Paths to a knowledge economy in Brazil and India: skills and industrial relations

Introduction

Brazil and India share many political economy commonalities. Both were former colonies and to this day have a highly stratified and unequal society. Both possess large emerging markets and are BRIC members. India and Brazil are currently among the largest manufacturing countries in the world, but Brazil has a declining share of 1.98% of world manufacturing output whereas India has kept a stable share of 3.33% (WTO, 2019). These countries also stand out by the existence of large informal labor markets with a large mass of low and unskilled labor forces (WIOD and ILOSTAT). Technological levels are also similar. India has a share of 0.6% of world patents when compared to 3.1% from China. Brazil has 0.2% of the total patents in the world. According to the OECD ranking, China ranks seventh in share of patents, whereas India and Brazil ranks 20th and 26th, respectively. Finally, they went through liberalizing reforms since the beginning of the nineties.

In the Varieties of Capitalism framework, India and Brazil also share institutional traits in the spheres of corporate governance with prevailing large and diversified business groups controlled by families (Sarkar, 2010; Aldrighi and Postali, 2010, Nölke, and colleagues, 2015). Although industrial relations patterns differ at the union density levels with an average of 13% in India[1] and 28% in Brazil[2], share key problems of employees' representation and collective bargaining.

The main feature of a knowledge-based economy looming since the 1970s is the increasing role of a science-based component in the new products and services deriving from a societal transformation in the supply of highly skilled labor (Stehr, 2015)[3]. Another is the emergence of new industries or the restructuring of existent industries in which a larger share of scientific knowledge applies. Further, the boundaries of technical and scientific knowledge become blurred not only in manufacturing, but also in services.

[1] This is perhaps due to the larger share of informal labor in India.
[2] Union density rate, net union membership as a proportion of wage earners in employment from ICTWSS Database Version 5.1 – September 2016.
[3] To talk of a knowledge economy may sound tautological in the sense that every economy is knowledge-based since the emergence of capitalism, as Marx (1990) stated technology is the fusion between scientific knowledge and production.

In regards to skills, a knowledge economy has a larger share of knowledge workers across different types of industry in the sense that the labor of knowledge workers becomes input for all sorts of products (Machlup, 1980). In addition, the role of tertiary education and knowledge infrastructures such as research labs, public and private research institutions and higher levels of schooling for the population as a whole in the transition to a knowledge economy, what raises a challenge for emerging economies. Clarke and Gholamshahi (2017) aptly ask: what would be the institutional arrangements to enable these societies to generate new skills and knowledge and assure their application across the economy? Thus, Cimoli and colleagues (2019) stress that policy-makers from latecomer countries ought to contribute to build institutions that strengthen absorptive capabilities at the national level rather than pursue convergence with the institutions providing Walrasian equilibrium. In other words, latecomers should be more concerned with institutions contributing to build technological and innovation capabilities rather than laying emphasis on reducing transaction costs.

Lacasa and colleagues (2019) break down the technology upgrading process for latecomers into three analytic levels: the intensity of technology upgrading, breadth of technology upgrading, and knowledge intensity of the upgrading. The intensity of innovation mirrors the accumulation of innovation capability[4]. The first level of technology upgrading refers to two types of innovation capabilities: capability to contribute to frontier technology by producing global innovation and increase in the domestic innovation capability behind the technology frontier. The second deals with the breadth of technology upgrading, indicating structural changes in the knowledge intensity of technological activities and the diversification of technological activities. The knowledge intensity of upgrading derives from the share of patent applications in high technology fields. Their analysis of paths of technology upgrading in the BRICS, conclude that India has improved the frontier technology and diversification of technology. Brazil appears as an intermediate case between India and China, on the one side, and South Africa and Russia on the other side[5].

By drawing on three different paths in the transition to a knowledge economy in three advanced capitalist countries (Germany, Netherlands, and Sweden), Thelen (2019)

[4] The concept of innovation capability is the ability to improve technology or to develop new products or services (Dahlman et al., 1987).

[5] Lazonick and Li (2012) propose a framework to delve into China's path to indigenous innovation. It consists of a dynamic interaction among investment in physical and human infrastructure mostly undertaken by the state, technology transfer from abroad, and indigenous companies improving upon existing technology.

claims these transitions toward a knowledge economy depend on the political dynamics and coalitions. Despite the several commonalities among knowledge economies, she reveals the institutional differences which do not coalesce towards convergence. This result supports a crucial tenet from the varieties of capitalism (VoC) approach. Besides, and this is particularly relevant for the argument of this article, different transitions in the same variety of capitalism unveils dynamic arrangements in countries sharing very similar institutions in the sense of VoC.

The VoC characteristic commonalties between India and Brazil calls forth the need to analyse their institutions related to skills and the labor market in these countries to explain their divergent paths to a knowledge economy. Thus the purpose of this article is to shed light upon the institutional differences and conditions that contribute to this divergence.

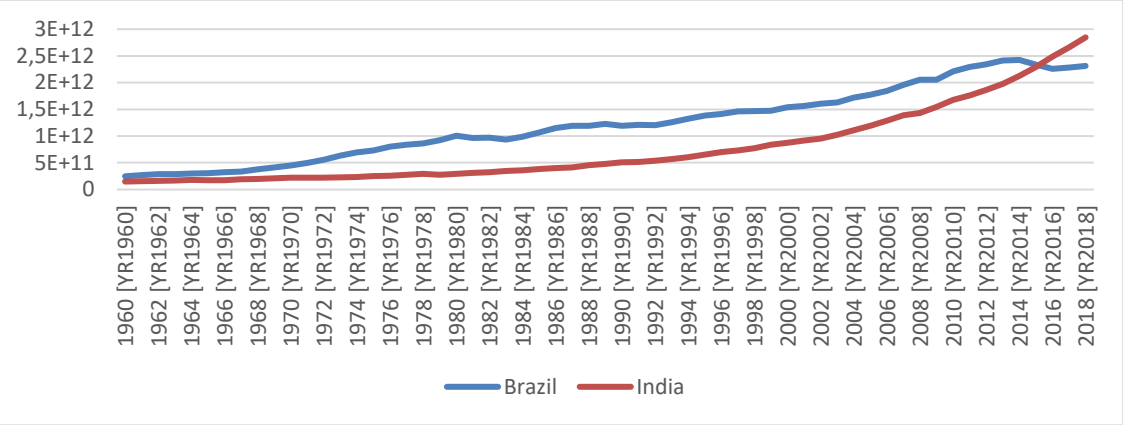
The article draws on the recent contributions from Thelen (2019), Ibsen and Thelen (2019), and Durazzi (2018) on the institutions related to the transition to a knowledge economy in advanced capitalist countries. It aims to expand the scope of this emerging analytic framework to transitions to knowledge economy in large emerging markets. The article has three sections besides the conclusion.

The first section discusses the central tenets from the knowledge economy contextualizing it in the catching-up from latecomers and skills and labor institutions in this transition. The second section discusses skills and labor relations in the knowledge transition in Brazil and India with aggregate data on the formation of skills as well as comparing institutions in both countries. The third section of the article explores the cases of the software and pharmaceuticals industries. These are two emblematic industries for the knowledge-based economy in which India and Brazil had a consistent performance in comparison with other developing countries.

Evolving productive structures: manufacturing and services paths to the knowledge economy

From 1960, Brazil growth took off until about 1980, whereas India's growth lingered. However, from the early 1990s, India growth rates poicked up so that its GDP surpassed that of Brazil in 2015, as Brazil entered a period of stagnant growth (Figure1).

Figure 1 - Brazil and India GDP Growth - 1960-2018 (2010US$)

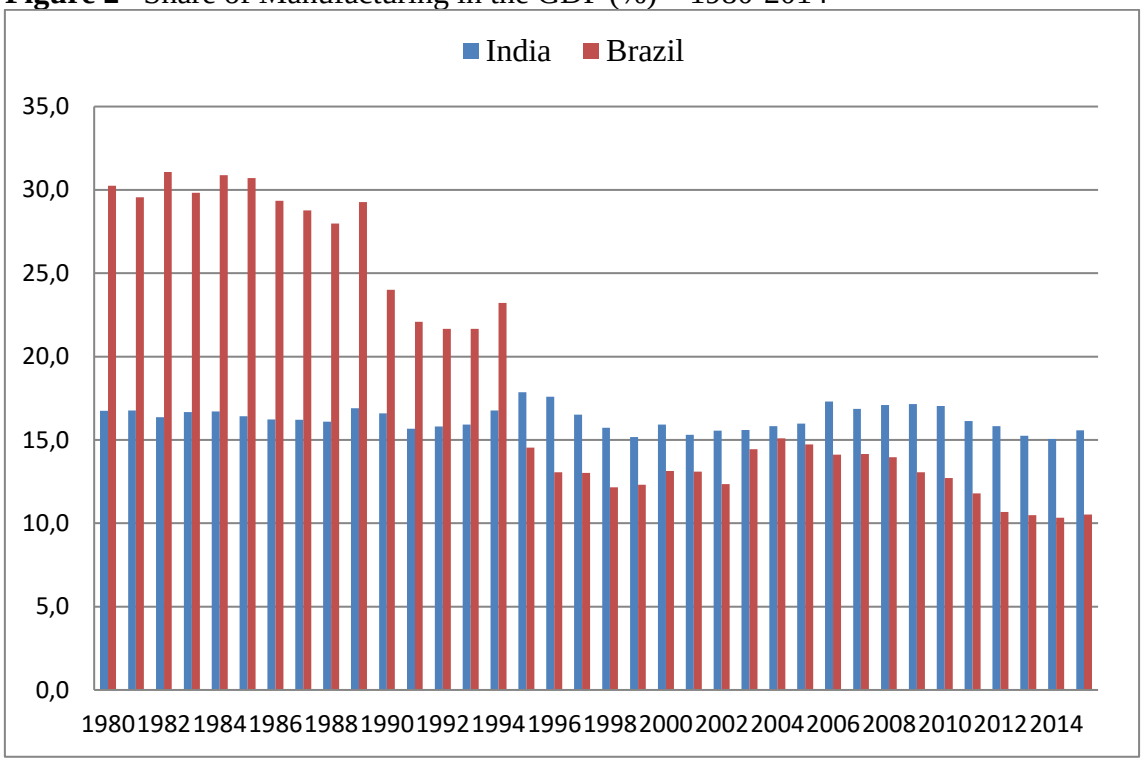


Source: World Development Indicators – World Bank

Although industry types differ regarding technological capabilities (Lall, 1992), virtually all latecomers count on a prominent role for manufacturing in their catching-up process. Amsden (2001) reminds us that manufacturing output is cumulative and the countries which managed to leap-frog had previous favorable variations in per capita manufacturing. As **Figure 2** shows, Brazilian manufacturing began to lose ground to India after 1994. It coincides with the successful Real Plan to fight hyperinflation in Brazil which seem to have had two unintended consequences for the country's industrial development: an overvalued real currency with very uncompetitive exchange rates for the exports coupled with interest rates at an average of 40% a year.

The role of manufacturing in each economy had sharply constrating trajectories since 1980. On the one hand, the Brazilian share of manufacturing in the GDP fell drastically: from 30% in 1980 to around 10% in 2014. Following a sharp decline until 1994, it remained below 15% since then and from 2010 has hovered around 10%. On the other hand, Indias's the share remained relatively stable around 15% of the GDP throughout the whole period, indicating significantly less structural change than Brazil (**Figure 2**).

