

Determinants of the High-Tech Industry Development in Argentina and Brazil – The Case of the Aerospace and Pharmaceutical Industry

Submitted: 11.04.17 | Accepted: 18.10.17

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Latin American countries (LACs) are trying to catch up with the developed countries. The most active in the field are Argentina and Brazil. Since the beginning of the noughties both countries have been searching for a new model of industrial policy. An important feature of such policy is the development of high-tech industry. Among high-tech sectors in Argentina and Brazil are aerospace and pharmaceutical sectors. The results of their development are diversified.

Keywords: high-tech industry, industrial policy, Latin America.

Determinanty rozwoju przemysłu high-tech w Argentynie i Brazylii – przykład przemysłu lotniczego i farmaceutycznego

Nadesłany: 11.04.17 | Zaakceptowany do druku: 18.10.17

Kraje Ameryki Łacińskiej (LAC) starają się naśladować kraje wysoko rozwinięte w celu przyspieszenia swojego rozwoju gospodarczego. Najbardziej aktywnymi są w tym obszarze Argentyna i Brazylia. Od początku pierwszej dekady XXI wieku oba kraje rozpoczęły poszukiwanie nowego modelu polityki przemysłowej. Szczególną cechą obecnego podejścia jest dążenie do wzrostu znaczenia przemysłu high-tech. Do istotnych gałęzi high-tech w Argentynie i Brazylii należą sektory: lotniczy i farmaceutyczny. Efekty rozwoju tych sektorów są zróżnicowane.

Słowa kluczowe: przemysł high-tech, polityka przemysłowa, Ameryka Łacińska.

JEL: L23, L52, O14, O25, O54

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1. Introduction

Economic globalization has generally caused a very positive impact on the developing countries (e.g. China, India, Eastern European countries, etc.). During the last three decades, some of the emerging markets have been experiencing faster growth than most of the Western world. Unfortunately, the positive processes have not occurred in all these markets. For example, Latin American countries (LACs) show the lack of positive results. The important question is what is the cause of their slower growth and what should be done in order to trigger the development of these countries.

Many actions have been taken in Argentina and Brazil to improve the development of their economies and to catch up with the developed countries. One of the most important strategies for sustaining growth in these countries is the development of competitive capabilities. After the previous periods of state-led economic development and later the market-oriented 'Washington Consensus', the last fifteen years was a time of new approach. The countries started to combine a liberal economic approach with state intervention, strengthening domestic companies and branches of industries, introducing changes in the industry structure and attaching great importance to the development of high-tech industry.

The article relates directly to the recent studies on the industrial development in LACs (Devlin and Moguillansky, 2012; Peres, 2009; Peres and Primi, 2009). They emphasize that since the beginning of the new century some LACs witnessed the renaissance of industrial policy. A strong argument is presented in the literature that catching up with the advanced countries requires creation of new technologies and for that a strong state support is needed (Khan and Blankenburg, 2009). Among the features which should characterize a proper approach is the development of high-tech sectors (Cimoli, Dosi and Stiglitz, 2009b).

The aim of the article is to analyze the development of the selected high-tech sectors in Argentina and Brazil in the context of the assumptions presented in the literature. The second aim is to indicate the role of active state support in these sectors' development during the years 2010–2015. In the theoretical part, answers to the following questions are sought: 1) Why has the industrial policy in LACs failed in the past? 2) What is the best policy for the contemporary high-tech industry development in LACs? 3) What are the main features of the industrial policy implemented by Argentina and Brazil during the decade of 2000–2010? In the empirical part, the article presents case studies of the development of the aerospace and pharmaceutical industries in Argentina and Brazil.

It is presumed that the development of technologically advanced industries and the government support for the development is critical for providing economic growth in some emerging markets in the future. There is

a need for an industrial policy oriented on the development of high-tech sectors. The intention is not to claim that the development of high-tech sectors should lead to the substitution of other industries, but rather that it should complement them. Argentina and Brazil already have competitive advantages in some high-tech industries and among them there are aviation and pharmaceutical industries. Taking into account certain factors, like the foregoing hypothesis that mainly foreign companies should be treated as technology suppliers, strong competition with other emerging markets (e.g. China) and some domestic specific conditioning (Amsden, 2009; Ramamurti and Singh, 2009), it can be assumed that the development of local high-tech sectors in the selected countries is necessary for catching-up with the developed countries.

The contribution of the article is the selection of the factors which had an impact on the development of aerospace and pharmaceutical industries in Argentina and Brazil. Based on the presented case studies, the advantages and disadvantages of the selected sectors development are investigated with particular emphasis on the national industrial policy applied in these countries during the years 2000–2010. It is necessary to highlight that the purpose of the paper is to present Argentina and Brazil as two case studies, but not to make a detailed comparison between them. The aim of the applied comparison is to highlight the main differences of the rationale of the selected industries' development.

Argentina and Brazil were chosen because they have the fastest development of high-tech industry among the countries of the region. The aerospace and pharmaceutical industries in these countries have been developed to a level that can be compared to their competitors from other emerging markets, like China, India, the Republic of Korea, Singapore and Thailand. The period of the empirical analysis covers the years 2000–2015. The main method used in the paper is the critical literature review and case studies research. The comparative analysis includes in particular: 1) industrial policy and state support, 2) the companies' approach to production (aerospace) and the approach to R&D (pharmaceutical), 3) the presence of foreign companies. The presented case studies indicate that the proper industrial policy is the key element of success in high-tech industry development. On the other hand, the development is determined by many other factors.

