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Development Patterns in the BRICS (1970-2016)

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Abstract: This thesis analyses development patterns in the BRICS from a long term perspective by focusing on key issues such as economic specialisation, GDP growth contribution and growth patterns. Moreover, it is also featured a discussion regarding human development indicators. In essence, this approach provides a thorough overview of the process of economic development in the countries analysed. Regarding the results, it should be noted that most of the BRICS are specialised in mid-range technological products while China is the only country that has a comparative advantage in high technology. Also, the model shows that there are certain common features associated to economic development that are shared among the BRICS. Finally, it should be noted that despite the good results in economic terms, it is also true that the BRICS must focus on making development more socially inclusive so as to achieve a successful transformation in the coming decades.

Key Words: BRICS, economic development, comparative advantage

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List of Abbreviations

ADB: Asian Development Bank

BRICS: Brazil, Russia, India, China and South Africa

BRICs: Brazil, Russia, India and China

ECI: Economic Complexity Index

EU: European Union

FDI: Foreign Direct Investment

FE: Fixed Effects

FTA: Free trade area

G7: Canada, France, Germany, Italy, Japan, United Kingdom, and United States

GER: Gross Enrolment Ratio

HDI: Human development index

ICT: Information and Communication Technologies

IMF: International Monetary Fund

ISI: Import substitution industrialisation

OLS: Ordinary Least Squares

RBM: Resource Based Manufactures

RCA: Revealed Comparative Advantage

TNCs: Transnational Corporations

UNCTAD: United Nations Conference on Trade and Development

UNDP: United Nations Development Programme

WB: World Bank

WTO: World Trade Organisation

1. Introduction

The globalisation phenomenon is widely discussed in academia as it is related to several issues that belong to both political and economic spheres. From an economic perspective, one of its most important implications concerns to the processes related to both convergence and divergence between developed and developing countries. In this regard, it cannot be overlooked that emerging economies have grown intensively during the last decades (Radulescu, Panait and Voica, 2014). Among emerging economies, the most relevant have been the BRICs as O'Neill (2001) supported the idea of including them as part of the G7 as their role in the international economy was expected to grow even further. In essence, it can be argued that the creation of the BRICs reflects the aim of establishing a world order that is fairer to emerging economies (Kiely, 2015, pp.15). Also, by 2010 South Africa joined this group and the BRICs became into the BRICS.

A key issue concerning the analysis of BRICS is the debate regarding whether they represent or not a category of study. For instance, it is argued that this group does not represent a valid category since these countries have followed different paths (Jacobs and Van Rossem, 2013). At the same time, this has caused divergence in political institutions and economic structures (Armijo, 2007). In contrast, by considering the framework of world systems theory it can be argued that the BRICS are a category of study since they are semi-peripheral countries. This means that they present either an intermediate level of political power and/or economic development (Chase-Dunn, Kawano and Brewer, 2000). Moreover, it should be noted that the BRICS have implemented some institutional efforts that reinforce them as a group (Shahrokhi, Cheng, Dandapani, Figueiredo, Parhizgari and Shachmurove, 2017). This is exemplified by the creation of organisations that may challenge the primacy of the World Bank (WB) and the International Monetary Fund (IMF) in the coming decades.

Despite the fact that BRICS have grown intensively during the last decades, there is not a consensus regarding their potential in the coming decades (Jacobs and Van Rossem, 2013; Radulescu, Panait and Voica, 2014). In this regard, it is suitable providing a thorough analysis of how these countries have achieved economic development. Regarding economic specialisation, it is important to analyse how globalisation forces influenced manufacturing in the BRICS, considering that exports are important for these countries. Moreover, as argued by Naudé, Szirmai and Haraguchi (2015, pp. 2), the importance of manufacturing is due to its implications on key issues such as technological progress or capital accumulation. One of the recurrent debates in economic history concerns the discussion of whether there exists or not certain patterns associated to economic development (Prados de la Escosura, 2007). Considering the diversity of the BRICS, it is suitable inferring whether these countries have followed some similarities in their respective development paths. With regards

to economic structure, the analysis of sectorial GDP growth contribution allows capturing the evolution of economic sectors overtime. Finally, it cannot be overlooked that economic development has also a qualitative dimension. Therefore, the analysis of key issues such as education or income inequality shows to what extent economic development has been inclusive in the BRICS. This contributes to the debate related to both the extent and sustainability of the transformation that these countries have experienced (Naudé, Szirmai and Haraguchi, 2015, pp. 1). In other words, it is unlikely that the BRICS will continue in the development path if there are strong imbalances in economic and social terms.

The empirical section of this thesis is divided in four major sections. The first part consists on the measurement of economic specialisation of the BRICS in manufacturing by using a revealed comparative advantage (RCA) index as provided in ADB (2002). In essence, this allows how comparative advantage has evolved for manufacturing from a technological point of view. This constitutes a different approach with respect to Havlik, Pindyuk and Stöllinger (2009), since they are based on a different taxonomy regarding the industries considered. Moreover, in this thesis is considered the evolution of South Africa. The index is followed by the estimation of an econometric model which is based on Chenery and Syrquin (1989) and considers some of the refinements provided by Prados de la Escosura (2007). The use of this model allows capturing certain patterns associated to economic development in the countries selected. Also, based on Robjohns (2007) GDP growth contribution is calculated for the primary sector, industry and services. Finally, it is also featured a discussion of some human development indicators which provide a deeper view of economic development in the BRICS.

With regards to the results, the estimation shows that in general, there are certain common trends that are shared across countries that go in line with the findings of Prados de la Escosura (2007). The RCA index shows that most countries are specialised in medium technology goods and resource-based manufactures (RBM). Moreover, China represents an exception since it presents a strong comparative advantage in high technology products. The analysis of the contribution to GDP growth shows that, in general, services has been the main sector, although China has shown a different evolution than the rest of the BRICS. Finally, the information provided by the human development indicators shows that the BRICS need to tackle several issues in order to make economic growth more inclusive and sustainable in the coming decades.

2. Theoretical Framework and Background Literature

One of the major features of globalisation is its strong influence in economic growth, inequality and development. At the same time, it cannot be overlooked that globalisation is also a consequence of a historical process. Therefore, it is important to consider its different phases so as to have a good perspective of how its impact has evolved overtime. Although already in the Middle Ages there were international trade networks operating, there is not significant evidence of price convergence during this period, which may indicate a low level of economic integration (Findlay and O'Rourke, 2003). In this regard, O'Rourke and Williamson (2002) argue that the first globalisation wave started from the 1820s. The main difference with respect to other periods was that the increase in trade was a consequence of a rise in economic integration. One of the main factors explaining this phenomenon was the set of technological innovations in transportation that caused a strong reduction in transportation costs (Findlay and O'Rourke, 2003). The increase in the level of economic integration gave way to the convergence of factor prices, as it happened with land-labour ratios (O'Rourke and Williamson, 2002). At the same time, this was possible due to the impact of international migration by which workers moved from Europe to frontier economies like the United States or Argentina. In essence, considering this set of developments, it can be argued that globalisation represents the transition from national to world markets (Chase-Dunn, Kawano and Brewer, 2000).

In the view of Baldwin and Martin (1999), the second globalisation wave started around the 1960s and is still undergoing. Although this phase presents certain similarities with the former, there are also significant differences. For instance, one of the major differences is the emergence of international organisations in both political and economic spheres. As a result, both creation and compliance of international agreements have represented a reinforcement of the globalisation process in a way that the degree of economic integration is significantly higher (Baldwin and Martin, 1999). This has caused, among other things, an increase in the need of international cooperation between countries in terms both political and economic governance. Another major difference between the two waves is based on the relative influence of trade in goods vs. trade in ideas. This has been possible due to the emergence of the information and communication technology (ICT) and their strong cost reduction in a short period. In the view of Kander, Malanima and Warde (2013, pp. 318), the ICT development block represents the beginning of the third industrial revolution. As a result, the generalisation of this technology has allowed the rise of short-term capital flows or the change in the nature of foreign direct investment (FDI) (Baldwin and Martin, 1999). Moreover, it can be argued that ICT has not only influenced the globalisation process but it has also deepened its impact at a global scale.

By considering the evolution of what they define as structural globalisation, Chase-Dunn, Kawano and Brewer (2000) argue that globalisation has undergone into three major periods. In their view, the main difference with respect to Baldwin and Martin (1999) is that by the 1990s, the world reached an unprecedented globalisation level. This is primarily explained by the increasing degree of openness that developing countries adopted due to the influence of international institutions. Therefore, the third wave represents the consolidation of free trade at a global scale. This contrast to other periods in which developing countries were hostile to free trade, as they underwent into a de-industrialisation phase during the first globalisation wave (Bairoch and Kozul-Wright (1996); Baldwin and Martin (1999)). The primacy of free trade is exemplified by the creation of the World Trade Organisation (WTO) in the early 1990s.This has represented a step forward towards harmonisation between countries in relation to the compliance of rules related to international trade.

When analysing globalisation, attention should be focused on its impact on global inequality. For instance, it should be noted that at the eve of industrialisation, there were not significant differences between countries in terms of income (Baldwin and Martin, 1999). In contrast, in the second wave, there were strong differences between developed and developing countries. At the same time, it can be argued that this period has featured the convergence phenomenon. This has been exemplified by the East Asian miracle by which the new industrialised countries (NICs) underwent into a process of catching-up with developed economies. When explaining this process, it is worth considering its mechanisms and whether there exists an advantage associated to economic backwardness. For instance, Gerschenkron (1962) provides an analysis of the features that industrialisation latecomers presented in the nineteenth and early twentieth century. One of the major points that can be derived is that the relative degree of economic backwardness has a strong influence behind the industrialisation potential across countries (Gerschenkron, 1962, pp. 8). In this regard, it also should be noted that latecomers to industrialisation usually create substitutes to the institutional elements that initially triggered industrialisation (Prados de la Escosura, 2007). At the same time, it can be argued that, in certain instances, there is an advantage associated to economic backwardness. This advantage is primarily based on the ability of benefitting from the implementation of policies and the use of technologies that have been successful abroad in a relatively short period. For instance, both Germany and the United States illustrated this transformation as they overtook Great Britain in the late nineteenth century (Broadberry, 1998).

As mentioned before, one of the most remarkable cases of catching-up is represented by the NICs in East Asia. Although the experience of these countries is diverse, it can be argued that technology transfer and the consolidation of an export-based model were essential for economic development (ADB, 2002; Krugman, 1994). Moreover, it should be noted that at an early stage, innovation was not a key component in the development path of these countries, as this process was primarily triggered by an increase in the productive capacity (Krugman, 1994). Therefore, as argued by Dowrick and Gemmell (1991), if certain conditions are met, backward countries may benefit from technological spillovers from developed countries. In fact, in the view of Baldwin and Martin (1999), the second globalisation phase showed a de-industrialisation process in developed economies. Therefore, NICs were able to exploit their comparative advantages in a changing scenario.

In the view of Bairoch and Kozul-Wright (1996), the main elements behind the deepening of the globalisation process have been open markets, transnational corporations (TNCs) and ICT. As a result, some emerging economies have experienced sustained economic growth during the last decades. For instance, it should be noted that the share of developing economies in world output doubled from 1970 to 2010 (Nayyar, 2015). This has also lead to an increase in the academic interest for the analysis of BRICS. One of the major reasons explaining this is based on the potential that these countries have of becoming into a relevant economic pole in the coming decades. As argued by Radulescu, Panait and Voica (2014), the BRICS have grown faster than developed economies since the beginning of the twenty-first century. Therefore, if this trend is not reversed, it is likely that in the coming decades these countries will experience economic convergence with developed countries. This is particularly important considering both their demographic and economic dimension, as they represented 43% of world population and 18% of world income in 2010 (Nayyar, 2015). At the same time, the BRICS have also attracted an increasing share of FDI during the last decades (Jadhav, 2012).

In relation to economic development, Kuznets (1959, pp. 164) argues that national factors are a primary cause behind the differences in terms of the outcome associated to this phenomenon. This is exemplified by the fact that countries present diversity in terms of economic structure or institutions. At the same time, countries also face heterogeneity regarding the obstacles to economic development. Therefore, this illustrates the necessity of implementing different policies that are suited to different contexts (Kuznets, 1973). In relation to the BRICS, this constitutes a key issue since when analysing this group, there is not a consensus regarding whether this group represents an identifiable category. In this regard, Jacobs and Van Rossem (2013) argue that it is not valid considering BRICS as a separate category of study, as this group of countries differ significantly in their paths. For instance, even if we consider that Russia and China were centrally planned economies, the way economic reform was implemented differed significantly. This made these

countries follow different paths that have featured a dissimilar outcome in economic terms (Kotz, 1999; Lo, 2006). At the same time, the BRICS also present a high diversity in relation to key factors such as political institutions and economic structures (Armijo, 2007). Therefore, if the analysis is restricted to these factors, it can be argued that this group of countries does not represent a specific category of study.

Considering the framework provided by world systems theory, it can be argued that the BRICS represent a category of study, as this group of countries belongs to the semi periphery. In the view of Chase-Dunn, Kawano and Brewer (2000), semi peripheral countries present either an intermediate level of political power and/or economic development. This is further explained by Armijo (2007), who argues that BRICs can be considered as a category if this group of countries have a strong influence behind international political economy. In this regard, it should be noted the set of institutional efforts that the BRICS are carrying out, which represent a step forward towards their consolidation as a group (Shahrokhi, Cheng, Dandapani, Figueiredo, Parhizgari and Shachmurove, 2017). By considering the implications of path-dependence, it can be argued that if these new organisations become successful, the existing ties within the BRICS may get reinforced. Moreover, as mentioned before, the economic dimension of these countries makes them influential in the international arena and their relevance may increase in the coming decades.

Besides being a driver of increasing economic integration, international agreements such as economic unions or free trade areas (FTAs) also have an influence on the political sphere. In this regard, Nayyar (2015) argues that BRICS have the potential of representing the voice of developing countries in a scenario of multilateralism. This can trigger the modification of both rules and functioning of international organisations in a way that regulatory convergence becomes more suitable for developing countries. From an economic perspective, it should be noted that the BRICS present a similar level of economic development, as it is shown by their GDP per capita levels (WB)[1]. Moreover, as argued by Baldwin and Martin (1999), in the present scenario, trade flows are stronger between nations with similar factor endowments, while intra-industry trade accounts for the majority of the world trade. Therefore, if the BRICS increase their trade linkages they can benefit from the deepening of the globalisation process.

[1] India represents an exception as it presents a lower level of GDP per capita than the other countries.

In relation to the analysis of economic development across countries, there has been a historical debate related to the idea whether countries follow or not some patterns associated to this process. In this regard, the existence of common patterns allows not only understanding which features are shared by countries, but also, it allows obtaining findings which are important for policy-making. Also, it should be noted that the theoretical discussion related to the existence of an ideal path of development has been a recurrent issue of debate since the beginning of economics science (Prados de la Escosura, 2007). In this regard, Chenery (1960) represents one of the first efforts that provide an answer to this debate from an empirical approach. In essence, this paper features an econometric model that measures the impact of factors associated to economic development. Chenery and Syrquin (1989) provide an extension of the original model by including more countries and other issues in the analysis as well as a longer time frame. By focusing in European countries, Prados de la Escosura (2007) uses a long term perspective as it covers both the nineteenth and twentieth century. Despite the heterogeneity that European countries have historically presented, it can be argued that there are some similarities in terms of institutions, policies and resource endowments (Prados de la Escosura, 2007). In essence, the results show that the rise in income per capita represented the following of a similar pattern across European nations. However, there were also differences in terms of path between early industrialised countries and latecomers. In this regard, the results coincide with Gerschenkron (1962) who emphasises the differences associated to industrialisation and timing.

