

The Brics-project - first draft of position paper

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1. Background

Globelics and BRICS

The basic idea behind GLOBELICS is to establish a global network of scholars who apply the concept 'system of innovation and competence building' as their analytical framework. The focus of the network is on processes of competence building and innovation and *comparative studies across continents and cultures will be stimulated and initiated by Globelics.*

The BRICS-project may be seen as one specific effort to realize these basic principles of GLOBELICS. A comparison between the different trajectories and strategies of the Brics-countries will provide both analytical and conceptual challenges associated with the use of the systems of innovation framework in environments characterized by turbulence and transition. Studying major emerging economies with different positions in the world system through the NSI-perspective will offer new insights in how to promote a more balanced world in terms of the distribution of well being and power.

The BRICS-project also creates a space for 'horizontal learning' where scholars and policy makers in the five countries can learn directly from each other without having to go through international institutions dominated by the US or Europe. Many of the problems are similar and by drawing upon each others experience the BRICS-countries can learn to find methods to find workable solutions.

BRICS and the global transformation

The last decades the world has experienced significant transformations in geopolitical and economic terms, and in the location, organization and distribution of production. For several reasons, large developing countries/emerging economies such as Brazil, Russian Federation (and former USSR), India, China, and South Africa (BRICS) have acquired a most important role in the world economy as producers of goods and services, receivers of capital, or potential consumer markets given their common characteristics of having a big part of their large

population still not integrated in the market economy. Although BRICS countries followed different trajectories in their integration into the globalizing learning economy all of them have acquired a more important role in the world system – *see the appendix for an empirical mapping of the BRICS-countries.*

The five countries went through major institutional transitions and changes in their economic structure in the recent history. Around the middle of the twentieth century China witnessed its communist revolution, India became independent, apartheid became institutionalized in South Africa, Brazil went into a period of 21 years of military regime, while the former Soviet Union came out of the second world war as a major rival to the United States. Later on, in all these countries inward orientated and more or less centrally planned development strategies from the 1950s to the 1970s were replaced by gradual integration in the global economy in the 1980s and 1990s.

Financial globalization and the diffusion of the new technological paradigm based on the Information and Communication Technologies (ICTs) led to significant transformation in the world economy. The world economy became even more integrated and the technological revolution spread rapidly but unevenly among different countries and world regions. One consequence of these changes is that competitiveness increasingly has become related to innovation, learning capacity and knowledge.

Different countries have found different ways to adapt to this new paradigm. The historical record of successful developed countries is not easily replicable in LDC in the current era. The barriers to access to economically useful knowledge have become more difficult to overcome. As verified in the case of the five countries referred to here there are fundamental issues (like those related to social and ecological development), which have to be addressed in order to transform into sustainable learning and knowledge societies.

The growing importance of BRICS

There is no doubt about the increasing economic and geopolitical importance of these five Less Developed Countries (LDC) on the international scene. At a first glance one can refer to their big dimensions - territorial extension and/or the size of the population that represents an enormous potential consumer market (see appendix A for the empirical evidence). Although South Africa

does not share all these characteristics, it plays an important strategic, economic and political role in the African continent. In the same way, the other countries exert great influence in their respective home region: Brazil in South America; China and India in East and South Asia; and the Russian Federation in east Europe and Asia.

A Goldman Sachs report, published in October of 2003, focused the attention on the current and future global importance of Brazil, Russian Federation, India and China. It also pointed out the importance of South Africa as the biggest economy on the African continent. The report suggested that by 2050 the sum of the GDP of the four countries may surpass the sum of the G6 countries' GDP.

Over the last few years the importance of these countries became even more evident as China took a lead role in world economic growth. Already at the end of the 1990s China ranked first in the world in the production of crude steel, coal, cement, fertilizer and TV-sets and second in the production of electricity, chemical fiber and cotton.

It is also important to note how the growth patterns of the different BRICS-countries are becoming increasingly interdependent. China is responsible both for the reduction of prices on labour-intensive manufactured goods that create problems for clothing producers elsewhere and for the increased commodity demand and for the rise of relative prices of many commodities that stimulate the demand for raw materials and energy in other parts of the developing world. India's growth, as well, has had a major influence on the price increase for specific commodities, especially petroleum. For instance, the relative strength achieved in the last 2 years of the Brazilian trade balance is almost totally explained by the effects of the Chinese demand for such commodities.

This position paper presents preliminary ideas about how to study these countries' innovation systems and the related policies.

Strengths, weaknesses, opportunities and threats

The big scale of the BRICS economies may be seen both as strength and weakness. There are important scale economies in the production and use of new knowledge and this is especially true for some science-based sectors where small countries have a handicap. In order to reap these

advantages it is necessary build a strong knowledge infrastructure and to invest in scientific training.

On the other hand the big size in all the five Brics-countries is combined with extremely uneven regional development. The income gap between the most and the least developed regions in Brics countries are enormous and still growing. To develop modes of innovation that tackle this issue and to strengthen the mechanisms of regional redistribution with focus on investment in human resources is a common challenge for the Brics countries. It is also necessary to promote innovation in traditional parts of the economy and to stimulate learning based innovation in low technology sectors.

Another common characteristic is the affluence of unskilled labour and the corresponding shortage of capital and knowledge. In all the Brics countries the total of open and hidden unemployment among unskilled workers is extremely high while there may be shortages of skilled labour. Education and training is crucial in enhancing the skills of workers and the efforts made in these respects are crucial for the future development.

The scale and type of foreign direct investment is very different in the five countries. China has become the most attractive object of such investment while the inflow to the other four countries is much more limited. The case of China, and to some degree of India, illustrates the importance of the Diaspora as source of both capital and skilled labour.

The recent development in China illustrates that it is difficult to combine rapid economic growth with balanced exploitation of natural resources and with environmental balance. In the long run this might set limits to growth as the environmental costs become increasingly high. Therefore, to focus innovative activities on solving environmental problems and shortages of energy and other natural resources is a common challenge for these countries. Solutions that make use of the rich pool of unskilled labor might be of special importance.

The big size may give a certain strength in negotiations shaping global rules of the game but it also implies that what is going on in a BRICS-country is under constant scrutiny from the rich countries and international organisations. Joining forces in such negotiations might help BRICS-countries to create more balanced solutions world-wide. In this context BRICS-countries could act as representatives of their respective region and take into account also the problems of smaller developing economies.

Different development paths in BRICS-countries

While many of the problems and challenges are common it is important to stress that innovation systems in BRICS-countries have followed different paths towards integration in the globalizing learning economy and that they have responded differently on the opening up of their economies. Some countries such as Brazil and Russia have liberalized and deregulated their economy rapidly. As a result indigenous competences have been destroyed and they are currently going through difficulties with establishing sustained economic growth.

Others, such as China and India, have retained control of important parts of their economic policies while gradually integrating into the world economy and have been more successful in retaining and building competences as the economy has been made more open to foreign trade. Differences in the policy regimes are important when it comes to explain differences in economic and innovation performance. But it is also important to understand the structural and institutional characteristics of innovation systems that result in different performance in terms of creation and destruction when they are exposed to similar forms of transformation pressure.

2. Towards a research design for BRICS

The innovation system concept

The innovation system concept has roots in the work of Friedrich List who was developed in parallel at different places in Europe and in the US in the eighties. The emphasis of the approach is on accumulating capabilities and knowledge for sustained competitiveness and not 'spurious competitiveness': low price products based on low labor cost, the intense use of natural resources and manipulation of the rate of exchange but without a long-term perspective.