2. The Problems with LAC Industrial Development During the ISI and Neo-Liberal Approach

The approach to the industrial development in LACs for the most of the second half of the twentieth century was a state-led industrial policy (Import Substitution Industrialization, ISI). State interventions were the most characteristic feature in the period (Devlin and Moguil-

lansky, 2012). The main aim was to create new sectors of industry and to foster the diversification of production structure. The countries applying the ISI tried to increase the share of higher value-added industries and technology intensive activities in the production structure (Peres and Primi, 2009).

During the period of the application of the ISI approach (1950–1990), there were some positive effects and accelerated growth of the economies, but simultaneously many weaknesses occurred. Among the biggest flaws of the policy were bad planning, poor project management and corruption (Peres, 2009). As time went by, the failures of ISI became increasingly apparent (led to macroeconomic instability) and the approach was criticized. The consequence of the mistakes made during the ISI period was the desire to move away from the industrial policy in favor of the free market (neo-liberal approach). The ISI period in LACs ended with programs imposed on the countries by the IMF and the World Bank, called the ‘Washington Consensus’. The programs were directed towards macroeconomic stabilization, liberalization of the economy and the reduction of government impact on the industry. The main idea was ‘more market, less government intervention’.

The liberal policy which was applied in the 1990s helped to develop economic activity on a broader scale than before, but there are several reasons why the approach had a negative impact on the development of the analyzed countries. The key issue is that the countries had many problems with transforming the structures of their industry. They could not develop new, modern branches which played a more important role in the global economy (Lin and Treichel, 2012). Slow industrial development of this group of countries was caused by an improper approach in areas such as: the education system, R&D policy, management models and many other areas which are responsible for innovation and production development (Cimoli et al., 2009b). The existing limitations were even more far-reaching – the countries were unable to acquire new technologies from imported goods and to implement the learning-by-doing strategy. Rapid liberalization, instead of being useful, turned out to be harmful. E. Reinert illustrates it best in the words: ‘When two nations at widely different technological levels integrate, the first casualty is the most advanced economic activity in the least advanced nation’ (Reinert, 2009). In the case of Argentina and Brazil during the neo-liberal period, it resulted in wiping out of domestic firms, maintenance of relatively low productivity, growing unemployment and many other negative processes (Cimoli, Dosi, Nelson and Stiglitz, 2009a). As Khan and Blankenburg point out, the situation in Argentina and Brazil resulted in a structure of industry in which a small group of foreign transnational corporations was the base of the countries’ production system, and a large number of low-productive local firms where

their suppliers. In such a structure, there was no technological spillover from foreign TNCs to local companies. Sometimes foreign companies led locally owned companies to destruction, restraining their productivity and viability (Khan and Blankenburg, 2009).

Besides the internal processes, the situation in Argentina and Brazil was also influenced by external factors. The slowing pace of their development was caused especially by the rising development of China and some other Asian countries. The fast growing Chinese economy had a huge impact on the countries' export as well as on the sales in their domestic market. While China was increasing its production and exports, Argentinian and Brazilian manufacturing was shrinking (Gallagher and Porzecanski, 2010). They increased their share in production of natural resources and maquila industries. It was accompanied by a decline in the share of high-tech products. This export structure caused a decrease in competitiveness of manufacturing and led to the deindustrialization of these economies (Castaldi et al., 2004; Gallagher, 2010; Devlin and Moguillansky, 2012).

3. Rationale for Contemporary Industrial Policy in LACs

The last decade of the twentieth century and the failures of the free-market model of development showed that the analyzed countries should return to an active industrial policy which was abandoned in the 1990s. State intervention has become necessary because the free market is unable to ensure the development of the industry to the level at which it will be able to compete with industries from more advanced countries. There are different arguments in favor or against the state intervention, but it is important to achieve a certain optimal point between market solutions and the state intervention (Rodrik, 2009). Despite arguments that the role of industrial policy should be limited to regulation of the market processes and maintaining the 'investment climate', in the case of developers (countries which are catching-up with more advanced countries) such an approach turned out to be insufficient. In some emerging markets, it is the local culture and the background for business, e.g. proper institutions, that are important (Spranz, Lenger and Goldschmidt, 2012). Such countries need a strong industrial policy, with a higher level of state intervention (Khan and Blankenburg, 2009). The state should provide particular institutional support for the development of the industry. The development of high-tech sectors is especially important as it could help quicken the pace of aggregate productivity growth and close the productivity gap between them and more advanced countries. It is emphasized that in LACs a public policy should play an important role in fostering the accumulation of technological knowledge and its economic exploitation (Castaldi et al., 2004). There is

a need to develop these sectors in which manufacturing processes generate higher value-added than in the past. It can be achieved by increasing the technological advancement in the industry. In the past, both analyzed countries were not able to adopt this approach. They failed to move into shorter-cycle technologies (which provides higher growth prospects) and adopted replication strategies oriented on technologies with longer cycles, e.g. food and beverages, hydraulic engineering, metal working, etc. (Industrial Development Report, 2016).