One of the major transformations derived from economic development is the set of changes that take place in the economic structure of countries. Moreover, the relevance of this issue has grown especially due to the deepening of the globalisation process during the last decades. In the literature is frequently emphasised that, as economic integration increases across countries, this also affects economic specialisation of countries. For instance, one of the main tenets of the Ricardian model is the idea of comparative advantage which determines how countries specialise in producing some goods in contrast to others (Krugman, Obstfeld and Melitz, 2012, pp. 26). By following this concept, Balassa (1965) provides an index that measures revealed comparative advantage. In essence, this allows understanding the impact derived from trade liberalisation in comparative advantage across countries. This has strong policy implications as it provides information regarding which countries benefit or lose from international trade agreements. Balassa and Noland (1989) represents a refinement of the previous index as it provides a calculation procedure that focus on simplicity. This modification is based on the idea that the exports of a country are compared respect to its total exports and world total exports[2]. In this regard, Hausmann et al. (2013) argue that a country presents

[2] The technical issues related to the calculation of this index are explained in the methodology section.

RCA in a product if it exports more, in relative terms, than the share of total world trade that this good represents.

The RCA index has been used in the literature in order to analyse countries' productive structures. For instance, in ADB (2002) economic specialisation of East Asian countries is analysed by using the RCA index from Balassa and Noland (1989). The results show that this group of countries featured a strong comparative advantage in both low and high technology exports prior to the 1997 financial crisis. The main advantage of using this indicator is that it allows measuring the export structure of countries and its relative specialisation with respect to the world from a technological perspective. Therefore, it provides a good overview of how countries evolve in terms of comparative advantage in a scenario of increasing economic integration. Similarly, Havlik, Pindyuk and Stöllinger (2009) compared the performance in goods and services between the BRICs and the European Union (EU) by using the RCA index. In essence, the results show that the BRICs have been successful in diversifying their exports although they present some heterogeneity in their productive structures. This is primarily based on the fact that China is the only country that has achieved an export profile that represents a threat to the competitiveness of industries of developed regions like the EU.

3. Methodology

This section covers a description of the technical issues concerning the RCA index, the model selected and the GDP growth contribution measurement.

Formula 1: RCA Index

$$RCA_i^k = \frac{E_i^k / E_i^t}{E_w^k / E_w^t}$$

Formula 1 shows the structure of the RCA index which is based on Balassa and Noland (1989). Similarly as in ADB (2002), it has been decided to group the data into technological groups. The main advantage of using this indicator is that it allows measuring the comparative advantage of countries' exports, and hence, economic specialisation. The decision of using export data is based on the fact that, as shown in the appendix, exports have represented an important share of GDP. The structure of the index is the following, *E* represents exports, *k* denotes the technology level of country *i* while *t* represents total exports. Therefore, the numerator expresses the technology level of exports of a country in comparison to its total exports. In the denominator it appears *w* which represents the world aggregate; *k* also represents the technology level and *t* the sum of total exports. Due to the existence of several technological categories, the RCA index is calculated by following two classifications. The first classification follows Eurostat guidelines, and specifically, the NACE Rev. 2. The reason motivating this choice is explained in detail in the next section. In essence, by considering different technological categories it is possible inferring how the countries selected have evolved in terms of productive specialisation during the period analysed. In this regard, it has been decided to use several benchmarks which correspond to a 5-year period; this allows presenting the results in a clearer way.

One of the major issues related to the use of indices concerns their limitations. In other words, the relative structure of indices may be useful for measuring some factors but inefficient for others. In the case of the Balassa index, Gnidchenko and Salnikov (2015) argue that this index has a tendency to provide biased results when the number of products analysed is low. At the same time, it provides inaccurate results for heterogeneous countries in terms of both development level and trade openness. However, as it is shown in the data section, there is a high degree of homogeneity in the products exported by the countries that are analysed. Moreover, the BRICS present a similar level of

economic development as well as trade openness[3]. Therefore, considering this information, it can be argued that this index is suitable for analysing the evolution of economic specialisation overtime. Finally, with regards to the interpretation of the RCA index, a value above unity indicates that a country has comparative advantage in a category (Gnidchenko and Salnikov, 2015; Yeats, 1985).

Equation 1: Structure of the Model

$$U_{it}^{'} = \{c, LnIncome_{it}, (LnIncome_{it})^2, LnPopulation_{it}, (LnPopulation_{it})^2, Net\ exports_{it}, TREND_t\}$$

Besides measuring economic specialisation, this thesis also features the estimation of a model which is based on both Chenery and Syrquin (1989) and Prados de la Escosura (2007). The use of this model allows capturing certain regularities or patterns that are associated to economic development. Equation 1 shows the basic structure of the model. The dependent variables are represented by the term $U_{it}^{'}$ which belongs to four major categories which are external trade, labour allocation, demand structure and output structure. Table 1 shows the detailed information related to the dependent variables that belong to the categories included. It should be noted that in the original model there is also an estimation that covers variables related to education and demographic indicators. However, as in this thesis the period of analysis is different, it has been decided to discuss some indicators related to human development. In essence, this provides a deeper view of how economic development has transformed the BRICS from a qualitative perspective.

With regards to the explanatory variables, $LnIncome_{it}$ is the logarithm of GDP per capita of country *i* at time *t*, the second variable is the same but expressed in squared terms. Income per capita is used since it is an indicator of economic development as well as it measures output (Prados de la Escosura, 2007). $LnPopulation_{it}$ represents the logarithm of population of country *i* at time *t* while $(LnPopulation_{it})^2$ is the square of previous variable. In this case, population represents a proxy of market size; moreover, it also reflects the effects derived from economies of scale. At the same time, it is expected that the effects of both income and population are independent from each other since these two variables do not necessarily have to be correlated (Prados de la Escosura, 2007). Also, the inclusion of *Net exports* allows understanding how trade has affected the dependent variables[4]. Finally, the variable $TREND_t$ is a time trend dummy that reflects the transformations associated to time evolution which has a uniform effect among the countries selected.

[3] By measuring the sum of both imports and exports as percentage of GDP, it can be argued that the BRICS present a similar degree of openness.

[4] In contrast to Prados de la Escosura (2007), it has been decided to use *Net Exports* rather than *Net Imports*.

Table 1: List of Dependent Variables

External Trade	Exports/GDP
	Imports/GDP
	Openness
	Industrial Exports/GDP
	Primary Exports/GDP
Labour Allocation	Labour Force in Agriculture/Total Labour Force
	Labour Force in Industry/Total Labour Force
	Labour Force in Services/Total Labour Force
Demand Structure	Consumption/GDP
	Investment/GDP
	Public Expenditure/GDP
Output Structure	Agricultural Value Added/Total Value Added
	Industrial Value Added/Total Value Added
	Services Value Added/Total Value Added

Although the model used in this thesis is based on both Chenery and Syrquin (1989) and Prados de la Escosura (2007), there are some differences that are worth explaining. First, considering that the estimation deals with panel data, it is more suitable using fixed effects (FE) rather than ordinary least squares (OLS)[5]. Moreover, since in our model captures the time evolution of variables, it is possible that the use of OLS may cause serial correlation. As argued by Wooldridge (2012, pp. 414), serial correlation may cause some bias in the OLS variance estimator that invalidates the use of the t-statistics for assessing the significance of coefficients. Therefore, it can be argued that, given these circumstances, FE estimation provides a more accurate estimation than OLS. Moreover, it should be noted that since there is a country that does not contain the same number of observation as the others, this causes our data to have an unbalanced structure. However, Wooldridge (2002, pp. 578) argues that this is not an issue as long as the unit of analysis do not drop out from the sample, as it may happen when conducting a survey. Another difference with the original model is that the variable *LnSize* is dropped because of multicollinearity issues. However, it should be noted that this variable is not the most relevant for the analysis and that variable *Country* is performing a similar function as *LnSize* in the model used by Prados de la Escosura (2007).

[5] The panel variable selected for the estimation is *Country*.

Table 2: List of Dummy Variables

D1	Value 1 from 1970 to 1985, 0 otherwise
D2	Value 1 from 1986 to 2000, 0 otherwise
D3	Value 1 from 2001 to 2015, 0 otherwise

In a similar way as in both Chenery and Syrquin (1989) and Prados de la Escosura (2007), there is an alternative estimation that includes time dummy variables. The use of dummies is based on the idea that the relative effect of both population and income variables changes during the period analysed. As a result, in the new estimation both *LnY* and *LnN* are interacted with dummies in order to find structural breaks. Table 2 shows the variables which belong to different sub-periods of the period analysed. The first dummy corresponds to an era in which the majority of the countries analysed were evolving from inward looking policies to start implementing economic reforms. During the second phase, the BRICS were starting to consolidate their stance towards globalisation, and also, Russia emerged as one of the countries after the collapse of the Soviet Union. During the last sub-period the BRICS have experienced an intense phase of economic growth. Moreover, they have also become into a category of analysis and they have carried out important institutional arrangements.

Equation 2: GDP Growth Contribution Formula

$$\left(\sum w_{i,t-1}\,\frac{q_{i,t}}{q_{i,t-1}}-1\right)*100=\left(\sum w_{i,t-1}\,\frac{q_{i,t}}{q_{i,t-1}}-\sum w_{i,t-1}\right)*100\;as\sum w_{i,t-1}=1,$$

$$\text{Hence } C_{it}=w_{i,t-1}\left(\frac{q_{i,t}}{q_{i,t-1}}-1\right)*100$$

The concept of structural change is associated to economic development as it reflects the evolution of economic sectors in the structure of countries overtime. In essence, structural change reflects the transition from traditional sectors that feature low productivity to modern sectors with high productivity (Naudé, Szirmai and Haraguchi, 2015, pp. 1). In this regard, it has been decided to measure the sectorial contribution to GDP growth by using the annually chain-linking procedure of Robjohns (2007). In essence, this allows identifying how economic sectors (primary, industry and services) contribute to the growth of GDP on an annual basis. The chain-linking approach consists on updating the sectorial weights on a yearly basis which provides a more accurate analysis of the changes that take place in the economic structure (Robjohns, 2007). The formula is derived by taking the steps provided in equation 2, *wi,t-1* represents the weight of the sector *i* at time *t-1* which is obtained by dividing the contribution of this industry over total value added in current prices. The

second part of the equation represents the division of the contribution of industry *i* at time *t* over the same at *t-1* expressed in constant prices. Finally, with regards to the interpretation of the data, it should be noted that a negative sign indicates that a sector has a negative impact on total growth. Conversely, the sector with a higher value represents the main contributor to growth.

4. Data

This section provides a discussion of the main issues related to the collection and use of data in the empirical section.

With regards to the RCA index, it has been decided to choose two different classifications which are the Eurostat NACE Rev. 2 and the Lall (2000) classification. In both cases, the data has been retrieved from the United Nations Conference on Trade and Development (UNCTAD) database. Moreover, the data used for the index consists of exports of products in thousands of dollars. However, while in the first case it has been necessary to select and aggregate different groups, in the second case the database provides information in a more aggregated way as illustrated in the appendix section. The main reason explaining the selection of these two classifications is based on the fact that both provide categories that are important for the analysis of economic structures. Therefore, the elaboration of the RCA index is divided in two steps. The first part uses Eurostat classification as the guideline for the analysis of data. Also, this classification features four categories which are high technology, medium-high technology, medium-low technology and low technology. As the UNCTAD database presents a high number of product sub-categories, these have been grouped into the four technological groups previously mentioned[6].

The second part of the RCA index uses the Lall (2000) classification which includes three technology categories (high technology, medium technology and low technology) and RBM. Although these technology groups are divided in sub-categories, the level of disaggregation is not as high as in the previous case. There is one difference with the previous case which is the inclusion of the RBM category that is formed by agro-based, forest-based and mineral-based products. Therefore, the analysis of this category allows understanding the relevance of the activities based on the transformation of primary goods in the BRICS. At the same time, this may also indicate the relative dependency on natural resources. Due to data availability, the analysis of the RCA index is restricted from 1995 to 2016, although it is also the period in which these countries underwent into the strongest transformation. Finally, it should be noted that since the data used for the index is exports, it is possible that, for certain goods, it is not considered that some productive phases take place in

[6] The information related to the categories retrieved from UNCTAD and its classification for the RCA index is provided in the Appendix section.

more than one country. In this regard, Lall (2000) argues that this issue can only be solved by using data of products at a high disaggregation level or by considering small country samples. Nevertheless, it should be noted that the use of this type of data goes beyond the scope of this thesis.

With regards to the econometric model, the majority of the dependent variables have been created by using data that belongs to the UNCTAD database. In the case of labour allocation and agricultural value added, the data concerning employment shares has been retrieved from the WB database. This source has also been used for retrieving information related to human development indicators. Since more than one database has been used for creating the variables for the estimation, this has created some heterogeneity regarding the time frame. This means that for most dependent variables, the period analysed is 1970-2015. However, for both primary and secondary exports is 1995-2015 and, in the case of labour allocation, the period analysed is 1991-2015. Finally, it should be noted that due to political reasons, there is only available data for the Russian Federation from 1992 onwards. As mentioned before, the measurement of GDP growth contribution is based on Robjohns (2007). Again, the data has been retrieved from UNCTAD database, which is GDP in both constant 2005 prices and current prices. Similarly to the previous case, it should be noted that as the Russian Federation was not created until 1992, the number of observations is lower than in the other countries. Nevertheless, considering that the last observation is 2015, there is still enough information to have a good overview of the sectorial GDP growth contribution in this country.

5. Main Results and Discussion

The following section covers a discussion of the results provided by the RCA index, the estimation of the econometric model and the GDP growth contribution. Moreover, this is followed by the analysis of some human development indicators in the countries selected. In order to have a deep understanding of the results, it is suitable to cover some issues related to both historical and economic paths of the BRICS.

5.1 Historical Overview

Brazil has undergone into some political transformations during the last four decades, as this country was under a military dictatorship until the mid-1980s. From that point onwards, Brazil has featured a multi-party system which presents similarities to the Western model. In terms of economic policy, this country implemented during several decades a strategy based on import substitution industrialisation (ISI) which was abandoned after the 1982 debt crisis (Vernengo, 2007, pp. 42). This was followed by several stabilisation programs that aimed to tackle macroeconomic imbalances (Amadeo and Neri, 1999, pp. 223). However, the persistence of high inflation led to the implementation of *Plan Real* which was based on economic liberalisation by following a shock therapy approach (Vernengo, 2007, pp. 45). The implementation of reform led to the control of inflation as well as the growth in both domestic investment and productivity (Vernengo, 2007, pp. 60). However, it is also true that the growth performance of Brazil was not as good as during the ISI period. With the turn of the new millennium the situation slightly improved and Brazil became into one of the leading emerging economies. Nevertheless, despite economic growth has contributed to a decline in income inequality, the levels have been traditionally high (Gasparini and Lustig, 2011)[7].

