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Historical Development in Brazil and Turkish Automotive Industry and Innovation Policies

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It is possible to say that the automotive industries of Brazil and Turkey have developed as assembly industries and show great similarities in this context. In the 1980s, in line with the development direction of the world's automotive industry, Turkey tried to make the country's investment environment attractive for foreign international companies to produce in the country. We can say that while Brazil created the state incentive system in order to attract foreign investments to its country since the 1950s, it tried to increase its dose with the 1990s. Although, like Turkey, Brazil has thought of producing local cars, the difference between Turkey and Brazil is that it has considered exporting and was able to export not only to South America, but also to African countries. Another difference of Brazil is that it has implemented incentive policies for the automotive sector and has been able to rearrange its incentive elements according to changing conditions. Turkey, on the other hand, has decided to return from the policy of attracting foreign investments to its country since 2006, and in 2011, it decided to produce domestic automobiles. As of December 2019, a prototype of the domestic car was produced by Turkey's Automobile Initiative Group and work for mass production began. Thus, the problem of adaptation to electric vehicle production was tried to be overcome by moving to a new phase in the way of technology development. This approach was used by the South Korean automotive industry in the 1980s and it was successful and technology development capability was gained in a short time. In order to see the success of the application of this method in Turkey, it is thought that it is necessary to wait for the result of the domestic automobile project. Brazil, on the other hand, was able to rank high in world automotive industry production with its sectoral incentive policies that can adapt to changing conditions and its structure that considers exports from the past, while Turkey lagged behind.

Keywords: automotive industry, lagging industries, gaining technology development capability, path dependency, domestic automobile

Introduction

A Portuguese saying that lauds the discoveries they have made says that if the earth were larger, we would still circumnavigate it. The Portuguese, from Vasco de Gama to Serpa Pinto, believed that they took civilization to the places they went on the sea and on land. The Portuguese believed that they were performing a divine mission. Christophe Colomb applied to King Joao of Portugal to be given the necessary equipment to go to Cipangu (Japan) from the west towards 1484. Because at that time, the starting point of all journeys was Portugal (Ferro, 2002, pp. 55-56; Dolanay, 2021d, p. 233).

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The rivalry between Portugal and Castile had the risk of turning into a conflict from the very first discoveries. Portugal got the monopoly of African trade with the Alçovas agreement signed with Spain in 1479. However, after 1492, the great success that the Castilians began to achieve in the Atlantic, Pope III directed Calixtus to grant Portugal a monopoly in the Atlantic as well. Since the Pontifical Institution was the only state with worldwide authority at that time, Pope VI, who was the spiritual nephew of Calixtus, Alexander Borgia determined the areas of influence of the two countries with the papal edict entitled Inter Caetera. Like this, the islands and landmasses, 100 leagues westward from the last of the Azores, towards India and in all other directions, were ceded to Spain. Later, Portugal objected to this sharing and with the Tordesillas agreement dated June 7, 1494, the distance was increased to 170 leagues. The text of the agreement was approved by Pope Julius II in 1506. Accordingly, the Portuguese appeared to be victorious. Because they reached India by crossing the Cape of Good Hope and gained dominance over the Arab merchants in India, they continued to be at the forefront of maritime trade. However, when Portuguese came to Brazil, we could say that it started to offer South American treasures to Portugal, and Portugal's superior position in these lands began to become evident (Ferro, 2002, pp. 101-102; Dolanay, 2021d, p. 233).

Brief History of Brazil

Brazil was a colony of Portugal between 1500 and 1822. The economy was shaped according to the rules set by Portugal, and basically, the export or import of agricultural products produced in Brazil to Europe (especially Portugal) was in question. In the first years of colonization, especially Brazilian wood was brought to Europe. Then, in the 1530s, rapid transfer of Brazilian products (sugarcane, gold, tobacco, cocoa, cotton, coffee, and rubber) to Europe began (Naritomi, Soares, & Assunçao, 2009, p. 5; Dolanay, 2021d, pp. 233-234). In addition to the climate and geographical characteristics in general, the level of Portugal's demand for the products produced in the regions determines the development of the Brazilian region and that which activity will be carried out where. In the early years of colonization, the northeast of Brazil was chosen for sugarcane production due to its climate and soil characteristics. While there was a boom in sugar cane exports to Europe, on the other hand, by the 17th century, Brazil had become the world's main sugar producer. As of roughly 1600, 120 sugar production facilities have been identified in Brazil. Sugar production in Brazil was based on the plantation system; sugar was a profitable business between 1530 and 1760, and there were periods of increase, peak, and decline. Sugar production was based on large land ownership, monocultural social structure, and slave labor. During the sugar cane period, a class society structure required by the local aristocracy, which had production, technological, political and economic power, was formed (Naritomi et al., 2009, pp. 5-10 and p. 13; Dolanay, 2021d, p. 234).

