"*, Vienna, 16-17 August 2012.

certainly played a key role in the BRICS countries' growth, especially in China. Yet the recovery of growth in the BRICS following the 2008 global financial crisis is increasingly being driven by domestic consumption, investment and productivity growth.

The sustained growth of the BRICS countries, their increasing importance as global markets and production hubs as well as their potential impacts on economic developments in the rest of the world make them a particularly interesting case for further study. However, apart from their population and geographic size, their economic performance and regional prominence, there are important differences in their development patterns and policies. While manufacturing has been the main engine of growth in China, services have played an increasingly important role in India and Brazil. The contribution of natural resources to the economic development of the Russian Federation, Brazil and South Africa must also be taken into account.

Table 2.1 presents the 30 largest economies in the world based on their GDP in 2010 in PPP US$. China (2), India (4), the Russian Federation (6) and Brazil (9) rank higher in the list than South Africa, which places 23rd. The joint share of the BRICS in global GDP in the world is 26 percent. Since 2001, this share has climbed by around 50 percent. In contrast, the relative share of GDP of the G7 countries dropped by 25 percent between 2001 and 2010, and currently accounts for 39 percent of world GDP.

Table 2.1: Thirty largest economies by GDP in 2010

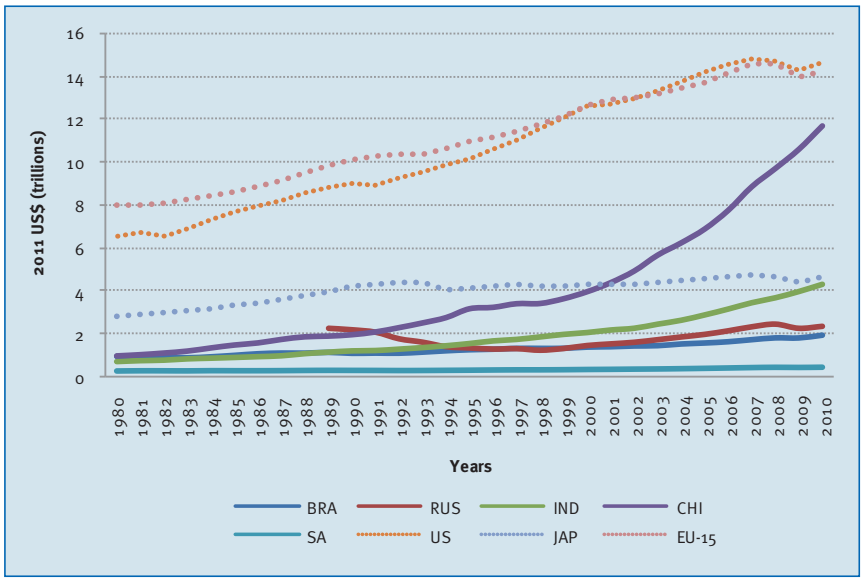
	GDP, US$ bn in PPP	Share of world total (%)	Change of share since 2001 (percentage points)	Population (mn)	GDP per capita, US$ in PPP
United States	14,587	19.0	-4.0	309	47,207
China	10,170	13.3	5.8	1,338	7,601
Japan	4,302	5.6	-1.9	127	33,874
India	4,195	5.5	1.6	1,171	3,582
Germany	3,044	4.0	-1.0	82	37,122
Russian Federation	2,812	3.7	1.3	142	19,803
United Kingdom	2,234	2.9	-0.8	62	36,032
France	2,194	2.9	-0.8	65	33,754
Brazil	2,185	2.9	0.0	195	11,205
Italy	1,909	2.5	-1.0	60	31,817
Mexico	1,644	2.2	0.1	113	14,549
Spain	1,478	1.9	-0.1	46	32,130
Korea, Republic of	1,418	1.9	-0.1	49	28,939
Canada	1,330	1.7	-0.3	34	39,118
Turkey	1,115	1.5	0.2	73	15,274
Indonesia	1,038	1.4	0.2	240	4,325
Australia	851	1.1	-0.1	22	38,682
Poland	755	1.0	0.0	38	19,868
The Netherlands	702	0.9	-0.2	17	41,294
Argentina	647	0.8	0.1	40	16,175
Saudi Arabia	623	0.8	0.0	27	23,074
Thailand	591	0.8	0.1	69	8,565
South Africa	528	0.7	0.0	50	10,560
Belgium	409	0.5	-0.1	11	37,182
Sweden	366	0.5	-0.1	9	40,667
Switzerland	365	0.5	-0.1	8	45,625
Venezuela	353	0.5	0.0	29	12,172
Austria	335	0.4	-0.1	8	41,875
Norway	277	0.4	0.0	5	55,400
Denmark	219	0.3	-0.1	6	36,500
World	76,647	100.0		6,841	11,204
of which BRICS	19,891	26.0	8.7	2,896	6,868
of which G7	29,599	39.0	-9.8	740	39,999

Source: Haraguchi and Rezonja (2012) based on World Development Indicators

2.3 Growth Performance, Exports and Catching-Up

Increases in the share of the BRICS in global GDP can be attributed to their relatively rapid economic growth. Figure 2.1 shows the evolution of GDP in the BRICS (in constant PPP dollars) compared to that of the US, the EU and Japan. Figure 2.2 documents the increasing share of the BRICS in world GDP.

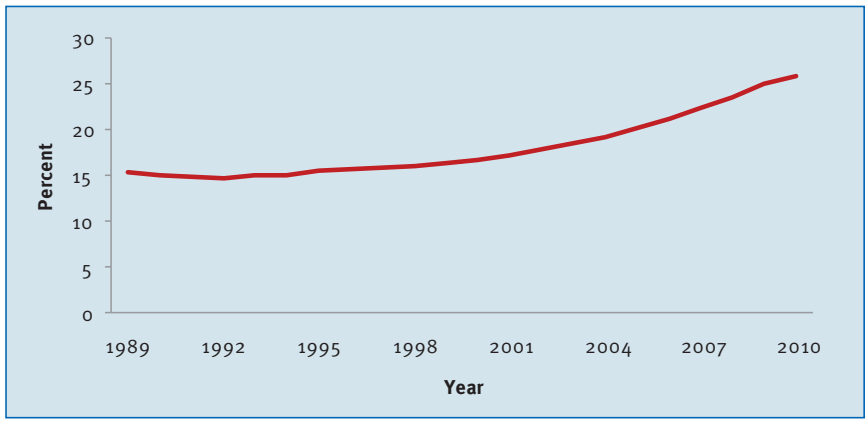
Figure 2.1: GDP in the BRICS, US, EU and Japan, 1980-2010 (in trillions of 2011 PPP dollars)



Source: Naudé et al. (2012) based on The Conference Board Total Economy Database

As Figure 2.2 illustrates, the BRICS have continued to increase their share in global GDP since 2000, and have accelerated this growth since the mid-2000s. The exception to this trend is South Africa, whose share has remained unchanged since.

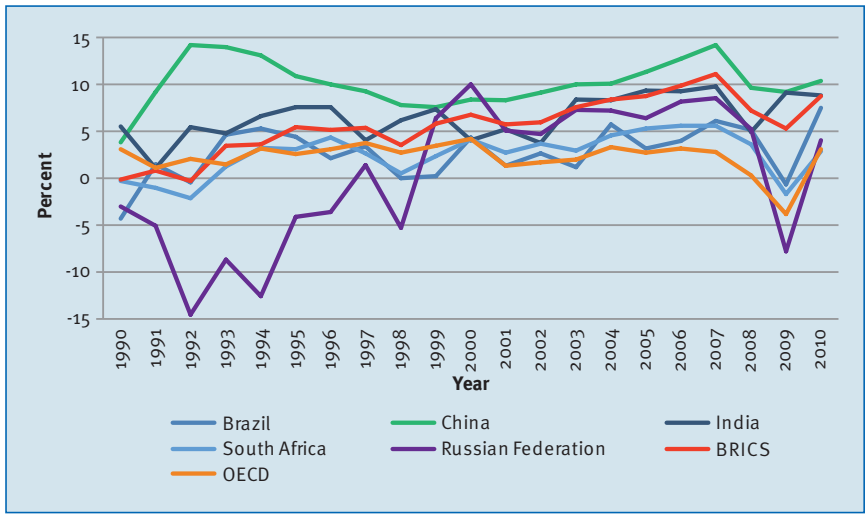
Figure 2.2: Share of the BRICS in world GDP, 1989-2010 (in %)



Source: Haraguchi and Rezonja (2012) based on World Development Indicators

GDP growth in the BRICS was erratic until 2000, and occasionally was even lower than the OECD average (Figure 2.3). Since 2000, however, the BRICS have shown consistently high growth rates, outperforming the world and G7 growth rates for most of the years.

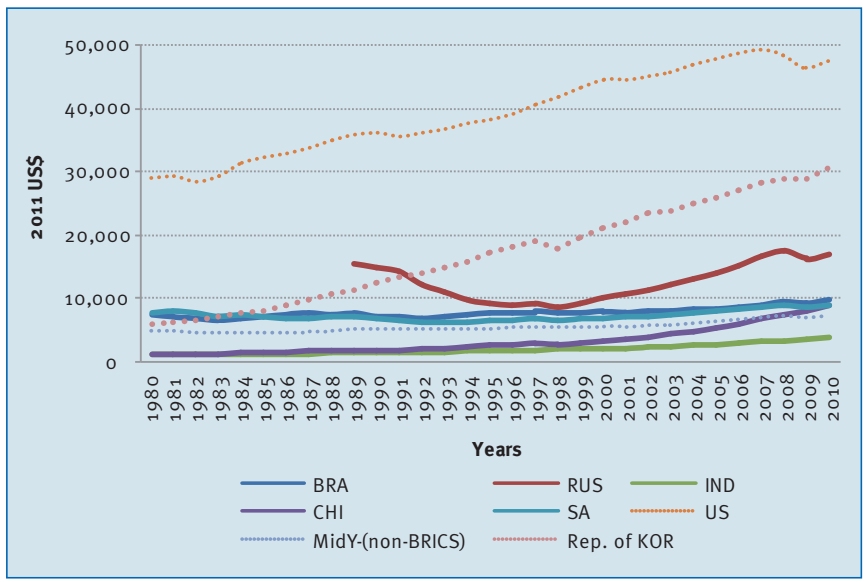
Figure 2.3: GDP growth rates in the BRICS, 1990-2010 (in %)



Source: Haraguchi and Rezonja (2012) based on World Development Indicators

In per capita terms, the GDP of the BRICS is still much smaller on average than that of the G7 countries, reaching one-sixth of the G7 countries' per capita GDP (Table 2.1). The income gaps are also illustrated in Figure 2.4, which plots the GDP levels of the BRICS against those of the US and Republic of Korea.

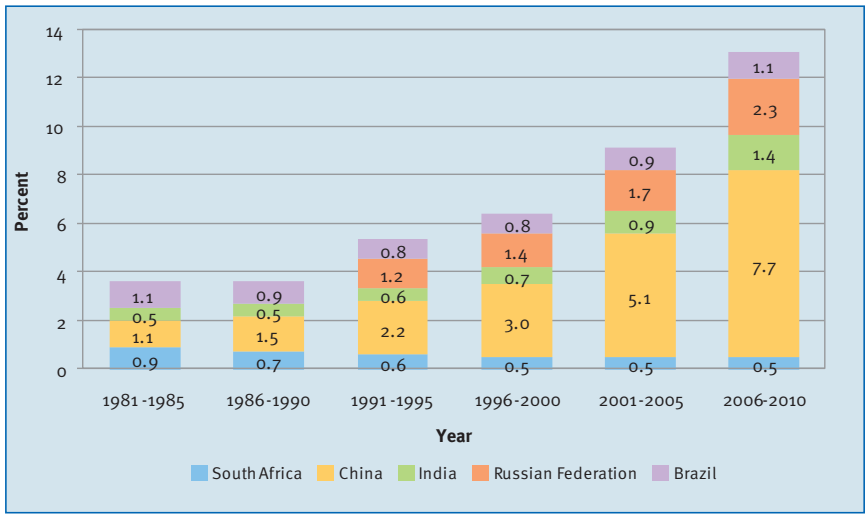
Figure 2.4: GDP per capita in the BRICS, US, Republic of Korea and other middle income economies, 1980-2010 (in 2011 PPP dollars)



Source: Naudé et al. (2012) based on the Conference Board Total Economy Database

Trade—particularly exports—has substantially contributed to the economic growth and structural transformation of the BRICS countries. China's export-led growth (exports of manufactured goods) is well known. India has increasingly been exporting IT services in addition to manufactured products, and the Russian Federation and South Africa primarily export resource-based goods and commodities. Brazil has successfully exported its natural resources as well as certain categories of manufactured goods. These patterns of integration into the world economy have played an important part for the relative performance of these economies. It is well established that trade is an important mechanism in terms of exposure to and adoption of foreign technologies and management techniques.

Figure 2.5: Share of world exports of the BRICS (5-year averages), 1980-2010 (in %)



Source: Naudé et al. (2012) based on COMTRADE

The rise of the BRICS in world trade is depicted in Figure 2.5, which shows their share of world exports. Whereas the BRICS accounted for less than 4 percent of world exports in the early 1980s, their combined share had reached 13 percent by 2010. This increase is mainly attributable to China's (manufacturing) export growth. Similar patterns of expanding shares are observable when we consider exports of manufactures only.[2]

2.4 Structural Change Patterns

The BRICS's economic structures and patterns of structural change are quite diverse. As indicated in Table 2.2, the economies of Brazil and South Africa are the most service-oriented while China has the largest share of manufacturing by far. India, even in comparison with other lower middle income economies, has a relatively high share of agriculture. The contribution of mining to the Russian Federation's and South Africa's GDP is relatively large.[3]

2 Manufacturing exports are defined as all exported goods produced by manufacturing industries according to the ISIC classification. For a discussion of different definitions of manufacturing exports, see Lavopa and Szirmai (2012). For a review of the empirical evidence, see Naudé et al. (2012).

3 Besides manufacturing, the classification of industry includes mining, utilities and construction as its major components. Share distributions within industry are based on the UN's National Accounts Main Aggregates Database and show that the share of mining and utilities in the Russian Federation's and South Africa's economy accounted for 12 percent of the two countries' GDP in 2009.

Table 2.2: The BRICS GDP sectoral breakdown, 2010 (in %)

	Agriculture, share in total value added (%)	Industry, share in total value added (%)	Manufacturing, share in total value added (%) (part of industry)	Services, share in total value added (%)	Total
	1	2		3	1+2+3
Brazil	5.8	26.8	15.8	67.4	100
China	10.1	46.8	29.6	43.1	100
India	19.0	26.3	14.2	54.7	100
Russian Federation	4.0	36.7	16.4	59.3	100
South Africa (2009 data)	3.0	31.3	15.2	65.7	100
BRICS	8.4	33.6	18.2	58.0	100
OECD	1.5	23.7	15.3	74.8	100
Upper middle income	7.6	36.7	21.5	55.7	100
Lower middle income	17.0	31.3	16.5	51.6	100
World	3.2	26.1	16.4	70.7	100

Source: Haraguchi and Rezonja (2012) based on data from World Development Indicators

Tables 2.3 and 2.4 provide information about changes in the structure of the BRICS's economies since 1980. The Russian Federation and South Africa began experiencing deindustrialization at middle income stages of development. China's rapid growth over the last two decades is attributable to the economy's industrialization. India has witnessed a modest increase in the share of manufacturing, but it is mostly the share of its service sector that has increased at the expense of the agricultural sector.

Manufacturing shares in total employment are typically lower than those of value added because of the relatively capital intensive nature of industrial production. In the case of Brazil, it is interesting to note that the share of manufacturing in employment increased despite the decline of manufacturing's share in value added.

Table 2.3: The BRICS sectoral value added shares, selected years (in %)

	Brazil		Russian Federation		India		China		South Africa	
	1980	2008	1995	2008	1980	2008	1987	2008[4]	1980	2008
Agriculture	4.9	6.4	7.2	4.2	37.4	16.3	29.9	9.2	3.5	2.6
Mining	0.5	1.0	6.3	5.0	1.9	1.8	4.5	3.2	13.8	6.1
Manufacturing	21.0	19.4	19.6	16.6	14.9	16.4	22.2	44.7	21.9	18.4
Utilities	1.4	2.5	4.2	2.5	1.8	2.2	2.6	2.7	1.8	2.1
Construction	7.6	4.8	6.6	7.2	5.8	6.3	6.4	5.0	4.1	3.3
Services	64.5	65.9	56.1	64.5	38.2	57.1	34.3	35.1	60.8	67.5
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Naudé et al. (2012). Estimates based on de Vries et al. (2011), Statistics South Africa (2012) and UNIDO INDSTAT (2011)

Table 2.4: The BRICS sectoral employment shares, selected years (in %)

	Brazil		Russian Federation		India		China		South Africa	
	1980	2008	1995	2008	1980	2008	1987	2008	1980	2008
Agriculture	38.4	17.8	27.7	21.5	69.9	54.0	59.2	40.2	12.6	5.7
Mining	0.5	0.3	1.4	1.2	0.5	0.6	1.8	1.3	11.1	2.4
Manufacturing	12.8	13.0	17.3	13.7	10.3	12.3	16.0	18.5	15.0	14.3
Utilities	0.8	0.4	1.9	2.3	0.3	0.3	0.3	0.5	1.6	0.7
Construction	8.9	7.2	7.7	7.3	1.9	6.7	4.5	6.7	7.8	8.3
Services	38.6	61.3	44.0	54.0	17.1	26.0	18.3	32.8	51.8	68.6
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Naudé et al. (2012). Estimates based on de Vries et al. (2011), Statistics South Africa (2012) and UNIDO INDSTAT (2011)

To better understand the role of the manufacturing sector (which has been an engine of economic growth for many countries in the past), we must consider the changing composition of a country's manufacturing sector. In order to do so, we present the shares of total MVA and employment for 14 manufacturing

4 The shares are based on the estimated sub-sector values and their summation.

industries in the BRICS in 1980[5] and 2008. We observe that a number of important changes took place within the manufacturing sector (Tables 2.5, 2.6 and 2.7).

Table 2.5: The BRICS shares of MVA by industry, selected years (in %)

	Brazil		Russian Federation		India		China		South Africa	
	1980	2008	1995	2008	1980	2008	1987	2008	1980	2008
Food, beverages and tobacco	15.5	13.1	18.5	20.4	12.3	10.5	14.9	10.7	18.3	17.0
Textiles and textile products	12.2	7.9	2.7	1.6	22.0	15.1	14.3	8.4	5.8	3.4
Leather and footwear	1.8	0.9	0.4	0.3	-	-	1.1	1.6	1.1	0.6
Wood and products of wood and cork	2.6	1.5	2.9	2.7	8.5	1.4	1.3	2.5	2.2	1.9
Pulp, paper, paper products and publishing	7.2	6.8	4.1	5.5	3.9	2.8	3.4	3.6	7.7	6.5
Coke, refined petroleum products, nuclear fuel	3.8	5.5	6.0	5.6	1.2	3.3	6.5	1.3	6.0	10.5
Chemicals and chemical products	11.8	16.0	6.7	6.6	8.3	15.9	12.2	10.1	2.9	8.3
Rubber and plastic products	3.9	2.5	2.0	3.6	2.3	1.8	3.2	3.4	3.1	5.3
Other non-metallic mineral products	4.2	3.5	6.8	6.7	4.6	5.6	7.9	7.2	5.4	3.8
Basic metals and metal products	11.3	11.2	17.6	17.8	15.8	16.3	15.0	13.1	18.1	16.0
Machinery nec	5.8	7.8	8.5	8.3	7.1	4.9	9.5	11.2	7.4	4.8
Electrical and optical equipment	7.6	7.2	5.4	7.1	6.4	11.6	5.9	16.7	3.9	4.2
Transport equipment	7.5	11.3	10.2	7.0	4.8	6.4	2.6	8.2	11.5	9.5
Furniture, manufacturing nec and recycling	4.9	4.6	8.3	6.8	2.7	4.5	2.2	2.0	6.6	8.1
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Naudé et al. (2012). Estimates based on de Vries et al. (2011), Statistics South Africa (2012) and UNIDO INDSTAT (2011)

Note: At constant local currency unit.

5 In the cases of China and the Russian Federation, comparable data has only been available since 1987 and 1995, respectively.

Table 2.6: The BRICS shares of manufacturing employment by industry, selected years (in %)

	Brazil		Russian Federation		India		China		South Africa	
	1980	2008	1995	2008	1980	2008	1987	2008	1980	2008
Food, beverages and tobacco	17.3	18.9	12.5	16.4	20.1	17.0	10.6	10.2	15.0	15.7
Textiles and textile products	26.3	23.5	9.3	5.8	34.6	32.6	15.0	15.1	15.4	9.0
Leather and footwear	4.9	5.1	1.5	0.9	-	-	2.2	4.6	2.5	1.4
Wood and products of wood and cork	4.7	3.8	4.1	5.2	13.4	9.7	3.4	6.9	5.7	4.2
Pulp, paper, paper products and publishing	5.9	4.9	2.7	4.0	2.3	3.2	4.9	8.0	5.1	6.6
Coke, refined petroleum products, nuclear fuel	0.8	1.3	1.9	2.0	0.1	0.1	0.5	0.7	1.2	1.2
Chemicals and chemical products	5.0	4.0	5.1	4.8	3.0	3.7	5.6	5.5	5.4	5.4
Rubber and plastic products	2.9	3.4	1.8	2.9	0.6	1.2	5.1	8.2	3.0	4.0
Other non-metallic mineral products	5.1	5.0	7.4	6.9	8.6	8.8	13.6	5.8	5.6	5.2
Basic metals and metal products	7.9	8.6	9.7	11.0	6.7	6.9	8.3	6.8	18.0	15.3
Machinery nec	4.0	5.0	19.8	15.4	2.0	2.6	11.7	8.1	5.9	7.9
Electrical and optical equipment	3.7	4.3	9.8	8.7	1.3	2.0	5.6	10.7	5.3	5.3
Transport equipment	3.5	4.7	11.2	11.1	1.4	2.5	3.3	4.2	7.1	10.9
Furniture, manufacturing nec and recycling	8.0	7.5	3.3	4.9	5.7	9.6	10.2	5.4	4.7	8.0
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Naudé et al. (2012) Estimates based on de Vries et al. (2011), Statistics South Africa (2012) and UNIDO INDSTAT (2011)

Table 2.7: Changes in the BRICS shares of value added and employment within manufacturing, selected years (in percentage points)

	Brazil		Russian Federation		India		China		South Africa	
	(1980-2008)		(1995-2008)		(1980-2008)		(1987-2008)		(1980-2008)	
	VA	No.	VA	No.	VA	No.	VA	No.	VA	No.
Food, beverages and tobacco	-2.4	1.5	1.9	3.9	-1.9	-3.0	-4.2	-0.4	-1.3	0.7
Textiles and textile products	-4.3	-2.8	-1.1	-3.5	-6.8	-2.0	-6.0	0.0	-2.4	-6.4
Leather and footwear	-0.8	0.2	-0.1	-0.6	-	-	0.5	2.4	-0.5	-1.1
Wood and products of wood and cork	-1.0	-0.9	-0.2	1.2	-7.2	-3.7	1.3	3.5	-0.3	-1.5
Pulp, paper, paper products and publishing	-0.4	-1.0	1.5	1.4	-1.2	0.9	0.2	3.1	-1.2	1.5
Coke, refined petroleum products, nuclear fuel	1.7	0.5	-0.4	0.1	2.0	0.0	-5.2	0.1	4.5	0.0
Chemicals and chemical products	4.2	-1.0	-0.1	-0.3	7.6	0.7	-2.1	-0.1	5.4	-0.1
Rubber and plastic products	-1.4	0.5	1.6	1.1	-0.5	0.6	0.2	3.2	2.2	1.0
Other non-metallic mineral products	-0.6	0.0	-0.2	-0.5	1.0	0.2	-0.8	-7.8	-1.6	-0.4
Basic metals and metal products	-0.1	0.8	0.2	1.3	0.5	0.2	-2.0	-1.6	-2.1	-2.7
Machinery nec	2.0	1.0	-0.2	-4.4	-2.3	0.6	1.8	-3.6	-2.6	1.9
Electrical and optical equipment	-0.5	0.6	1.7	-1.1	5.2	0.7	10.8	5.1	0.3	0.0
Transport equipment	3.9	1.2	-3.2	-0.1	1.6	1.1	5.6	0.9	-2.0	3.8
Furniture, manufacturing nec and recycling	-0.3	-0.4	-1.5	1.6	1.9	3.8	-0.2	-4.8	1.5	3.3

Source: Naudé et al. (2012) based on the same sources used in Table 2.5 and Table 2.6

These tables suggest that a gradual shift has taken place in the BRICS from labour intensive to capital intensive (and higher skill intensive) manufacturing. Industries such as food processing, textiles, leather and footwear, and wood and wood products (typically labour and low skill intensive industries) have only shown moderate changes in output, while output grew more rapidly in more capital intensive industries such as chemicals, machinery, electrical and optical equipment, transport equipment and metals and metal products.

Some country-specific features that stand out include the growth in value added in the petroleum and chemicals industries in Brazil, India and South Africa, the growth of transport equipment in China and Brazil, of rubber and plastics in the Russian Federation and of electrical and optical equipment in China and India.

The type of manufactured goods and services exported provides an interesting glimpse at how structural change patterns differ amongst the BRICS. As can be deduced from Table 2.8, China and India's manufacturing export structure has undergone the most dramatic change. Both countries managed to transform their specialization pattern within manufacturing exports, shifting from an export structure concentrated in labour intensive and low-tech products (mainly food and textiles) to a structure concentrated in capital intensive and high-tech products (metal products, machinery and electrical equipment in China, and chemicals in India). A similar change—albeit less drastic—has taken place in Brazil and South Africa, where exports of transport equipment, chemicals, machinery and electrical equipment have expanded. In contrast, the Russian Federation's manufacturing exports have experienced little change in the short period reported (1995-2008), as the structure was already concentrated around capital intensive products such as chemicals, metal products, machinery and transport equipment.

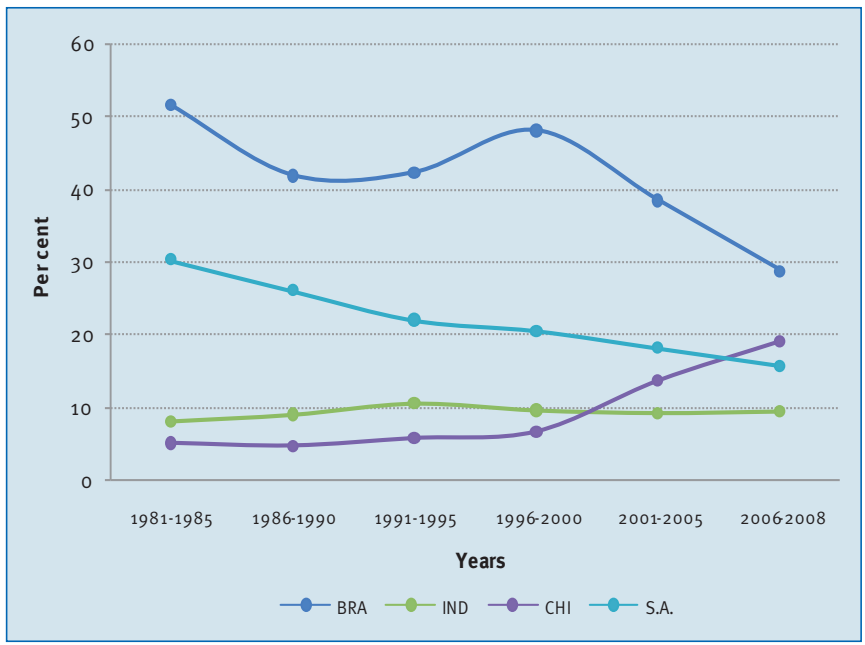
Table 2.8: The BRICS share of manufacturing exports by industry, selected years (in %)

	Brazil		Russian Federation		India		China		South Africa	
	1980	2008	1995	2008	1980	2008	1987	2008	1980	2008
Food, beverages and tobacco	15.5	13.1	18.5	20.4	12.3	10.5	14.9	10.7	18.3	17.0
Textiles and textiles products	12.2	7.9	2.7	1.6	22.0	15.1	14.3	8.4	5.8	3.4
Leather and footwear	1.8	0.9	0.4	0.3	-	-	1.1	1.6	1.1	0.6
Wood and products of wood and cork	2.6	1.5	2.9	2.7	8.5	1.4	1.3	2.5	2.2	1.9
Pulp, paper, paper products and publishing	7.2	6.8	4.1	5.5	3.9	2.8	3.4	3.6	7.7	6.5
Coke, refined petroleum products, nuclear fuel	3.8	5.5	6.0	5.6	1.2	3.3	6.5	1.3	6.0	10.5
Chemicals and chemical products	11.8	16.0	6.7	6.6	8.3	15.9	12.2	10.1	2.9	8.3
Rubber and plastic products	3.9	2.5	2.0	3.6	2.3	1.8	3.2	3.4	3.1	5.3
Other non-metallic mineral products	4.2	3.5	6.8	6.7	4.6	5.6	7.9	7.2	5.4	3.8
Basic metals and metal products	11.3	11.2	17.6	17.8	15.8	16.3	15.0	13.1	18.1	16.0
Machinery nec	5.8	7.8	8.5	8.3	7.1	4.9	9.5	11.2	7.4	4.8
Electrical and optical equipment	7.6	7.2	5.4	7.1	6.4	11.6	5.9	16.7	3.9	4.2
Transport equipment	7.5	11.3	10.2	7.0	4.8	6.4	2.6	8.2	11.5	9.5
Furniture, manufacturing nec and recycling	4.9	4.6	8.3	6.8	2.7	4.5	2.2	2.0	6.6	8.1
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Naudé et al. (2012). Estimates based on de Vries et al. (2011), Statistics South Africa (2012) and UNIDO INDSTAT (2011)

Figure 2.6 provides a snapshot of comparative labour productivity trends in the manufacturing sectors of Brazil, China, India and South Africa since 1981. Here we see that China underwent rapid productivity catch-up, while India maintained its relative position. Both Brazil and South Africa show secular decline in comparative productivity performance in manufacturing. This suggests that other sectors are responsible for these two countries' macro-level growth performance. As Section 3.3 of this report on the experiences of the Russian Federation illustrates, its pattern of manufacturing productivity growth also shows declining trends compared with those of Brazil and South Africa.

Figure 2.6: Brazil, China, India and South Africa's labour productivity in manufacturing relative to US, 1981-2008 (5-year averages) (US=100)



Source: Naudé et al. (2012) based on Szirmai (2013) and van Dijk (2003) for South Africa (extrapolated until 2008)

Note: Comparable data not available for the Russian Federation.

2.5 Contributions of Structural Change to Growth

De Vries et al. (2011) have analysed the contributions of structural change to productivity growth in Brazil, China, India and the Russian Federation in recent decades. Their study is based on a database of 34 industries and distinguishes between formal and informal sectors. The authors argue that using a more disaggregated database throws new light on the contribution of structural change to productivity. Based on a structural decomposition, the study concludes that the reallocation of labour across sectors has contributed positively to productivity growth in China, India and the Russian Federation, but not in Brazil. However, when a distinction is made between formal and informal activities within each sector, de Vries et al. find that the increasing formalization of the Brazilian economy since 2000 has been growth enhancing, while the rise in informality of India's economy following the reforms of 1991 has been growth reducing. These findings will be further analysed in the country chapters of this report.

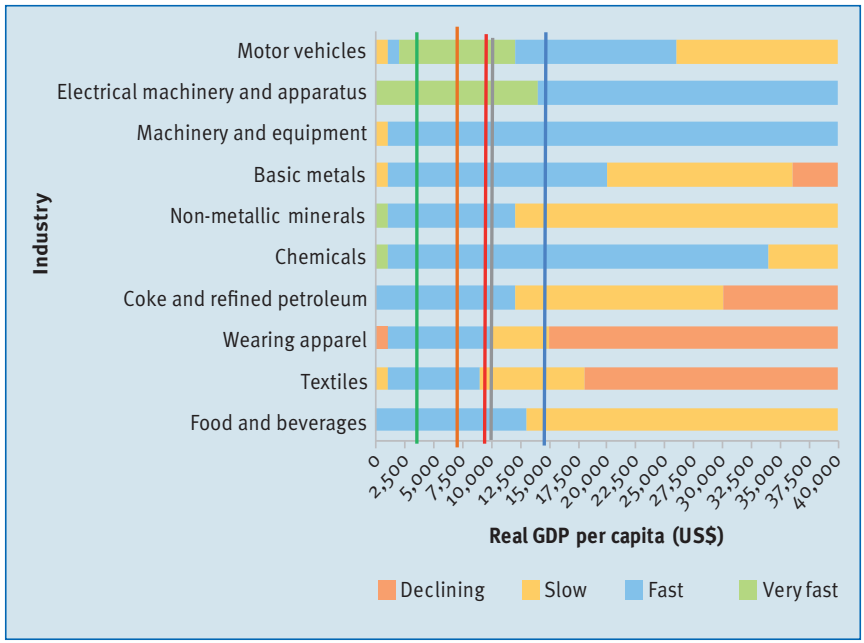
Tables 2.3, 2.4 and 2.5 above highlight a gradual shift in the BRICS from labour intensive to capital intensive manufacturing over the last 30 years. This shift is consistent with available evidence for a larger sample of similar countries and is likely to continue in the future.[6] On the basis of regression estimates of the manufacturing sector's growth rates for the levels of GDP per capita for large countries, the expectation is that the BRICS will continue to become ever more capital and skill intensive as their income levels increase (Haraguchi and Rezonja, 2012).

Figure 2.7 charts the estimated relationship between levels of GDP per capita and the growth of manufacturing industries. At low levels of GDP per capita, certain industries grow rapidly, while this growth tapers off at higher levels when other industries typically become more important. The bar charts in Figure 2.7 show the growth or decline of manufacturing industries in relation to GDP per capita. They are based on regression results for a sample of large countries and allow us to illustrate the evolution of individual industries as GDP per capita increases up to US$ 40,000. Four different elasticity thresholds are calculated in relation to GDP per capita. The first stage is characterized by rapid growth of value added per capita with an elasticity higher than 2. At this stage, a 10 percent growth of GDP per capita leads to a more than 20 percent growth of value added per capita in the respective manufacturing industries. In the second stage, value added per capita grows with an elasticity between 2 and 1, and between 1 and 0 in the third stage in which value added continues to grow,

6 The data corresponds to a sample of large countries, that is, countries with a population of over 12.5 million, see Haraguchi and Rezonja (2012).

but less than GDP per capita. In the fourth stage in which elasticity is smaller than 0, industries experience absolute decline in terms of value added.

Figure 2.7: Speed of growth of manufacturing industries by per capita GDP



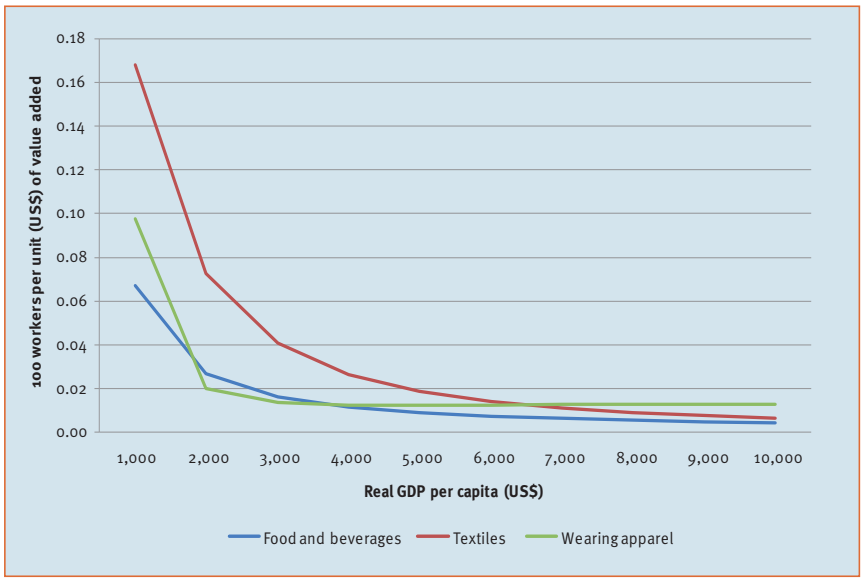
Source: Haraguchi and Rezonja (2012) based on UNIDO INDSTAT (2011) data

According to the data in Figure 2.7, India (denoted by the green vertical line) is the only BRICS country which might continue to experience growth in labour intensive industries in the short to medium term. The production processes in the BRICS will become less labour intensive, even in India, as seen in Figure 2.8. China (represented by the orange vertical line) is likely to experience slower growth in the early industries[7] in terms of both value added and employment and will need to further diversify into more capital intensive industries. However, late industries have a much lower capacity to absorb labour compared with the early industries as depicted in Figure 2.9. South Africa (represented by the red vertical line in Figure 2.7) and Brazil (denoted by the gray line) have already lost their comparative advantage in labour intensive early industries, and are consequently expected to grow more slowly than the rest of the economy.

7 The early industries include food and beverages, tobacco, textiles, wearing apparel, wood products, printing and publishing, coke and refined petroleum, non-metallic minerals and furniture, nec.

Capital intensive early industries, such as coke and petroleum and non-metallic minerals, will also experience lower growth. Brazil and South Africa need to shift their industrialization efforts to the middle and late industries[8] and continue to upgrade them to achieve sustained growth. Finally, the Russian Federation (represented by the blue line) has entered a late stage of industrialization in which industries other than skill and knowledge intensive ones usually grow at slower rates than the economy on average. As Figure 2.7 indicates, the future of the Russian Federation's manufacturing development lies in the chemicals, machinery and equipment, electrical machinery and apparatus and motor vehicle industries.