The Russian Federation is one of the nation-states that emerged after the collapse of the Soviet Union in the early 1990s. As argued by Kotz (1999), the reform strategy that was implemented in this country emphasised the role of private actors as the main drivers of the process. One of the major consequences derived from this is that the Russian economy faced a period of economic instability which lasted until the end of the 1990s (Chansomphou and Ichihashi, 2001). This instability was due, among other things, to the elimination of the institutions of the centralised system before the emergence of a sound market system (Kotz, 1999). With the turn of the new century, the economic situation began to stabilise and during the last decade, the Russian economy experienced a phase of

[7] According to the WB, the Gini coefficient for Brazil in 2015 was of 51.3 which represented a high level of income inequality.

economic expansion[8]. One of the particular differences of the Russian experience with respect to the other BRICS is that, since the mid-1990s, an important share of manufacturing employment has moved to the primary sector (de Vries, Erumban, Timmer, Voskoboynikov and Wu, 2012). This has important implications in terms of economic specialisation and can be a consequence of resource dependency in this country.

India differs with respect to other countries insofar as it is the only country that has featured the same political regime since it became into an independent nation-state. Although India has never featured a centrally planned economy, its government followed an interventionist stance towards economic issues during several decades. This was exemplified by the existence of a license system or the implementation of protectionist policies (Mohan-Rao and Krishna-Dutt, 2007, pp. 141). This trend started to change around the mid-1980s when the Indian government implemented reforms oriented to liberalise the economy (Soo, 2008). In essence, the aim was not only to liberalise the economy, but also, to increase the participation in global markets (Mohan-Rao and Krishna-Dutt, 2007, pp. 139). When comparing the politico-economic regimes of India, one of the major differences can be found in terms of economic performance. According to the results of Aggarwal and Kumar (2015, pp. 205), India has shown the fastest growth rates after the reform, while the opposite occurred during the interventionist period. Nevertheless, despite the good results in macroeconomic terms, India features a high level of precariousness in employment which constitutes an obstacle for both economic development and poverty reduction. This is partly due to the inability to accomplish structural change in employment due to capital and skill constraints (Aggarwal and Kumar, 2015, pp. 218).

The case of China is somewhat similar to Russia insofar as this country also featured a centrally planned economy during several decades. However, it also differs since in China, economic reform started to be implemented earlier and by following a gradual approach (Kotz, 1999). As a result, the impact derived from economic reform in China was less destructive than in Russia (Lo, 2006). Moreover, in the view of Kotz (1999), the economic performance of China after the transition has been significantly better than in Russia. In this regard, one of the particular features of this country is that, despite economic reform has led to a decentralisation of the economy, the role of the state is still very important and this has allowed China to profit from a mixed system. This is exemplified by its ability to develop an export oriented model with high value added products, especially considering its income level (Rodrik, 2006). Despite the unprecedented performance of the Chinese economy, this country is currently facing several challenges that are necessary to tackle. In the view

[8] From 2000 to 2010 the annual growth rates of the Russian economy have been above 4% with the exception of 2009 (WB).

of Dollar (2013), China needs to re-orient its development strategy from an export-based model to increase the size of its internal market in order to continue its development path.

Similarly to other countries, South Africa featured an inward-looking stance to economic development during several decades of the twentieth century. This started to change with the demise of Apartheid which put into an end the international blockade, as exemplified by the accession into the WTO in 1995 (Kaplan, 2015, pp. 245). At the same time, this also represented a change of paradigm for the manufacturing sector which had to adapt to international competition. As a result of the increasing participation in international markets, the performance of the South African manufacturing has been mixed as there are significant differences in productivity across sectors. This is exemplified by the fact that the most dynamic sectors usually employ unskilled labour more intensively (Kaplan, 2015, pp. 261). Moreover, this country features a capital intensive manufacturing sector which does not absorb unskilled labour. As a result, this has strong implications for both poverty reduction and income inequality which may hinder further economic development in this country.

5.2 The State of Manufacturing in the BRICS prior to 1995

As mentioned before, due to the availability of data, it is only possible to analyse economic specialisation with the RCA index from 1995 onwards. Therefore, it is suitable to discuss some features of the manufacturing sector in the BRICS prior to 1995.

In the case of the Russian Federation, the manufacturing sector was facing an adverse situation due to the influence of the transition from a command to a liberalised economy. Therefore, as argued by Kuznetsov, Gimpelson and Yakovlev (2015, pp. 144), the existence of strong macroeconomic imbalances impeded industrial restructuring. With regards to economic structure, it can be argued that the legacy of the Soviet period was very strong, which featured, among other things, an overemphasis in the military sector. As mentioned before, China has gone through a different path when compared to Russia since economic reform was implemented in a different way. As argued by Lin and Yu (2015, pp. 98), the reform represented the shift from emphasising the growth of heavy industry to focus on developing the activities that exploited its comparative advantage. In other words, as China was ill-endowed in capital, it changed to labour intensive industries which experienced growth during the 1980s. In terms of industrial upgrading, one of the key elements of this process has been the development of processing trades, which import raw materials or intermediate inputs that are further transformed. As a result, this has caused a technology transfer which has allowed China to undergo into technological leapfrogging while it has also started to innovate in some areas (Naudé, Szirmai and Lavopa, 2015, pp. 327).

Regarding Brazil, India and South Africa, it should be noted that the idea of following a rapid industrialisation strategy for development purposes stopped being a priority for policy makers during the last decades (Haraguchi and Rezonja, 2015, pp. 29). As mentioned before, Brazil had a fast growing performance during the twentieth century as a result of the implementation of ISI-based policies. During this period the main manufacturing activities, in terms of productivity, were textiles, chemicals, electrical materials, metal products and transport equipment (Aldrighi and Perim-Colistete, 2015, pp. 179). At the same time, it should be noted that the international competitiveness of Brazilian industry was primarily affected by volatility of the exchange rates rather than by labour costs (Aldrighi and Perim-Colistete, 2015, pp. 181). In the case of India, until the mid-1990s both medium low and medium high technologies were the most dynamic in terms of labour productivity growth (Aggarwal and Kumar, 2015, pp. 226). However, it should be noted that the low tech sector has traditionally been the biggest employer in this country and as a result, this has been one of the obstacles for structural transformation in India. Finally, as argued by Fedderke (2002), South Africa featured a strong degree of heterogeneity in its manufacturing sector in terms of technological progress during the 1970s and 1980s. At the same time, this also influenced labour productivity which, prior to the 1990s, was the highest in leather products and footwear and electrical machinery and equipment (van Dijk, 2002)[9].

5.3 RCA Index

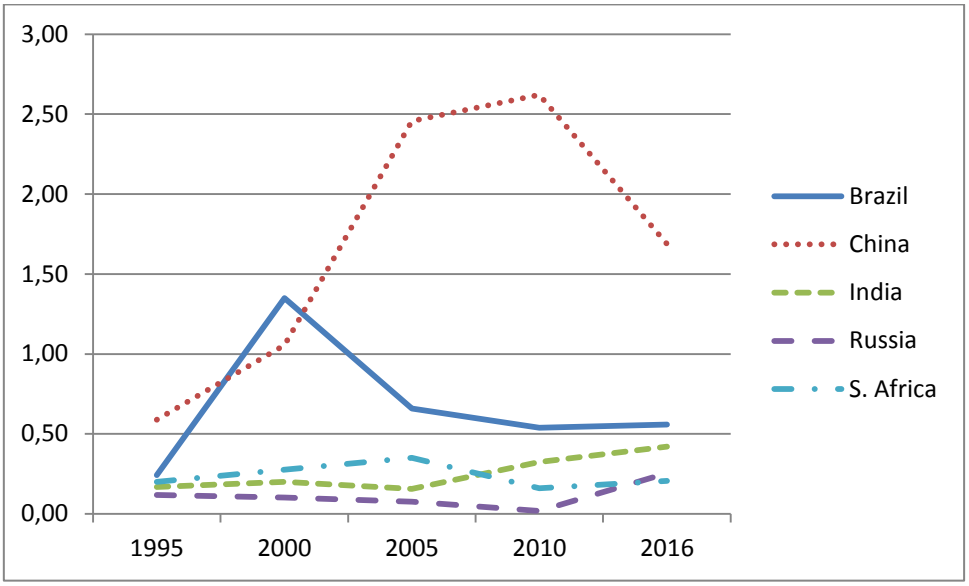
As mentioned before, the RCA index has been obtained by following two classifications which are Eurostat and Lall. The selection of more than one classification is based on the idea of providing a more thorough analysis of economic specialisation in the countries selected.

5.3.1 Eurostat Classification

The first part of the RCA index follows Eurostat classification, for the sake of clarity it has been decided to group graphs according to technology level. Also, as the information retrieved presents a high degree of disaggregation, it is possible to identify which product has a bigger impact in terms of exports for every technological group. Moreover, this has been done by taking the average of product exports during the period considered.

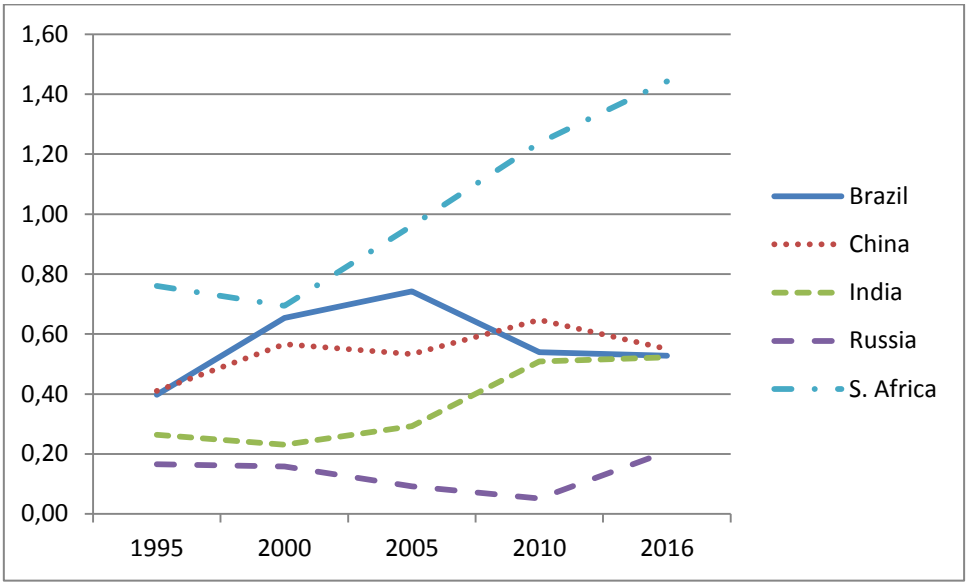
[9] In this case labour productivity is considered as a percentage of productivity in the USA.

Graph 1: RCA Index of High Technology



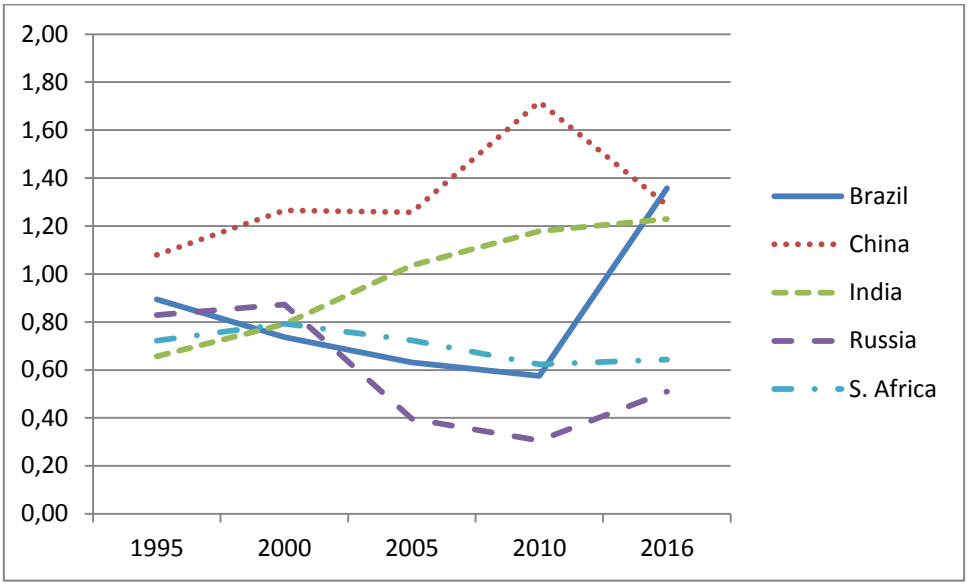
In China, high technology manufactures have experienced a strong increase from 1995 to 2010, although it is also true that they also declined afterwards. This can be explained by the fact that, as argued by Havlik, Pyndiuk and Stöllinger (2009), China is an important hub for the productive processes of TNCs. As a result, these activities are more sensitive to the evolution of the international economy. Also, the high technology products with the highest relevance in Chinese exports are automatic data processing machines. In Brazil, although they increased at the beginning and had values above unity, high-technology manufactures experienced a strong reduction afterwards. In this case, the most relevant product is aircraft and associated equipment. In India, although there has been a positive evolution, the value is still low when compared to other countries like China. Similarly to Brazil, the majority of high technology exports for India is aircraft and associated equipment. Russia, alongside South Africa, is one of the countries with the worst performance in high technology. Also, the majority of Russia's exports are concentrated in aircraft and associated equipment, which can be influenced by the relevance of the military sector. Finally, South Africa is stagnant in this technological range as there are no significant differences between the values of 1995 and 2016. Moreover, in a similar way to Brazil, India and Russia, the most important product is aircraft and associated equipment.