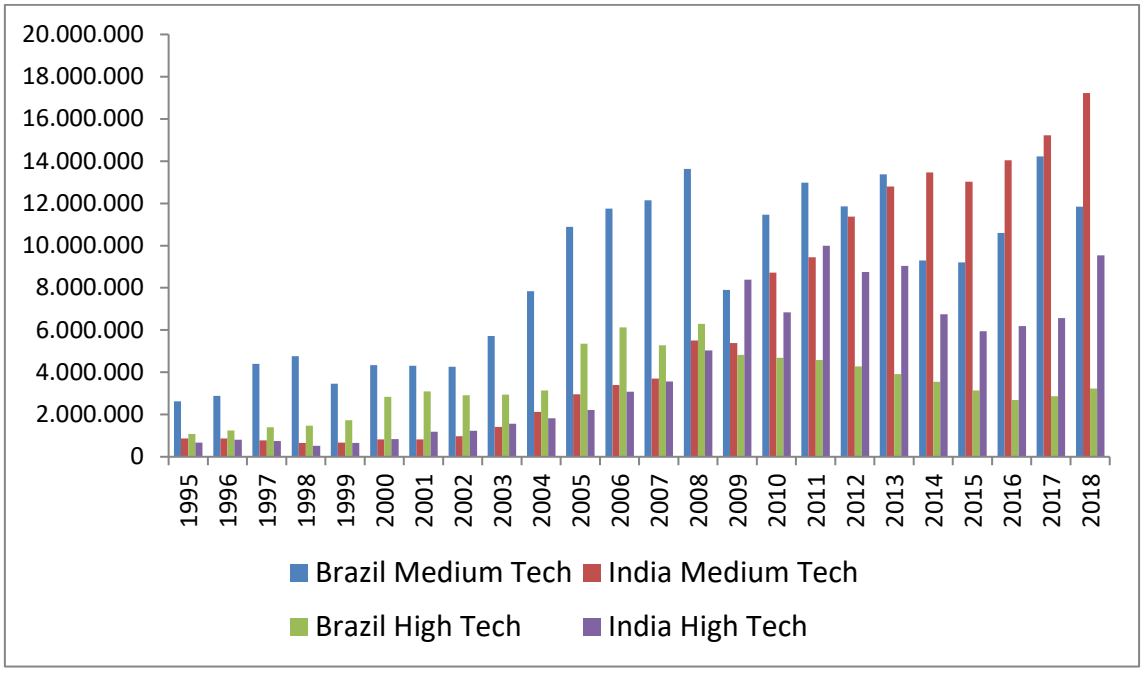
Figure 2– Share of Manufacturing in the GDP (%) – 1980-2014



Source: UNCTAD Stats https://unctadstat.unctad.org

Particularly relevant markers for a transition to the knowledge economy and related skills development of are exports with high and medium technological content. From 1995 to 2017, Brazil and India experienced contrasting trajectories. While Brazil increased its high-tech exports from around $ 1 billion in 1995 to about $ 3 billion in 2017, India increased its high-tech exports from $ 665 million in 1995 to $ 9.5 billion in 2017 (**Figure 3**). The same holds for medium-tech exports when India's figure was less than one billion in 1995 compared to Brazil, with 2.6 billion in the same year. In 2018, Indian medium-tech exports were more than 17 billion in contrast to nearly 12 billion from Brazil. Between 1995 and 2018, the medium-tech exports in India grew by 25 times and four times in Brazil. In short, exports of medium and high-tech (MHT) products never resumed their previous indexes after the 2008 crisis in Brazil, while India managed to give sequence to an exponential growth process initiated in the 2000s, with only a brief hiccup.

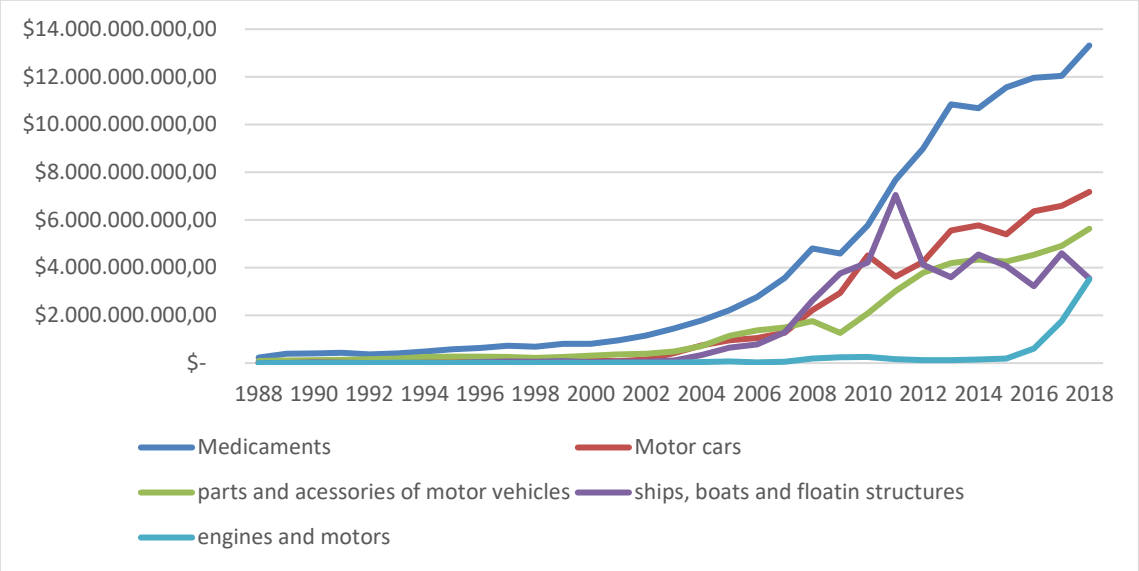
Figure 3 – Medium and high-tech exports from Brazil and India – 1995-2018 ($1,000)



Source: UNCTAD Stats https://unctadstat.unctad.org

Brazil goods trade trajectory is characterized by an increasing dependence on food products (from 25% in 2005 to 36% in 2017) and a loss of importance on the exports of medium and high tech manufactured products (which reached its peak in 2004 when 48% of the manufactured goods exports was in this category). By contrast, when one observes the growth pattern for exports of top five MHT technology products in India to 2018 the main highlight are the continuous and sharp growth of the pharnaceutical sector and the steady growth from 2005 of autos and auto parts and that of ships, boats and floating structures, interrupted after 2011 (**Figure 4**).

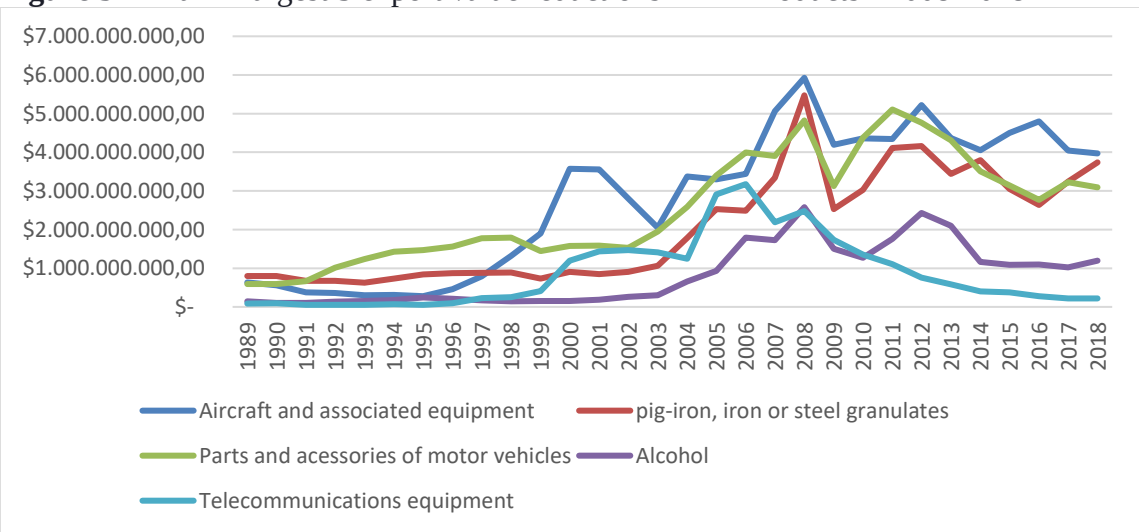
Figure 4 - Export values (5 top MHT products India)



Source: UN Comtrade Database

The overall reduction of MHT products exports by Brazil can be better grasped by looking at the five MHT products with the biggest overall decrease on exports between 2008 and 2018 (**Figure 5**). There's a large impact of products that serve as industrial input (alcohol and steel) as well as a very large and continuous loss of participation in the telecommunications equipment sector, with a more erratic behavior in the aircraft and automotive parts sector.

Figure 5 – Brazil Largest 5 export value reductions MHT Products - 2008-2018

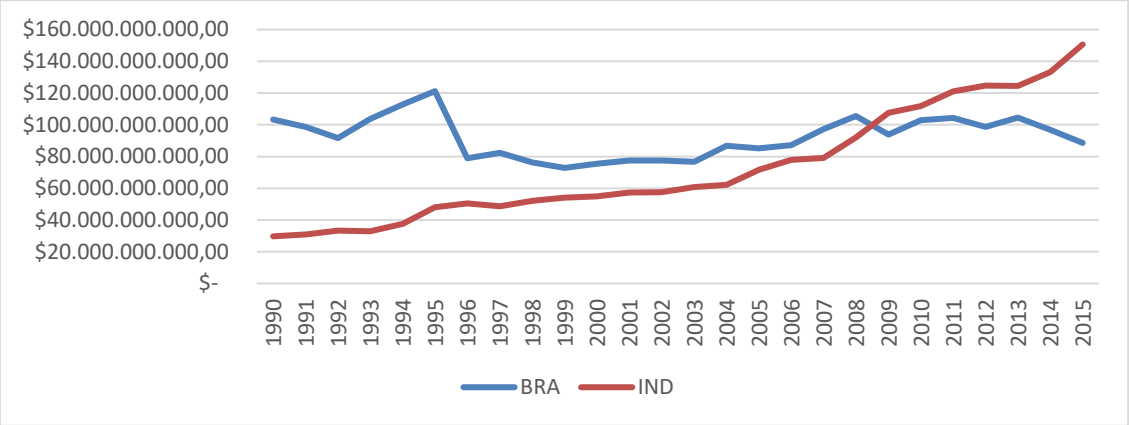


Source: UN Comtrade Database

Moreover, India overtaking Brazil in manufactured goods exports from 2008 was also accompanied by the overall MHT industry value added of India overtaking Brazil

in the same yreart and and India's GDP ultimately surpassing that of Brazil in 2016 (**Figure 6**).

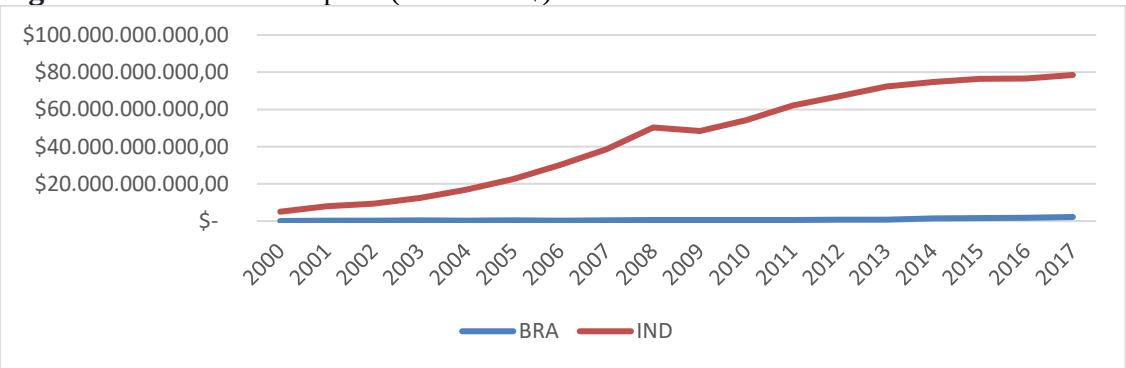
Figure 6 – Medium and High Tech Industry Value Added (2010 US$)



Source: World Development Indicators – World Bank

Further, as the boundaries between services and manufacturing have became increasingly blurred and a larger share of manufacturing value added consists of services, India has become particularly strong in the exports of IT services (**Figure 7**). Between 2005 and 2018, IT services exports rose from $ 17 billion to $ 58 billion. India is usually seen as a case of relative success in the transition to the knowledge economy, identified by the high rates of economic growth (from 2003 to 2018, an average growth rate of GDP per capita of 5.7% per year), with special emphasis on the export of ICT services having been for many years the largest exporter of ICT services in the world, being surpassed by Ireland only in 2017. ICT makes for 47% percent of a total service export of 185 billion dollars in 2017. On the other hand, Brazil does not have an important export service sector, with only $ 34 billion exported in 2017, of which just 6% from ICT services.