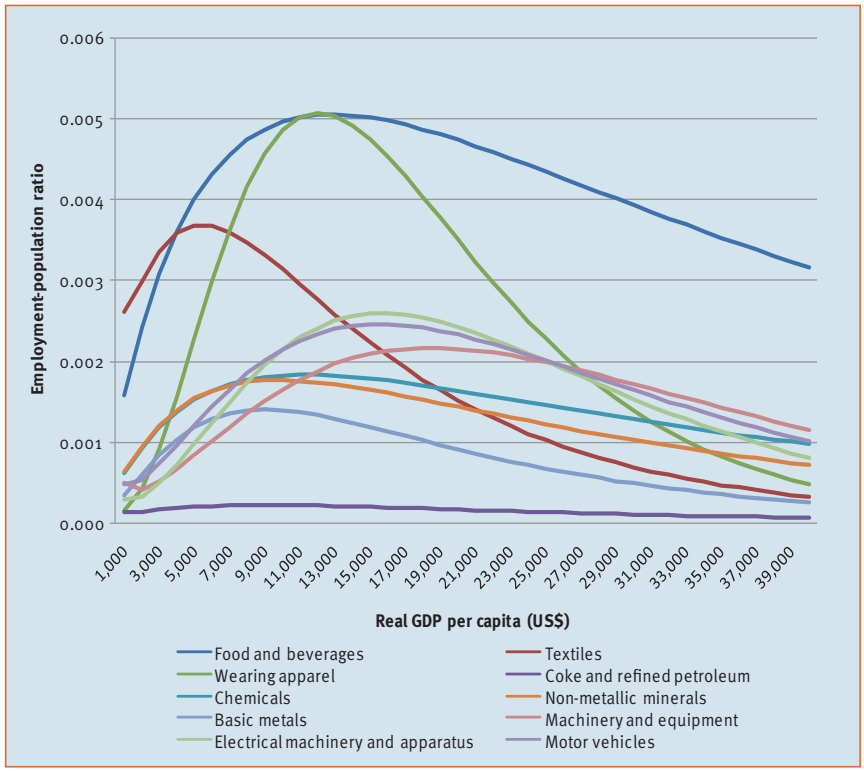
Figure 2.8: Estimated changes in labour intensity of the food and beverages, textiles and wearing apparel industries, by per capita GDP



Source: Haraguchi and Rezonja (2012) based on UNIDO INDSTAT (2011) data

8 The middle industries are paper, basic metals, fabricated metals and precision instruments. The late industries comprise chemicals, rubber and plastic, machinery and equipment, electrical machinery and apparatus and motor vehicles.

Figure 2.9: Estimated changes in manufacturing employment by per capita GDP



Source: Haraguchi and Rezonja (2012) based on UNIDO INDSTAT (2011) data

2.6 Concluding Remarks

This chapter has highlighted the rise of the BRICS in the global economy. The share of the BRICS in global GDP has been increasing, though the gap with the advanced economies in terms of per capita GDP is still large. Their growth has mostly been underpinned by export growth, though the importance of domestic markets has increased in recent years. The BRICS countries' patterns of rapid structural change have been quite diverse, with manufacturing playing the most important role in China and to a lesser extent in India.

Chapter 3: Country Experiences with Structural Change

3.1 Introduction

In this chapter, we attempt to answer two questions: what did the pattern of structural change in each of the BRICS countries look like, and what is the relationship between their structural change and economic growth, productivity, employment and, ultimately, poverty reduction?

The chapter is divided into five sections covering Brazil, the Russian Federation, India, China and South Africa. Each section consists of (i) an analysis of the relevant economic history of the country; (ii) an evaluation of trends in MVA and productivity; (iii) a discussion of how structural change has contributed to the reduction of poverty; and (iv) what potential lessons can be learned.

3.2 Brazil[9]

3.2.1 Background

During the late nineteenth century, Brazil's economic growth soared in the wake of booming coffee exports, mass immigration, accelerating urbanization and expanding consumer markets. Developing as a natural extension of the burgeoning export economy, the importance of local industrial firms grew rapidly and they began to supply most of the domestic market for manufactures. By the 1950s, the manufacturing sector surpassed agriculture in its contribution to national output, although Brazil's exports continued to be largely dominated by primary products.

9 This section draws upon a background paper prepared for the UNIDO BRICS project: D. Aldrigh and R. Colistete "The Untold Story: Structural Change for Poverty Reduction – The Case of Brazil", paper presented at the UNIDO and UNU-MERIT International Workshop on "*The Untold Story: Structural Change for Poverty Reduction – The Case of the BRICS*", Vienna, 16-17 August 2012.

Between 1950 and 1980, Brazil experienced exceptionally rapid growth, with the manufacturing sector contributing an important part to this growth and increasing its price share in GDP substantially from 19 to 33 percent (Szirmai and Verspagen, 2011). Shortage of foreign exchange was a constraint on growth for most of the period, which was only temporarily alleviated by major inflows of foreign capital. Macroeconomic imbalance increased. The debt crisis of the 1980s had a significant impact on Brazil's macroeconomic performance. Rapid economic and industrial expansion gave way to sluggish economic growth rates even after the adoption of market reforms and the success of stabilization policies in the 1990s. The 1980s is generally considered a "lost decade".

During the early 1990s, the Brazilian economy continued to suffer from the legacy of the external debt crisis. Despite the dramatic measures adopted by the new administration that took office in 1990 (such as the freezing of financial assets), high and volatile inflation persisted.

After five failed attempts of macroeconomic stabilization, the Real Plan, launched in 1994, managed to reduce inflation from 2,708 percent in 1993 to less than 15 percent in 1995. Apart from creating a new currency, the Real, the stabilization programme also introduced tight monetary policies aiming to prevent demand pressures that might jeopardize its success. Price stabilization became a turning point in the country's recent economic history, redefining incentives and payoffs to economic and political actors and imposing changes in deeply ingrained economic practices. Firms' inefficiencies could no longer be concealed under the inflationary veil. Banks, in turn, were hit by a drop in inflation tax revenues, forcing the government to intervene in some of them as a result of mismanagement or even wrongdoing. Overall, the maintenance of low inflation improved the business environment by reducing uncertainties in input and output prices – such as those of labour and capital goods.

The Real Plan also required the Brazilian government to reach an agreement with its main creditors to restructure and securitize medium- and long-term foreign loans. Debt renegotiation favoured a new wave of foreign capital inflows. However, high interest rates combined with the near-fixed exchange rate regime in a period when the domestic inflation rate was higher than those of Brazil's main trade partners, resulted in an overvaluation of the real exchange rate. In the context of successive international currency and financial crises (Mexico in 1994-95, Asian countries in 1997-98 and the Russian Federation in 1998), the increasingly overvalued exchange rate led to a currency crisis that culminated with the devaluation of the Real in 1999. This gave rise to a new macroeconomic regime founded on a floating exchange rate, inflation targeting and commitment

to a primary fiscal surplus. The impact of these macroeconomic challenges on structural change, and in particular on manufacturing, is described in the next subsection.

3.2.2 Manufacturing, GDP and exports

The share of manufacturing in Brazil's GDP dropped to 14.6 percent in 2011 after peaking at 35.8 percent in 1985 (IBGE 2012, National Accounts). These figures have, however, been marred by methodological changes in Brazil's National Accounts, particularly in 1990 and 1995.[10] In an attempt to address these methodological changes, Bonelli and de Abreu Pessôa (2010) recalculated the series (using constant 2008 prices) to generate a consistent series.

Although confirming the decline in the share of manufacturing in the Brazilian economy, they also found that (i) the decline in manufacturing's share began in the mid-1970s, and (ii) the decline occurred between the 1970s from 21 percent to 15.6 percent in 2008.

Other studies also support the conclusion that Brazil's manufacturing sector has experienced a relative decline over the last two decades. Moreover, the drop in the share of manufacturing in GDP at current prices from 16.2 percent in 2010 to 14.6 percent in 2011 may indicate that the sector is suffering from structural problems.[11] Nonetheless, whether or not premature deindustrialization is occurring is a matter of debate, as the declining share of manufacturing in GDP may merely reflect a normal structural shift as a result of changes in productivity that accompany development, i.e. a shift from manufacturing to services in the aggregate, as well as from labour intensive to capital intensive activities within the manufacturing sector. Manufacturing data by industry reflects such a process of structural change. As shown in Table 2.3, major declines in the shares of total manufacturing value added occurred in the textiles, food and wood products industries, while those of the chemicals, transport equipment and machinery industries increased.

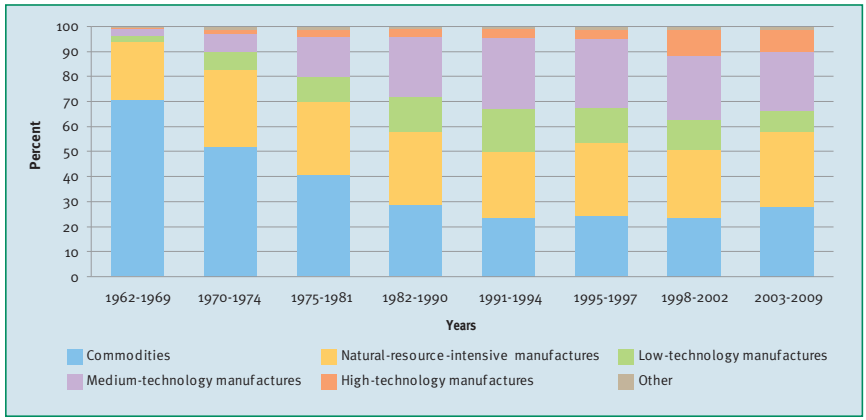
This structural shift within manufacturing towards higher technological content products is reflected in the changing structure of Brazil's exports. Figure 3.1 presents the structure of Brazilian exports from 1962 to 2009, classified according to six technological groups: commodities (or primary products),

10 IBGE changed the National Accounts methodology in 2005 and only revised the series back to 1995. Thus, no official consistent series covering the period since 1990 exists, undermining an accurate examination of the effects of events such as trade liberalization introduced at the beginning of the 1990s.

11 IBGE, National Accounts. At the time of writing, aggregate data was only available for 2010 and 2011. Agriculture and services had a stable share in total output in 2010 and 2011 (agriculture: 5.3 percent in 2010 and 5.5 percent in 2011; services: 66.6 percent in 2010 and 67.0 percent in 2011).

natural-resource-intensive manufactures, low-tech manufactures, medium-tech manufactures, high-tech manufactures and others (for details, see Annex II). The figures suggest that Brazil has managed to successfully increase its exports of technology intensive goods.

Figure 3.1: Sectoral share of exports in total exports in Brazil, 1962-2009 (5-year averages) (in %)



Source: ECLAC (2012, Figure I.A-6)

Figure 3.1 also shows that the first important shift occurred between the early 1960s and the early 1990s. During this period, the share of Brazil's exports of low- and medium-tech products increased, and the share of commodities in exports declined. By the mid-1990s, Brazil's specialization pattern began to gradually shift from low-tech to high-tech manufactures.

3.2.3 Productivity dynamics

According to Pages et al. (2010), Latin American countries' productivity continues to lag behind that of developed countries and could also not attain the growth rates seen in East Asian countries. Since Brazil is the largest country in Latin America, this picture for the region to a certain extent reflects its poor productivity performance. Pages et al. (2010) estimate that Brazil ranked below seven other Latin American countries in total factor productivity (TFP)—among them Argentina, Uruguay, Mexico and Chile—and its TFP level was 60 percent of that of the US (Chile's gap was only 20 percent) in 2005.

Aldrigh and Colistete (2012) calculate the level and growth rate of labour productivity in Brazil for different sectors and industries between 1995 and

2009. Using data from the National Accounts, they decompose overall labour productivity growth into three factors: (i) relating to productivity growth within each sector; (ii) capturing static shifts of labour from low productivity to high productivity sectors, and (iii) reflecting dynamic shifts from sectors with slow productivity growth to those with rapid productivity growth.

Table 3.1: Labour productivity growth by sector in Brazil, 1995-2009 (in %)

Sectors	1995-2000	2000-2005	2005-2009	1995-2009
Agriculture and livestock	5.0	2.6	5.1	4.5
Extractive	8.2	3.0	0.2	4.0
Manufacturing	0.1	-1.0	-0.6	-0.5
Public utilities	4.2	0.6	0.8	1.9
Construction	-1.6	-1.8	0.1	-1.2
Services	-0.6	-0.2	1.1	0.1
Total	0.5	0.1	1.5	0.8

Source: IBGE, 2012, National Accounts

Note: Annual compound growth rates. Labour productivity is defined as the ratio between sectoral value added and number of employees. Nominal value added deflated by sectoral deflators.

Table 3.1 shows that labour productivity growth was high in the agriculture and livestock sector, with annual growth rates exceeding 5 percent in 1995-2000 and 2005-2009, and more modest growth in 2000-2005. Labour productivity in the extractive industries also expanded considerably throughout the entire period, but after reaching peak rates in 1995-2000, nearly came to a halt in 2005-2009. More modest gains in labour productivity were achieved in the public utilities and service sectors, while actual losses were registered in the manufacturing and construction industries for the 1995-2000 period. As a result, the gap in labour productivity levels between manufacturing and services shrunk: in 2000, labour productivity in manufacturing was 25 percent higher than in services, whereas in 2009, it was only 11 percent higher.[12]

As far as the contribution of structural change and sectoral productivity gains to Brazil's aggregate labour productivity growth is concerned, Table 3.2 shows

12 A different picture emerges when using data for manufacturing's formal sector for the 2001-2011 period: labour productivity presents an unambiguous upward trend and increases at 2.2 percent per annum if measured as output per paid hour, and at 2.1 percent if measured as output per worker. Aldrigh and Colistete (2012) calculate the average of the seasonally adjusted monthly indexes for every year as well as the annual compound growth rates. For the 2001-2009 period, labour productivity in manufacturing grew at 2.2 percent per annum according to PIMPF/PIMES data, and -1.2 percent based on National Accounts data.

that within-sector productivity growth explained 45.8 percent of aggregate labour productivity growth in the Brazilian economy between 1995 and 2009. The impact of the transfer of labour to higher productivity activities (static shift effect, 70.3 percent) was partially offset by the negative dynamic shift effect (-16.1 percent) resulting from the declining share of fast growing sectors in total employment. Still, the structural change effect contributed considerably (54 percent) to Brazil's very modest aggregate labour productivity growth of 0.8 percent from 1995 to 2009.[13]

Table 3.2: Decomposition of labour productivity growth for the Brazilian economy, 1995-2009

Labour productivity growth		Labour productivity growth decomposition (in %)			
Periods	Annual average compound growth (%)	Within-sector effect	Static shift effect	Dynamic shift effect	Total effect
1995-2000	0.5	17.8	105.0	-22.8	100
2000-2005	0.1	-191.9	312.7	-20.8	100
2005-2009	1.5	64.8	36.3	-1.0	100
1995-2009	0.8	45.8	70.3	-16.1	100

Source: IBGE, 2012, National Accounts

A significant variation in the nature of structural change over sub-periods is evident. From 1995 to 2000, for example, modest aggregate labour productivity growth (0.5 percent annually) resulted from the transfer of labour to higher productivity activities (105 percent), although the dynamic shift effect was negative (-22.8 percent). In the following sub-period (2000 to 2005), the within-sector effect was strongly negative (-191.9 percent) and the static structural change component was dominant (312.7 percent). However, between 2005 and 2009, the sectoral gains in labour productivity recovered (64.8 percent) and contributed significantly more to productivity growth in Brazil's economy than structural change. The early 2000s was the worst period for labour productivity growth in general (annual growth of 0.1 percent) and for improvements in efficiency within sectors.

13 The methodology used to calculate these effects is presented in Annex I.

The issue can be examined in more detail by considering the weighted contribution by individual sectors to total labour productivity growth. Table 3.3 shows that services, by far, had the largest impact (93.6 percent) on national labour productivity growth between 1995 and 2009. Agriculture and livestock (11.4 percent) had the second largest impact, playing a significant role in sustaining overall productivity growth during the early 2000s. Manufacturing's contribution to national productivity growth was negative (-15.3 percent). Only during the early 2000s did it play a positive role in Brazil's recent productivity growth. During that period, its contribution was even more important than that of services.

Table 3.3: Contribution by individual sectors to labour productivity growth in Brazil, 1995-2009 (in %)

Sectors	1995-2000	2000-2005	2005-2009	1995-2009
Agriculture and livestock	18.6	79.4	5.0	11.4
Extractive	12.3	60.3	0.5	5.9
Manufacturing	-48.5	66.0	-9.2	-15.3
Public utilities	9.6	-19.4	3.5	3.9
Construction	9.1	-149.7	6.6	0.4
Services	98.9	64.4	93.6	93.6
Total	100	100	100	100

Source: IBGE, 2012, National Accounts

Pages et al. (2010) and McMillan and Rodrik (2011) provide evidence that the structural change effect on Latin America's labour productivity growth from 1990 to 2005 was negative or, when the decomposition of labour productivity growth for the region is calculated with weighted averages, positive but statistically non-significant. As shown above, the shift share analysis for the Brazilian economy over the 1995 to 2009 period indicates that structural change effects were positive and far from negligible. To determine whether the economic liberalization measures of the 1990s promoted "productivity-enhancing structural change", McMillan and Rodrik (2011) found evidence that, notwithstanding the fact that some relatively low labour productivity types of services were amidst the most rapidly expanding sectors, the decline in the share of employment was even more substantial in agriculture—one of the lower labour productivity sectors—than in manufacturing.

Aldrigh and Colistete (2012) replicate the McMillan-Rodrik methodology but use data from 42 industries in Brazil for the period 1995 to 2009. In contrast with the findings of the two previous studies mentioned, they find evidence of labour productivity-enhancing structural change in Brazil.

In Table 3.4, the shift share estimates show that the decline of labour productivity within industries—rather than structural change—accounted for the bulk of the negative labour productivity growth (-0.5 percent annually) within the manufacturing sector from 1995 to 2009.

Table 3.4: Decomposition of labour productivity growth in manufacturing in Brazil, 1995-2009

Labour productivity growth		Labour productivity growth decomposition (in %)			
Periods	Annual average compound growth (%)	Within-sector effect	Static shift effect	Dynamic shift effect	Total effect
1995-2000	0.1	-1.1	83.7	17.4	100
2000-2005	-1.0	3.7	70.0	26.3	100
2005-2009	-0.6	205.1	-122.3	17.3	100
1995-2009	-0.5	127.3	-47.8	20.5	100

Source: IBGE, 2012, National Accounts

One reason for the declining importance and competitiveness of the manufacturing sector is the increase in labour cost, as will be further explained below.

3.2.4 Manufacturing employment, wages and poverty reduction

The share of the manufacturing sector in total employment also exhibited appreciable decline from 15.6 percent in 1990 to 13.0 percent in 1995, at a time when trade liberalization advanced faster, later stabilizing at 12-13 percent (Table 3.5). Agriculture's share of employment rose during the first five years, only to decline in later years, from 25.7 percent in 1990 to 17.4 percent in 2009. Services, by contrast, experienced a rising share in employment from 50.7 percent to 62.1 percent over the same period. Whereas employment in manufacturing grew at an annual compound growth rate of only 1.5 percent from 1990 to 2009 (0.6 percent

from 1990 to 1995), employment in services expanded by 3.7 percent in the same period. Only the extractive sector lost jobs during this period.

Table 3.5: Employment by sector in Brazil, 1990, 1995, 2000, 2005 and 2009

Sectors	Employment (thousands)					Share in total employment (%)				
	1990	1995	2000	2005	2009	1990	1995	2000	2005	2009
Agriculture and livestock	15,247	19,101	17,611	18,981	16,778	25.7	26.0	22.3	20.9	17.4
Extractive	343	261	236	276	296	0.6	0.4	0.3	0.3	0.3
Manufacturing	9,261	9,535	9,494	11,674	12,256	15.6	13.0	12.0	12.8	12.7
Public utilities	341	362	342	372	412	0.6	0.5	0.4	0.4	0.4
Construction	4,061	4,380	5,330	5,873	6,885	6.8	6.0	6.7	6.5	7.1
Services	30,109	39,906	45,960	53,730	60,020	50.7	54.3	58.2	59.1	62.1
Total	59,362	73,545	78,972	90,906	96,647	100	100	100	100	100

Source: IBGE, 2012, National Accounts

Between 1990 and 2009, the manufacturing industries that suffered most from declining employment included oil refinery (-8.6 percent), steel (-19.5 percent), chemical products (-27.9 percent), coffee processing (-56.9 percent) and vegetal oil (-31.6 percent). In turn, chemical elements, pharmaceuticals, plastic material, meat processing, textiles, sugar refinery and dairy products created jobs at a higher rate than the average for the whole economy.[14]

Despite the decreasing employment share of Brazilian manufacturing, total employment in manufacturing increased in absolute terms. Overall, these results do not support the conclusion that Brazil has entered a phase of premature deindustrialization, though the recent decline in the share of manufacturing in GDP does raise concerns that this sector may be suffering from structural problems.

To assess how labour cost competitiveness in manufacturing has evolved, Aldrigh and Colistete (2012) analyse unit labour costs (ULC).[15] During the 1990s, the growth in manufacturing wages lagged behind the growth of value added, resulting in a decline of the share of wages in manufacturing GDP and of ULC. Later, particularly

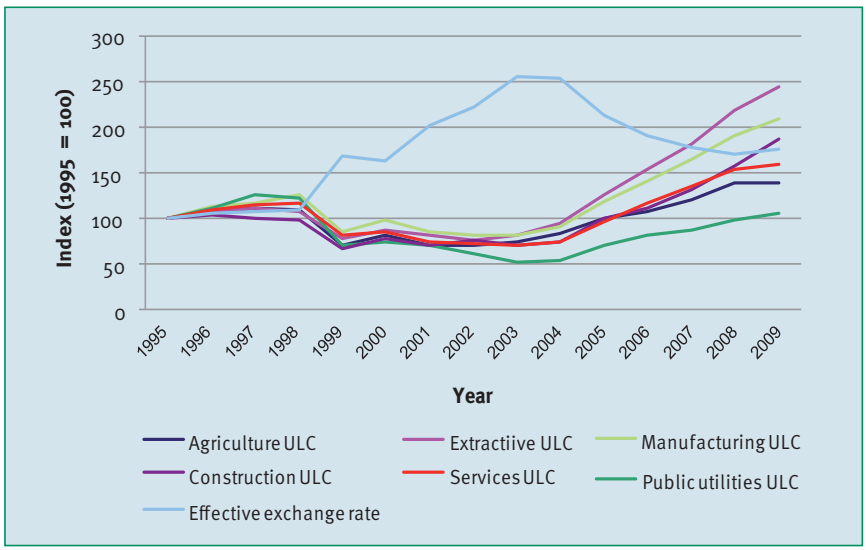
14 Data not shown here, available upon request.

15 Unit labour costs are calculated as labour compensation per unit of employment divided by labour productivity, adjusted by the exchange rate.

after 2003, ULC increased sharply, primarily as a result of currency appreciation and sluggish productivity growth. Labour compensation rose modestly in real terms and its contribution to increasing ULC, which were primarily determined by stagnant labour productivity in the 2000s, was almost insignificant.

Figure 3.2 charts ULC for the major economic sectors from 1995 to 2009.[16] Following a decline between 1999 and 2004 due to local currency devaluation, ULC in all sectors experienced rapid subsequent growth. ULC increased by more than 110 percent for the Brazilian economy in aggregate and by more than 130 percent for manufacturing between 2004 and 2009. The increase in ULC was associated with the appreciation of the Brazilian Real following the commodity boom in this period. Growth in average labour compensation for the entire economy, when deflated by the effective exchange rate, reached nearly 17 percent annually between 2004 and 2009, while labour productivity growth was stagnant, as discussed earlier.

Figure 3.2: Evolution of ULC by sector in Brazil, 1995-2009 (1995=100)



Source: IBGE, 2012, National Accounts

Note: Effective exchange rate to the currencies of Brazil's 16 largest trade partners.

16 ULC deflates labour compensation by the effective exchange rate of Brazil's 16 largest trade partners, as calculated by the Bank for International Settlements (BIS). Labour compensation is the sum of wages, social contributions and mixed earnings. Mixed earnings refer to earnings received by self-employed persons and owners of non-registered economic units, which are not classified as part of the formal business sector.

The structural changes that took place in the Brazilian economy have been accompanied by a reduction in poverty. Table 3.6 provides an overview of the poverty rate for rural and urban areas in Brazil. It shows that poverty declined from 48 percent of the total population in 1990 to 24.9 percent in 2009. In rural areas, the reduction in poverty was even more significant, declining from 70.6 percent in 1990 to 39.3 percent in 2009. The poverty rate in urban areas also declined from 41.2 percent in 1990 to 22.1 percent in 2009.

Table 3.6: Population below the poverty line in Brazil, 1990-2009 (in %)

	1990	1993	1996	1999	2001	2002	2003	2004	2005	2006	2007	2008	2009
Urban	41.2	40.3	30.6	32.9	34.1	34.4	35.8	34.4	32.9	30.0	27.0	22.8	22.1
Rural	70.6	63.0	55.6	55.3	55.2	55.7	54.6	54.1	53.3	50.1	45.7	41.2	39.3
Total	48.0	45.3	35.8	37.5	37.5	37.8	38.7	37.8	36.4	33.4	30.2	25.8	24.9

Source: ECLAC (2011, Table A-4)

Note: Includes people below the indigence line or living in extreme poverty.

3.2.5 Conclusions

Labour productivity growth in Brazil's manufacturing sector has been slow over the past two decades. Moreover, manufacturing shares in total GDP and in total employment has declined over the same period. Within the manufacturing sector, however, Brazil seems to have transformed its productive structure from low-tech to high-tech manufactures and has thereby realized a net increase of employment in the manufacturing sector. Labour compensation per employee has increased modestly in recent years. These factors have contributed to a significant reduction in poverty rates.

Despite these improvements in the decline in poverty, poverty, growth and the sustainability of current trends remain a concern. The increase in labour costs is reflected by a loss of competitiveness in international markets, thus casting some doubts about the economic prospects of the Brazilian economy.

3.3 The Russian Federation[17]

3.3.1 Background

Until the dissolution of the Soviet Union in 1991, the government's industrial focus was on subsidized heavy industry (based on natural resources such as oil, metals, chemicals, etc.) and the military-industrial complex (MIC). Despite the partial or full privatization of the majority of manufacturing enterprises in the 1990s, and the conversion of many MIC enterprises into civil ones, manufacturing output declined. Consumer goods manufacturing was underdeveloped and firms could not produce competitive goods in terms of either quality or price due to the lack of investment, low production capacity and competition from imports resulting from the liberalization of trade.

By the mid-1990s, the Russian Federation government had stabilized the inflation rate—which stood at 800 percent in 1993—and the exchange rate by financing budget deficits through borrowing at very high interest rates. Uncontrolled borrowing and the ensuing crowding out of private investment as well as the decline in productivity ultimately led to the financial crisis of 1998, with the government defaulting on domestic debt and a resulting four-fold devaluation of the national currency. While output contraction affected all sectors, it was more severe among consumer goods manufacturing industries than among resource-based or resource-related industries. The output of the oil and energy industry decreased by 63.9 percent compared with the level of 1992 and production in the metal industry fell by 51.7 percent. On the other hand, the consumer goods and construction materials industries experienced even sharper declines of output to 11.1 percent and 27.1 percent of the levels of 1992 (Yasin, 2008).

The majority of manufacturing enterprises had been involved in barter and non-monetary deals prior to 1998, and thus had no major bank deposits to lose when the banks declared bankruptcy in 1998. Any obligations manufacturing firms had to banks devalued considerably, while the depreciation of the exchange rate increased the price of imported goods, which consequently boosted the price competitiveness of domestic producers. This in turn facilitated import substitution. In addition, real wages plunged to their lowest levels since 1991, which reduced labour costs and encouraged domestic consumers to switch

17 This section draws upon a background paper prepared for the UNIDO BRICS project: B. Kuznetsov, V. Gimpelson and A. Yakovlev, " The Manufacturing Sector in Economic Development, Employment and Incomes: The Case of Russia", paper presented at the UNIDO and UNU-MERIT International Workshop on "*The Untold Story: Structural Change for Poverty Reduction – The Case of the BRICS*", Vienna, 16-17 August 2012.

from imported to relatively cheaper domestic products.

Manufacturing declined in absolute as well as in relative terms. The service sector grew or at least declined less rapidly than the manufacturing sector (the share of services in GDP increased from 25 percent in 1991 to 43 percent in 2002), while the extractive industries (primarily oil and gas production) also outperformed manufacturing by focusing on export markets rather than on the domestic one. The metal industries (such as the ferrous and non-ferrous metals industries) also shifted their orientation from the domestic towards export markets, thereby increasing their share in both total manufacturing and total manufacturing employment. The food processing industries were also successful in increasing their share in total manufacturing.

3.3.2 Manufacturing output and exports

The growth of production following the 1998 crisis allowed enterprises to increase their capacity and labour utilization which, in turn, lowered the costs of production. Manufacturing output had grown continually until the onset of the global financial crisis in 2008 (Table 3.7). It should be noted that the output growth of some industries was higher than their growth of value added due to a shift to assembly and processing of imported intermediate goods with low value added content. By 2008, manufacturing output had recovered to around 84 percent of its 1992 level. Certain industries, such as electrical equipment and electronics (139.3 percent), pulp and paper (127.9 percent) and rubber and plastic (124.4 percent) exceeded their 1992 level of activity, while others like textiles (-26 percent), leather products (-27.1 percent) and machines and equipment (-61 percent) deteriorated further (Rosstat, 2009, pp. 204-205). On the whole, the share of manufacturing industries in the economy steadily declined with the exception of the basic metals and fabricated metal products industries.

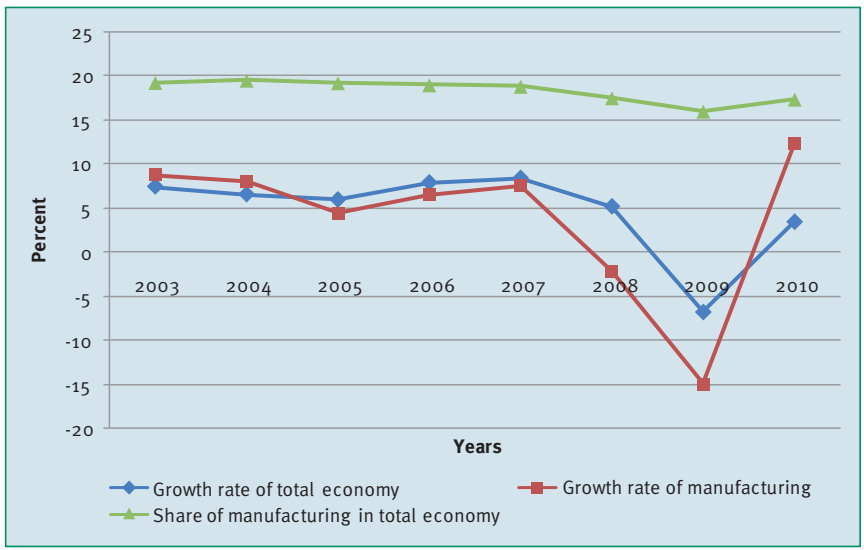
Table 3.7: Annual output growth in manufacturing by industry in the Russian Federation, 2000-2011 (in %)

	2000	2003	2005	2006	2007	2008	2009	2010	2011
Total manufacturing	10.9	10.3	7.6	8.4	10.5	0.5	-15.2	11.8	6.5
Food and beverages, tobacco	5.3	6.9	6.6	7.3	7.3	1.9	-0.6	5.4	1.0
Textiles, wearing apparel, fur	24.9	1.2	3.6	11.8	-0.5	-5.4	-16.2	12.1	2.6
Wood products	14.1	9.7	7.1	3.6	7.9	-0.1	-20.7	11.4	4.0
Chemicals and chemical products	15.2	5.4	4.1	4.7	6.6	-4.6	-6.9	14.6	5.2
Basic metals, fabricated metal products	15.3	7.2	7.0	9.7	4.5	-2.2	-14.7	12.4	2.9
Machinery and equipment nec	5.7	19.0	-0.3	11.7	26.7	-0.5	-31.5	12.2	9.5
Electrical machinery and apparatus	25.0	43.2	33.2	15.0	10.9	-7.4	-32.2	22.8	5.1
Transport equipment	10.7	14.0	7.1	4.7	7.8	0.4	-37.2	32.2	24.6

Source: Kuznetsov et al. (2012) based on Rosstat data

Growth between 1999 and 2008 was relatively high, but mostly reflected the country's economic recovery from the 1998 crisis, fuelled by an increase in the utilization of existing production capacity and labour. With the exception of the energy and metal industries, which are driven by exports, manufacturing growth in the Russian Federation has primarily been attributable to domestic demand. There are clear signals that the global competitiveness of the Russian Federation's manufacturing sector has declined, i.e. it is characterized by relatively low productivity growth in relation to labour cost increase, and that domestically manufactured goods are increasingly losing out to imported products. The fastest growing sectors over the past decade have mostly been non-tradable goods and services such as retail trade, construction, real estate and telecommunications. These sectors are also the main generators of employment growth.

Figure 3.3: MVA growth rates and the share of manufacturing in the Russian Federation economy, 2003-2010 (in %)



Source: Kuznetsov et al. (2012) based on Rosstat data

3.3.3 Productivity dynamics

Labour productivity in Russian Federation manufacturing has been improving steadily since the first half of the 1990s. This reflects a "creative destruction" process driven primarily by the shedding of excess labour and the closing down of inefficient lines of production. The "creative" component has only played a minor role: few new enterprises have been established and few new productive jobs created in existing firms; technological innovation continues to be low, both in terms of new process technologies and new products.

Given that the employed labour force grew only modestly and that post-crisis (i.e. post-1998) investment levels remained low, growth at the macro-level has mostly been based on increases in the productivity of capital and labour. This is reflected in micro-level data which indicates improved efficiency in terms of total factor productivity (TFP) in nearly all industries and sectors (excluding state regulated industries such as the electric power industry) (Yasin, 2004).

Table 3.8: Annual labour productivity growth rates by major activities in the Russian Federation (in %)

	2003	2004	2005	2006	2007	2008	2009	2010
Total Economy	**7.0**	**6.5**	**5.5**	**7.5**	**7.5**	**4.8**	**-4.1**	**3.0**
Agriculture	5.6	2.9	1.8	4.3	5.0	10.0	4.6	-10.0
Fishing	2.1	4.3	-3.5	1.6	3.2	-4.6	6.3	-23.6
Mining	9.2	7.3	6.3	3.3	3.1	0.9	8.5	0.6
Manufacturing	8.8	9.8	6.0	8.5	8.4	2.6	-4.1	8.3
Construction	5.3	6.8	5.9	15.8	12.8	9.1	-5.6	-1.3
Trade	9.8	10.5	5.1	10.8	4.8	8.1	-1.0	-1.2
Transport and communication	7.5	8.7	2.1	10.7	7.5	6.4	-4.6	2.4

Source: Kuznetsov et al. (2012) based on Rosstat data

Labour productivity in manufacturing increased by more than 60 percent between 2002 and 2010 (Table 3.8). However, a significant increase in labour costs and in other costs such as energy, intermediate goods, etc., meant that the manufacturing sector was only able to hold the ground it had gained by the mid-2000s, and was not able to enhance its competitiveness. In terms of output growth, labour productivity improvements and investment attractiveness, the construction industry, retail trade and other services outperformed manufacturing industries. Prior to the global financial crisis of 2008, the share of manufacturing imports (consumer and investment products) had accelerated, reflecting the fact that domestic producers failed to meet increasing domestic demand with the supply of affordable quality products. Manufacturing exports also did not expand significantly. Resource-based and resource-related industries, including the metal, chemicals and wood industries, continued to account for the bulk of exports. Higher capacity utilization was not accompanied by new capacity creation, despite growing domestic demand. Low-technological innovation and technological backwardness remain the Achilles' heel of of the Russian Federation's manufacturing sector. No progress in terms of innovation is visible among manufacturing firms (Table 3.9).

Table 3.9: Indicators of innovation activity in the manufacturing sector in the Russian Federation, 2000-2010 (in %)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Share of firms in manufacturing producing technological innovations	10.6	9.6	9.8	10.3	10.5	9.3	9.4	9.4	9.6	9.4	9.3
Share of new (innovative) goods and services in total sales in manufacturing	4.4	4.2	4.3	4.7	5.4	5.0	5.5	5.5	5.1	4.6	4.9
Share of expenditure on innovation in total sales in manufacturing	1.4	1.4	1.8	1.6	1.5	1.2	1.4	1.2	1.4	1.9	1.5

Source: Kuznetsov et al. (2012) based on Rosstat data

The reason for the sluggish innovation in Russian Federation firms is partly attributable to the history of the Russian Federation's national innovation system (NIS) and its institutional shortcomings. Following the collapse of the Soviet Union and the privatization of the majority of former state-owned manufacturing firms, the link between R&D institutions and production was severed. The unstable macroeconomic conditions during the transition period of the 1990s, which provided little incentive for innovation combined with a decrease in state funding, resulted in a downgrading of industrial R&D in the Russian Federation by the early 2000s.

3.3.4 Manufacturing employment, wages and poverty reduction

Employment in extraction industries (particularly in the oil and gas industry) increased in the 1990s as higher wages attracted workers, but net job creation remained modest. By the mid-1990s, the share of employment in the extractive industries as a whole amounted to around 7.5 percent. For the manufacturing sector, however, the transition from a centrally planned to a market economy came at a high cost: approximately 5 million jobs were lost in total. By the end of the 1990s, manufacturing employment had become even more volatile: the economic crisis of 1998 affected many manufacturing industries (Table 3.10), with the machinery and equipment and the textiles, leather and footwear

industries being hit the hardest. These industries were simply uncompetitive and employment decreased further between 1997 and 1999: machinery (-10 percent), electronic components (-12 percent), textiles (-15 percent) and leather and footwear (-15 percent).

Employment in manufacturing did not improve much in the 2000s. The relatively low growth of manufacturing's share of GDP resulted in further job destruction in all major manufacturing industries. Between 2000 and 2007, 2 million manufacturing jobs were lost, although MVA grew at 8 percent annually. This substantial reduction in employment, which largely occurred in medium and large enterprises (MLE), was attributable to two factors.[18] First, the downsizing of production (and employment) in MLEs (most of which had been established in the Soviet era) meant that some MLEs became small firms. Second, the restructuring of MLEs included the outsourcing of many functions to smaller firms – a "creative destruction" process which resulted in improved productivity as discussed in the previous subsection. In spite of the implementation of formal and informal anti-crisis measures by the Russian Federation government to minimize job losses at the height of the 2008 global financial crisis, employment in manufacturing again significantly declined in 2009 (Table 3.10).

Manufacturing wages began to increase higher than productivity growth following a decreasing trend in the 1990s. Between 2002 and 2008, real wages in manufacturing grew by around 17 percent annually. However, wage increases in manufacturing were lower than those in other sectors and lagged behind average wages. The average wage in manufacturing had been 6.3 percent higher in 2000 than the national average wage. By 2005, it was 1.5 percent lower and by 2008, 7 percent lower than the national average wage.

One interesting characteristic of the Russian Federation's labour market is that manufacturing employment fluctuates much less than output. Firms generally do not adjust to market fluctuations by dismissing workers, but rather by reducing their working hours and cutting wages. That is, employment functions as a type of safety net against poverty in the face of economic crises and market fluctuations. The downside of this approach is that wage cuts allow less efficient firms to survive. Although employers generally refrain from laying off workers, net employment in manufacturing has declined over the long run. A sector that sheds jobs and pays lower than average wages can only make a limited contribution to poverty alleviation. Moreover, the process of deindustrialization of the Russian Federation which began in the 1990s has dealt a significant

18 Ninety percent of jobs in industry in 1999-2000 were in MLEs (84.3 percent in 2004). Between 2000 and 2004, 14 percent jobs (or 1.7 million) in MLEs were lost, most in manufacturing enterprises (1.3 million jobs or 16.4 percent). The decline in employment was even more pronounced in some industries such as the wood and pulp industry (-22.6 percent) and the textiles, wearing apparel and leather and footwear industries (-34 percent).