Graph 2: RCA Index of Medium High Technology



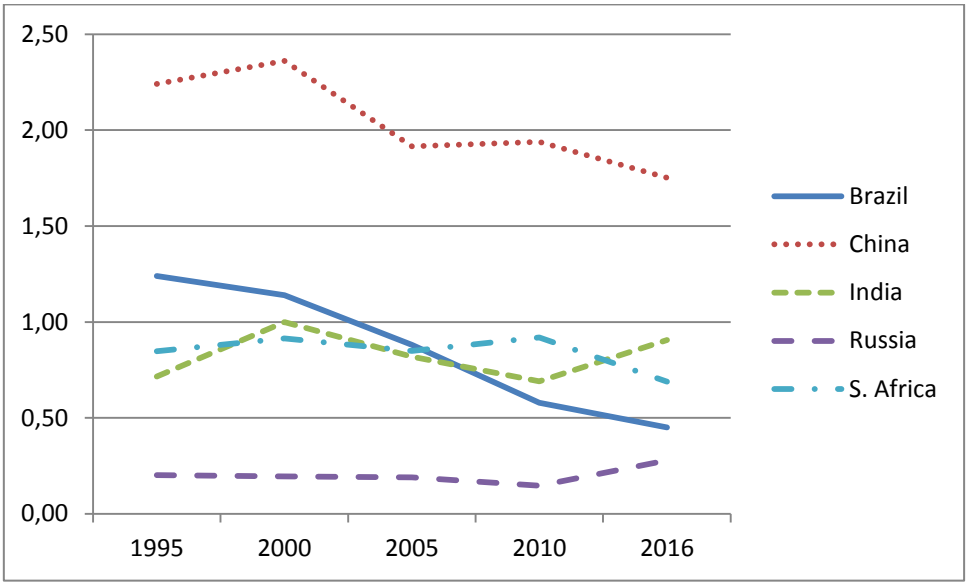
In the case of medium high technology, graph 2 shows that South Africa is the leader, as it is the only country that presents values above unity. Among the exports belonging to the medium-high range, the most relevant are motor vehicles for both the transport of goods and persons. In the case of Brazil, the values have remained relatively stable since there have been both weak increases as well as decreases. The medium high technology product which Brazil exports the most is vehicles for the transports of persons. It can be argued that this product has been traditionally important in this country since it was also relevant during the ISI period (Aldrighi and Perim-Colistete, 2015, pp. 179). The evolution of China has been positive but the growth of the index values has not been strong enough. In relation to this technological group, most exports correspond to electrical machinery and apparatus. Although India has experienced an increase during the period observed, it is also true that it shows similar values than China or Brazil. In this case the most exported product is motor vehicles for the transport of persons. Russia has not shown any significant improvement during the period observed, also, the most relevant product is motor vehicles for the transport of persons and goods.

Graph 3: RCA Index of Medium Low Technology



Regarding medium low technology goods, both China and India have shown comparative advantage during most of the period considered. China shows the highest values of the BRICS while its most relevant export category is ships, boats and floating structures and manufactures of base metal. In the case of India, the RCA index has been increasing overtime until showing similar values than China in 2016. Another similarity that this country presents with China is that its major export is also ships, boats and floating structures and manufactures of base metal. The evolution of Brazil is somewhat striking as it shows a declining trend until the last benchmark in which it shows a value close to 1.4. At the same time, the most relevant export for this country is the same as for both China and India. In the case of both Russia and South Africa, the RCA index has been declining overtime, although this has occurred in a stronger way in the former. Moreover, although in Russia the most relevant export is the same as in the previous countries, in contrast, in South Africa are structures and parts of metal.

Graph 4: RCA Index of Low Technology

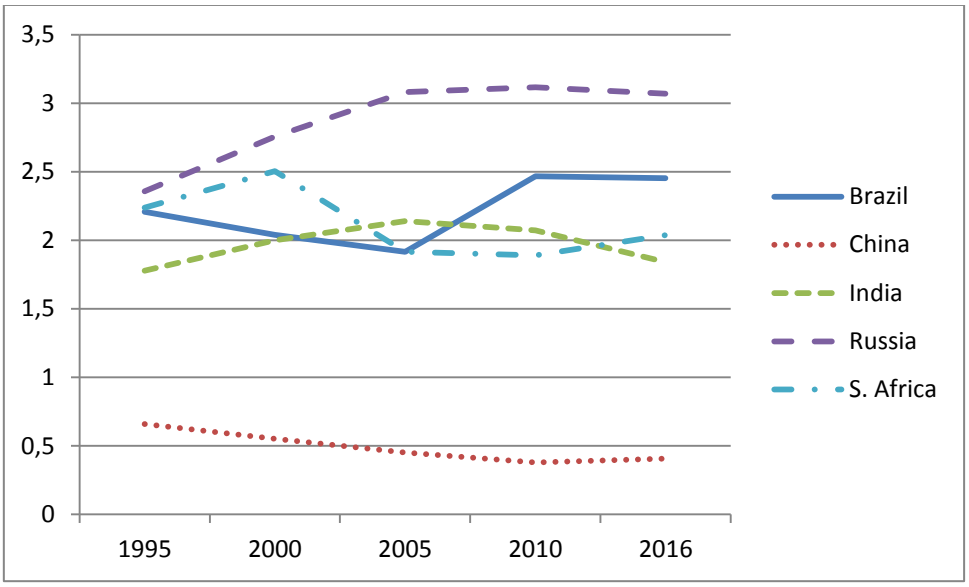


The general trend of BRICS regarding low technology products has been of a decline in terms of comparative advantage. Nevertheless in the case of China, it is also true that by 2016 the RCA index was above 1.5. The most relevant exports in this case are products of apparel, footwear and furniture and parts. Although Brazil presented a comparative advantage in the first benchmark, this trend was reversed with the turn of the new century. In this case, the main exports are footwear and paper and paperboard. In India there has been a slight increase in terms of comparative advantage in which the values are close to unity in both 2000 and 2016. Similarly to China, the most relevant export in India is articles of apparel. South Africa has experienced a slight decline in terms of comparative advantage in this technological branch. Moreover, the product that shows the best performance in terms of exports is alcoholic beverages, which may due to the relevance of the wine sector. Finally, as it happens in other categories, Russia shows the worst performance in terms of comparative advantage. Also, paper and paperboard is the most relevant product among those that belong to the low technology tier in this country.

5.3.2 Lall Classification

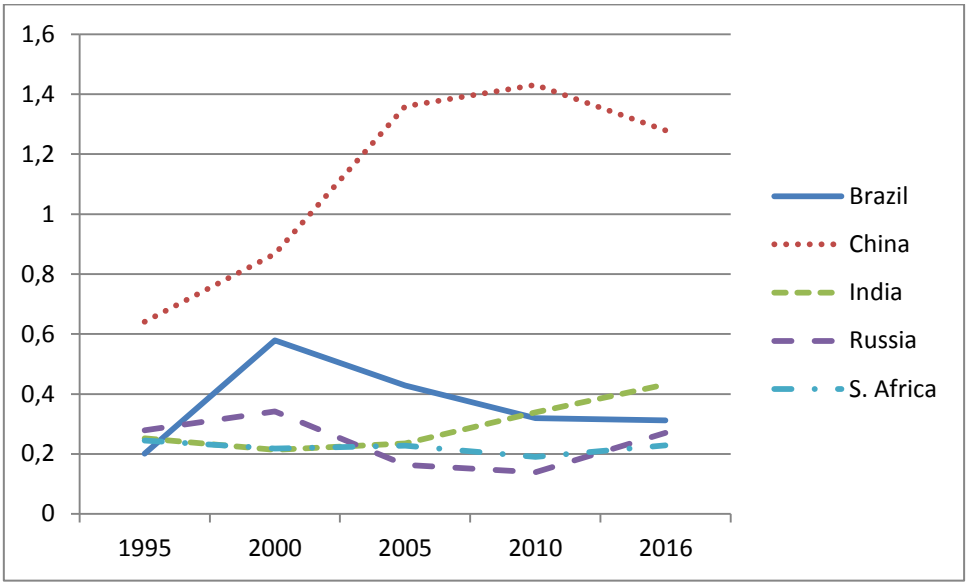
As mentioned before, the Lall (2000) classification differs with Eurostat classification since it provides information at a less disaggregated level and because it provides another category which is RBM. This new category comprises of agro/forest-based goods and minerals-based products. Moreover, it should be noted that since the data is provided by major sub-categories, it has not been possible to infer which the most relevant export is by technological category.

Graph 5: RCA Index of RBM



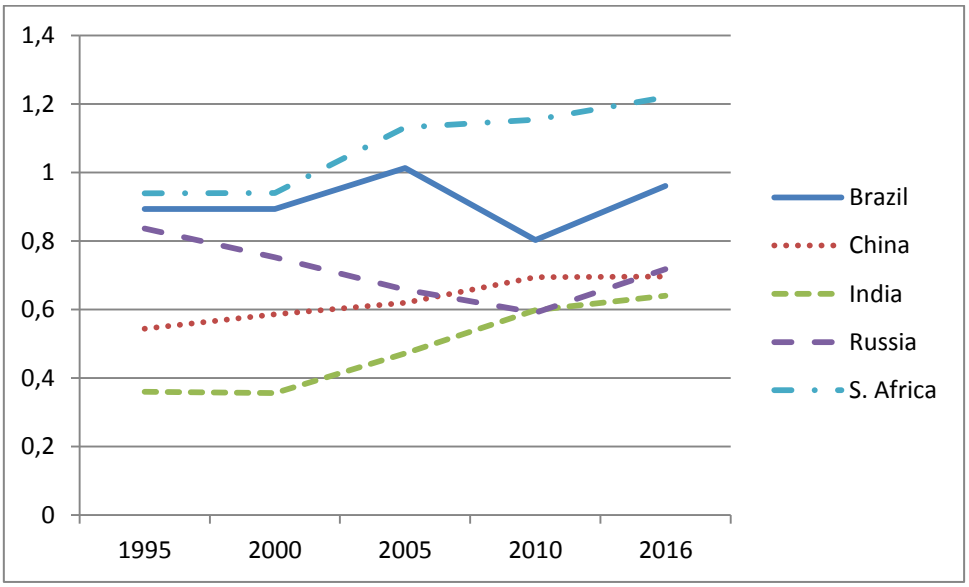
Graph 5 shows the evolution of RBM which considers manufacturing activities based on the transformation of primary goods. Russia is the leader of this category as it presents values above 3 from 2005 onwards. As argued by Haraguchi and Rezonja (2015, pp. 40), this can be explained by the abundance of natural resources in this country. The second country with the highest RBM is Brazil, which showed values around 2.5 by 2016. Although it has been declining overtime, the RCA index for South Africa is still very high, in this regard; the major cause is the relevance of mineral exports in this country (WTO, 2010, pp. 119). India also presents very high values throughout the period considered. This can be due to the fact that agriculture is still relevant in terms of employment since by 2015 agricultural employment represented a 46% of total employment. Finally, China is the only country that does not present a comparative advantage in this category. Moreover, it is also should be noted that this country alongside India are net importers of natural resources (WTO, 2010, pp. 49). At the same time, in the case of China, both Russia and Brazil are two of the main suppliers of this type of inputs (WTO, 2010, pp. 59). In essence, this shows the existence of certain linkages between the BRICS in which the most technologically advanced country is supplied by resource-abundant countries.

Graph 6: RCA Index of High Technology



Although the value of the RCA index is different when compared to the previous sub-section, it is also true that China is the leader in the high technology branch. This is noteworthy since, as argued by Rodrik (2006), this type of economic structure does not usually correspond to a country with the income level of China. With regards to the other countries, although the evolution has been generally positive, it is also true that the values of the RCA index were around 0.4 by 2016. Therefore, this does not indicate that these countries present comparative advantage in high technology goods.

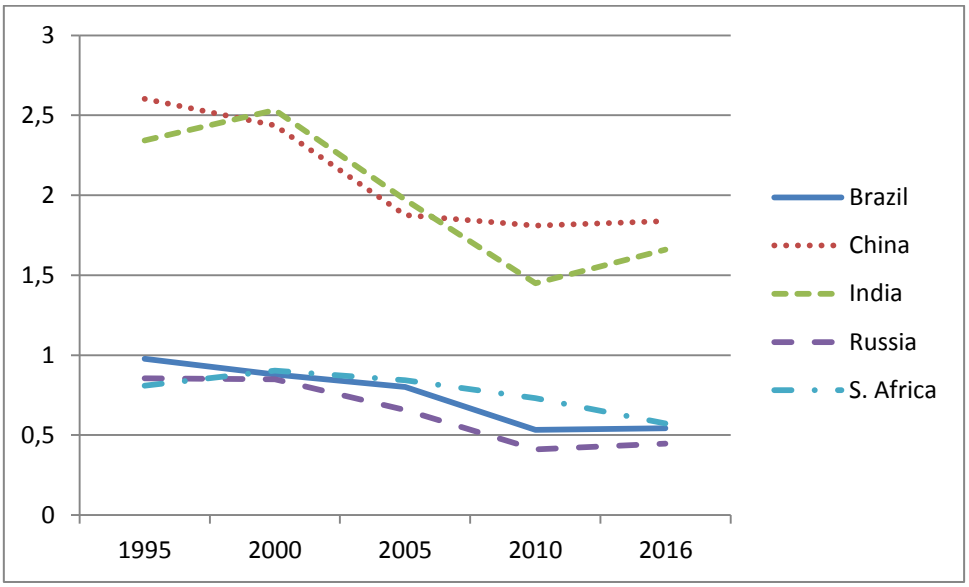
Graph 7: RCA Index of Medium Technology



In the case of medium technology, South Africa is the only country that presents values above unity during more than one benchmark. This coincides with the results of previous section since this

country has a good RCA index in medium high technology goods. Brazil also presents a RCA index above unity in 2005 but is also true that its trend presents more volatility than South Africa. Moreover, both China and India have improved although it cannot be considered that these countries present a comparative advantage in this technological branch. Finally, the RCA index for Russia has declined although by 2016 it presented similar values as both China and India.

Graph 8: RCA Index of Low Technology



Considering previous results, it can be argued that China is an example of technological transition as comparative advantage in low technology manufactures has declined while the opposite has occurred for high technology manufactures. Something similar has happened in India since the RCA index has strongly declined during the period observed. Nevertheless, it should be noted that both countries present a comparative advantage in low technology products. Although the rest of the BRICS have also declined, it is also true that their overall RCA values are around 0.5. This indicates that by 2016, none of these three countries presented a comparative advantage in low technology.

In summary, it can be argued that despite the use of two classifications, there are not significant differences with regards to the results. Therefore, the major differences between Eurostat and Lall are based on the use of different taxonomies and the fact that the latter includes a new category. Moreover, the results show that China is the only country that presents a high comparative advantage in high technology manufactures. At the same time, it is also striking that this country is also competitive in terms of low technology manufactures; this indicates the existence of duality in its productive structure. In the case of South Africa, it is the most competitive country in medium-high technologies. Moreover, it should be noted that the decline of comparative advantage in low

technology products has coincided with a decline of labour intensive manufactures in terms of value added (Kaplan, 2015, pp. 246). In the case of medium low technologies, there are three countries that have comparative advantage which are China, Brazil and India.

Considering its general performance; it can be argued that Russia is facing the most adverse situation, as it only presents a high comparative advantage in resource based manufactures. This has strong implications in terms of economic development, as this sector is the one that has a lower contribution in terms of value added. At the same time, this may also indicate a strong dependency on natural resources which has negative implications in the long run. As mentioned before, this has been caused by the shift from manufacturing to the primary sector since the mid-1990s (de Vries, Erumban, Timmer, Voskoboynikov and Wu, 2012). With the exception of China, the other countries also present high values in RBM. It should be noted that having a comparative advantage in this sector is not necessarily detrimental for economic development. For instance, as shown in the appendix section, Sweden is a developed country that has a comparative advantage in this category. Therefore, what cannot be overlooked is that countries need to diversify their economic structure since this increases their resilience to adverse economic shocks. Moreover, despite focusing on different issues, the results coincide with Havlik, Pindyuk and Stöllinger (2009) as it is shown that the BRICS present some heterogeneity in terms of productive structures.

