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Joint ventures or Independence? Alternative Ways of R&D Capability

Building at Emerging Economy Firms

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Abstract

Studies of the rapid economic development in East Asia suggest several factors which influence how industries in latecomer economies can utilize external knowledge to upgrade from low-end manufacturing to full-blown product development capabilities. A main aspect in this process is the learning and capability development at the level of firms. However, there are few studies of the innovation journey of specific latecomer firms and the challenges, managerial efforts and uncertainties involved in accessing and learning from international knowledge centers. Specifically, the various ways to acquire knowledge for innovation suggested in the literature need to be examined.

This paper analyzes the strategic options confronting latecomer firms which aspire to succeed in global competition. Based on in-depth studies in two Turkish industries, white goods and automotive, the paper details the combination of efforts and investments required to move up the technology ladder from license-based domestic businesses to internationally competitive capabilities. Two principal ways of acquiring innovation proficiency are compared: independent capability building versus international joint ventures. The paper shows the power of the former, but also indicates the difficulty of fostering brand value commensurate with technological achievements. Further the analysis reveals the reasons for and the limits of the alternative way, joint venture agreements, where MNEs tend to retain exclusive control of core technologies. The discussion section suggests that in sectors where independent capability building is implausible; it might be possible to position local firms as global niche centers of excellence within multinational configurations, if private and government efforts are skilfully coordinated.

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Key words: R&D management, capability building, joint ventures, licensing, innovation, emerging economies, white goods, automotive industry.

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Capability Building at Emerging Economy Firms

I. Introduction

“So we invited McKinsey and Bain Co. Consultants to analyze what would happen when Turkey entered the Customs Union with EU. And both of them argued, with a lot of statistics from previous examples, that the customs union with EU would bring a new level of competition. The value of the company would drop dramatically, so they suggested us to sell Arçelik. Another option was to enter a joint venture (JV) with one of the MNEs, and we negotiated for years with all the leading international firms. But after lengthy discussion we decided not to do anything of this, but to invest in our own R&D and innovation, although at that time we didn't know anything what this really meant...” (Huseyin Subasi, previous CEO of Arçelik and President of Consumer Durables Group, Koç Holding, interview 2013 04 25).

There is a rich literature on emerging economies and the catch-up of countries and industries (e. g. Hobday, 1995; Lall, 1992; Malerba, 2011). With the exception of some Korean and Taiwanese cases, however, there is a dearth of studies of the innovation journey of specific firms, and the uncertainties, hard managerial decisions and challenges involved in this process. Moreover, although many studies point to the necessity for latecomer-firms to acquire external knowledge beyond the spillovers from multinational direct investments (Fu, Pietrobelli, Soete, 2011), research has only begun to critically compare the available ways for accessing such knowledge (Mahmood and Zheng, 2009).

Against this background, this paper analyzes alternative firm innovation journeys, using case studies in two industry sectors in an advanced emerging economy, Turkey. The first case details the managerial efforts required to independently build internationally competitive

capabilities in the white goods industry. The second case, a study in the automotive industry, examines the advantages and the constraints of the alternative way to acquire advanced technological knowledge: international joint venture agreements. By comparing the two ways to achieve innovation capabilities, the paper contributes to a deeper understanding of how firms in emerging economies grapple with the challenge to acquire critical external knowledge, the choices they face and the contextual factors which impinge on their choice.

The rest of the paper is structured as follows. A review of the literature and a presentation of the methods of data collection are followed in section 3 by an outline of the two selected industry contexts. Section 4 contains a detailed account of the efforts involved in autonomous capability building at Turkey's leading white goods firm. The next section presents an international JV-case in the automotive industry and its prospects. The discussion and conclusion sections analyze these alternative ways of developing innovation capabilities and their limitations, and suggest future challenges presented by the alternatives. In the text, the terms "emerging economy firm" and "latecomer firm" are used interchangeably.

2. Theoretical background: Factors influencing the upgrading of latecomer firms

A long research tradition has studied internationalization of R&D from the perspective of established multinational firms, pointing to the tendency of MNEs to retain core parts of R&D in their home countries (Patel and Vega, 1999, Bergek and Berggren 2005, Mudambi, 2008). A different stream of research investigates the opposite processes of upgrading and R&D capability building by emerging economy firms, the most successful being companies such as Samsung and Hyundai in Korea (Hobday, Rush and Bessant, 2002; Kim, 1998), Acer in Taiwan and Huawei in China (Xu, Zheng, Yi, and Wei, 2003) and the Indian wind turbine manufacturer Suzlon (Awate, Larssen, and Mudambi, 2012). This research emphasizes several general factors required for successful technology upgrading, such as investments in

education and human capital, an economic regime which creates incentives for firms to export, and access to international knowledge beyond foreign direct investments (Fu, et al., 2011; Lall, 1992; Malerba and Nelson 2011,).

Studies of successful catch-up countries have investigated specific industry conditions or “technology regimes” which may facilitate new firm entries. These studies highlight the importance of access to an industry’s external knowledge base and of predictability of its technological trajectory (Lee and Lim, 2001). Comparisons of Korea and Taiwan during their catch-up phases show significant differences between these two countries, however, related to the different structures and organization of their industries. Whereas the Korean chaebols focused their patenting activities to fields with high cumulateness and low appropriability, the Taiwanese network economy preferred fields with the opposite pattern. In both cases, however, industries with short technological cycle times and relatively easy access to external knowledge were more conducive to catch-up in innovation performance than other industries (Park and Lee, 2006:737, 746).

A small but growing literature is also investigating the role of ownership structures, in particular business groups, for firm performance and innovation. Diversified business groups play a crucial role in many emerging economies, including Turkey (Colpan and Hikino, 2010; Karabag and Berggren 2014). These groups are important both for creating internal technology markets and for building linkages to external knowledge providers and some studies indicate that the affiliates of business groups are more innovative than non-affiliates (Hsieh, Yeh, and Cheng, 2010). Detailed comparative studies show this innovation effect to be dependent both on the structure of the groups and the country’s general economic infrastructure development; the centrally coordinated business groups in Korea seem to be

more effective in supporting innovation than the more loosely coupled groups in Taiwan (Chang, Chung, and Mahmood, 2006).

A common feature in the catch-up and late-comer literature is its emphasis on the role of firms and their technological efforts: "... in any sector, learning and capability by firms are of central importance.... the main factor determining catch-up" (Malerba and Nelson, 2011: 1648, 1659). To understand how firms build on factors in their environment to develop new capabilities, the literature proposes several evolutionary models. Hobday (1995) suggests three steps: learning assembly processes for standard goods; learning product improvement and development; conducting R&D for own products. In a complementary way, Mathews (2002) presents a generic model for resource acquisition and capability building, based on the key processes of linking, leverage and learning: linking to international knowledge centers, e.g. by manufacturing agreements, licenses or joint ventures; using the resources targeted by these links to leverage the emerging firm's own resources; and learning from repeated cycles of linking and resource leverage to upgrade in-house processes and capabilities. Several other approaches have been suggested. In a case study of the learning path of Hyundai, for example, Kim (1998) developed a four-step model for integrating external and internal knowledge, with the four phases preparation, acquisition, assimilation and improvement (see also Bell and Figuiredo, 2012). Albeit helpful for the general understanding of upgrading in latecomer firms, these models implicitly convey the impression of a linear process, where firms inexorably move up the innovation ladder. It can be assumed, however, that the development of capabilities to compete on innovation in the globalized economy requires extraordinary efforts for latecomer firms, and recognition of these challenges and obstacles are important to understand the choices and constraints faced by these firms.