Table 3.10: Evolution of employment by manufacturing industry in the Russian Federation, 1995-2010 (thousands)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total economy	58,759	56,982	54,073	51,505	51,158	51,238	50,613	50,615	49,882	49,130	48,197	48,096	48,944	49,363	47,428	46,719
Mining and quarrying	1,261	1,224	1,151	1,152	1,060	1,082	1,179	1,125	1,065	1,032	986	976	975	976	915	898
Manufacturing	13,930	12,930	11,932	11,102	11,101	11,272	10,987	10,799	10,303	9,920	9,512	9,241	9,259	9,126	8,118	7,810
Food products, including beverages and tobacco	1,644	1,621	1,583	1,512	1,597	1,641	1,623	1,605	1,588	1,542	1,447	1,436	1,457	1,411	1,344	1,317
Textiles and textile products	1,163	1,005	897	789	763	749	717	696	611	556	495	463	431	392	337	333
Leather, leather products and footwear	193	159	140	155	119	118	107	106	94	81	70	67	79	73	58	57
Wood and wood products	500	461	419	400	368	390	406	409	390	382	358	336	341	327	276	264
Pulp, paper and paper products; publishing and printing	371	385	369	362	384	415	346	380	376	370	393	401	399	400	362	364
Coke, refined petroleum products and nuclear fuel	261	263	242	218	215	216	218	202	202	138	136	134	134	121	108	105
Chemicals, chemical products and man-made fibres	758	722	688	712	678	707	680	650	624	550	563	550	512	488	441	431
Rubber and plastic products	257	240	219	190	205	207	231	237	229	239	257	271	285	295	259	245
Other non-metallic mineral products	1,072	956	873	766	814	787	767	754	709	675	649	644	675	698	596	561
Basic metals and fabricated metal products	1,415	1,369	1,264	1,157	1,217	1,259	1,301	1,267	1,240	1,208	1,220	1,172	1,154	1,130	998	970
Machinery and equipment	2,834	2,601	2,370	2,317	2,130	2,081	2,005	1,994	1,803	1,387	1,205	1,153	1,109	1,089	673	661
Electrical, electronic and optical equipment	1,449	1,292	1,144	969	1,004	1,035	1,002	953	931	905	887	869	906	912	824	760
Transport equipment	1,664	1,544	1,437	1,340	1,345	1,408	1,306	1,271	1,238	1,207	1,202	1,144	1,148	1,156	1,042	997
Other manufacturing	349	313	288	218	264	260	278	277	269	273	298	297	319	331	287	292

Source: Kuznetsov et al. (2012) based on Rosstat data.
Note: Organized employment, i.e. number of employees in large, medium and small firms. Individual entrepreneurs not registered as a legal entity are not included.

blow to wages in some regions, especially in so-called one-company towns ("monotowns"), where one large manufacturing enterprise is the main provider of jobs. In the Russian Federation, unlike in other emerging economies, the development of manufacturing has not contributed to the generation of relatively higher paid jobs. Furthermore, in the last two decades, jobs in manufacturing (particularly 'blue collar jobs') have become less attractive for young people. The system of education and training in manufacturing has essentially disappeared and the lack of suitably qualified labour represents a major constraint for the manufacturing sector.

Despite the disappointing performance of manufacturing, the Russian Federation witnessed a decline in poverty during the 2000s (the population below the poverty line decreased from 29 percent in 2000 to approximately 12.8 percent in 2011). This is primarily attributable to higher pensions, wage growth in non-market service sectors (such as state-financed healthcare and education) and to a lesser extent to state and municipal job creation.

3.3.5 Conclusions

Although the Russian Federation has been experiencing deindustrialization since 1989, manufacturing continues to play an important role in the economy. The sector's importance is not so much related to its size in terms of output or employment, but rather to its role in producing both consumer goods and intermediate inputs for other industries. Moreover, manufacturing is a high-technology sector that generates and absorbs a majority of technological innovations. In these industries, Russian Federation manufacturing is particularly vulnerable. Most manufacturing industries lag behind global leaders in terms of technology, input utilization efficiency and quality of manufactured goods. The challenges the Russian Federation's manufacturing sector faces include obsolete capacities, inadequate skills and competencies, inefficient allocation of production and labour, lack of modern infrastructure and inadequate market institutions.

Over the last two decades, manufacturing firms in the Russian Federation have undergone an extensive and largely healthy 'creative destruction' process that has facilitated adjustments to a market economy and the further development of market institutions. Despite these positive developments, there still is a lot of room for government policies to further promote manufacturing competitiveness.

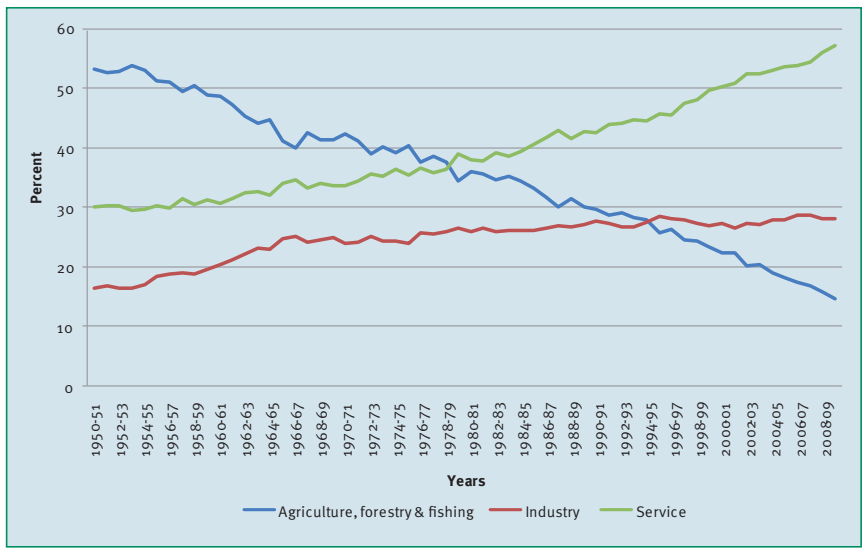
3.4 India[19]

3.4.1 Background

In India, the relationship between structural change, growth and poverty reduction reflects the country's changing economic policies – from a free trade regime to a relatively closed, protectionist regime following independence in the 1950s until the 1980s, when the country began to move back towards an open, increasingly liberal economic regime.

A substantial shift in the share of GDP from agriculture to industry and services (Figure 3.5) has taken place. The service sector growth rate accelerated in the late 1970s, with the share of agriculture in GDP declining and that of industry remaining almost stagnant.

Figure 3.5: Composition of GDP in India, 1950-1951 to 2009-2010 (in %)



Source: Aggarwal and Kumar (2012) based on Central Statistical Organization (CSO)

19 This section draws upon a background paper prepared for the UNIDO BRICS project: A. Aggarwal and N. Kumar, "Structural Change, Industrialization and Poverty Reduction: The Case of India", paper presented at the UNIDO and UNU-MERIT International Workshop on "*The Untold Story: Structural Change for Poverty Reduction – The Case of the BRICS*", Vienna, 16-17 August 2012.

The emergence of services as a leading sector does not come as a complete surprise, considering that in market-led growth economies, competitive advantage drives resource allocation and technical efficiency. India appears to have developed competitive advantages in services due to the availability of a large pool of skilled labour, which the education and technology policies adopted in the early phases of development helped to create (Kumar, 2001). The near stagnant share of manufacturing in the economy makes plain that India did not enjoy similar competitive advantages in the manufacturing sector.

A key question has therefore been whether the service sector can continue to be an engine of growth for India. Many argue that this pattern of growth may not be sustainable, given that the manufacturing rather than the service sector has the strongest links to India's domestic economy on the whole. Others point out that service-led growth may not be sustainable due to the service sector's high degree of informality.

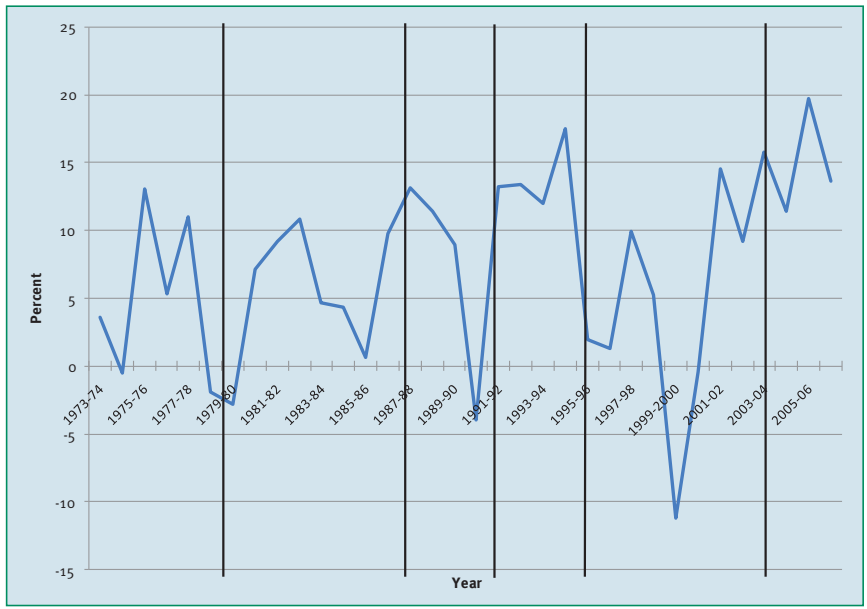
3.4.2 Manufacturing GDP and exports

The growth performance of manufacturing was mixed from 1974 to 2008. Although manufacturing expanded at an average annual growth rate of 7.4 percent (Figure 3.6), periods of high growth were followed by sharp declines. Six broad phases of growth can be identified, each covering a complete business cycle: 1973-74 to 1979-80; 1980-81 to 1987-88; 1988-89 to 1991-92; 1992-93 to 1995-96; 1996-97 to 2003-04; and 2003-04 to 2007-08.

We will use these six phases of growth and sectoral technology taxonomy to analyse structural change. We distinguish between four categories: the low-tech, medium-low-tech, medium-high-tech and the high-tech sectors.[20] Low-tech sectors are primarily processors of agricultural raw materials and include labour intensive activities with low capital-labour ratios. Enterprises in this category are usually small. Medium-low-tech sectors include mineral-based firms and large enterprises operating with high capital-labour ratios. Medium high-tech industries largely consist of chemical and engineering firms, while high-tech industries are science-based, modern industries with large R&D expenditures.

20 The four-group classification is taken from a taxonomy developed by the OECD (1987). For more information, see Kumar and Siddharthan (1994), Aggarwal (2001), Kumar and Joseph (eds.) (2007).

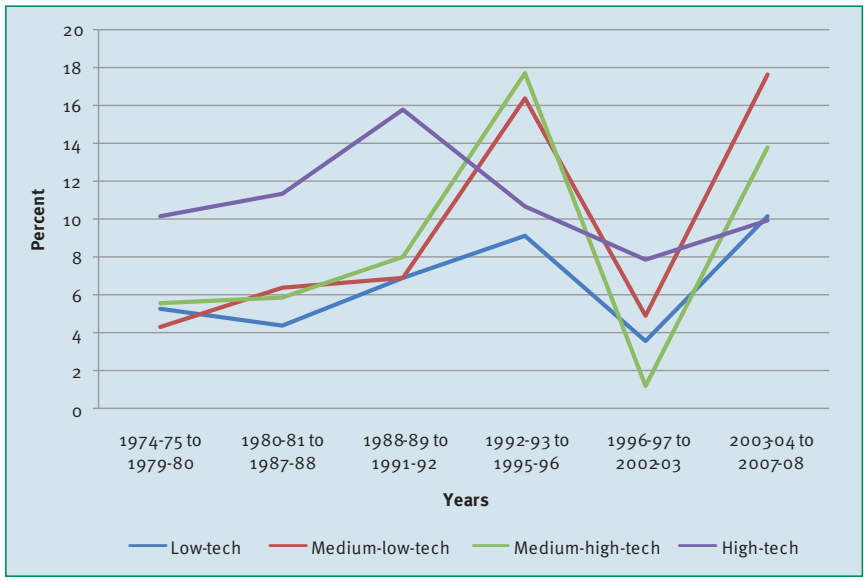
Figure 3.6: Manufacturing growth rates in India, 1973-1974 to 2007-2008 (in %)



Source: Aggarwal and Kumar (2012) based on the Annual Survey of Industries (ASI) data

High-tech industries were the fastest growing segment of the manufacturing sector prior to 1990. Their growth subsequently slowed, with the lowest growth rates recorded in 1996-2002, as depicted in Figure 3.7. High growth in this segment in earlier periods was, in part, attributable to a much lower starting point than that of firms in the medium- or low-tech industries. Yet the sharp drop in its growth rate cannot be explained by its increasing size. It remains the smallest segment of the manufacturing sector by a wide margin. Interestingly, the low-tech segment, which witnessed steady growth in the 1980s and early 1990s, also suffered in later years. It partly recovered during the boom period of 2003 to 2007. While both high- and low-tech firms experienced slower growth, medium-low-tech and medium-high-tech sectors grew rapidly during the boom years of the early 2000s.

Figure 3.7: Average growth rates by technology-based segment in Indian manufacturing, 1974-1975 to 2007-2008 (in %)



Source: Aggarwal and Kumar (2012) based on the Annual Survey of Industries (ASI) data
Note: These calculations use the average annual growth rate of each segment over the sub-periods identified above to smooth the growth rate time series for each segment.

Although the medium-high-tech sector grew rapidly between the mid-1970s and the late 1990s, it was the medium-low-tech industries (consisting mainly of petroleum and steel products) that grew more rapidly and captured over 40 percent of the total share of value added in manufacturing. The medium-tech segments (medium-low plus medium-high-tech) account for nearly three-fourths of MVA. Until the early 1990s, the science-based high-tech segment also increased its share steadily from 1.4 percent in 1973 to 3.5 percent by 1993. In the post-1993 period, however, the trend has reversed. This segment remains the smallest component of India's manufacturing sector, which explains India's inability to successfully export high-tech products (Kumar and Joseph, eds., 2007).

Overall, India has moved towards scale-based capital intensive medium-tech industries (low- and high-tech) and away from both labour intensive low-tech industries and science-based high-tech ones.

3.4.3 Productivity dynamics

Productivity per worker in the Indian economy has grown considerably since 1980. Productivity growth was most rapid in the service sector, with industry coming in second (Aggarwal and Kumar, 2012). Agriculture, on the other hand, witnessed only marginal improvement of productivity. A more disaggregated picture indicates that productivity in community services grew slowest within the service sector, while manufacturing and construction experienced little productivity growth in the industrial sector.

The effects of productivity performance on employment and poverty are ambiguous, since productivity growth can displace labour. If the displaced labour ends up in activities with lower productivity, economy-wide growth may slow down and poverty may increase. To analyse the contribution of structural change (changes in the composition of employment) to labour productivity growth, a reduced version of the shift share analysis applied in Section 3.2 for Brazil is used.[21] Thus, labour productivity growth is decomposed into two components: within-sector productivity growth and productivity growth attributable to structural change. The decomposition analysis was performed for six major sectors: (i) agriculture, (ii) mining and quarrying, (iii) manufacturing, (iv) construction, (v) trade, financial and business services, and (vi) transport, storage and communications.

The structural change effects have been positive in India, as the results in Table 3.11 indicate. Labour displaced from agriculture has been moving to more productive non-primary sectors. However, the structural change induced effects were more palpable during the 1970s and 1980s than in later periods. For instance, between 2004 and 2010, structural change only explained 5.6 percent of total productivity growth. Intra-sectoral productivity growth was the primary source of productivity growth during the entire period from 1972 to 2010, particularly in the latest sub-period. The slowdown in structural change effects indicates that while there has been structural change in Indian employment from less to more productive sectors, the shift has not taken place towards the most productive sectors in recent years.

21 In this version of the shift share analysis, annual changes for all years in a given period are taken into account. Therefore, the dynamic effect becomes zero. Productivity change is now decomposed into a within-effect and structural change effect (Van Ark and Timmer, 2003).

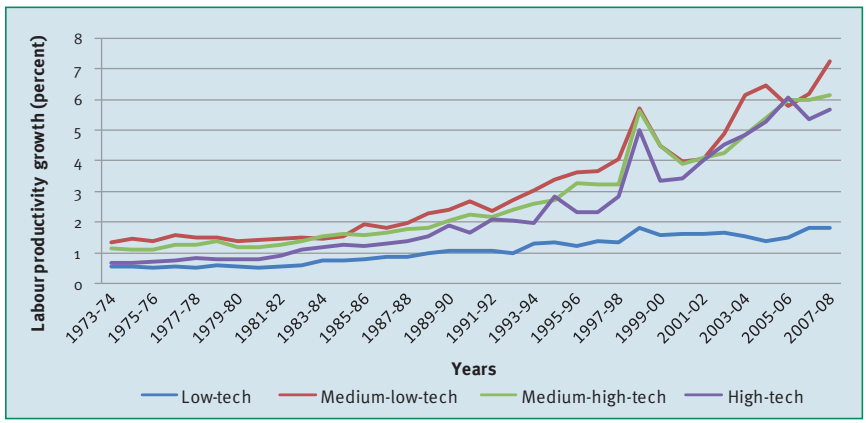
Table 3.11: Contribution of structural change in employment to labour productivity in India, 1972-2010

	1972-73 to 1977-78	1977-78 to 1983-84	1983-84 to 1987-88	1993-94 to 1999-00	1999-00 to 2004-05	2004-05 to 2009-10
Within-effect	8.6	3.3	2.5	30.1	9.7	48.0
Structural change	3.4	7.2	7.5	9.3	5.0	2.9
Total labour productivity growth	12.0	10.6	10.0	39.4	14.7	50.8
Share of structural change (%)	28.1	68.5	75.0	23.5	34.1	5.6
Share of within-effects (%)	71.9	31.5	25.0	76.5	65.9	94.4

Source: Aggarwal and Kumar (2012) based on National Sample Survey (NSS) data

A similar decomposition of labour productivity growth can be performed within the manufacturing sector, distinguishing between the four main categories based on level of technology. Figure 3.8 presents labour productivity trends in the four technology categories. The low-tech segment has the lowest productivity level and growth rate; productivity growth in the other categories is higher. Though productivity has grown in all subsectors, growth is most pronounced in the capital intensive medium-tech and in the science-based high-tech sectors.

Figure 3.8: Labour productivity growth by technology-based segment in Indian manufacturing, 1973-1974 to 2007-2008 (in %)



Source: Aggarwal and Kumar (2012) based on the Annual Survey of Industries (ASI) data

Table 3.12 shows that labour productivity growth in Indian manufacturing is mainly driven by intra-sectoral growth. Structural change effects have been marginal. More importantly, however, the structural change effect is not even positive for three out of six sub-periods. In fact, sectoral reallocation of labour in the manufacturing sector has been growth–reducing since 1996, with workers increasingly being absorbed into lower productivity activities.

Table 3.12: Labour productivity growth by technology segment and decomposition of productivity growth in Indian manufacturing, 1974-1975 to 2007-2008 (in %)

Year	Low-tech	Medium low-tech	Medium high-tech	High-tech	Productivity change due to structural change	Intra-sectoral productivity growth	Total labour productivity growth
1974-75 to 1979-80	-0.1	0.2	1.2	2.6	-2.1	4.5	2.4
1980-81 to 1987-88	4.6	4.0	1.4	6.8	7.3	84.2	91.5
1988-89 to 1991-92	5.0	4.2	2.0	9.1	0.8	37.3	38.1
1992-93 to 1995-96	2.6	10.0	2.5	0.8	1.1	61.7	62.8
1996-97 to 2002-03	3.5	2.5	4.0	5.7	-3.5	66.6	63.1
2003-04 to 2007-08	1.5	7.0	5.3	4.0	-0.9	68.7	67.8

Source: Aggarwal and Kumar (2012) based on the Annual Survey of Industries (ASI) data

3.4.4 Manufacturing employment, wages and poverty reduction

Survey data show that less than half of the population make up the labour force and that the labour market participation rate has been stagnating. According to Aggarwal and Kumar (2012), employment growth reached its peak level in the 1970s and has been declining since. The global boom of the early 2000s resulted in more rapid growth of employment, but the growth rate dropped to below 2 percent following the global financial crisis of 2008, despite the fact that India's GDP grew at around 7 percent during this period (Table 3.13).

Table 3.13: Employment growth rate in the Indian economy, 1961-2010 (in %)

	1961-1970	1971-1980	1981-1990	1991-2000	2001-2007	2008-2010
Employment growth rate	0.9	3.1	2.6	1.8	2.5	1.8

Source: Aggarwal and Kumar (2012) based on Total Economy Database

The different sectoral growth rates in GDP have had obvious impacts on the structure of employment. Nevertheless, due to heavy concentration of the workforce in the agricultural sector during the early 1970s, the distribution of employment in India is still highly skewed in favour of agriculture. Thus, in 2009-10, 53 percent of the workforce was still employed in agriculture and only contributed 14.6 percent to GDP. The 25.4 percent of the workforce in services contributed about 57 percent of GDP. Industry, including manufacturing, employed 21.7 percent of the labour force and accounted for over 28 percent of value added.

Within industry, the construction sector boasted the fastest employment growth, followed by mining and quarrying. Between 2004 and 2010, employment in both manufacturing and infrastructure declined. This reflects the fact that deindustrialization is already underway in manufacturing. Much of the labour released from agriculture has been absorbed by the construction industry, where employment has been expanding rapidly (Eichengreen and Gupta, 2011). Mining and quarrying is another important sector that has consistently demonstrated higher employment growth than manufacturing. Infrastructure has been marginalized since the 1990s. Within the service sector, community and personal services have declined sharply, while trade and business services have recorded rapid increases. Much of this growth is attributable to a reallocation of labour within the service sector rather than to net creation of employment.

The average earnings of workers have risen. However, given that structural change in employment has not resulted in the reallocation of labour towards more productive sectors, it is likely that the average daily wage earnings of labourers have not improved much either. Table 3.14 presents earnings indices by sector relative to agriculture. Although labour as a whole has gained in real terms, there is considerable and increasing inter-sectoral wage inequality. Real wages are lowest in agriculture followed by wages in trade, low-tech manufacturing, construction and transport. Financial and business services not only have the highest wages, they have also witnessed the most rapid growth in

terms of earnings and salaries. Clearly, wages in skill intensive, modern sectors have increased the fastest.

Table 3.14: 2009 earnings index and earning changes 2004-2005 to 2009-2010 in India (Agriculture = 100)

	Earning index: Agriculture=100	Change in earnings: Agriculture=100
Agriculture	100	100
Mining	311.5	-7.4
Low-tech manufacturing	140.3	359.0
Medium- and high-tech manufacturing	254.8	377.7
Electricity	394.4	213.6
Construction	231.2	531.3
Trade	133.9	348.7
Transport	235.8	308.9
Financial and business services	430.3	498.3
Community services	321.3	343.2

Source: Aggarwal and Kumar (2012) based on National Sample Survey (NSS) data

The majority of jobs created since economic liberalization in India in the 1990s has been in the informal labour segment, with formal sector employment declining. There are significant productivity differences between the informal and the formal sectors (Kochhar et al., 2006; Mazumdar and Sarkar, 2008; Kathuria, 2011). The lack of significant structural change that reallocates activity from the low productivity informal sector to the high productivity formal sector can constrain the growth of aggregate productivity in the economy. Most informal jobs have been created in the service sector, which casts doubts on the sustainability of service-led growth. An argument for a shift in favour of the manufacturing sector is the fact that the degree of formal employment in manufacturing is among the highest of the economy.

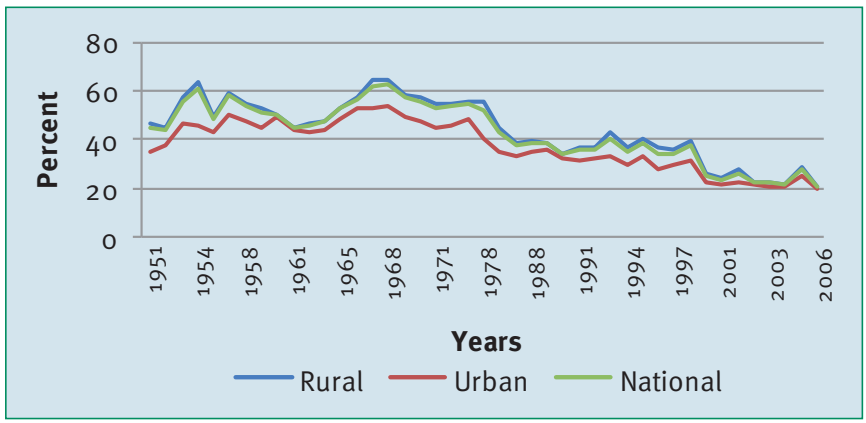
Table 3.15: Share of informal economy in value added in India, 2004-2005 and 2009-2010 (in %)

Sector	2004-05	2009-10
Agriculture	94.4	94.6
Mining and quarrying	8.7	12.2
Manufacturing	35.5	31.7
Electricity, water, etc	3.1	2.9
Construction	63.6	56.3
Trade, hotels & restaurants	77.4	75.1
Transport, storage & communications	55.8	60.2
Financing, real estate & business services	49.2	50.0
Community services	43.0	40.3
Total	56.2	54.8

Source: Aggarwal and Kumar (2012) based on Central Statistical Organization (CSO)

Poverty rates in India have been declining significantly since 1968, though the 2006 figures are still comparatively high (Figure 3.9).[22]

Figure 3.9: Poverty rates in India, 1951-2006 (in %)



Source: Aggarwal and Kumar (2012), based on Datt and Ravallion (2011)

22 All observers agree that the trend in Indian poverty is a declining one, but some estimates claim that there have been higher levels of poverty in recent years. For instance, according to Chen and Ravallion (2008), the poverty headcount in 2005 was over 40 percent of the population.

The 'very poor' in India refers to those who fall below 75 percent of the poverty line. According to estimates of Dev and Ravi (2007), the poverty ratio of the 'very poor' declined from 24.8 percent of the total population in 1983 to 15.5 percent in 1993, and to 10.3 percent in 2005 (Table 3.16). Notably, the reduction in the percentage of the very poor has been more striking in rural areas than in urban ones, particularly during the period 1993 to 1994 and 2004 to 2005.

Table 3.16: Poverty ratios in rural and urban areas in India, 1983-1984 to 2004-2005 (in %)

	Rural		Urban		All	
	Poor	Very poor	Poor	Very poor	Poor	Very poor
1983-84	45.8	25.5	42.3	22.5	44.9	24.8
1993–94	37.3	29.2	32.6	16.0	36.0	15.5
2004–05	29.2	9.6	26.0	12.0	28.3	10.3

Source: Aggarwal and Kumar (2012) based on Asian Development Bank (2011)

On average, it is clear that economic growth in India has substantially reduced poverty, in particular amongst the poorest.[23] But the reduction of poverty slowed down in the period after 2000, and there are indications that poverty has again begun to increase in the post-2007 period (Aggarwal and Kumar, 2012). Rural poverty, in particular, remains high.

As far as the relationship between structural change and poverty is concerned, structural change has not been especially conducive to poverty reduction. A large part of employment remains in low productivity agriculture. Reallocation of labour takes place in the direction of the service sector where informal, low-paid employment is quite prevalent. Within manufacturing, the resource and labour intensive sectors remain the largest employers. A sustained decline of poverty would require a different type of structural change, with greater emphasis on manufacturing and a shift of employment towards more high-tech sectors.

23 It should be mentioned that the poverty estimates have been subject to huge debate. Despite poverty reduction, an examination of trends in the Gini coefficient reveals that inequality has increased in both rural and urban areas. For urban areas, the level of inequality was at its highest in 2004-2005, at 0.376. Moreover, in September 2011, the government introduced a new definition of poverty: people spending Rs 32 (US$ 0.64) in cities or Rs 26 (US$ 0.52) in villages are not poor. Based on this yardstick, there are now 407.4 million poor in India.

3.4.5 Conclusions

The Indian economy has recorded substantial growth in GDP while undergoing structural changes away from low productivity sectors such as agriculture towards higher productivity sectors such as services. Structural change in India has been a 'service-oriented transformation' unlike the 'industry-oriented transformation' which has characterized the East Asian countries like Japan, Republic of Korea and China.

The changing sectoral distribution of GDP has not been matched by a commensurate change in the distribution pattern of the labour force, as the agricultural sector and other low productivity sectors continue to dominate employment. Moreover, India's pattern of growth has not been characterized by a change in the structure of employment towards manufacturing, with the share of this sector in total employment stagnating and recently declining, despite growth of output. Even within this sector, the resource and labour intensive low-tech sectors remain the largest employers.

Movement out of agriculture has indeed occurred, but the resulting labour force has not automatically been absorbed into the formal sector. Instead, workers have moved disproportionately into informal employment or low productivity services and even manufacturing activities, where the scope for sustained growth in productivity and improvements in incomes is limited.

Thus, two general conclusions can be drawn. First, despite a reasonable growth performance of the Indian economy, employment continues to be dominated by low productivity activities. Second, permanent wage employment only exists for a fraction of workers. India's growth and structural change have been accompanied by reductions in poverty rates, but a sizable share of the population is still poor. Further reductions in poverty would require a different type of structural change.

3.5 China[24]

3.5.1 Background

In the three decades of economic reform since 1979, China has successfully maintained a 9.9 percent annual GDP growth rate and a 16.3 percent annual growth rate for exports (Lin, 2010).[25] China has already overtaken Japan as the second largest economy in the world, and it will become the largest economy by the 2020s (or earlier) in terms of PPP.[26] In 1979, China was one of the poorest agrarian countries in the world, with a per capita annual income of US$ 243 at 1979 exchange rates[27], about one-third of the average in sub-Saharan countries. Within only three decades, China's per capita GDP increased to approximately US$ 5,000 in 2011, with the country being classified as an upper middle income economy.

China's rapid growth was accompanied by substantial structural change. For instance, in 1978, primary goods accounted for 28.2 percent of GDP and agricultural exports for around 35 percent of China's entire exports. In contrast, by 2009, the proportion of primary industry in China's GDP had shrunk to 11 percent, and agricultural exports accounted for less than 3.5 percent of China's total exports. With the declining share of agricultural goods, manufacturing exports increased from 65 percent of total exports in 1980 to approximately 96.5 percent in 2009 (Yu, 2011). The share of the labour force in primary industry declined from 70.5 percent in 1978 to 38.1 in 2009, while the labour force in secondary industry increased from 17.3 percent to 27.8 percent over the same period.

Industrial upgrading has been a feature of China's structural change process since it initiated economic reforms in the late 1970s. The country's successful structural transformation raises the question of how it developed from a backward, closed and agrarian economy to an open, competitive world factory. The transformation can primarily be attributed to the adoption of an appropriate development strategy, namely a comparative advantage following (CAF) strategy driven by China's endowment of abundant cheap labour (Lin, 2003, 2009,

24 This section draws upon two background papers prepared for the UNIDO BRICS project: M. Yu, "Industrial Structural Upgrading and Poverty Reduction in China" and X. Yue, "Industrial Structural Change, Employment and Poverty Alleviation in China." Both papers were presented at the UNIDO and UNU-MERIT International Workshop on *"The Untold Story: Structural Change for Poverty Reduction – The Case of the BRICS"*, Vienna, 16-17 August 2012.

25 These growth rates are based on official estimates. There is no disagreement about the fact that China has experienced exceptionally rapid growth since 1978, but some researchers argue that official statistics overestimate the actual rate of growth (Yue, 2012; Wu, 2011, forthcoming). Wu's estimate of the Chinese growth rate since 1978 is 7.1 percent per annum.

26 Some studies, such as Feenstra et al. (2011), even predict that China will surpass the US in 2013 in terms of real-price adjusted PPP.

27 Yu (2012), based on National Bureau of Statistics of China, China Statistical Yearbook 2011.

2012; Lin et al., 2004). Before the end of the 1970s, this (latent) comparative advantage was suppressed, with the Chinese government preferring to follow a comparative advantage-defying heavy industry-oriented development strategy. This entailed the fixing of input and output prices by central planners. Firms were deprived of production autonomy and lacked incentives. Efficiency was low. As heavy industries are capital intensive and were incapable of absorbing more workers, employment opportunities in the industrial sector were limited in spite of large investments. As the state required its state-owned enterprises (SOEs) to squeeze as much profit as possible out of production, wages for workers were fixed at a low level, and the prices of agricultural products were set with unfavourable internal terms of trade against rural inhabitants and small farmers.

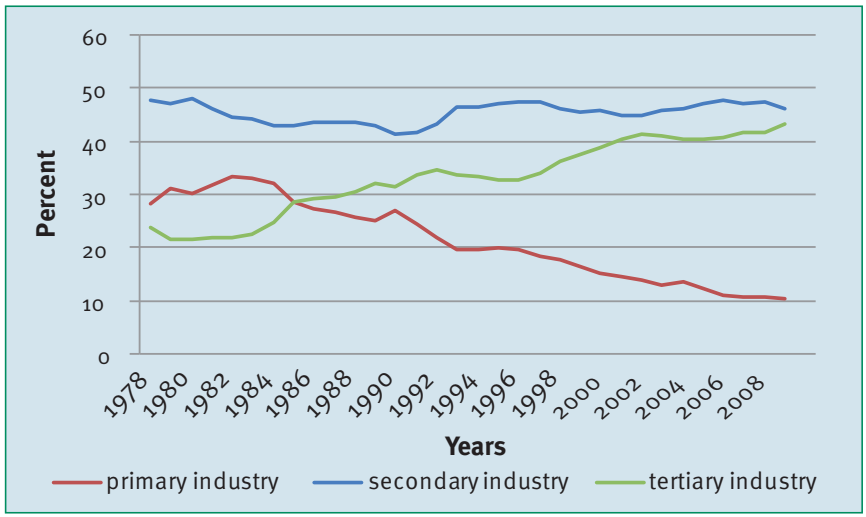
The economic reforms introduced since 1978 put China's development strategy more in line with its comparative advantages. China has, since 1978, given priority to labour intensive industries based on its comparative advantage in factor endowments. This strategy is similar to the development strategies of the four "Little Dragons", that is, Republic of Korea, Taiwan, Province of China, Hong Kong SAR China and Singapore. Thereby, China was able to explore its latent comparative advantage and increase its export volume of labour intensive products.

In the implementation of economic reforms, China pursued a dual-track reform process which consisted of the temporary protection of old sectors while at the same time encouraging the emergence of new sectors and activities in line with the country's comparative advantages. The two tracks subsequently converged and unified into a market track. Similarly, to avoid the collapse of SOEs due to the shock of rapid reform, SOE reform began incrementally with more management autonomy being granted to firms, while encouraging the emergence of other types of firms such as township and village enterprises and later moving to more fundamental institutional transitions. New firms and industries aligned with China's comparative advantage were greatly encouraged (Lin, 2012). The opening up to international trade and foreign investment started with the establishment of free trade zones. After 1992, this was followed by a liberalization of import tariffs and the removal of various non-tariff barriers.

3.5.2 Manufacturing GDP and exports

The sectoral composition of GDP in China underwent a change after 1978, as shown in Figure 3.10. The share of secondary industry in GDP remained the same. In sharp contrast, the share of tertiary industry increased from 23.9 percent in 1978 to 42 percent in 2010. Moreover, the GDP share of the primary industry declined from 28.3 percent in 1978 to only 11 percent in 2010.

Figure 3.10: Sectoral composition of GDP, 1978-2010 (in %)



Sources: National Bureau of Statistics of China (2010, 2011, 2012)

Within the secondary sector, manufacturing increased its share at the expense of mining and public utilities (Table 3.17).

Table 3.17: Sectoral share of value added in China, selected years (indices and %)

	1982	1987	1990	1995	2000	2005	2009
(Indices: 1982=100)							
Total	100	142	143	265	288	566	893
Mining	100	138	114	162	142	185	290
Manufacturing	100	142	149	290	318	659	1,053
Public utilities	100	150	152	242	312	448	534
(Composition: %)							
Mining	16.8	16.5	13.4	10.3	8.3	5.5	5.5
Manufacturing	77.0	77.0	80.1	84.1	85.0	89.6	90.9
Public utilities	6.1	6.5	6.5	5.6	6.6	4.9	3.7
Total	100	100	100	100	100	100	100

Source: Yue (2012) based on National Bureau of Statistics of China (2006)
Note: At constant 1997 CNY.

Within the manufacturing industry, the share of labour intensive light industries increased from 43.1 percent in 1978 to 48.9 percent in 1991. The shift in structure followed changes in investment patterns, with the ratio of investment in heavy industries divided by that in light industries, declining from 8.5 percent during the fifth Five-Year Plan period 1978-1982 to 6.5 percent in 1991. These figures provide further evidence that China has been successfully moving away from its previously heavy industry-oriented development strategy to a CAF strategy, as explained in the previous subsection.

In 1999, the oil and natural gas extractive industry had the largest share in industrial GDP (12.3 percent). By 2009, this share had been reduced to 1.5 percent only, with the share of communication equipment and computers increasing to become the largest in the industrial sector (8.7 percent). Electrical machinery and equipment also increased to 6.6 percent.

In terms of exports, China was a closed economy before 1978. The trade dependence ratio, defined as the sum of exports and imports over GDP, was only

10 percent. However, this figure increased by more than six times within three decades. In 2008, the openness ratio of China reached 67 percent, compared to 25 percent in the US.

The composition of China's exports reflects its manufacturing transformation. Over the past three decades, China's exports have undergone four phases. During the *first phase* (1978 to 1985), the most important export was still agricultural products (50.3 percent of exports in 1980). In terms of industrial exports, China was exporting low value added mineral fuels, such as petroleum, oil and other natural resources. The key reason behind this was that the petroleum products milled from one of its main fields in Daqing, Heilongjiang, increased between 1978 and 1980. The government was aware of the importance of promoting labour intensive industries, such as textiles and garments, but the magnitude of exports from light industries was still small. Mineral fuels, lubricants and related materials accounted for 23.6 percent of China's exports in 1980. This figure rose to 26 percent in 1985, higher than the 16 percent of light textiles and rubber products, which were the second largest category of exports.

In the *second phase*, from 1985 to 1995, China produced and exported labour intensive products such as textiles, garments and other light manufacturing goods, as the CAF development strategy was implemented. In this second phase, textiles and rubber products assumed a dominant position in China's export products. Interestingly, in 1996, China exported transport equipment machinery in the amount of US$ 35.3 billion, which was more than the US$ 28.5 billion from exporting light manufacturing goods that same year. This finding indicates that China had entered its third phase of exports. In the *third phase*, the most important exports were capital intensive products such as machinery and transport equipment.

The difference between the second and third phase is that China's main exports shifted away from standard labour intensive products, such as textiles and garments. By the beginning of the 21st century, low value added and labour intensive products were no longer among the top-10 exports of China. Currently, China's top exports are electrical machinery and equipment (25 percent of total exports), followed by machinery and mechanical appliances (14 percent) and mineral fuels and mineral oils (11 percent). The mineral fuel industry has made its way back to the top of the export list. It is noteworthy that China had a very high value added output ratio of 77.7 percent in 2007, much higher than the 26.2 percent for textiles. Together, the top-3 industries account for more than half of China's total exports.