Gold mining started in the central parts of Brazil in 1695. The first gold mine was found in the Minas Gerais region. In 1728, a diamond mine was discovered in the Matto Grosso and Goias regions. However, production started to decline with the year 1760 and ended at the end of the 18th century. With the collapse of the mining economy, it was not possible to carry out other economic activities other than mining by individual entrepreneurs and the population of metropolises decreased from 20 thousand settlers in 1740 to 7,000 settlers in 1804 (Naritomi et al., 2009, p. 10; Dolanay, 2021d, p. 234).

Gold mining was largely based on slave labor due to technological inadequacies. This was done by sending the slaves who worked in the sugar cane fields to the mines, and the agreements between the miners and the slave owners were established with difficulty. The slaves' knowledge of the structure of the soil and

their knowledge of where and how to extract the mine gave them bargaining power (Naritomi et al., 2009, pp. 10-12; Dolanay, 2021d, p. 234).

In the 19th century, industrial capitalism in Brazil was realized in the northern and southern regions by cooperatives, associations and combined entrepreneurs, and in the 1970s, this structure led to the formation of European-style social welfare. Keynesian regulations, on the other hand, have created a new social structure in which economic crises have been experienced (Ferrarini, Gaiger, & Veranese, n.d., p. 3; Dolanay, 2021d, p. 234).

Brazil has given importance to science and technology since the 1930s, when it started to create industrial sectors with national security concerns. It was not until Brazil had moved towards democracy in the 1980s and gradually opened its markets to trade that the government turned its attention to economic competitiveness. The first major funding program targeting innovation went into effect in 1999; since then, several policies and strategic plans have been implemented that target both specific technology sectors as well as the framework conditions that support innovation. Brazil has leveraged its rich and plentiful natural resources to build strong S&T driven sectors with state support (Gupta, Weber, Pena, Shipp, & Healey, 2013, p. 4).

The government's efforts at fostering innovation in the Brazilian economy are fairly recent and have had mixed success to date; on the one hand, total undergraduate degrees granted have more than doubled in the past decade, with similarly significant trends seen in post-graduate degrees attained, an outcome of an education push by the Lula and Rousseff administrations. On the other hand, a cultural bias towards pure research and a historical mistrust of the military have traditionally diverted the majority of qualified S&T researchers to academia, where they have little interaction with industry, a trend that policies have not been able to impact thus far. As a result, industry-university linkages are poor, and publicly funded research is by and large not accessed or exploited by industry. This, in turn, also negatively impacts industry's capacity to engage in R&D-based innovation (Gupta et al., 2013, p. 5).

As the South American economy, Brazil's in particular, has grown in the past decade; strong customer demand has enabled Brazilian companies to grow regionally without necessarily becoming more innovative or globally competitive. Companies are unmotivated to push the boundaries of technology, despite having a skilled and efficient engineering workforce. This reticence results in part from Brazil's tradition of state-supported industrial development. In addition, the Brazilian government's response to macroeconomic shocks that could increase vulnerability to global competition (such as currency appreciation resulting from trade surpluses) has been to implement short-term protectionist measures to benefit local companies. Thus, Brazilian firms perceive that the government will continually defend the domestic industry, and this provides a disincentive to invest in long-term R&D and innovation strategies. Business investment in R&D is low (Gupta et al., 2013, p. 6).

Brazilian Automotive Industry Between 1915-2000

Brazil's first automotive assembly plant was opened in Sao Paulo in 1919 by Ford to assemble Ford T model cars and Ford TT model trucks. Ford established its own production facility in 1921. In 1926, General Motor opened an assembly plant in Sao Paulo for the production of Chevrolet cars (Dolanay, 2021d, p. 234).

The Brazilian automotive industry basically started mass production in the 1950s. With the establishment of the Automotive Industry Management Board (GEIA), the government began to ask the automotive industry to provide a local contribution rate of 90-95%, especially in the parts industry (Marx & De Mello, 2014, p. 143;

Dolanay, 2021d, p. 235). In 1956, Brazil's first domestic car, the Romi-Isetta, was manufactured in Sao Paulo. In 1958, Japanese Toyota's Land Cruiser model vehicles began to be produced, and in 1959, German Volkswagen Kombi model vehicles began to be produced in Sao Bernardo do Campo. Chevrolet and Ford started to produce trucks in 1957, while other business vehicles and automobiles started in the 1960s. In the period between 1960 and 1980, the automotive industry developed by taking advantage of the prohibition of the import of completed vehicles and parts and the encouragement of exports (Marx & De Mello, 2014, p. 143; Dolanay, 2021d, p. 235).

Sebastiao William Cardoso, a Brazilian entrepreneur, started to produce Tupi, small electric vehicles, in 1967, and Puma started selling sports cars. German Mercedes Benz started to produce buses and trucks in the 1950s and established an automobile factory in 1998 (Dolanay, 2021d, p. 235).