One of the major consequences derived from productive specialisation is its impact on both inter-industry and intra-industry linkages. This means that the relative specialisation in a certain category of goods may influence the development of new economic activities. In this regard, one of the recent contributions in academia has been the economic complexity index (ECI) by Hausmann et al. (2013). In essence, this index shows how the set of linkages existing within countries' productive structures lead to different degrees of complexity. Regarding the BRICS, it should be noted that China was the best positioned country in 2008 as it was the 29th most complex country in the world. Moreover, Russia was ranked on position 46, India on the 51, Brazil on the 52 and South Africa on the 55. Considering the results of the RCA index, it can be argued that the high degree of economic complexity in China has been influenced by a high comparative advantage in high technology goods. Therefore, what can be interpreted from the ECI is that when a country has an advanced economic structure this entails a higher degree of economic complexity.

5.4 Estimation Results

As mentioned before, the model estimated considers different sets of dependent variables which are demand structure, output structure, external trade and labour allocation. Moreover, it should be noted that, in some instances, there are some independent variables which are not included since there is not a theoretical justification behind. For instance, if the dependent variable is *Exports/GDP*, it does not make sense to include *Net exports* in the model since this is somewhat tautological. Moreover, since the estimation follows a fixed effects approach, the standard errors that are used are cluster robust. In the view of Cameron and Miller (2015), the use of this type of standard error is preferable since conventional standard error may be understated and, as a result, this distorts the significance of coefficients.

Before analysing the results, attention should be focused to the expectations regarding the results and their relation to the theory. This goes in line with the set of regularities that Kaldor (1957) associated to economic development. For instance, regarding consumption, it is expected that as countries develop, the relative share of consumption over GDP declines as investment or public expenditure overtakes it. Also, as a consequence of structural change, it is expected that the share of agricultural value added tends to decline overtime while in the case of industry it increases and then declines. This is also the case for sectoral employment shares which consider agriculture, industry and services. Moreover, in the case of income coefficients, it should be noted that the differences in sign of *Ln(Income)* and $Ln(Income)^2$ denote that the effect derived from structural change diminishes with the increase of income per capita (Prados de la Escosura, 2007).

5.4.1 Single Pattern Estimation

Table 3 shows the estimation output of the demand structure. In the case of the share of consumption, it is negatively influenced by income per capita which means that as countries become richer, the share of consumption over GDP decreases. This is also the case for variable *Net Exports*, which means that a positive trade balance has a negative influence on the share of consumption. Also, the difference in sign of population variables shows that as population grows, the effect tends is positive but its strength declines overtime. The coefficients of income *Ln(Income)* and *Ln(Income)*^{2} are not significant in the case of investment. However, this is not the case for population variables which have an overall negative effect. As in the previous case, the sign of *Net exports* coefficient is negative and significant. Finally, in the case of public expenditure none of the coefficients are significant. Nevertheless, it should be noted that this estimation is adjusted in the next sub-section.

Table 3: Demand Structure Estimation Output

VARIABLES	C/GDP	I/GDP	G/GDP
Ln(Income)	0.017	0.057	-0.078
	(0.016)	(0.034)	(0.049)
Ln(Income)^2	-0.004**	-0.001	0.006
	(0.000995)	(0.002)	(0.003)
Ln(Population)	1.995***	-1.721***	0.189
	(0.113)	(0.114)	(0.279)
Ln(Population)^2	-0.061***	0.046***	-0.001
	(0.003)	(0.003)	(0.008)
Net Exports	-0.261***	-0.409***	0.099
	(0.040)	(0.078)	(0.065)
Trend	0.006*	-0.003	-0.001
	(0.002)	(0.002)	(0.001)
Constant	-15.05***	15.97***	-2.901
	(1.674)	(1.548)	(2.439)
Observations	208	208	208
R-squared	0.816	0.703	0.568
Number of Countries	5	5	5

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As mentioned before, output structure has as dependent variables the share of agricultural value added (*Yagr/GDP*), the share of industrial value added (*Yind/GDP*) and the share of services value added (*Yser/GDP*). In the first case, the differences in the signs of *Ln(Income)* and $Ln(Income)^2$ shows that although the effect of income is negative, this diminishes as income grows overtime. However, the overall effect of population growth is positive. Moreover, the sign of variable *Trend* is negative which indicates that the share of agricultural value added tends to decline overtime. Regarding industrial value added, the results match the expectations since the overall effect of income per capita is positive but it tends to decline as it increases. Similarly as in the case of agricultural value added, the sign of variable *Trend* is negative. In the case of services, the variable *Net exports* is not included in the estimation as it is expected that net exports do not have a strong impact on services[10]. Moreover, it is striking that none of the variables related to either per capita income or population are significant. The only variable that is positive and significant is *Trend*, which is an expected result since the share of services value added has increased in the BRICS during the last decades.

Table 4: Output Structure Estimation Output

VARIABLES	Yagr/GDP	Yind/GDP	Yser/GDP
Ln(Income)	-16.58***	23.99**	-7.518
	(1.546)	(6.182)	(4.022)
$Ln(Income)^2$	1.009***	-1.412**	0.413
	(0.100)	(0.444)	(0.273)
Ln(Population)	88.52***	-47.10	-46.40
	(14.15)	(49.45)	(29.04)
$Ln(Population)^2$	-2.200***	1.511	0.880
	(0.353)	(1.398)	(0.833)
Net Exports	1.349	6.718	
	(5.640)	(5.216)	
Trend	-0.318**	-0.569**	0.848***
	(0.097)	(0.161)	(0.170)
Constant	-797.1***	295.7	627.1*
	(158.5)	(465.4)	(282.5)
Observations	208	208	208
R-squared	0.941	0.674	0.858
Number of Countries	5	5	5

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[10] In the estimation where variable *Net Exports* was included the coefficient was not significant.

Table 5 shows the external trade estimation which is formed by *imports and exports as a share of GDP, openness, and industrial and primary exports as a share of GDP*. It should be noted that, due to the availability of data, the number of observations for both *industrial and primary exports* is lower. Moreover, as we are dealing with both imports and exports, it has been decided not to include the variable *Net Exports* as this would represent a tautology. In other words, the rise of exports is likely to be associated to net exports while the opposite would occur for imports. In the case of *exports*, *imports* and *openness*, the sign of *Ln(Income)* is positive while the opposite occurs for *Ln(Income)*^{2}. This means that, although the effect of income is positive for these three variables, its relative strength tends to decline as income per capita increases. Regarding *industrial exports*, *Ln(Income)* is positive but the significance level is of only 10%. Finally, in the case of primary exports none of the coefficients are significant.

Table 5: External Trade Single Pattern Estimation

VARIABLES	Xt/GDP	Mt/GDP	Open	XInd/GDP	Xprim/GDP
Ln(Income)	0.296**	0.165**	0.461**	0.492*	-0.028
	(0.087)	(0.057)	(0.138)	(0.229)	(0.034)
Ln(Income)^2	-0.019**	-0.011**	-0.030**	-0.025	0.000
	(0.005)	(0.003)	(0.008)	(0.013)	(0.002)
Ln(Population)	-0.338	-0.814**	-1.153	3.148	-0.227
	(0.346)	(0.251)	(0.597)	(1.722)	(0.216)
Ln(Population)^2	0.006	0.022**	0.029	-0.087	0.004
	(0.01)	(0.007)	(0.017)	(0.049)	(0.005)
Trend	0.004	0.002	0.005	0.002	0.003
	(0.005)	(0.006)	(0.011)	(0.002)	(0.002)
Constant	3.169	6.857	10.03	-30.47	3.041
	(4.551)	(4.204)	(8.730)	(15.84)	(2.487)
Observations	208	208	208	105	105
R-squared	0.604	0.620	0.638	0.854	0.251
Number of Countries	5	5	5	5	5

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

With regards to labour allocation, the sign of income coefficients is different for the agricultural labour share. This shows that, although the overall effect of income is negative, it diminishes as countries become richer. In contrast, the opposite happens with the share of services employment. In the case of industrial employment, none of the income coefficients are significant. Regarding population variables, both *Ln(Population)* and *Ln(Population)*^{2} have positive and negative signs for agrarian employment. This means that although the effect of population is negative, its relative strength diminishes as population increases. Also, as variable *Ln(Population)* is significant at the 10% level, it can be argued that population has a positive impact on the share of industrial employment. Moreover, the coefficient of variable *Trend* is negative and significant which is an expected result. In the case of services employment, the overall effect of both income and population variables is positive. Moreover, although the coefficient of variable *Trend* is positive, it is only significant at the 10% level.

Table 6: Labour Allocation Single Pattern Estimation

VARIABLES	LAgr/L	Lind/L	LSer/L
Ln(Income)	-0.236***	0.063	0.171***
	(0.031)	(0.047)	(0.034)
Ln(Income)^2	0.011**	-0.003	-0.008**
	(0.003)	(0.003)	(0.001)
Ln(Population)	-1.799***	-0.796*	2.340***
	(0.362)	(0.299)	(0.250)
Ln(Population)^2	0.040**	0.026**	-0.062***
	(0.009)	(0.008)	(0.007)
Net Exports	-0.149	0.004	
	(0.084)	(0.051)	
Trend	0.001	-0.002**	0.002*
	(0.002)	(0.001)	(0.001)
Constant	21.11***	5.557	-22.47***
	(3.668)	(2.918)	(2.352)
Observations	124	124	124
R-squared	0.914	0.716	0.889
Number of Countries	5	5	5

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5.4.2 Adjusted Pattern Estimation

As mentioned before, the estimation of the model also considers the inclusion of time dummies that replace the variable *Trend*. This is based on the idea that during the period analysed (1970-2015) there are different phases. Therefore, it is suitable inferring the evolution of both income and population by interacting *Ln(Income)* and *Ln(Population)* with time dummies. Moreover, it should be noted that, due to the availability of data, labour allocation and some variables of external trade are not included in the analysis.

Table 7: Demand Structure Adjusted Pattern Estimation

VARIABLES	C/GDP	I/GDP	G/GDP
Ln(Income)	0.003	0.081	-0.096*
	(0.048)	(0.048)	(0.038)
$Ln(Income)^2$	-0.001	-0.004	0.006**
	(0.003)	(0.003)	(0.002)
Ln(Population)	1.463***	-0.785*	-0.291
	(0.306)	(0.285)	(0.220)
$Ln(Population)^2$	-0.042***	0.02**	0.009
	(0.008)	(0.007)	(0.006)
Net Exports	-0.189	-0.433***	0.08
	(0.095)	(0.080)	(0.06)
D1	-0.496	0.663	-0.279
	(0.364)	(0.382)	(0.280)
D2	-0.125	0.327	-0.526**
	(0.414)	(0.366)	(0.147)
Ln(Income)*D1	0.007	-0.006	0.001
	(0.025)	(0.016)	(0.015)
Ln(Income)*D2	-0.004	-0.009	0.025**
	(0.018)	(0.015)	(0.007)
Ln(Population)*D1	0.023	-0.031*	0.013
	(0.012)	(0.014)	(0.011)
Ln(Population)*D2	0.008	-0.014	0.018**
	(0.015)	(0.013)	(0.006)
Constant	-11.84**	7.626*	2.776
	(3.114)	(3.113)	(2.035)
Observations	208	208	208
R-squared	0.782	0.715	0.685
Number of Countries	5	5	5

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In the case of demand structure, the only coefficients that are significant are population variables which show a similar sign as in the single pattern estimation. In the case of investment, only interaction *Ln(Population)*D1* is significant but at the 10% level. Similarly to consumption, the population coefficients show a negative evolution and variable *Net Exports* is negative and significant at the 1% level. Regarding the share of public expenditure, both *Ln(Income)*D2* and *Ln(Population)*D2* are positive and significant at the 5% level. This indicates that population and income per capita had a positive influence on the share of public expenditure during the years 1986 to 2000.

Table 8: Output Structure Adjusted Pattern Estimation

VARIABLES	Yagr/GDP	Yind/GDP	Yser/GDP
Ln(Income)	-15.26***	19.45**	-3.818
	(2.650)	(6.288)	(4.107)
$Ln(Income)^2$	0.943**	-1.025	0.069
	(0.239)	(0.514)	(0.366)
Ln(Population)	13.54	-33.82	15.53
	(33.75)	(25.17)	(24.59)
$Ln(Population)^2$	-0.454	0.775	-0.199
	(0.925)	(0.714)	(0.596)
Net Exports	-0.368	-2.919	
	(6.032)	(11.09)	
D2	62.95	124.1*	-181.6**
	(36.11)	(46.34)	(42.42)
D3	70.88	45.36	-113.1*
	(38.29)	(53.72)	(47.11)
Ln(Income)*D2	-2.061	-7.414**	9.170***
	(1.534)	(2.519)	(1.881)
Ln(Population)*D2	-2.641	-3.971*	6.433**
	(1.349)	(1.502)	(1.582)
Ln(Income)*D3	-1.471	-4.783	5.942*
	(1.386)	(3.062)	(2.607)
Ln(Population)*D3	-3.348*	-0.945	4.240*
	(1.512)	(1.718)	(1.705)
Constant	-13.56	319.7	-161.9
	(311.8)	(233.2)	(249.2)
Observations	208	208	208
R-squared	0.953	0.733	0.889
Number of Countries	5	5	5

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The estimation output from table 8 shows that although the signs of the interactions are negative, none of their coefficients have a strong level of significance for the share of agricultural value added. In the second case, the variable *Ln(Income)*D2* is negative and significant at the 5% level which indicates that income had a negative impact on the *share of industrial value added* during the period 1985-2000. Moreover, the influence of population is negative but its significance level is low. In the services estimation, the interaction terms show that during the second sub-period both population and income have positively influenced services value added. Also, although the sign for both *Ln(Income)*D3* and *Ln(Population)*D3* is positive there is a decline in terms of significance. In summary, considering the results of value added in both industry and services, it can be argued that the BRICS experienced a sectorial shift in their economies.

Table 9: External Trade Adjusted Pattern Estimation

VARIABLES	Xt/GDP	Mt/GDP	Openness
Ln(Income)	0.397***	0.276***	0.673***
	(0.0454)	(0.038)	(0.054)
$Ln(Income)^2$	-0.031***	-0.023***	-0.054***
	(0.004)	(0.003)	(0.004)
Ln(Population)	1.891**	1.153*	3.044*
	(0.620)	(0.494)	(1.111)
$Ln(Population)^2$	-0.048**	-0.026*	-0.074*
	(0.015)	(0.012)	(0.027)
D2	-1.870*	-2.295***	-4.165**
	(0.709)	(0.460)	(1.114)
D3	-2.591**	-2.303**	-4.893**
	(0.867)	(0.613)	(1.468)
Ln(Income)*D2	0.064*	0.085**	0.148**
	(0.029)	(0.019)	(0.042)
Ln(Population)*D2	0.074**	0.087***	0.161**
	(0.027)	(0.018)	(0.043)
Ln(Income)*D3	0.089**	0.083***	0.171**
	(0.029)	(0.018)	(0.042)
Ln(Population)*D3	0.103**	0.089**	0.192**
	(0.033)	(0.027)	(0.06)
Constant	-19.70**	-13.10*	-32.79**
	(6.243)	(4.932)	(11.17)
Observations	208	208	208
R-squared	0.716	0.775	0.772
Number of Countries	5	5	5

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The selection of dummies in the external trade estimation is based on the fact that the BRICS have shown a higher degree of participation in the international economy during the last two sub-periods. Regarding the interaction coefficients, the majority of them show high significance levels, with the exception of *Ln(Income)*D2* which is only significant at the 10% level in the case of *exports as a share of GDP*. Moreover, the sign of all these variables is positive which indicates that both population and income per capita had a positive influence on trade variables during the two last sub-periods. At the same time, it should be noted that, in general, the coefficients of interaction variables increase overtime. This means that, as a result of the deepening of globalisation, the relative influence of both population and income is higher.