The *fourth export phase* started in 2001 when China joined the World Trade Organization (WTO). In this phase, a growing range of high-technology products, such as aerospace, computers, pharmaceuticals, scientific instruments and electrical machinery, has been exported. By 2007, the export of high-technology products accounted for 30 percent of manufacturing exports and 18.1 percent of the world's high-technology exports (Yu, 2011). Thus, there is a clear pattern of technological upgrading in exports over time.

3.5.3 Productivity dynamics

Table 3.18 presents sectoral TFP levels and growth rates for Chinese firms, with annual sales higher than CNY 5 million (approximately US$ 770,000) from 2000 to 2006.[28] The average TFP level for all manufacturing sectors is 1.454, which suggests that technological improvements are underway in Chinese firms. Most sectors have positive TFP growth. The average TFP growth rate is quite high at 2.43 percent, indicating the importance of technological progress. The results in this and the previous section indicate that productivity growth in industry and manufacturing has been associated with both structural transformation and technological upgrading in recent years.

28 To obtain accurate TFP estimates, Yu adopted an augmented Olley–Pakes approach to overcome the possible simultaneity issues and selection bias of the usual ordinary least square estimates, such as the Solow residual. Readers interested in such manufacturing firm-level data and detailed discussions and procedures of the Olley–Pakes TFP estimation can refer to Yu and Tian (2012).

Table 3.18: Total factor productivity of Chinese firms, 2000-2006

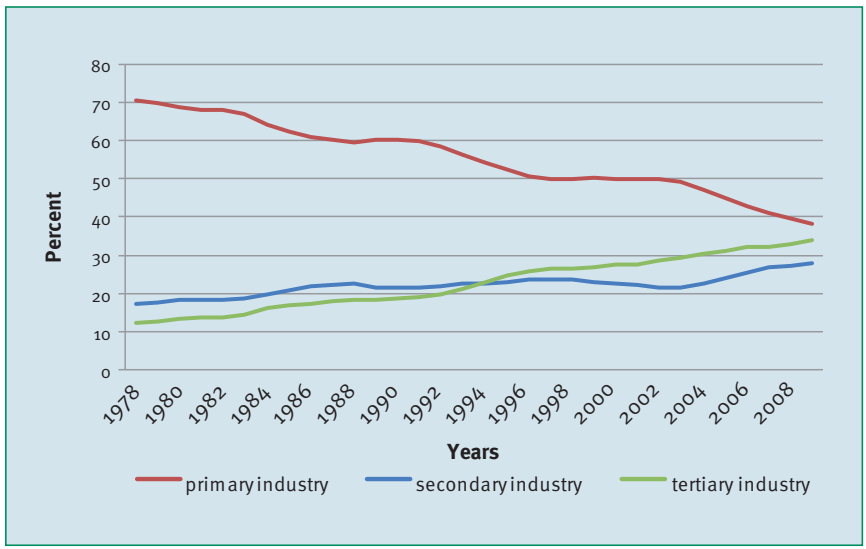
Industries	Labour	Materials	Capital	TFP	TFP Growth rate (%)
Processing of food	0.04	0.89	0.06	1.32	0.57
Manufacture of foods	0.06	0.84	0.02	1.39	2.56
Manufacture of beverages	0.07	0.86	0.04	1.38	2.44
Manufacture of tobacco	0.05	0.85	0.18	2.02	-0.57
Manufacture of textile	0.06	0.88	0.04	1.39	-1.27
Manufacture of apparel, footwear & caps	0.10	0.80	0.02	1.32	1.68
Manufacture of leather fur & feather	0.08	0.84	0.08	1.31	3.62
Processing of timber, wood	0.05	0.88	0.05	1.61	-0.80
Manufacture of furniture	0.15	0.73	0.08	1.47	6.83
Manufacture of paper & paper products	0.06	0.85	0.05	1.54	1.59
Printing, reproduction of recording media	0.06	0.85	0.05	1.43	3.83
Manufacture of articles for culture	0.07	0.83	0.05	1.37	5.03
Processing of petroleum, coking & fuel	0.04	0.91	0.06	1.46	0.01
Manufacture of raw chemical materials	0.03	0.86	0.07	1.47	-1.33
Manufacture of medicines	0.06	0.80	0.00	1.60	0.65
Manufacture of chemical fibres	0.03	0.92	0.03	1.40	2.22
Manufacture of rubber	0.09	0.73	0.14	1.52	1.96
Manufacture of plastics	0.07	0.82	0.05	1.48	4.13
Manufacture of non-metallic mineral goods	0.04	0.87	0.87	1.53	4.83
Smelting & pressing of ferrous metals	0.04	0.92	0.04	1.49	1.82
Smelting & pressing of non-ferrous metals	0.04	0.89	0.05	1.34	-0.07
Manufacture of metal products	0.10	0.71	0.06	1.35	-0.15
Manufacture of general purpose machinery	0.05	0.84	0.06	1.50	0.07
Manufacture of special purpose machinery	0.03	0.87	0.07	1.51	1.64
Manufacture of transport equipment	0.08	0.80	0.06	1.41	3.09
Electrical machinery & equipment	0.07	0.83	0.12	1.35	-0.94
Manufacture of communication equipment	0.09	0.79	0.15	1.68	3.99
Manufacture of measuring instruments	0.05	0.82	0.05	1.58	1.22
Manufacture of artwork	0.07	0.85	0.05	1.36	0.61
All industries	0.06	0.83	0.08	1.45	2.43

Source: Yu (2012) based on Chinese Annual Manufacturing Survey (2000-2006)

3.5.4 Manufacturing employment, wages and poverty reduction

Before the economic reforms of the late 1970s, China was an agrarian economy with a development strategy supporting heavy, capital intensive investment that could only absorb a relatively low number of workers. As a result, a high share of the labour force was employed in the primary sector in 1978 (Figure 3.11).

Figure 3.11: Share in total employment by economic activity in China, 1978-2009 (in %)



Source: National Bureau of Statistics of China (2010, 2011, 2012)

Following the economic reforms of the late 1970s, China experienced a gradual structural transformation, as discussed above, with the GDP share of agriculture declining from 28.3 percent in 1978 to only 11 percent in 2009, and that of the tertiary industry increasing from 23.9 percent in 1978 to 42 percent in 2010. The share of the secondary industry remained stable.

By 2010, the proportion of workers engaged in the primary sector had declined from over 70 percent in 1978 to 38.1 percent, a near 50 percent reduction over a span of three decades. The share of the tertiary industry increased from 12 percent to 34.1 percent in the same period, almost tripling since the introduction

of the reforms. The share of employees in the secondary sector also increased from less than 20 percent in 1978 to 27.8 percent in 2010.[29]

In 1982, manufacturing workers accounted for around 71 percent of labour in the secondary industry. This proportion decreased to around 50 percent in 2009, indicating that more workers have moved towards industries such as construction, partly due to labour-saving technological advances in manufacturing. Important shifts also took place within the manufacturing sector. By 2009, the manufacturing industry with the largest number of workers was no longer textiles and apparel, but communication equipment (9 percent of all manufacturing employment) followed by transport equipment (8 percent of all manufacturing employment). Textiles and wearing apparel had dropped to fourth position at 6 percent. Again, this finding suggests that industrial upgrading has had an effect on the employment structure within the manufacturing sector.[30]

Economic growth has resulted in jobs for rural migrants and new entrants into urban labour markets. Table 3.19 provides an overview of total migration from rural to urban areas. There were 8 million migrant labourers in 1985, 76 million in 2000 with a further substantial increase to 132.1 million in 2006. Migrant workers as a share of the total rural labour force increased from 2.2 percent in 1985 to 25.9 percent in 2006. The increase in the number of migrant workers accelerated following the recovery of the Chinese economy after the 1997 Asian crisis.

29 Using new adjusted estimates of labour input, Yue (2012, Table 1) finds similar trends, but the share of the primary sector in the early years is even higher (74.8 percent in 1982) and the decline is somewhat less pronounced (58.9 percent in 2005). The discrepancies between these different estimates point to the need for further research on employment trends in China (see also Szirmai and Ren, 2007).

30 Sectoral data on output and employment in the Chinese Statistical Yearbooks usually refer to a subset of larger establishments. Comprehensive labour input estimates based on census data are provided in Yue (2012).

Table 3.19: Share of migrant workers in China's rural labour force 1985-2006 (in %)

Year	Proportion of migrants in rural (%)	Rural labour (10 thousands)	Of which migrant workers (10 thousands)
	(a)=((c)/(b)*100)	(b)	(c)
1985	2.2	37,065	800
1986	2.4	37,990	900
1987	2.7	39,000	1,050
1988	3.1	40,067	1,250
1989	3.7	40,939	1,500
1990	4.3	42,010	1,800
1991	5.0	43,093	2,140
1992	5.9	43,802	2,592
1993	6.2	44,256	2,752
1994	6.5	44,654	2,888
1995	6.7	45,042	3,000
1996	7.5	45,288	3,400
1997	8.5	45,962	3,890
1998	10.6	46,432	4,936
1999	11.2	46,897	5,240
2000	15.8	47,962	7,600
2001	18.8	48,229	9,050
2002	21.6	48,527	10,470
2003	23.3	48,971	11,390
2004	23.8	49,695	11,823
2005	25.0	50,387	12,578
2006	25.9	51,023	13,212

Source: Yue (2012) based on National Bureau of Statistics of China (2006), Table 8: Shares of migrant workers in urban employment

Table 3.20 depicts the sectors of the economy in which migrant workers have found employment. As can been seen in column (c) of the table, manufacturing was the sector with the highest share of migrant workers (32.8 percent) in 2005. This is followed by hotels and catering services with 32.2 percent, construction with 29.4 percent and household services with 28.1 percent. Wholesale and retail trade, real estate, leasing and business services, and culture, sports and

entertainment are also among those sectors in which migrant workers make up a large proportion of total employment.

Table 3.20: Total number and share of migrant workers in urban employment in China, 2005 (in thousands and %)

Industries	Total employment (000)	Of which migrant workers (000)	Share of migrant workers in total employment (%)	Sectoral shares of migrant workers (%)
	(a)	(b)	(c)	(d)
Agriculture, forestry, animal husbandry and fishery	136,122	2,161	1.6	2.2
Mining	9,731	806	8.3	0.8
Manufacturing	138,909	45,514	32.8	45.8
Production and supply of electricity, gas and water	9,157	289	3.2	0.3
Construction	31,371	9,212	29.4	9.3
Transport, storage and post	36,640	4,311	11.8	4.3
Information transmission, computer services and software	5,942	451	7.6	0.5
Wholesale and retail trade	83,087	17,678	21.3	17.8
Hotels and catering services	24,469	7,873	32.2	7.9
Financial intermediation	8,615	147	1.7	0.1
Real estate	5,993	907	15.1	0.9
Leasing and business services	7,702	1,013	13.2	1.0
Scientific research, technical services and geologic prospecting	4,434	187	4.2	0.2
Management of water conservation, environment and public facilities	4,471	444	9.9	0.4
Services to households and other services	22,204	6,247	28.1	6.3
Education	26,899	455	1.7	0.5
Health, social security and social welfare	13,690	412	3.0	0.4
Culture, sports and entertainment	5,979	777	13.0	0.8
Public management and social organizations	32,707	448	1.4	0.5
International organizations	30	4	13.3	0.0
Total	608,152	99,336	16.3	100

Sources: Yue (2012) based on National Bureau of Statistics (2006) and Sheng (2008)

Rapid rates of economic growth and structural transformation have led to a significant reduction in poverty. In 1984, the poverty rate in China was 15 percent. Two decades later, poverty in China had been reduced to less than 3 percent of its total population.

Table 3.21 provides further information on the decline of poverty in rural areas, using official Chinese poverty lines. As the Chinese government increased the poverty line in 2007 from CNY 785 per capita to CNY 1,067, there are two sets of estimates for the period 2000-2010. This table also documents the decline in poverty rates.

Estimates using international PPP adjusted poverty lines (such as Chen and Ravallion, 2008) result in substantially higher poverty estimates for China than the national poverty lines. Thus, Chen and Ravaillon estimate that in 2005, 15.9 percent of the Chinese population lived on less than 1.25 PPP dollars a day. Although the poverty levels are higher, this study documents a dramatic decline in Chinese poverty rates over time.

There are several reasons why structural transformation has had such a significant impact on poverty reduction. One of the first measures of the economic reform programmes was the liberalization of agricultural/rural markets. Accordingly, the terms of trade of agriculture improved rapidly and were helpful in improving the income of rural inhabitants and small farmers. Second, lands were reallocated to farmers who were also given full autonomy of production. Hence, the production incentives improved dramatically. Third, the Chinese government also abolished agricultural taxation which had been collected for over 2000 years, contributing to further improvements in farmers' disposable incomes.

In addition, the increasing importance of the service sector contributed to poverty reduction. As service providers (such as restaurants) are generally labour intensive, they were able to absorb labour migration. Finally, anti-poverty initiatives developed by the government also contributed to the reduction of poverty. In 1992, the government identified poor provinces and counties around the country and funded anti-poverty programmes in these areas. For instance, in 2002, a programme to promote regional development in the western and central regions was adopted. In this and other regional anti-poverty programmes, fiscal grants and infrastructure investments were prominent tools.

The income of urban households increased significantly after the economic reforms were introduced. Per capita annual disposable income of urban households increased from CNY 343.4 in 1978 to CNY 11,759.5 in 2006 (measured

in current prices), a more than 30-fold increase. The improvement in the living standard in urban areas can also be attributed to a successful reform of SOEs and booming private entrepreneurship.

Table 3.21: Official statistics of rural poverty in China, 1978-2004

Year	Poverty line (CNY/year)	Size of poverty (10 thousands)	Poverty rate (%)	Poverty line (CNY/year)	Size of poverty (10 thousands)	Poverty rate (%)
1978	100	25,000	30.7			
1983						
1984	200	12,800	15.1			
1985	206	12,500	14.8			
1986	213	13,100	15.5			
1987	227	12,200	14.3			
1988	236	9,600	11.1			
1989	259	10,200	11.6			
1990	300	8,500	9.4			
1991	304	9,400	10.4			
1992	317	8,000	8.8			
1993						
1994	440	7,000	7.7			
1995	530	6,540	7.1			
1996						
1997	640	4,962	5.4			
1998	635	4,210	4.6			
1999	625	3,412	3.7			
2000	625	3,209	3.4	865	9,422	10.2
2001	630	2,927	3.2	872	9,030	9.8
2002	627	2,820	3.0	869	8,645	9.2
2003	637	2,900	3.1	882	8,517	9.1
2004	668	2,610	2.8	924	7,587	8.1
2005	683	2,365	2.5	944	6,432	6.8
2006	693	2,148	2.3	958	5,698	6.0
2007	785	1,479	1.6	1,067	4,320	4.6
2008				1,196	4,007	4.2
2009				1,197	3,597	3.8
2010				1,274	2,688	2.8

Sources: Yu (2012) based on National Bureau of Statistics (2006)

3.5.5 Conclusions

The successful structural transformation and manufacturing upgrading in China has changed the country from a backward and closed economy to a growing and open one, creating numerous new job opportunities for both urban and rural workers. The implementation of the country's comparative advantage following strategy, i.e. prioritizing labour intensive industries to exploit its abundance of cheap labour, drove the structural transformation of the economy. China was thereby able to increase its export volume of labour intensive products. At the same time, the country began opening up to international trade and foreign investment by establishing free trade zones and later by liberalizing import tariffs, removing non-tariff barriers and ultimately joining the WTO. Today, China's manufacturing transformation is reflected in the composition of its exports, which clearly indicates a pattern of technological upgrading over time.

The manufacturing sector became a dominant source of employment for migrant workers from rural areas, which had positive effects on poverty reduction. Additional factors have also played a role in significantly reducing the poverty rate in China, including an improvement of the terms of trade of agriculture, which raised the income level of rural inhabitants and small farmers, as well as a reallocation of land to farmers who consequently enjoyed full autonomy of production. The removal of agricultural taxation and far-reaching anti-poverty measures introduced by the government further reduced poverty. Hence, within three decades, China has successfully developed from a low income country to an upper middle income country.

3.6 South Africa[31]

3.6.1 Background

Until the mid-1990s, South Africa's structural change and development was based on an inward-oriented development strategy in which the use of tariff protection and capital subsidies featured prominently (Lewis et al., 2004) and the mining and export of minerals, particularly gold and platinum, drove investment and urbanization. From the 1980s onwards, this strategy was

31 This section draws upon a background paper prepared for the UNIDO BRICS project: D. Kaplan, "The Untold Story: Structural Change for Poverty Reduction - The Case of the BRICS. A Country Case Study: South Africa", paper presented at the UNIDO and UNU-MERIT International Workshop on "*The Untold Story: Structural Change for Poverty Reduction – The Case of the BRICS*", Vienna, 16-17 August 2012.

reinforced by international sanctions against the policies of apartheid of the then-National Party government. The end of apartheid in the 1990s and the election of South Africa's first fully democratic government in 1994 saw a marked shift in the country's development strategy towards a more open economy.

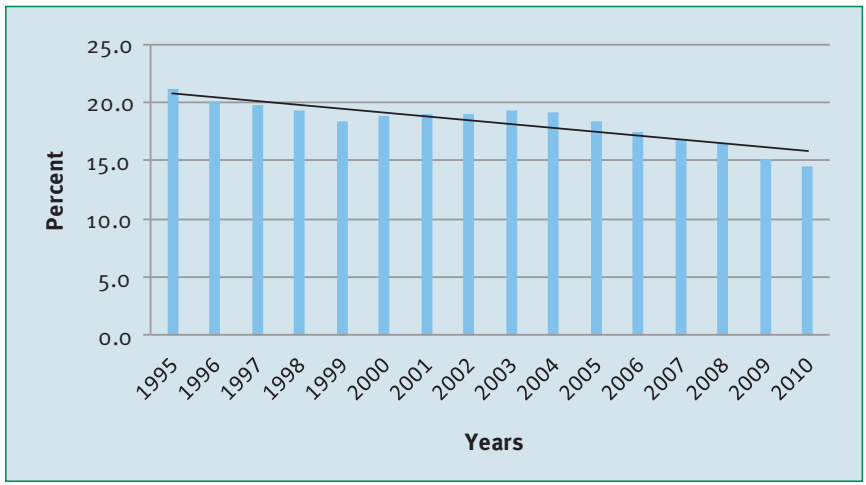
Over time, the share of manufacturing in GDP has declined. Given South Africa's comparative advantage in mining, this decline is not exceptional. The fact that the share of mining in the South African economy has declined, even over the past ten years, a period that includes one of the strongest commodity booms since the Second World War, is more perplexing. Structural change in South Africa over the past three decades has thus been characterized by the rise of the service sector and the relative decline of mining and manufacturing.

Much doubt has been expressed whether this pattern of structural change has been beneficial for development and poverty alleviation. The most damaging criticism is that the service sector has not been able to create sufficient jobs (Rodrik, 2006). Unemployment in South Africa exceeded 20 percent by the end of the 2010s, and poverty and inequality have remained at the level they were 20 years ago at the onset of the transition to democracy. In this regard, one may ask whether renewed consideration of the potentials of manufacturing development and of the reasons for the country's deindustrialization is not overdue. In the remainder of this section, the manufacturing sector and its relative position in the structure of South Africa's economy is explored in more detail.

3.6.2 Manufacturing GDP and exports

Manufacturing value added as a share of GDP declined from 21 percent in 1995 to 14 percent in 2010 (Figure 3.12). This relatively rapid decline may suggest that South Africa has entered a process of deindustrialization. The South African government is consequently pursuing an active industrial policy focused on promoting the manufacturing industry.

Figure 3.12: MVA as share of South Africa's GDP, 1995-2010 (in %)



Source: Kaplan (2012) based on Statistics South Africa (2012)

As of 2008, for a country at its level of GDP per capita, manufacturing in South Africa still had a relatively high share of GDP. However, as is the case in other countries with comparable per capita income levels, increments to income in South Africa are increasingly being spent on services and proportionately less on manufactures. The high and increasing level of income inequality in South Africa tends to reinforce such expenditure patterns as the higher income groups spend proportionately less on manufactured goods. The declining share of the manufacturing sector is—in large part—therefore a function of shifting patterns of demand attributable to the distribution of income.

South African manufacturing disaggregated by industry has, nonetheless, a higher than "normal" share of GDP in eight industries compared to a large number of other countries. It has a "normal" share in five industries and a below average share in only five industries (Table 3.22).

Table 3.22: South African manufacturing output as share of GDP, 2008

Below "Normal"	At "Normal"	Above "Normal"
Non-metallic mineral products	Electrical machinery and apparatus	Rubber and plastic products
Tobacco products	Machinery and equipment	Fabricated metal products
Apparel and footwear	Medical, precision and optical instruments	Paper and paper products
Textiles	Printing and publishing	Motor vehicles
	Wood products	Coke and refined petroleum
		Furniture and other manufactures nec
		Chemicals and chemical products
		Basic metals

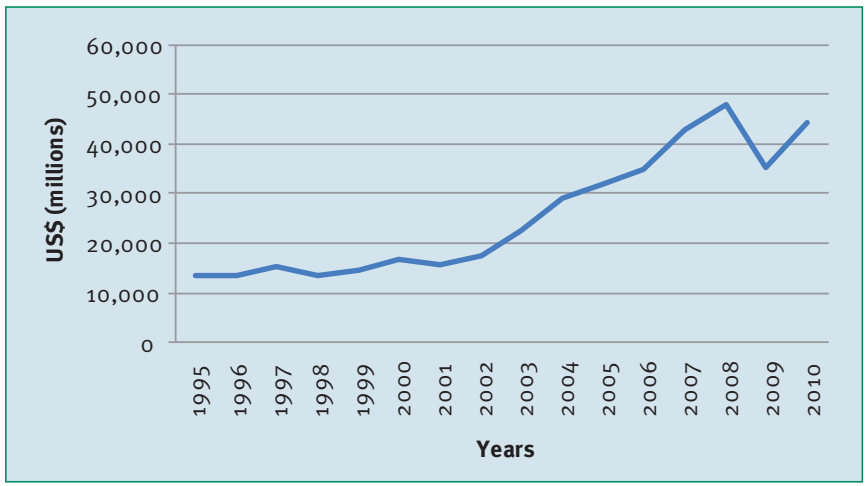
Source: Kaplan (2012) based on UNIDO (2011)

Note: Utilizing cross-panel data from 72 countries over a period of 10 years; this includes both developed and developing countries.

In terms of export performance, South Africa has gradually increased its share of manufacturing exports (Figure 3.13). Expressed in current US dollars, manufacturing exports were flat between 1995 and 2001, but rose steadily until 2008. This was followed by a short yet sharp contraction in 2009, with manufacturing exports recovering in 2010. In current US dollars, manufacturing exports today are approximately three times higher than they were in the mid-1990s. A similar pattern is found when exports are expressed in constant price Rands.

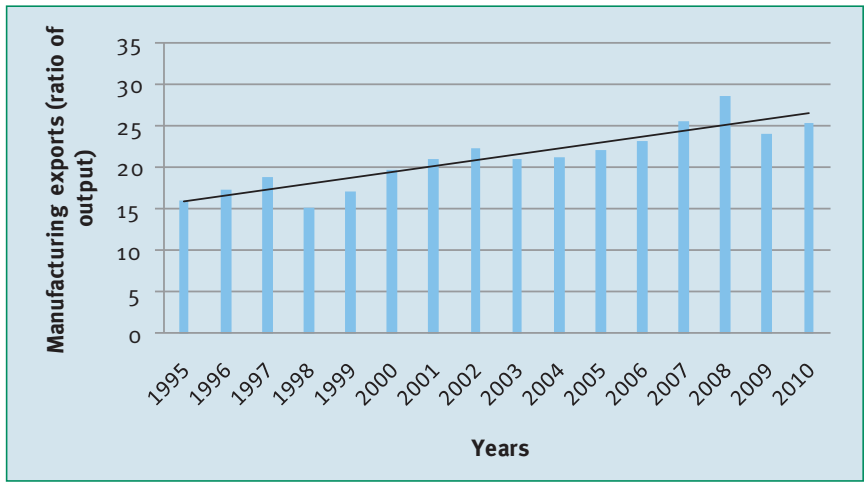
Expressed as a share of total manufacturing output, manufacturing exports rose steadily until 2008 and slightly declined thereafter (Figure 3.14). Currently, the export ratio is around 25 percent compared to 16 percent in 1995.

Figure 3.13: South African manufacturing exports, 1995-2010 (in current US$ million)



Source: Kaplan (2012) based on South African Customs and Excise (2012)

Figure 3.14: Manufacturing exports share in South Africa's total manufacturing output, 1995-2010 (in %)



Source: Kaplan (2012) based on South African Customs and Excise (2012) and Statistics South Africa (2012)

While growth in manufacturing exports and an export orientation of South African manufacturing industries is evident, South African manufacturing firms are not as export-oriented as manufacturing firms in East Asia or Latin America. Exports have increased but "[...] exports per capita as of 2004 are barely higher than they were in 1960" (Hausmann and Klinger, 2006, p. 4). The World Bank (2007a, 2007b), noted a smaller export market participation rate for South African manufacturing firms relative to that of East Asian and Latin American comparators (Edwards and Alves, 2006). In fact, the export participation rate of South African manufacturers was lower than that of Egyptian or Moroccan manufacturing firms. South Africa belongs to the weakest performers globally.

One reason for this is the decline in mining exports. This shortfall has not been matched by increases in manufacturing exports. "Manufacturing per capita exports did expand in the 1960s and 1970s, but they dropped off significantly, expanding only slowly after 1995" (Hausmann and Klinger, 2006, p. 8). Hausmann and Klinger (2006) also point out that South Africa only has high net exports in mineral products. In manufactured products, very few categories boast positive net exports, and if they do, the net exports are very limited.

The level of sophistication of South African exports indicates an upward trend since 1995. However, "[...] the increase in sophistication of South African exports is not overly impressive by comparison with other countries." (Hausmann and Klinger, 2006, p. 12). South Africa's share of global high-technology exports has, in turn, declined. By contrast, Brazil's share of global high-technology exports has been increasing. Moreover, the share of high-technology products in South Africa's total exports is much lower than Brazil's (Kaplan, 2010).

In summary, while an overall increase in manufacturing exports, the export ratio as well as the sophistication of South African exports is observable, the improvements have been modest in *vis-à-vis* with other comparable countries. Clearly, "[...] in terms of export volumes, value and sophistication, South Africa has been a relatively poor performer." (Hausmann and Klinger, 2006, p.12).

3.6.3 Productivity dynamics

While there has been some increase in manufacturing productivity, the growth rate of TFP in South African manufacturing has lagged behind that of comparable countries since the 1970s (Edwards and Golub, 2003; Van Dijk, 2003). Similarly, the World Bank (2007a, 2007b) shows that aggregate TFP in South Africa generally lags behind that of its competitors (Clarke et al., 2007; World Bank, 2011).

A decline in manufacturing employment combined with a moderate increase in output has resulted in an increase in labour productivity. World Bank kernel density estimates of labour productivity based on a sample of South African firms show that South Africa's average labour productivity is higher than that of Mexico, Malaysia, China, Brazil and Poland, and is comparable to Chile's (World Bank, 2011).

Growth in labour productivity has been driven by capital deepening. Manufacturing firms have become more capital intensive and the share of capital intensive industries within manufacturing has increased. Capital intensive sectors are characterized by higher labour productivity. The net result has been an increasing K/L ratio. South Africa has one of the highest K/L ratios relative to its comparator countries – including China and Brazil.

Growth in capital stock has been the major contributor to the increase in manufacturing output (Fedderke, 2002; McCarthy, 2005). South Africa's manufacturing sector is characterized by increasing capital intensity in both production and exports (World Bank, 2010).

Hence, although the South African manufacturing sector's labour productivity

is high in comparison with other similar middle income countries, when controlling for factor intensity, its labour productivity is in fact one of the lowest in the group. The output weighted average TFP of the South African sample is lower than that of the samples from any of its upper middle income comparators in East Asia and Latin America (World Bank, 2010).

Aggregate TFP is a market share weighted mean of the TFP of individual enterprises. It comprises two elements: (i) the TFP of each producer, known as 'within-firm' TFP, and (ii) the allocative efficiency of the industry. Allocative efficiency is a measure of the correlation between 'within-firm' TFP and its market share. Aggregate TFP will be higher, the higher the covariance between 'within-firm' TFP and its market share.

According to the World Bank (2009), the 'within-firm' TFP of South African firms is one of the highest in the survey sample, performing better than that of Brazil, China, Thailand, Malaysia, Mexico and other countries. By contrast, aggregate TFP of South African industry is lower than that of its comparator group. Thus, while South Africa has fairly many firms with high TFP, its aggregate TFP is low. This is a consequence of South Africa's low allocative efficiency. "The reason that aggregate TFP is lower in South African industry than in those of most in its peer group is, rather, that the correlation between enterprise productivity and enterprise market share is weaker in South Africa – that is, the allocative efficiency of South African industry is lower." (World Bank, 2010, pp. 33-35).

An important dimension of this lack of allocative efficiency relates to exports. World Bank survey data show that the marginal revenue productivity of both capital and labour is significantly higher among exporters than among non-exporters in the same sample. The persistence of this premium in the two surveys of 2003 and 2008 suggests that there are some obstacles to the flow of resources into the export sector (World Bank, 2010).

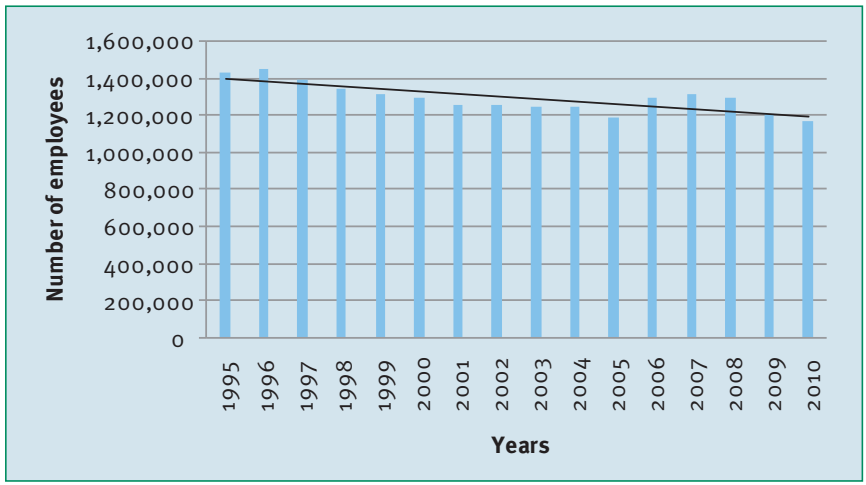
3.6.4 Manufacturing employment, wages and poverty reduction

As mentioned, in recent years, the poor absorption of labour in South Africa's economy has been a major concern. The manufacturing sector has not been able to provide a solution to this problem.

With the exception of the years of strong growth in the global and national economy (2006-2008), when a small increase in the absolute number of employees in manufacturing was recorded, this figure has declined consistently (see Figure 3.15). Manufacturing employment reached its peak in 1996. In the

second quarter of 1996, manufacturing employment accounted for 1.46 million jobs; in the second quarter of 2011, manufacturing employment had dropped to 1.15 million – a decline of 21 percent.

Figure 3.15: Manufacturing employment in South Africa, 1995-2010



Source: Kaplan (2012) based on Statistics South Africa (2012)

This decrease in employment was mainly driven by the sharp downward trends in textiles, apparel and footwear. Taken together, the textiles and apparel and footwear industries witnessed a reduction in employment of approximately 158,000 jobs between 1995 and 2010. Employment loss in these sectors was more than half of the employment loss for the manufacturing sector as a whole. The total share of textiles, apparel and footwear in manufacturing employment declined from 17 percent in 1995 to 8 percent in 2011.

Wage increases have also slowed down recently, although wages are still relatively high. Table 3.23 compares labour costs in South Africa with those in the other BRICS countries and in Bangladesh, the country with the lowest labour costs. While South Africa's labour costs are lower than those of Brazil, they are still relatively high.

Table 3.23: Apparel manufacturing labour costs in selected countries, 2008 (US$ per hour)

Countries	Labour Cost (US$/Hour)	Labour Cost (US$/Hour) Bangladesh = 100
Bangladesh	0.2	100
China (Inland)	0.6-0.8	305
China (Coastal 2)	0.9	409
Russian Federation	1.0	459
China (Coastal 1)	1.1	491
South Africa	**1.8**	**795**
Brazil	2.6	1,168

Source: Jassin-O'Rourke Group, LLC (2008)

A more detailed analysis of the wages by skill level reveals that there is a shortage of skills in South Africa and that there consequently is a high skill premium. The World Bank Enterprise Survey of 2003 revealed that the shortage of skills was considered a severe or major constraint by the majority of firms (35 percent) (Clarke et al., 2007). In the 2008 survey, only half that number of firms identified skills as a serious constraint (World Bank, 2011).

Skilled and semi-skilled or unskilled labour is complementary, i.e. a shortage of skilled workers results in decreased demand for lower skilled workers (Hausmann, 2008). The limited supply of skilled workers also raises the costs of employment for skilled workers and significantly contributes to South Africa's high wage structure and high ULC. Managers and professionals in South Africa earn high incomes relative to comparable countries. Also, the wage gap between managers, professionals and skilled workers, on the one hand, and unskilled production workers, on the other, is much higher in South Africa than in comparable countries (Table 3.24).

Table 3.24: Median monthly wage by worker type in the BRICS (US$)

Country	Managers	Professionals	Skilled Production Workers	Unskilled Production Workers
Brazil	542	568	241	167
China	128	120	72	76
India	53	62	-	31
South Africa	1,848	803	487	241

Source: Clarke et al. (2007, p. 51)

Enhancing the supply of skills will, therefore, increase demand for unskilled labour and will directly and indirectly enhance investment and employment by lowering the ULC.

Despite the shortage of skills, the share of South African manufacturing firms that provide training to their workers and the proportion of production and non-production workers who receive training are lower in South Africa than in a group of comparator countries. In 2008, less than half of the South African firms surveyed provided training to their employees as compared to more than two-thirds of the firms in Brazil, Thailand and China (World Bank, 2011). Exporting firms were far more likely to provide training to their employees – indicating that skill shortages represent a major constraint for South African manufacturing exporters (World Bank, 2011).

In terms of poverty, South Africa is a case of a missed opportunity, because the decreasing share of manufacturing in GDP and employment together with low productivity (particularly with reference to allocative efficiency) and the large wage gap between skilled and non-skilled workers has slowed the reduction of poverty, which only fell from 42.2 percent to 34.8 percent of the total population between 2000 and 2006 (Statistics South Africa and UNDP, 2010).[32]

32 These percentages refer to the share of the population that lives on less than US$2.50 (PPP) per day.

3.6.5 Conclusions

Poor manufacturing performance in terms of production and even more so in terms of manufacturing exports has been a factor limiting employment and retarding South Africa's economic growth.[33] Short- to medium-term forecasts for South Africa suggest only moderate economic growth, and the domestic market is unlikely to provide a major impetus to the manufacturing sector. This will continue to hold true if the tendency for moderate growth is accompanied by increasing levels of inequality, as higher income consumers allocate additional increments of their income to services rather than manufactured products.

The key to the growth of manufacturing output and employment lies in improved export performance. However, in the short term, the export prospects are not particularly promising, especially since economic growth in Europe, South Africa's major market for manufacturing exports, is likely to be quite limited. Nevertheless, the export orientation of South African manufacturing firms is low and there is considerable room for improvement. More policy attention could be given to enhancing manufacturing exports – eliminating the constraints exporters presently face and discussing how current policies may be impeding the growth of manufacturing exports.

The labour intensive industries—textiles and apparel and footwear—have recorded a markedly poor performance despite substantial support for these industries. They enjoy extensive tariff protection in the domestic market, and until recently, exporters benefitted considerably from a duty rebate scheme. Despite these supportive policies, the industries have lost market share in the domestic market, exports have declined and the export propensity is about one-quarter of that for the manufacturing sector as a whole. The key to any improvement in output and employment in these industries may not lie with industrial policy, but with the labour market – in wages, labour regulations and work practices. The high and growing levels of capital intensity of the South African manufacturing sector in aggregate further indicate that labour market reform may be a necessary complement to the government's industrial policy, if the ambitious targets for employment generation are to be achieved.

33 The deeper cause of South African unemployment "[...] is ultimately connected to the inability of South Africa to generate much growth momentum in the past decade. High unemployment and low growth are both ultimately the result of the shrinkage of the non-mineral tradable sector since the early 1990s. The weakness in particular of export-oriented manufacturing has deprived South Africa of growth opportunities that other countries have been able to avail themselves of" (Rodrik, 2006, p. 3).

Chapter 4: Sustainability of Structural Change: Energy Efficiency and the Diffusion of Sustainable Energy Technologies in the BRICS

4.1 Introduction

The BRICS countries face major challenges to maintain their rapid growth without proportionately large increases in carbon emissions (O'Conner, 1996; World Bank, 2003). The environmental effects of human actions can be decomposed into four elements, also referred to as the Kaya equation (Girod et al., 2009; Raupach et al., 2007; Szirmai, 2013): pollution per unit of output of energy (*F/E*); energy per unit of output (*E/GDP*), output per capita (*GDP/P*) and population size (*P*).

$$F = \left[\frac{F}{E}\right] * \left[\frac{E}{GDP}\right] * \left[\frac{GDP}{P}\right] * P$$

F here refers to emissions, E to energy consumption, F/E to the pollution intensity of energy use, E/GDP to energy consumption per unit of output (energy efficiency or energy intensity), GDP/P to GDP per capita and P to population.[34]

The BRICS are characterized by a large population and rapid increases in GDP per capita. This implies that their CO_2 emissions will increase rapidly, unless there are major breakthroughs in technologies and energy management to reduce energy intensity and pollution intensity.

34 Industrial energy efficiency is the ratio of the useful or desired output of a process to the energy input into a process; for a higher aggregated level, the ratio of the amount of economic activity produced from one unit of the amount of energy. Industrial energy intensity is the amount of energy used to produce one unit of economic activity across all sectors of an economy; related to the inverse of energy efficiency but only at the sectoral, economy or global level (UNIDO, 2011).

This chapter focuses on the extent and potential of "green" industrialization in the BRICS, primarily through improvements in the energy efficiency in manufacturing (Section 4.2) and the reduction of pollution intensity in the BRICS through the replacement of fossil fuels with renewable energy sources (Section 4.3).