The diverse strands of literature summarized above all emphasize the importance of accessibility to foreign knowledge to acquire these capabilities. Some authors argue that “well-established open global markets in applied technology, advanced machinery and equipment, latest instruments, and sophisticated materials and components” (Luo, Sun, and Wang, 2011:45) have reduced entry barriers and made technological catch-up much easier. Similar arguments are pursued in Mathews (2006). Studies of various “linkage instruments” show several learning limits, however. OEM-contracts, i. e. contracts to manufacture components or entire products to developed economy brand names, are effective to diffuse production skills, but may be negatively associated with efforts by the contract producer to develop her own brand, resulting from “constraints on inter-partner learning from the power asymmetry perspective” (Horng and Chen, 2008:126). Licenses are important to acquire basic designs but the next level requires more specialized knowledge (Mahmood and Zheng, 2009:1490), as will be discussed below. To compete internationally on new products and innovation emerging economy firms face two principal alternatives: to invest in the management and knowledge required to build independent capabilities supported by proprietary technologies; or to form joint ventures with leading international firms. The “independent innovation” road requires persistent long-term investments in R&D for an uncertain outcome. In complex-goods industries such investments may be massive; a case in point case being Hyundai’s investment in developing proprietary engine technologies in the 1990s, “a typical case of catch-up by huge investments” committed by a huge firm (Lee and Lim, 2001:470). The international joint venture road requires less upfront investments but may involve several other difficulties for host country firms, which so far have attracted little research interest: “Although strategies including collaborative strategies of multinational firms are heavily studied, far less attention has been placed on the risks of these partnerships impose on the domestic partners in these contexts” (Mahmood and Zheng, 2009:1500).

In the following sections these two alternatives are studied in detail, beginning with the stony road of independent capability building, followed by an account of the issues involved in advanced IJV-forms. The ambition is to uncover the challenges and constraints involved in both alternatives, to understand the industry context influencing their relative attractiveness, and to explore how emerging economy firms may maneuver within the chosen frameworks to maximize their innovation capabilities.

3. Methods

The paper builds on case studies of strategies to build R&D capabilities by two Turkish firms in the white goods and automotive industries. The first case is an in-depth analysis of the independent development of Arçelik from being a protected white goods producer to becoming a member of the group of internationally leading white goods firms, with a rapidly growing record in innovation. The second case, Fiat Tofaş, illustrates the alternative way: joint ventures with MNEs; the strategy of choice for firms in the automotive industry in most emerging economies to acquire state of the art-knowledge for international competition (Malerba and Nelson 2011: 1663). Both of the studied local firms are owned by Koç Holding, a major business group in Turkey which is renowned for its long-term orientation and investments in R&D (Colpan and Hikino, 2010; Koç Holding, 2011; Koç Holding Basın Bultenin, 2003; R&D Focus, 2009). Both industries enjoy government support, both in the form of targeted industry projects (especially in the automotive industry) and in the form of advanced training and education, e.g. in mechanical engineering. This support has not influenced the different capability building approaches chosen in the two cases, and will not be discussed in this paper.

Several data collection methods are used. Key informants inside and outside the firms were interviewed including previous CEOs and R&D executives as well as current R&D

managers, academic specialists at Istanbul Technical University, officers at the Department of Science, Technology and Innovation Policy at Tubitak (the major public agency for supporting Science and Innovation), complemented by interviews with a retired entrepreneur in the automotive and white goods sectors. See Appendix A for detailed information about interviewees. In collaboration with Thomson Reuters, patent data was analyzed in both sectors, with a special comparative analysis in the white goods sector. These primary data are complemented with annual reports, company publications, and Turkish PhD dissertations (Ilman, 2009; Tuncay-Celikel, 2009) as well as personal accounts by R&D executive, such as “An R&D Story” (Ureyen, 2010).

4. The White Goods and Automotive Industries in Turkey.

The production of white goods in Turkey goes back to 1959 when Arçelik assembled its first refrigerator (Esen, 2010) and soon was followed by other firms, such as Vestel and Profilo, later acquired by Bosch/Siemens (Hurriyet Gazetesi, 2009). In 2013 the Turkish white goods industry consisted of five final product-firms: Arçelik, BHS, Candy Group, Indesit and Vestel. Arçelik and Vestel are owned by Turkish business groups, the rest are controlled by German or Italian firms. When Arçelik and other Turkish white goods firms were established more than 90% of parts were imported, but successively this rate has been reduced significantly (Kirac, 1995). In the first decades, the white goods firms in Turkey competed on a highly protected domestic market and production expanded steadily but relatively slowly. In the 1990s Turkey changed its economic policy from import substitution to exports, culminating with a customs union with the EU in 1995. This dramatically changed the competitive conditions for the white goods industry increasing both domestic and foreign investments, and a few years after the EU integration had took effect, production and exports started to accelerate. From 1985 to 2012, total production in Turkey increased from 1 million

to 21.5 million units. Exports started in 1987, when 40 000 fridges and 18000 ovens were sold outside Turkey. Ten years later this humble figure had increased to 1 million units, and in 2012 exports totaled 16 million units, making Turkey the world’s fifth largest white goods exporter. See Figure 1 for an overview of production, domestic sales, exports and imports.

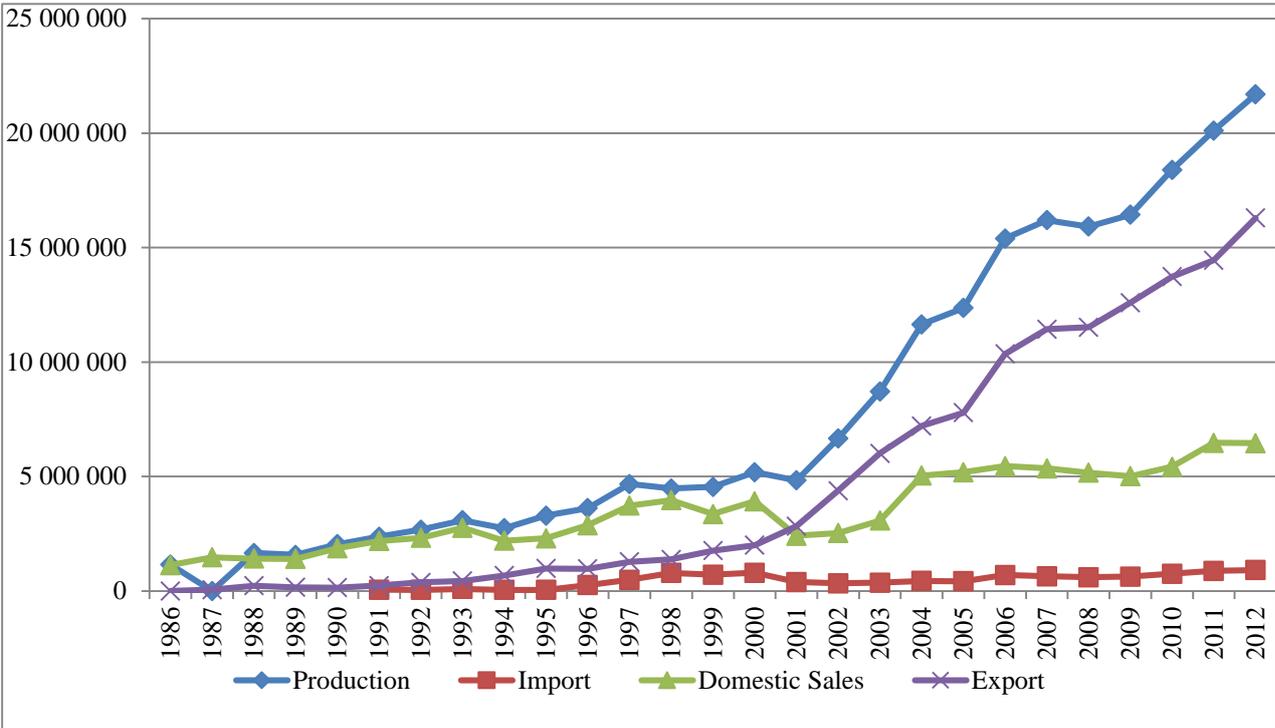


Figure 1. The Turkish white goods industry 1986 - 2012. (Source: TURKBESD, 2013)

The automotive industry is another major sector in Turkey with a production exceeding 1 million vehicles in 2006 (Otomotiv Sanayii Dernegi, 2013). This capital-intensive industry has evolved very differently from the white goods industry, however. Already during her import-substitution regime in the 1960s and 1970s, international firms started to invest in local manufacturing and joint ventures in Turkey supported by government policies (Ansal, 1990). This contributed to the formation of a broad Turkish supply industry, but also preempted the emergence of independent automotive firms. Similar to firms in the white goods sector, the automotive firms focused on the protected and profitable domestic market, and produced very little for exports. During the 1990s, new entrepreneurs also entered the

automotive industry, e.g. Özaltın Automotive in Adana, which built its business on simple designs and engines from China, component production and assembly in Turkey, and sales to low cost markets such as Syria (owner of Özaltın Otomotive, interview 2013 04 20). The combined pressure from more stringent emissions regulation, lack of state support, and competition from the incumbents soon forced such entrepreneurs to exit the industry, leaving it to be entirely dominated by JV-companies.