From the specific point of view of LDCs, the usefulness of this approach refers to the fact that its central building blocks allow for their specificities to be taken into account. These include (Lastres and Cassiolato 2005): the need for broader understanding of innovation; focus on social, economic and political agents and contexts; systemic approach; observance of micro, meso and macro relationships, etc.

The innovation process may be seen as an intricate interplay between micro and macro phenomena where macro structures condition micro-dynamics and vice versa new macro-

structures are shaped by micro-processes. In a dynamic context this means that we need to understand systems as being complex and characterised by co-evolution and self-organising.

How to study national systems of innovation?

In what follows I will sketch the outlines of a method to study national systems of innovation that moves from micro to macro – and back again to micro. The ‘model’ starts from the following stylised facts. We know that:

- firms are the units that play the most important role in the innovation system.
- firms innovate in an interaction with other firms and with knowledge infrastructure including universities and technological institutes.
- firms’ innovative activities are pursued by people in interaction and that how people interact depends upon national education systems, labour markets and welfare regimes.
- firms belonging to different sectors contribute differently to innovation processes.
- firms located in different types of regions/localities contribute differently to innovation processes.

Therefore four steps may be necessary in order to ‘explain’ in a comparative perspective the specialisation, competitiveness and growth performance of the Brics national innovation system.

The *first step* would be to select productive activities that play important roles in the national innovation system and to take the regional/local dimension into account.

The *second step* would be to analyse for each of these activities what takes place inside firms in terms of innovation, learning and competence building.

A *third step* would be to analyse for each of local systems the interaction among firms including competition, co-operation and networking and how firms interact with knowledge infrastructure.

A *fourth step* would be to see how firm behaviour and inter-organisational patterns are influenced by specificities in national education, labour markets and welfare regimes and by different implicit and explicit policies.

On this basis we can define the borders of the innovation system in two steps. We can locate a core and a wider setting around this core. *The core of the innovation system is thus firms in interaction with other firms, with the knowledge infrastructure and other organizations of the local innovation system.*

To explain international differences in these respects we need to include *a wider setting* including *the national education systems, labour markets, financial markets, intellectual property rights, competition in product markets and welfare regimes and the overall policy regime.*

Defining the core of the innovation system

A minority of firms introduce innovations that are both radical and new to the global economy. They are pioneers and they stimulate economic development by contributing to the diversity of the economy and technological opportunities. Among their competitors there are early and late followers that imitate and adapt the new products and processes. Among user firms and among consumers there are also early and late adopters of new products.

The early followers will be involved in debugging innovations and while doing so they solve problems with the new products and they might see new possibilities for their application. The early users may contribute directly by changing the new technology or they may give feed back information to pioneers. *Early followers and early users have an important role to play in the innovation system as a whole since they host processes that are as important for the over all innovation process as the pioneer firms.*

The late followers and late users may not contribute directly to the over all innovation process to the same degree as the early ones. But their difficulties to absorb and use new technologies may be considerable given their limited competence to do so. And for economic performance of the over all national economy the capacity of late-comers to absorb and use new technology may be as important as the capacity of pioneer firms and early followers and users.

Avoiding the bias toward hi technology sectors and the STI-mode

There is a certain bias in innovation policy in the direction of High Technology industries. This has some rational basis in the fact that the rate of innovation in such industries is often high as is the rate of growth in product markets. Even so and with the definitions given above the focus on such industries is too narrow. The frequency of pioneer firms and lead imitators may be higher in

these sectors but in order to understand how innovation affects macroeconomic performance all kinds of firms and sectors need to be included in the analysis. It has been demonstrated that there is a lot of innovation going on also in so called Low Technology industries and that most of these industries, to some degree, base their innovations on the use of science (Tunzelmann and Acha 2004).

Another bias is to give emphasis to activities related to science to the neglect of activities related to experience-based learning. On the one hand, innovation activities may give main emphasis to promoting R&D, utilising and creating access to explicit codified knowledge (STI-mode of innovation). On the other hand there are innovation strategies mainly based on learning by doing, using and interacting (DUI-mode of innovation). These will typically involve organizational frameworks and relationships between employees that utilize implicit knowledge and promote interactive learning. One is *experience-based* and the second is *science-based*. (see Jensen, Johnson, Lorenz and Lundvall 2004).

When drawing the lines around the innovation system they should include all firms and they should also include activities related both to experience based learning and activities related to science based search. The innovation system needs to encompass agents both in high and low technology industries as well activities that refer to the two modes of innovation (see diagram 1):

Diagram 1: Dimensions of the innovation system

	Low technology sectors	High technology sectors
DUI-mode of innovation	1	2
STI-mode of innovation	3	4

There is a tendency in the innovation literature to assume that only cells 1 and 4 are relevant and among innovation policy makers there is a tendency to focus the attention on cell 4. We see both as examples of biased. All four cells should be covered.

When it comes to empirical work two parallel efforts to analyse innovation systems seem to dominate the picture currently (Balzat and Hanusch 2003). One is focused on the performance of national innovation systems while the other is focused on comparing systems in more qualitative

terms. Sometimes the first tends to neglect the systemic aspect and degenerate to looking for ‘general best practice’ (Lundvall and Tomlinson 2002) while the other emphasises the unique systemic features of each single system. The Brics-project should try to bridge the gap between these two approaches.

Bringing in the wider setting: the education system, the labour markets, the welfare system and the financial system

As reported in Lundvall (2002) certain characteristics of the Danish education system, the labour market and the welfare system are reflected in how Danish firms organise learning and innovation.

The primary and secondary education gives strong emphasis on individual independence and combined with the low inequality in income in Denmark it implies ‘short power distance’ in organisations. The labour market promotes mobility and labour market training is a public responsibility. Combined with a basic social security net this gives a positive attitude to change in organisations – the fear of falling in between jobs is less than in other countries.

These characteristics tend to support a mode of innovation in firms where there is frequent and close interaction among different categories of employees and among firms and where most innovations are incremental. The Lorenz Valeyre analysis shows that Denmark together with Netherlands is the country where work is most frequently combining autonomy and learning.

Another important dimension is related to the role the financial system on innovation strategies. The financial context was already recognized by Schumpeter (1912) in his Theory of Economic Development. For him entrepreneurs, to become the driving force in a process of innovation, they must be able to convince banks to provide the credit to finance innovation. In this sense, any discussion about innovation systems has to include the financial system.

On the need to adapt the NSI-concept to the BRICS-context

The systems of innovation approach has been used to describe and compare relatively strong and homogenous systems with well developed institutional and infrastructure support of innovation activities. Usually the perspective has been that innovation processes are evolutionary and path dependent and systems of innovation evolve over time in a largely unplanned manner. When applied to the BRICS the focus need to be shifted in the direction of system construction and

system promotion – something that was central in List’s ideas for catching up - and to the fact that innovation policy is a conscious activity that need to stimulate and supplement the spontaneous development of systems of innovation. The uneven regional development and diversity of BRICS-countries calls for a mapping that is explicit on regional/local differences and on a focus on national, regional and local policies aiming at overcoming the regional gaps in learning and innovation capacity.

Another weakness of the system of innovation approach is that it is still lacking in its treatment of the power aspects of development. The focus on interactive learning – a process in which agents communicate and cooperate in the creation and utilization of new economically useful knowledge – may lead to an underestimation of the conflicts over income and power, which are also connected to the innovation process. Interactive learning and innovation may be positive sum games, in which everybody may gain. Class privileges may block learning possibilities and existing competences may be destroyed for political reasons related to the distribution of power. Regional interests may reproduce regional inequality.