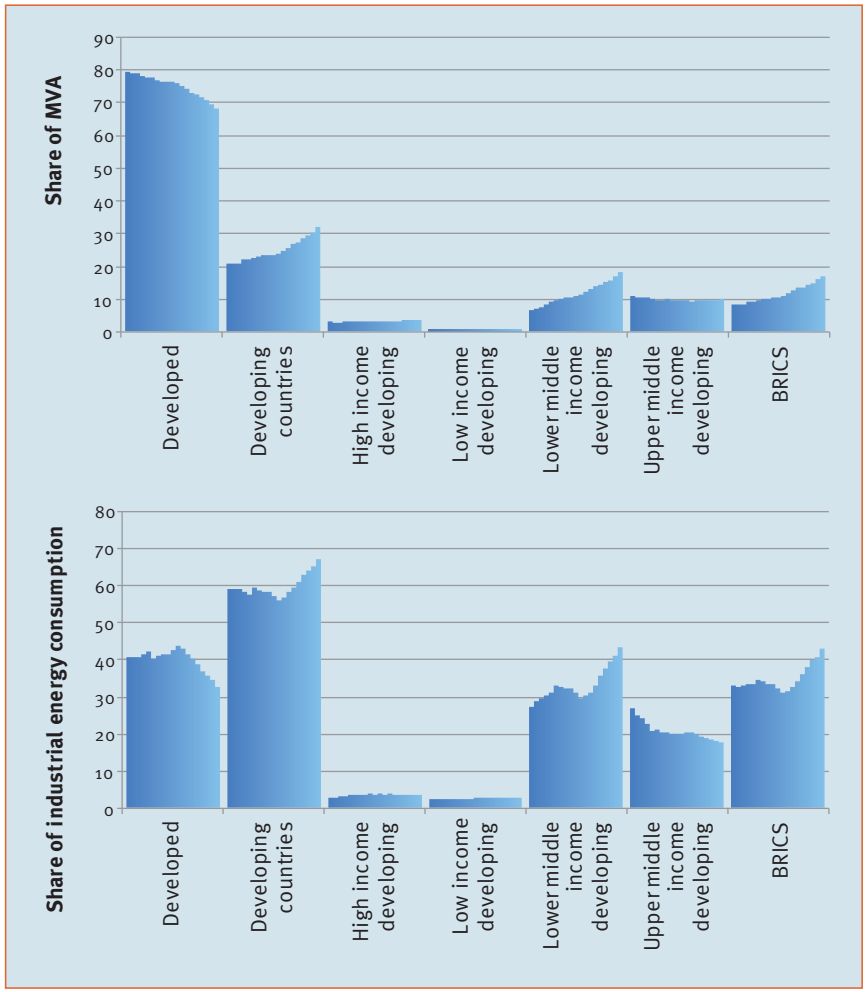
4.2 Energy Efficiency

The world's energy consumption increased from 6.0 Gigatonnes of oil equivalent in 1990 to 8.2 Gigatonnes of oil equivalent in 2008, mainly due to the rapid increase of energy consumption in developing countries (UNIDO, 2011). Insofar as energy consumption has become a major source of CO_2 emissions, growing levels of energy use will increase pollution levels.

Manufacturing industry is the largest energy user, accounting for around 31 percent of world energy consumption since the early 1990s. In developed countries, manufacturing only accounts for 24 percent of total energy consumption while in developing countries it is more than 36 percent of the total (UNIDO, 2011).

Figure 4.1 shows that the BRICS account for more than half of the developing countries' share of industrial energy consumption. This share has rapidly increased in recent years due to their rapidly growing industrial production and the high energy intensity of their production structure.

Figure 4.1: Share of industrial energy consumption and share of MVA, by country income group and BRICS, 1990-2008 (in %)

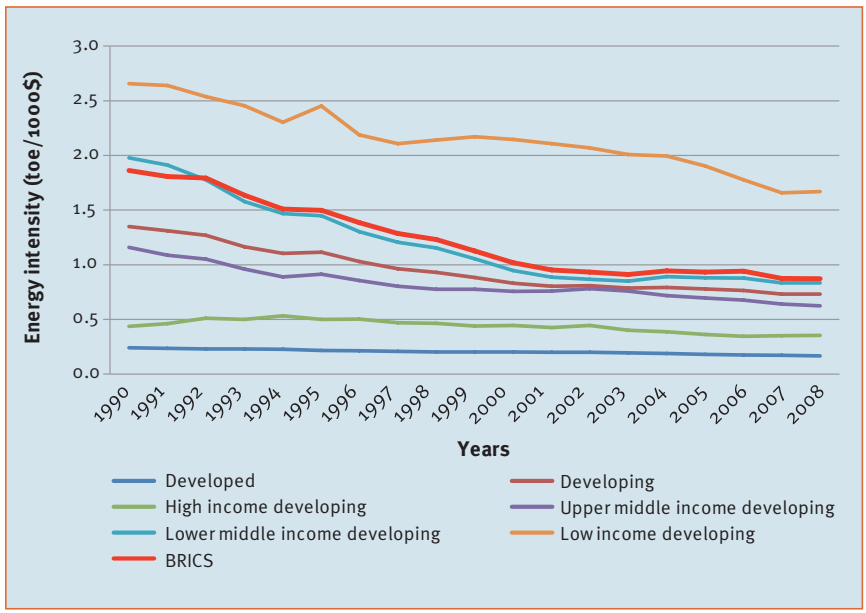


Source: UNIDO (2011)

Figure 4.2 illustrates changes in the energy intensity of various country income groups from 1990 to 2007. The BRICS as a group had relatively high energy intensity at the beginning of the 1990s. They succeeded in quickly reducing their energy intensity by 2003 and have considerably narrowed the gap with

other developing countries. However, since 2003, the BRICS's energy intensity level has largely remained unchanged and it is still slightly higher than that of lower middle income countries.

Figure 4.2: Manufacturing energy intensity by country income group, 1990-2008 (in toe/1000 US$)



Source: UNIDO (2011)

Industrial energy efficiency improved between 1990 and 2008 in all BRICS countries except Brazil. China reduced its industrial energy intensity by nearly two-thirds, India by nearly half and in the Russian Federation and South Africa by around 30 percent (UNIDO, 2011). The major driver was technological change as countries adopted new vintages of energy-efficient capital goods, modernized production processes and offered new resource-efficient products, which saved on energy by reducing the volume of inputs used. Concerns about energy efficiency also emerged among policymakers and a number of energy saving policies and schemes were introduced. In Brazil, heavy investments in the petrochemical and steel industries meant that average energy intensity in manufacturing increased due to the high volumes of energy per unit of output used in these industries (UNIDO, 2011).

Although the BRICS's manufacturing energy intensity has decreased over time, there is still substantial potential for further reducing it and, thus, 'greening' the BRICS's industrial development.

4.3 Diffusion of Installed Capacity to Generate Renewable Energy[35]

One of the major sources of environmentally sustainable economic development is the (growing) use of renewable energy. Hence, in the remainder of this chapter, the focus shifts from energy efficiency to the reduction of pollution intensity in the BRICS through the replacement of fossil fuels with renewable energy sources. This section analyses the diffusion of renewable energy in the BRICS, focusing on two dimensions: (i) installed capacity to produce renewable energy, and (ii) the capacity to manufacture and innovate in renewable technology.

The diffusion literature documents that the process of innovation diffusion is associated with processes of knowledge and capabilities development in a co-evolving manner. The use of renewable energy, the manufacture of equipment for the production of renewable energy and innovation/invention in the field of renewable energy technology are stimulated by various factors such as national socio-economic characteristics, policies and natural resource endowments, as well as interactions with external agents such as actors in international markets, multinational firms and foreign investors. These factors co-evolve in aggregate terms in accordance with the stages of a country's development. Hence, the process of diffusion in emerging countries is expected to be very complex and different from that of industrialized countries, where the technologies tend to be pioneered and used first. In developing and emerging countries, the development and diffusion of innovations is instead often associated with a catching-up process in which the capabilities to use the technologies do not necessarily evolve in parallel with the capabilities to develop them.

Thus, the diffusion of the capabilities to use, manufacture and innovate (invent) may not evolve in parallel in the BRICS. The analysis of the capacity to use and produce wind turbines and solar photovoltaics (PV) (Iizuka et al., 2012) provides insights into how the diffusion of the capacities to use and produce

35 This section has drawn on a background paper by M. Iizuka, E. Dantas, and I.M. Bodas Freitas, "The Production and Diffusion of Renewable Energy Technologies in the BRICS Countries", paper prepared for the UNIDO and UNU-MERIT International Workshop on "*The Untold Story: Structural Change for Poverty Reduction – The Case of the BRICS*", Vienna, 16-17 August 2012.

renewable energy technologies evolves. The capabilities to develop and produce technologies of medium to high complexity seem to hinge much more on capabilities to use these technologies than on the production capabilities for technologies of low to medium complexity. The reason for this is that the knowledge developed while using the technology offers an important source of information for problem-solving and innovation, when technologies, are more complex and less mature (von Hippel, 1994). Production capabilities for technologies of low and medium complexity are increasingly associated with low labour costs, earlier capabilities to produce or use related technologies and with public policies, including procurement and policies supporting domestic industries.

Besides the complexity of the technologies, the availability of specific natural resource endowments and the role of public procurement play an import role in explaining the co-evolution of the capacity to use and produce renewable technologies.

4.3.1 Adoption of renewable energy technologies

Diffusion of installed capacity to generate renewable energy reflects the adoption of renewable energy technologies by energy producers. In 2010, fossil fuels accounted for 80.6 percent of global final energy consumption, including power, heat and transport; nuclear energy accounted for 2.7 percent and renewable energy for 16.7 percent (REN21, 2012). If we focus on renewable energy sources in 2011, traditional biomass accounts for 8.5 percent of total energy consumption (10 percent in 2010), hydropower for 3.3 percent, biofuels for 7 percent and the rest for 4.1 percent (2.2 percent in 2010). Renewable energy capacity is growing very rapidly, in particular in the emerging countries (REN21, 2011, 2012). Table 4.1 provides a snapshot of countries leading in the use of different renewable energy sources.

Table 4.1: Ranking of world leaders in renewable energy capacity and production, 2006 and 2010

2006		2010	2006		2010
RENEWABLE ENERGY			**SOLAR PV**		
1	China	China	1	Germany	Germany
2	US	Germany	2	Japan	Spain
3	Germany	US	3	US	Japan
4	Spain	Spain	4	Spain	Italy
5	India	India	5	Netherlands	US
WIND POWER			**SOLAR THERMAL**		
1	Germany	China	1	China	China
2	Spain	US	2	Turkey	Turkey
2	US	Germany	3	Germany	Germany
4	India	India	4	Japan	Japan
5	Denmark	Spain	5	Israel	Greece
BIOMASS			**BIO DIESEL PRODUCTION**		
1	US	US	1	Germany	Germany
2	Brazil	Brazil	2	US	Brazil
2	Philippines	Germany	3	France	Argentina
4	Sweden	China	4	Italy	France
4	Finland	Sweden	5	Czech Republic	US
ETHANOL PRODUCTION					
1	US	US			
2	Brazil	Brazil			
3	China	China			
4	Germany	Canada			
5	Spain	France			

Source: REN21 (2007, 2011)

Note: Solar PV only includes those connected to a grid.

Table 4.2 presents data on the share of renewable electricity in world energy production in the BRICS countries and the three developed countries with the largest installed capacity for renewable electricity in 2008, Germany, Spain

and the US. In 2008, the BRICS's renewable energy production, including hydroelectric capacity, accounted for one-third of global renewable electricity capacity; excluding hydroelectric capacity, it only accounted for one-tenth. Germany, Spain and the US together make up 15 percent of global renewable electricity capacity, including hydroelectric capacity, and 45 percent of global renewable capacity, excluding hydroelectric capacity.

Table 4.2: Share of renewable electricity in world's total energy production, 2008 (in %)

	Share of world electricity production	
	Renewable electricity	Non-hydroelectric renewable electricity
	(% of total world electricity generated)	(% of total world electricity generated)
Brazil	2.0	0.1
China	2.8	0.1
India	0.7	0.1
Russian Federation	0.9	0.0
South Africa	0.0	0.0
Germany	0.5	0.4
Spain	0.3	0.2
United States	2.1	0.7
World	19.1	2.8

Source: International Energy Agency (2009) and energy production source (2011)

Table 4.3 provides information on the share of electricity produced from renewable sources from 1990 to 2009. When hydroelectric sources are included, Brazil has one of the highest shares of renewables in electricity generation (almost 90 percent for the period under consideration), while the US and South Africa have the lowest shares of renewable energy sources. In South Africa, in particular, electricity is mainly generated from fossil fuels. Between 15 to 20 percent of energy in China, India and the Russian Federation consisted of renewable energy sources in the period under consideration. While the share of renewables increased significantly in Germany and Spain between 2000 and 2009, no similar trend was visible in the BRICS, primarily because their total energy consumption increased so rapidly in this period.

If we focus on non-hydroelectric sources of energy (second panel of Table 4.3), we find that from 2000 onwards, Germany and Spain overtook Brazil in terms of the share of renewable electricity. In 2009, Spain and Germany had the highest reliance on non-hydroelectric renewable electricity sources, with 16.23 percent and 12.85 percent of the total, respectively, followed by Brazil (5.22 percent), the US (3.68 percent) and India (2.22 percent). The countries included in the analysis had very high annual growth rates of the share of non-hydroelectric sources (between 5 and 7 percent) from 2000 to 2009, higher than the world average rate (4.8 percent), except for the US (4.5 percent) and South Africa (-2 percent).

Table 4.3: Electricity produced from renewable sources including and excluding hydroelectric, selected countries and years (in % of total)

	1990	1995	2000	2005	2009
Electricity produced from renewable sources (in % of total)					
Brazil	94.0	94.0	89.0	87.0	89.0
China	20.0	19.0	17.0	16.0	17.0
India	25.0	18.0	14.0	16.0	14.0
Russian Federation	15.0	20.0	19.0	18.0	18.0
South Africa	0.0	1.0	1.0	1.0	1.0
Spain	17.0	15.0	16.0	14.0	25.0
United States	12.0	11.0	8.0	9.0	10.0
Germany	3.0	5.0	6.0	10.0	16.0
World	19.0	20.0	18.0	18.0	19.0
Electricity produced from non-hydroelectric sources of energy (in % of total)					
Brazil	1.3	2.0	2.2	3.7	5.2
China	1.7	0.3	0.2	0.2	0.8
India	0.0	0.1	0.5	1.2	2.2
Russian Federation	0.3	0.0	0.0	0.1	0.1
South Africa	0.0	0.0	0.2	0.1	0.1
Spain	0.0	0.8	2.8	8.3	16.2
United States	0.4	2.0	1.9	2.2	3.7
Germany	3.0	0.8	2.4	6.9	12.9
World	0.0	1.2	1.4	2.0	3.0

Source: Iizuka et al. (2012) based on World Development Indicators

The composition of electricity generation by energy source differs across countries. According to the World Bank (2012), natural gas was the main input in 2005 for electricity production in the Russian Federation (45 percent), and coal was the main input for electricity production in South Africa (90 percent), China (80 percent) and India (70 percent). Hydropower was the most important source in Brazil (82 percent). The main difference between the BRICS and developed countries with respect to energy sources for electricity production is the relatively high reliance of the latter on nuclear energy, of which the use is low in the BRICS countries.

Table 4.4 presents the composition of the electricity generated in the BRICS, Germany, Spain and the US in 2008. Hydroelectric power is by far the largest renewable energy source in the world. Biomass represents 1.3 percent of world electricity generation, about 4 percent of the electricity produced in Germany and in Brazil, 1.5 percent in Spain and the US, and about 0.1-0.2 percent in the other countries included in the analysis. Wind energy accounts for 1.1 percent of the world generation of electricity, 10 percent in Spain, 6.5 percent in Germany, 1.7 percent in India, 1.3 percent in the US and 0.4 percent in China. On the other hand, grid-connected solar PV represents less than 0.01 percent in all the BRICS and in the US, and 0.7-0.8 percent in Spain and Germany.

Table 4.4: Composition of electricity generation in the BRICS and selected countries in 2008 (in %)

	Conventional	Nuclear	Hydroelectric	Biomass	Solar	Wind
	% of total	% of total	% of total	% of total	% of total	% of total
Brazil	12.2	3.1	80.4	4.1	0.0	0.1
China	81.3	2.0	16.2	0.1	0.0	0.4
India	82.0	1.7	14.4	0.2	0.0	1.7
Russian Federation	67.6	15.7	16.6	0.2	0.0	0.0
South Africa	95.0	4.7	0.5	0.1	0.0	0.0
United States	71.1	19.6	6.2	1.6	0.0	1.3
Spain	60.7	19.1	7.9	1.4	0.8	10.4
Germany	61.3	23.7	3.5	4.7	0.7	6.5
World	67.4	13.6	16.3	1.3	0.1	1.1

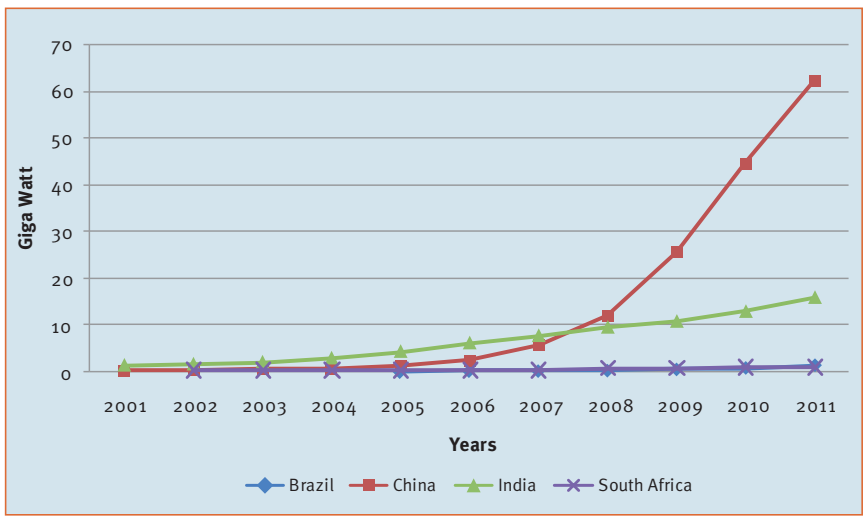
Source: International Energy Agency (2009) and Energy Production Source (2011)

The results in Tables 4.2 to 4.4 suggest that the energy needs of the BRICS are increasing fast. Conventional fossil fuels respond most rapidly to the increasing energy demand of the industrial sectors of these countries. The share of conventional energy sources in most of the BRICS is indeed increasing. This seems to be attributable to the fact that, with the exception of the Russian Federation, reliance on nuclear energy is still low in the BRICS, and the relative importance of traditional renewables has been decreasing. With regard to renewables, the BRICS countries have very different energy realities. Yet the use of renewables is not lower than that of the three developed countries that have had the largest installed capacity for renewable electricity production since 2006, namely Germany, Spain and the US.

4.3.2 Diffusion of capacities to generate wind and solar energy and to manufacture wind and solar energy technologies

This section focuses on two important renewable energy technologies, wind and solar energy. It discusses both the diffusion of installed capacity and diffusion of capabilities to manufacture the machinery and equipment for wind and solar energy production in the BRICS.

Figure 4.3: Wind power installed capacity in the BRICS, 2001-2011 (in GWs)



Source: GWEC (2011) and REN21 (2011, 2012)

There are significant differences in the level and rate of diffusion of installed capacity and production capabilities among the BRICS. Figure 4.3 illustrates the diffusion of installed capacity for wind energy production.

From 2005 onwards, China and India's installed capacity to produce wind energy increased very rapidly. In China, emphasis have been put on mega projects in remote areas since 2008, which have caused some problems in terms of connecting wind power energy to the grid. In 2010, China had 44.7 GW of wind power capacity and overtook the US as the leader in installed wind energy capacity. In 2011, China had 62.3 GW and ranked third in the world, after the UK and Denmark, in offshore wind capacity, corresponding to 258.4 MW (GWEC, 2011, 2012).

In India, wind power installations in the 1980s and 1990s were most commonly used off-grid for water irrigation and rural electrification. In 2000, grid connected wind power was 0.2 GW, and increased to 3 GW in 2003. By 2006, India had the fourth largest wind power capacity installed, with 6.27 GW. In 2009, 2010 and 2011, grid connected wind power capacity increased to 10.9 GW, 13 GW and 16 GW, respectively. The growth of wind power capacity in China and India has been constrained by the extension of the grid, especially to remote and rural areas (GWEC, 2011, 2012). In the other BRICS countries, the evolution of the installed capacity of wind energy has been slow.

The world's on-grid solar PV capacity took off in 2005. It reached 5.4 GW in 2005, 23 GW in 2009 and 40 GW in 2010. In 2010, Germany was responsible for 44 percent of global solar capacity, Spain for 10 percent, Japan and Italy for 9 percent and the US for 6 percent (REN21, 2011). In 2008, solar PV only represented 0.06 percent of global electricity sources, and 0.01 percent or less of total electricity sources in the BRICS (REN21, 2011).

Among the BRICS, China has the highest installed capacity to generate solar energy, but still has a low capacity overall when compared with the world's leading countries in solar energy production. In 2008, China's solar PV installed capacity accounted for 1 percent of the world's installed capacity and kept pace with international diffusion, maintaining the same share in global solar capacity in 2010 (REN21, 2011). Similar to China, India has very limited installed capacity to use technologies to generate solar energy. Indian PV applications mainly focus on off-grid connectivity and small capacity applications, used mostly for public lighting and domestic power back-up in cities and small electrification systems and solar lanterns in rural areas (Pillai and Banerjee, 2009). In 2002-2003, off-grid PV represented 27.5 percent of total PV application, which compares with the world average of 10.6 percent of solar PV off-grid applications. In 2008, PV

on-grid installed capacity was about 0.12-0.15 GW; in 2011, it was 0.46 GW, about 1 percent of world installed capacity. In 2011, public efforts were made to increase solar PV capacity in India. In the remaining BRICS, the installed capacity for on-grid solar energy is still incipient.

As for solar heating installed capacity, China is the world leader, representing 64 percent of the world's installed capacity in both 2006 and 2009. In India and Brazil, installed capacity for the generation of solar heating increased considerably during the 2000s. Use of solar heating in the Russian Federation and South Africa is still negligible.

With regard to manufacturing capacity, China and India have experienced the most rapid diffusion. Four Chinese firms are presently among the top-10 leading wind turbine producers in the world, and China is the largest global producer of wind turbines. The number of Chinese companies rapidly increased to 80 in 2011. India has some 30 wind turbine manufacturers and is the world's fifth largest producer of wind turbines (Iizuka et al., 2012). In contrast, Brazil, the Russian Federation and South Africa only have little installed capacity to manufacture these products, though the Russian Federation seems to have some potential in terms of its technological capabilities.

The aggregate size of the global PV industry in 2011 exceeded US$ 100 billion per year. The rapid expansion of capacity entailed harsh price competition among firms, which is reflected in the many changes in major producers. The location of leading manufacturers changed from the US to Japan to Europe, and the majority are now located in other Asian countries, especially China. In 2011, 11 of the top-15 firms were located in Asia compared to ten in 2010. The most likely cause of this rapid change is price competition, which is mainly led by China. The low-cost solar modules produced in China are making it difficult for incumbent solar panel producers to compete, even with government subsidies. In 2008, China accounted for 35 percent of global production of PV cells. Two years later, in 2010, firms from China and Taiwan, Province of China accounted for 59 percent of global PV module production, up from 50 percent in 2009. In 2011, seven of the ten largest PV cell production companies in the world were of Chinese origin. Although no Indian firm is present among the world's 15 largest producers, India's solar PV module production represents nearly 10 percent of global production capacity.

The upgrading of production capabilities has also been accompanied by patenting activities (Table 4.5). The share of BRICS countries in innovative/inventive activities over the last 30 years is still very limited compared to that of developed countries, though the data in Table 4.5 may be biased towards

developed countries, as the stock data do not show the rapid increase in patenting in specific countries such as China and India.

Table 4.5: Participation in patenting activity for selected climate change mitigation technologies (CCMT) by top-10 inventor and BRIC countries, 1998-2007 (in %)

		Solar PV	Wind	Bio-fuels	Solar TH	Rest of CCMTs	Se-lected CCMTs	F&N energy	All sectors
1	JAPAN	43.9	8.8	15.3	8.7	12.9	29.7	19.0	29.9
2	UNITED STATES	14.5	14.3	18.5	10.5	26.5	15.9	18.3	18.3
3	GERMANY	10.4	29.1	18.2	27.5	10.5	15.2	19.3	14.5
4	REP. of KOREA	8.9	1.4	1.5	0.8	1.2	5.6	1.9	4.6
5	FRANCE	2.7	3.8	6.2	5.4	6.8	3.9	9.2	5.5
6	GREAT BRITAIN	2.4	3.9	3.7	2.9	8.6	3.6	3.4	3.6
7	ITALY	1.0	1.8	3.7	3.2	2.9	1.7	2.8	2.0
8	THE NETHER-LANDS	1.1	2.5	1.8	3.1	0.9	1.5	1.8	1.3
9	CANADA	0.6	2.2	3.0	2.4	3.3	1.5	1.8	1.5
	TAIWAN, PoC	1.8	0.4	0.5	0.7	0.5	1.2	0.4	0.9
10	DENMARK	0.1	6.8	0.5	0.3	0.5	1.1	0.6	0.3
10	SPAIN	0.3	4.0	0.8	2.6	0.3	1.1	0.6	0.5
	CHINA	0.9	0.9	1.5	0.8	0.9	0.9	0.4	0.8
	INDIA	0.3	0.1	0.8	0.1	0.3	0.3	0.1	0.2
	RUSSIAN FEDERATION	0.1	0.3	0.3	0.5	0.2	0.2	0.5	0.2
	BRAZIL	0.0	0.2	0.7	0.0	0.7	0.2	0.2	0.1
	Rest of countries	11.1	19.4	23.0	30.7	23.0	16.5	19.7	15.7
World total		100	100	100	100	100	100	100	100
Total no. of patents		8,972	2,232	731	1,639	2,181	15,755	30,235	2,310,472

Source: Iizuka et al. (2012) based on Hascic et al. (2010)

Note: Inventor countries were selected for those where Total>1000 or CCMT>10 (original data of 27 selected OECD countries and 10 non-OECD countries). Hence, South Africa was not included in the original statistics. We then selected the BRIC countries and the top-10 OECD countries based on the contribution of all CCMT. F&N energy= Fossil fuel & nuclear energy. Total refers to the entire stock of CP patent applications in PATSTAT during the indicated year, 1988-2007. Approximately 8.5 percent of all claimed properties had unknown inventors.

Patenting activities in which inventors from advanced economies patent inventions in emerging countries (duplicate patenting) can be interpreted as indications of technology flows. Large flows of solar PV technology to China are taking place, which may explain the rapid growth of manufacturing activities without corresponding increases in installed energy production capacity. The flow of technology in wind energy technology is also similar, yet somewhat smaller. This may explain why the gap between installed capacity to produce energy and the capacity to manufacture is larger in solar PV than in wind energy.

The development of the capacity to use and manufacture renewable energy technologies was, in some cases, decoupled from the other. However, the development of solar and wind technologies has differed. In the late 1990s, China and India had low installed capacity to generate wind power energy (especially on-grid installed capacity), but they were already intensively involved in the production of wind turbines. From the mid-2000s, efforts were made to develop capacity to use the technologies to produce renewable energy. In 2010, China and India were among the world leaders in the use of wind turbines to generate wind power and developed top-front production capabilities. Hence, in the 1990s and 2000s, installed capacity to produce and use wind turbines converged in India and in China. Today, these countries have a large installed capacity both to produce and use wind energy technologies.

Installed capacity to use solar PV in China and India was limited in the 1990s, and is still limited today. The capacity to produce solar PV equipment and technology was substantial in the early/mid-2000s, and has increased considerably since. Hence, installed capacity to use and produce solar PV in China and in India continues to evolve independently. China is the world's largest cell photovoltaic manufacturer, but makes very limited use of this energy technology domestically (de la Tour et al., 2011). Similarly, India is a large solar PV cells and modules manufacturer, but has very limited installed capacity to use these technologies to produce solar energy domestically.

How can these divergent patterns of diffusion be explained? Wind turbines are relatively more mature and efficient than solar PVs. New technology standards based on the use of different solar PV technologies are still being introduced in the market. In addition, the technological capabilities of national wind turbine producers in China and India were somehow closer to the technology frontier than the capabilities of the producers of solar PV technologies. Additionally, Chinese and Indian producers of solar PV equipment were producing at the low-tech end and focused on the use of older technology vintages and price competitiveness. Furthermore, national policies targeted the increase in

capacity of wind energy production more strongly, while solar PV adoption still heavily relies on an individual decision of households, businesses and public organizations that analyse the cost-benefit of PV installations.

4.4 Concluding Remarks

The findings discussed in the preceding chapter suggest that there are both similarities and heterogeneity across the BRICS in terms of their improvements in energy intensity and of the intensity and composition of their use of renewable sources of energy.

Most of the BRICS have achieved significant improvements in energy efficiency as their industries modernized their technologies and production processes. Industrial energy intensity gaps with developed countries have been narrowed. The pace of change, however, has varied across countries reflecting the differences in the nature and stage of their respective industrialization processes. All BRICS share an immense potential for further improving their industrial energy efficiency, as there still is plenty of room for improvement to reach the levels of developed countries.

BRICS countries do not appear to be lagging behind developed countries with regard to reliance on renewable sources and are embracing modern renewable energy sources such as biofuels, solar PV and wind energy. The major difference between developed and developing countries is their reliance on solar PV technologies, which are much more diffused in developed countries, but there are also differences in the evolution of the use of renewable sources. Since the early 1990s, reliance on renewable sources of energy has generally decreased in the BRICS, reflecting a reduced use of traditional renewables such as firewood, crop residues and animal waste; in developed countries, reliance on renewable energy has increased as a result of investment in modern and more sustainable renewable technologies. On the other hand, the use of off-grid wind and solar energy generation equipment, which is very limited in developed countries, is more widespread in emerging economies, reflecting the specific social and geographic realities of these countries.

Focusing on the case of wind and solar PV technologies, their diffusion of use and production has developed rapidly in China and India, and less so in the Russian Federation, South Africa and Brazil. The reasons for these differences go back to factors that influence the diffusion process. These include the characteristics and capabilities of producers and adopters, natural resource

endowments, level of economic development, national policies and market conditions. For instance, the underdevelopment of solar PV technology both in terms of use and production in the Russian Federation can be explained by the availability of nuclear technology and the relative lack of sunlight, while in South Africa, it is the abundance of fossil fuels and available capacity of nuclear technology; in Brazil, on the other hand, it is the availability of hydro energy as well as the importance of biofuel technology, not to mention the needs for complementary levels of human resources. Hence, the diffusion of renewable technology is very much path dependent and specific at country level.

The differences in patterns of diffusion for use and production of capital goods in India and China for wind and solar PV technology point to two additional factors that need to be considered to understand the technology diffusion process: (i) the degree of maturity of the technology to be diffused, and (ii) the characteristics and numbers of adopters in the market. With regard to wind technology, both China and India have been successful in developing the capacity to use and produce technology in parallel, while this was not the case for solar PV technology. Compared to solar PV, wind technology is a mature technology with a limited number of adopters. Furthermore, these adopters are large and often associated with the public sector, where the adoption process can be facilitated by policy. On the other hand, solar PV technology is still progressing and there are large numbers of adopters, which requires more sophisticated policy interventions.

The case of solar PV suggests that different levels of technological capacity for entry into production or entry as a user are necessary. The entry into production of low-end solar PV systems may not require high technological capacities but mostly low labour costs. On the other hand, starting to use solar PVs in energy generation seems to require higher levels of technological maturity on the part of the adopting enterprises.

Chapter 5: The BRICS in the Global Economy: International Investment, Foreign and Domestic Demand, and Global Value Chains

5.1 Introduction

Whereas the patterns of structural change and their impact on poverty reduction in the BRICS were the subject of the previous chapters, this chapter explores how the BRICS's development patterns were shaped and how, in turn, these have contributed to the global economy. This chapter focuses on three central dimensions of the position of the BRICS in the global economy. These dimensions are (i) the contribution of international finance, particularly foreign direct investment (FDI), (ii) the role of international demand relative to domestic demand as a source of structural change, and (iii) the position of the BRICS in global value chains (GVCs).

The contribution of FDI and multinational enterprises (MNEs) in technological progress as a driver of industrialization in the BRICS is discussed in Section 5.2. The role of internal and external demand in the industrial development of the BRICS is addressed in Section 5.3. Finally, the rise of global production chains or GVCs and their implication for industrialization are the focus of Section 5.4, with a particular emphasis on the food and beverages GVC. Section 5.5 concludes.

5.2 Globalization of Financial Flows: The Role of Foreign and Domestic Investment in Technological Upgrading

Investment is crucial for technological change and economic growth, and the analysis of industrial development can therefore not disregard this factor. Moreover, as was discussed in Chapter 2, the flow of FDI to the BRICS countries, and particularly to China, has increased sharply since the 1990s.

Consideration of the different sources of investment raises several questions, including: How much of the economic performance in the BRICS can be explained by the inflow of FDI? How has FDI contributed to technological upgrading in the BRICS? What is its magnitude in relation to domestic investment? Does domestic and foreign investment have different sectoral preferences? How have multinational corporations influenced the industrial development of these countries? And considering the large size of the BRICS countries, how important is foreign demand for industrial growth relative to the domestic market?

This section attempts to answer these questions. First, the role of technological upgrading in the BRICS is discussed (Section 5.2.1). Next, Section 5.2.2[36] explores the contribution of FDI and MNEs to technological upgrading in the BRICS. Finally, the relationship between technological upgrading and domestic and foreign investment in China, for which detailed data was made available for this report, is analysed (Section 5.2.3).

5.2.1 Industrialization and technological change in the BRICS

The previous chapters indicate that the most rapid economic growth has taken place in those BRICS countries which experienced the most profound structural change and in which manufacturing continues to play a substantial role, such as in China and to a lesser extent India. These countries also had to catch up in terms of the labour productivity (technology) gap with the world frontier, and much work still remains to be done. We also noted that structural change has taken place in manufacturing, away from labour intensive manufacturing towards more capital (and technological/ skills) intensive production. Structural change has also occurred within labour intensive manufacturing industries towards more capital intensive production processes. Our estimations suggest

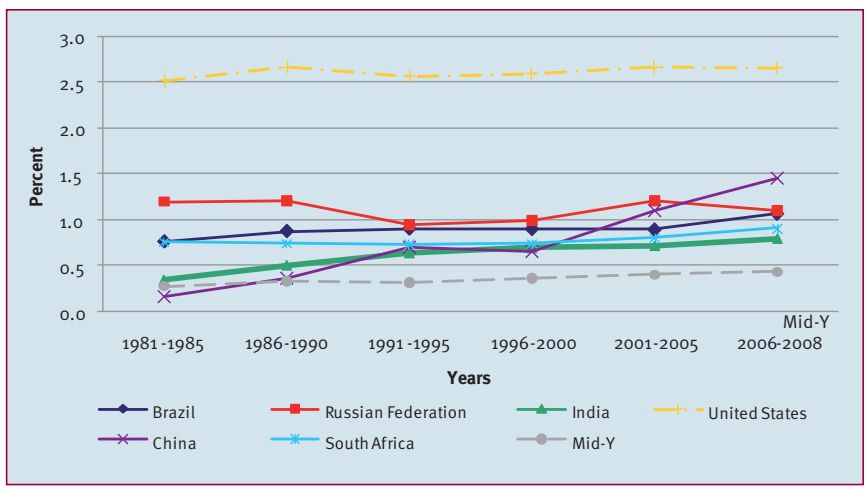
36 The first two sections draw on a background paper by W. Naudé, A. Lavopa and A. Szirmai, "Industrialization and Technological Change in BRICS: The Contribution of Multinational Enterprises and Domestic Investment", paper presented at the UNIDO/ UNU-MERIT International Workshop on *"The Untold Story: Structural Change for Poverty Reduction – The Case of the BRICS"*, Vienna 16-17 August 2012.

that structural change in this direction will continue in the future. This is likely to create further impetus for technological upgrading.

MNEs and domestic absorption capability are two crucial factors for achieving domestic technological upgrading. Hence, it is important to note the extent to which the structural changes have been influenced by MNEs/FDI and investments in domestic absorption capability. We start by considering the latter, namely by investigating the extent of investment and achievements in science and technology in the BRICS.

Investments in the domestic technology absorption capacity of a country can be proxied by: (i) expenditure on research and development (R&D) as a percentage of GDP, and (ii) patents granted by the US Patent and Trade Office (USPTO). Figure 5.1 depicts the extent of R&D in the BRICS. We compare the investments made by the BRICS with those made by the US and express these as five-year averages to obtain a measurement over a long term.

Figure 5.1: R&D expenditure in the BRICS, middle income countries and the US, 1981-2008 (5-year averages) (% of GDP)



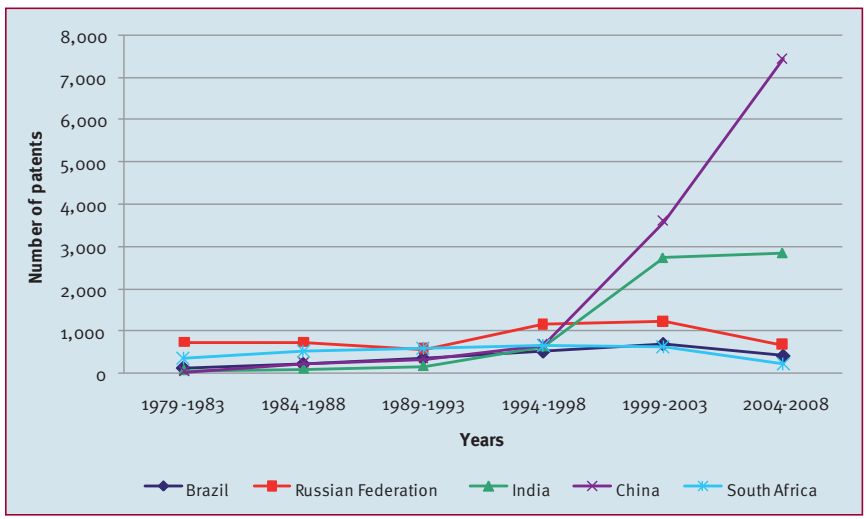
Source: Naudé et al. (2012) based on Castellacci and Natera (2011)

Figure 5.1 illustrates that R&D expenditures in all BRICS countries were higher in the period 1980-2008 than in the middle income countries on the whole, except in China before 1986. Apart from the Russian Federation, the rate of increase in

R&D spending exceeded the mean increase of middle income countries. China recorded the highest increase in R&D expenditure (especially since 1996), as did India (although its level of R&D is still the lowest of all the BRICS). In Brazil, the Russian Federation and South Africa, R&D expenditure has been stagnant (and has even been declining in the Russian Federation since 2001). It is also striking that the gap with the US continues to be substantial.

The second indicator of achievement in science and technology is the number of patents granted by the USPTO, which is an output indicator of technological performance. The trend for the BRICS since 1979 is depicted in Figure 5.2. The remarkable achievement of China and India is clearly visible in the figure. In China, unlike in the other BRICS, the growth in the number of patents registered shows exceedingly rapid growth. In India, the increase in new patent registrations was high between 1994 and 2000, but has tapered off since. The other BRICS countries have seen a decline in patents since 2000. South Africa is the poorest performer – by the early 1980s, the country was second only to the Russian Federation with regard to patent registrations, but had the least number of new patents of all BRICS countries by 2008.