When comparing the results of this estimation with Prados de la Escosura (2007), it should be noted that there are some similarities despite the differences in terms of estimation technique and period of study. For instance, in demand structure the effect of income has a negative influence on the consumption share of GDP. Regarding population, it has a positive impact for the consumption share while it has a negative for the share of investment. In the case of output structure, the results show that in both the BRICS and European countries the effect of income is negative for agricultural value added and positive for manufacturing value added. In relation to external trade variables, income exerts a positive influence for the *share of imports and exports to GDP* and *Openness*. Moreover, the effect of population is negative for the *share of imports to GDP*. Finally, the results are also similar in terms of the influence of income in agricultural employment. In essence, the comparison with the results of Prados de la Escosura (2007) shows that countries follow certain patterns as a consequence of economic development. Nevertheless, it cannot be overlooked that the differences are influenced by the type of countries analysed and by the historical period that has been selected for this thesis.

5.5 Sectorial GDP Growth Contribution

One of the major consequences derived from economic development is the fact that the overall contribution of economic sectors changes overtime. In general, countries tend to follow a pattern by which primary services are overtaken by industry, and then, services becomes into the main economic sector. In this section, GDP growth contribution is measured by using the annual chain-linking procedure as described in Robjohns (2007). In essence, three sectors are analysed which are primary (agriculture, hunting and forestry), industry and services. As mentioned before, the period analysed is 1970-2014 with the exception of Russia, since the number of observations are restricted from the year 1992 onwards. Finally, it should be noted that, due to space limitations the tables appear in section A of appendix.

(Table 8 about here)

In the case of Brazil, the contribution of the primary sector was not very relevant in the early 1970s. Moreover, it started to show values below unity around the late 1980s. The evolution of industry is somewhat different as it shows values that are similar to the contribution of services. Nevertheless, it should be noted that by the mid-1990s it started to lose relevance with respect to services. Finally, the evolution of services shows that this sector has been relevant for the Brazilian economy since the beginning of the sample. Therefore, the results coincide with Naudé, Szirmai and Lavopa (2013) who argue that the services sector was the largest in value added terms of the Brazilian economy already by the 1980s.

(Table 9 about here)

The evolution of economic sectors in China is somewhat different to the previous case, as the activities belonging to the primary sector were relevant until the mid-1980s. In the case of industry, it has been the dominant activity during most of the period observed. At the same time, it can be argued that the implementation of economic reform from 1978 onwards was not detrimental to this sector. This is shown by the high growth rates of industry in terms of value added. Moreover, it should be noted that services started to overtake industry in the last years of the sample. Therefore, it is expected that services will become into the main economic sector in the coming years.

(Table 10 about here)

Considering the evolution of economic sectors in India, it can be argued that this country represents a special case. This is due to the fact that, although there have been years in which it has been the main sector, there has not been a clear dominance of industry as in other countries. At the same time, the contribution of the primary sector has been negative in thirteen years, which is the worst

performance of all the countries analysed. This is particularly striking considering that, historically, agriculture has been very important for the Indian economy. Finally, the evolution of services shows that, since the 1980s, this sector has been more relevant than industry. Therefore, India represents a special case as the shift has been from the primary sector to services rather than from agriculture to industry and then to services.

(Table 11 about here)

Russia represents a special case in comparison to the other countries since the situation of its economy was particularly adverse during the 1990s as a result of the economic reform. As argued by de Vries, Erumban, Timmer, Voskoboynikov and Wu (2012), there has been a re-orientation of manufacturing employment to mining and services. In this regard, although the contribution of the primary sector in terms of value added is not very strong, this is not the case for services which became into the main contributor to growth from 2001 onwards.

(Table 12 about here)

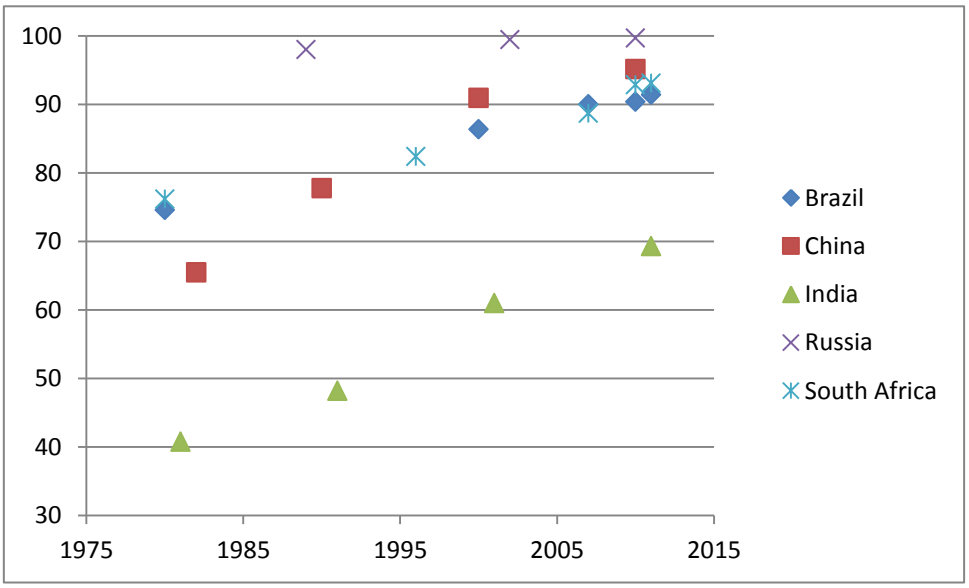
The evolution of the primary sector in South Africa shows that it had a low relevance in terms of value added contribution, since it shows values below 1% during most of the period analysed. In the case of industry, it presents some resemblance to the Indian case as it has not shown a clear dominance with respect to the other sectors. Therefore, it can be argued that from 1970 to 2014 the services sector has been the main contributor to value added in South Africa.

In summary, by considering the sectorial evolution of value added in the BRICS, it can be argued that these countries are somewhat heterogeneous. For instance, China is the only country that has followed the expected pattern of sectorial evolution. Moreover, in line with Naudé, Szirmai and Lavopa (2013), it is also the only country where industry has grown in relevance since the 1990s. Moreover, it should be noted that it is expected that services will overtake industry in the coming years. Russia also represents a special case as the influence of the economic reform had a strong impact on its economy. Nevertheless, the services sector became into the main contributor to growth with the turn of the new century. Finally, the evolution of Brazil, India and South Africa shows that services has been the main economic sector during the years considered.

5.6 Human Development Indicators

Although in Prados de la Escosura (2007), some issues concerning human development such as literacy are featured as part of the estimation, in the case of the BRICS, there are not sufficient observations to carry out this task. Nevertheless, considering that the time period selected in this thesis is different, it has been decided to include some graphs that provide information of indicators related to human development. The analysis of these issues allows understanding how economic development has influenced the BRICS from a qualitative perspective. As a result, this section is focused on education and income distribution. This is worth considering as, in certain instances, economic development is not directly associated to human development. In this regard, Andersson and Palacio (2017) argue that one of the downsides of the overemphasis of economic growth is that the analysis of social capabilities is often overlooked.

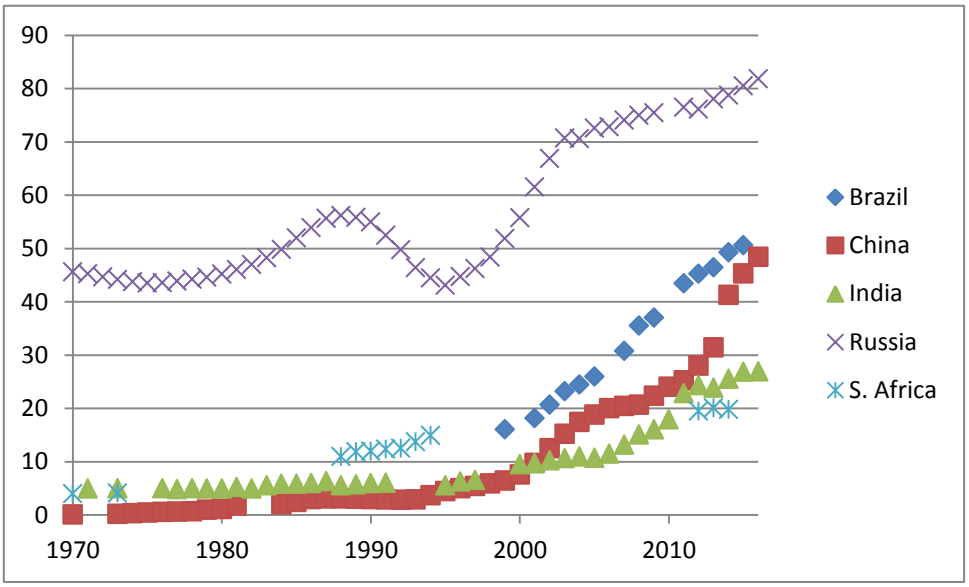
Graph 9: Adult Literacy Rates in the BRICS



Source: World Bank

The evolution of adult literacy rates in the BRICS shows that most countries have shown good results, especially in the case of Russia. However, it should be noted that India represents a laggard in this regard, which has strong implications in terms of education levels in this country. As a result, it is necessary to implement stronger efforts in order to tackle this issue.

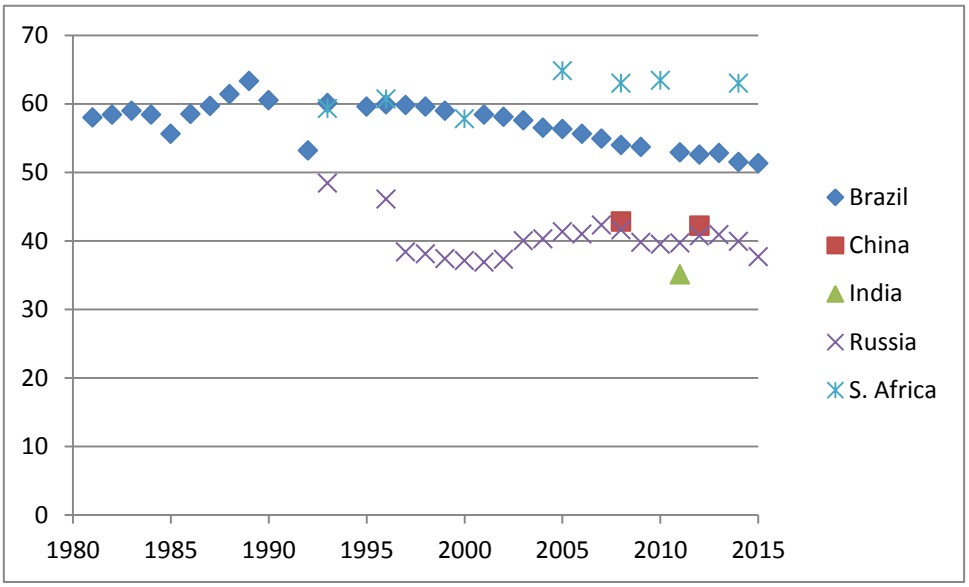
Graph 10: Tertiary School Gross Enrolment Ratio in the BRICS for both Sexes



Source: World Bank

Graph 12 shows the evolution of the gross enrolment ratio (GER) in the BRICS at the tertiary level for both sexes. According to UNESCO (2018), the GER indicates the number of students belonging to an education level that are expressed as a percentage of the official school age population corresponding to the same level of education. However, it should be noted that, for tertiary education, the population used is the 5-year age group starting after completion of secondary education. In general terms, the country that shows the best performance is Russia with a value around 80% in 2016. However, it should be noted that the GER featured a strong decline in the 1990s, which was probably due to the influence of the macroeconomic instability of the transition period. Both Brazil and China show a similar evolution as their values were around 50% by the mid-2010s. Finally, South Africa and India show the worst performance as their GER's are below 30%. It should be noted that when considering public investment on education, South Africa is one of the countries where it represents a higher share of GDP (WB). Therefore, what can be derived from this is that, policy makers should not only focus on how much money is spent, but also, about the relative efficiency of education investment overtime. This is further illustrated by the fact that in developed countries like Spain or Sweden, the investment in education represented 4% and 8% of GDP in 2014 respectively (WB).

Graph 11: Evolution of the Gini Index in the BRICS



Source: World Bank

Graph 11 provides the evolution of income inequality by using the Gini Index. Although in general income inequality has declined, the overall levels are still high from an international perspective[11]. Both Brazil and South Africa present high levels of inequality as the Gini index is above 50 in these two countries. In the case of Russia, the evolution has also been positive, although by 2015, the index was below 40, which indicates a moderate level of inequality. Finally, both India and China present a better performance than Brazil and South Africa, although the insufficient amount of observations does not allow inferring a clear trend. In the case of South Africa, it should be noted that it presents the highest level of unemployment in the BRICS (Kaplan, 2015, pp. 260), which is one of the main drivers of income inequality.

[11] In 2015 the Gini index for countries like Sweden or Spain was below 40 (WB).

Table 13: HDI Index

	HDI (2015)	Inequality Adjusted HDI (2015)	
	Value	Value	Overall loss (%)
Russia	0.804	0.725	9.8
Brazil	0.754	0.561	25.6
China	0.738	-	-
S. Africa	0.666	0.435	34.7
India	0.624	0.454	27.2

Source: UNDP (2016)

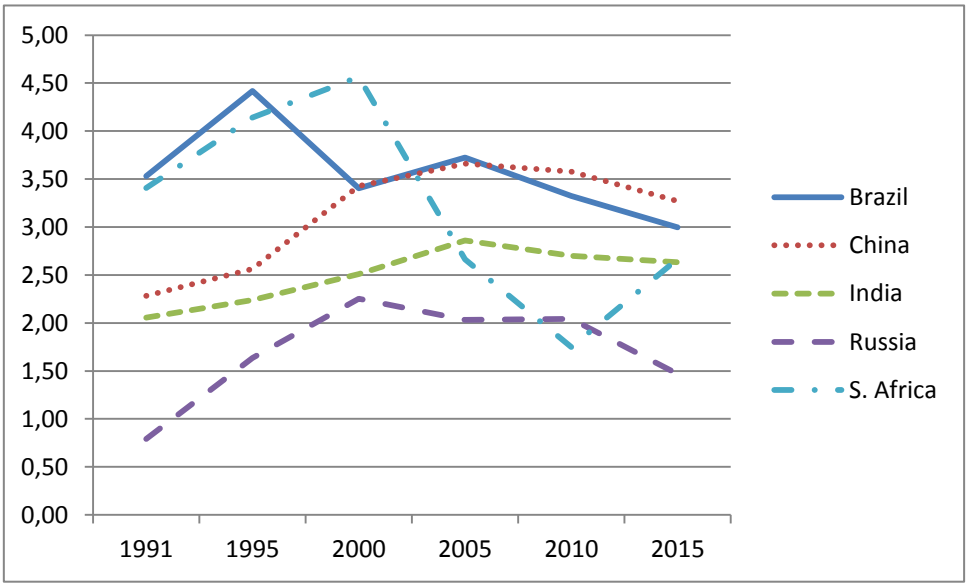
Table 13 shows both the unadjusted and inequality adjusted human development index (HDI) for the countries considered. This index has been selected because it considers income, education and life expectancy; therefore, it can be argued that it provides an overall picture of welfare. It should be noted that the inequality adjusted HDI considers disparities in terms of income, life expectancy and education. The results show that Russia is the only country that belongs to the very high level category in terms of HDI (UNDP, 2016). At the same time, when the HDI is adjusted for inequality the HDI declines considerably in most of the BRICS. However, it should be noted that due to the lack of data, it is not possible to analyse the influence of inequality in China.