Usually the first step in the process of raising the level of technological advancement by developing countries is the use of external technology. There are a few different opportunities to acquire technologies and integrate domestic companies into global production networks. Among others there are: imitation, reverse engineering, creating linkages with foreign suppliers of parts and components, market linkages, FDI inflow, home R&D and training of human resources (Dahlman, 2009). The development of native industry always takes time, but developing countries should make all efforts to stimulate the process. This was pointed out by Alice H. Amsden, who highlights that it really matters whether the high-tech industry in a developing economy is dominated by foreign-owned subsidiaries of a multinational corporation or nationally owned enterprise (2009). The bias toward fostering only foreign enterprises is not recommended. They are prone to prevent the development of local competitors in the high-tech sectors. Amsden indicated numerous advantages resulting from the countries' indigenous enterprises, e.g. they have a less complicated structure, they are prone to develop at home their most promising projects, they are less risk averse and more willing to reinvest their profits in the home market.

Technological learning is a key condition for the country which wants to catch up with the advanced economies and develop its own high-tech industry. Such countries need to invest in R&D. The past examples from LACs show that the backwardness and inaction in the field is very harmful and leads to poor growth performance (Castaldi et al., 2004). Innovation, adaptation and imitation are these activities which decide about the results of competition and determine which enterprises are growing, and which are going out of business (Dosi and Nelson, 2010). R&D is essential for further development. As C. Dahlman notes, at the stage of developing new branches of industry, emerging markets can rely on obtaining technology through imitation and reverse engineering, but when they reach the world level of technological advancement, conducting R&D activities is more fundamental for remaining competitive (2009). This implies not only the increase in spending on R&D, but also the creation of conditions for cooperation between universities and firms, etc. The foregoing studies show that the level of R&D in the majority of LACs is critically low and it must be changed (Heitor et al., 2014).

The industrial policy oriented on building high-tech sectors in developing countries should be flexible. Two stages are particularly important: the protection of 'infant industries' and later liberalization of the approach. At the beginning, a new industry must be protected to ensure that indigenous products are not easily replaced by the imported ones (which are cheaper and have better quality). The purpose of the protection should not be, however, the continuous support of domestic enterprises, but the assurance that they will quickly gain the ability to compete on an open, global market. The key phase for further development is the moment of withdrawal of the state support. At this stage, previous strategies of technological imitation and state protection for domestic enterprises should be replaced by a strategy based on trade liberalization and internationalization. It means the beginning of industrial competition in external markets. From this moment, the future position of the industry in the global market should be ensured by the scale of production and the quality of its products (Reinert, 2009).

4. Industrial Policy in Argentina and Brazil During the Period 2000–2010

Argentina and Brazil are fully aware that in order to continue development they must concentrate on the active support of the evolution of their industry. The essential matter is to implement strategies aimed at gradual industrial development and the shift to the production of more technologically advanced products. The key aspect is diversification of the production structure and achievement of a certain level of specialization. Such an approach will allow the formation of bonds between companies, subsequent technology transfer and as a result it will have a positive impact on economic growth (Peres, 2009).

The success or failure of high-tech industry development will depend on many factors:

- government policy as well as technological and institutional strategies applied;
- internal social factors;
- foreign influences.

Every country implementing a new policy should concentrate on all three groups of factors. The feature that distinguishes LACs from other parts of the world is the lack of regional convergence between individual countries. Some of them play an active role in increasing their industrial competitiveness, whereas other countries reject open assistance and avoid clearly defined industrial policies (Izquierdo and Talvi, 2011; Peres and Primi, 2009).

During the noughties, Argentina and Brazil employed new policies on their industrial development. One of the main questions is what is the

nature of the policy and if it is oriented on the development of high-tech industry?

The industrial policy in Argentina is relatively minimal and demand driven. Throughout the 2000s, the country emphasized an approach which was geared towards enhancing export oriented competitiveness of the local products. The most important initiative was implemented in 2007, when the Ministry for Science, Technology and Productive Innovation was created. The aim was to develop a knowledge-based growth pattern. During the last few years, Argentina established a number of technology and science parks whose goal is to foster research and development in the high-tech sectors (Sánchez, Butler and Rozemberg, 2011).

The nature of the industrial policy in Brazil is more sophisticated. The government in the country oriented its industrial policy with the aim of boosting the production of goods which can be competitive in foreign markets. In 2003, the Brazilian Ministry of Development, Industry and Foreign Trade prepared a guideline on *Industrial, Technological and Foreign Trade Policy*. One of the main aims of the new policy was to focus on high technology sectors which could improve the country's competitiveness. The sectors selected by the government were: medical, pharmaceuticals, semiconductors and software industries (Pereira, Marcelino and Kruglianskas, 2006). The goals established after the last financial crisis were continued in the *Productive Development Policy* (2008–2010) and then in *Plano Brasil Maior* in 2012 (Devlin and Mognillansky, 2012). In all of these programs, Brazil was promoting new branches of industry and supporting home companies to enter foreign markets (Cárdenas, 2010). The development strategy based on import of technology and imitation of products has dried up. Now the country has to create its own production capacity and develop its own advanced technology.