Figure 5.2: Number of patents granted in the USPTO to the BRICS (5-year sum), 1979-2008



Source: Naudé et al. (2012) based on OECD Stats online

In sum, the BRICS countries invest more in science and technology (measured by R&D expenditure) than middle income countries do on average. The increase in R&D and in scientific outputs, such as patents (which have a commercial objective), have been highest in China and India, the two fastest growing economies which also experienced the most profound structural shifts from agriculture into manufacturing and services.

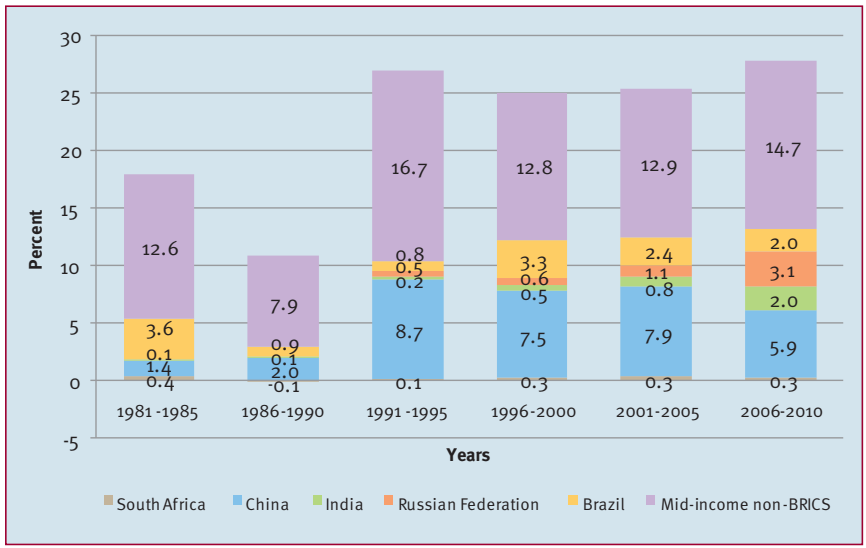
5.2.2 The role of FDI and the contribution of MNEs to technological upgrading in the BRICS

Investments of MNEs in the form of FDI can diffuse technologies and play an important role in fast-tracking industrialization in developing countries in three ways: (i) by directly transferring technology to affiliates or joint ventures (JV); (ii) through the spillover effects of MNE activities in the country, and (iii) by specifically developing and implementing technologies through R&D in the country (Lloyd, 1996).

The extent of MNE activity in the BRICS can be measured in two ways: (i) the amount and share of inward FDI in these countries, and (ii) the amount of FDI as a percentage of gross fixed capital formation (GFCF).

Figure 5.3 depicts inward FDI in the BRICS in comparison with the total in middle income countries. Based on this figure, it is clear that inward FDI may be potentially important for understanding the structural change and growth patterns of the BRICS countries. It shows a general upward trend in FDI to middle income economies. However, in the particular case of the BRICS, this increase is much more rapid. For instance, in 1980, the BRICS only received 5 percent of global FDI, while other middle income countries attracted 12 percent. Thirty years later, the BRICS attracted 13 percent of global FDI, and other middle income countries taken together only received 15 percent.

Figure 5.3: The BRICS share in global inward FDI compared to other middle income economies, 1980-2010 (in %)



Source: Naudé et al. (2012) based on UNCTAD Stats online

Thus, most of the increase in the share of middle income countries' global inward FDI has gone to the BRICS. The bulk has gone to China—especially after the period 1985-1990—as well as to India and the Russian Federation, particularly in the period after 2005, with the Russian Federation's oil-rich economy attracting a significant amount of foreign investment. Whether this inflow of FDI has had a substantial impact on the BRICS economies is a strongly debated issue. It depends on the relationship with respect to domestic investment, as well as the type of industry the FDI has flowed to.

In order to analyse the importance of FDI in each country's GFCF, we need to focus on greenfield FDI, i.e. the part of FDI that actually involves the creation of new capital in the host economy. Table 5.1 presents estimates on GFCF made available by domestic and foreign investment at three different points in time (second half of the 1980s, second half of the 1990s and second half of the 2000s), both in absolute terms and as a percentage of GDP.

Table 5.1: GFCF, domestic investment and greenfield FDI in the BRICS (5-year averages), 1986-1990, 1996-2000, 2006-2010 (% of GDP)

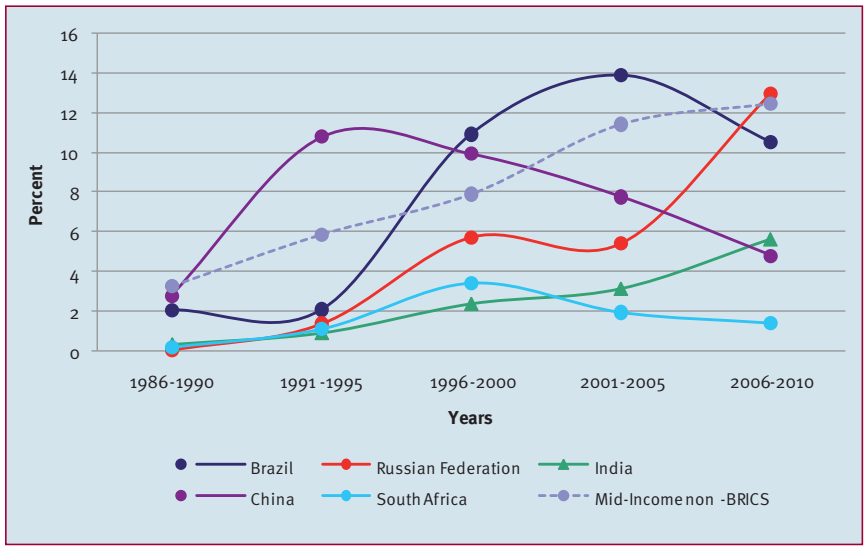
	Brazil			Russian Federation			India			China			South Africa		
	1986-1990	1996-2000	2006-2010	1986-1990	1996-2000	2006-2010	1986-1990	1996-2000	2006-2010	1986-1990	1996-2000	2006-2010	1986-1990	1996-2000	2006-2010
Domestic investment	22.1	14.9	15.8	-	16.3	18.4	23.7	23.1	30.9	27.2	29.8	40.3	19.1	15.5	20.4
Greenfield FDI	0.5	1.8	1.9	-	0.9	2.7	0.1	0.6	1.8	0.8	3.2	2.0	0.0	0.5	0.3
GFCF	22.6	16.7	17.7	-	17.2	21.2	23.8	23.7	32.8	28.0	33.0	42.3	19.2	16.0	20.7

Source: Naudé et al. (2012) based on UNCTAD Stats online

With the exception of Brazil, the ratio of GFCF to GDP of all BRICS countries increased between 2006 and 2010. As expected, the most impressive increase is found in China (which attained 42.3 percent of GDP from 2006-2010), followed by India (32.8 percent). In all cases, it is interesting to note that most of this growth is attributable to large increases in domestic investment rather than greenfield FDI.

To better capture the relationship between domestic and foreign investment in GFCF, Figure 5.4 depicts the share of greenfield FDI in GFCF in each BRICS country and in other middle income economies.

Figure 5.4: Greenfield FDI in the BRICS and other middle income economies, 1986-2010 (5-year averages) (% of GFCF)



Source: Naudé et al. (2012) based on UNCTAD Stats online

When we consider FDI in relative terms, conclusions about its importance differs to some degree. Although the ratios FDI/GDP and FDI/GFCF have grown steadily, the increase has been less dramatic than in other middle income economies. Greenfield FDI has become relatively more important in its contribution to GFCF in India and the Russian Federation, but has declined in relative importance in Brazil, China and South Africa. It is assumed that sustained growth and structural transformation accompanied or led by technological transfer may require FDI, but may also require strong growth in domestic fixed investment. It is also worth noting that the contribution of greenfield FDI is becoming crucial in all countries except South Africa (between 5 and 13 percent), but the overwhelming part of GFCF derives from domestic investment. Secondly, we need to consider where FDI is invested, i.e. into which industries it flows. Table 5.2 shows the 5-year averages of the distribution of FDI in major industries in the BRICS over a three period interval.[37]

37 The following tables refer to the distribution of total FDI (greenfield plus mergers and acquisitions). Unfortunately, data on the sectoral distribution of greenfield FDI is rarely available.

Table 5.2: Sectoral distribution of FDI in the BRICS, 1981-1985, 1996-2000, 2006-2010 (5-year averages) (in %)

	Brazil			Russian Federation			India			China			South Africa		
	81-85	96-00	06-10	81-85	96-00	06-10	86-90	95-99	06-10	84-88	96-00	06-10	81-85	96-00	06-10
Agriculture	0.6	0.3	1.5	-	0.5	1.9	9.6	2.7	0.3	2.2	1.5	1.3	-	0.3	0.1
Mining	2.9	1.4	14.8	-	12.4	29.8	0.4	0.3	0.8	24.4	1.7	0.6	-	16.1	36.7
Manufacturing	73.8	18.1	36.8	-	35.1	26.4	86.6	61.2	27.3	37.3	59.7	56.0	-	35.4	28.1
Utilities	0.0	15.0	4.5	-	0.0	2.3	0.0	5.5	4.5	7.2	6.9	2.3	-	0.0	0.0
Construction	0.0	0.4	3.6	-	2.7	3.9	0.0	2.0	7.8	1.6	2.9	0.9	-	0.2	0.3
Services	22.6	64.7	38.7	-	49.3	35.6	3.4	28.3	59.4	27.4	27.3	38.8	-	47.9	34.8
Trade... (1)	4.1	8.1	8.5	-	14.6	9.8	-	2.6	4.3	3.1	2.7	5.5	-	7.6	3.9
Transport... (2)	0.2	18.8	4.6	-	7.9	3.5	-	10.6	7.9	2.4	3.4	2.9	-	3.7	5.0
Financing... (3)	16.5	37.4	25.2	-	18.2	21.6	-	13.9	40.4	22.0	16.0	28.9	-	36.6	25.9
Other services	1.9	0.3	0.5	-	8.7	0.7	-	1.1	6.8	0.0	5.2	1.5	-	0.1	0.1
Total	100	100	100	-	100	100	100	100	100	100	100	100	-	100	100

Source: Naudé et al. (2012) based on country-specific sources (see Annex IV)

(1) Trade, restaurants and hotels

(2) Transport and telecommunications

(3) Financing, real estate and business

With the exception of South Africa, all BRICS indicate a growing importance of financing, real estate and business as a main destination of FDI.

In Brazil, the Russian Federation and South Africa, a reorientation of FDI over time from manufacturing towards mining is evident. The opposite seems to be true for China, where the share of mining in total FDI dropped sharply (from 25 percent in the 1980s to less than 1 percent in the 2000s), while the manufacturing sector gained in importance over time. This trend has probably boosted the sectoral output and export transformation that has taken place in the BRICS countries.

India, on the other hand, experienced a major decline in the share of FDI for the manufacturing sector, with the bulk of FDI flows to the service sector, in particular financing, real estate and business services. This is again consistent with the structural change of India's economy towards services, as described in the previous chapters.

5.2.3 Manufacturing investment and technological upgrading: The case of China[38]

According to the National Bureau of Statistics of China (2009b), the net fixed assets of China's industrial enterprises gradually increased between 1998 and 2008, which was an important contributor to the rapid growth of China's industrial value added.[39] Between 1998 and 2003, China's net investment in the fixed assets of industrial enterprises increased from CNY 2.8 trillion to CNY 3.9 trillion with an annual average growth rate of 6.4 percent. Between 2004 and 2008, China's heavy chemical industry developed extensively, with net investments in fixed assets achieving an average annual growth rate of 14.9 percent.

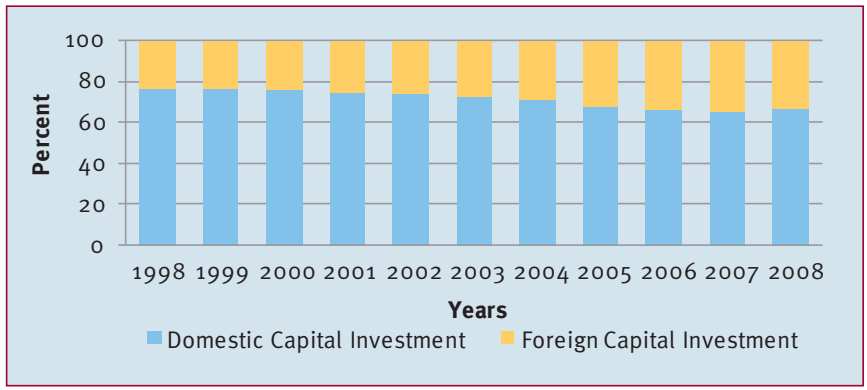
5.2.3.1 Overall investment structure

Figure 5.5 illustrates that the share of investment in fixed assets declined in domestic funded industrial enterprises, while that of foreign funded industrial enterprises kept rising. From 1998 to 2004, the share of investment in foreign funded enterprises increased from 23.1 percent to 28.7 percent, while domestic enterprises experienced a declining share of 76.9 percent in 1998 down to 71.3 percent in 2004. Between 2005 and 2008, the share of investment in fixed assets remained stable at around 33 percent in foreign funded industrial enterprises and 66 percent in domestic funded ones. Fixed asset investment in foreign funded industrial enterprises accounted for a rising share of China's industrial investment, reflecting the fact that foreign funded enterprises are more actively and more extensively participating in China's economic activities. Theoretically, this also promotes technology spillovers from FDI.

38 This section draws upon a background paper prepared by Y. Zhao et al., "Investment, Technological Change and Institutional Change in Industrial Development: The Case of China", paper presented at the UNIDO/ UNU-MERIT International Workshop on *"The Untold Story: Structural Change for Poverty Reduction – The Case of the BRICS"*, Vienna, 16-17 August 2012

39 Given the lack of data on sub-sectoral FDI, we will use industrial enterprises' net fixed assets to examine China's current industrial investment.

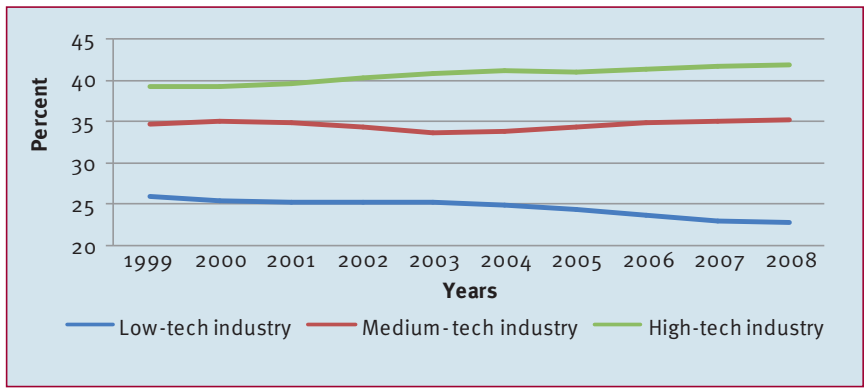
Figure 5.5: Share of net fixed assets in domestic and foreign funded enterprises in China, 1998-2008 (in %)



Source: National Bureau of Statistics of China (2009a, 2009b)

Figure 5.6 reveals an upward trend of high-tech manufactures, from 39.3 percent in 1999 to 42.0 percent in 2008. The medium-tech industry remained relatively stable with a share of around 35 percent during the same period, while the low-tech industries show a declining trend from 26.0 percent in 1999 to 22.8 percent in 2008. The structure of investment shows that China's manufacturing industry is gradually tending towards high-end development.

Figure 5.6: Share of net fixed assets in the manufacturing sector by level of technology in China, 1999-2008 (in %)



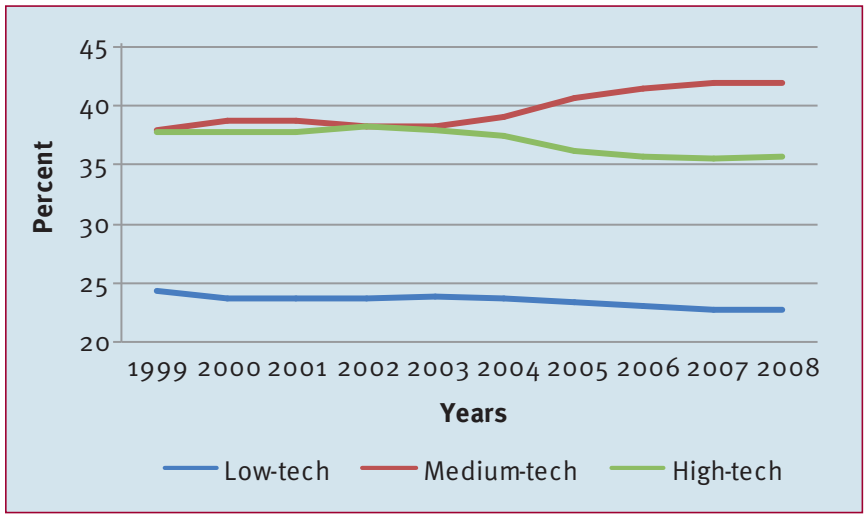
Source: National Bureau of Statistics of China (2009a, 2009b)

Fixed assets in China increased at an annual rate of 8 percent from 1999 to 2008. However, the increase in the rate of fixed assets differed in accordance with the technological level of the industries. The medium-tech industry had the highest annual growth rate at 9 percent, followed by high- and medium-tech industries (both growing at 7 percent). The main reason for this phenomenon is that China's domestic enterprises continually increased investments for steel, oil and other raw materials, and strongly promoted investment in medium-tech industries in the context of a new path to industrialization and further development of heavy chemical industries in 2002.

5.2.3.2 Domestic investment

Figure 5.7 shows that the share of fixed assets in low-tech and high-tech industries in domestic funded manufacturing firms declined from 24.3 percent in 1999 to 22.6 percent in 2008 in the former and from 37.8 percent in 1999 to 36.6 percent in 2008 in the latter. The medium-tech industry gradually increased from 37.9 percent in 1999 to 41.8 percent in 2008. The share of high-tech industries remained stable during the period 1999 to 2003 and only deviated sharply from the share of medium-tech industries after 2004.

Figure 5.7: Share of net fixed assets in China's domestic funded manufacturing enterprises by technological level, 1999-2008 (in %)

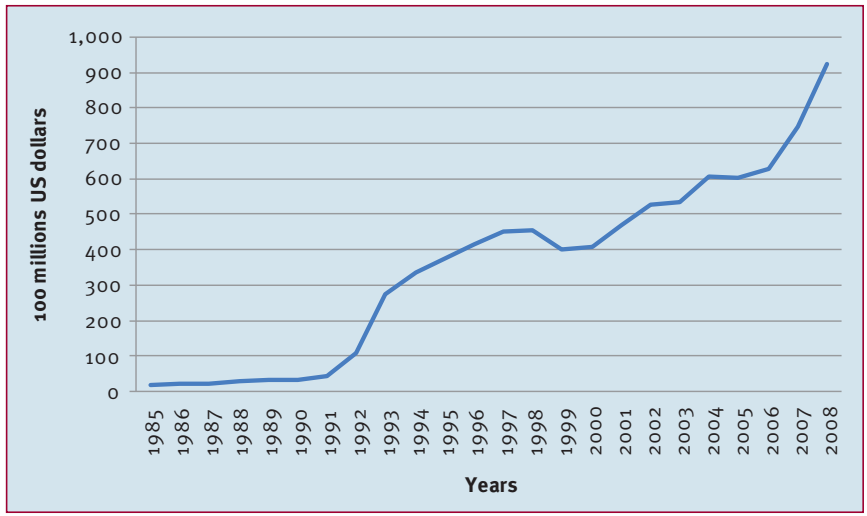


Source: National Bureau of Statistics of China (2009a, 2009b)

5.2.3.3 FDI in China

Foreign direct investment in China increased from US$ 2.0 billion in 1985 to US$ 92.4 billion in 2008, with the annual average growth rate up by 18.3 percent, which reflects the change in the country's stage of development.

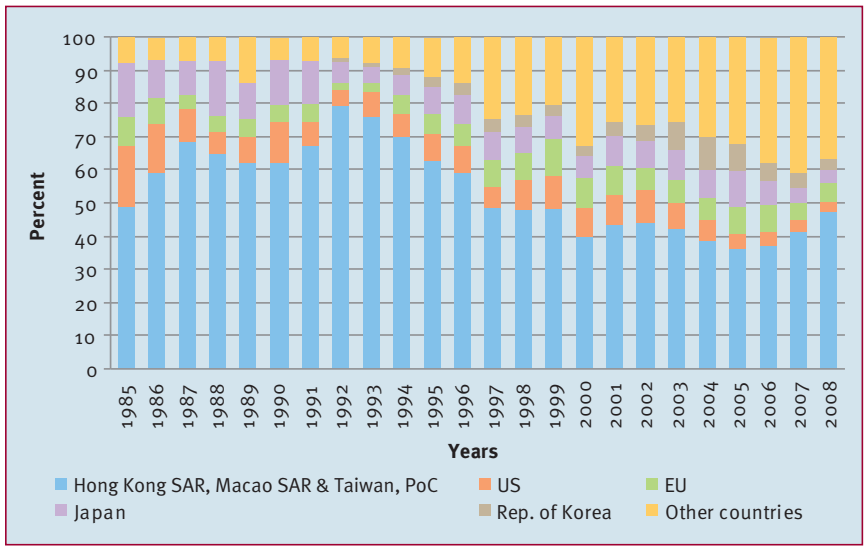
Figure 5.8: FDI disbursements to China, 1985-2008 (in constant 1995 US$ 100 million)



Source: National Bureau of Statistics of China (2009b)

As Figure 5.9 indicates, the sources of FDI have diversified – shifting from the dominance of Hong Kong SAR China, Macao SAR China and Taiwan, Province of China, to the participation of more countries. Meanwhile, investment from Hong Kong SAR China, Macao SAR China and Taiwan, Province of China, is mainly directed towards labour intensive, low-tech industries; that is, the quality of foreign investment has improved in recent years (Zhao et al., 2012). Moreover, the technology spillover effect of FDI has increasingly gained in significance (Zhao et al., 2012).

Figure 5.9: Sources of FDI in China, 1985-2008 (in %)



Source: National Bureau of Statistics of China (2009b)

Figure 5.10 shows that FDI in China underwent tremendous changes between 1985 and 2008. The share of FDI in JVs declined from 93.9 percent in 1985 to 20.2 percent in 2008, while that of foreign-owned investment increased from year to year, from 0.7 percent in 1985 to 75.9 percent in 2008. It is also evident that the share of foreign investment in foreign-owned enterprises accounted for more than 50 percent after China joined the WTO in 2001 as the legal framework for foreign investors changed. The trend seems to be that an increasing number of foreign enterprises are choosing full foreign ownership as the way to invest in China.

In the early stages of China's opening up, the government did not allow foreign ownership in many industries. The only option for a foreign firm to enter a Chinese industry was a JV. Moreover, the technological level of China's domestic funded enterprises was not high during this period, so it was difficult for domestic funded enterprises to compete with foreign investment. Foreign funded enterprises were eager to be involved in JVs with domestic enterprises as a way to benefit from favourable government policies and penetrate the local market.

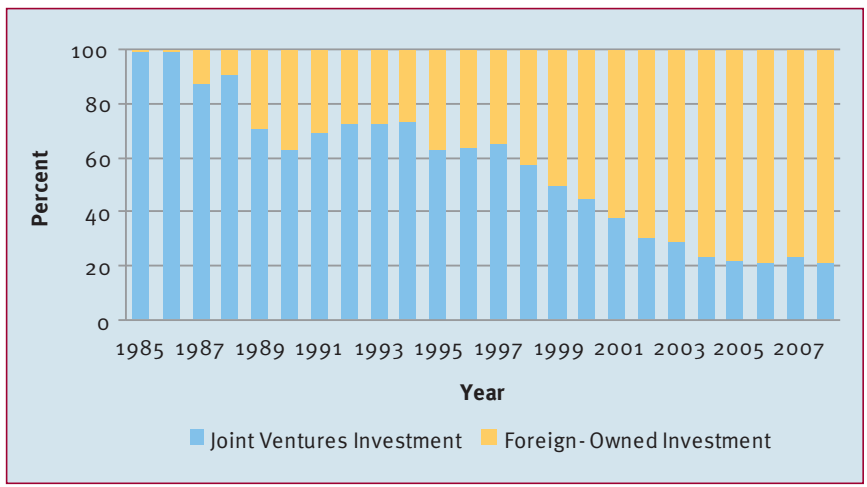
Since joining the WTO in 2001, China has gradually relaxed barriers to foreign investment, geographic and foreign exchange balances, the share of foreign

investment, and many other foreign investment restrictions. For example, entry is now possible in industries in which it previously was not. Where foreign investment was restricted in the past, it is now encouraged; where the permissible share of foreign equity was small, foreign investors can now be controlling shareholders; where company registrations involving a foreign enterprise had to be JVs, foreign-owned enterprises may now legally register. As the competitiveness of China's domestic enterprises increases, foreign funded enterprises face more challenges. Consequently, foreign funded enterprises are becoming increasingly reluctant to cooperate with Chinese domestic enterprises in order to limit technology spillovers to domestic enterprises.

Wholly owned foreign investment could have a negative impact on technology spillovers. As the number of wholly owned foreign investment increases, it may become more difficult for China's enterprises to observe, imitate and learn from foreign enterprises, which will inhibit FDI spillover. Increasing the amount of wholly owned foreign investment may lead to a greater technological gap between wholly owned foreign and domestic funded enterprises, which may make it difficult for domestic enterprises to absorb technology spillovers (Xu, 2009). Xu (2009) also provides some economic census data in support of this view.

Finally, Figures 5.10 to 5.12 provide more details about the composition of foreign investment, both in terms of JVs and in terms of technology levels.

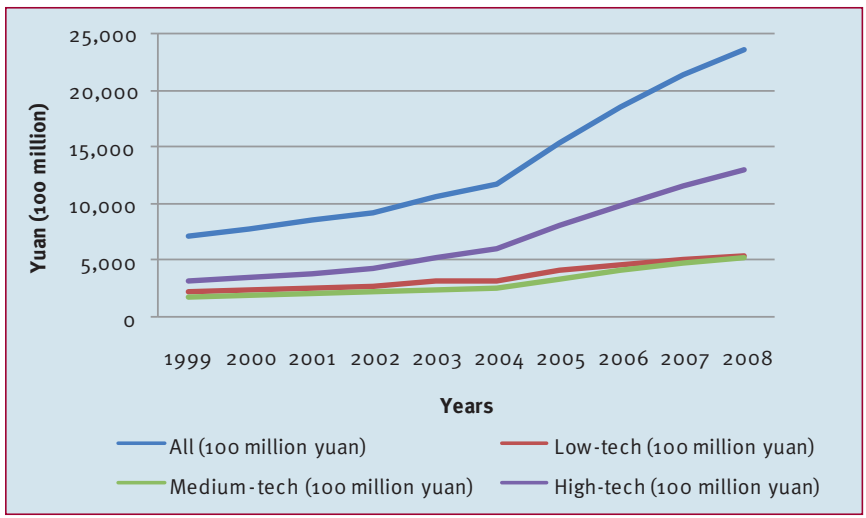
Figure 5.10: Share of foreign investment types in China, 1985-2008 (in %)



Source: National Bureau of Statistics of China (2009b)

Figure 5.11 shows that net fixed assets gradually increased, both for industry as a whole and for industries with varying levels of technology. Clearly, foreign investment in Chinese high-tech industries is largest, followed by low-tech industries. Investment in medium-tech industries is lowest, which is attributable to China's industrial policy which limits foreign investment in medium-tech resource-based industries. The growth rate of fixed asset investment of foreign funded enterprises in industry as a whole and in low-, medium- and high-tech industries in the period 2004-2008 was significantly greater than between 1998 and 2003.

Figure 5.11: Net fixed assets trends in foreign funded enterprises by technological level in China, 1998-2008 (in 100 mn yuan)

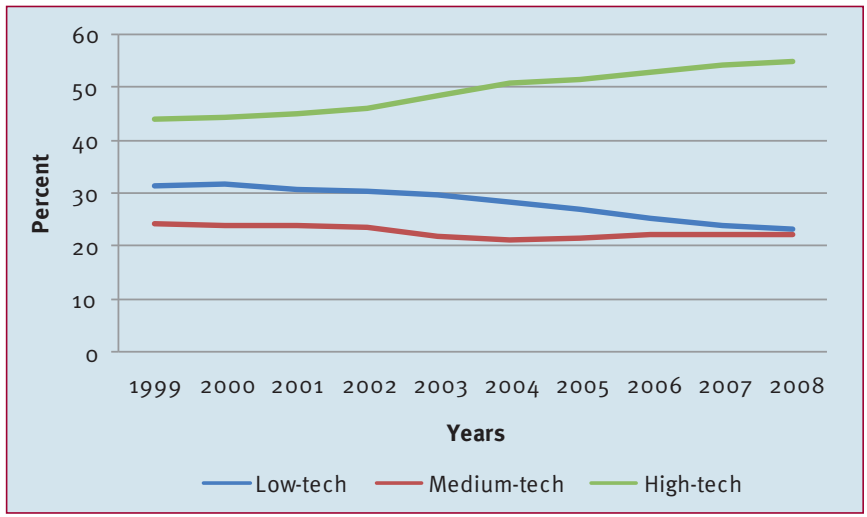


Source: National Bureau of Statistics of China (2009a, 2009b)

As indicated in Figure 5.12, the overall share of net fixed assets of foreign funded enterprises in low-tech manufacturing industry declined from 31 percent in 1999 to 23 percent in 2008; the share of net fixed assets of foreign funded enterprises in medium-tech manufacturing industry was relatively stable in 1999-2008, fluctuating around 24 percent, with fluctuations of no more than -2 percent or +2 percent; the share of net fixed assets of foreign funded enterprises in high-tech manufacturing industry showed an increasing trend, from 44 percent in 1999 to 55 percent in 2008. We also find that the share of net fixed assets of foreign funded enterprises in high-tech manufacturing industries was significantly higher than that in medium- and low-tech industries between 1999 and 2008.

After 2004, the share of net fixed assets of foreign funded enterprises in high-tech industry remained highest at more than 50 percent.

Figure 5.12: Share of net fixed assets of foreign funded enterprises by technological level in China, 1999-2008 (in %)



Source: National Bureau of Statistics of China (2009a, 2009b)

5.3 Foreign and Domestic Demand[40]

5.3.1 Models for manufacturing export expansion

One way to evaluate the patterns of structural change described in Chapter 2 is to examine the relative importance of domestic and export markets as sources of demand for a country's industrial products. The respective role of internal and external demand was intensely debated in the 1960s and 70s in the context of the merits of 'import substitution' versus 'export promotion' strategies. That debate has largely been resolved, since we now know that the internal market alone is unlikely to expand rapidly enough in all but the very largest economies to generate the necessary demand to promote fast growth of manufacturing, and that export expansion can potentially create significant gains in terms of learning and technology spillovers.

40 This section mainly draws upon a background paper prepared by J. Weiss, "Internal and External Demand and Manufacturing Development in the BRICS", paper presented at the UNIDO/ UNU-MERIT International Workshop on *"The Untold Story: Structural Change for Poverty Reduction – The Case of the BRICS"*, Vienna, 16-17 August 2012.

Nonetheless, there are important policy issues that have not yet been resolved since, broadly speaking, there are two alternative models for manufacturing export expansion. One model involves the establishment of 'export enclaves' based on manufactures. Here, production is focused on the export market, typically located in 'export platforms' of special economic or export processing zones or bonded warehouses, often highly import-intensive with relatively few local linkages and often involving FDI. Goods produced are likely to be either unskilled labour intensive, taking advantage of low wage costs or they may be intensive in locally available low cost raw materials. Even domestically owned operations concentrating on export may to some extent follow this enclave approach.

In the second model, manufacturers sell their goods in both the domestic and export market, shifting between them in response to economic incentives and changes in market demand. Here, initial experience in selling in the domestic market may be a factor for export success and, as a result of this experience and the process of technological adaptation it entails, exports may not be restricted to simple labour or raw material intensive goods. In the case of the BRICS, it seems that a mix of these two models has been applied, but only in China has the export platform model based on special economic zones been crucial for the development of manufacturing exports. Elsewhere, whilst such special arrangements have been used, they have not even come close to being as significant as in China.

The extent to which manufactures in an economy are divided between internal and external sales is principally determined by three factors:

1. the scale of the domestic market – other things being equal, it is usually cheaper for a producer to sell domestically than to export;
2. the trade policy of the given country and that of its trading partners – the more open the trade regime, the greater the incentive to sell abroad and the need to export and to finance imports;
3. the country's given resource endowments – a manufacturing sector specialized in processed natural resources may need to export a higher share of manufactured goods due to the limited absorptive capacity of the domestic market for such products.

Larger economies like the BRICS—as purported by the first factor—are expected to sell a higher share of manufactured goods domestically, other things being equal. The second and third factors will be discussed in greater detail below.

5.3.2 Policy background

Policy towards foreign trade has clearly impacted on the structure of manufacturing activity in the BRICS and on the respective roles of internal and external demand. With the exception of the Russian Federation, which at the time of writing was still negotiating its WTO membership, trade policy has roughly followed a similar pattern with some differences in timing and speed of change. All BRICS economies were relatively highly protected prior to trade liberalization which was introduced at different times and speeds in the 1990s as part of WTO negotiations.[41] Trade protection through tariffs or quotas raises the profitability of selling in the domestic market and acts as a tax on exports. This anti-export bias was fully or partially countered by import duty drawbacks and various tax concessions for exporters, often combined with the creation of special economic or export processing zones.[42]

Significant trade reform in the BRICS has been accompanied by exchange rate depreciations in both nominal and real terms, as managed flexible exchange rates were introduced and economies had to adjust to lower levels of import protection. In all cases, initial depreciations were reversed and the last decade has seen real appreciations primarily driven by productivity growth and exports (China and India) or commodity booms (Brazil, the Russian Federation and South Africa). Nonetheless, throughout most of 1970-2000, the BRICS witnessed exchange rate depreciations and increased price competitiveness of their exports. The appreciation of real exchange rates without strong underlying productivity growth will almost certainly have undermined the competitiveness of manufacturing exports from Brazil, the Russian Federation and South Africa.

Table 5.3 and Table 5.4 show shifts in nominal and real exchange rates for national currencies relative to the US dollar for selected years from 1980 onwards. Trade liberalization and real exchange rate adjustment have both been found to be associated with export growth, although trade liberalization has also been been linked to strong import growth, so that the net effect on both the balance of payments and overall GDP growth depends on the strength of demand and supply elasticities and the accompanying shifts in fiscal and monetary policy. Hence, empirical studies on the link between trade liberalization and growth are often ambiguous.[43]

41 Based on the Sachs-Warner index of trade openness, China and India were classified as 'fully closed economies' up to the early 1990s, and Brazil and South Africa as 'late liberalizers' as a result of reforms in 1991-92. The Russian Federation was not included in the index (Sachs and Warner, 1995).

42 Various biases are possible. The simplest is to compare nominal protection rates, so bias B is $B = (1 + t)/(1 + s)$ where t is net taxes on imports and s is net subsidies on exports, with $B > 1$ denoting an anti-export bias; see, for example, Greenaway et al. (1998).

43 Santos-Paulino and Thirlwall (2004), for example, find that trade liberalization across a large sample of countries raised export growth by two percentage points, on average, but increased import growth to a much greater extent.

Table 5.3: Nominal exchange rate indices vis-à-vis the US$, 1980-2010 (2005=100)

Country	1980	1985	1990	1995	2000	2006	2007	2008	2009	2010
Brazil				37.6	75.1	89.3	79.9	75.3	82.1	72.2
China	18.2	35.8	58.3	101.9	101.0	97.3	92.8	84.8	83.4	82.6
India	17.8	28.0	39.6	73.5	101.9	102.7	93.8	98.6	109.7	103.7
Russian Federation				16.1	99.4	96.1	90.4	87.9	112.2	107.4
South Africa	12.2	35.0	40.7	57.0	109.1	106.4	110.8.	129.9	133.2	115.1

Source: Weiss (2012) based on World Development Indicators.
Note: Depreciation is a rise in the index.

Table 5.4: Real exchange rate indices vis-à-vis the US$, 1980-2010 (2005=100)

Country	1980	1985	1990	1995	2000	2006	2007	2008	2009	2010
Brazil				63.8	100.3	88.5	78.6	72.8	75.4	64.2
China		78.5	83.5	92.8	95.3	98.9	92.7	83.1	82.0	79.9
India	49.2	64.7	76.4	104.1	109.2	99.9	88.2	88.9	88.9	76.2
Russian Federation				122.0	175.1	90.5	80.3	71.0	80.9	73.7
South Africa	61.5	118.7	82.1	78.7	123.2	105.0	104.9	114.5	109.3	92.1

Source: Weiss (2012) based on World Development Indicators
Note: Real exchange rates are calculated using consumer price indices. Depreciation is a rise in the index.

5.3.3 Role of foreign and domestic demand

To test for the relative significance of internal and external demand, we apply a simple decomposition analysis which decomposes changes in production into (i) demand growth (holding import shares constant); (ii) export growth, and (iii) import substitution (allowing for changing import shares).[44] Manufacturing data were broken down into three technology categories—low-technology, medium-low-technology and medium-high-technology—to compare the role of internal and external demand for manufactures of varying technological levels.

44 See Annex III for details.

Low-technology manufactures comprise agro-processing, labour intensive manufactures and some resource-based activities. Medium-low-technology manufactures are relatively capital and scale intensive, whilst medium-high-technology encompasses more knowledge-based activities.

Previous studies along these lines have generally found that export growth only contributed modestly to manufacturing expansion in the 1970s, accounting for no more than 5 percent growth in India and 3 percent in Brazil between 1968 and 1974 (Weiss, 2012). However, more recent research suggests that export expansion was relatively more important in the newly industrialized economies of East Asia in the 1980s and 1990s. Our decomposition analysis is influenced by the periods chosen to calculate the allocation of the change in production. We first report the results for the periods for which data by level of technology are available in each country, and then homogenize the periods for the different countries. We use the change between the end and start year of the different periods (Table 5.5) and find that in all cases internal demand growth dominated together—in some cases (particularly in South Africa)—with negative import substitution (since imports rise as a share of apparent consumption). In all instances, exports represented a minority share in additional production. India has the lowest export share in additional production. The export share is highest in the medium-high-technology category in South Africa. The Russian Federation's export share is highest in medium-low-technology manufactures and Brazil's in the low-technology category.

Whilst there are notable differences between the BRICS countries in the relative role of export expansion in additional production and in the different technology categories, these differences are less significant if the analysis is conducted at the level of manufacturing as a whole. Here, the overall share of export expansion ranges from 17 percent in India to 22 percent in China, Brazil and the Russian Federation, and 23 percent in South Africa. Negative import substitution is 6 percent of production in India and 16 percent in South Africa, reflecting the strong growth of manufactured imports by these economies. This result may appear paradoxical in that the period of import substitution trade policy was associated—particularly in South Africa—with relatively rapid growth of manufacturing. The negative result here refers to the period from the late 1990s onwards, when import barriers were reduced, and not to the period of import substitution trade policy in the 1970s and 1980s.