Figure 7 - ICT Service Exports (current US$)

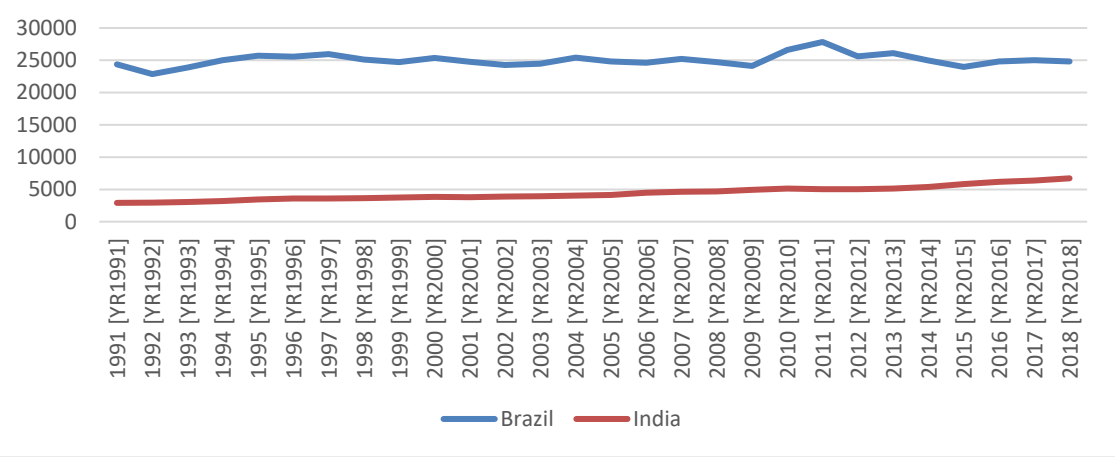


Source: World Development Indicators – World Bank

The contrasting recent trajectories of the two countries seem to reveal a stagnant Brazil and an India that seems to have been better able to adapt to the requirements of a transition to a knowledge economy, with continuous growth in production and provision of services with higher technological content. However, a closer look may lead to a questioning of India's promising results, which coud well be a red herring produced by the country's large population, as evidenced by its lack of capacity to disseminate these fruits to the wider set of workers and economic agents.

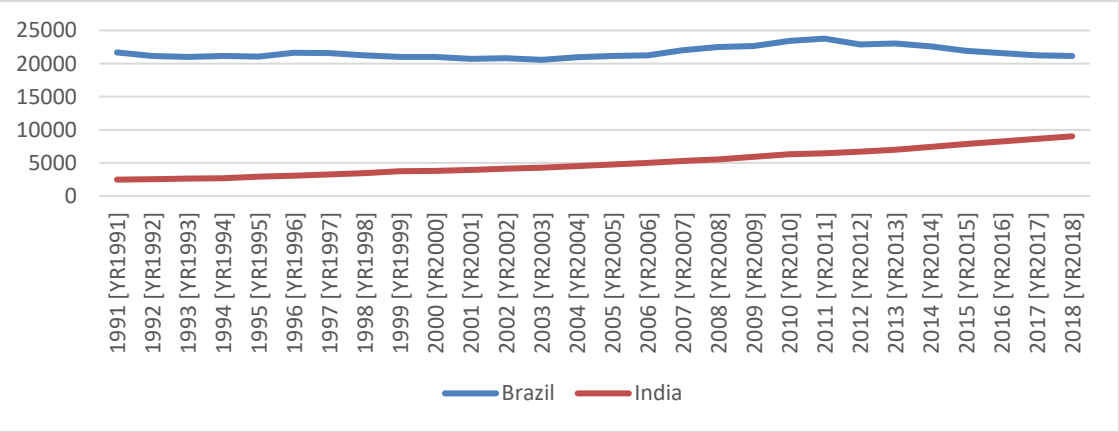
Therefore, in 2018, India's GDP per capita was 20% lower than that of the Brazil. Similarly, although India has a highly developed ICT service sector and a slightly larger share of the medium and high technology manufacturing industry than Brazil, the latter's value added per worker in the industry is four times higher and more than twice as much in services, although here the gap has been narrowing more rapidly (**Figures 8 and 9**).

Figure 8 - Value added per worker in Industry



Source: World Development Indicators – World Bank

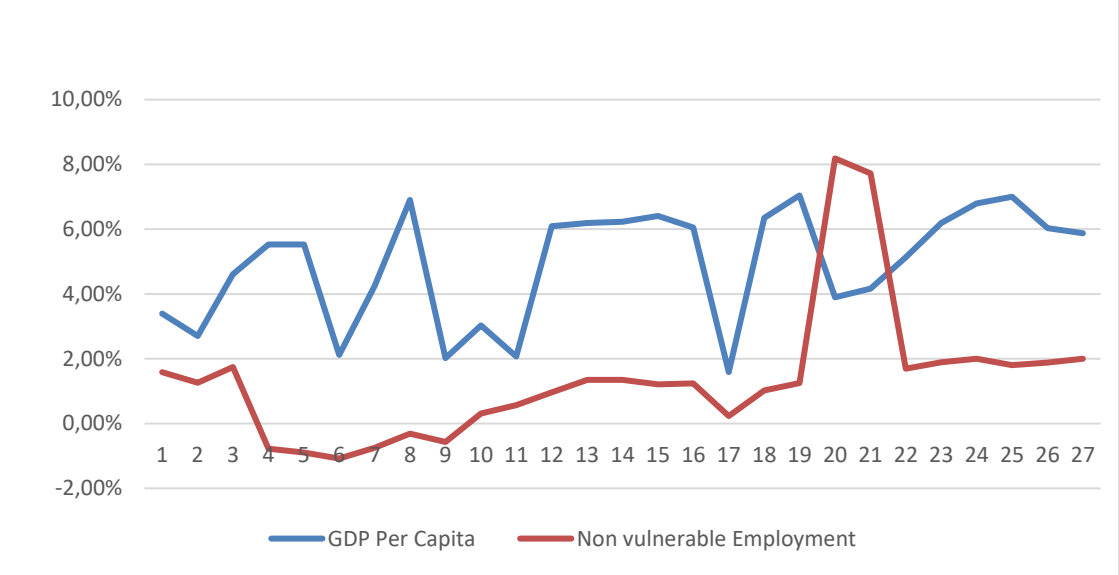
Figure 9 - Value added per worker in Services



Source: World Development Indicators – World Bank

In both countries, the above analysis reveals, increasingly present high-tech sectors coexists with a still very large percentage of backward sectors, with consequences for labour quality and income distribution. In fact, since the nineties, several studies have approached the issue of Indian jobless growth (for example, Bhalotra, 1998; Khanan and Raveendran, 2009 and Abraham, 2019). Indeed, increase in GDP per capita has not been translated into a comparable reduction in vulnerable employment. Between 1991 and 2018, while the Indian per capita GDP increased by 3.66 times in the period, the vulnerable labour rate decreased from 84% to 77% and remains very high in international standards (**Figure 10**). Thus, the capacity of technology intensive growth to reduce already historically high patterns of inequality and exclusion in the country is questioned.

Figure 10 – India GDP Per Capita X Non-vulnerable Employment – 1991-2018



Source: World Development Indicators – World Bank

In Brazil, on the other hand, though starting from a comparatively higher level of income, one observes a stagnation which, from the general point of view of economic growth, has been extant since 2014, but has affected, since 2008, the medium and high added value manufacturing sector. Here, a combination of a continous deindustrialization process (albeit with a small recovery between 2002 and 2005) is identified[6], both with regard to the participation of the industry in the GDP and the percentage of labor dedicated to industry (which reached its lowest point in 2018 since the beginning of the historical series in 1991, with 20.42% of GDP). The

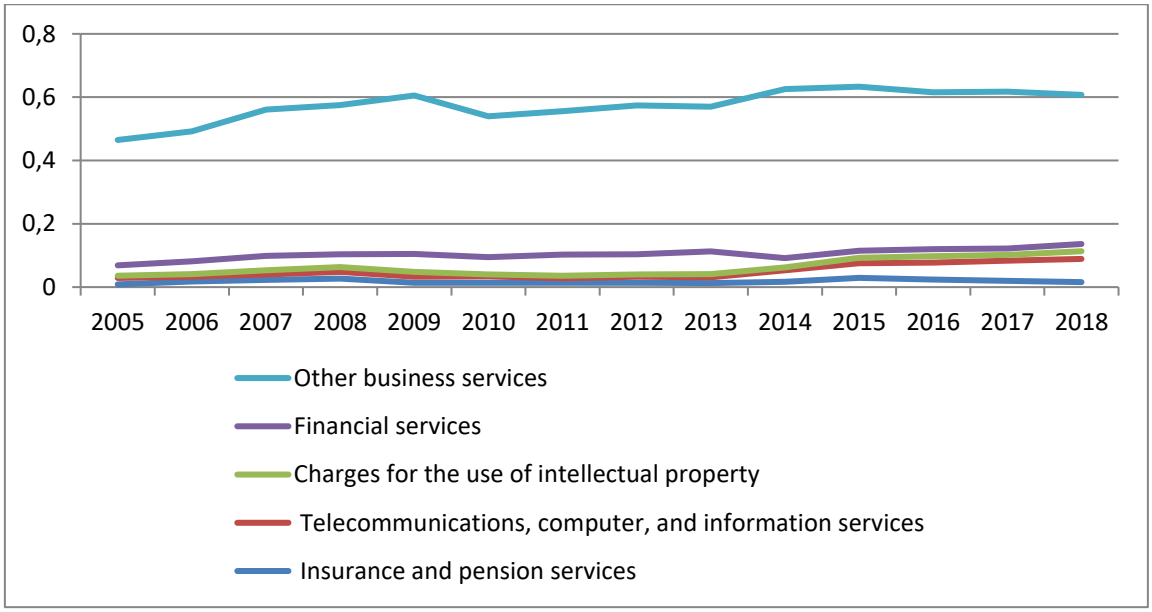
[6] For the debate on deindustrialization in Brazil see Oreiro and Feijo (2010) and Nassif (2012).

deindustrialization is combined with a swelling in the service sector which, in turn, grows without increasing the value added in the activities, as shown above.

This situation is in sharp contrats with that of India, where the growth in the share of the service sector has been accompanied by the sustainability or even expansion of the share of manufacturing sector activities, both in terms of the share of population employed and the percentage of GDP. Such trajectory can be explained, in part, by the constant decrease in the rather large percentages of the occupied population and of the GDP participation of agriculture (in 2018, 44% and 15%, respectively).

Further, an analysis of Brazil's share of knowledge-intensive services in services exports between 2005 and 2018 (**Figure 11**), one observes an increase from 46% in 2005 to 57% in 2018. However, this growth is concentrated in business services, which jumped from 39.6% in 2005 to 47% in 2018. There was also a small rise in telecommunications, computer and information services, which stood at 7% in 2018.

Figure 11 – Brazil Share of Knowledge-intensive services in the services exports in Brazil – 2005-2018

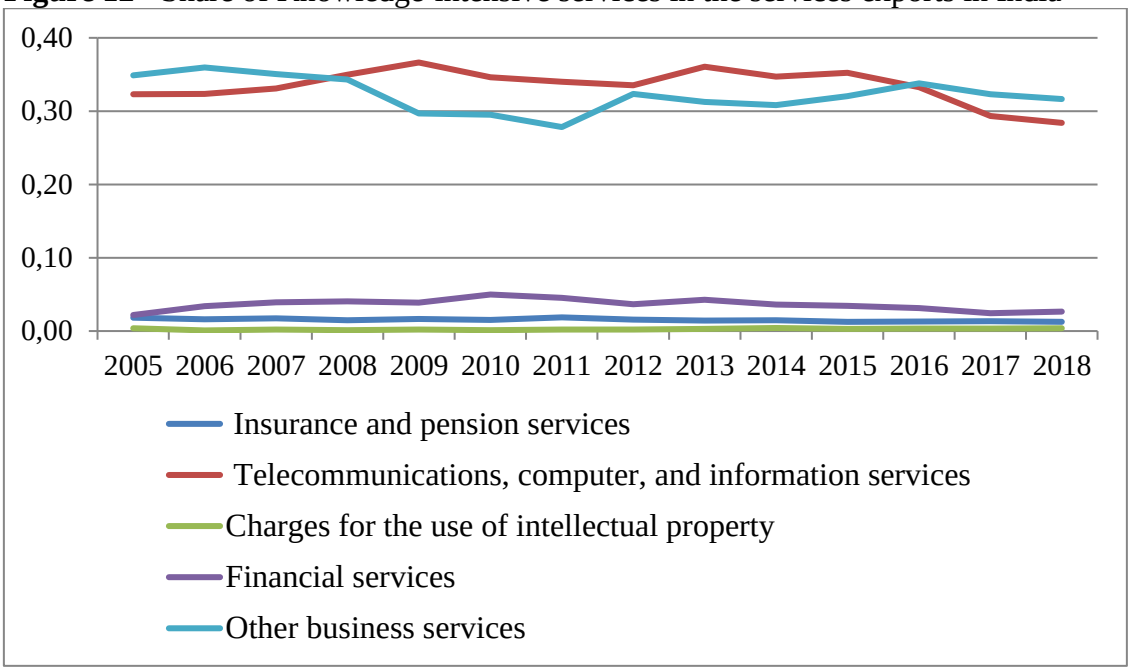


Source: UNCTAD Stats https://unctadstat.unctad.org

In contrast to Brazil, the share of knowledge-intensive services in the services exports in India declined from 72% in 2005 to 64% in 2018. Nevertheless, in absolute numbers, the difference in value between India and Brazil is huge: $34 billion for Brazil in 2018 versus $205 billion for India in 2018. Despite India's relative drop, its share is still larger than in Brazil by 17%. Another point is that the share of telecommunications, computer, and information services was 29% in 2018 a aslight decline from 32% in

1995. Other business services rank first convereging with telecommunications, computer and information services (**Figure 12**).