The feature that distinguishes the contemporary industrial policy in Brazil is the state financial support. It is treated as one of the key elements necessary for the technological development. The most important institution oriented on supporting high-tech industry in the country is the Brazilian Development Bank (*Banco Nacional de Desenvolvimento Econômico e Social*, BNDES). Since its creation in 1952, the institution has been focusing on lending to public and private companies and promoting technological development. It supports the development of the capital market in Brazil and implements new programs and financing tools aimed at the innovation development (Hochstetler and Montero, 2013; Musacchio and Lazzarini, 2014; Shapiro, 2014).

Argentina and Brazil have the most developed high-tech industries among all LACs (except from Mexico). It can be noticed that these industries were growing fast, and their share in high technology exports, as a percentage of manufactured exports, doubled in the period of 1995–2015 (Figures 1 and 2).

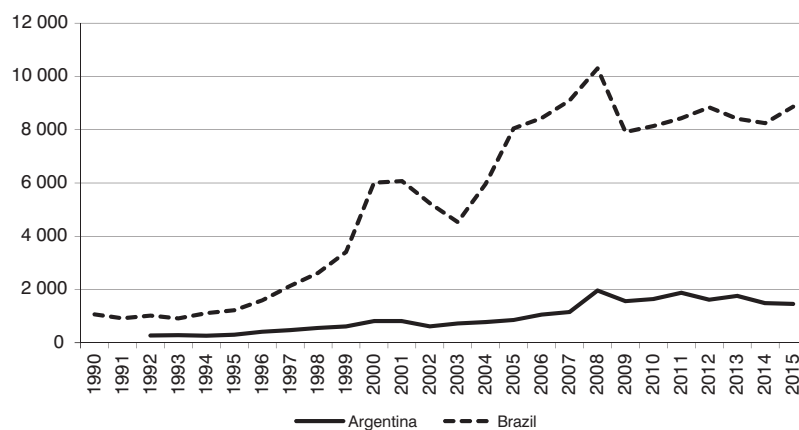


Fig. 1. High technology exports in Argentina and Brazil in the period 1990–2015 (current US \$ million). Source: World Bank statistics (accessed: 24.03.2017).

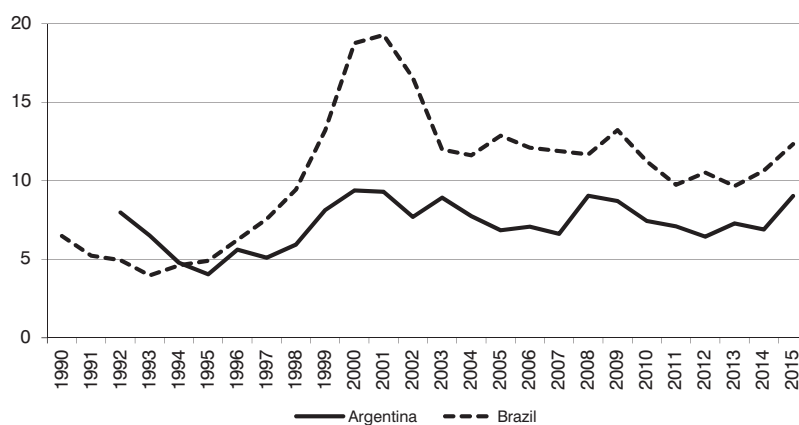


Fig. 2. High technology exports in Argentina and Brazil in the period 1990–2015 (% of manufactured exports). Source: World Bank statistics (accessed: 24.03.2017).

5. Development of the Aerospace Industry in Argentina and Brazil

The experiences of high-tech sector development in Argentina and Brazil include aerospace and pharmaceutical industries. The countries selected for the analysis have particular importance for several reasons:

- industrial policy has been introduced in Argentina and Brazil during the last few decades;

- from the beginning of the industry onward, the variation in the industrial policy allows for the identification of differentials in the development of the selected countries;
- both of these countries experienced a period of far-reaching liberalization of the economy, which gave an interesting context for the analysis. Both of the selected industries, aerospace and pharmaceutical, have a long tradition in these countries.

In the case of aerospace, one feature should be highlighted. The aircraft manufacturers are playing the most important role in this branch, however, the industry cannot be only evaluated through the prism of the airframe producers. There are many external entities, such as: aero engines producers, navigation and flight systems producers, aircraft flight simulators producers and many others which play a very important role in the industry (Stahl, 2012).

5.1. Development of Aerospace Industry in Argentina

The origins of the Argentinian aircraft industry go back to 1927. It was established in Cordoba. The first Argentinian plane factory was the *Fábrica Militar de Aviones (FMA, Military Aircraft Factory)*¹ and it was a state enterprise aimed at promoting industrialization. At the beginning, the Argentinian aerospace industry was developed without private companies. All the institutions linked to the industry belonged to the Argentine Air Force. As the technological knowledge in Argentinian aviation industry was very poor, planes were assembled under license from foreign producers and Argentinian factories employed foreign engineers. The intention was to build small planes for the domestic market which did not help in capability accumulation. All the processes led the aerospace industry in Argentina into a severe crisis. The main fault was the lack of strategic vision of the development of the industry, the lack of private firms and educational institutions. The government underestimated the importance of aviation, which had a negative impact on the industry's development (Hira and Oliveira, 2007; Vertesy and Szirmai, 2010).

During the 1960s and 1970s, there was still no government policy oriented on the development of the domestic aircraft industry and no incentives for entrepreneurship. In the second part of the 1980s, Argentina tried to introduce private capital to its aerospace industry, but it resulted in no real improvements.