Table 5.5: Demand decomposition by technology category in the BRICS, selected years

Brazil				
1996-2007	**Low-tech**	**Med-Low**	**Med-High**	**All***
domestic demand	0.7	0.8	0.8	0.8
exports	0.3	0.2	0.2	0.2
import substitution	0.0	0.0	0.0	0.0

Russia				
2000-2007	**Low-tech**	**Med-Low**	**Med-High**	**All**
domestic demand	0.9	0.6	0.9	0.8
exports	0.1	0.2	0.1	0.2
import substitution	0.1	0.1	0.0	0.0

India				
1998-2007	**Low-tech**	**Med-Low**	**Med-High**	**All**
domestic demand	0.9	0.8	1.0	0.9
exports	0.1	0.2	0.2	0.2
import substitution	0.0	0.0	0.2	-0.1

China				
2003-2007	**Low-tech**	**Med-Low**	**Med-High**	**All**
domestic demand	0.7	0.8	0.6	0.7
exports	0.2	0.2	0.3	0.2
import substitution	0.1	0.1	0.1	0.1

South Africa				
1999-2007	**Low-tech**	**Med-Low**	**Med-High**	**All**
domestic demand	1.0	0.9	0.8	0.9
exports	0.1	0.2	0.4	0.2
import substitution	-0.1	-0.1	0.3	-0.2

Source: Weiss (2012) based on UNIDO INDSTAT (2011)
Note: * All refers to all manufacturing.

Table 5.6: Demand decomposition by technology category in the BRICS, 2003-2007

Brazil				
2003-2007	**Low-tech**	**Med-Low**	**Med-High**	**All**
domestic demand	0.9	0.9	0.8	0.8
exports	0.2	0.1	0.2	0.2
import substitution	0.0	0.0	0.1	0.0

Russian Federation				
2003-2007	**Low-tech**	**Med-Low**	**Med-High**	**All**
domestic demand	0.9	0.7	1.0	0.8
exports	0.1	0.3	0.1	0.2
import substitution	0.0	0.0	0.1	0.0

India				
2003-2007	**Low-tech**	**Med-Low**	**Med-High**	**All**
domestic demand	0.9	0.9	1.0	0.9
exports	0.1	0.2	0.2	0.2
import substitution	0.0	-0.1	0.1	-0.1

China				
2003-2007	**Low-tech**	**Med-Low**	**Med-High**	**All**
domestic demand	0.7	0.8	0.6	0.7
exports	0.2	0.1	0.3	0.2
import substitution	0.1	0.1	0.1	0.1

South Africa				
2003-2007	**Low-tech**	**Med-Low**	**Med-High**	**All**
domestic demand	1.1	1.0	1.0	1.0
exports	0.1	0.2	0.6	0.3
import substitution	-0.1	-0.2	0.6	-0.3

Source: Weiss (2012) based on UNIDO INDSTAT (2011)

Table 5.6 presents the results for the period 2003-2007. The analysis for more recent periods confirms the continued importance of internal demand as, apart from the cases of medium-high-technology goods in South Africa and medium-low-technology goods in the Russian Federation, additional exports do not comprise more than 30 percent of incremental production and the export share in most countries is below 20 percent. In South Africa, imports of these products exceed their export, implying strong negative import substitution, with imports increasing considerably relative to domestic production. At the level of manufacturing on the whole, India and Brazil have had the lowest shares of export expansion in incremental production in recent years, at 15 percent and 16 percent, respectively. South Africa has had the highest share at 26 percent. Both South Africa and India have strong negative import substitution, reflecting a substantial increase in imports.

Our decomposition analysis suggests that manufacturing expansion has largely been domestic demand-driven. Import substitution where it has occurred has only played a negligible role and has been strongly negative in South Africa and to a lesser degree in India. It should be noted that these negative figures do not imply declining domestic production, but rather that imports grew more rapidly in response to the process of import liberalization. All BRICS countries have witnessed a major rise in manufacturing exports, but this has accounted for around 15-26 percent of additional production in total, with lower figures for India and Brazil. This relatively low share of exports in additional production can be explained by these economies' large internal markets and the fact that enclave manufacturing based on special zones has not been a major feature in the BRICS, apart from China.

5.3.1.1 Differences in market orientation within manufacturing and country characteristics

To gain greater insights into the role different markets play for production, Table 5.7 disaggregates the shares of domestic demand sources into final household consumption (C), final government consumption (G), gross fixed capital formation (I) and others (O), and the shares of foreign demand sources into intermediate (IX) and final export demands (FX). The table indicates a relatively high domestic orientation of the food and beverages industry and the non-metallic minerals industry in most of the BRICS. The Brazilian food and beverages industry is an exception and has strengthened its export orientation over the last 15 years.

Among the five BRICS countries, China's manufacturing sector is the most export-oriented. Aside from the food and beverages and the non-metallic minerals industries, more than 30 percent of demand for products from manufacturing industries derives from exports. The textiles and electrical and optical equipment industries produce more than 65 percent of outputs for exports. The majority of textiles are exported to meet foreign final demand, whereas electrical and optical equipment exports are evenly divided between use for both intermediate and final demand. In terms of domestic final demand, fixed capital formation is clearly the most important demand source for China's manufacturing sector. The trend of exporting and investment-driven manufacturing development has strengthened over the last 15 years. As a result, final consumption by households accounted for less of manufacturing production in 2009.

Domestic final demand has played a relatively significant role for the Brazilian, Indian and South African manufacturing industries. In the case of Brazil, household consumption has represented a sizeable share as a source of demand across manufacturing industries, while GFCF and exports have represented a much greater source of demand for India's relatively technology intensive industries. Although the share of exports as a source of demand is relatively low in general, Brazil seems to have an advantage in the export of natural resource-based products, such as food and beverages and metals, whereas the majority of exports from India represent less resource-intensive manufactured products. Finally, the Russian Federation's export strength clearly lies in natural resource-based industries. Most of such exports represent intermediate inputs for foreign manufacturers. This comparative advantage has not changed since 1995.

Table 5.7: Sources of demand for the BRICS manufacturing production by industry, selected years (in %)

	1995								2009							
Brazil	**DD**	C	G	I	O	**EX**	IX	FX	**DD**	C	G	I	O	**EX**	IX	FX
Food	**85**	81	3	1	0	**15**	9	6	**78**	75	2	1	0	**22**	9	13
Textiles	**93**	84	3	3	3	**7**	4	3	**92**	88	2	2	0	**7**	5	3
Coke	**91**	74	8	9	0	**9**	7	2	**82**	65	8	8	1	**18**	12	5
Chemicals	**84**	66	8	11	-1	**16**	14	2	**81**	64	9	8	0	**19**	15	4
Non-Metallic	**90**	17	6	64	3	**10**	8	1	**88**	21	9	58	0	**12**	10	2
Metals	**68**	27	4	39	-2	**32**	29	3	**70**	32	4	34	0	**30**	25	5
Machinery	**83**	31	2	52	-1	**17**	8	9	**85**	33	2	50	0	**16**	8	8
Electrical	**90**	36	3	53	-1	**10**	6	4	**84**	44	3	38	-1	**16**	10	6
Transport	**84**	57	2	29	-3	**16**	12	4	**81**	53	1	27	0	**18**	7	11
	1995								2009							
China	**DD**	C	G	I	O	**EX**	IX	FX	**DD**	C	G	I	O	**EX**	IX	FX
Food	**85**	70	4	4	7	**14**	3	11	**79**	63	4	10	3	**21**	7	13
Textiles	**45**	25	2	6	12	**55**	17	38	**34**	21	3	8	1	**66**	20	46
Coke	**77**	29	9	32	7	**23**	12	10	**61**	17	7	36	1	**39**	24	15
Chemicals	**75**	37	9	18	11	**26**	12	14	**56**	21	8	25	2	**44**	26	19
Non-Metallic	**86**	17	4	58	7	**14**	7	7	**83**	5	2	76	0	**17**	10	6
Metals	**78**	18	5	43	5	**28**	16	13	**61**	7	2	50	2	**39**	23	16
Machinery	**82**	15	6	53	9	**18**	8	10	**64**	6	2	55	1	**36**	15	21
Electrical	**52**	21	4	23	5	**48**	21	27	**32**	7	2	22	1	**68**	33	34
Transport	**85**	18	5	51	11	**15**	7	7	**69**	12	4	50	3	**31**	17	14
	1995								2009							
India	**DD**	C	G	I	O	**EX**	IX	FX	**DD**	C	G	I	O	**EX**	IX	FX
Food	**93**	90	1	1	1	**7**	3	4	**92**	85	2	1	3	**8**	4	4
Textiles	**69**	59	2	7	2	**31**	9	21	**71**	64	2	2	2	**29**	4	25
Coke	**90**	55	5	22	7	**10**	7	3	**84**	52	4	24	3	**16**	10	6
Chemicals	**76**	45	4	13	14	**24**	16	7	**84**	40	4	12	19	**26**	17	10
Non-Metallic	**67**	15	3	47	2	**33**	31	2	**91**	12	2	76	1	**9**	6	3
Metals	**84**	29	4	46	4	**16**	10	6	**77**	14	1	54	8	**23**	14	9
Machinery	**89**	18	5	64	2	**11**	6	4	**81**	20	2	50	10	**19**	9	9
Electrical	**84**	23	2	47	12	**16**	10	6	**55**	8	1	32	14	**45**	16	28
Transport	**93**	33	3	54	4	**7**	5	2	**79**	21	2	52	4	**21**	10	11

	1995								2009							
Russian Federation	**DD**	C	G	I	O	**EX**	IX	FX	**DD**	C	G	I	O	**EX**	IX	FX
Food	**97**	83	5	0	8	**3**	1	2	**97**	95	4	0	-3	**3**	1	2
Textiles	**89**	73	3	1	12	**11**	7	4	**90**	84	11	5	-10	**10**	8	2
Coke	**63**	41	12	9	2	**37**	29	7	**61**	41	9	13	-3	**39**	33	6
Chemicals	**54**	29	10	6	10	**46**	43	3	**54**	35	10	12	-4	**46**	43	3
Non-Metallic	**89**	29	7	49	4	**11**	10	1	**90**	23	4	64	-1	**10**	9	1
Metals	**40**	17	3	12	8	**60**	57	3	**52**	26	5	25	-3	**48**	46	2
Machinery	**64**	15	4	24	21	**36**	15	21	**66**	43	10	21	-8	**34**	23	11
Electrical	**79**	25	9	32	13	**21**	15	6	**78**	30	9	44	-5	**22**	17	4
Transport	**81**	55	4	12	10	**19**	11	8	**86**	54	4	32	-4	**14**	10	5
	1995								**2005**							
South Africa	**DD**	C	G	I	O	**EX**			**DD**	C	G	I	O	**EX**		
Food	**93**	90	2	1	1	**7**			**90**	86	1	1	1	**10**		
Textiles	**86**	81	2	3	0	**14**			**88**	76	5	5	2	**12**		
Coke	**81**	66	6	8	1	**19**			**78**	61	7	8	2	**22**		
Chemicals	**75**	61	7	6	1	**25**										
Non-Metallic	**84**	31	11	41	1	**16**										
Metals	**63**	32	6	24	1	**37**			**83**	35	9	38	3	**17**		
Machinery	**82**	29	5	47	0	**18**										
Electrical	**89**	37	10	41	0	**11**			**81**	27	7	44	2	**19**		
Transport	**86**	49	5	32	0	**14**			**77**	44	9	24	0	**23**		

Source: Haraguchi and Rezonja (2012) based on WIOD and OECD Input-Output tables

Note: DD = total domestic demand, DD is disaggregated into final consumption by households (C), final consumption by government (G), gross fixed capital formation (I), and other domestic demand, including consumption by non-profit organizations and changes in inventories and valuables (O). EX= total export demand. EX is disaggregated into intermediate exports IX and exports for foreign final demand FX. Due to rounding errors, the sum of total domestic and foreign demand may not add up to 100 percent. For the full names of the industries, refer to Table 5.10.

5.4 Distributed Production: The BRICS in the Context of Global Value Chains

It has been argued that "Economic development has become synonymous with 'upgrading' in global value chains, defined as a shifting of production from lower to higher value added parts of global value chains [...]." (Jiang and Milberg, (2012, p. 6). [45] But "upgrading" in global value chains does not necessarily lead to industrialization. Whether or not countries and regions benefit from GVCs is not automatic, and the extent to which GVCs can be realized depends, *inter alia,* on the general and specific policy framework in the individual host country, the balance of bargaining power between local enterprises, MNEs and host governments, and local firms' capabilities and their development over time, which in turn depends on technology transfer, development and diffusion, R&D, education and training, and the effectiveness and efficiency of government policies in these areas.

If these conditions can be met, the potential benefits of GVCs for industrialization and structural change may include the following (UNCTAD, 2011, p. 6):

- Generation of new jobs
- Adding local value and strengthening business linkages
- Increasing export generation and foreign market access for local firms
- Contributing to technology and skills transfers.

A substantial body of literature exists on GVCs and the requirements for developing country producers that benefit from their existence. A key question which has as of yet not been satisfactorily answered in the literature, is what the longer term implications of participation in or reliance on GVCs are for industrial capacity building. In much of the literature, the assumption seems to be that GVCs are both necessary and sufficient, with some minor qualifications, for attaining sustained industrialization and development. In some cases, entry into GVCs is seen as synonymous with industrialization. Baldwin (2011) argues that through the emergence of GVCs from the mid-1980s onwards, industrialization has become easier and faster, although perhaps less beneficial for a country's overall development.

In this regard, it is valid to ask whether the experience of the BRICS, as outlined in the previous chapters, provides an answer to this question. Hence, this

45 This section mainly draws upon a background paper prepared for the BRICS project by F. Nixson, *"The Dynamics of Global Value Chain Development"*, paper presented at the International Workshop on "The Untold Story: Structural Change for Poverty Reduction – The Case of the BRICS", Vienna, 16-17 August 2012.

section first considers the extent of the BRICS's involvement in GVCs (5.4.1) and examines the interesting case of food value chains (5.4.2)

5.4.1 The BRICS in global value chains

Perhaps surprisingly, the BRICS—with the exception of China—are unevenly integrated into GVCs. Table 5.8, taken from Sturgeon and Memedovic (2011, Table 2, p.16) shows the ranking of the BRICS's presence in GVCs according to total trade in manufactured intermediate goods.

Table 5.8: Presence of the BRICS in GVCs, 2006

Country	Ranking
China	3
India	21
Russian Federation	24
Brazil	26
South Africa	37

Source: Sturgeon and Memedovic (2011)

Countries that rank low in terms of presence in GVCs may have economies that have well developed domestic manufacturing sectors which are the source of domestically manufacturing intermediate inputs for manufacturing exports (i.e. high domestic value added); it may also suggest that these economies do not yet to a significant extent participate in GVCs, either because they are mainly primary commodity exporters (Russian Federation) and/or have a relatively underdeveloped manufacturing sector (South Africa). Only China can be said to be well integrated into GVCs.

The impact of GVCs can be determined by observing how countries have changed their production and trade patterns. Using production and trade data, Jiang and Milberg (2012) calculate a vertical specialization index (VS – the measure of the import content of exports) for five countries – the US, China, India, Brazil and South Africa. The underlying idea of this index is the following: "If a country's sector reduces the import content of exports (netting out the effect of export growth), then we say the sector has upgraded vertically within a global production network" (Jiang and Milberg, 2012, p.2).

Table 5.9: Aggregate vertical specialization (VS) by country, 2005

Country	VS
India	13.8
Brazil	14.2
USA	17.0
South Africa	23.7
China	32.1

Source: Jiang and Milberg, 2012

For the period 1995-2005, vertical specialization increased in all selected industries in the US except two (radio, television and communication and business and related services); in China, vertical specialization dropped in all selected manufacturing industries (especially chemicals, office accounting and computing, electrical machinery and apparatus, nec and transportation); in India, all selected industries showed an increase in vertical specialization (except computer and business-related industries); in Brazil, there was a decrease in vertical specialization in the primary and tertiary sectors, but an increase in selected manufacturing industries; in South Africa, there was a marked increase, or no change, in vertical specialization in all industries.

Table 5.10 depicts domestic and foreign production linkages (input-output linkages) in the BRICS between 1995 and 2009.[46] The numbers in the table indicate how much a US$ 1 increase in the output of one industry would increase the inputs required by other industries. This includes both a direct and indirect effect. The column labelled "domestic" denotes the extent of domestic linkages in a given industry. The column labelled "foreign" indicates the extent of foreign linkages in a given industry, calculated as total linkages (including foreign as well as domestic linkages) minus domestic linkages. It shows how much an increase in one unit of a given industry's output requires an increase in inputs from foreign sources. The last two columns show the changes between the 2009 and 1995 values of "domestic" and "foreign" linkages, respectively.[47]

Table 5.10 confirms that, of all the BRICS, Chinese industries generally have the most extensive production linkages with both domestic and foreign suppliers

46 The analysis is based on input-output analysis using the World Input-Output Database (WIOD) and OECD Input-Output tables. The latter is only used for South Africa, as it was not included in the WIOD. In the case of South Africa, the backward linkages presented here are from 1995 and 2005 instead of 2009, because 2005 is the most recent year of the OECD Input-Output tables.

47 In the case of South Africa, the backward linkages presented here are from 1995 and 2005 instead of 2009, because 2005 is the most recent year of the OECD Input-Output tables.

(for all industries). In 2009, China had particularly strong domestic backward linkages in the textiles, leather and transport equipment industries, and also had more extensive linkages than Brazil, the Russian Federation, India or South Africa in all other industries, except for the coke and refined petroleum industry. In 1995, the level of China's domestic linkages was more extensive than the 2009 levels of the other countries. From that relatively high level, China increased its domestic as well as its foreign linkages more than other countries, except South Africa. Over the last 15 years, China's international production linkages for the coke and refined petroleum industry and the electrical and optical equipment industry have increased far more than those of the other BRICS countries.

Table 5.10: The BRICS domestic and foreign production linkages, 1995 and 2009

	1995	1995	2009	2009	2009-1995	2009-1995
BRAZIL	**domestic**	**foreign**	**domestic**	**foreign**	**domestic**	**foreign**
Food, beverages and tobacco	2.14	0.12	2.35	0.17	0.21	0.05
Textiles and textile products	1.82	0.18	1.91	0.25	0.09	0.07
Leather and footwear	2.25	0.21	2.18	0.21	-0.08	0.00
Coke, refined petroleum	2.19	0.34	2.39	0.38	0.20	0.04
Chemicals and chemical products	1.89	0.21	2.17	0.33	0.27	0.12
Other non-metallic mineral	1.84	0.15	2.02	0.21	0.18	0.06
Basic metals and fabricated metals	1.92	0.21	2.06	0.27	0.14	0.06
Machinery nec	1.99	0.21	2.12	0.30	0.13	0.09
Electrical and optical equipment	2.03	0.30	2.04	0.49	0.01	0.19
Transport equipment	2.18	0.26	2.30	0.43	0.12	0.16
Average	**2.03**	**0.22**	**2.15**	**0.30**	**0.13**	**0.08**

	1995	1995	2009	2009	2009-1995	2009-1995
CHINA	**domestic**	**foreign**	**domestic**	**foreign**	**domestic**	**foreign**
Food, beverages and tobacco	2.37	0.19	2.51	0.26	0.15	0.08
Textiles and textile products	2.46	0.43	2.95	0.39	0.49	-0.04
Leather and footwear	2.54	0.46	2.93	0.38	0.39	-0.08
Coke, refined petroleum	2.29	0.39	2.05	0.80	-0.24	0.41
Chemicals and chemical products	2.45	0.35	2.64	0.58	0.18	0.23
Other non-metallic mineral	2.45	0.25	2.59	0.40	0.13	0.16
Basic metals and fabricated metals	2.69	0.35	2.64	0.61	-0.05	0.25
Machinery nec	2.52	0.35	2.69	0.62	0.18	0.27
Electrical and optical equipment	2.51	0.53	2.61	0.90	0.11	0.37
Transport equipment	2.67	0.39	2.90	0.63	0.23	0.24
Average	**2.49**	**0.37**	**2.65**	**0.56**	**0.16**	**0.19**

	1995	1995	2009	2009	2009-1995	2009-1995
INDIA	**domestic**	**foreign**	**domestic**	**foreign**	**domestic**	**foreign**
Food, beverages and tobacco	2.24	0.19	2.22	0.25	-0.01	0.06
Textiles and textile products	2.26	0.18	2.17	0.39	-0.09	0.20
Leather and footwear	2.30	0.23	2.18	0.26	-0.12	0.03
Coke, refined petroleum	1.93	0.44	1.80	0.61	-0.13	0.17
Chemicals and chemical products	2.18	0.35	2.15	0.49	-0.03	0.14
Other non-metallic mineral	1.94	0.32	2.02	0.35	0.08	0.03
Basic metals and fabricated metals	2.36	0.29	2.21	0.46	-0.15	0.17
Machinery nec	2.32	0.34	2.12	0.46	-0.20	0.12
Electrical and optical equipment	1.91	0.25	2.06	0.48	0.15	0.23
Transport equipment	2.49	0.30	2.14	0.50	-0.35	0.21
Average	**2.19**	**0.29**	**2.11**	**0.43**	**-0.09**	**0.14**

	1995	1995	2009	2009	2009-1995	2009-1995
RUSSIAN FEDERATION	**domestic**	**foreign**	**domestic**	**foreign**	**domestic**	**foreign**
Food, beverages and tobacco	2.21	0.25	2.21	0.20	0.00	-0.05
Textiles and textile products	1.77	0.56	1.70	0.58	-0.07	0.02
Leather and footwear	1.85	0.42	1.98	0.32	0.13	-0.10
Coke, refined petroleum	2.19	0.14	2.13	0.10	-0.06	-0.04
Chemicals and chemical products	2.02	0.28	2.14	0.26	0.12	-0.01
Other non-metallic mineral	1.92	0.18	2.12	0.17	0.20	-0.01
Basic metals and fabricated metals	1.95	0.26	2.26	0.19	0.31	-0.07
Machinery nec	1.84	0.33	2.19	0.28	0.35	-0.05
Electrical and optical equipment	1.84	0.31	2.15	0.30	0.30	-0.01
Transport equipment	2.02	0.39	2.12	0.64	0.10	0.26
Average	**1.96**	**0.31**	**2.10**	**0.31**	**0.14**	**-0.01**

	1995	1995	2005	2005	2005-1995	2005-1995
South Africa	**domestic**	**foreign**	**domestic**	**foreign**	**domestic**	**foreign**
Food, beverages and tobacco	2.20	0.21	2.32	0.35	0.13	0.14
Textiles and textile products	1.99	0.38	2.22	0.43	0.23	0.05
Leather and footwear						
Coke, refined petroleum	1.68	0.41	2.17	0.46	0.49	0.06
Chemicals and chemical products	2.01	0.43				
Other non-metallic mineral	1.85	0.27				
Basic metals and fabricated metals	2.12	0.29	2.11	0.58	-0.02	0.29
Machinery nec	2.11	0.33				
Electrical and optical equipment	1.93	0.33	2.00	0.67	0.07	0.35
Transport equipment	2.02	0.40	2.19	1.06	0.17	0.66
Average	**1.99**	**0.34**	**2.17**	**0.59**	**0.18**	**0.26**

Source: Haraguchi and Rezonja (2012) based on WIOD and OECD Input-Output tables

India is the only country among the BRICS in which the industries' domestic linkages declined. However, its industries' international linkages strengthened, reflecting the fact that following the country's economic liberalization after 1991, a greater number of foreign suppliers entered the economy. Apart from China, India's natural resource-based industries, such as coke and petroleum, chemicals and metals, appear to be highly dependent on foreign suppliers. The country's industries are also becoming increasingly dependent on foreign suppliers for products from the electrical and optical equipment and the transport equipment industries.

In contrast, the foreign linkages of most of the Russian Federation 's industries have weakened while their domestic linkages have strengthened. Table 5.10 depicts the increase in domestic linkages at the expense of foreign linkages. The recent improvement in the Russian Federation's manufacturing performance since 2000 may be a rebound or recovery after a period of economic contraction in the 1990s. The extent of the Russian Federation industry's domestic linkages seems to be the weakest among the BRICS on average. The dominance of natural resource-based industries is one reason for the Russian Federation's weak reliance on foreign industrial inputs.

In Brazil, domestic industrial linkages in the natural resource-based industries have strengthened since 1995, particularly in the food and beverages and tobacco, coke, refined petroleum and the chemical products industries. The country had developed a relatively extensive domestic value chain network in these industries by 2009. Brazil also enjoys a high degree of backward linkages in the transport equipment industry. However, in contrast to the transport equipment industry, Brazil's electrical and optical equipment industry has weaker domestic linkages compared with those of the other BRICS, and has seen almost no change since 1995.

South Africa's industrial linkages resemble those of Brazil to some degree – South Africa is highly dependent on foreign inputs in manufacturing in general and in the electrical and optical equipment and transport equipment industries, in particular. The foreign linkages in South Africa's electrical and transport equipment industries have increased since 1995.

5.4.2 The BRICS in the food and beverages GVCs[48]

The BRICS's food and beverages industry has received considerable attention in recent years, mainly because of the industry's linkage with agriculture, its relevance with regard to food and nutritional security, and in light of the rapid globalization and growing dominance of MNEs in the industry. As a result of these trends, many emerging countries, including the BRICS, have focused more efforts on attracting FDI into their food and beverages industry. Emerging and developing countries have, on the whole, only had mixed success: most FDI in food and beverages still flows to advanced economies (Rama and Martínez, forthcoming).

Although "standard" factors such as small internal markets, geography and highly uncertain domestic business and political environments limit their success in attracting FDI into their food and beverages industry, food consumption is also, to a large degree, culturally influenced. Many foreign firms therefore find it difficult to deploy their (firm-specific) assets in countries with different cultures. Recent trends to homogenize the consumption of food and beverages seem to be mainly restricted to Western countries (Connor, 1994). Major differences in local tastes exist and persist all over the world. World leaders in the food and beverages industry are more likely to expand their operations to countries that display cultural characteristics similar to those of their home countries, most of

48 This section draws upon a background paper prepared by R. Rama, "The BRICS and TNCs in the Food Value Chain", paper presented at the UNIDO/UNU-MERIT International Workshop on *"The Untold Story: Structural Change for Poverty Reduction – The Case of the BRICS"*, Vienna, 16-17 August 2012.

them being Western countries (Filippaios and Rama, 2011).

Moreover, the modern food and beverages industry depends on modern distribution channels which are not always in place in developing countries, especially in small cities and rural areas. An insufficient development of modern retailing facilities hampers the expansion of large food and beverages firms, even in agriculturally rich countries (ECLAC, 1983; Geroski and Vlassopoulos, 1991). Food and beverages require refrigeration and rapid transportation (e.g. dairy products and pre-prepared foods) or frequent substitution on the shelves of retailers (e.g. cookies, packaged bread, confectionary products). With the exception of the most affluent areas, these facilities are often unavailable in many developing countries.

Whereas many countries have faced difficulties in attracting FDI into their food and beverages industry, those that have been successful have often attracted MNEs, which however have not become substantially embedded in the local economy. As a result, the overall benefits from FDI have been much lower than expected (UNCTAD, 2001).

In light of these challenges the food and beverages industry in developing countries face in terms of attracting and benefitting from FDI, and considering the specific positions of the various BRICS in global value chains in general, the remainder of this section attempts to answer two questions. First, have the BRICS been successful in attracting FDI into their food and beverages industry? Second, to what extent are MNEs in the food and beverages industry embedded in the BRICS's local economies?

Have the BRICS been successful in attracting FDI into their food and beverages industry?

The BRICS have generally achieved mixed success in attracting FDI into their food and beverages industry. China's food and beverages industry has been the most important destination for FDI in the BRICS, while South Africa has attracted the least FDI. By 2007, the stock of foreign investment in China was US$ 6,156.2 million, in Brazil it was US$ 383.6 million, in India US$ 109.7 million and only US$ 126.0 million in South Africa.

Previously, Brazil was the preferred destination for food and beverages MNEs from the US. More recently, nearly all of US greenfield investments have flowed into China and the Russian Federation. By contrast, almost all of their divestitures (e.g. closure of industrial plants, selling of affiliates or selling off

stock) have occurred in Brazil and South Africa.

Outward FDI from the world's 100 largest food and beverages MNEs (mainly based in the US, EU and Japan) have thus targeted different industries in the BRICS countries. Brazil, for example, was the preferred destination of US food and beverages FDI, followed at a distance by China. However, a geographic shift may be taking place since food and beverages FDI from the US to Brazil has been lagging behind investments in China in recent years. By 2010, China had become the most important destination of US outward FDI channelled to the food industry.

EU food and beverages MNEs have preferred to locate their foreign affiliates in the Russian Federation and Brazil.[49] In each of the recipient countries, the most important EU food, beverages and tobacco investor has been The Netherlands. According to EUROSTSAT, The Netherlands accounted for 18 percent of total EU food FDI in Brazil in 2009, 13 percent in China (54 percent in Hong Kong SAR), 8 percent in India and 29 percent in the Russian Federation.

Japan's overall outward FDI decreased between 2005 and 2010. In an analysis of the top-100 MNEs, Tozanli (2005) notes a shift in large Japanese food and beverages MNEs towards the domestic market, a trend the author characterizes as "an evolutionary path counter to the general trend" [of the top-100] (p.19). Japanese MNEs favour China as a destination, with Brazil trailing far behind; the other countries are much less important both in terms of the number of projects and their value.

How are food and beverages MNEs embedded in the local economies of the BRICS?

The embeddedness of food and beverages MNEs in the BRICS can be determined based on three dimensions of their local interactions, namely (i) their knowledge of local circumstances and customs, (ii) their business linkages with local partners, and (iii) the extent of their R&D in the host country.

It has often been suggested that extensive experience in the host country may help companies build local linkages. The experience of MNEs in food and beverages is strongest in Brazil and South Africa; however, this does not seem

49 The dataset is based on EUROSTAT, which provides no data on the scope of EU investment in the manufacture of food products, beverages and tobacco products in South Africa in 2008 and 2009 (last update, 03-05-2012). In 2008-2009, however, EU investment in the Russian Federation's food and beverages industry tended to decrease, while investment in the other BRICS's food and beverages industries increased.

to have encouraged MNEs to build strong local linkages. Food and beverages MNEs in Brazil and South Africa have in fact acquired domestic firms rather than establishing JVs with local partners.

In contrast, JVs have played a much more important role in China, India and the Russian Federation. Possible reasons include the local policies, which require the establishment of JVs, as well as the need to recruit reliable local partners in China to deal with bureaucracy or with the complex governance of internal commodity markets. Food and beverages MNEs seem to be more embedded in the local economies of China, India and the Russian Federation, despite more extensive knowledge of and experience with the South African, and even more so, the Brazilian economy.

As regards R&D in host economies, food and beverages MNEs conduct most of their R&D in Europe and the US. However, the BRICS are acquiring increasing importance as "loci" for MNEs' innovative activities. India has become the most important location outside Europe and the US. MNEs generate a greater number of patented inventions in India and Brazil. Within the BRICS, South Africa and the Russian Federation, in particular, are the least popular destinations for such activities. Consequently, transfer of technology to local industry seems more likely in Brazil and, especially, in India.

5.5 Concluding Remarks

This chapter has focused on three central dimensions of the position of the BRICS in the global economy from the perspective of the patterns of structural change discussed in previous chapters. These dimensions are the contribution of FDI and domestic investment to technological upgrading; the role of international demand relative to domestic demand as a source of structural change; and finally, the position of the BRICS in GVCs.

In Section 5.2, the increase in FDI to the BRICS, particularly to China, was addressed. In the present chapter, we conclude that the BRICS countries invest more in science and technology than middle income countries do on average. Innovation related to FDI has been substantial, particularly in China and India, the two fastest growing economies which, in addition, have experienced the most profound structural change from agriculture to manufacturing and services. We have found that FDI has significantly contributed to structural change in China by focusing on manufacturing, but also by being accompanied by technological upgrading and transfers that were considerably higher than in

the other BRICS countries. Since 1996, the most significant growth in R&D has been witnessed in both China and India (although the level of R&D in India is still the lowest of all the BRICS countries). It is noteworthy that R&D expenditure has been stagnating in Brazil, the Russian Federation and South Africa (and even declining in the Russian Federation since 2001). In China, the rise in the number of registered patents shows no sign of slowing down. In India, the increase in new patent registrations was rapid between 1994 and 2000, but has tapered off since. The other countries—most notably the Russian Federation, Brazil and South Africa—have seen a decline in patent registrations since 2000. South Africa is perhaps the poorest performer – by the early 1980s, the country was second only to the Russian Federation in terms of patent registrations, but by 2008, it registered the least number of new patents.

An important point with reference to the clearly substantial role FDI plays in technological upgrading and structural change is that while it may be necessary for sustained growth and structural transformation, accompanied or led by technological transfer, it may not suffice. Adequate conditions may include strong growth in domestic fixed investments. This chapter reveals that all BRICS, with the exception of Brazil, have experienced an increase in the ratio of GFCF in GDP (the most impressive increase occurred in China at 42.3 percent of GDP by 2008). Most of this growth is attributable to major increases in domestic investment rather than in greenfield FDI.

While FDI has been important (especially where complemented by domestic investment) in driving structural change by facilitating technological upgrading, one major feature of the global impact of the rise of the BRICS has been the growing international demand for their products. The rise in exports from the BRICS, particularly of manufacturing exports, is an important part of the explanation of their structural transformation. As already discussed in Section 5.2, the linkage between FDI and export growth has been considerable, with FDI flowing into industries that primarily produce for export markets – in other words, linking production in the BRICS with GVCs. This feature of the BRICS's structural change has lead to extensive discussions about the importance and impact of the BRICS's position in GVCs, as well as about the relative merits of foreign and domestic demand in industrialization. The final sections of this chapter deal with these aspects.

This chapter finds that China has been the most successful in integrating into and benefitting from GVCs. The Russian Federation's manufacturing sector is the least integrated into value chains, and integration has slowly increased over time in India and Brazil at the expense of domestic production linkages. One

specific value chain, food and beverages, has played an important role in the BRICS (and other developing and emerging economies) because of its potential benefits, but also because of the difficulties in sharing and benefitting from this value chain. The BRICS have generally achieved mixed success in attracting FDI into their food and beverages industry. China's food and beverages industry has been the most important destination for FDI among the BRICS, while South Africa's food and beverages industry has attracted the least FDI.

Finally, while the international economy has played an important role in fostering the different patterns of structural change described in Section 5.2 through FDI and exporting, as well as the integration of the BRICS into GVCs, the role of domestic demand as a factor in structural change should not be underestimated (this also holds true for the case of domestic investment). Results from a decomposition analysis presented in this chapter indicate that the bulk of manufacturing expansion in the BRICS has, in fact, been domestic demand-driven. Import substitution where it has occurred has only played a very modest role and has been strongly negative in South Africa and to a lesser degree in India. It should be noted that these negative figures do not imply a decline in domestic production, but rather a rapid rise of imports due to import liberalization. All BRICS have seen a major increase in manufacturing exports, but overall, this has been in the range of between 15-26 percent of additional production, with lower figures in India and Brazil. This relatively low share of exports in additional production can be explained by these economies' large internal markets and the fact that enclave manufacturing based on special zones has not been a major feature in the BRICS, apart from China.

The implication is that domestic policies on investment and consumption have been important for industrialization in the BRICS and that relying solely on the global economy for structural change may not lead to successful industrialization. However, how the relative contribution of the international versus the domestic economy is influenced by policies must be considered, as the different industrial outcomes in the BRICS and their diverging experiences and results show. Some policy considerations will be addressed in the next chapter.

Chapter 6: The Role of Industrial Policy

6.1 Introduction

The focus of this report has been on patterns of structural change—in particular, industrialization—in the BRICS and their implications for employment and poverty. One relevant question in this regard is what the BRICS's approach to industrial policy has been and, specifically, the role of industrial policy in helping to achieve structural change and the resulting employment gains and poverty reduction.

For present purposes, industrial policy refers to the ways in which governments aim to achieve or fast-track structural change. Industrial policy has more specifically been defined as guiding government intervention to selectively promote certain industries or activities with the aim of encouraging a country to 'defy' its static comparative advantage and develop its 'latent' comparative advantage (e.g. Amsden, 1989; Chang, 2002; Lin and Chang, 2009). Industrial policies are not limited to the manufacturing sector, but to the entire supply side of the economy, including services and tourism (Budzinski and Schmidt, 2006; Rodrik, 2007). As discussed in Naudé (2010a, 2010b), Szirmai et al. (eds., forthcoming) and Chapter 1 of this report, there are good arguments for industrial policies to expand their focus towards promoting the 'competitiveness' of the manufacturing sector.

The debate on industrial policy is characterized by a number of disagreements, mainly over the concept of industrial policy and its merits. As noted by Pack and Saggi (2006, p. 1), "few phrases elicit such strong reactions from economists and policymakers as industrial policy". More recently, however, the strong ideological opposition against industrial policy has been waning, with growing recognition that appropriate industrial policies—minimizing rent-seeking and corruption and maximizing learning, experimentation and flexibility—may contribute to structural transformation. As the majority of countries today implement some form of industrial policy, the issue is no longer whether there is a case for industrial policy, but rather how it should be conducted.

In addressing the BRICS's approach to industrial policy it is important to emphasize that individual countries followed very distinct industrial policies against the background of different domestic resources and political constraints and also faced a very different global context. Moreover, industrial policy in the BRICS has never remained static, but has been evolving in response to changing circumstances. To better illustrate these points, the following subsection provides a brief summary of the salient features of industrial policy in the BRICS since the 1950s.

6.2 Industrial Policy in the BRICS[50]

In all the BRICS, current industrial policies tend to focus on internationalization, including export and attraction of FDI, as well as on technological upgrading and learning ('capability development') as important requirements for improved competitiveness of the manufacturing and service sectors.

This was not always the case, however. In all the BRICS, initial stages of industrialization were accompanied by traditional import substitution industrialization (ISI) policies. Hence, starting with the *Plano de Metas* (Targets Plan), the Brazilian government has promoted the establishment of capital intensive industries since the 1950s, including the automobile and chemicals industries, through subsidies and protected domestic markets. In 1974, the country adopted an ambitious programme of industrial development, the *Plano Nacional de Desenvolvimento* II (PND-II), in which trade protection was combined with (domestic and foreign) investment promotion, with subsidies to manufacturing exports. The Brazilian government was also a direct investor, owner and manager of enterprises in a range of industries, including utilities, basic industries, petroleum and even consumer goods.