Figure 12 - Share of Knowledge-intensive services in the services exports in India



Source: UNCTAD Stats https://unctadstat.unctad.org

The contrast in the countries' productive structure evolutionary trajectory is somewhat puzzling in regard to challenges they faced in the transition to a knowledge economy. The next section that compares and constrast their institutional frameworks labor relations and skills formation aims to identify elements that influence this trajectory.

Labor Relations Institutions

A way to obtain a comparative understanding of Brazil and India's labor market is through the concept of dualization (Thelen , 2014). Although developed in a different context to understand divergent varieties of liberalization, its differentiation between the dimension of coordinating capacities (Hall and Soskice, 2004) and the dimension of coverage of these coordination mechanisms prove useful to understanding emergent countries labour market.

Thelen (2014, p.14), taking Germany as her main example, describes one form of dualization as "maintaining strong employment for regular workers while the number of atypical or irregular workers grows". This is a description very similar to those made of

latin-american economies since the work of structuralists in the fifties (Boianovsky, 2010) and, as well, much akin to current understanding of the Indian economy.

In Brazil and India this division can be seen roughly as that between informal and formal workers. One commonly used measure of informality (see for instance La Porta and Schleifer, 2014) takes into account the percentage of self-employed and auxiliary family workers in occupied labor force. This percentage reached 27% in Brazil and 79% in India, according to 2012 data (last year available. This sub-category accounts for a much bigger penetration of such a wage relationship in Brazil than in India, which has in its workforce a large number of peasant and poor self-employed workers.

This factor, however, does not exhaust all labor informalities, as they also exist within the wage relation regime. According to Rodgers (2016), salaried work is segmented through different forms in each country. While in Brazil the split is between workers that have a labor card and are, therefore, registered and those who do not have it, in India, otherwise, there is an usual distinction between casual (daily paid) and regular (monthly paid) workers. Even in this last category, only one third of the workers have formal contracts, leading to an estimated amount of only 12.5% of the registered wage workers, while this total was around 75% for Brazil in 2012 (**Table 1**).

Table 1 - Share of employees and formal employees in the occupied workers.

	Brazil	India
Employees as % of occupied workers	69%	19%
Regular employees as % of total employees		37%
Formal employees as % of total employees	75%	12.5%
Formal Employees as % of occupied workers	51.75%	2.5%

Source: ILO Stats and Rodgers (2016)

We shall now see how different developments of labour market institutions contributed to these outcomes. The cornerstones for the modern labor legislation in Brazil (CLT – Consolidation of Labor Laws, from 1943) and India (Industrial Disputes Act and Factories Act, from 1947 and 1948) are still valid, having passed through several ammendments, which brought divergent institutional outcomes to the present days. In respect to their governance mechanisms, these labour legislations were created based on a relatively high degree of labour protection and a high emphasis on the role of the State as a mediator between the interests of the employees and the employers.

As Cardoso and Gindin (2009, p.1) put for the case of Brazil and other latin-merican countries “the main feature of the IR systems (…) was the fact that the law –

not collective bargaining – played the major role in regulating relationships between the State, labour and capital". Examples of this prevailing role of the government include the "unicidade sindical" (union unity legislation that stipulates a monopoly of representation for a given jurisdiction, with the necessity of registration to government department), prerrogative or arbitration over bargaining by labour courts and the importance on government minimum wage setting in arbitrating labour relation. India trade union legislation has a more open and pluralistic character (Pal and Saha, 2014). But the State has a more present role in labor market legislation, particularly since the 1976 Ammendment on the Industrial Disputes Act, which "made it mandatory for employers to seek prior permission from the government to layoff or retrench any worker, or to close down a unit", a procedure that, from 1982 onwards, has been required to be followed by all units employing 100 or more workers (Pal and Saha, 2014, p.825,826).

When it comes to coverage, both legislations had, from the beginning, dualization embedded in its core. Brazilian CLT was originally applicable only to urban workers of private companies, while the Indian Industrial Employment Act from 1946, established rights as severance payment, only applied to labor workers on industrial establishments with 50 or more workers. Therefore, unregistered and informal work at that time were not illegal but actually envisaged by legislation, which, to what concerns India for this matter, it is still the ruling *modus operandi*.

Departing from similar starting points (high government protection and coordination and high segmentation or dualization) these IR institutions have developed in different directions. Indian legislation has gone through a path of improved employment protection starting from the 1976 ammendment and the increased segmentation that follows it, as the Contract Labour Act from 1971, which increased the possibilities for bypassing labour legislation, allowing the usage of contract labour that lacks anywage commitments. In that manner, even with huge economic growth since the 90s, the organized labour in the private sector further has decreased proportionately (Acharya, 2006, p. 67), with insecure contract labour doubling from 12% of the employed workforcein 1980 to 25% in 2004, according to Harris-White (2010, p134).

In Brazil, by contrast, there has been a gradual movement of enlarging legislation coverage through efforts of enforcement (Araujo, 2018), this is, through legislative changes that, on one hand, have gradually extended urban labour rights towards rural workers (as from 1963 onwards, passing through the promulgation of the new

Constitution in 1988, and later with the regulamentation of some other laws not yet made clear by the Constitution itself) and to housekeeping workers as well, with both groups coming to be granted with the majority of law prerrogatives applicable to all other urban workers, at last. As to housekeeping workers, these law prerrogatives were finally granted to them in 2013. On the other hand, there have also been movements towards flexibilization of labor protection during this 50 years period, particularly the substitution, in 1967, of the work stability statute (used to give full stability after 10 years of steady work) by the FGTS (Guarantee Fund for Length of Service), a mechanism consisting of a monthly money deposit paid by the employer, made available for the worker in case of unfair dismissal.

Overall, both countries' labor legislation reached the current period with very different levels of employment protection according to the OECD Employment Protection Index. Usually political economists (Schneider, 2013, Rueda *et al*, 2015) cluster Brazil together with other latin-american countries with comparatively higher protective labour legislations. However, OECD (2012) ranks Brazil very low on rigidity of employment protection for regular contracts, higher than the liberal market economies of Canada, United States and New Zealand and below all other OECD countries, including the United Kingdom. This low average is explained mainly by a low score in the level of protection for individual dismissals, particularly regarding low procedurial inconvenience, non-strict definition of justified or unfair dismissal and low compensation following unfair dismissal. However, when it comes to the protection for temporary contracts, Brazil appears as the third more restrictive country in the ranking (only behind Turkey and Mexico), especially due to restrictions on valid cases for the use of fixed-term contracts.

India, on the other hand, ranks in the top tier of Employment Protection for regular contracts ranking, but is still below ten OECD countries, mostly the ones considered Coordinated Market Economies (CME), with high scores for procedural inconvenience and possibility of reinstatement following unfair individual dismissals. Also in the rank for temporary contracts, India is relatively highly ranked and remains above OECD average (**Table 2**).

Table 2 - Index of employment protection in Brazil and India

	Regular Employment Protection Index	Temporary Employment Protection Index
Brazil	1,75	4,08
India	2,61	2,54
OECD Average	2,31	2,09

Source: OECD

The main way industrial relations institutions may affect the possibilities of emerging countries transitioning to the knowledge economy is through their impact on the incentives for skill formation. Acording to Estevez-abe et al (2004), the shape of social protection arrangements influences the kind of skills to be developed in a given country. In this manner, a country can either go through a path of development of specific skills, which would require appropriate level of social protection and institutional arrangements or, in its absence, go through a path of development of general skills: "the only way to encourage workers to carry a substantial part of the costs of firm-specific training is to increase job security and/or reduce the insecurity of job loss. Hence we can interpret institutionalized lifetime employment, or subsidies to keep redundant workers within the firm, as safeguarding mechanisms for firm-specific skill investment" (Estevez-abe, et al 2004 p. 151).

Applying such reasoning to industrial relations of the countries studied, we find an absence of incentive for longer job tenures that would foster the development of specific skills. Beginning with the case of India, there is a big pervasiveness of informality, including companies having possibilities to avoiding labour legislation through the use of contract workers, farming-out worker or through splitting themselves into smaller units. Acharya (2006, p.68) asserts that these strategies can be seen as a reality even in the more modern sectors, such as the computer-enabled service industry, major mechanical, electrical or eletronic companies and consumer goods industries.

Harris-White (2010, p.131) adds that the entire industrial clusters making goods for exports are in the informal economy and insecure contract labour is also growing in the pharmaceutical and chemical industry, having for the overal economy increased from 12% of the employment rate in 1980 to 25% in 2004. As described, these legislatives loopholes seem to be strongly used by the most knowledge intensive companies on a opposite way of what could be a successfull dualist strategy to maintaining employment protection on highly specific skill sector.

In the case of Brazil, labor informality also seems to have its influence on low skill development incentives, but it is more related to possible pervasive incentives, for relying on unemployment insurance mechanisms while maintaining informal jobs. This is seemed as one of the causes influencing the extremely high labor turnover rate and short job tenures, considered the highest in the world among countries with comparable measures, and a majour source of labor market ineffciencies (Gonzaga and Pinto, 2014).

Divergences exist on the understanding of the sources and institutional changes required to tackle this issue. While Gonzaga and Pinto (2014) call for a reform on the FGTS and on the unemployment insurance to reduce workers incentives for being fired, DIEESE (2014, p.15) calls for a greater employment protection, particularly legislative changes, in order to impose further restrictions for unfair dismissals and to impose additional taxes on companies with labor turnover above sectoral averages. Whichever is the prognostic, there is a general agreement that current institutions are pervasive and act in disfavour of upskilling.

In a nutshell, this section has shown tthat for both countries, Brazil and India, the development of IR institutions tends to generate unproductive labour market dualization, short-tenure jobs, lack of cooperation between workers and employers. As this configuration is expected to deliver low incentives for skill development, particularly specific skills, the next section discusses how it can mold the efforts to enhance the workers' skills.

Skill Formation Regimes

As discussed earlier, extremely high turnover level and short job tenure, produced by informality and weak legislative incentives, has led to expect low levels of investment in skill formation in the Brazilian and the Indian economies, particularly regarding specific skills. For the division between specific skill regimes (characterized by high levels of vocational education and training) and general skill regimes (characterized by high levels of tertiary university education), a traditional element of VoC analytic framework, it has been recently upended by the developments of the knowledge economy.

Durazzi (2018, p.3), for example, argues that such binary distinction "holds increasingly less explanatory power as enrolment rates in higher education have been booming across countries, including those where this development was least expected." However, both Brazil and India are way behind OECD countries' indicators in both

vocational educational and training and tertiary education, in what conforms a general low skill trap (**Table 3**).

Table 3 - Vocational training and tertiary education

	Brazil	**India**	**OECD Average**
% Vocational Pupils in Secondary Education	4%	1%	19%
Gross Enrollment in Tertiary Education	50%	27%	74%

Source: World Development Indicators, World Bank, 2016[7]

This section presents and discusses the strategies from both countries to overcome gaps in their educational systems. Busemeyer and Trampusch (2012) view of Vocational Education and Training (VET) proposes an analytical differentiation of four varieties in skill formation systems, based on degrees of public commitment and involvement: 1) liberal (skills provided through market mechanisms), 2) 'segmentalist' (firms invest directly in the formation of their employers), 3) statist (VET fully integrated into the general education system), and 4) collective (strong commitment of both state and firms).