Furthermore, the relationships between global power structures and national systems need to be further researched. The evolution of any national (or regional) economic system depends, to a large extent, on its place in the hierarchy and power structure of the world economy. In the current global context the access to technical knowledge is becoming restricted not only by weak ‘absorptive capacity’ but also by more and more ambitious schemes to protect intellectual property world-wide. It is important to know more about how globalisation processes affect the possibilities to build and support national and local systems of innovation in developing countries. The acquisition of technology abroad is not a substitute for local efforts since local knowledge is necessary to allow the selection, buying (or copying), transforming and internalizing of technologies.

It is thus clear that the innovation system approach proposed here needs to be adapted to the situation in developing countries, if it is to be applied to system building. It is also clear, that what is most relevant for developing economies is a broad definition of the NSI including not only low tech industries but also primary sectors such as agriculture. Activities contributing to competence building needs to be taken into account and narrow perspectives that focus only on the STI-mode needs to be avoided.

3. Organising the BRICS-project – some preliminary ideas

It is proposed to build the understanding of the national systems of BRICS through three complementary types of studies. The first type would aim at building a bottom-up understanding of the national system. In order to focus the analysis we propose that analyses are centred upon local innovation systems, how learning, innovation, capacity-building processes evolve, how new products/new services are introduced and how these systems are influenced by the wider setting. The studies on local systems would concentrate on a limited number of cases, if possible by choosing at least two examples of the same sector to illustrate regional differences and diversity in each country. The second type would focus on the specialization and institutional set up of the over all national system, including the pattern of social and regional inequality. The third type would include some common themes of special importance for the learning and innovation process.

Building the national system bottom up through studies on local innovation systems

The choice of case-studies should be determined by different considerations. We would like to include productive activities that play a significant role in the Brics-countries and that play different roles in the national innovation system. We also want to choose cases to compare differences inside Brics countries to cope with the diversity within national innovation systems. Here are six examples of activities that could be selected:

1. Agro-Food industry (rural region)
2. Automobile industry (urban region)
3. Mobile communication (metropolitan region)
4. Health services (rural region)
5. Environmental industry and services (urban region)
6. Film industry (metropolitan region)

Historical statistical analysis of sector with external links to suppliers, customers and knowledge infrastructure. Case studies of single firms regarding technical innovation, human resources and organisational change with external links to suppliers, customers and knowledge infrastructure.

For each sector the focus might be on performance indicators related to **product innovation/imitation** and **competence building through organisational learning**. The following themes/factors may be evoked as explanatory factors:

1. Ownership and governance.
2. International and domestic competition and intellectual property rights.
3. The role of venture capital and individual and collective entrepreneurship.
4. Research and development, interaction with knowledge institutions.
5. Links to education system and labour markets.
6. Interaction with foreign and domestic users and suppliers, including suppliers of business services.
7. Impact of government regulation and government policies.

For each sector a common manual for the research should be developed. Studies of single firms might be combined with minisurveys. Production structure and specialization in production, trade and patenting would be mapped together with the presence of foreign ownership and control for each sector. The character and change of transformation pressure as well as the transformations actually taking place would be analysed. The impact of major nationwide reforms at the level of the firm and the sector would be studied.

One purpose would be to get a concrete understanding of how and why firms innovate differently in different national context in spite of belonging to the same sector and operating in a similar regional context. A second purpose would be to construct the national system of innovation on the basis of the sector studies. This would be combined with a top down analysis of the national system

A top-down analysis of the transformation of the national system

The top down approach might start with mapping the economic structure and the competitiveness of the whole national economy including the changing patterns of production specialization and insertion in world trade. Adequate innovation indicators need to be developed together with measures of productivity growth in different areas of the economy.

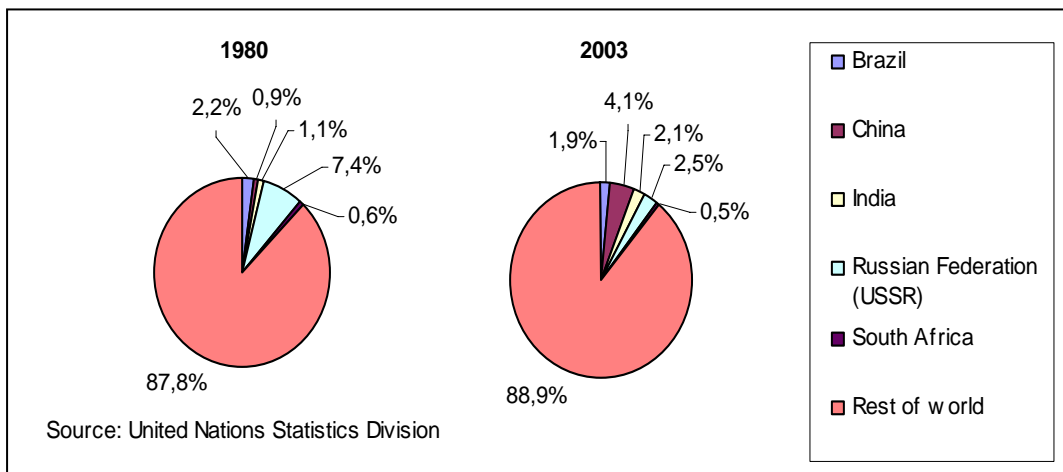
A second step would be to analyse how the different BRICS-countries respond to the transformation pressure coming from financial liberalization, the new WTO trade disciplines and agricultural subsidies in the developed countries.

The third step would be to analyse the role of implicit and explicit policies including the impact of structural adjustment policies and policies towards FDI upon innovation systems. Industrial and innovation policies as well as policies toward education, skills and the development of human capital.

Appendix: BRICS – data on Economic and Geopolitical Relevance

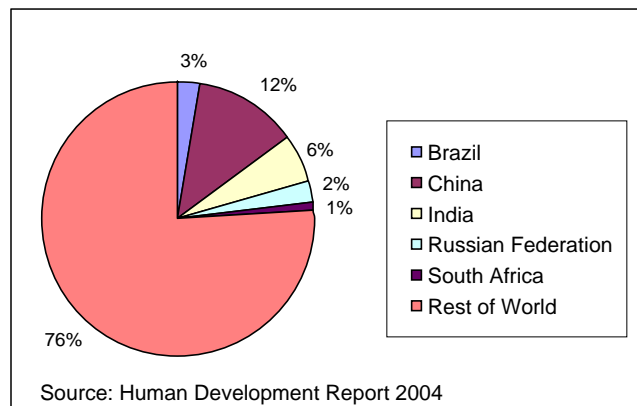
Over the last 25 years the combined GDP of BRICS – in terms of constant 1990 US\$ - fluctuated around 11-12% of world's GDP as may be gathered from the figure below. Even if the information shown in the figure for years 1980 and 2003 are not totally comparable - the part of what is today Russia (2.5% of the world GDP in 2003) is not comparable to Soviet Union in 1980 (7.5% of the world GDP) - one can get an impression of the increasing economic importance of BRICS countries. China and India, for example, increased their share from 0.9% and 1.1% of world GDP in 1980 to 4.1% and 2.1% in 2003.

Figure 1 – BRICS' GDP in constant 1990 US\$ – Share in World GDP – 1980-2003



If we use data about GDP in terms of purchasing power parity (PPP), we find a still more impressive performance. In fact in PPP-terms the combined GDP of BRICS countries represents 24% of the world GDP in 2002 (figure below) which is more than the US GDP. If we use PPP China's and India's share in world GDP would be 12 and 6% respectively in 2002.