The integration of the Turkish market in the EU via the Customs Union in 1995 was a watershed event also for the automotive industry, forcing major car firms such as Fiat, Ford, Hyundai, Renault, and Toyota to make substantial investments in increased manufacturing capacity and quality. By means of a successful transition from local adaptations for domestic customers to the production of competitive models for the European market, several firms including Fiat-Tofaş (see below) became major exporters, selling 70% or more of their production internationally. This contributed to a strong growth in overall production, making Turkey no. 16 on the global ranking list of automotive producers (2012). From 1999 to 2012 production in Turkey grew by 260 %, from 300 000 to 1070 000 vehicles. See Figure 2 for an overview of production, domestic sales, exports and imports.

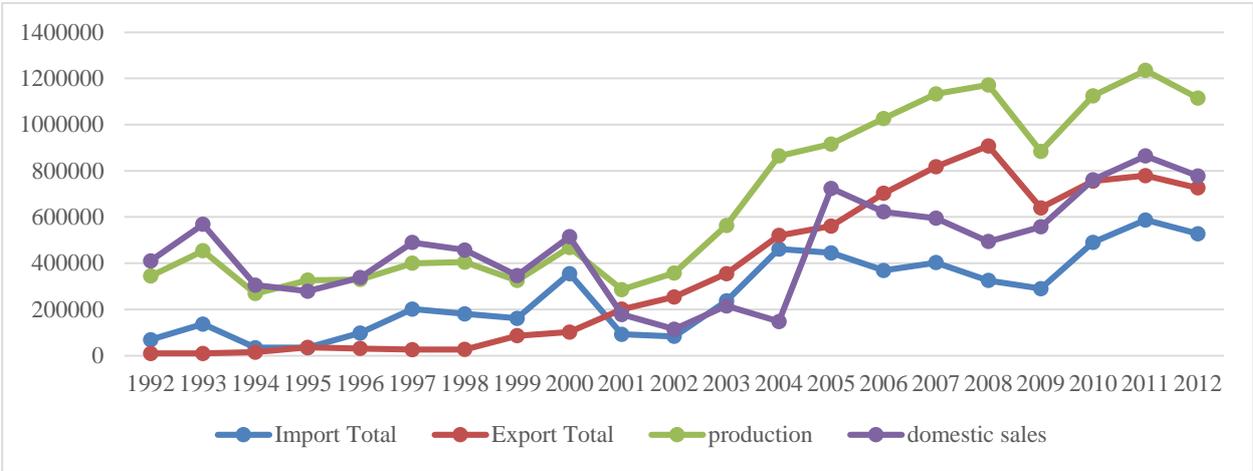


Figure 2. An Overview of Turkish Automotive Industry between 1992 & 2012 (Source:

Otomotiv Sanayii Derneği, 2013).

5. R&D Capability Building Cases

5.1. R&D Capability Building at Independent Firm: Case of Arçelik

Arçelik, originally an office furniture company, started in the white goods industry with a pure domestic orientation. In the 1980s, the company entered into original equipment manufacturing (OEM) contracts with several international firms. These collaborations helped Arçelik to improve its manufacturing capabilities in areas such as standardized production, quality control and logistic (Gülsoy, Özkanlı, and Lynch, 2012; Markaya, 2001). When domestic demand was becoming saturated, Arçelik began exporting its own products. International sales gradually increased to become a dominant part of total sales. In 2012, Arçelik had 20,000+ employees and 14 production units in four countries outside Turkey: China, Romania, Russia, and South Africa (Arçelik Annual Report, 2012). From year 2000 to 2012, sales at Arçelik trebled, from 1,564 to 4,481 million € and international sales increased from 16% to 59% (Arçelik Annual Reports 2000, 2012).

Since 2000, the international white goods industry has changed significantly. As shown in Table 1, emerging economy firms from China and Korea have gained considerable market shares, and Arçelik too has enjoyed a stronger market growth than its established competitors.

Table 1. Global White Goods Firms in 2010

Company	Global Ranking 2008	Global Ranking 2009	Global Ranking 2010	% Unit Volume Share 2010	Actual Unit Volumes ('000) 2010	% Unit Volume Growth 2009-2010
Whirlpool Corp	1	1	1	10.5	42,891	4.4
Electrolux AB	2	2	2	7.3	29,881	3.0
Haier Group	4	3	3	6.9	28,066	13.1
Bosch & Siemens	3	4	4	5.8	23,679	5.4
LG Corp	5	5	5	5.1	20,901	7.3
GD Midea Holding Co	10	9	6	3.5	14,141	15.3
Samsung Corp	8	8	7	3.4	13,913	11.9
General Electric Co	6	6	8	3.3	13,449	1.2
Indesit Co SpA	7	7	9	3.2	13,295	2.2
Panasonic Corp	9	10	10	2.9	11,754	3.6
Açelik AS	11	11	11	2.1	8,684	7.1

(Source: Euromonitor, 2012)

Capability formation and knowledge acquisition in the early phase.

To start producing its first washing machines and refrigerators in Turkey in 1959-1960 Arçelik used several different knowledge sources such as basic licenses and know-how agreements with foreign white goods firms, complemented with knowledge brought by international component producers and visits to licensors and component makers. To interpret, internalize and implement this knowledge, the company employed several

engineers, technical draftsman and prototype technicians. After an initial period of limited competition, western firms became active and brought novel products to Turkey. The new competition and the enhanced products raised the expectation among buyers. Arçelik managers discovered that its previously acquired knowledge was inadequate and started to search for new sources, which in the mid-1980s resulted in a license agreement with Bosch-Siemens for several types of white goods (correspondence with Refik Ureyen 09 May 2013).

This agreement supported Arçelik 's development and market expansion in Turkey, but also had several drawbacks. One was the limited access to markets outside Turkey, since the licensor sought to avoid competition from its licensee. Moreover, the agreement was based on products in the mature or declining stage of their life cycles, and excluded new or future products. Hence product engineering and manufacturing departments at Arçelik could only develop on the basis of the existing technical levels. When retailers in Turkey started to import and sell advanced products directly on the Turkish market, Arçelik started negotiations to extend the license agreement to future products from Bosch-Siemens. This coincided with preparations for the Customs Union with EU. Top managers at the company realized that free trade would result in a complete change of the competitive landscape in Turkey with cut-throat competition on price and performance. The high cost of extending license agreements, the export restrictions involved, and the demand from the licensor to have the priority of acquiring Arçelik in case it would be sold made negotiations difficult. Invited consultants McKinsey and Bain 's suggested Koç Holding to sell the company (see introductory quote). But after lengthy deliberations, group executives instead decided to develop the firm 's independent innovation capabilities.

Swimming against the tide: Building R&D against a prevailing business logic

The effort to build independent R&D resources encountered a host of difficulties. The first obstacles were related to the dominant business logics in the Turkish industries in the 1980s and 1990s. Knowledge and technology were perceived as any traded goods, epitomized by the saying “pay the money, get the technology”. Refik Ureyen, the first R&D manager at Arçelik, remembered a business conversation portraying investments in R&D as a monetary drain: “I heard that you are going to establish an R&D group. You should be very careful, the engineers can invest the money in tools and equipment and you would not get any results.” According to a widespread view investing in R&D was not an interesting or relevant issue for competitive success and firm performance (correspondence with Refik Ureyen 09 May 2013).

The second group of difficulties was created by the culture of the middle managers at Arçelik who had been recruited from the Turkish Railway Corporation. They brought their railway logic to Arçelik with a focus on “maximum production at minimum time” and “keeping the production system operating”. This logic was very effective in the market conditions of the 1970s and 1980s, when the economy was closed to the outside and there was a supply shortage in Turkey. The focus was to ship the planned volume from the factories; “if products have defects after they are delivered to dealers that will be the problems of consumers and the after sales departments” (correspondence with Refik Ureyen 09 May 2013).