As for the labor legislation, the critical juncture for the formation of the Brazilian skill regime was the industrialization pushed by Vargas' government in the 1940s. Assumpção-Rodrigues (2013) describes a battle for protagonism between the government that pushed for industrialists pro financing a government-managed regime, and industrialists against the responsibility for financing vocational training.

Eventually, the dispute was settled with the creation, in 1942, of the so-called "Sistema S" ('S System'). It consists on a 1.5% levy on the payroll, which is collected by the government but managed by a privately appointed board under the control of state industrial federations, which later came to include other branches of the economic activity, without straight connection to the public education system. This policy regime can be considered 'segmentalist' as it has been almost entirely under employers' control, and without much consultation to governments, workers, or trade unions.

As the 'S System' remained almost unchanged until the end of the last century, its lack of capacity to meet demand led to various attempts to raise the level of vocational

[7] Gross enrollment ratio for tertiary school is calculated by dividing the number of students enrolled in tertiary education regardless of age by the population of the age group which officially corresponds to tertiary education, and multiplying by 100 (World Development Indicators – World Bank).

education through the existing public school system at the end of the century, performed mainly through state-level programs[1] and a raise on the offer of private VET. Thus

Assumpção-Rodriguez (2013) shows that in 2007 that the 'S System' accounted for just 14.4% of all students enrolled in vocational training systems, with the remaining of them distributed among public educational institutions (20.6%) and private institutions (61,5%). Although not generally accounted in VET statistics, it is worth noting that the 2000 Apprenticeship Law introduced a mandatory quota of 5 -15% for apprentices hiring in all companies. Because of it, In 2007 the level of apprentices hired by companies under this law went to 386.000, but being concentrated on unskilled occupations such as office and administrative assistant, for example (Almeida, 2019).
Indian skill formation system, by contrast, is characterized by Pilz (2016, p.351) as a "market-liberal system," with the absence of employer commitment and a robust private education sector.

Historically, Rajput (2009) argues, India had a fairly-developed Vocational Education and Training, which was dismantled by the British colonial administration. Since the country's independence, vocational training has not got much attention. Thus Gupta et al. (2016, p.43) state that "vocational education and training has been the blind spot of the central and state governments for the past six decades."

According to Kumar (2016, p.66, 67), in India the leading institution responsible for formal vocational education training are the Industrial Training Institutes, which departed in 1953 from a number of 54 institutions to reach a total of 10,750 institutes in 2014, being 8,475 of them private (with a capacity a little over a million students) and 2,275 public (with a capacity for 490 thousand students). While these institutes are responsible for what is called the craftsmen training scheme, other vocational training modalities are the Apprenticeship Training Scheme (with a low participation of only 211,000 trade apprentices on 28,000 industrial establishments, Gupta et al, 2016); the private agencies that offer unstructured education to the informal sector; and the 'vocationalization' of secondary education, which started to be government-sponsored in 1988, but till nowadays has a very low participation rate in the system.

At the beginning of the twenty-first century, the high levels of growth reached by both countries (although much higher in India than in Brazil) started to draw attention to the problem of intermediary skill shortage (see Cassiolato and Garcia, 2014, for the case of Brazil; and King, 2012 and Majumdar, 2016 for the case of India). As the issue climbed the agenda, Brazil implemented a directly statist strategy with the National

Program for Access to Vocational Education and Employment (PRONATEC) while India struggled to create collective skill formation institutions to implementing its National Skills Development Policy (NSDP).

For our purposes it is possible to summarize PRONATEC strategy in three-axis: 1) continuation of expansion of public vocational education through the expansion of federal network, from 140 to 562 establishments, and through federal incentives to state-level schools; 2) increase to the state supervision on the 'S System' and the increase in the demand for free training provisions and 3) "bolsa formação" (training scholarship), federal government funding for the opening of vacancies for initial (mainly supplied by public institutions) and continuous (mainly supplied by the S System) vocational education.

OECD (2018) states that the program ensured an improvement in training when compared to past governmental experiences, but also pointed out the lack of a more systemic methodology to collect information about training needs. Offering courses according to employers' demand was a practice only in one of the many lines of the program (the most successful one, established in partnership with Ministry of Development, Industry, and Commerce).

Another point is that the expansion of vacancies has not tackled institutional deficiencies in the system, such as a lack of integration between PRONATEC courses and secondary schools' programs, burdening students to concomitant double shifts. State officials recognized it as a second-best solution to cope with the lack of vacancies for integrated secondary vocational schools in the public school network (Cassiolato and Garcia, 2014).

The Indian NSDP, by contrast, has institutional innovation and creation of coordinative capacities, allied with the industry's participation as one of its primary goals and a tool to pursue a bold target to move vocational education from 2% to 50% of the workforce between 2007 and 2022. As to this issue, Kumar (2016, p.65, 66) emphasizes the role played by a World Bank report, dated back from 2008, in the design of the policy.

Chenoy (2013), the CEO of the National Skill Development Corporation of India (NSDC) recounts that the need for involving employers on skill formation was recognized early on 2004, upon the decision to upgrade 1,396 Industrial Training Institutes through a PPP model, a scheme launched in 2007-2008. Participating institutes were required to create an Institutional Management Committee with an

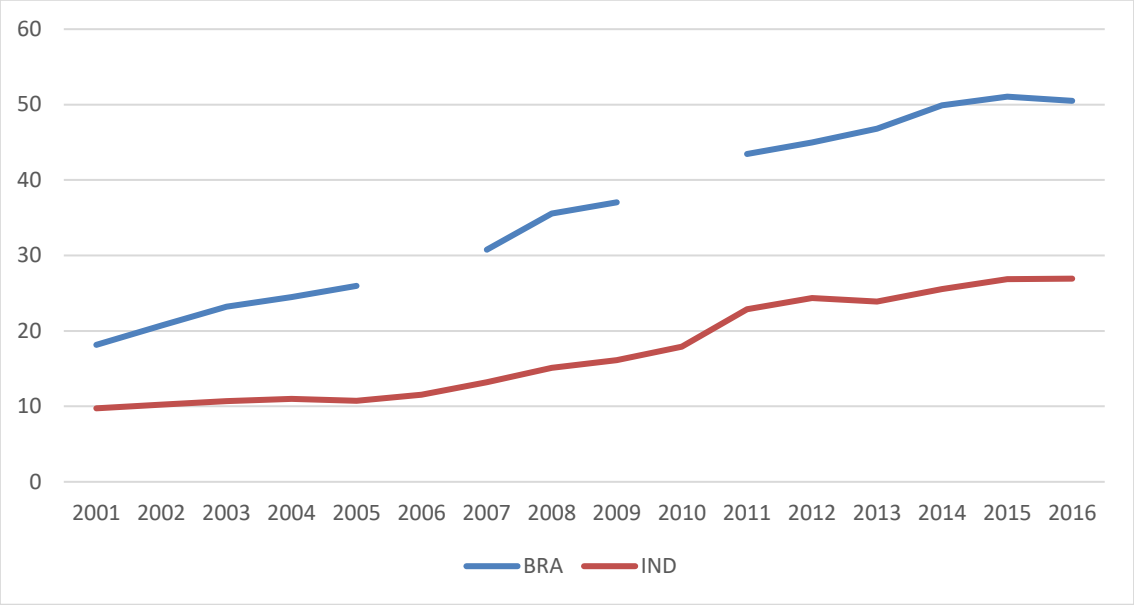
industry partner as chairperson responsible for managing an interest-free loan of half a million dollars, while state governments would retain academic autonomy and regulate fees and admission.

On 2009 the PPP project took a step further with the creation of the NSDC, with 49% government ownership and 51% split between different industry organizations, responsible for managing the National Skill Development Fund. According to Chenoy (2013), the fund's vision is the creation of a social market for skill development under which innovative financing models, such as splitting of payment, with most costs being incurred by students after being hired at the end of the course; charging of placement fees towards employers; and development of a vocational loan product with banks. Industry demand orientation is envisaged through the incubation of Sectoral Skill Councils and Labor Market Information Systems.

Nevertheless, analysts are still skeptical about the capacity for mobilization of the private sector. Pilz (2016, p.348) considers that "in contrast to this state-driven approach, the initiatives for a stronger involvement of employers have been mostly without success (…) and that the initiatives (has) not lead to a stronger activation of employers in vocational education processes so far".

King (2012) suggests that these difficulties are related to a private sector's reliance on cheap unregulated labor, which allows selecting those who would be worthy of investment by training on the job. While Indian NSDC struggles with difficulties of coordination construction and Brazil state-led strategy is hampered by financial constraints and political change, both countries appear to have found a more successful strategy in increasing tertiary education participation, even if numbers remain below OECD average (**Figure 13**).

Figure 13 – Brazil and India - Gross enrolment in tertiary education -2001-2016



Source: World Development Indicators, World Bank

Nevertheless, the success in raising enrollment rates in tertiary education masks issues concerning the quality of education and the capacity of course graduation. Two areas of particular relevance when considering the knowledge economy are the ICT field and, more generally, the STEM courses (Science, Technology, Engineering, and Mathematics). Despite Brazil's overall higher enrollment in tertiary education, India has much more extensive participation of graduates in STEM courses and a much higher completion for ICT courses.

The Indian Pharmaceutical Sector

The Indian pharmaceutical industry is the world's 8th most significant in terms of revenues (2.5% of global share), the world's third-largest of drugs by volume, and has had the highest growth rate over the past decade[8]. Indian pharmaceutical sector industry supplies over 50% of the global demand for various vaccines, 40% of generic demand in the US and 25% of all medicine in the UK. Indian drugs are exported to more than 200 countries in the world. Generic drugs account for 20% of global exports in terms of volume, making the country the largest provider of generic medicines globally and expected to expand even further in the coming years. India's pharmaceutical exports stood at US$ 19.14 billion in FY19 and US$ 3.1 billion in FY20 (up to June 2019).

In FY18, 31% of these exports coming from India went to the US. India's domestic pharmaceutical market turnover reached US$ 18.12 billion in 2018, growing 9.4% year-on-year (in Rs) from US$ 17.87 billion in 2017. In February 2019, the Indian

[8] Indian Pharmaceutical Alliance. The Indian pharmaceutical Industry – the way forward. June 2019.

pharmaceutical market grew by 10% year-on-year. With a 71% market share, generic drugs form the largest segment of the Indian pharmaceutical sector. However, 50 to 65% of the population does not have regular access to essential medicines, and the majority of the healthcare expenditure is out-of-pocket, a significant proportion of which is spent only on medicines. A significant factor contributing to high drug prices in India is the unreasonably high trade margins.

The Industry's journey to annual revenues of about USD 38 billion today can be attributed to world-class capabilities in formulation development, the entrepreneurial ability of the firms and the vision of the Industry to establish India's footprint in large international markets such as the United States. India has the highest number of manufacturing facilities (332 sites) approved by the US FDA. Indian pharmaceutical companies have manufacturing opportunities in two segments - formulations and bulk drugs. The Industry is dominated by exports (in both bulk drugs and formulations), which contributed about 60 percent to the Industry's sales in 2013-14[9].

Over 100,000 drugs, across various therapeutic categories, are being produced in India. The domestic formulations industry is highly fragmented, in terms of both the number of manufacturers and a variety of products. There are 300-400 organized players and about 15,000 unorganized players. However, organized players dominate the formulation market in terms of sales.

Government policy has played an essential role in this development and continues to evolve[10]. Recently, the Draft Policy Paper-2017 recognized that medicines manufactured and sold in India for domestic consumption had issues of quality problems and that there were needs for fixing the problem, which constitutes a paradigm shift in the government attitude. Further, the Draft Policy-2017 states that the government aimed to guide and nurture the Industry to enable it to maintain and enhance its competitiveness in quality and price on a global context. For achieving these

[9] USA (with a share of 30.9 percent), Russia (4.8 percent), South Africa (4.3 percent), UK (3.6 percent) and Nigeria (3 percent) are the major export destinations for India's drug formulations and biological products during 2013-14. In the year 2013, the USA imported pharmaceutical products worth US$ 63 billion. India is the fifth-largest supplier of drug formulations and biological products to the USA. The USA made up to a share of 39.1 percent in India's total exports of drug formulations and biological products in 2013. The USA is also a significant market for bulk drugs exports from India, accounting for 71 percent of India's total bulk drug exports to North America. Export-Import Bank of India. Study on Indian Pharmaceutical Industry. Working Paper No. 37. March 2015.