In essence, the analysis of human development indicators shows that the BRICS present some issues that need to be tackled. This is primarily based on the idea that if economic growth does not become more inclusive, it is likely that the development trend might be halted in the coming years. As further economic development is associated to structural change, and hence, on the primacy of services, the BRICS need to improve the overall skill levels of their population. This would not only increase productivity but it would also diminish income inequality which, in general, is high.

5.7 Potential Limitations to Structural Change

Considering the evolution of the BRICS, it can be argued that these countries have undergone into a phase of sustained economic growth during the last decades. Moreover, the evolution of the sectorial GDP growth contribution shows that the economic structures of these countries have evolved. Nevertheless, it is worth considering to what extent these transformations have contributed to structural change. In essence, this phenomenon represents the transition from traditional low productivity activities to more dynamic activities with a high degree of productivity (Naudé, Szirmai and Haraguchi, 2015, pp. 1). In this regard, it can be argued that although the relevance of the services sector has increased, this does not necessarily imply a growth of activities that are highly productive. Therefore, one of the major issues that developing countries need to tackle is the duality phenomenon. In essence, this issue appears when there are significant productivity gaps between traditional vs. modern sectors and informal vs. formal sectors (McMillan and Rodrik, 2011). The necessity of tackling duality is due to its implications in key issues such as income distribution while it can also represent an obstacle for further development.

Graph 12: Agricultural Employment and Agricultural Value Added Ratio in the BRICS



Source: World Bank

As argued by Andersson and Palacio (2017), one indicator of dualism is the agricultural gap which indicates the difference between agricultural employment and the contribution of agriculture to GDP. Graph 12 shows the ratio between the shares of agricultural employment in percentage terms over agricultural value added as a percentage of GDP. Considering this information, a high ratio indicates a low level of productivity in agriculture which may be a consequence of duality. This is

worth considering as a productivity gap between sectors can be a cause of income inequality since agricultural employment is still high in many of the BRICS[12]. The results show that, despite showing different phases, Russia is the country which presents the best situation, as it presented values below 2 by 2015. As shown in the appendix, developed countries like Spain or Sweden present values that are similar to Russia. This ratio has increased in both China and India, which can be interpreted as a strengthening of duality. Moreover, although the value of the ratios was close to 3 in 2015, both Brazil and South Africa have improved in this regard.

One of the major points raised by McMillan and Rodrik (2011) is the fact that countries with a revealed comparative advantage in primary products face a major obstacle to structural change. This is striking for the BRICS since, with the exception of China; they have a comparative advantage in resource based manufactures. Moreover, this is particularly the case for those which are abundant in minerals such as Russia and South Africa. This is explained by the fact that the extraction of natural resources is weak in terms of employment generation (McMillan and Rodrik, 2011). Therefore, even in those cases where these activities have a high productivity level, their overall contribution to structural change is weak. In the BRICS, the concept of duality also applies to the existing differences between the formal and informal sector (de Vries, Erumban, Timmer, Voskoboynikov and Wu, 2012). For instance, in the case of Brazil, Aldrighi and Perim-Colistete (2015, pp. 185) argue that agriculture shows very low levels of formal employment and this constitutes another source of duality. At the same time, it should be noted that while the share of informal employment has declined in Brazil, it has increased in India (de Vries, Erumban, Timmer, Voskoboynikov and Wu, 2012).

As mentioned before, although it is true that the overall contribution of economic sectors has changed, this does not necessarily imply that structural change has taken place. Therefore, by considering the evolution of human development indicators and the duality phenomenon, it can be argued that these countries are facing major obstacles to structural change. This is based on the idea that as services will grow in relevance, it will be necessary to have a more skilled population that can work at activities that render higher productivity levels. However, if the set of social inequalities are not tackled it is likely that further development will not be achieved, and hence, these countries may fall into the middle-income trap.

[12] In the appendix section appears the labour shares of the BRICS in agriculture.

6. Conclusion

The analysis of development patterns provides a thorough overview of economic development while it also highlights both the similarities and differences that the BRICS present. The results provided by the RCA index show that China is the only country which has achieved a comparative advantage in high technology goods. Surprisingly, this country also presents a comparative advantage in low technology products. In general, the rest of the BRICS are specialised in goods that belong to the medium technology range. In this regard, Russia represents an exception since it does not have a comparative advantage in any of the technology categories. Moreover, with regards to resource-based manufactures, all the countries with the exception of China present a strong comparative advantage. Although the activities belonging to this category are not the same for all countries, it can be argued that, in the case of Russia, there is a strong bias towards natural resources which can be detrimental for further development.

With regards to the econometric model, it can be argued that the BRICS have followed certain patterns which coincide with some of the results provided by Prados de la Escosura (2007). This confirms the idea that, despite this thesis covers a different period, economic development is associated to certain regularities that follow the tradition of Gerschenkron (1962) and Kaldor (1957). Moreover, it should be noted that the use of dummies has allowed inferring how the effects of income and population have evolved overtime in the BRICS. This is particularly important since the period considered features an increase in the strength of globalisation forces.

The analysis of the GDP growth contribution shows that China is the only country that has followed the expected pattern of sectorial evolution. Regarding the rest of the BRICS, it can be argued that they have re-oriented to the services sector. This is particularly striking in India, in which there has been a marked shift from primary activities to the services sector, while agriculture is still important in terms of employment. In essence, the fact that industry is not so relevant in many of these countries may be a source of duality since many activities belonging to the services sector do not feature high productivity levels.

When analysing human development indicators it can be argued that the BRICS need to tackle several issues. For instance, income inequality represents a serious issue as these countries show high levels from an international perspective. One of its major causes is the duality phenomenon that exists between urban and agrarian employment and between formal and informal employment. Moreover, although the education indicators have improved in the BRICS, it is necessary to improve the overall efficiency of public investment. This would not only provide a higher quality but also a

higher degree of provision of this service. The necessity of improving education is based on the idea that as countries develop, the overall complexity of economies grows and this requires a more skilled workforce. Moreover, the improvement of human capital entails higher productivity levels, especially when services becomes into the main economic sector. Therefore, it can be argued that making development more inclusive in the BRICS is not only necessary because of its social impact, but also, because it will be necessary in order to achieve a successful transformation in the coming decades.

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Appendix

Section A: GDP Growth Contribution Tables

Table 8: GDP Growth Contribution by Economic Sector in Brazil

	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82
Primary	1.19	0.49	0.01	0.16	0.76	0.26	1.32	-0.34	0.48	0.94	0.81	-0.02
Industry	4.23	5.26	6.34	3.34	1.98	4.69	1.24	2.47	2.69	3.70	-3.62	-0.02
Services	5.89	6.28	7.93	5.15	2.40	5.70	2.46	3.02	3.91	4.51	-1.21	1.05
Total	11.30	12.03	14.28	8.65	5.14	10.65	5.01	5.16	7.09	9.16	-4.03	1.01
	1982-83	**1983-84**	**1984-85**	**1985-86**	**1986-87**	**1987-88**	**1988-89**	**1989-90**	**1990-91**	**1991-92**	**1992-93**	**1993-94**
Primary	-0.04	0.29	1.16	-0.89	1.68	0.08	0.28	-0.29	0.14	0.57	0.06	0.43
Industry	-2.44	2.46	3.37	4.92	0.43	-1.06	1.15	-2.99	0.04	-1.42	2.28	2.54
Services	-0.27	2.68	3.27	3.78	1.42	1.16	1.78	-0.42	1.04	0.41	1.97	2.52
Total	-2.74	5.43	7.81	7.80	3.53	0.18	3.20	-3.70	1.22	-0.44	4.32	5.48
	1994-95	**1995-96**	**1996-97**	**1997-98**	**1998-99**	**1999-00**	**2000-01**	**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**
Primary	0.50	0.16	0.04	0.17	0.34	0.14	0.33	0.38	0.37	0.14	0.07	0.25
Industry	1.70	0.33	1.04	-0.45	-0.52	1.30	-0.09	0.81	0.44	1.93	0.58	0.57
Services	1.78	1.19	1.88	0.52	0.78	2.61	1.51	2.29	0.57	3.26	2.25	2.65
Total	3.98	1.69	2.96	0.24	0.59	4.05	1.75	3.48	1.38	5.33	2.90	3.48
	2006-07	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**			
Primary	0.17	0.30	-0.20	0.35	0.27	-0.16	0.41	0.37	0.20			
Industry	1.72	1.11	-1.27	2.58	1.07	-0.25	0.54	0.64	-0.64			
Services	3.50	2.94	1.34	3.92	2.22	1.88	1.89	0.23	-1.91			
Total	5.39	4.35	-0.13	6.85	3.56	1.48	2.84	1.24	-2.35			

Table 9: GDP Growth Contribution by Economic Sector in China

	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82
Primary	0.67	-0.31	2.94	1.36	0.67	-0.58	-0.72	1.20	1.71	-0.46	2.09	3.64
Industry	4.95	2.35	3.33	0.84	6.63	-0.77	5.35	6.23	3.65	6.93	0.96	2.48
Services	1.48	1.15	1.30	0.43	1.20	0.14	2.06	3.19	1.80	1.78	2.29	2.78
Total	7.10	3.19	7.57	2.63	8.50	-1.22	6.70	10.62	7.16	8.25	5.34	8.90
	1982-83	**1983-84**	**1984-85**	**1985-86**	**1986-87**	**1987-88**	**1988-89**	**1989-90**	**1990-91**	**1991-92**	**1992-93**	**1993-94**
Primary	2.75	4.23	0.59	0.93	1.26	0.68	0.78	1.83	0.64	1.14	1.01	0.78
Industry	4.90	6.25	8.06	4.60	6.11	5.97	1.14	1.29	5.58	8.75	8.50	8.34
Services	3.32	4.45	4.68	3.48	4.34	3.94	1.63	0.57	2.99	4.33	4.32	3.90
Total	10.98	14.94	13.33	9.01	11.71	10.59	3.55	3.69	9.21	14.22	13.83	13.02
	1994-95	**1995-96**	**1996-97**	**1997-98**	**1998-99**	**1999-00**	**2000-01**	**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**
Primary	0.98	1.01	0.68	0.63	0.49	0.39	0.42	0.41	0.34	0.80	0.69	0.60
Industry	6.37	5.59	4.78	4.21	3.68	4.25	3.88	4.45	5.65	5.10	5.59	6.34
Services	3.41	3.08	3.56	2.89	3.40	3.81	4.05	4.28	3.99	4.15	5.04	5.86
Total	10.76	9.68	9.03	7.73	7.56	8.45	8.34	9.14	9.98	10.05	11.32	12.80
	2006-07	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**			
Primary	0.41	0.57	0.44	0.43	0.42	0.44	0.38	0.40	0.36			
Industry	7.20	4.66	4.85	5.87	5.02	3.89	3.64	3.24	2.60			
Services	6.77	4.35	4.11	4.22	4.14	3.52	3.71	3.65	3.92			
Total	14.38	9.58	9.41	10.52	9.58	7.85	7.73	7.29	6.89			

Table 10: GDP Growth Contribution by Economic Sector in India

	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82
Primary	-0.83	-2.12	3.04	-0.70	5.51	-2.30	3.79	0.90	-4.79	4.59	2.22	-0.44
Industry	0.58	0.89	0.09	0.34	1.91	2.15	1.85	1.50	-0.64	1.70	2.28	1.17
Services	1.33	1.08	1.05	1.13	2.07	1.73	1.65	2.23	0.93	1.44	1.59	2.36
Total	1.08	-0.14	4.19	0.77	9.49	1.58	7.28	4.64	-4.50	7.73	6.10	3.09
	1982-83	**1983-84**	**1984-85**	**1985-86**	**1986-87**	**1987-88**	**1988-89**	**1989-90**	**1990-91**	**1991-92**	**1992-93**	**1993-94**
Primary	3.75	-0.01	0.10	-0.57	0.12	5.07	0.54	1.16	-0.72	1.88	1.12	1.51
Industry	2.30	1.57	1.48	2.39	1.76	3.00	2.88	2.64	0.01	1.17	1.62	2.99
Services	1.80	2.28	2.57	2.88	2.38	2.76	3.31	1.89	2.06	2.01	2.97	2.46
Total	7.85	3.83	4.15	4.70	4.26	10.84	6.73	5.69	1.35	5.06	5.71	6.96
	1994-95	**1995-96**	**1996-97**	**1997-98**	**1998-99**	**1999-00**	**2000-01**	**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**
Primary	-0.26	2.65	-0.69	1.69	0.08	-0.14	1.57	-1.76	2.12	0.04	1.02	0.81
Industry	3.39	2.03	1.65	1.24	1.53	1.56	1.05	1.75	2.33	3.43	3.26	3.95
Services	3.76	2.77	4.09	3.46	4.37	2.08	3.23	3.12	3.58	4.27	5.10	4.71
Total	6.90	7.45	5.05	6.39	5.98	3.50	5.85	3.12	8.03	7.74	9.38	9.47
	2006-07	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**			
Primary	1.10	0.00	0.17	1.60	0.94	0.28	0.76	-0.05	0.22			
Industry	3.29	1.50	2.99	2.56	2.44	1.19	1.60	1.82	2.25			
Services	4.79	4.82	5.13	4.57	3.50	3.96	3.95	5.21	4.71			
Total	9.19	6.32	8.29	8.73	6.88	5.42	6.31	6.99	7.17			