Due to the extreme increases in oil prices in the 1970s, the government considered the use of sugar cane ethanol in vehicles with the Pro Alcool program. Then, this practice spread from the automotive industry to all other industries with the scattering effect. This contributed to the development of engineering locally. The use of ethanol in vehicles continued until the 1990s, then there was a stretch towards the use of gasoline vehicles; the use of ethanol in vehicles ended, but although the use of flexible fuel in vehicles was re-established in 2003, by 2012, 95% of the vehicles produced in Brazil were flexible. It has been produced with fuel use (Marx & De Mello, 2014, pp. 143-144; Dolanay, 2021d, p. 235).

Due to the economic crises experienced in the 1980s and early 1990s, investments in technology and new models decreased, while market growth remained at very low levels. Considering these conditions, the government brought import liberalization, but we can say that this new economic policy dragged the country into a bigger market crisis (Marx & De Mello, 2014, p. 144; Dolanay, 2021d, p. 235). Thus, companies consisting of Nissan, Renault, Peugeot, Citroën, Honda, Hyundai, Mitsubishi, Chrysler, and Audi started production in Brazil. Policy measures introduced since 1992 and 1993 included reductions in regional and general taxes, credit incentives, and extra tax reductions for low engine displacement vehicles. Thus, these small vehicles became 70% of the market in 2002 (Marx & De Mello, 2014, p. 144; Dolanay, 2021d, p. 235).

In 1995, the Automobile Regime was adopted to create sectoral policies. This regulation included an increase in import taxes and regulations to increase automobile production in Brazil. By 1997, local production and sales records were broken and investments to increase production capacity were expanded. However, with the world financial crisis experienced in 1997, the deterioration in the automotive sector continued until 2003 (Marx & De Mello, 2014, p. 144; Dolanay, 2021d, pp. 235-236).

Brazil's lack of capacity for science, technology, and innovation has been influenced by its history. Despite adopting a constitution in 1891, Brazil oscillated between authoritarian and military rule throughout the period from 1930 to 1984. During this time, Brazil underwent a long process of industrialization as the government developed statist monopolies, including well-known companies such as Petrobras in the oil and gas sector and Vale in the mining sector. Other sectors were also developed through a combination of import substitution and export promotion policies, including manufacturing in the automobile industry, and agriculture. Although the Brazilian government lacked a central innovation policy throughout this time, it indirectly supported research and development (R&D) investments through public universities, human resources, and infrastructure that were important to industrial growth (Gupta et al., 2013, p. 5).

A democratic government was established in 1984. Policies during 1980s and 1990s, discouraged investments in the industrial sector but stabilized inflation and economic growth. As Brazil began to attract

significant foreign direct investments After World War II, Brazil experienced a wave of democratization and held presidential elections in 1945. However, a military regime returned to power from 1964 until 1984. The Real Plan (*Plano Real*) was a set of measures taken in 1994, during the Presidency of Itamar Franco, to stabilize Brazil's domestic currency in nominal terms after a string of failed plans to control inflation. The domestic companies struggled to compete; the government began to recognize the importance of innovation and productivity growth to economic growth (Gupta et al., 2013, pp. 5-6).

National Fund for Scientific and Technological Development (FNDCT) was created in 1969 but refreshed in 1999 with funding from sectorial sources (De Negri & Rauen, 2018, p. 10).

The leadership of Brazil's federal government since the mid-1990s has emphasized the integration of innovation into national policies. It was under the Cardoso presidency that large-scale innovation funding first appeared in 1999 and was directed solely to university and research institutes. Substantial increases in federal R&D spending (from 0.33% to 0.43% of GDP) occurred over 2003-2010 under President Lula, when the government expanded its S&T policy to support both academic research and private sector productivity and innovation (Gupta et al., 2013, p. 21).

A major part of Brazil's prioritization of innovation is the role played by the Financier of Studies and Projects (Financiadora de Estudos e Projetos, FINEP), a public firm under the Brazilian Ministry of Science, Technology and Innovation (MCTI), established to mobilize S&T research in the public, private, and nonprofit sectors. FINEP serves as a bank, issuing loans to the private sector for innovation-related projects through the National Fund for Science and Technology. Brazil's banking sector has also developed and matured as a result of aggressive reforms in 1988 and 1994-1995 that supported modernization and regulation of the banking sector. These reforms have encouraged foreign banks to invest in Brazil, which increased competition and lowered interest rates. Two of Brazil's largest ongoing funding instruments are the Sectoral Funds for Science and Technology and the Economic Subvention Program. A recently initiated plan, the Action Plan on Science, Technology and Innovation for National Development (PACTI) addresses key deficiencies in previous policies, particularly those related to industrial investment in R&D and industrial capacity for engaging in R&D-based innovation activities. This section briefly describes the innovation-related policies that have gone into effect since 1999 (Roett, 2011; Gupta et al., 2013, p. 21).