A great hope was bound to the changes which occurred in the mid 1990s. After the previous problems, the Argentinian government tried to privatize its aerospace industry. In 1995, the *FAdeA* was integrated with Lockheed Martin from the United States (concession agreement). The joint business was a difficult time for Lockheed Martin, because of multiple economic crises in Argentina and the lack of economic and political support from the country's government. The concession finally eroded in 2009 and the

Argentinian government renationalized the company and undertook some activities to revive the sector and to consider the real possibilities of this industry in the current global context. The FAdEa accepted the export strategy, entered the civilian aircraft sector and started cooperation with Brazilian Embraer as a supplier of components (*Industria aeronáutica en Argentina: ¿Renace como el ave fénix?*; Sobie, 2010).

5.2. Development of Aerospace Industry in Brazil

The origins of the aviation industry in Brazil date back to 1910, when the first plane was built in the country. At the beginning, the industry was organized in the form of a private partnership between Brazilian enterprises and foreign aircraft manufacturers. With time, the government began to support R&D in this sector and in the 1950s it created: the Technology Institute of Aeronautics (ITA) and the Aerospace Technical Center (CTA). Despite government support, Brazilian private companies were not able to compete at an international level. Access to technology during that time period was also very limited (Hira and Oliveira, 2007).

The first state-owned enterprise, Embraer (Empresa Brasileira de Aeronáutica), was established in 1969. The establishment of the company is equated with the origins of the Brazilian passenger aircraft (Liderska, 1989). During the first stage of Embraer's development, most of the parts, components and sub-systems of the produced aircrafts were imported. It was difficult to produce them locally because of low production scale, high quality expectations and high development costs. Embraer was a government owned company, and achieved initial success as a result of maintaining the strategy based on the adoption of foreign experiences (Marques and Oliveira, 2009; Vertesy and Szirmai, 2010).

The second stage of Brazilian aerospace development, called "international market phase", began at the end of the 1970s. Embraer realized that the key strategic decision would be its partnership with foreign firms. The company signed license agreements with a couple of foreign companies. Among them were: Piper (the United States), AerMacchi (Italy), Northrop (United States) and Pratt & Whitney (Canadian engine manufacturer). The collaboration with the companies allowed Brazil to acquire foreign technology, to raise the quality of local products and to access foreign markets (especially in the United States and other LACs). An important characteristic of the stage was the increasing reliance on imported systems, structural parts, components and sub-systems. Local suppliers lacked government incentives and economies of scale for technological upgrading, so importing was the best solution (Marques and Oliveira, 2009).

At the beginning of the 1990s, Embraer got into trouble as a result of the recession in the international civil aircraft sector. It led to the third stage – privatization of the company, which took place in 1994. This caused real changes in the company – it led to cost-cutting and other forms of

austerity measures, which strengthened the performance, investments and international presence of the company. In the second half of the 1990s and throughout the 2000s, Embraer was treated as an example of a successful corporation. The company expanded its cooperation with foreign markets. An example is China, where Embraer established its assembly plant. The cooperation between Brazil and China in the aerospace industry is gaining more and more importance (Luberska, 2014).

5.3. Comparison of Argentinian and Brazilian Approaches

The aerospace industries in Argentina and Brazil were at the same level of development by the end of World War II. Both countries concentrated on military planes but Argentina adopted a more isolationist approach. This policy led to short-lived success in the years coming after the war, but turned to be a long-standing failure in the following decades. Brazil had the chance for greater international cooperation, which had a sizable impact on further development of its aerospace industry (Vertesy, 2011).

State support is crucial for the development of industries with high-tech content, especially in emerging markets where industries are at an 'infant stage'. In the case of Argentina, the state applied a strategy of import substitution, but it turned out to be an inadequate approach – the government never had a consistent strategy for the FAdeA development. It resulted in the lack of indigenous design in the aerospace sector, the lack of foreign partnerships, stable government financial support, or export strategy, etc. (Vertesy and Szirmai, 2010; Hira and Oliveira, 2007).

In Brazil, from the very beginning the aerospace industry acquired government support as a national priority. The government provided Embraer with protection from foreign competitors during the first stage of development and was its most important customer. The company was also exempted from any local public liabilities, e.g. taxes, duties, etc. While the company reoriented its main area of operation from military aircraft towards commercial planes, it remained under continuous state support (Hira and Oliveira, 2007; Goldstein, 2002). In the case of Embraer, the export oriented approach has a great contribution as well, favoring a more flexible approach to innovation and fostering education and research (Industrial Development Report, 2016).

From the very beginning, the FAdeA strategy was oriented towards the production of military planes, which was a big mistake and had a huge impact on the industry's growth. Although the company tried to reorientate its approach at the end of 1980s, it turned out to be unsuccessful (Vertesy, 2011). After the move towards commercial (civilian) production, the industry was in its infancy period. The planes were not competitive and the whole production system was unsustainable. It was composed of older models, which were cheaper, but contained obsolete technological solutions. The second mistake is that FAdeA never took into account the orientation of

production for export, which resulted in the fact that Argentina was unable to compete in foreign markets.