Table 11: GDP Growth Contribution by Economic Sector in Russia

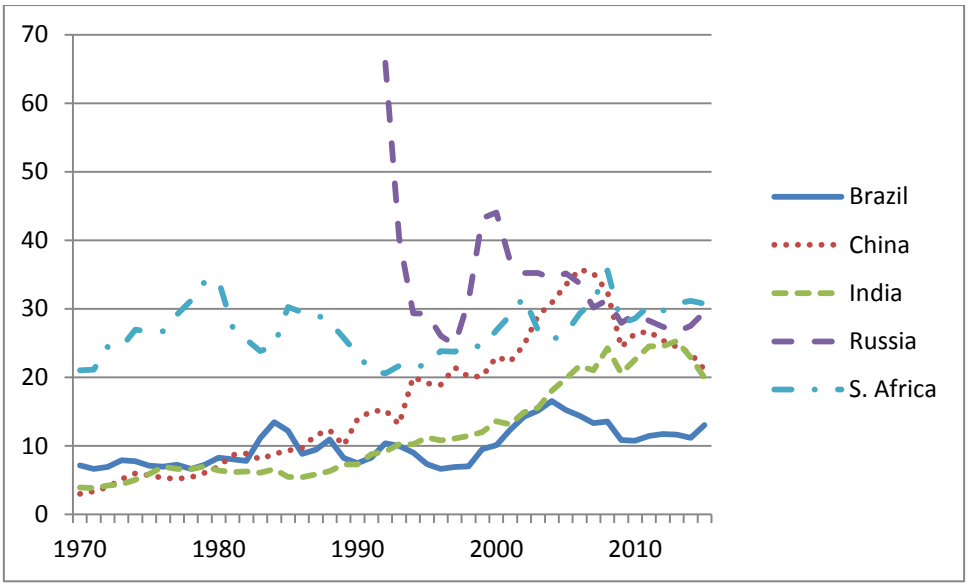
	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Primary	-0.28	-0.95	-0.62	-0.37	0.12	-1.19	0.92	0.87	0.70	0.19	-0.10	0.07
Industry	-5.63	-8.73	-1.95	-1.90	0.35	-2.09	3.76	4.64	2.16	1.39	2.91	3.25
Services	-2.35	-4.12	-1.40	0.05	1.02	-1.36	1.42	3.19	1.80	2.81	4.34	3.34
Total	-8.26	-13.80	-3.97	-2.23	1.50	-4.63	6.10	8.71	4.66	4.38	7.15	6.66
	2004-05	**2005-06**	**2006-07**	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	
Primary	-0.03	0.14	0.05	0.26	0.07	-0.56	0.54	-0.04	0.17	0.08	0.12	
Industry	1.38	1.57	1.55	0.45	-3.65	2.28	1.71	1.27	0.22	0.07	-1.17	
Services	4.16	5.94	6.53	4.62	-3.02	2.57	1.67	2.29	0.88	0.83	-2.46	
Total	5.51	7.66	8.13	5.32	-6.59	4.28	3.93	3.51	1.27	0.97	-3.50	

Table 12: GDP Growth Contribution by Economic Sector in South Africa

	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82
Primary	1.32	-0.05	-0.95	2.17	-0.73	-0.18	0.78	0.28	-0.14	0.59	0.35	-0.54
Industry	0.38	-0.16	1.02	-0.21	-0.22	1.64	-0.26	0.91	1.96	1.47	2.17	-0.99
Services	2.70	2.00	3.13	3.52	2.65	1.57	-0.11	1.14	1.38	3.12	2.53	0.89
Total	4.41	1.79	3.20	5.47	1.70	3.03	0.41	2.33	3.20	5.18	5.05	-0.64
	1982-83	**1983-84**	**1984-85**	**1985-86**	**1986-87**	**1987-88**	**1988-89**	**1989-90**	**1990-91**	**1991-92**	**1992-93**	**1993-94**
Primary	-1.28	0.50	0.96	0.34	0.13	0.15	0.85	-0.38	0.20	-1.22	0.90	0.32
Industry	-0.50	2.19	-0.53	-0.92	-0.63	1.68	0.53	-0.43	-1.22	-0.44	0.24	0.69
Services	1.48	2.98	-0.15	0.42	1.75	1.73	1.11	0.46	0.33	0.17	0.41	1.75
Total	-0.29	5.67	0.28	-0.15	1.25	3.57	2.49	-0.35	-0.68	-1.49	1.55	2.77
	1994-95	**1995-96**	**1996-97**	**1997-98**	**1998-99**	**1999-00**	**2000-01**	**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**
Primary	-0.90	0.91	0.03	-0.21	0.23	0.16	-0.10	0.22	0.03	0.03	0.09	-0.15
Industry	0.61	0.46	0.80	-0.39	-0.14	1.16	0.45	0.76	0.44	1.28	1.45	1.24
Services	2.62	2.61	1.59	1.28	2.51	2.67	2.25	2.64	2.67	3.75	3.60	4.12
Total	2.34	3.98	2.43	0.68	2.60	4.00	2.59	3.62	3.14	5.06	5.13	5.22
	2006-07	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**			
Primary	0.08	0.57	-0.06	-0.01	0.05	0.04	0.09	0.16	-0.14			
Industry	1.24	0.06	-1.83	1.42	0.42	0.14	0.62	0.01	0.28			
Services	4.20	2.88	0.48	1.48	2.72	2.04	1.70	1.55	1.10			
Total	5.52	3.51	-1.41	2.89	3.20	2.22	2.41	1.72	1.25			

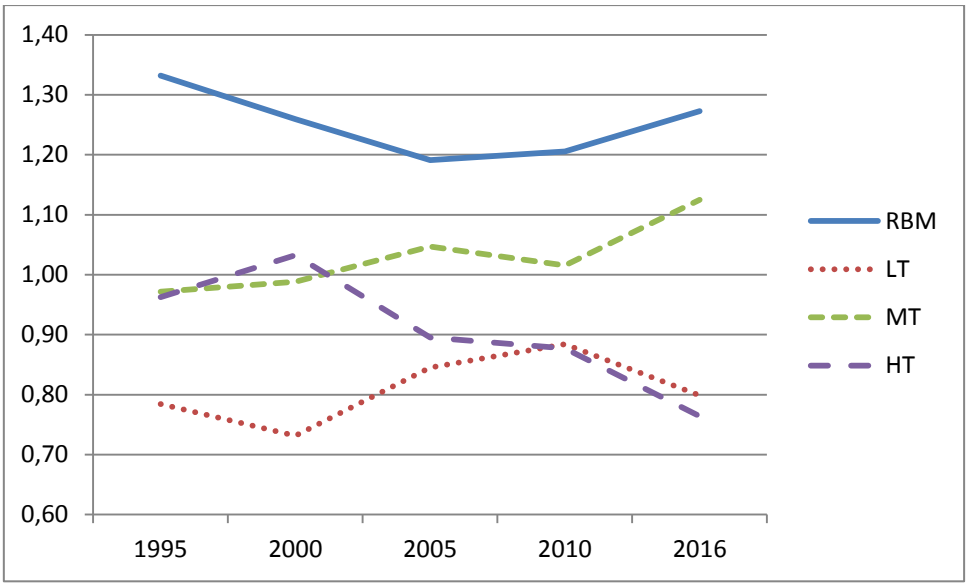
Section B: Supplementary Graphs

Graph 15: Exports as a percentage of GDP



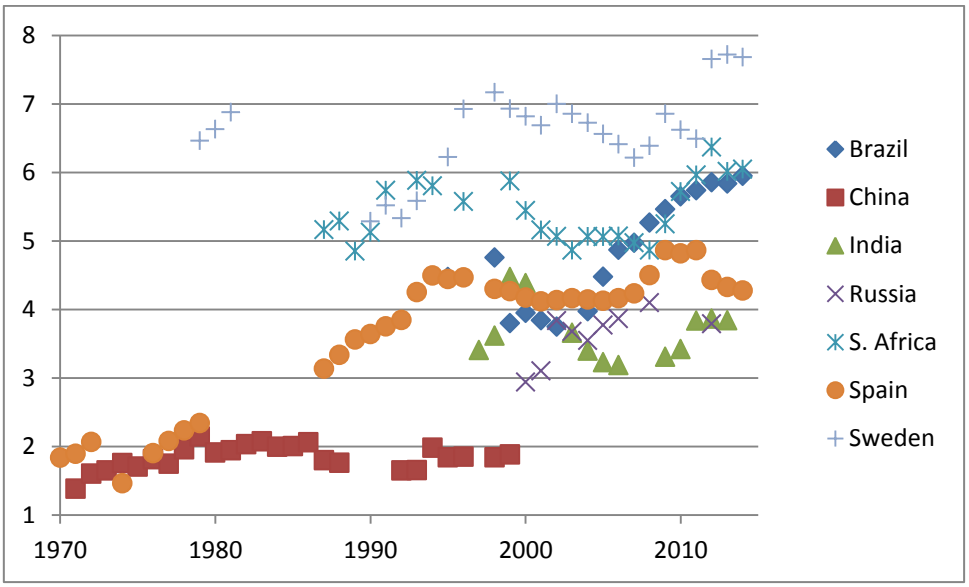
Source: UNCTAD

Graph 16: RCA index of Sweden (Lall Classification)



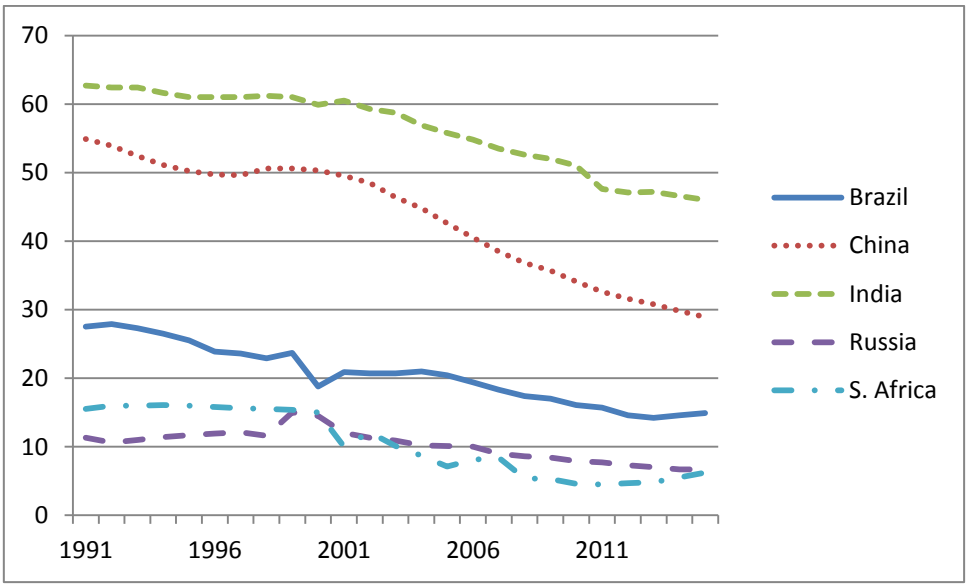
Source: UNCTAD

Graph 17: Government Expenditure in Education as % of GDP in the BRICS, Spain and Sweden



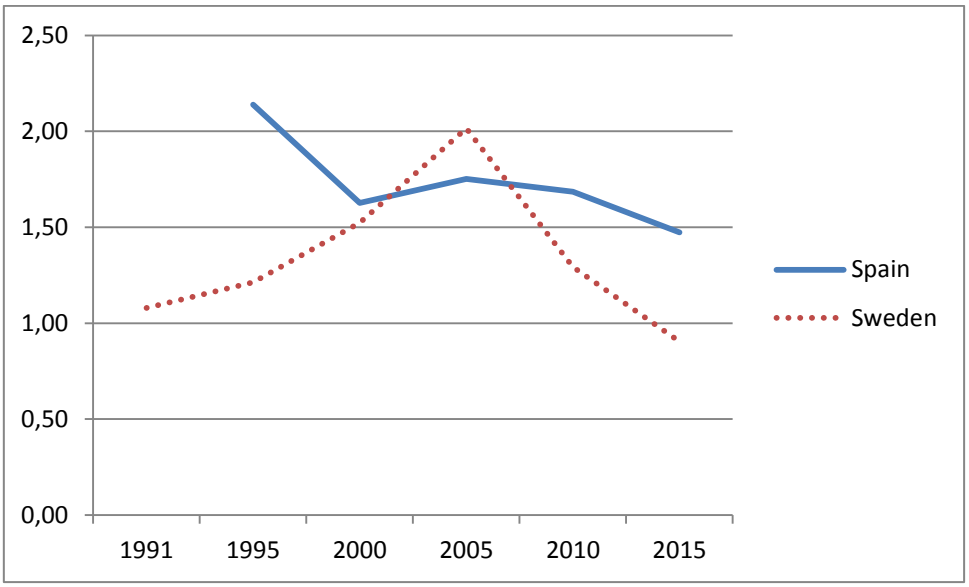
Source: World Bank

Graph 18: Share of Agricultural Employment of Total Employment in the BRICS



Source: World Bank

Graph 18: Agricultural Employment and Agricultural Value Added Ratio in Spain and Sweden



Source: World Bank

Section C: Data

With regards to the variables used in the econometric model, it should be noted that the majority have been used as they are provided in their respective databases. As mentioned in the data section, the databases that have been used are the UNCTAD and the World Bank.

The following variables have been obtained by transforming data provided by UNCTAD database:

The variable *Net Exports* has been obtained by subtracting the share of exports minus the share of imports as a percentage of GDP which belong to GDP by expenditure.

It should be noted that the variable *primary exports as percentage of GDP* has been obtained by dividing primary exports according to Lall (2000) classification over GDP in current prices. In a similar way, *manufactured exports as percentage of GDP* considers total manufacturing exports of Lall classification that are divided over GDP in current prices.

Section D: UNCTAD and Lall Classification

Table 15: UNCTAD Groups Selected According to Eurostat Classification

High Technology	541: Medicinal & Pharmaceutical Products
	752: Automatic Data Processing Machines
	792: Aircraft & Associated Equipment
	871: Optical Instruments
Medium-High Technology	598: Miscellaneous Chemicals
	778: Electrical Machinery & Apparatus
	781: Motor Vehicles for Transport of Persons
	782: Motor Vehicles for Transport of Goods
	785: Motorcycles & Cycles
	786: Trailers & Semi-Trailers
	872: Instruments & Appliances for Medical
	891: Arms & Ammunition
Medium-Low Technology	325: Coke & Semi-Cokes
	621: Materials of Rubber
	625: Rubber tyres, Tyre treads & Inner tubes
	663: Mineral Manufactures
	691: Structures & Parts of Metal
	699: Manufactures of Base Metal
	793: Ships, Boats & Floating Structures
Low Technology	98: Edible Products & Preparations
	111: Non-Alcoholic Beverages
	112: Alcoholic Beverages
	122: Tobacco (Manufactured)
	612: Manufactures of Leather
	633: Cork Manufactures
	635: Wood Manufactures
	641: Paper & Paperboard
	821: Furniture & Parts
	845: Articles of Apparel
	846: Clothing Accessories
	851: Footwear
	899: Miscellaneous Manufacturing Articles

Table 16: Lall Classification Components

Resource Based Manufactures	Agro/forest-based products	Prepared meats/fruits, beverages, wood produsts, vegetable oils
	Minerals-based products	Ore concentrates, petroleum/rubber products, cement, cut gems, glass
Low Technology Manufactures	Textile/fashion cluster	Textile fabrics, clothing, headgear, footwear, leather manufactures, travel goods
	Other low technology	Pottery, simple metal parts/structures, furniture, jewellery, toys, plastic products
Medium Technology Manufactures	Automotive products	Passenger vehicles and parts, commercial vehicles, motorcycles and parts
	Process industries	Synthetic fibres, chemicals and paints, fertilizers, plastics, iron, iron-tubes
	Engineering Industries	Engines, motors, industrial machinery, pumps, switchgear, ships, watches
High Technology Manufactures	Electronics and Electrical	Office/data processing/telecommunications equipment, TVs, transistors, turbines, power-generating equipment
	Other High Technology	Pharmeaceuticals, aerospace, optical/measuring instruments, cameras

Source: Lall (2000)