As Brazil began to attract significant foreign direct investments in the early 2000s, the broader S&T support for industry coincided with the creation of new policies and funding instruments centered on promoting innovation, with the intent of helping domestic companies compete with foreign competition. Brazil's state-owned and state-run institutions in petroleum (Petrobras), aeronautics (Embraer), and agriculture (Embrapa), were privatized or partially privatized in the 1990s (Gupta et al., 2013, p. 21).

In 1999, the sectoral funds for science and technology were created to fund innovation and S&T development in cross-cutting areas, such as infrastructure, and specific sectors, such as petroleum, energy, and agriculture. From 1999 to 2012, these funds distributed about $6.4 billion to finance more than 30,000 projects throughout Brazil (Ministry of Science, Technology and Innovation, 2012). Implementation of the funds was initially considered to be misguided in some aspects; although the funds aimed to increase university-industry cooperation, funding was provided directly to the university or research institute, not the firm, giving universities a disproportionate advantage in attracting talented researchers. Direct allocation of funding to firms was not legislated until the Law of Innovation was passed in 2004 (Gupta et al., 2013, p. 23).

Brazilian Automotive Industry After 2000

With the increase in the population, income and purchasing power of the country in the 2000s, the production and sales of passenger and commercial automotive vehicles increased rapidly. This rapid increase has made the Brazilian automotive industry the 7th largest manufacturer worldwide and the fourth largest market in the world as of 2012. However, the Brazilian Technological Innovation Research (PINTEC) showed that there was no similar increase in the R&D expenditures of automotive manufacturers in the period when there was an increase in production. It has been understood that the innovations developed by the automotive manufacturers are not new to the market and according to the same research, the engines of the cars produced in Brazil have more backward technology than those in Europe. Thus, the automotive industry has become only the assembly of imported parts (Marx & De Mello, 2014, pp. 141-142; Dolanay, 2021d, p. 236).

In order to overcome this problem and increase the competitiveness of the Brazilian industry, the federal government announced the Brazil Master Plan (PBM) in August 2011. As part of the plan, Inovar Auto was announced in 2012 for the automotive industry. In order to increase the courage to invest and innovate, Inovar Auto has introduced new measures in the areas of increasing foreign trade, protecting the industry and the local market (Marx & De Mello, 2014, pp. 142-143 and p. 145; Dolanay, 2021d, p. 236). The Inovar Auto program aimed to increase competitiveness, and in line with this target, it introduced a 30% reduction in the federal tax rate on industrial products. However, in order to provide these incentives, the program stipulated that companies should allocate 0.5% of their gross income to R&D expenditures at the beginning, and it aimed to increase this rate from 0.5% to 1% in the period between 2013 and 2017. In addition, companies were asked to keep the regional contribution rate of 65%. Although the main goal of the program was to increase competitiveness, another goal was to increase energy savings. By October 2013, many multinational companies have been willing to invest locally in order to be included in the program. However, the program did not include any regulation or incentive for electric vehicle production (Marx & De Mello, 2014, pp. 145-146; Dolanay, 2021d, p. 236).

While the total production of the Brazilian automotive industry was 3,402,508 units in 2012, it decreased to 2,429,463 units in 2015 and decreased to 2,014,055 units in 2020 (Dolanay, 2021d, p. 236).

We can say that Brazil's inadequacy of science, technology and innovation capacity has been determined by its historical past. The process from the 1930s to the 1980s was spent with reducing bureaucracy for entrepreneurs; New Public Administration reforms were started to be implemented in the 1990s; modernization efforts began in the 2000s, and only from the 2010s on, innovation has been given increasing importance (Dolanay, 2021d, p. 236).

The Industrial, Technological and Foreign Trade Policy (A Política Industrial, Tecnológica e de Comércio Exterior, PITCE), introduced in 2003, is a multiagency initiative whose mandate goes beyond R&D promotion to include broader economic and industrial goals, such as expansion of trade policy. The PITCE has defined its priority areas along three themes: horizontal actions (innovation and technological development, exports, industrial modernization, and institutional environment), strategic sectors (software, semiconductor, capital goods, and pharmaceuticals), and future activities (biotechnology, nanotechnology, and renewable energy). To date, its effectiveness has been dampened by coordination challenges and dissent among the various participant agencies. The Economic Subvention Program is the main policy instrument for the Brazilian government to

distribute R&D funds directly to the private sector. The program has almost doubled its total funding and number of awards between 2006 and 2013 (Gupta et al., 2013, p. 23).

An important improvement in the Brazilian innovation ecosystem was the implementation of the Innovation Law (Law no. 10,973/04) in 2004, which stipulates the rules for researchers from public institutions participating in research projects with companies and the guidelines for the commercialization of intellectual property rights derived from these partnerships. Indeed, this law was intended to stimulate the sharing of facilities as well as human and financial resources between the public and private sectors. Beyond this, one of the most important aspects of the law was that it created the possibility for the state to subsidize R&D investments at private companies through grants, something that had not been possible within Brazil's legal framework up until that point (De Negri & Rauen, 2018, p. 10).