From its creation, Embraer had the intention to develop the national aircraft and it strived to create a competitive industry. Its managers were obsessed with technology (instead of commercial viability), which led to the company's success. The company was initially created by the Brazilian government, and was privatized in its mature stage of development (in 1994). What is significant, Embraer behaved very flexibly to the changes in the global market. For the aerospace industry development in Brazil, the crucial factor was the strategy orientated to export, which Embraer had been applying since the 1970s. It led to a policy intended to fulfill the external markets' expectations, achieve economies of scale and capture world-class technology. The need to reach external markets caused the adoption of global trends in design, production, marketing, etc. Additionally, Embraer effectively took advantage of the niche created in the aircraft manufacturers market and became oriented towards manufacturing of small and medium-sized civil planes. Such niches provide a less competitive environment, and as an enterprise from an emerging market, it is able to develop its capacity and strengthen the level of competitiveness.

The next important factor responsible for Embraer's success was its production system. The company concentrated on designing the aircraft, producing fuselages and assembling the final product. The production of more expensive and more technologically advanced components was outsourced to foreign partners (Goldstein, 2002; Liberska, 2011). The way of obtaining technology from foreign producers is called 'reverse outsourcing'. The essential thing is that the parent company is situated in an emerging market and the components are made in the developed countries, like the United States, Japan or in Europe. In the case of Embraer, the main suppliers are: GE (the United States), which supplies engines, Honeywell (the United States) – avionics supplier, Kawasaki (Japan) – wing stubs and pylons supplier, VSMPO (Russia) – titanium plates supplier. Electronic devices are made by other companies based in the United States whereas many parts for doors and fuselages are produced in France, Spain and Belgium (Agtmael, 2007; Avrichir, 2015). The way of producing in accordance with the 'reverse outsourcing' model enables obtaining the highest quality and cheapest components. The parent company can use the latest high-tech innovations without bearing the expenses connected with the whole process of developing technology in many different areas. It means that the innovation is foreign but it brings profits for the parent company (*The Brazilian model*, 'The Economist', 2010).

A further important factor of Brazil's success was the development of its domestic enterprises, alongside the main producer – Embraer. During the 1960s and 1970s, Brazil kept license production but treated this approach as a way for acquisition of specific know-how. The country treated 'entrepre-

neurship' as an additional way of development. Contradistinctively to Brazil, Argentina failed to acquire foreign frontier technology. It was impossible in the country because of the lack of private companies, frequently changing governments and the lack of financial and political support for such development of infant industries (Vertesy, 2011). The aerospace industry in Argentina was transformed from aircraft manufacture into maintenance hub.

It can be concluded that, while the industry in Brazil is thriving, Argentina did not succeed in the aerospace sector. The most important factor which had an impact on the situation was an incorrectly implemented industrial policy. The government should recognize the needs of the industry, understand the existing conditions, and actively stimulate the development of the branch. Brazil applied this approach.

6. Development of the Pharmaceutical Industry in Argentina and Brazil

The pharmaceutical industry is different from many other industries in two main aspects. First – it is usually more fragmented in comparison to other branches of industry. Second – it is less susceptible to economic fluctuations. There are three categories of drugs: branded drugs, generics (copies of branded drugs), vaccines and other pharmaceutical products. The key for producing branded drugs and generics are active pharmaceutical ingredients (API). Whereas the production of generics is possible by copying, re-engineering and such processes, the APIs are developed by research processes and new discoveries.

6.1. Development of the Pharmaceutical Industry in Argentina

The development of the pharmaceutical industry in Argentina has its origins in agriculture. The economy has always had strong agricultural grounds. A strong biotechnology industry has arisen from the agricultural model and the growth in biotechnology has stimulated Argentina's pharmaceutical industry (Delpino and Dion, 2014). The beginning of the pharmaceutical industry in Argentina dates back to the end of the 19th century. From that time, local entrepreneurs and pharmacists produced remedies for various diseases and they conducted their own research. Over time, such businesses grew and formed domestic companies which became pioneers of the Argentinian pharmaceutical industry. Most of the current major Argentinian pharmaceutical companies were set up in Buenos Aires in the first decades of the twentieth century. Among them were: La F armaco Argentina (1905), Andr omaco (1926), Bag o (1934), Lostal o (1936), Sidus (1938), and Laboratories del Dr. Andreu (1942) (Campins and Pfeiffer, 2011).

The second important stage of the Argentinian pharmaceutical industry development started in the 1950s. During this decade, domestic companies began their internationalization, exporting antibiotics to other LACs, and

then (from the 1970s) they started to build production plants on the whole continent. Afterwards, they used the capabilities acquired initially in the internal market and later in the regional one; they moved their investments to Eastern Europe, Asia and Africa.

The next big change in the industry occurred in the 1990s. The liberalization of the market resulted in an increase in the share of foreign companies in the local market. Domestic companies and laboratories developed their cooperation with foreign companies, e.g. through licensing agreements and contracts. It helped to acquire knowledge and was a good strategy which triggered spectacular growth.

After the crisis in the second half of 1990s, the country's pharmaceutical industry was at the turning point. The key factors boosting the development of the industry in Argentina at that time comprise: joint cooperation between domestic and foreign companies operating in the same sector, and knowledge development. During the last decade, some Argentinian companies became leaders and strategic partners of some of the most important pharmaceutical companies in the world.