Another difficulty concerned organizational power and structure. To safeguard the autonomy of the new R&D department from the prevailing culture it reported directly to the CEO, which created friction with middle management. In addition, the new R&D department was criticized for experimenting with new ideas at a time when the company’s existing product development unit was overburdened with problems related to current products. As a result of the criticism, several managers argued that the new R&D department was

dysfunctional and should be closed down. Other culturally related problems were related to idea creation and problem solving at Arçelik. Under the license regime, engineers or managers had not been encouraged to suggest any independent ideas since it might be dangerous to implement any change in the production or product. Moreover, when there was a problem, the managers or responsible person's first question before acting tended to be "Who did this?" This attitude generated an atmosphere where employees were hesitant to develop any ideas of their own (correspondence with Refik Ureyen 09 May 2013).

The uncertain future of Arçelik also created difficulties. International companies which wanted to enter Turkey announced their interest in acquiring Arçelik both to its owners and managers and some of these managers showed Arçelik to potential buyers. Their visits led to a demotivating gossip that the R&D center would be closed down since the new owner would have its own R&D in its home country and easily could dispose of the Arçelik R&D center.

Strategic capability building at Arçelik

A key issue for the new R&D department was to identify and recruit talented staff. The first R&D manager, Refik Ureyen, had previously worked at General Electric and various compressor firms and could bring this technological know-how to Arçelik. Several researchers with ph. d degrees from Germany and the US were recruited at the start, followed by engineering graduates from well-known Turkish universities. The company also developed close cooperation with leading Turkish academic researchers who participated as project partners. These practices were later institutionalized and Arçelik opened its R&D centers for bachelor, master and PhD students from Istanbul Technical University and other universities. As a result, Arçelik could diffuse its new R&D culture more widely, and more than 200 master and PhD theses have been written on its products or research areas (Arçelik, 2013).

The staff of the R&D department increased rapidly, from three engineers in its first year to 800 researchers at eight research centers in 2012 (see Figure 3).

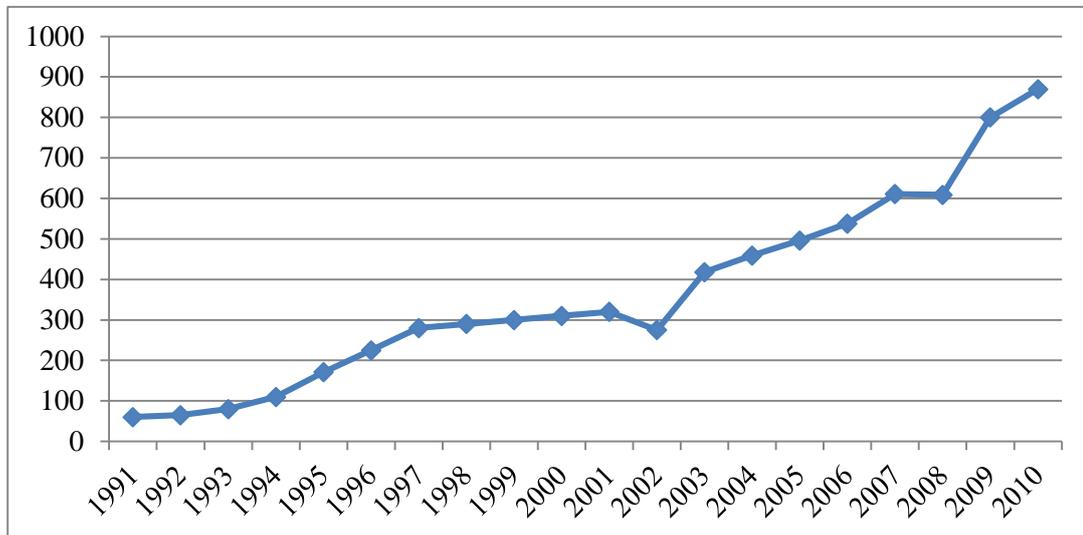


Figure 3. R&D employees of Arçelik 1991 – 2010 (Source: Dede, 2011; Inan, 2009)

In addition to recruiting, the new R&D managers and engineers devised several other ways to acquire necessary knowledge. By visiting the R&D centers of licensors and component specialists, as well as producers of lab equipment and instruments, they could gain broad knowledge about technology trends. They invited outside R&D experts, discussed how to build a better R&D center and create an effective management system and shared the observations and suggestions of the invited experts with top management.

A key issue was to identify strategic projects which could leverage the new department's resources. For refrigerators and freezers, the international Montreal protocol which required producers to replace ozone-depleting gases such as Chlorofluorocarbons (CFCs) with new environmentally friendly coolants, provided Arçelik with an opportunity both to focus its efforts and move closer to the technology frontier. The protocol prescribed a series of limits with 1996 as a very important deadline if companies wanted to stay in business. All over the world companies struggled to meet the deadline, and UN agencies

including the World Bank encouraged knowledge dissemination. This made external knowledge acquisition much easier for an emerging entrant such as Arçelik than it had been before (cf. Lee & Lim, 2001). The R&D team at Arçelik participated in several conferences to increase its knowledge, met leading scientists and invited them to Arçelik. Several other academicians from Turkish universities and their graduate students took part in the project. This networking helped the team to successfully apply for World Bank funding for its CFC phase-out project, and created valuable resources for the future. When the US announced that from 1995 it would not allow fridges with harmful gases the project became even more urgent, and R&D engineers collaborated closely with production engineers to meet the EU and US criteria. With this effort the new department also proved its importance for the overall company (interview with Meydanli 19 April 2013; Ureyen, 2010).

In the wet goods area, R&D managers identified the company's "walking washing machine" as a critical project to target. To compete with a popular product from one of its rivals, Arçelik had increased the spinning cycle speed of its washing machines. This created stability problems which made the machines move uncontrollably. Production engineers at Arçelik could not solve the problem and the new R&D department had to be involved. By collaborating with experts in machine dynamics at Bosphorus University and using computer simulation, the problem of dynamic instability could finally be solved. By doing this R&D demonstrated its value to the existing product development department. Moreover, the R&D department used its new skills and extended academic contacts to reduce the noise level of the products (interview Meydanli 19 April 2013; Ureyen, 2010).

As a long-term strategy the company decided to focus on energy consumption and environment. This followed the technological trajectory of the European industry and thus reduced overall uncertainty (cf. Park and Lee 2006). Already at its start, the Arçelik R&D

team engaged in analysis of the future energy needs of white goods. Collaboration started with university scientists to develop more efficient electrical machines, which resulted in several patent applications. To increase the appeal of the new technology, the R&D department also worked with designers which resulted in a new product series displayed at the Köln Appliance Fair and launched in EU markets in 1997. Market reception was modest, but the launch symbolized that the company had started to go beyond the catch-up and copy phase, and was designing its own unique products (Ureyen, 2010). Subsequently, R&D at Arçelik was able to launch a stream of sophisticated products advertised as “The Least Energy Consuming Washing Machine in the World” with 50% less energy consumption than standard class A with 8-kg capacity, or “The World’s First A+++ No-Frost Refrigerator Consuming the Lowest Energy in its own class” (Arçelik, 2012). Other innovative products included built-in ovens with reduced energy consumption, patented SURF® (Surround Flow) cooking technology, and nano-technology enhanced surfaces (Interview with Meydanli 19 April 2013; Özgül, 2011, Ureyen, 2010).

Patenting performance

Arçelik submitted its first national patent application in 1964 and another three in the next few years. Then there were no new patent applications from Arçelik in almost 25 years. The build-up of its own R&D department changed this picture and in year 2000 the firm submitted 12 international applications, a figure that increased tenfold in 2007, when 137 applications were submitted. With this performance Arçelik had advanced to the top three-group of innovative European companies in the white goods sector, surpassing established names such as Miele or Whirlpool. See Figure 4.