Before the early 1990s, state ownership and support of domestically protected industries in the Russian Federation was ideologically driven – the country pursued a de facto ISI strategy. Every aspect of economic activity (demand, supply and prices) was centrally planned by the Gosplan (State Committee on Planning) based on a number of five-year plans. The Soviet Union's large majority of resources were controlled by the Party, not only in the military-industrial sector but also in such industries as construction, mining, trade and power engineering. Entrepreneurship was virtually non-existent, with the state being

50 This section draws on a background paper by M. di Maio, "Industrial Policy in the BRICS Countries: Similarities, Differences and Future Challenges", paper presented at the UNIDO and UNU-MERIT International Workshop on "*The Untold Story: Structural Change for Poverty Reduction – The Case of the BRICS*", Vienna, 16-17 August 2012.

the only employer, and the managers of SOEs (which were politically appointed) or the Party *nomenklatura* leaders being the main economic decision-makers (Ageev et al., 1995).

Like Brazil, India followed an ISI strategy between 1948 and 1980. During this period, economic policy in India followed a number of five-year plans inspired by the Soviet planning of industrial development (Singh, 2009). The five-year plans pursued multiple objectives: industrialize the country, raise per capita incomes and achieve equity in the regional distribution of industrial development. The basic view was that the state could undertake any type of industrial production, also to prevent private monopolies. But at the same time, and in contrast to the Russian Federation's (Soviet Union) approach, the Indian government allowed the private sector to develop.

Industrial policy in China was already firmly in place in the 1950s during the Maoist Great Leap Forward. As was the case in the Soviet Union and India, central plans were formulated to push industrialization, and in particular to transform China from an agrarian into a more modern economy. As political stability was gradually restored following the Cultural Revolution of the late 1960s, a renewed drive for economic development was set in motion, but with few changes. Until the late 1970s, the Chinese government's de facto ISI strategy focused on developing heavy industries and defying the country's comparative advantage. It specifically entailed the fixing of input and output prices by central planners. Firms were deprived of production autonomy and lacked incentives. As the state required its SOEs to squeeze as much profit out of production as possible, wages for workers were suppressed at a low level, and the price of agricultural products were set with unfavourable terms of trade against rural inhabitants and small farmers.

South Africa also initially followed an ISI strategy. It was adopted in the 1940s and was based on tariff protection, capital subsidies for selected firms (for instance, in metal processing and automobile manufacturing) and the creation of state-owned utilities and strategic energy producers in the country's "mineral-energy complex" through state-funded venture capital (Lewis et al., 2004). As a result of international sanctions against the apartheid policies of the then-Nationalist Party government, the country's economy remained essentially closed to foreign investment and competition, and actually experienced a period of disinvestment, especially during the 1980s.

In all the BRICS countries, significant, indeed radical changes in industrial policy were adopted from the late 1970s to the early 1990s. In Brazil, the

country's debt crisis in the early 1980s, which according to some accounts was attributable to the government's highly interventionist policies, (temporarily) suspended industrial transformation. By the early 1990s, Brazil had adopted drastic tariff reductions and large-scale privatization. Four overriding objectives of the country's new industrial policy during the late 1990s were: (i) to increase international trade competitiveness; (ii) to use functional rather than selective industrial policies; (iii) to support SMEs, micro-enterprises and entrepreneurship rather than large SOEs, and (iv) to focus more on science, technology and innovation policies. These changes in policy were gradual. Government intervention continued during the 1990s: the state did not withdraw from the market, cluster development and provision of investment incentives continued (especially in the automobile industry). The 2003 *Política Industrial, Tecnológica e de Comércio Exterior*/Policy for Industry, Technology and Foreign Trade (PITCE) marked the official return of industrial policies. The PITCE set out strategic sectoral strategies in four knowledge intensive activities: semi-conductors, software, pharmaceuticals and medicines and capital goods. This policy was accompanied by the creation of a new institution in charge of the coordination and implementation of the policy, the Brazilian Industrial Development Agency (ABDI). In 2008, the government launched the *Política de Desenvolvimento Produtivo* /Production Development Policies (PDP) which has an even stronger sectoral focus than PITCE. In 2011, the new *Plano Brasil Maior* 2011-2014 was introduced. Beyond horizontal measures and six strategic technological programmes, this policy also includes seven programmes targeting leading sectors under the control of the BNDES and 12 industrial competitiveness programmes under the direct control of the Ministry for Development, Industry and Foreign Trade.

In the Russian Federation, the break came with the collapse of the Soviet Union in the early 1990s. This ushered in a period of a significant number of economic reforms aiming at dismantling the previous Soviet economic model and liberalizing the economy. Industrial policy focused on privatization and price liberalization. Privatization began in 1993, when all SOEs were allocated to the property funds of the federal and local governments. The federal government took control of large enterprises in the manufacturing, communication, energy and heavy industry sectors. Local governments usually took control of small shops and stores predominately operating in trade and retail services. The intensity of reform efforts in privatization and price liberalization varied markedly across regions. Interestingly, Berkowitz and De Jong (2001) find that these regional differences account for the regional differences in growth rates. This exemplifies the fact that industrial policy can assume very different forms: in the case of the

Russian Federation, privatization and price liberalization acted as a stimulus for industrialization. The Russian Federation began attracting FDI which has played an important role in the modernization of the Russian Federation economy, with the government providing many incentives, including equal rights for domestic and foreign investors, and simplifying customs regulations, particularly in the automobile industry. Recently, the Russian Federation government has been expanding the role of the state in the economy through the establishment of SOEs in energy, aircraft, shipbuilding, automobile manufacturing, forestry and the banking sector. Subsidized SOEs have often absorbed private firms and have assumed a dominant position in the sector, significantly reducing the level of domestic competition.

In India, the ISI strategy introduced had played out by the 1980s. As was the case in Brazil, increasing external debt, among other problems, plunged India's balance of payments into a crisis in 1990 and 1991 (Acharya, 2007). After a first round of tentative liberalization in the 1980s, the ISI model was fully abandoned in favour of a new model in 1991 based on liberalization of foreign trade and the de-regulation of economic activity. New forms of industrial policy included the liberalization of international trade and investment and the loosening of (some of) the control over the exchange rate and over foreign capital flows. The government also adopted a New Industrial Policy which marked a significant change from the past. The industrial licensing regime was abolished for all except 18 industries. The government eliminated most of the industrial controls, permits and regulations, and abolished the requirement for approval of enterprise expansion. The reform also brought about the privatization of SOEs and only six industries were reserved for public companies: arms and ammunition, atomic energy, mineral oils, atomic minerals and railway transport. The reforms also eliminated the levy and non-levied price system, and reduced purchase preference for public sector enterprises. India also began focusing, as was the case in Brazil, the Russian Federation and China, on attracting more FDI. While policies for FDI were restrictive and selective under ISI, majority foreign ownership in firms was permitted in all industries after 1991, except for banking, insurance, telecommunications and airlines. Foreign investors were given full repatriation benefits, and there were no restrictions on the volume of trade and no lock-in periods. A system of automatic approval for agreements related to high priority industries was introduced and the procedures for hiring foreign technical experts were significantly eased. A foreign investment promotion board was set up to consider the proposals that did not qualify automatically. While most scholars emphasize the drastic changes that were introduced, Singh (2009) suggests that there has been far greater continuity in the industrial policy framework over the last five decades than is usually suggested. In fact, he notes that following

the reforms, the Indian government continues to play an important coordinating and sometimes guiding role in various spheres. The Planning Commission is the body primarily in charge of industrial policy.

Whereas Brazil and India shifted the focus of their industrial policies from ISI towards more outward-oriented policies in the 1980s, and the Russian Federation adapted its industrial policy in the 1990s, major reforms had already been initiated in China in 1978, which entailed a rejection of the comparative advantage-defying policies of the Maoist era in favour of policies that were more in line with the country's latent comparative advantage. Between 1980 and 2010, China creatively combined heterodox policies to realize the transition from a centrally planned to a market economy, in which state enterprises continue to play an important role along with MNEs and private domestic firms. Key elements in this transition have been the gradual reduction of the overwhelming role of SOEs in the economy and the incremental and selective introduction of reforms of the price system, the labour market, foreign trade and FDI. Although the importance of the market economy has grown, the Chinese government continues to play a pivotal role in the economic system. The government has, in particular, directed both domestic and foreign investment towards specifically targeted sectors. Investment promotion has mainly assumed the form of (public) investment in physical infrastructure, the provision of credit at preferential interest rates and fiscal incentives. For instance, manufacturing industries and industries based on non-agricultural raw materials enjoyed (up to 80 percent) reduced tax rates relative to other industries (Lu, 2001). One important aspect of China's industrial policy is the regulation of the co-existence of SOEs and private enterprises in the economy. The government was able to achieve this by reducing the conflict between the two types of enterprises to a minimum. The economy is divided into sectors in which barriers to the private sector are extremely high and others in which competition between the private and public sectors is open. While this implies that there are *de facto* separate spheres of operation, it does not imply that there are no frictions. For instance, there is some indication that the state has an interest in discouraging the emergence of large Chinese family conglomerates, as has been the case in other Asian countries, in order to prevent counterparts from being established that are too powerful. At the same time, the government is trying to create national champions, especially in high-tech industries. For instance, in 2009, a policy was elaborated to provide advantages for innovative domestic enterprises in the procurement market.

As in Brazil and the Russian Federation, a focus on attracting FDI has been central to industrial policies after 1978 – and perhaps more so than in any of

the other BRICS countries. During the 1980s, four special economic zones were created so new enterprises could establish duty-free imports and extended periods of tax exemption were offered. In 2000, the country acceded to the WTO. Prior to its accession, China's trade policy included several import restrictions. At the time, careful management of external trade supported industrialization and structural change in two ways. First, gradual trade liberalization enabled the cheap import of technologies that were essential for Chinese industry (UNCTAD, 2002). Second, the gradual opening up of the economy allowed the export of surplus production. In fact, exporting firms received strong support from the government: they benefitted from various pricing, tax and loan facilitations, as well as support for technological upgrading and for maintaining and increasing their exports. After WTO accession, many of the incentives were phased out and non-tariff barriers have gradually been dismantled or lowered significantly. As a response, indirect instruments such as tax rebates are increasingly being used by the government to support industrial sectors.

By the time of South Africa's transition to democracy in 1994, it was clear that despite some considerable successes in establishing certain critical upstream industries based on natural resources (such as Sasol, Iscor, Eskom, SAPPI, SAB and others), the ISI policies of the apartheid regime were economically unsustainable (Chang, 1998). The 1994 democratic transition entailed a shift away from ISI policies towards policies aiming at industrialization through the integration of South Africa's economy into the global economy. These included limited privatization of SOEs, accession (like China) to the WTO and extensive liberalization of import tariffs, the conclusion of free trade agreements with the EU and the Southern African Development Community (SADC), and the adoption of a regional industrial location strategy. A new dimension of the post-apartheid approach to industrial policy was the active participation of labour unions through the National Economic Development and Labour Council (NEDLAC). Furthermore, new industrial policies placed much more emphasis on skills and innovation, indicating a shift from a 'selective' sectoral towards a 'functional' approach. At the same time, industrial policy was reoriented from 'demand side' towards 'supply side' industrial promotion and measures to support export have been strengthened. Most recently, a National Industrial Policy Framework (NIPF) and an Industrial Policy Action Plan (IPAP) were adopted. The NIPF is a very broad approach to industrialization that includes trade policy and regional integration agreements, competition policy and public procurement as instruments. Yet it also recognizes the need to use trade instruments such as tariffs and standards to favour specific industrial sectors, and targets a lower carbon intensity of growth, 'green jobs' and industrial energy efficiency.

6.2.2 Mixed success of industrial policies

The previous subsection provided only a very cursory overview of the evolution of industrial policy in the BRICS. It showed that the similarities between the BRICS included an initial encouragement of manufacturing behind import barriers and active state subsidies or direct intervention in the form of creation of SOEs. Secondly, there was a shift towards more open, outward-oriented policies in the 1980s, as ISI industrialization became unsustainable and out of step with the globalization of the world economy. However, the previous subsection also showed that after initial periods of liberalization, a rethinking process has taken place with regard to openness and liberalization, and a cautious re-entry of the State in more selectively and actively promoting industry is evident, albeit not to the same extent as during the ISI era. These are, however, only broad trends; within these general trends, the instruments and motivation for industrial policy varied quite substantially.

There were also considerable differences in the success of industrial policies in the BRICS. To put it more accurately, the outcomes in terms of manufacturing development and poverty reduction differ substantially. Whether and to what extent this is attributable to the industrial policies implemented—or in spite of them—is difficult to establish in the absence of any counterfactuals.

What the previous chapters of this report have pointed out, however, is that manufacturing development and industrial policies have been most successful in China, moderately successful in India and Brazil and slightly less successful in the Russian Federation and South Africa, the two mineral rich economies. Generally, success in terms of economic growth and poverty reduction reflects the achievements of the countries in manufacturing, in line with the premise of Chapter 1 of this report that manufacturing continues to be an important engine of growth and development. Growth, catch-up and poverty reduction has been most substantial in China, lower and mixed in Brazil and India, and much lower in South Africa and the Russian Federation. In recent years, the standard of living in the Russian Federation has definitely improved and poverty has declined, but this followed a period of generalized deterioration of economic conditions for large sections of the population during the transition period.

Chapter 7: Conclusions

This report presents a systematic comparative empirical analysis of the nature of structural economic change in the BRICS from the late 1970s to the present. The role and importance of manufacturing as an engine of growth across these countries, and the extent of differences and change within the countries' manufacturing sector is elaborated. Specifically, the report aims to determine whether the BRICS countries' patterns of industrialization are sustainable (in terms of the environment/energy), how structural change has contributed to employment generation, and whether it has played a significant part in reducing poverty. In this final chapter, we summarize the key findings.

7.1 Summary of Key Findings

7.1.1 Patterns of structural change

"Development is fundamentally about structural change" (Rodrik, 2007, p. 6). The BRICS have been successful to varying degrees in fostering economic growth and development through structural change in the past three decades. In China and India, structural change has resulted in the rise of the share of manufacturing and services, respectively, and the decline in the share of agriculture in GDP. In contrast, the manufacturing sector's share of value added shrank by nearly 3 percentage points in the Russian Federation between 1995 and 2008. South Africa has likewise experienced a decline in its manufacturing share and an increase in the share of its service sector – but strangely, an even larger decline in the relative share of mining over a period that includes one of the strongest commodity booms since the Second World War. The service sector is the leading sector in South Africa, the Russian Federation and Brazil. In fact, the service sector has been the dominant sector in Brazil's economy since 1980. China is the only country where services do not account for over 50 percent of GDP.

Within manufacturing, a gradual shift from more labour intensive to capital intensive (and higher skill intensive) manufacturing has taken place. Thus, industries such as food processing, textiles, leather and footwear and wood and wood products (typically labour and low skill intensive industries) have only shown moderate changes in output, while output grew fastest in more capital intensive industries such as chemicals, machinery, electrical and optical

equipment, transport equipment and metals and metal products. Some country-specific features that stand out are the growth in value added in the petroleum and chemicals industries in Brazil, India and South Africa, transport equipment in China and Brazil, rubber and plastics in the Russian Federation, and electrical and optical equipment in China and India.

As a group, the combined size of their economies is already larger than that of the US or the EU. This is the result of relatively stable economic growth which has driven the structural changes identified, although not all the BRICS have been growing equally fast. Furthermore, they still have much to achieve in terms of catching-up. Compared to other countries with successful catching-up experiences (such as Republic of Korea) or the world technological leader (the US), the BRICS countries still have a long way to go. In 2010, in terms of PPP dollars, the GDP per capita of Brazil, China and South Africa represented only around one-fifth of that of the US, while India did not even reach 10 percent of the US's GDP per capita.

7.1.2 The role of trade and FDI

Trade—particularly exports—has played an important part in the structural transformation and growth performances of the BRICS countries, especially since the 1990s. While the BRICS only accounted for less than 4 percent of world exports at the beginning of the 1980s, their combined share reached 13 percent by 2010. China's phenomenal export-led growth (export of manufactured goods) is well known and is largely responsible for the increase in the share of exports from the BRICS. India has increasingly been exporting IT services and exports of resource-based goods, and commodities have risen in the Russian Federation and South Africa, with less dynamic manufacturing exports. Brazil has been successful in exporting natural resources as well as certain categories of manufactured goods, often natural resource-based products.

Within manufacturing, China and India have managed to transform the nature of their manufacturing exports from an export structure concentrated on labour intensive and low-tech products (mainly food and textiles) towards a structure concentrated on capital intensive and high-tech products (metal products, machinery and electrical equipment in China, and chemicals and other manufacturing goods in India). Brazil and South Africa have witnessed similar changes, albeit less drastic, with transport equipment, machinery and electrical equipment gaining shares. In contrast, the Russian Federation's manufacturing exports show a trend towards a concentration exclusively in refined petroleum products (driven by its oil and gas resources).

During the past 30 years, an important characteristic of the globalization process has been the emergence of global production sharing, or as it is also known, the rise of GVCs, which refers to the global outsourcing of the chain of production across countries. Incorporation into GVCs today is deemed crucial for industrialization. The differential export success of the BRICS suggests that they also have very different patterns of incorporation into GVCs.

More research is required to determine what common experiences the BRICS share with respect to their participation in GVCs or what lessons can be drawn from their experience. Although not specifically looking at the BRICS as a group, empirical and case studies reveal widely diverging experiences. China is clearly the most active and successful participant in GVCs at present, with the four other economies trailing far behind.

The food and beverages GVC is of special significance for the BRICS. The BRICS countries have been successful in attracting FDI to their food and beverages industry, though again differences between the countries are evident. While China has been the preferred destination for food and beverages FDI among the BRICS, South Africa's appears to attract the least FDI. According to food and beverages outward FDI data from the US, a recent geographic shift seems to have taken place from Brazil to China. Data on restructuring of major companies in this industry seem to corroborate this interpretation. The major food and beverages MNEs have not been engaged in many greenfield investments in the BRICS. However, nearly all of such greenfield investments (i.e. the construction of new industrial production facilities) have taken place in China and the Russian Federation. In contrast, nearly all their divestitures (e.g. closure of industrial plants, selling of affiliates or selling of stock) have occurred in Brazil and South Africa.

The structural changes in the BRICS economies and the extent to which these have been driven by success in manufacturing exports are attributable to their differential success in upgrading technological capabilities. Technological progress has been most significant in China, followed by India, and to a lesser extent in Brazil, the Russian Federation and South Africa – corresponding closely to their patterns of structural transformation and success in manufacturing. The latter two remain economies that are essentially dominated by natural resource extraction and services, and characterized by difficulties in their political and social transition processes.

There are two explanations for the differential success in technological upgrading, namely differences in human capital accumulation (education

and skills formation) and in attracting foreign technology through FDI. Brazil, Russia, China and India were amongst the top-5 countries in the world in terms of university enrolments in 2007. The BRICS received only 5 percent of global FDI in 1980, while other middle income countries attracted 12 percent. Thirty years later, the BRICS countries now attract 13 percent of global FDI while all other middle income countries together attract only 15 percent. China and India stand out from the other BRICS in attracting FDI.

The bulk of FDI has gone to China, especially after the period 1985 to 1990, and to India and the Russian Federation in the period after 2005. FDI has driven China's export-led growth as well as industrialization, with most FDI to China going to manufacturing sectors. In Brazil, the Russian Federation and South Africa, there has been a reorientation of FDI over time from manufacturing towards mining. The share of FDI flowing into manufacturing in India has declined considerably. The bulk of FDI in India flows into the service sector, in particular financing, real estate and business services. In Brazil, the Russian Federation, India and South Africa, FDI is increasingly focusing on the exploitation of natural resources or services, and is thus less conducive to manufacturing.

In addition to direct investment in human capital, factors such as increased domestic investment in infrastructure, attracting return migration of skilled workers, transferring surplus labour from rural to urban areas, and promoting JVs with foreign companies (Harrison and Rodriguez-Clare, 2010) have played a significant role in making technology transfers from MNEs more effective in China.[51] This has accelerated the structural transformation of China (and to an extent also of India), which in turn has made their economies even more attractive as destinations for foreign investment, and recently also as destinations for the rising trend of global R&D expenditures. In contrast, South Africa, the science and technology laggard, is widely seen as being hampered by a lack of skilled workers and significant brain drain.

7.1.3 Impacts on poverty

The structural transformation described above has had very different impacts on poverty reduction in the BRICS. Only in China did manufacturing growth directly and significantly contribute to poverty reduction. For instance, between 1984 and 2004, the poverty rate in China declined from 15 to 3 percent (using national poverty lines). One major reason for this was that poor rural inhabitants migrating to urban areas found work in the manufacturing sector – the largest single sector of employment for migrant workers in China. It should be noted,

51 The importance of JVs in China has declined dramatically in recent years (see Section 5.2 of this report).

however, that the decline in China's poverty is not only attributable to growth in manufacturing jobs, but also to policies that supported rural development and the position of small farmers.

In Brazil, the Russian Federation and India, structural change was also accompanied by declining poverty rates. A very substantial decrease in poverty was witnessed in India between 1969 and 2006, driven by economic growth, industrialization and distribution policies. Aggarwal and Kumar (2012) conclude that service-led growth has not been especially conducive to poverty reduction. In recent years, Indian manufacturing has also been shedding jobs, and employment in the sector is dominated by low skilled, low wage earning industries. The decline in poverty is slowing down.

In Brazil, poverty declined by 23 percent between 1990 and 2009, dropping from 48 percent of the total population to 24.9 percent (ECLAC, 2011). In the Russian Federation, the poverty rate was halved between 2000 and 2011, dropping from 29 percent of the population in 1990 to 12.8 percent in 2011 (Kuznetsov et al., 2012). This decline in poverty comes after a period of economic turmoil, plummeting GDP per capita and declining standards of living after the collapse of communism and the dissolution of the Soviet Union in 1989. The labour market in the Russian Federation functioned as a partial buffer against poverty, as enterprises were slow to lay off labour when output declined and instead adjusted wages downward.

The decline in poverty in Brazil and the Russian Federation cannot be directly attributed to industrialization or the manufacturing sector, mainly due to the fact that employment in manufacturing either declined or grew very slowly in these countries. For instance, employment in manufacturing in Brazil grew at an annual compound growth rate of only 1.5 percent between 1990 and 2009. In the Russian Federation, low growth in manufacturing after 2000 was accompanied by job destruction in all major industrial sectors – between 2000 and 2007, manufacturing employment decreased by 2 million. In these two countries as well as in South Africa, declines in poverty were mainly attributable to improved social welfare (higher pensions) and more jobs in services, such as in healthcare, education, finance and government. A number of factors had dampening effects on poverty decline in South Africa, namely the exclusion of large parts of the labour force from the formal labour market, the decline in manufacturing employment and excessively capital intensive production methods and capital intensive subsectors in the manufacturing sector.

7.1.4 Sustainability of structural change - What are the prospects for green industrialization?

Energy consumption in manufacturing is one of the most significant contributors to greenhouse gases (GHG). Increasing energy efficiency and reducing pollution intensity are two important routes towards more sustainable patterns of industrialization. Chapter 4 of this report shows that major gains can be achieved by increasing energy efficiency. The prospects for green industrialization in the BRICS may also depend on the adoption and diffusion of renewable energy technologies as an alternative to fossil fuel technologies.

This report highlights the fact that significant differences currently exist among the BRICS in the level of diffusion of the installed capacity to produce renewable energy. China and India lead diffusion efforts. Since 2005, China and India have installed capacity to produce wind energy very rapidly. In 2010, China overtook the US in terms of installed wind energy capacity. In 2011, China ranked third in the world, behind the UK and Denmark, in offshore wind capacity. By 2006, India had the fourth largest wind power capacity installed with 6.27 GW. In 2009, 2010 and 2011, the grid-connected wind power capacity in India increased to 10.9 GW, 13 GW and 16 GW, respectively. In the other BRICS countries, the development of installed capacity in wind energy has been slow. In terms of hydroelectric power generation, Brazil stands out amongst the BRICS as a world leader, producing over 80 percent of its electricity through hydroelectric power. With regard to solar electricity generation, the BRICS are lagging far behind the advanced economies. Among the BRICS, China has the highest installed capacity to generate solar energy, but still has a low capacity overall when compared with the world's leading countries in solar energy production. In solar heating installed capacity, China is the world leader, followed by India and Brazil, whereas in the Russian Federation and South Africa, there is negligible diffusion in the use of solar heating. Despite the diffusion of renewable energy capacity, energy demand is rising so rapidly in the BRICS that they are becoming increasingly reliant on conventional fossil fuel energy sources.

Another side of the story is the diffusion of the capability to produce machinery for sustainable energy technologies. Here there are some remarkable success stories. With regard to manufacturing capabilities in wind turbines, China has become the world's largest producer, with India ranking fifth. Brazil and South Africa are also investing in production capacity at more modest levels. the Russian Federation's installed capacity to manufacture these products is incipient, though the Russian Federation seems to show some potential in technological capabilities. Brazil has achieved considerable success in

producing biofuels. For grid-connected solar PV systems, China, followed by India, has the highest installed capacity to generate solar energy among the BRICS. In 2008, China accounted for 35 percent of the global production of PV cells. In other BRICS countries (Brazil,the Russian Federation and South Africa), the diffusion of production capabilities is still at an incipient stage.

7.1.5 What lessons can be drawn from the BRICS's industrial policy?

The previous chapter showed that the similarities between the BRICS were an initial encouragement of manufacturing behind import barriers and active state subsidies or direct intervention in the form of the creation of SOEs. Secondly, there was a shift towards more open, outward-oriented policies in the 1980s, as ISI industrialization became unsustainable and out of step with the globalization of the world economy. However, the previous chapter also showed that after initial periods of liberalization, a rethinking process has taken place with regard to openness and liberalization, and a cautious re-entry of the state in more selectively and actively promoting industry is evident, albeit not to the same extent as during the ISI era. These are, however, only broad trends; within these general trends, the instruments and motivation for industrial policy varied quite substantially.

The industrial policies implemented in the BRICS as well as the impact of these policies differed considerably, particularly with regard to manufacturing development and poverty reduction. However, in the absence of any counterfactuals, it is not clear whether this divergence in outcomes is attributable to the given industrial policies or in spite of them.

What lessons can we draw from the industrial policy in the BRICS? In addressing this question some caution needs to be exercised. As argued more extensively by Hobday (2011) in the context of the debate on the East Asian "miracle", one should be wary of trying to extract general lessons from the experiences of specific countries. As Hobday points out, the East Asian experience has been characterized by a variety of experiences: countries followed vastly different policies, the market and state played varying roles in the different countries, the focus was on different types of firms, and the different countries in East Asia experienced varying success with respect to FDI and multinational companies. Rather than drawing some general lessons from East Asia, Hobday argues that one should formulate industrial policies in alignment with the stage of a country's development, its resources and characteristics, and to take the rapidly changing global environment into account.

This argument also applies to any lesson-drawing attempt from the BRICS's experience. This notwithstanding, it is clear that the most successful countries seem to be those in which industrial policy has enhanced latent comparative advantages, facilitated foreign investment and technology transfer, and where industrial policies were flexibly adapted and modified in light of changing external circumstances.

This report illustrates that structural change and industrialization have contributed to reducing poverty, although the links are not straightforward. Industrial policies have, apart from China, not always generated a significant number of jobs. Yet, they have been important in terms of their contribution to technological upgrading, productivity enhancement and attraction of FDI (and foreign exchange). These indirect benefits have contributed to structural change and higher growth – although the direct jobs created in most BRICS have often not been fast enough to keep up with increases in the labour force. As a result, Brazil, the Russian Federation and South Africa have large reservoirs of unemployed people and amongst the highest levels of inequality in the world. Despite the continued attention these countries have paid to industrial policy, they continue to face formidable development challenges.

7.2 Final Remarks

Structural economic change can be an important contributor to economic development by promoting higher productivity, improved national competitiveness and growth in per capita incomes. Indeed, there are few instances of successful economic development that have not been accompanied by structural change and industrialization.

Structural economic change does not, however, follow a set or predictable pattern. Over the past three decades, a group of developing countries called the BRICS have received much attention in the world economy in terms of their contribution to global GDP, trade and regional economic dynamism. This report described their economic rise and their accompanying structural changes. Our analysis reveals that the BRICS countries are characterized by heterogeneity in terms of their structural change, the impact of these changes on productivity levels, and ultimately, on development and poverty. While it is difficult to generalize, one tentative conclusion is that the countries with the greatest success in terms of productivity enhancement, growth and poverty reduction are also those countries in which manufacturing development and the absorption of foreign investment and technology were most substantial.

Important development challenges and areas for future research remain. Foremost is the need for the BRICS to further promote their structural economic transformation by stimulating innovation and upgrading their economic capabilities. The second challenge is to find creative ways of continuing to absorb large reserves of surplus labour through a combination of accelerated growth and the most appropriate types of structural change. The third challenge is to identify the strongest links between structural change and reductions in poverty. While this report has proposed some steps in this direction, further research is required to establish causalities and derive specific and sound policy recommendations.

Annex I: Shift and Share Analysis

The shift-share analysis assesses the contribution to overall productivity growth made by the shift of labour between sectors (structural change) and the productivity gains obtained within individual industries. The analysis breaks down aggregate productivity growth in three components (Timmer and Szirmai, 2000, p. 377):

$$\text{Growth} = \frac{LP_{T,t} - LP_{T,t-1}}{LP_{T,t-1}}$$

(I) within-industry effect (II) static shift effect (III) dynamic shift

$$\frac{\sum_{i=1}^{n} S_{i,t-1}(LP_{i,t} - LP_{i,t-1}) + \sum_{i=1}^{n} LP_{i,t-1}(S_{i,t} - S_{i,t-1}) + \sum_{i=1}^{n} (LP_{i,t} - LP_{i,t-1})(S_{i,t} - S_{i,t-1})}{LP_{T,t-1}}$$

Where *LP* is labour productivity, *i* an individual industry, *Si* the share of industry *i* in total manufacturing, *T* the sum of industries *i*, *t*-1 the initial year and *t* the final year.

The first component (within-industry effect) measures the contribution of productivity growth within individual industries resulting from factors such as learning by doing, capital intensity and average hours of work. The other two terms of the equation reflect structural change.

The second term (static effect) shows how much a shift of labour to industries with a higher or lower level of labour productivity affects aggregate labour productivity.

The third term (dynamic effect) measures the combined effect of changes in labour productivity of individual industries and the shifts of their relative shares in total manufacturing.

Annex II: ISIC Rev. 3 by Technology Category

Low-technology

Division 15	Manufacture of food products and beverages
Division 16	Manufacture of tobacco products
Division 17	Manufacture of textiles
Division 18	Manufacture of wearing apparel; dressing and dyeing of fur
Division 19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
Division 20	Manufacture of wood and of wood products
Division 21	Manufacture of paper and paper products
Division 22	Publishing, printing and reproduction of recorded media
Division 36	Manufacture of furniture; manufacturing nec.
Division 37	Recycling

Medium-low-technology

Division 23	Manufacture of coke, refined petroleum products and nuclear fuel
Division 25	Manufacture of rubber and plastic products
Division 26	Manufacture of other non-metallic mineral products
Division 27	Manufacture of basic metals
Division 28	Manufacture of fabricated metal products, except machinery and equipment

Medium-high and high-technology (MHT)

Division 24	Manufacture of chemicals and chemical products
Division 29	Manufacture of machinery and equipment nec
Division 30	Manufacture of office, accounting and computing machinery
Division 31	Manufacture of electrical machinery and apparatus nec
Division 32	Manufacture of radio, television and communication equipment and apparatus
Division 33	Manufacture of medical, precision and optical instruments, watches and clocks
Division 34	Manufacture of motor vehicles, trailers
Division 35	Manufacture of other transport equipment

Source: UNIDO (2011)

Annex III: Decomposition of Changes in Demand

The decomposition follows from the identity:

$$\Delta P = d_1*(\Delta P + \Delta M - \Delta X) + (d_2 - d_1)*(P_2 + M_2 - X_2) + \Delta X \quad (1)$$

Where P is domestic output, M is imports, X is exports, Δ refers to a change between periods 1 and 2, subscripts refer to time periods 1 and 2 and d refers to (1- m) where m is the share of imports in apparent consumption (P + M – X).

When the three terms in (1) are divided by Δ P, the first term (d1*(ΔP + ΔM - ΔX))/ Δ P gives domestic demand growth defined as the share in change in production, holding the import share in apparent consumption constant, the second term ((d2 – d1)*(P2 + M2 - X2))/ Δ P gives the share in change in production attributed to import substitution, and the third Δ X/ Δ P gives the share in change in production attributed to export expansion. A negative sign on the second term is negative import substitution, where the share of imports in apparent consumption rises.

Annex IV: Sectoral Distribution of FDI in the BRICS

The main data sources and methods used to construct the tables on sectoral distribution of FDI in the BRICS countries are detailed in this Annex.

BRAZIL

1981-1995:
Sectoral distribution of FDI based on "Distribuição por ramo de atividade da empresa receptora (1980-Jun/1995)" (http://www.bcb.gov.br/?INVEDIR)
The original data refers to yearly stocks of FDI. Flows have been calculated as annual differences in the stocks and thus include both inward and outward FDI.
To build the sectoral distribution, negative variations (sectors in which the stock decreased between two years) were imputed as zero.

1996-2000:
Sectoral distribution of FDI based on "Investimento estrangeiro direto - Tabelas - Censo 1995 e ingressos 1996 a 2000"
http://www.bcb.gov.br/rex/IED/Port/ingressos/htms/index1.asp?idpai=INVEDIR
The original data refers to yearly flows.

2001-2006
Sectoral distribution of FDI based on "Investimento estrangeiro direto - Tabelas - Censos 1995/2000 e ingressos 2001 a 2006"
http://www.bcb.gov.br/rex/IED/Port/ingressos/htms/index2.asp?idpai=INVEDIR
The original data refers to yearly flows.

2007-2009
Sectoral distribution of FDI based on "Investimento estrangeiro direto - Tabelas - Ingressos a partir de 2007"
http://www.bcb.gov.br/rex/IED/Port/ingressos/htms/index3.asp?idpai=INVEDIR
The original data refers to yearly flows

RUSSIA

1995-2003:
Sectoral distribution of FDI based on Iwasaki and Suganuma (2005). This paper presents information on FDI by sector based on Goskomstat RF (2001, 2003, 2004). Unfortunately, the disaggregation is lower than the one used here and thus, some sectors include part of the FDI which actually belongs to other sectors.
For the years 1998-2000, information is also available from UNCTAD. Since it is very similar to the one presented in Iwasaki and Suganuma (2005) but for a shorter period, we decided to use the latter source.

2005-2010:
Sectoral distribution of FDI based on Federal State Statistics Service: "Russia in Figures. Table 23.11", various issues.
http://www.gks.ru/wps/wcm/connect/rosstat/rosstatsite/main/publishing/catalog/statisticCollections/doc_1135075100641

INDIA

1980 and 1990:
Sectoral distribution of FDI based on Kumar (2005). The original data refers to FDI stocks. Unfortunately, it was not possible to calculate the implicit FDI inflows. Thus, we assumed that the distributions of FDI stock in 1990 is representative of the distribution of FDI inflows during 1986-1990.

1991-2004:
Sectoral distribution of FDI based on SIA Newsletter, January edition for the years 1999 to 2005 (http://dipp.gov.in/English/Archive/Archive.aspx)
The original data refers to cumulative inflows of FDI starting in August 1991. Flows have been calculated as annual differences in the cumulative inflows.

2005-2010:
Sectoral distribution of FDI based on SIA Newsletter, January edition for 2006 to 2011 (http://dipp.gov.in/English/Archive/Archive.aspx)
The original data refers to yearly inflows.

CHINA

1984, 1988 and 1993:
Sectoral distribution of FDI based on Broadman and Sun (1997).

1995-2010:
Sectoral distribution of FDI based on shares published in the China Statistical Yearbook (CSY), various issues.
http://www.stats.gov.cn/english/statisticaldata/yearlydata/

Note: Given the lack of information on FDI by industry within the manufacturing sector, a proxy estimation has been used. This proxy is based on annual figures of fixed assets in foreign firms by industry sector published in the CSY. Sectoral FDI has been approximated as the annual change in fixed assets of foreign founded enterprises in each industry.

SOUTH AFRICA

1994-2004
Sectoral distribution of FDI based on UNCTAD "WID Country Profile – South Africa", which presents information from the African Reserve Bank. This information, however, has no disaggregation within manufacturing, transport and business services.
The distribution within manufacturing, transport and business services is based on Thomas and Leape (2005), who use the Business Map Foundation Database.

2004-2010
Sectoral distribution of FDI based on South African Reserve Bank, Quarterly Bulletin, December Edition for the years 2004 to 2011
http://www.resbank.co.za/Publications/QuarterlyBulletins/Pages/Quarterly-

Annex V: List of Background Papers

Papers with a complete listing of co-authors

1. Nobuya Haraguchi and Gorazd Rezonja, UNIDO, *Industrial Structural Change in the BRICS*
2. Gjalt de Vries, Abdul Erumban, Marcel Timmer, Ilya Voskoboynikov and Harry X. Wu, Groningen Growth and Development Centre, University of Groningen, *Deconstructing the BRICs: Structural Transformation and Aggregate Productivity Growth*

Country papers

3. Renato Perim Colistete and Dante Mendes Aldrigh, University of Sao Paulo, *The Untold Story: Industrial Structural Change for Poverty Reduction — The Case of Brazil*
4. Boris Kuznetsov, Vladimir Gimpelson and Andrei Yakovlev, National Research University, Higher School of Economics, *Manufacturing Sector in Economic Development, Employment and Incomes: The Case of Russia*
5. Aradhna Aggarwa and Nagesh Kumar, National Council of Applied Economic Research and ESCAP, *Structural Change, Industrialization and Poverty Reduction: The Case of India*
6. Miaojie Yu, China Centre for Economic Research, Peking University, *Industrial Structural Upgrading and Poverty Reduction in China*
7. Ximing Yue, School of Finance, Renmin University of China, *Industrial Structural Change, Employment and Poverty Alleviation in China*
8. David Kaplan, University of Cape Town, *The Untold Story: Structural Change for Poverty Reduction – The Case of the BRICS. A Country Case Study: South Africa*

Thematic papers

9. Wim Naudé, Alejandro Lavopa and Adam Szirmai, UNU-MERIT, *Industrialization and Technological Change in the BRICS. The Contribution of Multinational Enterprises and Domestic Investment*
10. Yanyun Zhao, Liu Siming and Li Wangyue, Renmin University of China, *Investment, Technological Change and Institutional Change in Industrial Development. The Case of China*
11. John Weiss, University of Bradford, *Internal and External Demand and Manufacturing Development in the BRICS*
12. Ruth Rama, Instituto de Economía y Geografía (IEG)/Consejo Superior de Investigaciones Científicas (CSIC), Spain, *The BRICS and TNCs in the Food Value Chain*
13. Fred Nixson, University of Manchester, *The Dynamics of Global Value Chain Development*
14. Michiko Iizuka, Eva Dantas and Isabel Maria Bodas Freitas, UNU-MERIT, University of Sussex, UK and Politecnico di Torino, Italy, *The Production and Diffusion of Renewable Energy Technologies in BRICS Countries*
15. Michele Di Maio, University of Naples, Italy, *Industrial Policy in the BRICS Countries: Similarities, Differences and Future Challenges.*

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