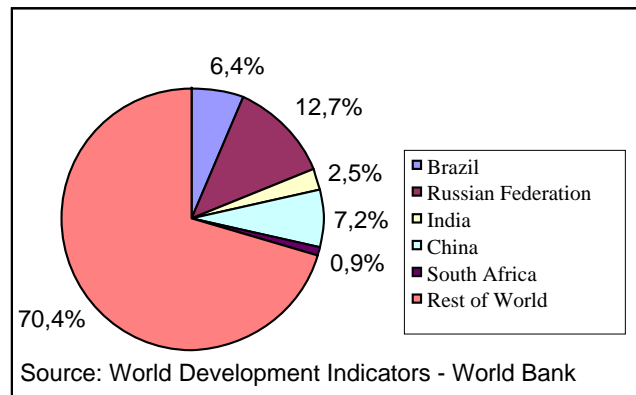
Figure 2 – Share in World GDP in PPP US\$ – 2002



Together, the five countries, account for nearly 30% of the world surface area. The relevance of these vast territorial extensions relate to the probability of existence of mineral resources, fertile lands for agriculture and a biodiversity. The agricultural activity and mineral resources may be reflected in the insertion in world commodity trade, and may also give rise to industry in basic sectors. Rich biodiversity represents a chance for the development of dynamic industries such as pharmaceuticals and biotechnology. In fact, all the countries have developed activities in these areas with varying intensity and degree of success. Specifically, all countries have significant resources in their underground and the extraction and/or transformation of these are reflected in the sector composition of their GDP.

A common challenge posed by the great territorial extension is the need for a complex infrastructure for the integration of the different regions, implying the need for substantial investment in transport and communications. These huge territories also incorporate an ample ethnic and cultural diversity, which at the same time represents a rich intangible resource for these countries.

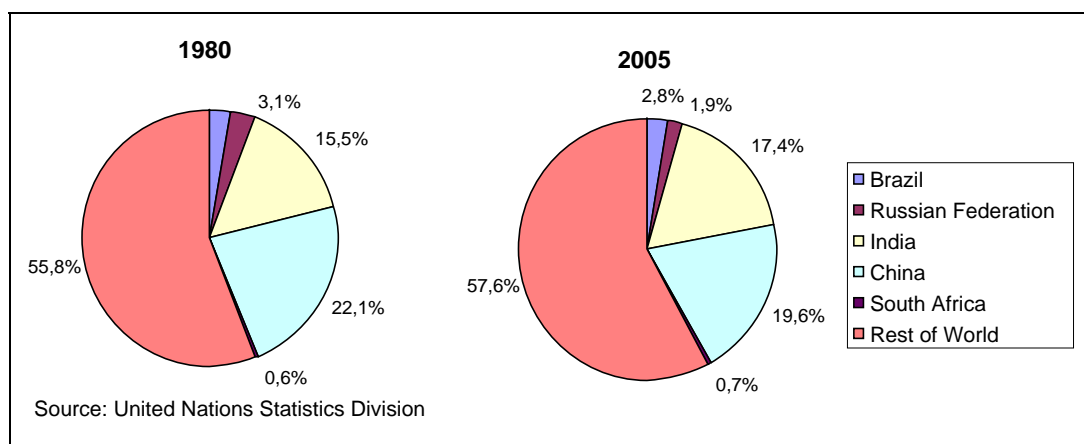
Figure 3 – BRICS' Share in World surface area – 2003



The share of the population of these countries in the total world population is even more significant. The total population of the five countries accounts for about 42% of the world population in 2005. As shown in the graph below, this share remained almost unchanged throughout more than two decades. China, the most populous country, has been trying to control population growth with some success and managed to decrease its share from 22.1% in 1980 to 19.6% in 2005. However, with the exception of Russia, all the other BRICS countries have increased their population in both relative and absolute terms. The most significant increase was that of the share of the Indian population, which reached 17.4% of the world population in 2005.

Challenges that commonly arise with great populations are related to the supply of water, food, energy, etc. Brazil didn't suffer problems related to water or food supply but experienced electric energy rationing in 2001 because most of its energy is produced by hydroelectric plants and the reservoirs went almost empty. China suffered severe food supply problems and starvation during the late 1950s and still faces the problem of decreasing agriculture area. India also experienced recurring food shortages until the 1970s. Similarly, food rationing became a great challenge in the early years after the fall of the Soviet Union.

Figure 4 – BRICS' population – Share in World Population – 1980 - 2005



The great population represents at the same time a challenge and a source of opportunities. A common characteristic is BRICS countries is under-employment and a highly unequal income distribution, with large parts of their population being more or less excluded from the monetary market economy. The possibility of incorporating this marginalized workers first in productive work and then as consumers in consumer markets points to a potential for the economic development of the countries. In a long term perspective, it represents an interesting alternative to a one-sided promotion of production for global markets, since the consumer markets for industrial products of the countries with high purchasing power are more or less saturated.

Table 1 below gives an overall picture of the unequal income distribution characterizing these countries. Brazil and South Africa are among the countries with the most unequal income distribution. India and the Russian Federation have a big share of their population below the national poverty line. China has nearly 800 million people living in very modest standards in the inland rural area.

Table 1- BRICS countries - Income distribution statistics – last available year

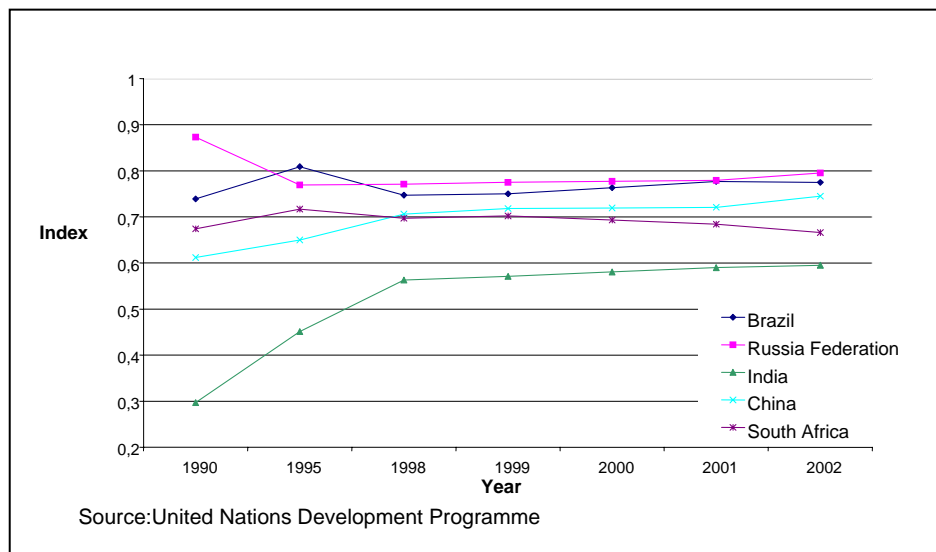
Country	GINI Index	Poorest quintile's share in national income or	Percentage of population below national poverty line
Brazil	0.591	2.4	17.4
China	0.447	4.7	4.6
India	0.325	8.9	28.6
Russian Federation	0.456	8.2	30.9

South Africa	0.593	3.5	-
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Source: United Nations Statistics Division

Beyond the unequal income distribution, differences in access to services such as education, health, housing and urban infrastructure, social security, etc. represent a considerable challenge for these countries. These difficulties are reflected in the Human Development Index with all five countries included in the medium range (HDI between 0,5 and 0,8) as may be seen in the figure below.