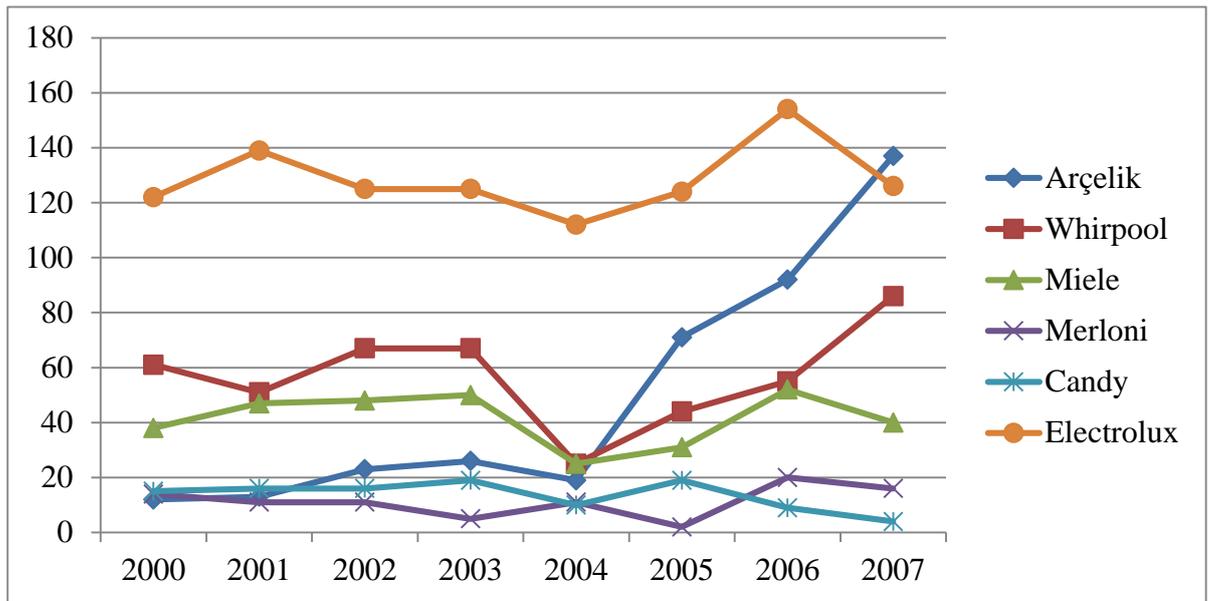


Figure 4. Number of international patent applications (PCT-applications) from selected European white goods firms 2000- 2007(Source: Inan, 2009)

Based on market data from 2000, Bonaglia, Goldstein and Mathews, (2007) classify white goods firms in four groups: global firms, candidate of global firms, strong regional firms and strong local firms with some regional presence. In this classification Whirlpool, Electrolux and General Electric were global firms; China's Haier was denoted a Candidate of Global Firms, whereas Arçelik and other emerging economy firms such as Midea Group in China were labeled strong local firms with some regional presence. A detailed patent analysis comparing Arçelik with the European leader Electrolux and China's white goods firm provides a different picture, however. See Table 2.

Table 2. Patent analysis of Electrolux, Arçelik, Haier and Midea.

Firms	Total no., applied and granted	Granted %	Average family citations	Geographic Protection EPO	USPTO	China
Electrolux	1425	52	2,6	1267	539	364
Arçelik	849	33	1,5	569	86	170
Haier	2096	36	0,1	30	49	2057
Midea Group	3431	23	0,0	3	14	3421

(Source: Thomson Reuters, 2014).

The data in Table 2 show that Haier and Midea are prolific patent applicants but domestically oriented with very little patent protection outside their China home market. By contrast, Arçelik has a substantial number of patents (most of them applications) in the two leading OECD regions, Europe and North America, but still only half of the volume registered by Electrolux. In terms of patent citations, Electrolux is the undisputed leader, again with Arçelik as a strong No 2. An analysis of patents related to product categories show different company profiles, with a particular Arçelik strength in refrigerators and freezers, where its patent volume (applications and granted) is almost double the Electrolux volume, whereas the latter firm enjoys an advantage of 3:1 over the Turkish rival in cooking appliances, and 2:1 in washing machines and dishwashers. The Arçelik advantage in refrigerators and freezers may be related to its pioneering projects generated by the Montreal agreement to replace dangerous coolants and the opportunities for international collaboration opened up by this protocol, as well as the company's subsequent focus on developing energy efficient technologies.

5. 1. R&D Capability Building at Joint Ventures – an alternative way? Case of Fiat Tofaş

In stark contrast to the white goods sector, international firms invested in Turkey already during the import-substitution regime in the 1960s, quickly entering joint venture agreements with local business partners. Koç Holding developed partnerships both with Ford (the Ford Otosan JV) and Fiat (the Fiat Tofaş JV), and compared to other JVs in the Turkish automotive industry, these ventures stand out for their efforts to build local R&D capabilities.

Ford Otosan started production of Transit minibuses in the late 1960. Twenty years later the JV started its first product development department to assist in solving daily problems in the production process. Gradually the JV increased its product development capabilities, supported by government policies and tax incentives for MNEs to localize R&D. Ford Otosan took active part in developing the Ford Transit launched in 2007 and in developing subsequent models, but has not filed for independent patent protection. Oyak, the Turkish partner of Renault, has lately become a prolific applicant for patent protection, but as late as 2012 none of them had been granted, and there was no Oyak application for protection outside Turkey. Thus we will concentrate on Koç Holding's Italian partnership Fiat Tofaş, the only Turkish vehicle builder with international IPR presence. Similar to Ford Otosan, this partnership has evolved gradually. Founded in 1968 to produce light commercial vehicles for the local market, Tofaş became a major exporter after Turkey joined the customs union with the EU. In 1994, a product development department with a handful of engineers was established to support production and the localization of components to Turkish suppliers. The responsibilities of the department expanded from production support (1994), process verification (2002), prototype production (2004) to new product development (2007). A study of product development in the Turkish automotive industry notes: "Fiat's main goal was to

make production in Turkey, but there was no thought of involving Tofaş in Fiat’s R&D activities. ...On the other hand, Tofaş was very ambitious to start R&D in Turkey. Tofaş definitely believed that establishing R&D would not only enable them to improve their product quality, but it would also increase the added value in new models” (Karabag, Tuncay-Celikel and Berggren. 2011; Tuncay-Celikel, 2009:79-80)

As a result of these efforts, Tofaş increased its responsibilities in new development projects, for example the light commercial vehicle “New Doblo”, which came off the line in 2009, and is sold under different brand in Europe. Supported by government incentives, the R&D Center recruited more staff and in 2013 the center employed 500 engineers (see Figure 5). Compared to the challenges at Arçelik of getting access to external knowledge, Tofaş enjoys the advantage of learning from its MNE partner, with significant numbers of Turkish engineers going to Italy for training and project participation, and Italian engineers coming to Turkey to support Tofaş when needed (in both cases around 50 – 100 per year).

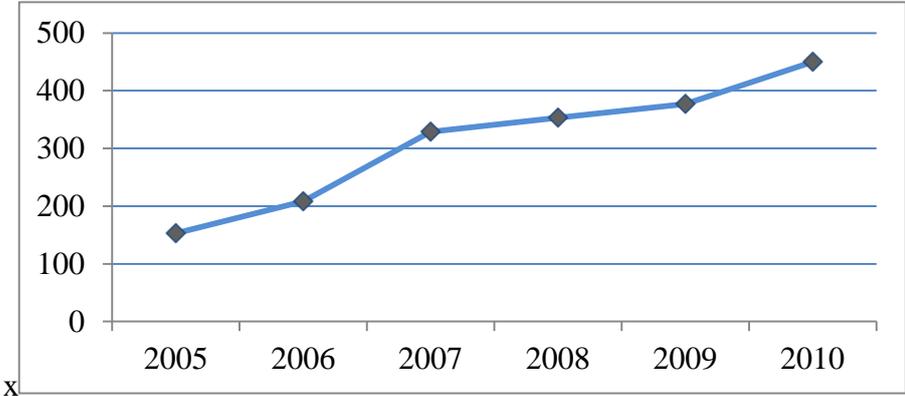


Figure 5: Number of R&D employees at Fiat Tofaş 2005 – 2010 (Source: Pandir, 2009; Yazici, 2010).

The increase in R&D staff and the expanded role in new product development projects have also resulted in a growing number of patent applications. By 2012, Tofaş portfolio consisted of 77 filings; 70% of them had applied for or been granted protection outside

Turkey (see Figure 6).