A more modern scheme of tax incentives to encourage companies to invest in R&D was put in place in 2005, when the so-called "Lei do Bem" (Law no. 11,196/05) was enacted. The Lei do Bem represented a significant improvement for business strategy since it established a specific tax deduction that could be automatically applied to R&D investments. Both the Innovation Law and the Lei do Bem were implemented during the first term of President Lula's government in the context of the new industrial policy (Industrial, Technological and Foreign Trade Policy—PITCE) launched in 2003 (De Negri & Rauen, 2018, p. 10).

Informatics Law, however, was not primarily oriented towards fostering R&D in Brazil but was designed to increase the amount of local content in the electronic and informatics products produced in the country. To encourage the inclusion of local content, the law gives tax breaks on manufactured products if companies follow some basic rules. Basically, the Brazilian government tells companies how they should produce specific goods using inputs and components sourced from the local market. If the company decides to invest in R&D, an additional tax reduction is granted. After 2005, many other tax breaks were created with the explicit objective of spurring innovation, among them the "Inovar Auto" Program (Law no. 7,819/12) stands out. This is the current automotive industry regime and this incentive is designed not only to support innovation, but also to guarantee employment and production. In the context of this regime, the tax incentive program for new projects in automotive industries in peripheral regions of the country (Law no. 12,407/11) is also significant (De Negri & Rauen, 2018, p. 11).

The Action Plan for Science, Technology and Innovation for National Development (PACTI) and the Productive Development Policy (PDP) were instituted in 2007 and 2008, respectively, to improve coordination of S&T and innovation governance across the various government agencies. The PACTI addresses key weaknesses in the innovation framework, such as lack of industry investment in technological R&D, lack of scientists and engineers employed in the private sector, and limited avenues for commercialization of publicly funded research (Gupta et al., 2013, p. 24).

The Business Innovation Plan (Plano Inova Empresa) was announced in March 2013 to stimulate private sector investment in innovation. The aim of the plan was to transfer fund from government to business for research facilities (Gupta et al., 2013, p. 25).

In terms of demand-side innovation policies, the main initiative was the 2010 launch of a type of "Buy Brazilian Act" that allowed a preference margin of up to 25% to local producers if the product or service they supplied was not only produced in Brazil but developed domestically as well. Local suppliers of products that were not domestically developed had fewer margins, depending on the economic sector (Law no. 12,349/10).

Within the scope of the Greater Brazil Plan (launched in 2010), FINEP and the Brazilian National Development Bank (BNDES) launched the Innovate Company Program in 2013. This was a massive public line of credit with subsidized interest, which focused on innovation projects rather than just R&D (De Negri & Rauen, 2018, p. 12).

In 2014, the federal government launched two bold initiatives: (1) the Knowledge Platform Program and (2) the Brazilian Industrial Innovation and Research Corporation (Empresa Brasileira de Pesquisa e Inovação Industrial, EMBRAPII). The first of these was an ambitious program designed to overcome societal problems through technology procurement. In fact, this was the first time Brazil had attempted a more mission-oriented R&D approach. Unfortunately, the political turmoil that took place just after the launch of the program prevented its implementation. In contrast, EMBRAPII is currently fully functional and growing. EMBRAPII is a public funding agency inspired by the German Fraunhofer model and is aimed at fostering innovation projects in partnership with private companies. The agency works with accredited research institutions authorized to operate under the quality rules of the agency. Although there has yet to be a formal evaluation of its results, the creation of EMBRAPII seems to have been an important institutional innovation in the Brazilian scenario. In fact, the first data available indicate a high level of R&D investment leveraging (De Negri & Rauen, 2018, pp. 12-13).

In addition to the incentives for innovation offered in many developed countries, Brazil also has an unusual instrument to spur innovation in regulated sectors—obligatory R&D. By law, concessionary firms involved in energy and oil extraction must not only contribute to the above-mentioned Sectorial Funds, but also—through a federal approval process—invest in their own R&D projects. The consequence is a high level of external R&D investment that fuels the university system (De Negri & Rauen, 2018, p. 13).

Prior to 2014, the subsidized credit for innovation experimented the highest budgetary expansion. This type of instrument is used by the BNDES and FINEP. FINEP, the main innovation agency, has seen its budget for subsidized credit increase more than 10 times since 2007, till 2017 (De Negri & Rauen, 2018, p. 17).

Many of the innovation policies are designed to spur science and contribute to the public academic system. Yet, the ultimate intent of the S&T policy is to build better societies through socioeconomic development. In this way, the expectation is that these policies will change private behavior, encouraging firms to assume more risk and explore new technological possibilities. In other words, in capitalist societies, increased private investment is expected following increased S&T public investment (De Negri & Rauen, 2018, p. 25).