[10] Prasanta Kumar Ghosh, Government's Policies and Growth of Pharmaceutical Industry in India 1947-2018: A Review. Discussion Paper # 236. RIS Research and Information System for Developing Countries. January 2019; Nisha Chandran and Samir K. Brahmachari, "Policy as a driver of economic growth: historical evidence from the Indian pharmaceutical industry." Current Science, 114(6), 25 March 2018: 1181-1193.

objectives, the proposal was to move away from price control of medicines to price monitoring.

Recent initiatives from scientific departments such as through the Biotechnology Industry Research Assistance Council (BIRAC) and the Biotechnology Industry Partnership Programme (BIPP) of the DBT as also the New Millennium Indian Technology Leadership Initiative (NMITLI) and the Open Source Drug Discovery (OSDD) of CSIR aim to promote developmental skills. The government recognized that the human resources/talent pool is critical and established the National Institute of Pharmaceutical Education & Research (NIPER) at SAS Nagar (Mohali). Subsequently, during 2007-08, six new NIPERs were started at Ahmedabad, Guwahati, Hajipur, Hyderabad, Kolkata, and Raebareli with the help of Mentor Institutes. A NIPER at Madurai began in 2012. During 2015-16, Finance Minister in his Budget Speech announced three new NIPERs for the states of Chattisgarh,

Maharashtra and Rajasthan. The seven NIPERs have graduated 4,655 students (M Pharma- 3,905; 486 – MBA (Pharma); 264 – PhD) and have signed more than 30 MOUs signed with Industries, and had 15 patents filed, had 2,462 research papers published.[11].

India accounts for 20% of global exports in generics. India's pharmaceutical exports stood at US$ 17.27 billion in 2017-18 and are expected to reach US$ 20 billion by 2020. In 2018-19 these exports were expected to cross US$ 19 billion. The country's pharmaceutical industry is expected to expand at a CAGR of 22.4% over 2015–20 to reach US$ 55 billion. India is the second-largest contributor of global biotech and pharmaceutical workforce. The pharmaceutical sector valued US$ 33 billion in 2017.

The domestic generics market is expected to reach US$ 27.9 billion by 2020. India's generics market has immense potential for growth. Indian pharmaceutical companies received record 300 generic drug approvals in the USA during 2017 where the generic market is expected to reach US$ 88 billion by 2021.

By 2024-25, India's biotech industry is estimated to increase to US$ 100 billion. Increasing private sector investments in R&D and acquisitions are driving the sector's growth. In FY18, Indian pharma companies invested 8.8% of their sales in R&D[12]. Even at current rates of seven to eight percent CAGR, the industry's annual revenues can grow to about USD 80 to 90 billion by 2030.

[11] Government of India, Ministry of Chemicals & Fertilizers, Department of Pharmaceuticals. Annual Report 2017-18.
[12] The Pharmaceuticals and biotech sector has the highest R&D Intensity (R&D as a percentage of net sales – 2016) of 15.0%, followed by Software and computer services at 10.6%.

While shaping global and national public health outcomes[13], the industry has contributed to India's economic growth. Estimates suggest that the industry, directly and indirectly, employs over 2.7 million people, in high-skill areas like R&D and manufacturing. It is amongst the top five sectors contributing to the reduction of India's trade deficit. It has attracted more than USD 2 billion in FDI inflows over the last three years, making it one of the top eight sectors attracting FDI. Up to 100%, FDI in the pharmaceutical sector is permissible through automatic route for greenfield investment and up to 74% for brownfield sector. Beyond 74% FDI in the pharmaceutical sector for Brownfield investment is permissible through the Government approval route.

The Pharma Vision 2020 aims at making India a global leader in end-to-end drug manufacturing. The Indian pharmaceutical industry spurred its growth driven by an acceleration of the goal of universal health care across India and the world by providing access to high-quality, affordable drugs. Under Budget 2018-19, allocation to the Ministry of Health and Family Welfare increased by 11.5% to US$ 8.16 billion. Indian pharmaceutical sector is expected to grow at a CAGR of 15 percent, and medical device market expected to grow $50 billion by 2025[14].

The Indian Government Department of Pharmaceuticals is preparing an umbrella 'Scheme for Development of Pharma industry' comprising the following: (a) Assistance to Bulk Drug Industry for Common Facilitation Centres; (b) Assistance to Medical Device Industry for Common Facilitation Centres; (c) Assistance to Pharmaceutical Industry (CDP-PS); (d) Pharmaceuticals Technology Upgradation Assistance Scheme (PTUAS) and (e) Pharmaceutical Promotion and Development Scheme (PPDS)[15][2]. As per the Pharma Vision - 2020 of the Department of Pharmaceuticals, following goals have been set for the 12th Plan Period concerning SMEs: 1- Upgrading of SMEs to WHO-GMP and training of professionals therein; and 2-Establishment of Pharma Growth Clusters.

There is a need to focus on skill development and training of personnel for the pharmaceutical and life sciences industry. Skill development requires training in various functional disciplines in the industry, such as analytical, manufacturing, and quality

[13] India accounts for 60 percent of global vaccine production, contributing 40 to 70 percent of the WHO demand for Diphtheria, Tetanus, and Pertussis (DPT) and Bacillus Calmette–Guérin (BCG) vaccines, and 90 percent of the WHO demand the measles vaccine. Estimates suggest that an Indian generics manufacturer produces one in every three pills consumed in the United States.

[14] Indian Pharmaceuticals Industry Report (June 2019).

[15] Government of India, Ministry of Chemicals & Fertilizers, Department of Pharmaceuticals. Annual Report 2017-18.

management. There is an acute dearth of qualified personnel in regulatory norms governing the pharmaceutical industry, e.g., filing of New Drug Application (NDA), negotiation skills, documentation, regulatory requirements, and statistical techniques. Hence, such these disciplines should be in the academic syllabus of pharmaceutical training institutions. Also, the National Institute of Pharmaceutical Research and Education (NIPER) and the National Skill Development Council (NSDC) may develop training centers and modules mainly catering to the pharmaceutical industry[16][3].

They are pursuing opportunities in newer product classes such as biosimilars, gene therapy, and specialty drugs. Until now, the Indian pharmaceutical industry's success has been mainly due to the production of generics drugs. Successes in the developments at the scale of next-generation product classes such as gene therapy and specialty drugs were limited. Spurring innovation in these product classes can usher-in the next leg of growth for the Indian pharma industry. For example, the biosimilars market could exceed USD 60 billion by 2030. Pharmaceutical companies, however, will have to take a long-term view.

It means to capitalize on its rich demographic dividend as India has a large skilled, and cost-efficient workforce. Over 225,000 pharmacy students graduate from India's education system (compared to just about 17,000 pharmacy students graduating in the US). The workforce includes highly skilled medical practitioners and specialists who bring significant expertise and actively contribute to clinical research. Moreover, the availability of a diverse patient pool makes India one of the most potential destinations for clinical research. Additionally, labor cost efficiencies provide a significant competitive advantage to the Indian companies since their workforce costs are, on average, about 33 percent less than their western counterparts.

> "On the R&D front, India has done excellent innovative work on the development of non-infringing newer processes for manufacturing a wide range of patent-expired APIs, and have been able to produce for sale, both for local consumption as well as for exports. The present Patents Act 2005 enables companies to protect their innovations. The R&D expenditure can have a claim for deduction of expenses with R&D u/s — 35 (2AB) of the Income Tax Act. The average R&D of all companies is, however, low, below 5% of sales. As the size of the companies is not large, the fund allocated by each company is significantly small to work for the NCEs and new APIs. More than 120 numbers of NCEs have been invented,

[16] Export-Import Bank of India. Study on Indian Pharmaceutical Industry. Working Paper No. 37. March 2015.view, about 8 to 10 years, to capture these opportunities, since investments in these technologies have high gestation periods. It may also need conducive investment environment in the domestic market to be able to do so.

which is commendable, and they are being evaluated through various stages of clinical experimentation. Otherwise, it would not be easy to come out with new APIs for global use; firstly because individual monetary strength of each company for such an aim is low; and secondly, the number of NCEs for new API development for global use, which has been invented, is considered small in number." (Gosh 2019: 51)

Table 4 below presents how Brazil stacks up against India in the pharmaceutical sector. Industrial production levels are similar in both countries. However, there are important differences in market structure. Brazil's sales per capita are ten times larger than India, signaling the earlier stage of the Indian market and thus its formidable growth potential as health services universalization and incomes grow. Second, conversely, Indian pharmaceutical exports are ten times larger than Brazil's.

Next, Brazil's larger and more mature domestic market has a trade deficit of about half of the size of India's surplus. Although India's production is about 25% larger than Brazil, it employs 5.5 times more people. India's gross value added is roughly three times higher than Brazil. However, the value-added per employee in Brazil is almost double that of India, signaling higher labor productivity.

Table 4: Pharmaceutical Industry in Brazil and India -2014

	Brazil	**India**
Pharmaceutical sales (USD per capita)	127.9	12.1
Total pharmaceutical sales (USD per capita)	26.35	15.63
Pharmaceutical industry production (USD Billion)	20.65	25.43
Pharmaceutical exports (USD Million)	1,284.01	11,333.18
Pharmaceutical imports (US$ Million)	7,040.11	1,487.41
Pharmaceutical trade balance (US$ Million)	-5,756.10	9,845.77
Number of employees	105,253.03	587,468.59
Wages and salaries (USD Million)	1,460.32	3,441.70
Gross value added (USD Million)	5,926.36	17,766.44
Value added per employee (USD)	56,305.84	30,242.37

[1] Globally, the production value of the pharmaceutical industry amounted to USD 997 billion (2014), over USD 345 billion higher than in 2006. In 2014, the pharmaceutical industry accounted for 3.8% of the gross value added in manufacturing worldwide. [2] Gross value added is the value of the products manufactured by a company less the value of its purchased materials and services, reflecting the additional value generated by the production process. Source: International Federation of Pharmaceutical Manufacturers & Associations IFPMA, the pharmaceutical industry and global health - Facts and figures 2017.

The Indian ITeS Sector

India's digital economy generates about $200 billion of economic value annually — 8% of India's GVA in 2017–18 — largely from existing digital ecosystem comprising information technology and business process management (IT-BPM),

digital communication services (including telecom), e-commerce, domestic electronics manufacturing, digital payments, and direct subsidy transfers. A recent article on a report on the industry states:

> "By 2025, India could create a digital economy of $800 billion to $1 trillion (value equivalent to 18-23 percent of the country's nominal GDP). The existing digital ecosystem could contribute up to $500 billion of economic value, but the potential economic value for India could be as much as double that amount — almost $1 trillion— if digital technologies are used to unlock productivity, savings, and efficiency across more diverse sectors such as agriculture, education, energy, financial services, government services, healthcare, logistics, manufacturing, trade, and transportation,"

According to Prasad, while India's e-commerce market grew to $35 billion, growing at 17% year-on-year in 2018 as much as two-thirds of that growth came from catchment areas in rural India, because "they don't have malls"[17].

Indias's information technology (IT) sector, specialized in IT-enabled services (ITeS), contributes to 7.7% to its GDP and to third ranking Foreign Direct Investment (FDI) share. The $154-billion IT sector has grown five-fold in FY17-18: IT Services ($86bn), Business Process Management (BPM) ($32bn), Software Products and Engineering services ($33bn) and Hardware ($15.40bn)[18]. Exports drive the industry ($126bn), and the domestic market accounts for less than a quarter representing ($41bn)[19][3].

> "Of the 10 top software service companies globally ranked by market cap, five are Indian. Of the top five, three are Indian. All of them have a massive presence in India. Of the total number of employees, amounting to nearly 2 million, in these top 10 companies, about 70 percent are based in India or travel out of India. The Indian offshore software industry dominates the software services world and has no parallel."[20][4]

The country is one of the largest global outsourcing destinations across the globe, with a 55% market share[21][5]. Main markets are USA (62%), UK (17%), Continental Europe (11%), Asia Pacific (8%) and 2% rest of the world. It will see revenue growth of

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[17] 'Digital economy a $1-trillion opportunity for India' Varun Aggarwal/ Venkatesh Ganesh Mumbai | Updated on February 20, 2019, Published on February 20, 2019. https://www.thehindubusinessline.com/info-tech/digital-economy-a-1-trillion-opportunity-for-india/article26323150.ece

[18] CAGR of 10.71% to US$ 167 billion in FY18 from US$ 74 billion in FY10.