Figure 5 – BRICS’ Human Development Index (HDI) – 1990-2002



For the year 2002, the Russian Federation reached an IDH of 0.795 being at the 57th place in the world ranking; Brazil presented an index of 0.775 in 72nd position; China 0.745 in 94th position and South Africa an index of 0.666 in 119th position. With South Africa as exception, since 1998 the other countries experienced a soft and continuous trend of growth of their population’s life quality, with a notable evolution in the Indian case. This country, in spite of rapid population growth, passed from an HDI of 0.297 in 1990 to one of 0.595 in 2002, reaching position 127 in the world ranking.

But the levels of human and economic development differ dramatically across the countries’ different regions. Huge regional disparities are present in the five countries and internal regional income redistribution is a major challenge. Normally the richer regions are those most

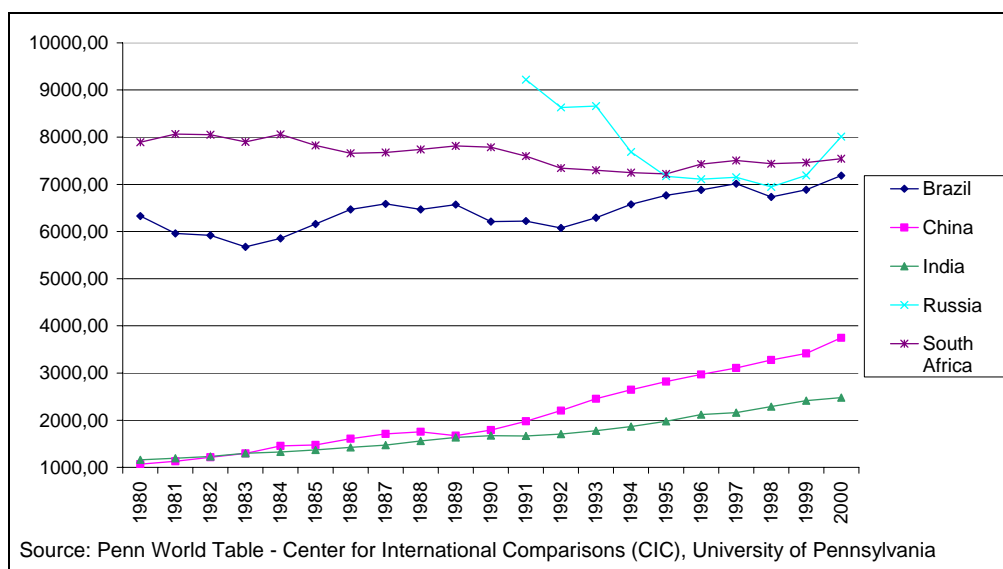
industrialized. Almost 60% of Brazil's total GDP originates in the southeast states. China's development model has favored the coastal provinces while inland provinces are far less developed. The gap is also huge between rural and urban population since the Chinese economy is heavily based on industrial production. Economic activity in South Africa is concentrated in Gauteng province, which accounts for over one-third of total GDP, and in the Western Cape with 15% of GDP. Russian industrial development occurred mainly around the cities of Moscow, St Petersburg, Yekaterinburg and Nizhny Novgorod while Siberia and the Russian Far Eastern regions remain largely unindustrialized. India has large inequalities between the wealthier southern region and the northern region and between rural and urban population.

BRICS - Recent trajectories

Since the 1980s BRICS countries pursued different development strategies embedded in different political and social contexts. These different paths are reflected in different patterns of integration into the world economy in the recent years and the degree of success in this process. As one can see in the graph below the economic performance of these countries in terms of the evolution of the per capita GDP at PPP terms is far from homogeneous.

Unfortunately there are no comparable data available for the USSR/Russia in this respect, but observing the per capita GDP in the national currency at constant prices we find an average growth rate of 3,25% during the 1980s and a decline of nearly 40% between 1989 and 1991. Data for the Russian Federation show a constant decline in the per capita GDP until 1998, year of the Russian crisis; since then there has been a slow recovery. The Brazilian economy experienced many ups and downs throughout the last two decades with low points in 1983, 1992, and 1998. The South African economy shows a smoothly declining trajectory in the 1980s and 1990s. China and India were on constant growth trajectories with the former experiencing higher growth rates during the 1990s.

Figure 6 – BRICS' GDP per capita at PPP (in 1996 constant prices: Laspeyres)



In order to understand these different growth patterns, we will briefly present the policy trajectories of these countries and their major challenges.

From the 1950s to 1980 Brazil followed a strategy of import substitution industrialization with great presence of state owned enterprises in basic industries (dominating in steel, mining and petrochemicals) and public utilities and increasing participation of multinationals, particularly – but not only - in consumer goods sectors. The domestic market was protected against foreign competition with tariffs, non-tariff barriers, exchange rate controls, and import licensing. Between 1950 and 1980 Brazil experienced a 7,4% average annual growth rate of the GDP. As a result, in Brazil domestic output increased nearly ten-fold in this 33-year period. This performance was accompanied by increasing inflation and balance of payment difficulties reflecting high import content of investment and massive external borrowing.

The 1980s was a decade of low average growth rate, attempts of external and fiscal adjustment and fight against inflation. In the 1990s inflation was reduced and Brazil engaged in a new development model in which privatization, deregulation and opening of the economy became the means of transformation towards integration with the global economy. The average growth for Brazil from 1980 to 1999 fell to just 2% per year.

Since the 1950s China's development was marked by central planning but with some degree of autonomy for the provinces and local authorities concerning the strategies to meet the goals set by central government. Pushed by massive investment of the state owned enterprises (focused in sectors such as heavy industry, mineral extraction, energy production and banking) China's growth was mainly based upon capital accumulation. Between 1978 and the mid 1990s China went through a process of slow and progressive internationalization of the economy selectively introducing elements of market economy. Foreign direct investment was permitted in some coastal areas and enterprises in these 'economic zones' were exempted from central control, labor regulations and many taxes. But FDI was not totally liberalized and remained subjected to a series of regulations. During the 1990s, China became the world's major recipient of FDI and accumulated large trade surpluses with fast accumulation of foreign reserves. The economic strategy in the mid-1990s focused on the transition from a traditional and planned economy to a partial market economy. The fight against inflation, reforming the state-owned enterprises and the integration with the international economy by becoming member of the WTO were on the agenda in this period.

The recent Indian economic history can be divided in two periods, the first marked by an import substitution strategy (1947-1991) and the second known as the liberalization era (post-1991). Since independence, the government exerted authority over infrastructure operations and established economic plans to implement a strategy of import substitution through placing high tariffs and restrictions on all goods coming into the country. In 1990, India faced tremendous political and social instability caused by the loss of its major trading partner, USSR. As a result of high oil prices and its stagnant export industry, India faced a severe balance of payments crisis. India was forced to turn to the IMF for assistance. The IMF granted the loan on the condition that India began making reforms consistent with the Washington Consensus policies. India embarked upon a plan of gradual liberalization toward a more market-oriented economy through reducing the regulations, removing import restrictions, reducing the public sector share in economy, etc. India's government also promoted privatization in order to increase foreign investment. The planned reforms have not been fully completed. But India is one of the fastest growing economies in the world with great potential for future growth.

The Soviet system achieved rapid economic growth between the 1920s and the 1950s. By the middle of the 1980s, however, the Soviet Union's once remarkable economic growth had

disappeared, leading eventually to crisis of legitimacy for both the Soviet state and the Communist regime. Since 1991, post-Soviet “Russia” is, officially, the Russian Federation, which has its own complex federal system inherited from the Soviet era. Pushed by the International Monetary Fund (IMF), the reform team implemented liberalization and stabilization plans. The process led to the privatization of 16,500 firms between 1992 and 1994. In 1998, the Russian economy seemed to have reached a high point, and it experienced a sharp drop in real income, living standards, and employment. After the retreat of Boris Yeltsin in 1999 Vladimir Putin initiated a reorganization of Russia’s federal system by adding an additional layer of political authority between the center and the regions. In recent years, the Russian Federation has experienced substantive economic recovery.

