

The indian software industry



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The Indian software industry was non-existing up to 1974. According to Tschang (2001), the evolution of the software industry in India can be explained by three movements.

History: unproductive investments preparing the ground

Tschang (2001) states that the software industry has found its origin in cities such as Mumbai (Bombay) and Bangalore. Bangalore was an excellent place for companies to set up an establishment thanks to the large pool of scientific talent developed by educational organizations and the laboratories that were provided by the government. Unfortunately, there was little gainful employment through which these investments weren't productive from an economic point of view. However, the combination of these two previously mentioned factors formed a critical basis for the growth of the software industry in India.

History: Nascent national companies, early foreign investment and the buildup of experience

In the emerging phase, some companies have been established such as the Computer Maintenance Corporation (CMC) in 1978, Tata Consultancy Systems (TCS) in 1968 and Hindustan Computers Limited (HCL) in 1976. Only two of these new companies, namely CMC that was founded by the government and TCS that was established by the Tata Group, succeeded. This latter company followed a different concept: companies could contact TCS and hire one of their programmers. This programmer will go to the company that needs help. Owing to these companies, the country gained both experience in software development and international experience.

Previously mentioned firms were successful at competing for and executing huge, complex programming assignments. For example, CMC has developed a passenger reservation system by order of the Indian railways. Furthermore, these companies have also traded with international customers through whom they were exposed to international practices and standards. Although these companies developed, this growth didn't boom. This statement can be explained by the behaviour of the government. At first, the Indian government was hostile towards foreign companies who wanted to establish an office in India. Since 1984, the Indian government promoted their country to foreign companies. Thus the government shifted from a custodial role towards a promotional role.

Besides the change in the behaviour of the government, international high-tech companies established new offices in India (in particular in Bangalore) in the 1980s and 1990s. Owing to this, the number of foreign investments in India increased. This increase can be contributed to reforms that took place in order to improve the environment for foreign direct investments and in particular to the creation of special software technology park zones which are managed by Software Technology Parks of India (STPIs). One of the companies that came to India was Texas Instruments (TI) which was attracted by the easy availability of staff and the low wages. On the other hand, there were also disadvantages such as the lack of good infrastructure. Building up better infrastructure would involve large fixed costs. TI had a good infrastructure at its disposal in its head quarters in the United States. In order to take advantage of the idle hardware facilities, TI invested in a dedicated satellite link. Because of this satellite link, employees in India can

have this infrastructure at their disposal if employees in the US aren't working with it. This is possible because of the time difference between the United States and India. If employees are working in India, employees are sleeping in the United States. This proves that an Indian subsidiary provides a low-cost manner to develop software for sale for large enterprises. Furthermore, this subsidiary can also supply the large enterprise with software for internal use. Summarizing, it may be stated that the software is established in India and will be used in other countries.

History Export

The export industry arose when a number of export-oriented firms as offshore development centres were ready to export. Initially, this export industry involved the sending of employees directly to places in the United States. In fact, the work from multinationals is executed by specialized “service” firms in India which is called onsite services (or body shopping). In 1991-1992, onsite services were dominating the software export. 95% of the total software export involved onsite work while only 5% involved offshore services. In 1999-2000, offshore services counted for 42% of the total software export while the overseas onsite involved the residual 58%.

The export industry consists out of a new emergent sector, namely business software market, and the domestic software market. The revenues from the business software market adds up to about 4.5 billion US Dollar. In the meantime, the domestic software market has also increased slowly. The total Indian software sector adds up to more than 20 billion US Dollar.

In 1996, the software industry involved 1 billion US Dollar. However, experts worry about for instance the limited amount of available skilled workers or software professionals, the bad infrastructure, the possible competition with China and the Philippines, the possible development of automated tools with the intention to substitute the lower end of software services supplied by India and the unwillingness or inability of the Indian software firms to look further than their low-cost employees (they don't want to make use of employees who need to be paid more by the company). Moreover, experts think that these previous mentioned issues are a threat to the Indian software industry.

The solution for previous mentioned threats is to “ move up the value chain”. This solution consists out of three parts. The first part involves the development of proprietary software. This software can be bought by one party and this party can give license to other parties in order to use this software. The second part involves the production of more technology-intensive services. The last part involves innovation, the Indian software needs to think about new products and technologies.