6.2. Development of the Pharmaceutical Industry in Brazil

The Brazilian pharmaceutical industry started to develop at the end of the 19th century. Only a few domestic firms from the country were involved in production of medicines at the beginning and they were doing it on a small scale. At the time, the country established a set of public laboratories (Guennif and Romani, 2011). By the 1930s, the pharmaceutical market in Brazil consisted of: public institutions which produced vaccines, national firms involved in the production of medicines, and foreign firms producing medicines. Brazilian firms were striving to promote industrialization and self sufficiency.

The government changed its approach in the 1950s, and the main goal became alluring the foreign capital inflow. Brazil became one of the biggest pharmaceutical markets in the world and attracted large investments from abroad. Brazilian pharmaceutical entities were very quickly taken over by foreign corporations. This processes led to the situation in which at the beginning of 1980s no autonomous local pharmaceutical industry capable of producing domestic APIs was present in Brazil.

During the 1980s, a plan of collaboration was developed between the state, academics (State University of Campinas) and a group of public and private firms. Local firms were not interested in the acquisition of knowledge but were oriented on imitating foreign transnational corporations. It was easy because the government applied the system which protected locally produced pharmaceuticals by fixing high tariffs or banning imports (Guennif and Romani, 2011).

The next big change occurred in Brazil in the mid 1990s, when the country accepted the neoliberal approach. It led to privatization of previously

state owned companies, abolition of import restrictions and attraction of foreign investments. In the aftermath, the industrial policy was dismissed (Delgado, 2012).

The liberal approach combined with the strict regulations of the intellectual property had a negative impact on the domestic market and led to a change at the end of 1990s. At the turn of the centuries, Brazil started to introduce a new approach which accentuated a need to return to the industrial policy. The action was taken in several areas, e.g.: increasing the investment in innovation, strengthening domestic enterprises, and attracting technologically advanced foreign producers. The new approach started the recovery of the Brazilian pharmaceutical industry.

6.3. Comparison of Argentinian and Brazilian Approach

The Argentinian pharmaceutical sector has been using its experience from the past several decades. Some of the main important factors are: a solid national educational system which resulted in the availability of skilled personnel, the prohibition of patents in the pharmaceutical industry, the protection of domestic sector by tariffs on foreign products, government support for granting marketing authorizations, etc. (*Local Production of Pharmaceuticals*, 2011). The policy implemented in the Argentinian pharmaceutical industry during the last decade is very reasonable because the local entities started to buy up internationally certified manufacturers which were being sold off by the MNCs. Moreover, they have oriented their approach to exporting drugs to foreign markets (*Argentina: Crisis Brings Opportunity*, 2009). An important factor of the new approach in Argentina is the public-private organization of the business which joins political decisions with private companies and leads to the increases in exports and helps to finance the necessary research.

Brazil started the development of its pharmaceutical industry by creating basic manufacturing capabilities and then turned to the development of re-engineering capabilities and the production of bulk drugs and APIs. The import substitution and export promotion policies at the beginning seemed to be very rational with the large internal market. However, very soon it became apparent that the approach was flawed. Despite the state programs launched in the 1970–1990s, the transfer of technology to the Brazilian pharmaceutical industry was not sufficient. Moreover, such an ambiguous situation was created that the government hesitated between the import substitution policy and the policy aimed at attracting FDI. Thereby the government applied two opposed approaches. One aimed at building a strong national pharmaceutical industry to increase self-sufficiency, whereas the other argued that the ownership was unimportant because the key issue was to satisfy the local demand. There was fierce competition between the two approaches during the 1970s and 1980s. The period is treated as ‘lost decades’ in the technological development area in Brazil.

During the 1990s, successive governments in the country discarded the industrial and technological policies. Additionally, the liberalization deepened the problems of many local companies. More active support for the pharmaceutical industry was given by Luiz Inácio Lula de Silva's government, which introduced new *Industrial, Technological and Trade Policy* in 2004. The pharmaceutical sector was classified, among others, to the prioritized sectors which, according to the government, had the potential for developing dynamic comparative advantages in Brazil (Ninomiya, 2015). At the beginning of the noughties, Brazil began to export drugs to the markets of the neighboring countries. In the first half of the noughties, generic producers made vast investments, modernized their units and developed innovation capabilities.

The key factor for the growth of the pharmaceutical industry in every country is R&D. In Argentina, strong pressure on R&D was one of the main features during the whole time of the industry's development. The pursuit for intangible assets and know-how rose and Argentinian enterprises used every possibility to reach this goal (e.g. cooperation with foundations, institutes, and universities; joint ventures with foreign corporations, etc.). Argentinian companies achieved rapid progress thanks to their deep specialization. Using their knowledge, they filed a patent application. Another important factor is the pressure on knowledge acquisition. Mergers, acquisitions, licensing partnerships with foreign companies and strategic alliances enable Argentinian companies to obtain significant and valuable know-how and help to boost the efficiency and the sale of activity of domestic enterprises.

Brazil centered its pharmaceutical industry on generics production. There is no strong pressure on R&D, which is a misguided approach because generics should not be the backbone of the industry. Generics are products with lower profit margins, the production of them can be complicated, and there is heavy competition in the market from the MNCs from developed countries, from Chinese and Indian companies. Brazil is characterized by high dependence on foreign imports of some components necessary for generic production. An additional obstacle for knowledge development in the country are strategies applied by local companies. They are still defined by import substitution praxis and protectionist measures. In such an approach, they very often neglect the need for innovation.