Despite the efforts of the 20 years, nothing has really changed in terms of the R&D structure and intensity of the Brazilian economy. In fact, business participation in R&D has decreased between 2000 and 2014. Business R&D intensity—which had been quite stable over the entire period—did increase slightly in 2014. However, this was due to the low growth of the Brazilian GDP and uncommon expenditures on external R&D by telecom service companies (possibly related to the FIFA World Cup and the Olympic Games). Therefore, in general, there seems to have been little or no change in private behavior with respect to R&D efforts. As a consequence, Brazil is losing ground in terms of international competition. For instance, in the 2007 Global Innovation Index, Brazil was the 40th most innovative country in the world. But in 2017 its position fell to 69th, well behind China, India, South Africa, and Russia (De Negri & Rauen, 2018, p. 26 and p. 28).

According to the data of the World Bank, Brazil's share of GDP in R&D was 1.26% in 2017, a decrease from 1.34% in 2015.

Brief History of Turkey

Since the establishment of the Ottoman Empire, great importance has been attached to science and it has been sensitive about the transfer of knowledge and technology (İnalcık, 2017; Dolanay & Oğuztürk, 2019; Dolanay, 2021a; 2021c). As a matter of fact, the first Ottoman Madrasa was established by Orhan Gazi in 1331 in İznik (Özilgen, 2009, p. 21; Dolanay, 2021a; 2021c). However, after the execution of Molla Lütfi, one of the important scholars on mental sciences, in 1495, with the decrease in the importance given to mental sciences, the process of knowledge and technology transfer began to be interrupted (Dolanay & Oğuztürk, 2019; Zelyut, 2019; Pala, 2019; Dolanay, 2021a; 2021c). Due to the defeats in the wars, the transfer process was tried to be revived by the trainers brought from abroad in the military field, and a hendesehane (geometry school) was opened in 1734 by Comte de Bonneval (Özilgen, 2009, p. 40; Dolanay, 2021a; 2021c) and this school was supported by the ilmiye class (Cihan, 2014, pp. 140-145; Dolanay, 2021a, p. 81; 2021c, p. 78). The Ottoman Academy of Sciences was established in 1862 and Darülfünun, which would later be accepted as a university, was established in 1863 (Özilgen, 2009, p. 63; Dolanay, 2021a, p. 82; 2021c).

In 1924, Madrasahs, which could be called the main pillar of the Ottoman education system, were closed (Zengin, 2002; Cihan, 2014). With the University Reform carried out in 1933, the institution of Darülfünun, which was able to establish a connection with the past knowledge once again and was formed with the knowledge gained from the Madrasa, was completely removed, and universities were established, which were required to provide education in Western norms. New trainers, mostly of foreign origin, were brought in place of the trainers. In addition, the Faculty of Language, History and Geography was established in 1935, which was understood to be aimed at completely erasing the knowledge of the Ottoman education system and aiming to create a new history thesis (Erdem, 2012, pp. 380-386; Dolanay, 2021c). The dismissal of faculty members from the university in certain periods also took place in the later years of the Republic. Thus, universities remained as institutions that transfer knowledge transferred from abroad to their students, that is, transfer knowledge (Dolanay, 2021c, p. 78).

In the system, which was implemented before 1838 and called Yed-i Vahit, the state was able to leave the trade and especially the export of a commodity in any region to a private person. In addition, the state was able to prohibit the export of this commodity during periods when there was a shortage of certain goods or foodstuffs. Before 1838, the Ottoman Empire had 3% customs duty on both exports and imports, and the internal customs tax rate was 8%. On August 16, 1838, in the mansion of Grand Vizier Reşit Pasha in Balta Harbor, the Balta Harbor Trade Agreement was signed between Reşit Pasha and the British Ambassador Possenby. With the agreement, the customs duty on exports was reduced to 12% and the customs duty on exports was reduced to 5%. While internal customs duties were abolished for foreigners, they continued to be applied to domestic traders. The customs duty on imports was increased to 8% in 1861, 11% in 1905, and 15% in 1908. Thus, we can say that the Ottoman State agreed to determine its own customs duties together with the European States (Pamuk, 1994, pp. 17-19).

Thus, the Ottoman Empire started to block the way of its own industrialists and entrepreneurs, which caused the entrepreneurs to focus only on trade. When the decline in industrial entrepreneurship combined with the decline of rational sciences in the field of science, the country began to have a state structure that only imports industrial products and exports raw materials without gaining profit. For this reason, the domestic

automotive industry could not be formed, and after the Republic, foreigners were asked to establish the automotive industry in the country (Dolanay, 2020, p. 543; 2021b, p. 57).

Turkish Automotive Industry Between 1923-1960

At the Izmir Economy Congress convened in 1923 after the War of Independence, it was decided that rapid industrialization would be provided by the private sector, and that the state would intervene in cases where the private sector's capital was not sufficient. In this context, an assembly facility was established in 1929 by Ford Motor Company in Istanbul Tophane to produce trucks and automobiles. However, this facility was closed in a short time due to the world economic depression and hostility to foreign capital (Pamuk, 1994, pp. 17-22; Keyder, 1993, pp. 80-84; Dolanay & Oğuztürk, 2018; Dolanay, 2021c; 2021d, p. 238). We can say that the automotive industry started to produce again with the military jeep assembly facility under license in the 1950s (Dolanay, 2021c, p. 79; 2021d, p. 238).