Although the possible solution is given, the Indian software companies don't take these into account. This can be seen out of following observations:

There is still a huge shortage of workers

The infrastructure has only known small improvements

Not much products produced by the Indian software industry are available on the World market

Owing to this export industry, the fortune of the Indian people has increased. This increase is not only caused by the increase in domestic IT expertise. Primarily, this increase can be contributed to the increased demand for skills and outsourcing of the software industry in the United States and other countries. There were not much skilled people available in for instance the United States and if they were available, the company had to pay large wages. Owing to this, India became more attractive due to the large pool of available skilled people and the low wages. Simultaneously to the increased demand in the United States, India could offer these companies skilled people who were willing to pay for small wages. The work that is outsourced by other countries involved merely lower value added work in which US consulting or application firms were not interested. This work involves jobs like for instance rewriting code to integrate applications from mainframes to the then newly emerging client-server platforms. In some cases, new applications are added. Other services involve the maintenance of such applications. Later on, data-conversion was another important task, the most important one was the Y2K. This project is better known as the ‘milleniumbug’ at the end of the 1990s. Hereby, the problem was that several operating systems saved dates by only using the last two numbers of the year. For example one January 1999 is saved as 01-01-99. By entering the new year, the data is saved as 01-01-00 which is the same for one January 1900. This can cause problems in for example stock systems. The system can think that a certain product with expiry date 01-01-00 is already a century old.

Explaining software success

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The success India has established within the software sector can be explained by several factors according to the human capital and comparative advantage, protection and learning from the domestic market, the role of public policy and finally entrepreneurship and openness.

Human capital and comparative advantage

The first reason to explain the success of this sector is the fact that India has a lot of people who are willing and able to develop software for less money. Owing to the fact that India has a huge pool of potential software professionals at its disposal, these people work for small wages. These small wages form the second advantage why the software industry has grown in India. However, these wages have increased over time but they are still lower compared to the wages of software professionals in the United States. This wage gap can be attributed to the difference in experience between these software professionals. These two reasons form a comparative advantage for this sector in India. Companies who establish an office in India can invest in a more labour-intensive structure. This means that the company will replace machinery with human capital.

Although the fact that India provides this huge pool of potential software professionals, not enough companies decided to come to India which resulted in an excess of Information Technology engineers during the 1970s and 1980s. At that time, these engineers resolved to go work overseas. Once these worked for for instance an American company, they also functioned as a broker to match small software contracts with Indian software firms. Kapur

calls these people “reputational intermediaries” (as cited in Bhagwati and Calomiris, 2006, p. 175).

Furthermore, the expansion of the schools has also contributed to the growth of the Indian software exports and thus also to the success of the Indian software sector. This expansion can't only be awarded to the government, also private investors have contributed. In 1981, almost the whole engineering college capacity was in hands of the government. Because of the restrictions on the public funding and regulatory constraints, the government wasn't able to fulfil the need for more colleges. Entrepreneurs have responded to this need and have invested in private colleges. At first, the government didn't allow this type of college although one private investor already had established such a college in 1977. The second private college was established in 1983 at the time the government had decided to permit such colleges. The following graph indicates the increase in private colleges.

Figure Shares of private colleges BRON

The evolution of the amount of private financed colleges can also be seen in connection to the export of the software sector. In the beginning of the export, the software professionals are merely graduated at colleges owned by the government. Since private investors were allowed to establish private colleges, the amount of colleges has known a remarkable boost.

The increase in number of colleges can also be interpreted as an increase in the amount of students that can be taught. In other words, the total

engineering college capacity has grown over the years. This can be seen in understanding table.

Table Evolution of capacity BRON

In 1985, the year where software export began, India graduated about 45.000 engineers. In 2004, the capacity had increased to 440.000 engineers which is almost ten times the capacity in 1985. By looking at the evolution between 1951 and 2004, we can see that the population in millions has multiplied with a factor three. In the meantime the engineering college capacity has multiplied with a factor hundred. As a result, the engineering college capacity per million of population has increased with 3015%. In 2004, 405 citizens out of one million were able to graduate as a software developer.

Protectionism

Although protectionist rules are not in favour of the welfare of the country, Bhagwati and Calomiris (2006) are stating that this is a factor that has contributed to the success of the Indian software sector. This can be explained by the fact that through these protectionist measures, India has built up a "reserve army of underemployed engineers" who are at the disposal of knowledge concerning software tools. Furthermore, these engineers are also willing to execute tedious tasks.

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The role of public policy

Within this second explanation, Bhagwati and Calomiris (2006) underline the importance of making a distinction between sector-specific policies and all other policies. Measures such as subsidies targeted to software exporters and R&D investments in software can be seen as examples of the first type of policies. On the other hand, policies with the aim to improve the business climate can be seen as an example of the latter mentioned policies.