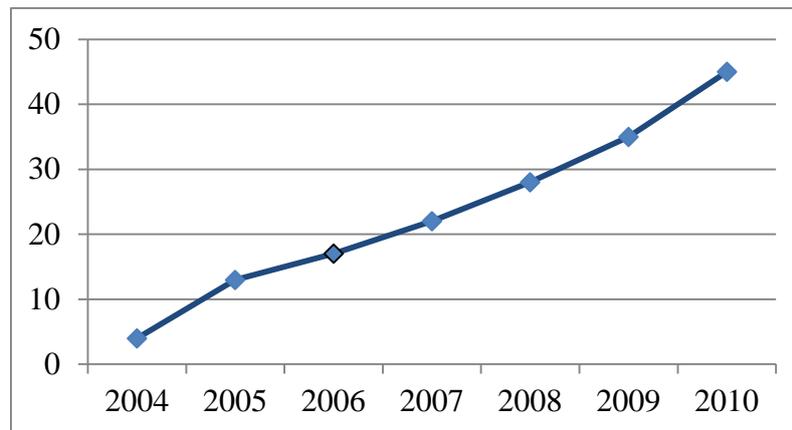


Figure 6. The patent application trend at Tofaş 2004 – 2010 (Source: Pandir, 2009; Yazici, 2010).

The limitations of international joint ventures

Tofaş and other Turkish JVs in the automotive industry have benefited from the MNE-partnerships both regarding transfer of technology and the MNE's brand value, which has provided access to international markets. The JV-designs also confer significant limitations, however, as observed by senior managers at Tofaş (interviews with the authors, April 2013). MNEs tend to have a finely elaborated structure regarding product decisions and intellectual property rights to ensure centralized MNE control, and according to Tofaş this is clearly so at Fiat. Thus development of internal combustion engines, a core technology, is fully owned and conducted by Fiat Powertrain in Italy, with no delegation to other sites. Decisions regarding product platforms and models are also the responsibilities of the home country organization, as are underbody design and styling. The Turkish partner is involved in the development of upper body and interior design, with its own IPR related to these design activities, which is required to be eligible for Turkish R&D subsidies. In contrast to power-train designs, the IPR rights of Tofaş refers to objects that are integral to the product and its production, cannot be

marketed independently, and have no real market value.

A patent analysis confirms this picture. Of all patents with Tofaş as the assignee granted or applied for in the 2000 – 2011 period, more than 50 % were classified as related to “fabrication/assembly”, “general components” or “personal accommodation” (such as seating). One single application concerned an engine invention. Another constraint for the upgrading of innovation capability at Tofaş and other joint ventures is the limited development work available in Turkey: “After launching one model, we have to wait for it to get old, before the development of a new model is started. German producers such as VW can balance it out between different product lines. At Fiat it is a rollercoaster, and in the downturns, engineers are redundant, and there are not enough opportunities at other firms to upgrade their skills, build a market for independent engineering service firms and expand an R&D culture” (Senior manager Fiat, April 2013).

Component manufacturing and development could theoretically provide a complementary venue for the creation of local innovation capabilities. Turkey has built a diversified automotive supplier base in its major automotive region around Bursa in Western Turkey, especially in mass-production of glass, plastic and sheet metal parts, including tools for injection moulds. In textile-related items, e.g. seats, specialist Turkish suppliers have emerged with their own offices in leading Italian and German regions. However, also in components there are clear constraints, according to the Fiat experience. Co-development of engineering components e.g. injection systems for engines, braking systems, steering columns, etc. requires component firms to be close to corporate R&D centers. Bosch, Valeo, Magneti Marelli and other Western European specialists sell licenses to Turkish suppliers or establish their own joint ventures in Turkey to supply local manufacturing, but maintain complete control of the development of these engineering items and provide no independent

space for Turkish R&D evolution in these areas. The Turkish Government directly and indirectly supports the upgrading of its automotive industry, from direct funding of manpower costs in R&D, to investments in advanced facilities for emission testing, crash tests, sound and vibration tests, etc. However, too few new vehicle models are developed in Turkey to create a robust demand for these laboratories, which anyway cannot substitute for technological efforts at the firm level. All these considerations emphasize the limits to innovation in joint ventures with multinational firms. At the same time it must be noted that in the scale- and capital-intensive automotive industry very few countries have succeeded in autonomously building internationally competitive firm capabilities. During the last 25 year, Hyundai in Korea stands out as the only exception. This makes it important to analyze not only the constraints but also the potential future dynamics of JV arrangements from the host country perspective.

6. Results and Discussion

The preceding study details how Arçelik built successful innovation capabilities by its own means in the white goods industry. When top management at the business group owner Koç Holding prepared for international competition, however, their first choice was to look for a joint venture with an international partner. Only after exhausting this established road to international linkage, did group managers decide to invest in independent building of innovation capabilities at its white goods firm. The case study section above demonstrates the extraordinary efforts required to sustain this choice: long-term executive and owner support for a high-risk strategy; selective recruitment of internationally experienced R&D managers; careful choice of development goals closely related to international trends and opportunities to access external knowledge; long-term efforts to build collaborative relations with Turkish universities in education and research; and comprehensive use of international associations

and arenas in the European context to keep track of new developments and technologies. In the long run, these efforts paid off. This is demonstrated by the strength of Arçelik compared to its domestic competitors Vestel and Profilo, which did not invest in innovation capability building, suffered from eroded margin and sales and ultimately, in the case of Profilo, found itself in a severe economic crisis. Another sign of success is the patenting performance of Arçelik, whose PCT-applications have caught up with multinationals in the industry, such as the European leader Electrolux. In terms of granted patents, international coverage, and patent quality, Electrolux is still far ahead of Arçelik, however. Moreover, in its air condition equipment business, Arçelik early on chose to sign a 50/50 JV agreement with Korean LG and there seems to be no intention to depart from this strategy, although it means that the Turkish firm builds no R&D capability or IPR in this area. To sum up, the “independence road” represented by Arçelik has succeeded in building volume and developing a promising portfolio of proprietary technology. Still, however, the company has a way to go to achieve technological parity with global leaders. Moreover, to recover the costs of future R&D investments the firm needs to build – or acquire - premium brands, which can make it possible to move up to higher price segments (Ilman, 2009). This problem of being stuck in the low- or medium-price segment seems to be a common challenge for emerging economy firms investing in innovation (with the noteworthy Korean exception), and may require more ambitious investments than the resources spent on the creation of R&D capabilities.

The automotive industry is a different sector, where international joint ventures are the norm in emerging economies from Brazil to China (Malerba and Nelson, 2011: 1663). In Turkey, Koç Holding early on entered JV agreements both with Ford Motor Company and with Fiat Auto. The preceding section shows that these joint ventures resulted in manufacturing operations with strong exports supported by the multinationals’ brand names, and significant investments and participation in new product development, encouraged by generous

government support schemes. The most independent JV, Fiat Tofaş, has developed substantial innovative activities including international patent applications, although the number and proportion of granted patents and overall patent impact remains inferior to the performance at Arçelik. The Tofaş account illustrates the constraints of JVs as a linkage to the technological frontier, and demonstrates how product decisions and core technologies, including IPR, remain home country activities for the MNE.

The automotive industry is less vertically integrated than white goods, and component suppliers play a key role in the industry's value chain and technological efforts. JV- and license-arrangements have limited the development of technology-intensity in the Turkish supplier industry, however, making domestic firms focus on less value adding activities in metal, plastic and seat fabrication, and international component specialists continue to locate their R&D in home country centers. Similar divisions of automotive R&D between Eastern and Western Europe have been observed by Pavlinek (2012).

The automotive industry is in an era of ferment, however, with deep uncertainty concerning future fuels and powertrains (Magnusson and Berggren, 2011). This “de-maturation”, with an increasing repertoire of technological options, from continued development of the internal combustion engine to various hybrid-electric configurations, to pure electric, hydrogen or fuel cell propulsion exceeds the limits also of many established multinationals. According to executives interviewed in this study, the new era of ferment might create opportunities for Tofaş e.g. to use its JV-alliance more aggressively and position itself in niches where the multinational has not made any significant investments in its core locations. Such a niche could be electrified commercial vehicles for urban transport and goods deliveries, where an emerging economy such as Turkey with its mega-cities, massive congestion and queues, presents an important market opportunity (EEMN, 2013). This might

be aided by, Turkey's significant knowledge in electrical engineering including know-how and manufacturing capacity in electric motors, for example at Arçelik. To make use of such opportunities however, would require both a IJV management with a capacity to align its R&D objectives to local needs, and synchronized government policies, less flamboyant than the goal of developing a "Turkish National Car", which remains a favorite idea in Turkish policy circles (Ensonhaber, 2013). A "pragmatic techno-nationalism" focused on realistic goals, as suggested by Kennedy (2013) in a study of renewable energy in China, could lead to a virtuous combination road of local efforts and multinational access, in line with the insight by that "the benefits of international technology diffusion can only be delivered with parallel indigenous innovation efforts and the presence of modern institutional and governance structures and conducive innovation systems" (Fu, et al. 2011:1204).