A new South Africa finally emerged in the early 1990s as a free and democratic state with black-majority ruled government out of a history of slavery, discrimination, and brutal apartheid. But in the wake of the post-apartheid boom, South Africa faced severe social challenges. Among the most pressing of these were crime, lack of education, unemployment, weak infrastructure and AIDS. By 1996, South Africa had recovered from the stagnation that had prevailed since the early 1980s by announcing a new macro-economic strategy – GEAR – that aimed at accelerating private sector investment and infrastructure development. GEAR depended on flexible wage and labor structure. The level of unemployment was intolerable and had to be improved if political stability were to be maintained. The government was committed to a tougher fiscal policy, with monetary restraint and constant fixed exchange rates. South Africa is experiencing slow and constant growth. Although the economy had slowed during the last two quarters of 1996, it appeared to be ready to expand again, with a more realistic budget, a somewhat depreciated currency, and stable inflation.

Productive structure

The five countries went through different transformations of their economic structure during the last two decades. But everywhere the service sector gained importance.

Brazil went through a radical structural transformation along the last two decades with a sharp decrease of manufacturing industry’s share in total GDP (19% in 2003) and the increasing share of services (75% in 2003). The period of import substitution industrialization led to an expressive growth of manufacture production, which accounted for nearly 44% of GDP in 1983. Although

industrial output grew during the two decades, the competition from external products, especially Asian consumer goods, as well as structural problems contributed to the relative decline of manufacturing. Although agricultural products play an increasing role for the Brazilian recent trade surplus, the share of agriculture in the GDP declined from 11% in 1983 to 5.7% in 2003.

China's GDP composition has an unusually large and increasing participation of the manufacturing industrial sector, the backbone of the country's development. However, a large part of the workforce remains on the land. Reforms in the countryside increased the relative share of the agricultural sector to 33% in 1983. Since then, the agriculture share has fallen constantly representing only 14.6% of GDP in 2003. During the 1980s, the share of services rose from 22% in 1983 to over 30% in 1993, but remaining afterwards at that level.

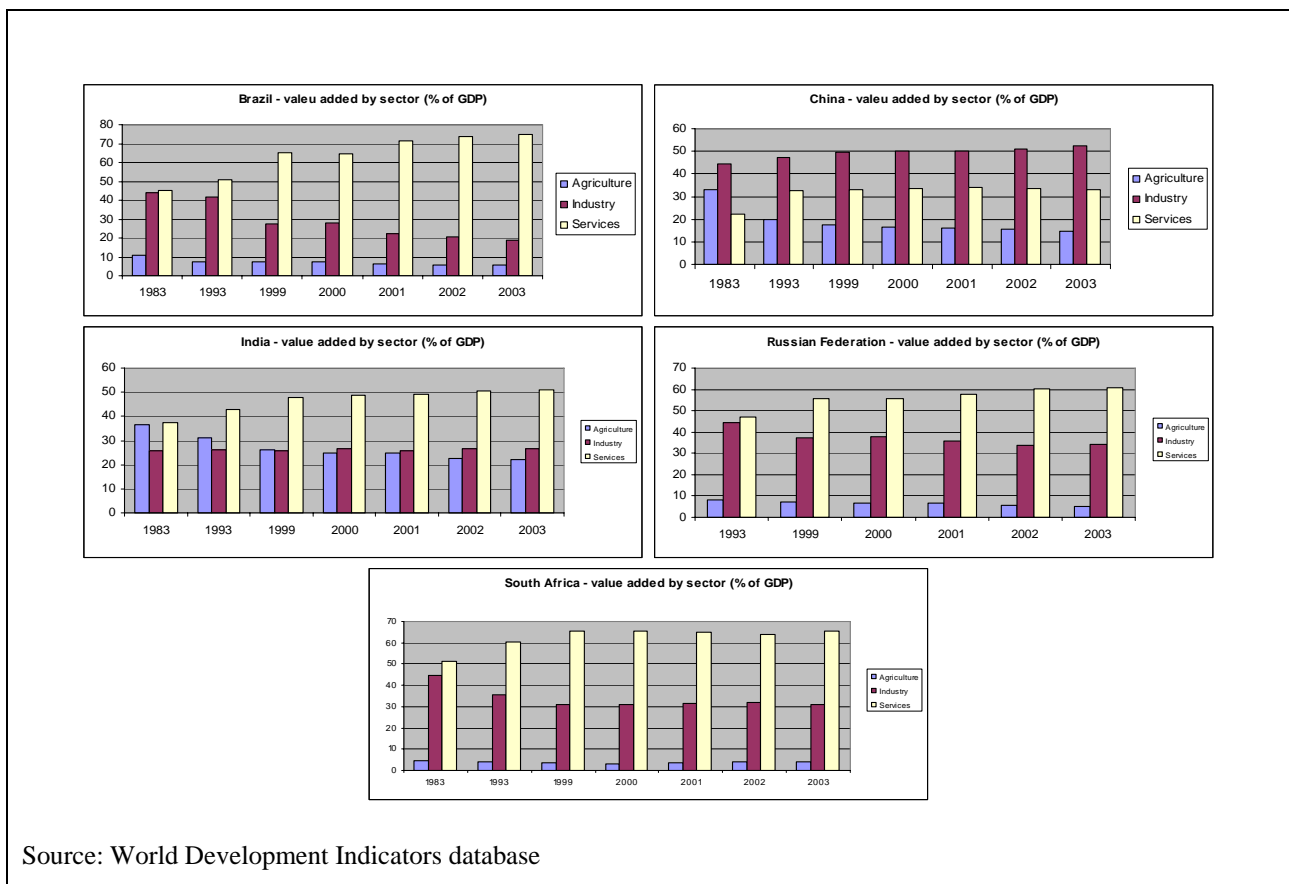
Although India's agricultural sector presents a declining share in total GDP it still accounted for nearly 22% in 2003 (in comparison to 36.6% in 1983) and is an important determinant of overall economic growth. The import substitution policy led to the development of a broad industrial base with the state owned enterprises playing a major role in heavy industry. Recent liberalizing programs led to a growing participation of foreign enterprises especially in the durable consumer goods sector. Throughout the two decades industrial's contribution to India's GDP remained almost constant at 26%. Services are India's fastest growing sector, especially those connected to telecommunications and information technology. The share of services in GDP rose from 37.6% in 1983 to 51.2% in 2003. The country benefits from advantage of the English speaking population and many foreign software companies are outsource the soft-ware programming to India.

The Soviet Union built a big industrial sector, which accounted for nearly half of its GDP in 1990. During the transition to a market-based economy the Russian Federation experienced a sharp decline in overall production and with a decreasing participation of agriculture and industry in total GDP. The share of agriculture declined from 8.3% in 1983 to 5.1% in 2003 leading to serious underemployment (rather than unemployment) in rural area. The share of the industrial sector declined from 44.6% in 1983 to 34.2% in 2003 of GDP and remains strongly based on heavy industries: Fuels and energy account for almost 20% of industrial output; metallurgy for around 17%; electricity 10%; and food 15%. Machine-building and metalworking remains the largest processing industry, accounting for just fewer than 20%. Retail trade and services have

undergone a radical transformation throughout the last two decades and its share of total GDP went from 36% in 1990 to 60.6% in 2003.