Although the process of establishing a national industry gained importance after 1923, the number of companies with foreign partners increased rapidly with the declaration of the Tanzimat Fermanı and we can say that the Encouragement of Industry Law of 1913 was beneficial for companies with foreign partners (Erdaş, 2015; Dolanay, 2021d, p. 238). As a matter of fact, Franko ve Şürekasi Inc. Co., which was a foreign partner company was understood as one of them (Dolanay, 2021d, p. 238).

Bernar Nahum, who played an important role in the establishment of the automotive industry in Turkey, founded in 1928 Franko ve Şürekasi A.Ş. He started to work within his organization and his supervisor was Joseph Kohen (Nahum, 1988, pp. 11-12; Dolanay, 2021d, p. 238).

Turkish Automotive Industry Between 1960-1980

In 1961, for the first time in the world, Turkey's first domestic automobile prototype, Devrim, was manufactured in the locomotive workshop in Eskişehir in a short period of four months. However, the mass production of Devrim could not be started (Şimşek, 2006; Dolanay & Oğuztürk, 2018; Dolanay, 2021a; 2021c). In 1960, Ford automotive products started to be produced in Otosan Koç Group company under the leadership of Bernar Nahum (Nahum, 1988, p. 118; Dolanay, 2021d, p. 238). In 1967, the production of Anadol cars was started by the Koç Group with the multiple license method. This initiative of the Koç Group did not turn into a continuous and permanent success story due to the fact that exports were not considered and the bodywork was manufactured from the wrong material. In 1971, TOFAŞ with the Italian Fiat license and OYAK Renault facilities with the French Renault license were established (Dolanay & Oğuztürk, 2018; Dolanay, 2021c; 2021d, p. 238).

With the TOFAŞ Bird series, production of which started in the 1970s; it was possible to move to the stage of creative imitation in a sense, but there was no development that could turn into innovation later (Küçükerman, 2000; Dolanay & Oğuztürk, 2018; Dolanay, 2021a, p. 83; 2021c, p. 80).

It was thought that this was due to the lack of sufficient knowledge that could lead to the acquisition of technology development capability (Dolanay, 2021a, p. 83; 2021d, p. 239).

Turkish Automotive Industry Between 1980-2000

In the 1980s, all automobile manufacturers diversified their products and tried not to be affected by the economic crisis that took place in 1980 (Dolanay & Oğuztürk, 2018; Dolanay, 2021a, p. 83; 2021c, p. 80).

After the establishment of TÜBİTAK (The Scientific and Technical Research Council of Turkey) in 1963 and the studies carried out within the scope of the Pilot Teams Project in the 1960s, a report on science and technology was published for the first time in the 1980s and BTYK (Science and Technology High Council) was established. With the active work of BTYK in the 1990s, new reports on science and technology were published and new institutions were established (Göker, 2013; Dolanay & Oğuztürk, 2018).

In the 1980s and especially in the 1990s, many documents on science and technology were produced. However, little has been done to ensure scientific and technological development. The objectives set out in the documents were generally not achieved (Göker, 2013; Dolanay, 2021d, p. 239).

In the 1990s, production facilities were established in Turkey by Honda, Toyota, and Hyundai companies, and with the Customs Union with EU countries in 1994, automobile exports from Turkey to EU countries increased (Dolanay & Oğuztürk, 2018; Dolanay, 2021c, p. 81; 2021d, p. 239).

Turkish Automotive Industry After 2000

After the economic crisis experienced in 2001, serious annual economic growth rates were achieved in Turkey from 2002 until 2008. This period was also a period in which the results of the Customs Union and OEM investments of foreign companies began to be seen in the automotive industry (Dolanay & Oğuztürk, 2018; Dolanay, 2021a, p. 85; 2021c; 2021d, p. 239).

However, when Hyundai could not get the incentives it wanted for the second factory that it wanted to establish in 2006, it could not come to an agreement with Turkey and made this investment in the Czech Republic (Dolanay, 2021a; 2021c; 2021d, p. 239). Thus, a policy change has occurred in the Turkish automotive industry and Turkey has decided to produce its own domestic automobile. Although this policy change emerged as an idea in 2011, it could only give its results in December 2018 and domestic automobile prototypes were introduced by TOGG. In July 2020, the foundation of the factory was laid (Şimşek, 2020, pp. 202-205; Dolanay, 2021a, p. 85; 2021d, p. 239). Ford Otosan aims to increase its production capacity from 440 thousand vehicles to 650 thousand vehicles in 2021 with its new investment decision. All of the vehicles to be produced with the new investment are designed as electric and hybrid, and the company plans to continue to export 90% of its production. With this investment, a battery capacity of 130,000 was also achieved. It is thought that this investment decision was made as a result of the decision to produce electric domestic cars and thanks to the policies supporting the entrepreneur (Dolanay, 2021d, p. 239).