Kapur (as cited in Bhagwati and Calomiris, 2006, p. 182) defines the domestic and international economic liberalisation as an important factor in the growth of the Indian software industry. This liberalisation took off in 1984. As previously mentioned, the government changed from a custodial role towards a promotional role in 1984. The software industry isn't a capital intensive industry through which there was no need for bank finance, the entry barrier was low and the industry was not likely to have to deal with union activities. From 1991, the Indian software industry was able to benefit from the eased policies concerning trade and foreign exchanges. Because these regulations became less rigid simultaneously with the jump in global demand for IT skills, India was able to benefit from this boom in global IT demand. Bhagwati and Colomoris (2006) emphasize that the element of luck may not be forgotten in this situation.

India has several sector-specific policies that vary according to focus and time. The policies that were told to aid the software industry were not always policies that were drawn up in particular for the software industry.

According to Athreye (2005), the software industry flew “under the radar” during its days of development. The Indian software sector was offered

protection but in fact, the Indian software sector couldn't benefit from this protection because the market was too small. Furthermore, this sector was also dispensed from several laws and regulations. Conversely, the Indian manufacturing was not dispensed from these regulations through which the growth in this sector was restrained. Although the Indian government invested in science and engineering with the aim to supply the manufacturing sector, this sector didn't grow as expected. Because of this, an excess supply of software engineers arose (as previously mentioned).

In accordance with Balakrishnan (2006), Bangalore became an attractive location for companies to establish an office owing to the fact that Bangalore was well supplied with public R&D resources. Furthermore, Balakrishnan (2006) even states that the success of the Indian software industry can be subscribed to the success of the government's strategic intentions.

Bhagwati and Calomiris (2006) are making two remarks on previous mentioned statement made by Balakrishnan. The first remark involves the amount of IT hubs in India. Although Bangalore is seen as the most important location, India disposes of five equal sized software clusters. The second remark contains the nature of software exports. At the beginning, the exports rather involved easy tasks and programmers that were sent to other countries to work over there.

Athreye has executed a study with the aim to draw up a list of factors that influence companies' decisions concerning the location of an office. Research links with universities and labs, government financial incentives and the presence of other firms were not highly ranked. According to Srinivasan

(2006), telecommunication reforms and the creation of Software Technology Parks (STPs) are important. (nog meer zeggen? P 186? Kijken naar de verwijzingen: hoe refereren? Indirect of direct?)

Entrepreneurship and openness

According to Bhagwati and Colomoris, the success within the Indian software sector can be contributed to the Indian entrepreneurship and openness.

Furthermore, two difficulties are mentioned. At first, the thought of Hausmann and Rodrik (2002) is mentioned. They state that it is difficult to outline how and where to make use of the profusion of resources in an uncertain world. Although developing countries have plenty labour resources at their disposal, these countries don't export a lot of different products to for instance the United States. The products that actually are exported by developing countries only involve a small range of products. Through this, Hasman and Rodrik concluded that industrial success only resulted in a concentration on only a small range of products or activities. The second difficulty for developing countries is to predict which products or activities will turn out as a success.

In order to be successful in the export market, Bhagwati and Calomiris state that it is important to dispose of information from other countries and in particular potential export markets. This can be seen in the sources of form formation in for instance India, Israel and Ireland. Sands (2005), Arora, Gambardella and Klepper (2005) have investigated this and have found that for instance Israeli entrepreneurs were technical skilled. However, these

entrepreneurs need both marketing and financial expertise from American managers in order to achieve commercial success.

A connection with foreign countries is also needed in case of the Indian software industry. Athreye (2005) has investigated this matter in India and was able to conclude that a number of successful software entrepreneurs had considerable overseas experience.

Although Indian entrepreneurs have been experienced resistance in the 1970s, a large number has taken up the gauntlet. These entrepreneurs had to deal with inexperienced engineers while competing for export orders. During this rivalry, Indian entrepreneurs were also confronted with power shortages, bad roads, high employee turnover and an (initially) indifferent government. In the 1970s, Indian entrepreneurs didn't have access to subsidies of the Indian government. In spite of these hampered factors, many Indian people became entrepreneur and many succeeded. Bhagwati and Calomiris (2006) state that this should provide comfort regarding to the future expectations of the Indian economy.