[19] Export revenue of the IT industry grew to US$ 126 billion in FY18 from US$ 117 billion in FY17. It is further expected to increase 7-9% YoY, to US$ 135-137 billion in FY19. Export of IT services is the major contributor, accounting for 55.6% of total IT exports (including hardware) during FY18. ITeS and Software products accounted for 22.2% of total IT exports during FY18, respectively.

[20] https://www.ndtv.com/opinion/no-obit-needed-our-software-industry-is-alive-and-kicking-1474789

[21] US$ 185-190 billion global services sourcing business in 2017-18. India acquired a share of around 38% in the overall Business Process Management (BPM) sourcing market.

7-9% in software services exports (in constant currency terms) in the fiscal year to March 2019. The sector employs 4.2 million people and added 100,000 new jobs in FY2018. It is expected to grow to US$350bn by 2025.

The country has more than 1,000 deliveries center in about 200 cities and 80 countries for IT services. For example, in 2015, Siemens Industry Software India Pvt. Ltd. (SISW), 100% subsidiary of Siemens product lifecycle management (PLM) Software (USA), announced the inauguration of its state-of-the-art Siemens PLM Software Global R&D Center in Baner, Pune, as the Asia-Pacific infrastructure hub focused on cutting-edge software product development. Further, the IT industry contributes to 37% of venture investment and equity funds in India.

However, the IT sector is weak on IT hardware and software products ($ 10 billion net trade deficit in software products), IT companies neglect engineering and R&D services and there's too much emphasis on low-end ITeS.

The factors behind India's successful competitiveness and sustained growth in ITeS include: young and skilled IT development manpower, lower IT wages (8x-10x lower than in developed nations), work quality and management efficiency, education and global exposure, government initiatives, academics and institute research and development of IT and the fact that globally banking and financial services are aiming toward new investment opportunities.

IT companies have adopted the global delivery model and set up development centers in Latin America, South East Asia and Eastern European countries to take advantage of low cost and also cater to the local market. In the US, such centers will help mitigate the risks of the new immigration bill and increase the probability of winning projects in highly regulated sectors such as healthcare, government services, utilities etc. Administrative services (payroll, help desk, credit card processing, etc.), which used to provide major chunk of revenues to the domestic IT players, has been severely affected due to the falling billing rates and companies are moving into high value services such as the new digital services.

In recent years, however, slowdown in technology spending affected growth, while uncertainty looms over work visa rules in the United States, the biggest market for Indian software services firms. Saikat Chaudhuri, executive director of Wharton's Mack Institute for Innovation Management, adds:

> "Essentially, Indian IT firms have been stuck in the middle; they are not low-end providers anymore with low costs, neither have they been able to propel

> themselves to become high-end providers performing core work and high-margin services. At the same time, on the technology side, automation threatens to render obsolete much of the labor arbitrage work on the lower end; while political changes such as protectionism compound the problem."

Still the sector strong and active trade group National Association of Software and Services Companies (NASSCOM) remains optimistic can weather the current uncertainty by moving from low-margin businesses such as server maintenance to more sophisticated work such as artificial intelligence (AI). An emerging constraint, though, is finding fresh talent to work on AI-driven solutions[22].

In late 2018, the Indian government launched National Policy on Software Products (NPSP 2019) targeted to the Indian software products sector, to generate 3.5 million jobs by 2025, worth $7-billion and growing at a rate of 9.5% annually, with 3,720 companies.

> "The policy aims to develop India as a global software product hub, driven by innovation, improved commercialization and sustainable IP. It will also promote technology start-ups and specialized skillsets for the development of the sector. NPSP hopes to nurture 10,000 technology startups in software product industry, including 1,000 such technology start-ups in Tier-II and Tier-III towns and cities and generate direct and indirect employment for 3.5 million people by 2025….develop 20 domain-specific Indian software product clusters around the existing industry concentrations, such as in automobile, textile, financial services, electronic manufacturing and energy."[23]

In order to meet these goals, NASSCOM has launched an ambitious, skills upgrading program, as shown in the table below (**Table 5**).

Table 5 – India Government and Industry Associations Programs – Auto, Textile and IT

[22] NASSCOM launched the program "Product Mission 2020", to support the process of creating foundation for world-class products in new technologies and product businesses in India over the next two years. T joins its other programs like Nasscom FutureSkills, Nasscom Accelerate 10X, Nasscom 10k Start-ups etc., to enable start-ups and software product businesses access to mentoring, international markets and opportunities.

[23] https://eandt.theiet.org/content/articles/2019/03/view-from-india-software-product-industry-to-generate-employment-for-35-million-people-by-2025/

Exhibit 6

Government and industry associations support in accessibility, infrastructure and resources has helped drive growth in Auto, Textile and IT industries

Policy initiative	Lever	Impact
FAME I and II (Faster Adoption) and Manufacturing of (Hybrid) and Electric Vehicles in India	**Demand generation and Accessibility:** State-led demand aggregation by including EVs in the public transportation system of 11 states (busses), enhanced adoption of EVs through affordability (price reduction to purchasers) and accessibility (investment in charging infrastructure)	**2,61,507 vehicles** covered under FAME in 2018; increased from 5,197 (2015)
Technology Upgradation Fund Scheme for the Textile Industry	**Facilitate technology upgradation through** credit-linked capital investment subsidy to make the textile industry globally competitive, and to reduce capital costs for the textile industry	**INR 5,226 crore** Investments made under the scheme with expected employment generation of 45,659
Online Skilling Platform, Future skills by NASSCOM	**Upskilling college graduates and industry personnel in emerging technologies** such as internet of things (IoT), robotic process automation (RPA), virtual reality, big data analytics, cloud computing and 3D printing	**~2 Lakh members** upskilled until Oct 2018 (3 months). Potential to train 20L, NASSCOM in discussion with MeitY to co-fund the skilling service platform and open up for general use (B2C)

Source: NASSCOM Report (Catalyzing the Ecosystem for A Trillion Dollar Digital Economy). FAME-India Scheme (PIB), Implementation of Amended Technology Upgradation Fund Scheme (PIB), IBPS Website (MeitY)

Table 6 below presents the major market and industrial contrasts between Brazil and India in this sector (as well as China and Israel). Beyond the main difference in market orientation – Brazil focused on the domestic market and India on exports and body-shopping – India's main advantages lies in its abundanced of relatively skilled labor and English language proficiency. Also, India is one of the largest visa recipients with 1,253 H-1B visas in the United States compared to 126,000 H-1B visas to Brazil in 2016[24]. Such a massive number of workers obtaining this sort of visa has a particular impact on the IT industry by encouraging the formation of international informal networks between India and the USA.

[24] See https://www.forbes.com/sites/niallmccarthy/2017/04/19/india-and-china-accounted-for-82-percent-of-u-s-h-1b-visas-in-2016-infographic/#655e81635344

Table 6 – IT Industry Differences - India, Brazil, China, and Israel

	Brazil	China	Israel	India
Market Orientation	Focus mostly on serving domestic market	Focus mostly on serving domestic market	Focus mostly on exports	Focus on exports and body-shopping
Strength	The presence of lead domestic client sectors for software firms provides opportunities for learning and competence deepening, a necessary preparation if you want to effectively compete at a global scale	Strong government support especially to local companies. The large size and broad, rapid economic growth of the Chinese economy and its increasing use of IT has generally benefited the industry by providing demand for software	A highly innovative industry due to significant involvement of the academia in the high-tech industries and the highly advanced level of scientific research conducted in the country. Massive inflow of foreign direct investment in terms of venture capital from American investors	Abundance of skilled labour Strong government involvement in terms of setting policies which have been favourable to the software industry. The time zone difference between India and US, which provided an opportunity for providing round-the-clock services -A large body of English-speaking personnel allowing them to swiftly operate in the international space
Challenges	The pressure of global competition as other international software companies start penetrating the Brazilian market. Most of the Brazilian software companies have no international recognition making it difficult for them to compete globally. The language barrier makes it difficult to expand in the region as well as worldwide	The local and fragmented nature of most operators has significantly hindered their growth into large scale, specialised software manufacturers which is essential considering the growing interest of international firms to break into the Chinese market. The language barrier making it difficult for Chinese firms to expand into global space	Lack of market diversity, since the industry relies mostly on American investors or exports to America	Slow rate of adoption or integration of the software industry to other local economic sectors. A limited domestic market as well as lack of firm-to-firm interaction within the local space which seems to hamper the innovativeness of the industry
Sources	(Arora & Gambardella, 2006; Botelho, Stefanuto, & Veloso, 2005; Breznitz, 2005; Nusca, 2012)	(Commander, 2005; Kshetri, 2005; Tschang & Xue, 2005)	(Breznitz, 2005; IVC Research Centre, 2013; Tessler et al., 2003)	(Arora & Gambardella, 2006; Athreye, 2005; Chaminade & Vang, 2008; Parthasarathy, 2004, 2010; UNCTAD, 2012)

Source : Mwalemba (2013)

However, one must also note the continued labor cost advantage of India, although its export market segments generally have a lower value-added than Brazil's main domestic markets. As shown in **Figures 17 and 18** below, between 2014 and 2019, wage differences between the two countries have persisted, with Indian annual salaries for somewhat comparable IT managers/software engineers one-third to half those of Brazilians.

Figure 17 - IT managers salaries across countries - 2004

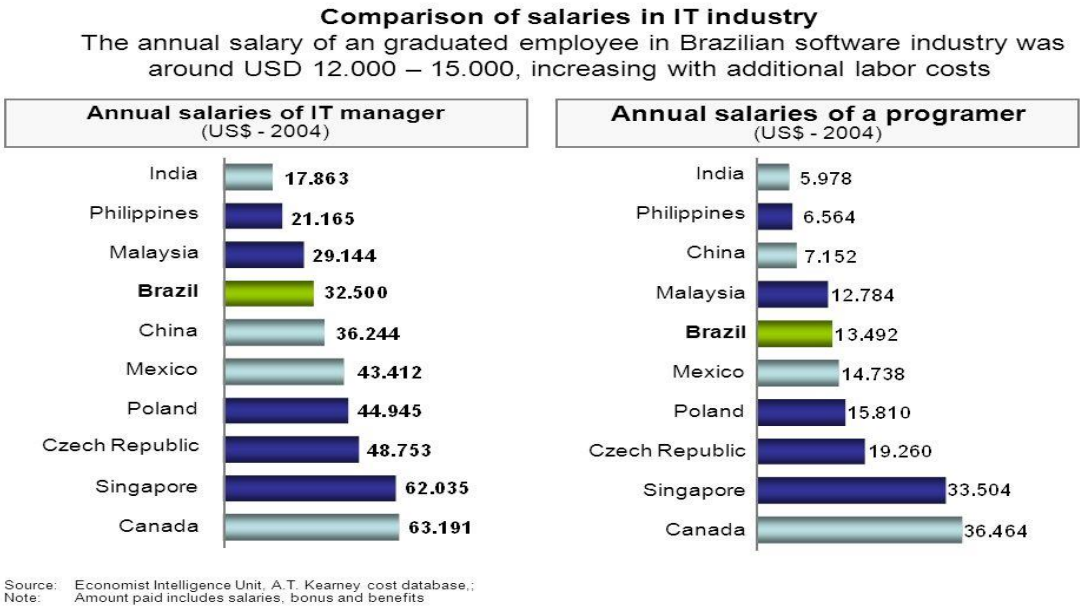
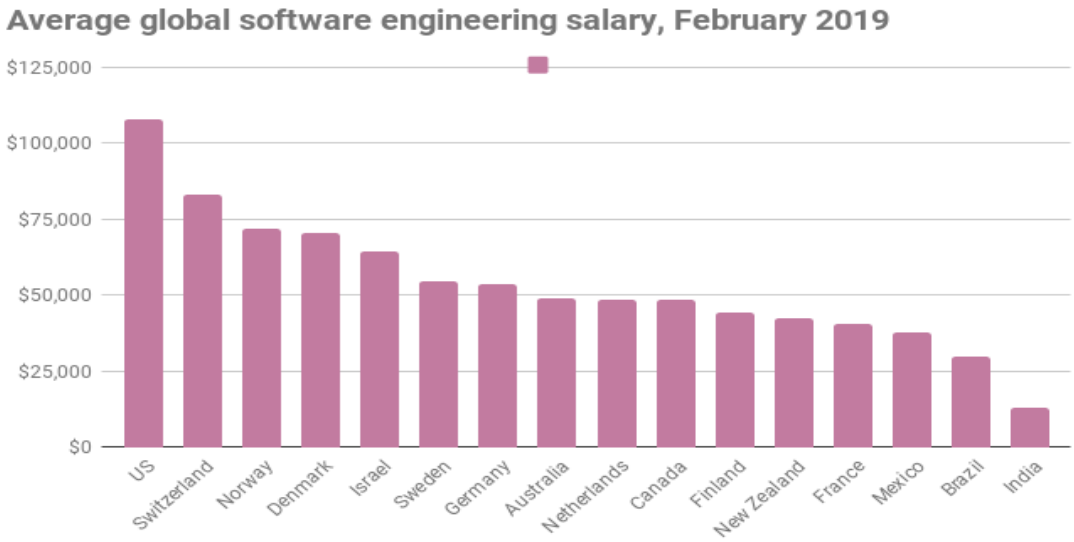