Starting from 1867, the Uzel company, which had produced horse-drawn carriages with mass production technique in Ruse and in Bursa in the 1870s, continued its production as a part manufacturer and tractor assembly company in the following years, while in 2009 it succeeded in producing the first domestic tractor. However, this innovative and entrepreneurial company could not escape from bankruptcy in the following years (Dolanay & Oğuztürk, 2018, p. 216; Dolanay, 2021c, p. 82; 2021d, p. 240). Again, Tata Motor, which planned to establish a production facility in Turkey in 2009, failed to do so (Dolanay, 2021c, p. 82; 2021d, p. 240). In February 2011, the desire to produce domestic cars was notified to the companies by the government. Again, the first domestic electric car, the prototype of which was manufactured in Hacettepe University technopark in 2015, could not be put into mass production because it could not find sufficient support and the project was canceled due to the fate of the Devrim cars project (Dolanay, 2021c, p. 82; 2021d, p. 240).

The inadequacy of Turkey's science, technology and innovation capacity is also due to the effect of its historical past (Dolanay & Oğuztürk, 2019). However, with the decrease in the importance given to mental

sciences after the execution of Molla Lütfi, one of the important scholars of mental sciences, in 1495, the process of knowledge and technology transfer began to be interrupted (Dolanay & Oğuztürk, 2019; Zelyut, 2019; Pala, 2019; Dolanay, 2021d, p. 240).

General Assessment

While the total production of the Brazilian automotive industry was 3,402,508 units in 2012 and 3,712,380 units in 2013, it decreased to 2,429,463 units in 2015 and decreased to 2,014,055 units in 2020 (Dolanay, 2021d, p. 240). Turkey's automotive industry total production was 1,072,978 units in 2012, 1,358,796 units in 2015, and 1,297,878 units in 2020 (Dolanay, 2021d, p. 240).

While Brazil's production values have decreased continuously since 2014, Turkey's production values have followed a fluctuating course (Dolanay, 2021d, p. 240).

Brazil increased its production in the 2000s as a result of the influence of the government's economic policies and its opening to foreign Sundays (markets); production values reached their highest point in 2013, but since 2014, production values have started to decline due to the competition of another regional country, Mexico (Dolanay, 2021d, p. 240).

Although the Brazilian automotive industry has fallen from 7th to 8th in the world in terms of production values in the world automotive industry ranking since 2014, it is in a higher order than Turkey. It was thought that this was due to the fact that they were more successful both in domestic automobile production and in opening up to foreign markets. It is thought that their higher performance in acquiring technology development skills and their efforts in technological improvements, especially in the 1970s, with the use of ethanol as a fuel, were also effective on this result (Dolanay, 2021d, pp. 240-241).

In addition, with the understanding of the importance of developments in science and technology and their contribution to industrial development, activities to establish and develop the national innovation system have increased since the 1990s in Turkey and the 2000s in Brazil. However, despite all efforts, as of 2017, the share of GDP allocated to R&D in Turkey remained at the level of 0.95%, while it reached the level of 1.26% in Brazil. Although Brazil seems to have been more successful in this regard, it has not yet gained the ability to develop technology in the automotive industry like Turkey. It is thought that this backwardness in technological ability is due to the fact that some events in the historical past in both countries have led to path dependence.

While it was thought that Brazil's path dependence was due to its past history shaped by military coups, it is thought that Turkey's path dependence resulted from the exclusion of intellectual (mental) sciences from the education system during the Ottoman period and the execution of Molla Lütfi, one of the important scholars in mental sciences, on charges of heresy and annexation (Dolanay & Oğuztürk, 2019; Zelyut, 2019).

Conclusions

While Brazil was a colonial country in the past, it gained its independence, but followed the same development path of the West in the automotive industry and tried to increase the production and sales of the automotive industry by thinking only of export before gaining the ability to develop technology. With this economic policy preference, in 2013, it was able to reach the highest production figures in its history, but it could not maintain and increase this production level in the following years.

Although Turkey was saved from becoming a colonial country with the War of Independence in the past, it followed the development path of the West in the automotive industry and did not consider exporting until

the 1980s. However, after the 1979 economic crisis, it started to give export incentives by choosing the export-based growth model in the 1980s, and in 1994, it entered the Customs Union with the European Union and started to follow a policy of opening up to foreign markets, just like Brazil. While a very high production and sales figure was achieved in 2018 with this policy, it was observed that the figures were lower in the following years. However, since 2011, the effort to produce domestic automobiles in addition to the export-oriented production policy has reached a new stage with the production of the domestic automobile prototype in December 2018, and we can say that a new move has been made towards gaining technology development capability in the automotive industry.

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