The prospects of the industry

Moving up the value chain: software products

Schware (1992) and Heeks (1996) have stated that India should start in investing in R&D because otherwise India should lose its competitive advantage due to increasing wages. Furthermore, Heeks (1996) also warns for “ brain drain” which involves the loss of skilled software engineers due to their employment in other countries. Bhagwati and Calomiris (2006) have

interviewed some managers and were able to conclude that the major part has adopted this thought. Sabeer Bhatia, the founder of Hotmail, says that Indian software entrepreneurs need to focalize more on innovation of new IT products instead of investing in services or outsourcing. This statement has been made with the aim of transforming India into a “ software powerhouse”.

Developing countries are trying to move up the technology ladder. Although policy makers treat their technological achievements as an indicator of success, India has not yet produced many technically advanced products or services. However, the growth India achieves isn't worse comparing to the best performing countries although skeptic state that eventually India will lose its comparative advantage because wages will increase in the future.

In fact, Indian software companies should move up the value chain. This can for instance be done by writing one single product and sell this product many times. However, creating new products is more complicated than this.

Although many Indian firms have tried to develop successful products, they weren't very successful. This can be explained by the Indian penny-pinching and risk-averse management habits. Besides this, the Indian firms have to develop products in a capital-scarce and labour-abundant environment. Due to these factors, it is very difficult for Indian software companies to achieve technological success. Furthermore, software companies in developing countries only try to satisfy current customers by producing the products they need and forget to predict needs from unknown customers. Although these companies should try to be (technically) innovative, they rather stick

to familiar products. So, technical innovation will have to be carried out by start-ups and other entrants.

The software industry is dominated by the United States. The United States cover about 21.7% of the software exports but in fact this percentage must be higher. The difference between the actual software exports and the percentage given in the OECD database discussed in the book written by Bhagwati and Calomiris (2006) can be attributed to Ireland. Ireland buys software products from the United States, adds value to these products and then sells these products for higher prices. The dominance of the United States within this export industry can be ascribed to the good user-producer interactions and the American lead users. Bhagwati and Calomiris (2006) state that as long as these lead users are American, the centre of the software export industry will be located in the United States.

This dominance of the United States doesn't mean that software companies in other countries aren't able to be successful. For example, an Israeli company has succeeded in developing security software. So the aim for software companies in developing countries is to develop software products for niches that American companies don't supply. If a non-American company has been able to develop such a product, the bulk of these companies has moved their commercial activities to the United States and only kept their research department in their home country.

Bhagwati and Calomiris (2006) underline the importance for companies of being close to its customers because the software company needs to know how the customer company runs its business.

As previously mentioned, the United States owns the greater part of the software industry and the most important lead users are American. Owing to this, software companies have a hard time competing with software companies that are located in the United States. However, Bhagwati and Calomiris (2006) mention two possibilities for these companies namely:

Software companies located in other countries can try to develop software with the aim to meet needs of customers who have other desires than American customers. i-Flex has employed this strategy.

These software companies can also establish a commercial department in the United States while the product development and maintenance department is still located in for instance India. Texas Instruments was the first company that has adopted this strategy. Afterwards, Motorola, Oracle, Cadence, Microsoft, Freescale and Intel have also adopted this strategy.

Moving up the value chain: R&D and engineering services

According to Bhagwati and Calomiris (2006), India can host the software industry in three ways:

By subsidiaries of large multinationals

By developing software whereby the distance between developer and customer isn't important

By doing contract investigation for overseas clients

As can be seen, some companies have already tried to locate product development activities with the aim to increase the tempo and decrease the

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cost of product development. Furthermore, Bhagwati and Calomiris (2006) refer to evidence of Indian software companies that have increased their R&D-intensive activities.

As previously mentioned, there were two possibilities for Indian firms to compete with American software companies. The latter possibility contains establishing a commercial department in the United States and keeping the development and maintenance department in for instance India. In order to conclude if India is really used as a site to do R&D, Bhagwati and Calomiris (2006) mention three possible indicators. At first, they are looking at the exports of R&D services, afterwards they take a look at the patent statistics and at last, they try to look at patent statistics in another way.

The exports of R&D services involve an important share, namely about five billion dollars. The major part of this amount can be explained by the software that is written for electronic devices such as mobile phones and printers. Thus, this major part can be explained by technical and engineering expertise about relevant fields like for instance electronics or automobiles.