Figure 18 – Average global software engineering salary – February 2019



Source: goodfirms.com in https://kitrum.com/blog/kitrum_opens_new_office_in_mexico_city/

Conclusions

India appears to be forging ahead of Brazil in the transition to the knowledge economy. From the 2008 financial crises, Indian medium and high-tech exports surpassed those of by Brazil by 2018. Brazil's long-term competitiveness decline can in part be attributed to broader domestic structural factors as the country accelerated its transition to a service economy. Over the period 1995 to 2011, manufacturing value added (% of GDP) in Brazil continued its downward trend (albeit at a lower rate) from 1990 (29.3% versus 30.3% in 1980) to reach its lowest 10.3% in 2014. By contrast, India's share experienced little change during the long period (1990 to 2015), going from 16.9% in 1990 (same share of 1980) to 15.6% in 2015, with a record-high 17.9% in 1996.

From 1995 to 2004, Brazil's share of skilled labor value-added on exports, which was about 10% lower than that of India at the beginning of the period, stagnated after that end year but the gap was reduced to about 2% as India's share also wavered in the latter period from 2004 to 2011.

Both countries have a highly heterogeneous economic structure like other emerging countries. The striking difference with 'leapfrogging' latecomers is the stagnation from such economic structure in aggregate terms. The path to the knowledge economy in India and Brazil is hampered by common structural problems such as ahigh share of informal labor and shortcomings in the supply of skills to the workforce.

Clues to the their contrasting paths, besides Brazil's earlier departure point in manufacturing, lies in labor laws and social inclusion programs. Without taking into account Brazil's latest neoliberal detour of the last few years the countries experienced diverse trajectories. India experienced improvements in the export of knowledge-intensive services whereas Brazil valued-added in manufacturing continued to fall.. Indai has made greater strides than Brazil in tertiary STEM education and intellectual property.. However, Brazil made strides towards more comprehensive social inclusion, bringing more workers into the formal labor market and increasing the rate of enrolment in tertiary education. Perhaps, building a more solid human resources base for its future transition. Brazil's political dynamics and coalitions success un these areas , however, was not accompanied by a strong promotion of knowledge intensive exports and in the

economy as a whole. India targeted and continuously iomproved knowledge intensive sectors of pharamceuticals manufacturing and IT enabled services.

However, both sectors currently face institutional challenges that go beyond the scaling up and addition of low level skills of the past decade that include the creation of multi-spheres linkages, establishment of multi-level innovation coordination and governance institutions and high skills capacity building promotion.

This article showed that labor relations and vocational training institutions have played a role in shaping the path to the transition. Innovation and economic performance are icapable of fostering susteained development when they are restricted to ‘islands of excellence islands’ with little spillover effects on the rest of the economy and society.

Deepening innovation and skills in leading sectors and moving beyond such islands are critical forks in the path to the knowledge a economy transition in Brazil and India.

References

Acharya, Sarthi (2006). Economic Development, deregulation and employment conditions: the Indian experience. In: Brassard, Caroline and Acharya, Sarthi, eds.. *Labour market regulation and deregulation in Asia*. Academic Foundation, New Delhi.

Aldrighi, D. M., & Postali, F. A. S. (2010). Business Groups in Brazil. In *The Oxford Handbook of Business Groups*, Oxford, Oxford University Press.

Almeida, Mariana; Silva, Tatiane; Nunes, Daniel; Bezerra, Kamila; Albuquerque, Augusto (2019). Aprendizagem profissional no Brasil: panorama e análise da trajetória laboral dos egressos. *Mercado de Trabalho: conjuntura e análise*. Ano 25, Abril 2019.

Araujo, Celso (2018). Avanços recentes na política de combate à informalidade do trabalho assalariado no Brasil: ações da Secretaria de Inspeção do Trabalho. *Mercado de Trabalho: conjuntura e análise*, Vol. 65.

Assumpção-Rodrigues, Marta (2013). Skill formation, governance, and democracy in Brazil: the state of the art of a public policy. *International Journal of Education and Research*, Vol. 1 No. 2 February. ISSN: 2201-6333 (Print) ISSN: 2201-6740 (Online) www.ijern.com

Boianovsky, Mauro (2010). A view from the tropics: Celso Furtado and the Theory of Economic Development in the 1950s. *History of Political Economy*, v. 42, n. 1, p. 221-266.

Busemeyer, M. and Trampusch, C. (2012): The Comparative Political Economy of Collective Skill Formation. In: Busemeyer, M. and Trampusch, C. (Eds.): *The Political Economy of Collective Skill Formation*. Oxford, New York: Oxford University Press. Pp. 3-38.

Cardoso, Adalberto; Gindin, Julián (2009). *Industrial relations and collective barganining: Argentina, Brazil and Mexico compared*. International Labour Office – Geneva: ILO.

Cassiolato, M. and R. Coutinho Garcia (2014), PRONATEC: múltiplos arranjos e ações para ampliar o acesso à educação profissional. *Boletin de Análise Político-Institucional*, IPEA.

Chenoy (2013). Public-private Partnership to Meet the Skills Challenges in India. In: Maclean, R. et al. (Eds.): *Skills Development for Inclusive and Sustainable Growth in Developing Asia-Pacific*. Springer.

Cimoli, M., Pereima, J. B., & Porcile, G. (2019). A technology gap interpretation of growth paths in Asia and Latin America. *Research Policy*. https://doi.org/10.1016/j.respol.2018.08.002

Clarke, T., & Gholamshahi, S. (2017). Developing human capital for knowledge based economies. In *Innovation in the Asia Pacific: From Manufacturing to the Knowledge Economy*. https://doi.org/10.1007/978-981-10-5895-0_12

DIEESE (2014). Rotatividade e políticas públicas para o mercado de trabalho / Departamento Intersindical de Estatística Estudos Socioeconômicos. -- São Paulo: DIEESE.

Dahlman, C. J., Ross-Larson, B., & Westphal, L. E. (1987). Managing technological development: Lessons from the newly industrializing countries. *World Development*. https://doi.org/10.1016/0305-750X(87)90058-1

Dominguez Lacasa, I., Jindra, B., Radosevic, S., & Shubbak, M. (2019). Paths of technology upgrading in the BRICS economies. *Research Policy*. https://doi.org/10.1016/j.respol.2018.08.016

Estevez-Abe, Margarita, Iversen, Torben, Soskice, David (2004). Social Protection and the Formation of Skills: a Reinterpretation of the Welfare State. In: Hall, Peter and Soskice, David, eds. *Varieties of Capitalism – The Institutional Foundations of Comparative Advantage*. Oxford, Oxford University Press.

Durazzi, Niccolo (2018): The political economy of high skills: higher education in knowledge-based labour markets, *Journal of European Public Policy*, DOI:10.1080/13501763.2018.1551415

Gonzaga, Gustavo; Pinto, Rafael (2014). Rotatividade do Trabalho e Incentivos da Legislação Trabalhista. In: Bonelli, R.; Veloso, F.. (Org.). *Panorama do mercado de trabalho no Brasil*. 1ed.Rio de Janeiro: FGV, v. , p. 181-199.

Gupta, Vishal; Raman, Charanya; Krishnan, Balasundaram et al (2016). Secondary (9-10) and Higher Secondary (11-12) Education: Preparation for the World of Work: Secondary and Higher Secondary Education in India. In: Pilz (ed) *India: Preparation for the World of Work Education System and School to Work Transition*, Springer, Wiesbaden.

Hall, Peter and Soskice, David (2004). An Introduction to Varieties of Capitalism. In: Hall, Peter e Soskice, David, *Varieties of Capitalism – The Institutional Foundations of Comparative Advantage*. Oxford, Oxford University Press.

Harris-White, Barbara (2010). Globalization, the Financial Crisis and Petty Commodity Production in Indias Socially Regulated Informal Economy. In: Bowles, Paul and Harris, John. *Globalization and Labour in China and India: impacts and responses*. Palgrave Macmillan, Houndmills, Basingstoke, Hampshire.

King, K. (2012): The geopolitics and meanings of India's massive skills development ambitions. *International Journal of Educational Development*. Vol. 32, No. 5, pp. 665–673.

Kothandaraman Kumar (2016). ITIs / ITCs: Industrial Training Institutes / Industrial Training Centres. In: Pilz ed., op. cit.

La Porta, Rafael and Shleifer, Andrei Informality and Development. *Journal of Economic Perspectives*, Volume 28, Number 3. 109–126, 2014.

Lall, S. (1992). Technological capabilities and industrialization. *World Development*. https://doi.org/10.1016/0305-750X(92)90097-F

Lazonick, W., Li, Y., (2012) China's path to indigenous innovation. Annual Conference of the Society for the Advancement of Socio-Economics.

Machlup, Fritz (1980) Knowledge: its creation, distribution, and economic significance, Vol. 1, Princeton, Princeton University Press.

Mwalemba, G. (2012). A Systemic Landscaping of the Software Industry of an Emerging Economy: A case of the Western Cape, South Africa. Master Thesis at the University of Cape Town.

Marx, Karl (1990) Capital, Vol. I. transl. by Ben Fowkes, London, Penguin Publishers.

Majumdar, Syamal 2016. Foreword: Reflections on Opportunities and Challenges of Skills Development in India. In: Pilz, ed., op. cit.

Nölke, A., ten Brink, T., Claar, S., & May, C. (2015). Domestic structures, foreign economic policies and global economic order: Implications from the rise of large emerging economies. *European Journal of International Relations*.

OECD (2018) *Getting Skills Right: Brazil*, OECD Publishing, Paris.

Pilz, Matthias (2016) A View from the Outside: India's School to Work Transition Challenge – Strengths and Weakness. In: Pilz ed., op. cit.

Rajput, Jagmohan (2009) The Changing Context of TVET for the Workforce in India in Maclean, R.; Wilson, D. *International Handbook of Education for the Changing World of Work: Bridging Academic and Vocational Learning*. Springer.

Rodgers, Gerry (2016). Inequality and the labour market: comparing India and Brazil. *Indian Journal of Labour Economics*, Volume 59, 39-55.

Rueda, David, Wibbels, Erik and Altamirano, Melina (2015). The origins of dualism. In: Beramendi, Pablo, Hausermann, Silja, Kitschelt, Herbert and Kriesi, Hanspeter, *The Politics of Advanced Capitalism*. New York: Cambridge University Press

Sarkar, J. (2010). Business Groups in India. In *The Oxford Handbook of Business*, Oxford, Oxford University Press.

Schneider, Ben Ross (2013). *Hierarchical Capitalism in Latin America. Business, Labor, and the Challenges of Equitable Development*. Cambridge University Press, New York.

Stehr, N. (2015). Knowledge Society, History of. In *International Encyclopedia of the Social & Behavioral Sciences: Second Edition*. https://doi.org/10.1016/B978-0-08-097086-8.03160-3

Stehr, Nico (2002). *Knowledge and Economic Conduct: The Social Foundations of the Modern Economy*. London, University of Toronto Press.

Thelen, K. (2019). Transitions to the knowledge economy in Germany, Sweden, and the Netherlands. Comparative Politics. https://doi.org/10.5129/001041519825256623

Thelen, Kathleen (2014). *Varieties of liberalization and the new politics of social solidarity*. Cambridge University Press, New York.