7. Conclusion

How do latecomer-firms build capabilities to compete on the innovation frontier in the global economy? This has been the key question driving the paper. A recurring conclusion in the literature on innovation in emerging economies is the importance of access to external knowledge (Lall 1992, Lee and Lim, 2011, Luo et al, 2011; Malerba and Nelson, 2011). More specifically, the literature emphasizes that emerging economy-firms need to create linkages to international knowledge carriers, in particular MNEs, manufacturing contract arrangements, joint ventures, or licenses, and use these linkages to leverage their own scarce resources and build new capabilities (Mathews, 2002). The analysis in this paper shows the limits of several of these arrangements.

Manufacturing contract arrangements was important for one of the studied firms, Arçelik, to expand its production scale and quality performance. But according to the Arçelik experience, OEM contracts are characterized by low margins and high uncertainty, and

relying on them, as its main competitor Vestel has done, builds no sufficient base of independent capability development (Ilman, 2009). A study of how firms can develop from contract manufacturing to own brand arrives at a similar conclusion: “learning from the buyer is insignificant” (Horng and Chen, 2008:126).

International licenses were the lifeblood of Turkish firms in the era of protected domestic market, but the opening to international markets (the advent of the EU customs union) demonstrated their inherent limitations. Licenses were costly, draining scarce resources needed for independent efforts. They tended to restrict knowledge transfer to previous technology generations and delayed catch-up of state-of-the-art technology; and they constrained market access outside Turkey to low cost regions of little interest to the MNEs. Similar observations have been made in East Asia, where researchers note that “closer to the frontier, licensing becomes more difficult and/or expensive” (Lee and Lim, 2001:481). In the era of open markets and international competition, which for Turkey started in the mid-1990s, two basic options remained: independent building of innovation capability, or international joint ventures combined with local capability building.

The study points to the possibilities of *the independent building of innovation capability* in sectors with moderate capital-intensity and product complexity, in the paper represented by white goods. The analysis shows the decisive importance of patient ownership support; focused development targets and agile efforts to maximize use of opportunities to access external knowledge. In the studied industry, the Turkish latecomer firm Arçelik has been rapidly catching up with international leaders in patent applications, but still lags in technological depth and impact, and faces the challenge of charging market prices which reflect the innovation investments.

In sectors characterized by high capital intensity and product complexity, and fierce global competition, such as autos, the study points to the value (or necessity) for emerging economy-firms to choose the other alternative and enter *international joint venture agreements*. The study emphasizes several benefits for local firms of being part of major corporations in such industries: knowledge transfer, training, brand recognition and international market access. Recent research has highlighted the potentially negative effect of international joint ventures for host country partners, due to excessive efforts spent on external coordination at the expense of internal development. This research has also demonstrated that the negative effect of IJVs is reduced when the emerging country partner is part of a larger corporate entity such as a business group with a cohesive internal structure (Mahmood and Zheng, 2009:1500). The studied automotive case analyzed in this paper, the JV involved a patient local partner who consistently encouraged upgrading ambitions from advanced manufacturing to product adaptation and participation in new product development. This support could not overcome the structural limitations of the JV-arrangement, however, embodied in the MNE's monopoly of core technologies and related intellectual property, which "truncated" (cf. Lall, 1992) the development of innovation capabilities at the local partner. The limits of JV-solution has also been observed in China recently (Jian, 2012:14): "Like the addictive drug, that make users fell happy for a short time but undermines their health in the long run, joint ventures enable state-owned automakers to generate profits but have made them lazy and reluctant to invest in the resources to make their own brands successful.... The first joint venture, Shanghai Volkswagen Automotive Works Co. was launched in 1983. But nearly three decades later, no state-owned automaker has developed a sustainable automotive business of its own." The paper suggests a combination road, where local JV-managers coordinate their efforts with pragmatic public policies to make it possible to escape from this truncated position, and make the partnership an international center of

excellence, without competing head on with core segments within their multinational partners. Electrified light commercial vehicles were suggested as such a possible area of JV excellence. This would require a skillful orchestration of internal corporate maneuvering and focused state policies, however, which presents a higher-order challenge than the ones studied here. Nevertheless, this alternative of creating global “niche” excellence within MNEs by coordinated private and government efforts may be fruitful to probe in several emerging economies.

References

Ansal, H.K. 1990. Technical change and industry policy - The case of truck manufacturing in Turkey. *World Development* 18(11):1513-1528.

Arçelik. 2013. Arcelik’s Cooperation, Available at:
<http://www.arcelikas.com/page/70/Cooperation>

Arçelik. 2012. 2012 Q1 Financial Results, Available at:
<http://www.arcelikas.com/UserFiles/file/2012Q1FinancialResultsPresentation.pdf>

Arçelik Annual Report. 2012. *Arçelik Annual Reports*. Istanbul: Arcelik.

Arçelik Annual Report. 2000. *Arçelik Annual Reports*. Istanbul: Arcelik.

Awate, S., M. Larssen and R. Mudambi. 2012. EMNE catch-up strategies in the wind turbine industry? *Global Strategy Journal* 2: 205-223.

Bell, M., and P. N. Figueiredo. 2012. Innovation capability building and learning mechanisms in latecomer firms: recent empirical contributions and implications for research. *Canadian Journal of Development Studies/Revue canadienne d'études du développement* 33(1): 14-40.

Bergek, A. and C. Berggren. 2005. Technological internationalisation in the electro-technical Industry: A cross-company comparison of patenting patterns 1986 – 2000 *Research Policy* 33(9):1285-1306.

Bonaglia, F., A. Goldstein, and J. A. Mathews. 2007. Accelerated internationalization by emerging markets' multinationals: The case of the white goods sector. *Journal of World Business* 42(4):369-383.

Chang, S., C. Chung, and I.P. Mahmood. 2006. When and How Does Business Group Affiliation Promote Firm Innovation? A Tale of Two Emerging Economies. *Organization Science* 17(5):637–656.

Colpan, A., and T. Hikino T. 2010. Foundations of business groups: Toward an integrated framework. In Colpan, A., T. Hikino, and J. Lincoln. (eds.). *Oxford Handbook of Business Groups*, 15-66. Oxford: Oxford University Press.

Dede, M. B. 2011. Arçelik is the first Turkish firm which is listed in top 500 patenting firms (in Turkish: Arçelik, patentte ilk 500'e giren tek Türk şirketi oldu). *Şafak Daily News*, Available at: <http://yenisafak.com.tr/Bilisim/?t=08.07.2011&c=10&i=328786>

Ensonhaber (2013) Erdogan: It does not matter what will happen we will produce national car (in Turkish: Erdoğan “Ne olursa olsun yerli otomobili yapacağız”). Available at: <http://www.ensonhaber.com/erdogan-ne-olursa-olsun-yerli-otomobili-yapacagiz-2013-05-17.html>

EEMN. 2013. Commercial EV Sales Outstrip Consumer EVs. *Environmental & Energy Management News*, Available at: <http://www.environmentalleader.com/2013/09/12/commercial-ev-sales-outstrip-consumer-evs/>

Esen, B. 2010. *Turkish White Goods Industry Report (in Turkish: Beyaz Eşya Endüstrisi Raporu)*, Ankara: İhracatı Geliştirme Etüd Merkezi.

Euromonitor. 2010. Major Appliances Millionaires Club - new 2010 company rankings. Available at: <http://blog.euromonitor.com/2010/12/major-appliances-millionaires-club-new-2010-company-rankings.html>

Fu, X., C. Pietrobelli, and L. Soete. 2011. The role of foreign technology and indigenous innovation in the emerging economies: Technological Change and Catching-up. *World Development*, 39(7): 1204–1212.

Gülsoy, T., Ö. Özkanlı, and R. Lynch. 2012. The role of innovation in the effective international expansion of an emerging-country firm: The case of Arçelik. *Procedia-Social and Behavioral Sciences* 41:116-129.