The second indicator involves patents statistics. Hereby, the result of an investigation executed by Arora, Forman and Yoon (2007) is given. Through this investigation, they wanted to link software inventive activities and globalization by using patent data. Unfortunately, no link was found. In understanding graph, the amount of US patents for products invented in Japan, the United States, other G-7 nations and all other countries is given. Arora, Foreman and Yoon (2006) found that patents by US inventors grew with twenty percent a year while this was sixteen percent in Japan and

eighteen percent in other G-7 nations. Out of these figures can be concluded that US firms are more likely to patent in the United States compared to companies from other countries which can be called a “home country bias”. On the other hand, this pattern can also be seen in the European patent system. So in fact, US firms are responsible for the major part of software patents.

Bron: paper van de prof

The patents that are counted in the graph above are patents concerning inventions in “underdog countries”. Of these “underdog countries”, Israel is the only one that seems to have a significant number of patented inventions in the United States. This number has increased from three in 1998 up to ninety in 2003. Next to this, the number of patents on invented products in India has increased from an average of 0.5 during the 1990s up to sixteen in 2004.

Bhagwati and Calomiris (2006) have taken a look at understanding table to verify if India has become a place to do R&D.

Bron: paper van de prof

Most of the firms that filed patents are American companies as can be seen in panel A. An overview of the amount of patents that are applied for by Indian software companies can be seen in panel B.

Bhagwati and Calomiris (2006) conclude that the R&D and software-related activities of software firms in India has grown. However, the quantitative significance of these activities is still small due to the challenges firms that

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want to develop software in India for distant markets have to face. These challenges are:

These firms have it difficult to coordinate software development activities across a globally distributed team

The distribution of projects between several team members is difficult

If a company tries to manage the above mentioned aspects from a distance, the company will have it even more difficult to handle these aspects.

Move up the value chain: more valuable business expertise

Indian companies can also move up the value chain by diversifying their business into emerging niches without violating any incumbents.

Furthermore, the leading Indian software firms will try to increase its capabilities in order to be able to execute large, complex, multi-year software development, implementation and maintenance projects.

While trying to concur for previous mentioned projects, Indian firms will have to compete with established incumbents. Both the Indian firms and the incumbents have its comparative advantages. The Indian firms have access to a huge labour force that is willing to work for small wages. On the other hand, the incumbents are more experienced in conducting large projects in a wider range of end-user sectors, established relationships with customers and global presence. The incumbent firms have realized that the Indian firms are rising and thus they have started to recruit Indian software engineers. By doing so, these companies can try to decrease their costs by which the Indian companies lose their comparative advantage.

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According to experts, Indian companies have become a “ global delivery” model of software services. Within this model, Indian companies execute some work on-site and some of the work is executed off-shore. This work is carried out by talented persons that are, unfortunately, sometimes poorly trained or inexperienced. Although this lack of experience, Indian software companies had to develop management practices in order to manage. Foreign companies still have to learn how to do this so in fact, the Indian software companies have taken a head start. But in the meanwhile, Indian software companies will still have to learn how to function as global companies with a multinational workforce.

As previously mentioned, the Indian software companies have a comparative advantage thanks to their extensive labour force. Besides all previous mentioned disadvantages, India will have to do something about the lack on hardware and system-integrated capabilities.

Bhagwati and Calomiris (2006) underline the importance of making a distinction between the outlooks of an Indian software company and the outlooks of India as a location for software and IT. The prospects of India as a location for software and IT surely look brighter than the outlooks of Indian software companies which can be confirmed by looking at IBM, Accenture and HP. These companies have already employed 70000 persons in India.

Implications for the Indian economy

Although the impact of the Indian software industry is rather small, this industry is growing rapidly. Bhagwati and Calomiris (2006) give hereby the evolution of the amount of employees within the Indian software and

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services sector (see understanding table). In this table, the term IT stands for Information Technology, the term ITES for Information Technology Enabled Services and BPO for Business Processing Outsourcing. In 2004, about 867000 employees were employed within this sector. Although this is a large number, it is only a miniscule fraction of the 340 million Indian employees. In 2008, the number of employees within the Indian software industry has grown up to about 1.2 million employees.

Bron: paper van prof (overgetypt)

The growth within the Indian software industry can be seen in understanding table.

Economic Survey 2008-2009; <http://indiabudget.nic.in/es2008-09/chapt2009/chap85.pdf>

Furthermore, also projections towards the future are given. Bhagwati and Calomiris (2006) mention the outcomes of the economic survey from 2005 in which they expect that the Indian software exports should be increased up to about 60 billion dollars in 2010 which will account for approximately thirty-five per cent of all Indian exports. Owing to understanding tables, we can try to conclude if these expectations were correct.

Economic Survey 2008-2009; <http://indiabudget.nic.in/es2008-09/chapt2009/chap67.pdf>

In the table above, the percentage of software service