The South African economy also shows an increasing role for the service sector. Its share in total GDP went from 51.1% in 1983 to 65.2% in 2003. An advanced financial sector and the growing tourism sector contributed to this increase. Although industry's share went down from 44.5% in 1983 to 31% in 2003, manufacturing experienced a relative increase, accounting for nearly 20% of total GDP in 2000. Metals and engineering, especially steel-related products, dominate the manufacturing sector. Nevertheless, mining remains an important foreign exchange earner and provider of employer. Although agriculture is responsible for a small part of South Africa's GDP it still represents an important provider of employment.

Figure 7 – BRICS – Value added by sector (% of GDP)



Insertion in the global economy: Trade and FDI

The different economic trajectories of the five countries are reflected in their pattern of specialization in international trade. All countries increased their volume of exports and imports as well as the share of trade in GDP in the last two decades. With exception of South Africa, at 1970 the share of trade was relatively low. But in 2002 China, Russian Federation and South Africa reached a percentage higher than 50% of GDP and Brazil and India nearly 30%.

In 2002 Brazil had a trade surplus of nearly US\$ 8 billion but it faces current account problems because of the high debt services, which reached 11% of GDP that year. Brazil's external debt of US\$ 220 billion in 2002 is the biggest among the five countries. China has growing surpluses in both trade and current account balance. Although India faces deficit in goods trade, a growing dynamic service sector (especially in telecoms and information technology) contributes for a total trade surplus and for a positive current account balance since 2001. In the Russian case a deficit in services is more than compensated by a huge surplus in goods trade and the external debt has been decreasing in recent years. South Africa's performance in the late 1990s and early 2000s is marked by surplus in trade but with oscillation between positive and negative values in the current account balance.

Table 2 – BRICS – Foreign Trade (current US\$ million) and share in GDP (%)

Country	Exports + imports				(Exports + Imports)/GDP			
	1970	1980	1990	2002	1970	1980	1990	2002
Brazil	8,719	25,412	61,212	133,196	13.0%	10.3%	14.0%	28.9%
China	4,833	38,919	114,710	696,909	5.3%	12.9%	29.9%	55.0%
India	4,792	28,839	51,144	156,581	7.9%	15.7%	15.8%	30.8%
Russian Federation	-	-	349,249	206,358	-	-	36.1%	59.7%
South Africa	8,352	50,411	48,600	67,230	45.7%	61.2%	43.4%	63.2%

Source: United Nations Statistics Division

Table 3 below shows exports and imports of BRICS countries both in value (current US\$) and as a percentage of world exports and imports during the 2000-2004. After a period of stagnation in 2000-2002 world exports rose significantly from US\$ 6,481 in 2002 to US\$ 9,123 in 2004. Imports also followed the same trend. The BRICS countries' share also varied significantly. Most striking is the increasing share of China in international merchandise trade: the country's exports rose from 3.9% of world's exports to 6.5% in 2004 (a 67.9% increase) and imports from 3.4% to 5.9% in the same period (76,8% increase). India, Russian Federation and South Africa also experienced a smoothly increasing share in both exports and imports throughout the period.

Table 3 – BRICS - Total merchandise trade in current US\$ billion – value and share in world total

EXPORTS	2000		2001		2002		2003		2004	
	value	share	value	share	value	share	value	share	value	share
World	6.446,61	100%	6.185,75	100%	6.481,17	100%	7.546,23	100%	9.123,52	100%
Brazil	55,09	0,85%	58,22	0,94%	60,36	0,93%	73,08	0,97%	96,47	1,06%
China	249,20	3,87%	266,10	4,30%	325,59	5,02%	438,37	5,81%	593,37	6,50%
India	42,38	0,66%	43,36	0,70%	49,25	0,76%	57,09	0,76%	72,53	0,79%
Russian Federation	105,57	1,64%	103,14	1,67%	107,11	1,65%	135,93	1,80%	183,19	2,01%
South Africa	29,98	0,47%	29,26	0,47%	29,72	0,46%	36,48	0,48%	45,93	0,50%

IMPORTS	2000		2001		2002		2003		2004	
	value	share	value	share	value	share	value	share	value	share
World	6.705,87	100%	6.467,56	100%	6.718,23	100%	7.818,46	100%	9.458,27	100%
Brazil	58,63	0,87%	58,35	0,90%	49,60	0,74%	50,70	0,65%	65,90	0,70%
China	225,09	3,36%	243,55	3,77%	295,17	4,39%	412,84	5,28%	561,42	5,94%
India	51,52	0,77%	50,39	0,78%	56,52	0,84%	71,24	0,91%	95,16	1,01%
Russian Federation	44,66	0,67%	53,63	0,83%	60,22	0,90%	74,23	0,95%	94,83	1,00%
South Africa	29,70	0,44%	28,25	0,44%	29,27	0,44%	41,08	0,53%	55,20	0,58%

Source: UNCTAD

These data demonstrate the importance of China's economic performance for the recent recovery of international merchandise trade that has had a noteworthy impact on the world economy. China's imports almost doubled in two years (from US\$ 296 billion in 2002 to US\$ 561 billion in 2004). The Chinese demand is heavily concentrated in primary commodities, as discussed next, and primary commodity exporters like Brazil benefited tremendously from that. In fact Brazil's share in world exports grew considerably given her specialization in commodities.

The following table shows the patterns of trade specialization in goods for the year 2002. While Brazil, China, and the Russian Federation are experiencing merchandise trade surplus in recent years, India and South Africa face deficits.

Brazil achieved a merchandise trade surplus of nearly US\$ 10 billion in 2002. A pattern of the recent export performance is the heavy concentration on low value-added primary products. The exports of agriculture products (nearly 32% of exports in 2002) and minerals (nearly 9% in 2002) are fundamental for the country's trade performance. It is also worth noticing that in 2002, 6.5% of Brazilian exports were aircrafts (exported by the company Embraer that rivals with the Canadian Bombardier in small passenger jets), and over 6% are passenger motor vehicles and parts (produced almost exclusively by multinationals). The country is still a net importer of manufactured goods (74% of imports) and fuel (15% of total imports), even though self-sufficiency in oil is expected for the next few years.

China's growth in foreign trade has averaged 15% annually since 1978. In 2002 the country exported nearly \$ 325 billion in goods, resulting in a trade surplus of nearly \$ 30 billion. It is a net importer of fuels (6.6% of imports) and minerals (5.3%). Especially impressive is the proportion of manufactured goods in both exports (nearly 90%) and imports (nearly 80%), explaining why China is named "the workshop of the world". Manufacturing exports consist of apparel and clothing (12.7%), computers (11.1%), electrical equipment, and telecommunication products (both with 9.8%). Imports consist mainly of electric equipment and parts (18.8%), machinery and parts (5.3%), and apparel and clothing (4.4%).

India's merchandise trade deficit is directly related to the massive import of fuel (32% of imports). The country is a net exporter of food items (12% of exports) and manufactured goods (75% of exports). India's major export items are textiles and garments (about 19% of good

exports), gems and jewellery (about 17%), and agricultural products (13%). The major import items are basic manufactures (43% of good imports), fuel, and machines and transport equipment (nearly 19%). India is finding a new source of exports in software products and services ,.

The Russian Federation had in 2002 a large trade surplus of nearly \$ 58 billions, mostly because of massive oil and gas exports (56% of exports). The devaluation of the Ruble in 1998 and the high oil and gas prices contributed to the positive trade performance and the shrinking foreign debt. Other major export items are metals (around 8% of good exports) and machinery and equipment (around 6.3%). The country is a net importer of food (23% of imports) and manufactured goods (68% of imports).