One of the key elements in the development of the pharmaceutical industry in both countries, Argentina and Brazil in the past, was no protection of the patenting of pharmaceutical products. Pharmaceutical companies in these countries were able to manufacture innovative medicines without far-reaching intellectual property restrictions (Fonseca, 2015). The situation changed in 1995, when intellectual property rights were introduced (the creation of WTO, and the Agreement on Trade-Related Aspects of Intellectual Property Rights – TRIPS). Argentina took advantage of the transitional period granted for developing countries. The country signed

the TRIPS agreement enforceable within a period of 3 to 5 years (Casaburi, 1997). Businesses had time to adapt to the new scenario. Brazil took opposite steps and immediately accepted the TRIPS provisions. During the 1990s, local firms were under a drastic adjustment process which had a bad impact on them (Delgado, 2012; Shadlen, 2017). They reduced their operational structures and started to seek to improve the quality of their products. Production structures were reduced through the dismantling of chains of production, and deactivation of high-technology segments (Suzigan and Furtado, 2006).

The next factor which had a huge impact on the development of the pharmaceutical industry in Argentina and Brazil is the presence of foreign companies in the region. The Argentinian market is dominated by domestic companies (most of them are private). They have always been dominant entities in the pharmaceutical market in the country (Bonofiglio and Ginsberg, 2010). In Brazil, it is just the opposite – there are large foreign multinational companies which have already established a network of their relationships with local entities. The dependence on foreign companies is an obstacle for the development of the domestic pharmaceutical industry. It leads to the lack of backward integration of local firms to incorporate manufacturing capabilities to produce drugs in the domestic market. The result is that the country level of imported drugs and components is high (Caliari and Ruiz, 2010).

The main disadvantage for further development is that the level of investment in R&D in Argentina and Brazil is very low in comparison to the developed countries. Moreover, the pharmaceutical industry is fragmented and needs consolidation and stronger cooperation with foreign partners (which could facilitate their export).

7. Conclusion

The aim of this article was to characterize the aerospace and pharmaceutical industries in Argentina and Brazil and to highlight the influence of an active state support on these sectors development during the years 2000–2015. It can be concluded that there is strong support for the idea that through the development of advanced technology, developing countries will be able to raise the productivity growth and catch up with advanced countries (Cimoli et al., 2009b; Dahlman 2009). To achieve this goal, they should apply a more active industrial policy (Amsden, 2009; Khan and Blankenburg, 2009; Peres, 2009; Rodrik, 2009).

The presented case studies of aerospace and pharmaceutical industries in Argentina and Brazil indicate that despite many similarities between the economies, their high-tech industries are developing in different ways. While the aerospace industry has been developing rapidly in Brazil, Argentina lost its significant position. The case of pharmaceutical industry shows

opposite results. While the Argentinian pharmaceutical industry had been developing very dynamically, Brazil has not been able to achieve its goals.

This study identifies the essential need of application an industrial policy by the analyzed countries in order to achieve successful development. A strong emphasis should be placed on the advanced technology development. In the case of the aviation industry, a proper approach was observed in Brazil. Argentina was characterized by the lack of export orientation and too small participation of the private sector.

In the case of the pharmaceutical industry, Argentinian companies were oriented on knowledge development and internationalization, whereas Brazilian pharmaceutical companies failed in the development of their own APIs and branded drugs. While the approach in Argentina was able to strengthen the advantages of domestic companies, the Brazilian approach was torn between domestic enterprises development and foreign FDI attraction. This led to the loss of competitive advantages of the Brazilian pharmaceutical industry.

It can be concluded that despite government efforts to strengthen the analyzed industries, the different approaches brought different effects. Governments in both countries did not recognize the processes that occurred in international markets, nor did they implement a well-planned, long-term strategy oriented on innovation, internationalization and cooperation between domestic enterprises and foreign partners. Moreover, these analyses clearly suggest that other factors have had greater influence on the industries than exclusively the intentional industrial policy. Among them, there are some local advantages (educational system, market determinants, origins and structure of the industry) and to a greater extent the behavior of the enterprises (corporations) operating in the industry.

The analysis leads to the general conclusion that a proper industrial policy needs to determine at which stage of the value chain a country should focus. It can be an assembly plant (as in the aerospace industry) or the R&D phase (as in the pharmaceutical sector). The country which focuses on the key area is able to reap the highest benefits. Moreover, a proper approach, oriented on the development of the high-tech sectors, should take into account many other determinants, but at the same time it should be very flexible and focused on the development. It can be a recommendation for the process of shaping the industrial development in the emerging markets in the future.

Endnotes

- ¹ The Fabrica Militar de Aviones changed its name ten times during the period 1927–2010, due to different stages of transition. All the names are used in the literature (e.g. Instituto Aerotécnico, Area de Material Córdoba, Lockheed Martin Aircraft Argentina S.A., etc.). Since 2010, its official name has been the Fabrica Argentina de Aviones (FAdeA). This name is used in further parts of this paper.

Acknowledgments

The author would like to thank Professor Barbara Liberska and Professor Giovanni Dosi for their assistance with the issues involved in this paper's fieldwork and their many comments. They were helpful in elaborating the final version of the article. I am also very grateful to my colleague Marta Gancarczyk who encouraged me to pursue this topic.

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