Hobday, M. 1995. *Innovation in East Asia: The Challenge to Japan*, Aldershot: Edgar Elgar.

Hobday, M., H. Rush, and J. Bessant. 2002. *Firm-level innovation in the Korean economy*. Report to the World Bank, Brighton: SPRU, University of Sussex.

Hornig, C., and W. Chen. 2008. From Contract Manufacturing to Own Brand Management: The Role of Learning and Cultural Heritage Identity. *Management and Organization Review* 4(1):109-133.

Hsieh, T., R. Yeh, and Y. Chen. 2010. Business group characteristics and affiliated firm innovation: The case of Taiwan. *Industrial Marketing Management* 39:560–570.

Hurriyet Gazetesi. 2009. We live in scarcity despite our wealth (in Turkish: Varlik Icinde Yokluk Yasiyoruz). *Hurriyet Daily*, Available at: <http://arama.hurriyet.com.tr/arsivnews.aspx?id=12224849>

- Jian, Y. 2012. China's painful JV addiction. *Automotive News*, Oct 2.
- Ilman, A. 2009. *Enabling Innovative Companies in Emerging Economies: Insights from the Turkish Innovation System and Turkish Consumer Electronics Companies*, PhD Dissertation no. 3625, St.Gallen: The University of St. Gallen.
- Inan, C. 2009. Managing R&D in Turkey: A case study: Arçelik. Paper presented at *European Industrial Research Management Association Conference*, EIRMA. Budapest.
- Karabag, S.F., and C. Berggren. 2014. Antecedents of firm performance in emerging economies: Business groups, strategy, industry structure, and state support. *Journal of Business Research*, Available at: <http://dx.doi.org/10.1016/j.jbusres.2014.01.004>
- Karabag, S. F., A. Tuncay-Celikel, and C. Berggren. 2011. The limits of R&D internationalization and the importance of local initiatives: Turkey as a critical case. *World Development* 39(8):1347-1357.
- Kennedy, A. B. 2013. China's Search for Renewable Energy: Pragmatic Techno-nationalism. *Asian Survey* 53(5):909-930.
- Kim, L. 1998. Crisis Construction and Organizational Learning: Capability Building in Catching-up at Hyundai Motor. *Organization Science* 9:4506-4521.
- Kirac, C. 1995. *Vehbi Koç with my Memories* (In Turkish: Anılarımla Patronum Vehbi Koç). Istanbul: Milliyet Yayınları.
- Koç Holding Basın Bultenini*. 2003. A Briefing Was Given about the 10th Year of Koç Holding (in Turkish: Koç Holding10. Basın ve Kamuoyunu Bilgilendirme Toplantısı Yapıldı). Istanbul: Koc Holding.
- Koç Holding. 2011. *Annual Report of Koç Holding in 2011*. Istanbul: Koc Holding Yayinlari.

Lall, S. 1992. Technological Capabilities and Industrialization. *World Development* 20(2):165-186.

Lee, K., and C. Lim. 2001. Technological regimes, catching-up and leapfrogging: findings from the Korean industries. *Research Policy* 30(3): 459 – 483.

Luo, Y., J. Sun, and S.L. Wang. 2011. Emerging Economy Copycats: Capability, Environment, and Strategy. *Academy of Management Perspectives* 25(2):37-56.

Magnusson, T., and C. Berggren, 2011. Entering an era of ferment–radical vs incrementalist strategies in automotive power train development. *Technology Analysis & Strategic Management* 23(3):313-330.

Mahmood, I. P., and W. Zheng. 2009. Whether and how: Effects of international joint ventures on local innovation in an emerging economy. *Research Policy* 38(9):1489-1503.

Malerba, F., and R. Nelson. 2011. Learning and catching up in different sectoral systems: evidence from six industries. *Industrial and Corporate Change* 6:1645-1676.

Mamulattan Markaya. 2001. *From Production to Brand: Arçelik Company History 1955-2000 (in Turkish: Mamulattan Markaya: Arçelik Kurum Tarihi 1955.2000)*, Istanbul: Arçelik Publication.

Mathews, J.A. 2002. Competitive advantages of the latecomer firm: A resource-based account of industrial catch-up strategies. *Asia-Pacific Journal of Management* 19:467-488.

Mathews, J. 2006. Catch-up strategies and the latecomer effect in industrial development, *New Political Economy* 11(3):313-335.

Mudambi, R. 2008. Location, control and innovation in knowledge-intensive industries. *Journal of Economic Geography* 8(5):699-725.

Otomotiv Sanayii Dernegi. 2013. Genel OSD Raporlari, Available at: <http://www.osd.org.tr/raporlar/>

Park, K. and K. Lee. 2006. Linking the technological regime to the technological catch-up: analyzing Korea and Taiwan using the US patent data. *Industrial and Corporate Change* 15(4):715–753.

Pandır A. (2009). R&D at Tofaş (in Turkish: Tofas ve Ar-Ge), 19. Bilim ve Teknoloji Yüksek Kurulunda presentation, Available at:

http://www.tubitak.gov.tr/tubitak_content_files/BTYPD/btyk/19/19btyk_tofas.pdf

Patel, P., and M. Vega. 1999. Patterns of internationalization of corporate technology: location vs. home country advantages. *Research Policy* 28:145–155.

Pavlinek, P. 2012. The Internationalization of Corporate R&D and the Automotive Industry R&D of East-Central Europe. *Economic Geography* 88(3):279-310.

R&D Focus. 2009. R&D Focus Making a Difference by Allocating the Highest R&D Investments in Turkey. Available at: http://koc.com.tr/en-us/investor-relations/financial-statements-and-statistics/Annual%20Reports/2009_14_Ko%C3%A7%20Group's%20R-D%20Focus.pdf#search=R%26d%20focus

Thomson Reuters. 2014. *Technology Intelligence Data and Analysis of White Goods and Automotive* [Data and general technology analysis]. Stockholm: Patent Search Service of Thomson Reuters.

Tuncay-Celikel, A. 2009. *Factors Affecting Research and Development (R&D) Collaboration of Multinational Enterprises (MNEs) and their Local Partner Firms: A Case Study of Turkish Automotive Industry*, Unpublished PhD Diss. Istanbul: Işık University Press.

TURKBESD (2013) *Production, Export, Import and National Sales Numbers of Turkish White Goods Industry*. Available at: <http://www.turkbesd.org/>

Özgül, E. 2011. *Arçelik AŞ's Company Profile*. Available at <http://www.een-b2b.org/foodsafety2012/Contents/ParticipantDetails.aspx?ORGANIZATIONID=1028>.

Ureyen, R. 2010. An R&D Story. *Mühendislik Mimarlık Öyküleri* 4:75.102.

Yazıcı K. (2010). Information about Tofas' R&D Center (in Turkish: Tofaş Ar-Ge Merkezi Tanıtımı), *Otam Aylık Bülten* 10:2.

Xu, Q.R., G. Zheng, Z. Yi, and S. Wei. 2003. Total innovation management – Haier case study. *Science Research Management* 5:1-7.

Appendix A. List of Interviewees and their general information

Name	Firm / Institution	Most important Positions	Date of Interview/ correspondence
Hasan Subasi	Arçelik	-General Manager 1983 – 1991 -President - Consumer Durables Group at Koç Holding 1991 -Vice Chairman - Board of Directors of Koç Holding 1998 - 2002	26 April 2012
Refik Ureyen	Arçelik	Different position at GM in 1960s and 1970s Arçelik R&D Manager 1987- 2001	Mail correspondences in April and May 2013
Iffet İyigün Meydanlı	Arçelik	R&D Manager - Innovation & System Development 1992 -	19 April 2013
Ali Pandır	Fiat	-Managerial positions at Otokar, GM, Opel, SPO, in Turkey, China, Thailand, 1983-2002 - Turkey country head at Fiat 2012-	26 April 2013
Prof.Dr. Seyhan Onbasioglu	Istanbul Technical University	Different academic position at ITU since 1980s	22 April 2013
Hüseyin Güler	Tubitak	Experts at different firms 2001-2004 <i>Head of Science, Technology and Innovation Policy Department Tubitak since 2011</i>	24 April 2013
Edip Özaltın	Özaltın Otomotiv & White Goods	Owner and manager of several enterprises between 1960-2010	20 April 2013