South Africa is a net exporter of food items and minerals and a net importer of manufactured goods (nearly 70% of imports). The country is known for its precious metals and gems, which account for nearly 30% of exports. Other major export items are metals and metal products (nearly 21% of good exports) and passenger motor vehicles (7%).

Table 4 – BRICS - Trade by commodity group - in million US\$ - 2002

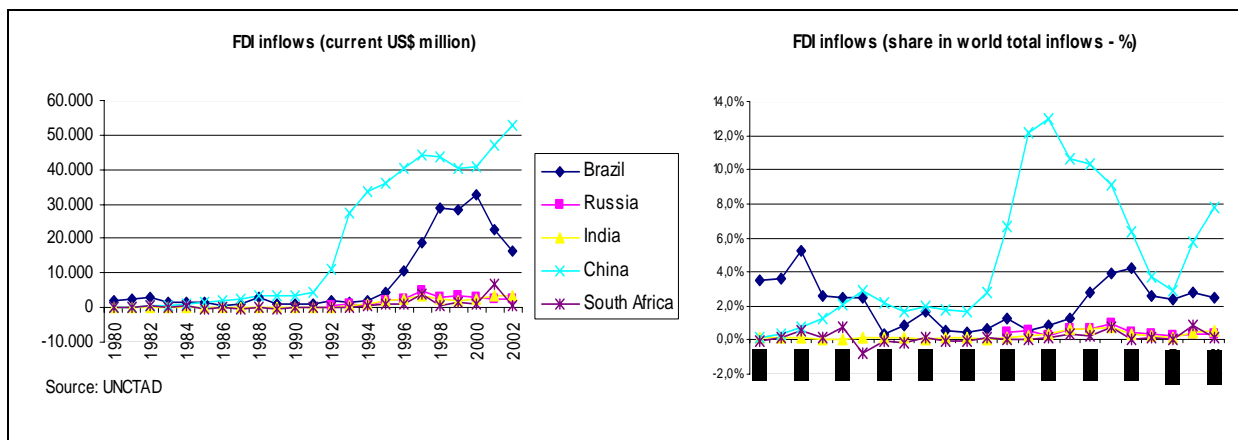
Commodity groups (SITC 0 to 9)	Brazil		China		India		Russian Federation		South Africa	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Value in current million US\$	60,362	49,735	325,596	295,170	52,471	61,118	100,364	42,103	23,064	26,212
All food items (0 + 1 + 22 + 4)	16,770	3,396	16,144	9,875	6,460	3,311	2,160	9,619	2,452	1,305
Agricultural raw materials (2 - 22 - 27 - 28)	2,391	751	2,609	11,736	552	1,755	3,618	607	839	384
Fuels (SITC 3)	2,953	7,593	8,449	19,490	2,706	19,629	55,737	1,053	2,857	3,286
Ores and metals (27 + 28 + 68)	5,282	1,408	5,137	15,653	2,269	2,590	7,518	1,757	2,598	667
Manufactured goods (5 to 8 less 68)	31,512	36,576	292,591	236,838	39,249	29,282	21,842	28,806	14,275	18,213
Chemical products (5)	3,577	9,968	15,176	38,520	5,852	5,577	4,650	5,414	2,143	3,127
Other manufactured goods (6 + 8 - 68)	13,214	7,103	150,486	61,067	28,973	12,187	10,907	9,220	6,872	5,257
Machinery and transport equipment (7)	14,721	19,504	126,929	137,251	4,424	11,519	6,285	14,172	5,259	9,828
Unallocated	1,454	11	664	1,578	1,235	4,551	9,489	261	43	2,357

source: UNCTAD

BRICS countries have been important receivers of foreign direct investment (FDI) during the last decades. However, the evolution of FDI inflows shows very distinct trajectories for the five countries. Until 1984, Brazil was the major FDI recipient country among the BRICSs. Overtaken by China in 1985, the country continued to be a major destiny of FDI, especially in the automotive and consumer durables sectors. The total inflows grew considerably since 1994, the year of the Real stabilization program that provided more confidence in the economy's stability. China became the world major recipient of FDI in the 1990s, matching the country's efforts to

integrate in world economy. Many multinationals have moved operations to China to take advantage of its low labor costs and huge domestic market. Even with a declining share in world total inflows from 1994 to 2000 the total amount shows a sharp increasing trajectory. South Africa and India received an almost constant and small part of total FDI during the two decades. India has many restrictions to FDI and public enterprises dominate in many sectors. An equally low and constant inflow applies to the Russian Federation since 1990. It is also worth pointing out that the type of FDI each country received has been significantly different and that the type depended on policies by the receiving countries. So, for example, some BRICS countries as Brazil, Russian Federation and perhaps South Africa that liberalized their economies in a more unconditional way have received more portfolio FDI. For these countries, FDI directed to the productive sector mostly were acquisitions of local firms. For China and India that did not liberalize the capital account, FDI seems to be concentrated in green field investments in new production capacity.

Figure 8 – BRICS – Foreign Direct Investment (FDI) inflows and share in world total – 1980-2002



BRICS National Innovation Systems

The NIS of BRICS countries present several similarities and differences. The share of R&D expenditures on GDP is relatively small for all countries (around 0.8% to 1.2%) if compared to more advanced countries. There are important cases of success, such as aircraft and oil in Brazil, pharmaceuticals in India and IT in China.

Also a good scientific infrastructure seems to be a general asset of these countries. Among developing nations, India has one of the strongest bases of scientific and technical manpower and infrastructure for research and development. This base was built largely by the government and resulted in significant achievements in strategic sectors such as atomic energy and space. In Brazil a comprehensive post-graduation and research system based on government controlled universities and research institutions were set up since the 1980s. Russia has got approximately 3.5 thousand researchers per million inhabitants. China has got by 2005 more than 1 million of engineers with less than 7 years of experience (more than twice as much as the U.S.A.) and is expected to reach, by 2008, the same number of U.S.A. graduates in biological sciences with less than 7 years of experience. However, with the exception of China, BRICS countries seem all to suffer from instability in government funding for S&T. This has been aggravated by fiscal crises.

While good infrastructure for S&T seems to be a common positive feature of all BRICS countries, in all cases innovation by private firms seems to be a major problem. The case of Brazil is exemplary. The results of two Innovation surveys published by the Brazilian Agency for Geography and Statistics summarize this general problem:

- Innovation rates (percentage of firms that introduced in the market new or improved products and/or processes in the 3 years prior to the survey) are very low and declining for most sectors.
- Innovation expenditures are concentrated on acquisition of capital goods not on pursuing R&D. More than 50% of the innovation expenditure of Brazilian manufacturing firms refer to the acquisition of tangibles (basically machinery). In most OECD countries this share is between 10% and 20% .
- R&D expenditures by firms are not only small, but seem to be declining.

To solve this common problem of having good infrastructure for S&T and poor innovative performance at the level of firms all countries are following some sort of innovation policy strategy. Again China is an exception in the sense that it is the only country that apparently has consistently been linking a S,T and I strategy to industry and trade policies. They include public research, trade protection, sector-specific financial incentives, selective government procurement, control of foreign participation, relaxed antitrust regulation, and provision of training and education for sector-specific skills. One example is the Chinese standard-setting designed to

decrease dependence on foreign know-how by developing domestically-controlled intellectual property (IP). The indigenous development of IP is a point of national pride, secures China a measure of technological independence, and reduces burdensome royalty payments by domestic producers of high-tech goods.

These more structured policies seem to be present in other BRICS only in very specific situations. These countries seem to be following some general recipes without linking them to broader policies: fiscal incentives to firms to invest in R&D, setting up of “Centres of Excellence” in research and fostering university/industry links.